PG&E Climate Adaptation and Vulnerability Assessment

FULL REPORT **2024**

PG&E Climate Adaptation and Vulnerability Assessment
Table of Contents

Section 1: Introduction

Table of Contents

Message from the CEO

Pacific Gas and Electric Company (PG&E) recognizes climate change as one of the greatest threats to our planet and our quality of life.

In California and beyond, we have been living with its effects for many years now—higher average temperatures, more frequent and extreme heat waves, increasing inland and coastal flooding, the threat of drought, and the risk of extreme wildfires.

We also have seen how these conditions can lead to devastation for our customers and the hometowns we serve.

As a company whose purpose includes serving our planet, we embrace our role as a leader in adapting to and reversing the effects of climate change to keep customers safe and help heal the planet.

We are encouraged by the many signs of progress in recent years. For example, through our layers of protection—from advanced weather stations to system inspections to technology that instantly shuts off power in response to powerline threats—we have reduced wildfire risk from our equipment by 94 percent.[1]

We also are working to put 10,000 miles of powerlines underground, both to reduce fire risk and improve resiliency in the face of other extreme weather events. In 2023, we buried 364 miles of powerlines—more than ever before in a single year—making 15,000 households safer and more energy resilient.

We have also become a world leader in clean energy, delivering 100 percent greenhouse gas-free electricity to our retail customers in 2023.

We know that there is a lot more work to do, and our commitment to building a clean, safe, climate-resilient energy system is as strong as ever.

PG&E's 2024 Climate Adaptation and Vulnerability Assessment is a critical step forward in supporting our efforts. The report reviews PG&E's system in the face of projected environmental changes over the next 10 to 60 years and provides early insight into how we can keep our system resilient to all extreme weather driven by climate change.

This systematic review is the basis for what comes next—more adaptive action that will allow us to continue serving California well into the future.

We at PG&E are proud to answer the call of today's climate challenge as we remain steadfast in our work to serve People, the Planet, and California's Prosperity.

Patti Poppe
Chief Executive Officer
PG&E Corporation

[1] This statistic is based on PG&E's comparison in the Utility's General Rate Case testimony on the wildfire risk score for a baseline risk level to a risk level reflecting the Utility's mitigation work. Risk scores are calculated using the scoring methodology established by the California Public Utilities Commission in the Safety Model Assessment Proceeding, which reflects the frequency with which various risks are expected to occur and the potential safety, reliability, and financial impacts of varying degrees of wildfire severity.

1.1 Introduction to the Vulnerability Assessment

Pacific Gas and Electric Company

Pacific Gas and Electric Company (PG&E, or the Company) is a subsidiary of PG&E Corporation, is a combined natural gas and electric utility serving more than 16 million people across 70,000 square miles in Northern and Central California. PG&E provides 7,652 megawatts of owned hydroelectric, nuclear, natural gas, and solar generation to more than 16 million customers, or one in every 20 Americans.

Our Commitment: A Climate-Resilient Energy System

Climate change is not a problem for the distant future. The physical impacts of climate change are already affecting the lives of Californians in significant ways. These negative impacts pose challenges to PG&E's customers while simultaneously making it more difficult to serve them. This dynamic motivates PG&E's stand that clean and resilient energy will be a reality for all. As the day-to-day lives of those we serve are affected by more frequent and severe climate hazards, it is more important than ever that they can rely on PG&E to provide the energy that powers modern life.

Purpose and Guiding Principles

This Climate Adaptation and Vulnerability Assessment (CAVA) is focused on environmental conditions in 2050 and will help to ensure that the decisions PG&E makes today—about the robustness of electrical equipment, how to protect coastal facilities, or where to underground equipment or invest in novel infrastructure solutions—will provide Californians with a reliable, resilient energy system into the future. While the CAVA focuses on the environmental conditions that will be more likely to occur by 2050, these conditions can still occur today. Climate-driven extreme weather events are already affecting PG&E and the communities we serve. Many of the adaptation options that are discussed in the CAVA to address climate change vulnerabilities will be important for mitigating both current and future physical risk due to climate change. This CAVA is a critical step forward in understanding the physical climate risk that must be managed now and in the future to ensure a clean, safe, and resilient energy system for all.

This CAVA was developed in accordance with the California Public Utilities Commission's (CPUC) Decision (D.) 20-08-046 of the Climate Adaptation Order Instituting Rulemaking (Climate Adaptation OIR) R.18-04-019. This decision requires utilities to file CAVAs every 4 years to help ensure the provision of resilient and reliable service to all customers in the face of climate change. CPUC's D.19-10-054 further outlines the requirements for utility CAVAs, including defining climate change adaptation and the use of climate change projection datasets.[2]

[2] PG&E refers to these decisions collectively as the CPUC Climate Adaptation OIR rulings. https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/climate-change

Appendix E is an index of compliance requirements and where the associated content can be found in the CAVA.)

The CAVA helps PG&E enhance resilience to climate-driven hazards by identifying which assets in which geographic areas are most at risk. It also provides a foundation to prioritize climate resilience investments in PG&E's risk and strategic planning processes. The CAVA builds on PG&E's significant progress in addressing extreme climate-driven wildfire risk in recent years by reviewing additional climate hazards and considering longer term environmental changes beyond a typical 4-year utility investment planning cycle.

The CAVA is guided by several key principles that are consistent with the requirements of the CPUC Climate Adaptation OIR rulings and industry best practices for assessing physical climate risk.[3] These include the following:

Use best available science and data on climate change projections: PG&E relies on a variety of sources and uses peer-reviewed data specific to the PG&E service area whenever possible, relying primarily on information from California's Fourth Climate Change Assessment. PG&E follows climate science best practices in the use of downscaled climate model projections and interpretation of climate hazard information. Additional information on the methodology used in this assessment can be found in Appendix A: Climate Data Methods and Appendix B: Projected Climate Change Exposures.

Focus on asset and operational resilience: The CAVA is designed to provide actionable information that PG&E can use in planning and operational activities to address the plausible impacts of climate change on PG&E's assets, infrastructure, and operations and services. This allows PG&E to identify where enhanced adaptive actions or new processes would lead to a more climate-resilient energy system.

Incorporate feedback from communities into how PG&E understands and manages climate change vulnerabilities: PG&E's commitment to building climate resilience is about providing safe and reliable energy to the communities we are privileged to serve. PG&E also recognizes that our most socially and economically vulnerable communities stand to be worst affected by climate change. A critical element of the CAVA is PG&E's "Resilient Together" initiative on community engagement, which partnered directly with respected community leaders from Disadvantaged Vulnerable Communities (DVCs)[4] to engage community members regarding their

[3] Including, but not limited to, the Electric Power Research Institute's (EPRI) Climate READi Program: EPRI Home.

[4] For the CAVA, the CPUC defines DVCs as consisting of communities in the 25th percentile highest scoring census tracts according to the most recent version of the California Communities Environmental Health Screening Tool (CalEnviroScreen 4.0), as well as all of California's tribal lands, census tracts with median household incomes less than 60 percent of the state median income, and census tracts that score in the highest 5 percent of Pollution Burden within CalEnviroScreen, but do not receive an overall CalEnviroScreen score due to unreliable public health and socioeconomic data.

energy-related climate resilience needs. This effort was implemented through PG&E's Community Engagement Plan (CEP). Community needs and preferences identified through this effort are a critical input as PG&E continues to make the grid resilient to the impacts of climate change on behalf of customers.

Organization of the CAVA

The CAVA is composed of two main parts:

1. **Climate Change and the Communities We Serve:** The first major section provides a summary of the Resilient Together initiative and how communities' feedback and top recommendations were integrated in the assessment of PG&E's assets, infrastructure, and operations and services. Full methodology, findings, and feedback are provided in Appendix C: Resilient Together Initiative, which is the implementation of PG&E's CEP, provided in Appendix D: Community Engagement Plan.

2. **The Vulnerability of Infrastructure, Assets, and Operations and Services:** The second major portion of the report provides the results of PG&E's climate vulnerability analyses, which use the California Department of Water Resources[5] vulnerability assessment methodology as directed by D.20-08-046. As shown in Figure 1-1, this methodology combines exposure, sensitivity, and adaptive capacity to determine the climate change risk of PG&E assets and infrastructure, as well as climate change vulnerabilities to operations and services. See the Vulnerability Assessment Framework subsection below for details.

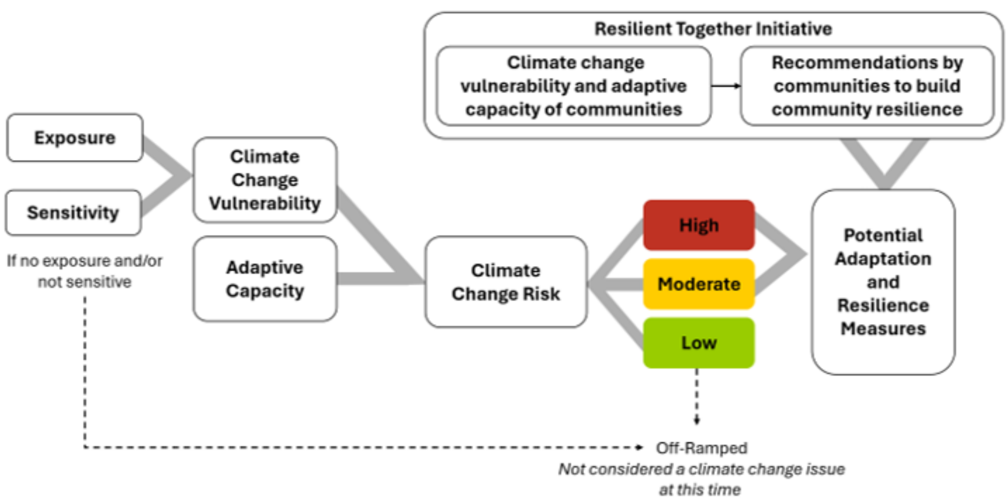


Figure 1-1. Vulnerability Assessment Framework for assessing the climate change vulnerability and climate change risk of infrastructure and assets.

Also included are the results from surveying third-party facility PG&E contracts for power, capacity, or reliability regarding their own climate vulnerability assessment efforts.

[5] Climate Change (ca.gov).

1.2 Climate Change and the Communities We Serve

While the vulnerability assessment is necessarily focused on the infrastructure, assets, and operations and services for which PG&E is responsible, this report serves to ensure that our customers have access to safe, clean, affordable, and reliable energy with regard to the climate hazards facing California. Customer perspectives are a critical input as PG&E makes decisions about how to adapt the energy system for the era of climate change today and in the future. PG&E is deeply grateful to the community members who chose to provide their time and expertise to the Resilient Together initiative.[6]

Beyond DVCs: Defining Climate-Vulnerable Communities

While most, if not all, Californians are exposed to some level of climate-driven hazards, not all Californians are affected by these hazards to the same extent or in the same manner. Historically, marginalized communities with fewer resources are more vulnerable to a wide range of hazards, including those driven by climate change.[7] For this reason, the development and implementation of the CEP was focused on engagement with DVCs as defined and directed by the CPUC Climate Adaptation OIR rulings.[8] The DVC map for PG&E's service area is seen in Figure 1-2.

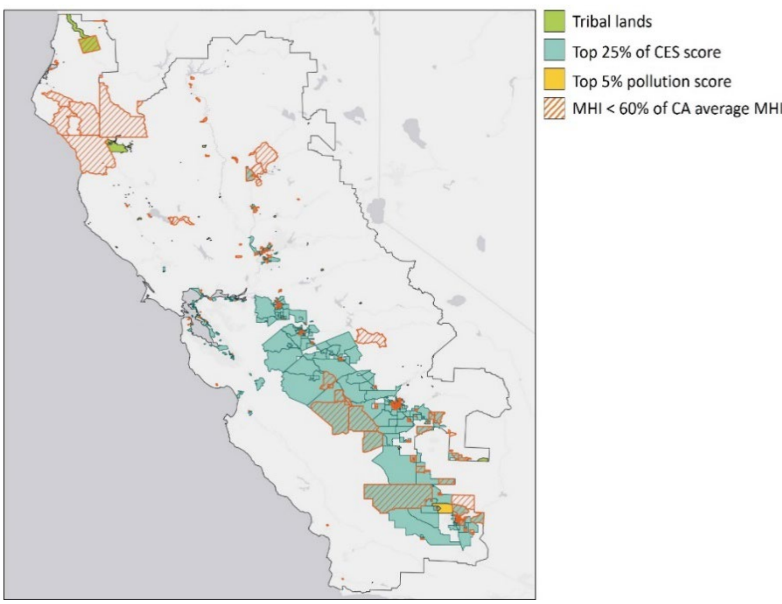


Figure 1-2. Disadvantaged and Vulnerable Communities (DVCs) within PG&E's Service Area. Map indicates tribal lands, top 25 percent CalEnviroScreen (CES) score, top 5 percent pollution score, and medium household income (MHI) scores under 60 percent of California average MHI. For more details and data sources, see Appendix D: Community Engagement Plan.

---

[6] See Appendix C for a full list of Resilient Together Advisory Group partners.

[7] Government of California. 2018. "Executive Order B-30-15 Resiliency Guidebook: Vulnerable Populations."

[8] https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/climate-change

Based on the input of the Resilient Together Advisory Group (RTAG), which is the key advisory group for the Resilient Together initiative, and community experts, PG&E expanded engagement efforts for the CAVA beyond the DVC-designated census tracts to include vulnerable communities that are outside of the CPUC definition (Appendix D) but are understood to be climate-vulnerable communities nonetheless. For example, outdoor workers were noted as being a particularly exposed and vulnerable constituency in the Central Valley Region.

Tribal Engagement

There are 62 federally recognized tribes in the PG&E service area, and 40 non-federally recognized tribes. PG&E's CEP included plans for engagement with federally recognized tribal governments (Appendix D). In consultation with PG&E's Principal Tribal Affairs Representative, we determined that it would be most appropriate to engage with tribal governments upon completion of the CAVA in parity with how PG&E intends to engage other governmental jurisdictions. PG&E will identify shared vulnerabilities and potential opportunities to cooperate in mutually beneficial adaptive action with both municipal and tribal governments.

The Adaptive Capacity of Communities

Assessments of adaptive capacity are critical to understanding the climate-driven risk that communities that face and the risks they face as they evaluate the readiness of communities to respond to short-term shocks and long-term stresses due to climate change. As directed by the CPUC Climate Adaptation OIR rulings, the development and implementation of the CEP includes an assessment of the adaptive capacity of DVCs.

To assess adaptive capacity, PG&E used the Baseline Resilience Indicators for Communities (BRIC) index.[9] The BRIC index is a publicly available and academically vetted index pulling from federal government data developed for U.S. counties to better understand and measure resilience across counties. For more details on the BRIC metric and application in the CEP and in the CAVA, see Appendix D: Community Engagement Plan.

1.3 The Vulnerability of Infrastructure, Assets, and Operations and Services

This CAVA analyzes the vulnerability of PG&E-owned and -operated infrastructure, assets, and operations and services to projected climate hazards. To determine relative levels of physical climate risk, this CAVA also considers existing adaptive capacity to these potential vulnerabilities.

The Scope of Infrastructure, Assets, and Operations and Services

This CAVA analyzes PG&E-owned and -managed infrastructure, assets, and operations and services. This analysis was a multiyear effort and most of the foundational analyses that

[9] FEMA. "Community Resilience, National Risk Index" (fema.gov).

underpin the vulnerability assessment results are based on infrastructure and asset data from 2020–2022. The CAVA focuses on spatial and temporal trends in projected changes of climate change vulnerability.

Assessment categories of the CAVA are organized primarily by asset family or PG&E group under asset type (Table 1-1).

Table 1-1. Organization of the CAVA.

Assessment Category	Asset Type	Asset Family or PG&E Group
Infrastructure and Assets	Electric	Transmission
		Substation
		Distribution
	Gas	Transmission
		Compression and Processing, and Storage
		Measurement and Control
		Distribution
		Liquefied Natural Gas/Compressed Natural Gas
	Power Generation	Hydroelectric
		Natural Gas
		Solar
		Nuclear
	Enterprisewide	Facilities
		Information Technology
Operations and Services		Critical Processes
Third-Party Facility Contracts		Third-Party Facility Contracts for Power, Capacity, or Reliability

Infrastructure and Assets

- **Utility Asset Types:** PG&E's energy system assets, operations, and engineering are grouped in electric, gas, and power generation utility asset types. The CAVA assesses the impacts of climate change to PG&E-owned infrastructure and assets within these utility asset types. The CAVA does not extend to non-PG&E-owned or non-PG&E-maintained energy system assets or operations within and outside of PG&E's service area.

  Summary findings of the CAVA are provided for each asset family or PG&E group within each utility asset type and precede deep dives into specific asset families (for example, Electric Transmission within Electric, or Gas Distribution within Gas). Regional differences in climate change vulnerability are discussed within each asset family section and organized by PG&E regions as defined by PG&E's Regional Service Model.

PG&E's five regions are seen in Figure 1-3 and are follows:

- Bay Area;
- Central Valley;
- North Valley and Sierra (Sierra);
- North Coast; and
- South Bay and Central Coast (Central Coast).

Figure 1-3. PG&E Regions.

- **Enterprisewide:** In addition to the three utility asset types, PG&E has certain enterprise-wide infrastructure and assets. These include our facilities and IT resources:

  Facilities: PG&E's facilities include office buildings, service centers, and other facilities that house critical infrastructure and assets, contact or call centers, and customer services offices. Most facilities are managed through PG&E's Corporate Real Estate Strategy and Services (CRESS) organization.

  IT: PG&E's IT assets operations enable and support PG&E's daily operations, including work execution, grid control, customer support, emergency response, and asset management, and also plays a critical role in allowing the Company to operate its electric and gas infrastructure. IT operations also support business administration and productivity functions, including facilitating remote work that is necessary for the Company's 23,000 employees.

Operations and Services

In addition to considering potential climate hazard impacts on the infrastructure and assets themselves, this CAVA examines how climate hazards may impact critical operations and services. As defined by the CPUC Climate Adaptation OIR rulings, operations and services are "functions that, if interrupted, would result in the loss of an essential or critical process." PG&E's Emergency Preparedness and Response (EP&R) department is responsible for identifying critical operations and services across the Company, identifying natural and other hazards that may affect the functioning of these operations and services, and setting up plans to ensure business continuity in case of disruption. PG&E identified these essential and critical business processes using our business impact analysis, which is a critical tool that EP&R uses to identify which PG&E processes, or operations, when disrupted, would most affect PG&E's major risk areas.

Third-Party Facility Contracts

As directed by the CPUC Climate Adaptation OIR rulings, PG&E analyzed third-party facility contracts for power, capacity, and reliability, and surveyed their owner/operators regarding the climate vulnerability of their facilities. Responses are included in Section 3.3.

The Vulnerability Assessment Framework and Methodology

The interactions of weather, energy systems, and supporting infrastructure are complex and include the impacts of weather patterns—both ambient conditions and extreme weather events—on individual asset, as well as the network of the power system. The vulnerability of any individual asset is itself a complex interaction among factors, such as asset type and design specifics, the location of the installation, age, system dynamics, and customer demand. The varying characteristics of climate hazards furthermore complicate the nature of climate change impacts and may include acute and chronic, and direct and indirect impacts on assets.

Predicting asset failure is a complex process and there is typically not one climate hazard threshold that, by itself, will predict damage or failure of (or the causation of) an asset without some consideration of that asset's design and other characteristics.

The Vulnerability Assessment Methodology

The CAVA investigates how PG&E-owned assets, operations, and services are directly affected by climate-driven natural hazards. This type of scenario-based vulnerability analysis proceeds along the following major steps:

1. Climate change hazards: identify those in scope for analysis
2. Climate change scenario selection
3. Geospatial application of future scenarios to existing energy system infrastructure to determine exposure
4. Review of the exposed assets for sensitivity to each hazard based on design criteria and other relevant asset-specific characteristics to determine vulnerability

5. Consideration of existing organizational capabilities (adaptive capacity) that may either prevent or minimize the physical impacts of hazards on vulnerable assets

The output of this process is a set of relative climate change risk ratings by asset family and operational process. The relative climate change risk ratings can then be used to prioritize adaptive action across the enterprise, with the underlying CAVA analysis as a starting point for adaptation program design or a specific adaptation investment proposal.

Climate Change Hazards

The climate hazards in scope for this assessment include temperature, variations in precipitation, inland flooding, sea level rise, wildfires, and other impacts, such as drought-driven subsidence and landslides. For more information regarding these hazards, an approach to vulnerability analyses, and climate change exposure analysis for PG&E's service area, see Appendix B.

Climate Change Scenario Selection

PG&E used the Representative Concentration Pathway (RCP) 8.5 emissions scenario for the analysis of temperature, precipitation, sea level rise, and wildfire variables. The use of this RCP scenario was a requirement from the CPUC Climate Adaptation OIR rulings.

Forward-looking climate projections reveal uncertainty in the future intensity and rate of change. Uncertainty reflects an array of complex factors, including uncertainty in the rate of future global greenhouse gas emissions, climate sensitivity to greenhouse gas emissions, and internal feedback and variability within the climate system. For example, science predicts with a high degree of certainty that temperatures will continue to increase and hazard conditions will continue to diverge from historical baselines. However, the overall timing, frequency, and magnitude of climate change and the resulting extreme events remain uncertain and the potential for less likely but worst case outcomes remains.

To capture some of the uncertainty related to the use of climate change variables, PG&E followed best practices and peer benchmarking[10] for energy utility vulnerability assessments. PG&E analyzed multiple global climate model results, typically up to 32 ensemble model results, for each climate change variable. Where relevant, PG&E selected the model results that represented the 90th percentile outcomes, which allows for a more complete understanding of the range of climate change impacts.

Timeframes

PG&E's vulnerability assessment considers potential climate change on three decadal timeframes: 2030, 2050, and 2080, representing near-term, intermediate, and long-term views, respectively. According to the CPUC Climate Adaptation OIR rulings, the focus of the

[10] Consolidated Edison of New York City also elected to use the 90th percentile of RCP 8.5 models as its high-end "stress test" scenario. Con Edison. 2023. "Our Climate Change Resiliency Plan." https://www.coned.com/en/our-energy-future/our-energy-vision/storm-hardening-enhancement-plan.

CAVA is on the decadal projections around 2050. In characterizing future change relative to the historical past, the CAVA uses a baseline of 1976–2005 for atmospheric variables[11] and 2010–2015 for sea level rise.[12] Additional details on specific climate change projections, applied timeframes, and data sources are provided in Appendix A: Climate Methods.

Despite the focus on the future, the results of this study are immediately actionable. Many utility assets have useful lives of multiple decades, meaning that asset investments being made today should be informed by the conditions to which they will be exposed in the climate-altered future. Additionally, climate projections rely on 30-year averages as a best practice to prevent inaccurate "overprediction" of specific conditions in a given future year. The focus on 2050 necessarily includes an analytical "envelope" spanning from 2035 to 2065. Similarly, climate projections focused on 2030 consider data from 2015 to 2045. While warming trends will make many climate-driven hazards more frequent and severe in the coming decades, it is possible that historically extreme events could occur in any given year; the likelihood simply increases as time passes and warming further progresses.

[11] The baseline for atmospheric variables was used in the Intergovernmental Panel on Climate Change Fifth Assessment Report and represents a common period used to evaluate bias between the simulations of historical climate by global climate models and observed historical climate.
[12] California Natural Resources Agency. 2018. "State of California Sea-Level Rise Guidance." opc.ca.gov/webmaster/ftp/pdf/agenda_items/20180314/Item3_Exhibit-A_OPC_SLR_Guidance-rd3.pdf.

The Vulnerability Assessment Framework

The framework to assess climate change vulnerability is based on several components as outlined below in Figure 1-4. Below the framework, the terms and steps are explained.

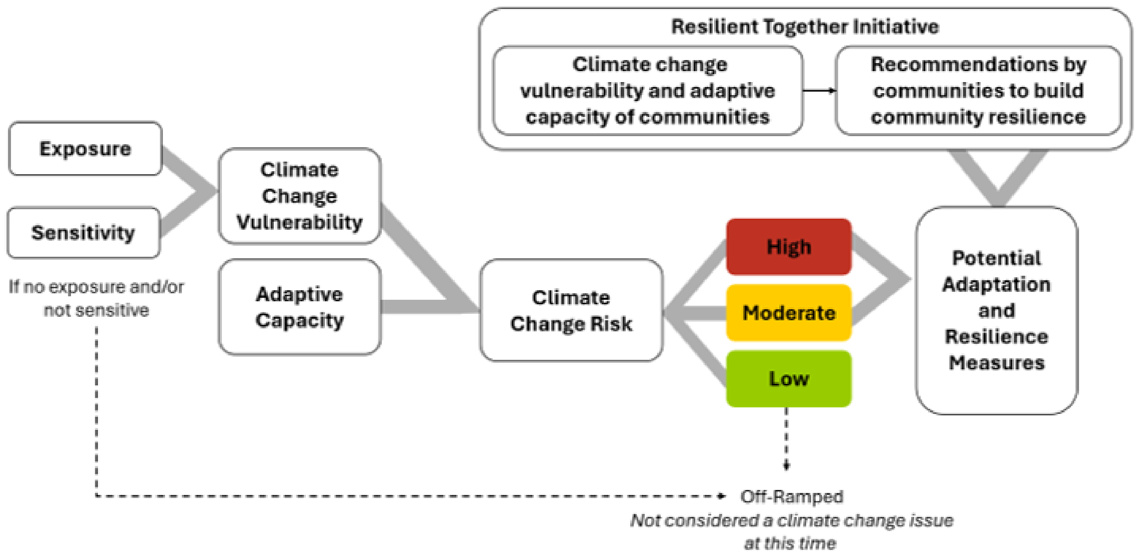


Figure 1-4. Vulnerability Assessment Framework for assessing the climate change vulnerability and climate change risk of infrastructure and assets.

Exposure

This is the nature and degree of the projected climate change hazard in relation to an asset (e.g., whether substations are projected to be exposed to coastal flooding during a 100-year coastal storm event by 2050).

Sensitivity

This is the degree to which assets may experience detrimental impacts if exposed to a climate hazard (e.g., why and how substation equipment and substation operations could be affected by water inundation caused by a 100-year coastal storm event).

Climate Change Vulnerability

This step uses asset- or function-specific metrics to assess the temporal and spatial trends in the climate change vulnerability of infrastructure and assets.

Vulnerability metrics for each asset and hazard are based on the known sensitivities of each infrastructure type. Given that much of California will be exposed to climate hazards in the coming decades, these vulnerability thresholds help to identify which future conditions are of concern, how they will affect the system, and what adaptive action PG&E may take.

The sensitivity thresholds used in the CAVA are based on the assumptions laid out in design or planning documents, based on subject matter experts' input, or benchmarked to California's

Fourth Climate Change Assessment.[13] These metrics are not representative of the full potential impacts of extreme weather events or of changing average conditions. The metrics are only meant to be representative of projected relative change from historical conditions. For example, the Federal Emergency Management Agency (FEMA) floodplain designations are currently the best available metric to understand vulnerability to flooding, although they are backward-looking and may not be accurate in predicting the frequency and severity of future flood risks.[14]

For example:

Analytical metric: Recognizing the overlap with FEMA floodplains in coastal areas, the metric of exposure specifically for sea level rise is the location of a substation in areas of current and future coastal inundation extent during a 100-year storm event over time.

Result: As sea levels rise, coastal substations and those near tidally influenced waters are likely to be exposed to increased flood exposure over time during coastal storm events, although the numbers remain quite low through 2080 (Table 1-2). The Bay Area Region has the highest number of coastal substations exposed to coastal inundation, indicating greater vulnerability (Table 1-2). As sea levels rise and Delta inflows increase driven by climate change, more substations in the Central Valley Region may be at risk of Delta flooding due to levee overtopping (Table 1-2).

Table 1-2. Substation counts exposed to increased flood exposure during coastal storm events, by region.

Region	Baseline	2030	2050	2080
Bay Area	2 (0.2%)	4 (0.4%)	6 (0.7%)	15 (1.6%)
Central Valley	2 (0.2%)	6 (0.7%)	8 (0.9%)	14 (1.5%)
Sierra	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
North Coast	2 (0.2%)	2 (0.2%)	3 (0.3%)	7 (0.8%)
Central Coast	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (0.2%)
Total	**6 (0.7%)**	**12 (1.3%)**	**17 (1.9%)**	**38 (4.2%)**

Adaptive Capacity

In the context of this report, adaptive capacity describes current capabilities that PG&E and our communities rely on to manage environmental hazards. Considering adaptive capacity in climate risk analysis is important because it helps determine whether current capabilities may be sufficient to manage projected future changes to a given hazard or whether more time, attention, or investment is required for resilience. Where appropriate, the capabilities are generally grouped by planning and operational capacities:

[13] California's Fourth Climate Change Assessment.
[14] How Federal Flood Maps Ignore the Risks of Climate Change, FRONTLINE (pbs.org).

- Planning capacities are focused on internal processes, design and engineering standards used in future construction efforts, asset hardening, and how the Company plans future system operations.
- Operational capacities are focused on near-term measures, how PG&E operates the energy system on a day-to-day basis, and the Company's planning for and response to emergency events.

The CAVA characterizes overall adaptive capacity using three categories for infrastructure and assets:

- Low: PG&E has no or very few current capabilities.
- Moderate: PG&E has some or many existing capabilities; however, there are opportunities to strengthen these, informed by projected changes in the hazard.
- High: PG&E has sufficient or excellent capabilities to manage the climate hazard now and in the future.

For example, PG&E's current adaptive capacity for managing the impacts of coastal flooding at substations includes existing flood protection measures that incorporate sea level rise projections for new build or major rework at substations, pumping capacity, and the mobilization of temporary flood barriers. This guidance applies to the design of new substations or for substations underdoing major work, and currently no guidance is provided for all other substations. The adaptive capacity to sea level rise is considered to be moderate.

Climate Change Risk

A synthesized climate change risk ranking is provided for all asset family-hazard combinations based on assessed climate change vulnerability and existing adaptive capacity. The primary benefit of this ranking is to prioritize the most vulnerable asset families for adaptive action in the form of resilience investment or further study to support future resilience investment.

The CAVA provides three categories of climate change risk for infrastructure and assets:

- High: Vulnerable assets, current operational/planning processes likely not to be sufficient given future projections. High-priority climate change issue.
- Moderate: Vulnerable assets, opportunities exist to bolster current operational/planning processes to enable greater resiliency. Recommend addressing the issue.
- Low (off-ramped): Not considered a climate change issue at this time; off-ramped pending reassessment.

The climate change risk rating system described above is specific to the CAVA and should not be understood as being the same used in PG&E's Risk Assessment and Mitigation Phase (RAMP) analysis. RAMP is an event-based risk analysis focused on assessing and mitigating a variety of near-term risks, while the CAVA is a scenario-based risk analysis focused on climate-driven physical hazards in 2050. RAMP and the CAVA are thus complementary risk assessment efforts.

PG&E is working to coordinate RAMP and the CAVA within the Company's overall risk assessment and investment planning processes. PG&E notes that, at the time of this filing, the relationship between RAMP and the CAVA is an ongoing topic of discussion in Phase II of the CPUC Climate Adaptation OIR.

Off-Ramping and a Mechanism to Reassess Climate Change Risk

Asset-hazard combinations that are rated as having a "low" climate change risk are considered "off-ramped," which means that the hazard can be responsibly deprioritized relative to more severe risks.

PG&E's mechanism to reassess this low-risk category is (1) every 4 years, in which all off-ramped asset-hazard combinations will be reexamined for any new information that may alter the climate change vulnerability ranking, or (2) if PG&E obtains new information that significantly changes the projected, plausible future risk environment.

The Identification of Potential Adaptation and Resilience Measures

The CAVA provides potential climate change adaptation options for all climate change risks identified as moderate or high. The potential options presented in each section are targeted toward individual future climate hazard conditions. The aim of this effort is to ensure consistency with D.20-08-046, which asks for utilities to "describe possible solutions ranging from easy to difficult,"[15] and to highlight incremental steps that PG&E can evaluate in the future. These adaptation options are not fully developed projects, nor are they requests for funding, which may or may not be developed into future funding requests.

In considering potential options as "easy fixes" or "more difficult, longer-term mitigation,"[16] where appropriate, the CAVA considers aligning potential adaptation options with existing PG&E planning and operational functions. The adaptation options identified in the CAVA are not ranked from easy to difficult. Two key factors limit the ability to readily determine the ease of any potential adaptation options: (1) the lack of a clear definition of *easy* or *difficult* adaption options, and (2) the uncertainty around the feasibility and level of effort for implementation of any adaptation options presented without each option being individually considered in the Company's risk and investment planning processes. Adaptation options that are considered difficult today may become less so as PG&E matures in analyzing and comparing options, technology improves, and implementation of mitigations becomes more efficient and cost-effective.

Given the Company's understanding that the inclusion of potential adaption options was intended to develop a list of options to consider in future efforts, PG&E presented these adaptation options in two related and overlapping categories: planning or operational. These categories, defined for the purposes of this CAVA, are as follows:

---

[15] D.20-08-046, p. 117.

[16] *Ibid*.

- Planning adaptation options are focused on internal processes, design and engineering standards used in future construction efforts, asset hardening, and how the Company plans future system operations.
- Operational adaptation options are focused on near-term measures, how PG&E operates the energy system, and the Company's planning for, and response to, emergency events.

These categories follow how PG&E plans and operates its assets. While there are different levels of feasibility and ease of implementation in each category, these should not be taken as substitutes for the easy or hard designations. Rather, this effort is to align these adaptation options with how PG&E will evaluate them in the future.

The potential adaptation options presented in the CAVA should be considered preliminary and non-comprehensive. They are a starting point for the development of detailed locational and asset-specific adaptation investments and programs. See Section 4 for more information regarding PG&E's potential next steps in climate adaptation and resilience planning, including a discussion on green and sustainable remedies for vulnerable infrastructure.

1.4 Summary of CAVA Findings

The figure below is a high-level synthesis of climate change risk findings for PG&E's assets and infrastructure by climate hazard (Figure 1-5). (Operations are addressed separately below.) The primary benefit of climate change risk categories is to prioritize the most vulnerable asset families for adaptive action in the form of resilience investment or further study to support future resilience investment.

Figure 1-5. Climate change risk categories for electric, gas, and power generation asset families, as well as PG&E facilities and IT infrastructure. No hydropower or solar assets are located within or near coastal or tidally influenced locations and sea level rise exposure analyses are not applicable (N/A) for the CAVA.

The impacts of climate change may also affect PG&E's critical operations and result in unsafe conditions for our field teams and coworkers who services are critical to meeting the needs of our customers and communities.

The results presented in Figure 1-5 can be narratively interpreted as follows:

- Projected increases in temperatures in excess of current planning and operational capabilities may result in insufficient capacity, reduced equipment life, asset failure, and result in diminished reliability of electric assets. This finding is particularly relevant as PG&E plans for the grid of the future to support electrification and the state's climate goals.
- Changing precipitation patterns and resulting flooding may adversely affect electric assets, such as substations and conductor support structures, as well as gas assets, such as the

McDonald Island Natural Gas Storage Facility and certain gas measurement and control stations. No-dam hydropower assets also may be at heightened risk of damage.
- The risk of wildfires from any source is projected to increase due to climate change, leading to a higher risk of wildfire damage to many of PG&E's assets. PG&E's existing wildfire mitigation plan, although focused on eliminating wildfire ignition by electrical equipment also represents a significant existing investment in climate resilience.

Detailed analyses of climate change risk that underpin the synthesis presented above, such as hazard exposure, equipment sensitivity, planning and operational capabilities, and regional differences in climate change vulnerabilities, are discussed at length in Section 3.1.

Potential climate adaptation options for all climate change risks identified as moderate or high are presented throughout Section 3 of this CAVA. A summary of these adaptation options and possible next steps are provided in Section 4.

Operational Resilience Key Findings

Besides facilities and IT assets, critical operations require essential people to execute the process, along with backup personnel. Many critical operations at PG&E also rely on field teams. Employee safety and access to PG&E infrastructure and assets are therefore key considerations in ensuring operational resilience.

Because those in the field will likely be most exposed to the impacts of extreme weather and other climate change hazards, further analysis specific to these impacts could be conducted for those PG&E operations that have field teams. This could include the analysis of spatial and temporal vulnerabilities of essential people and field teams to extreme weather events; potential impacts of extreme weather events and changing conditions due to climate change on current operational adaptive capacity; and procedural safety improvements and hazard awareness of climate change impacts for employees, essential people, and field teams.

PG&E's Next Steps in Adaptation and Resilience

The primary benefit of climate change risk ranking is to prioritize the most vulnerable asset families for adaptive action in the form of resilience investment or further study to support future resilience investment. The adaptation options identified for infrastructure and assets and identified resilience options for operations will be considered as PG&E continues to evaluate the appropriate mechanisms to include the expected impacts of climate change in short- and long-term planning and operational processes.

PG&E has a long history of considering the impacts of climate change in its risk management processes. The CAVA is the next step in the integration of climate change impacts and proactive planning; however, it is far from the only effort that the Company has made to adapt to a changing climate.

For more details regarding these efforts and PG&E's next steps for a climate-resilient energy system, see Section 4.

Section 2: Climate Change and the Communities We Serve

Table of Contents

2.1 Introduction

The purpose of this section is to summarize the results of the Resilient Together initiative ("the Initiative"), which is the implementation of the CAVA Community Engagement Plan (CEP) (Appendix D). The CEP outlined PG&E's approach for partnering with the communities we serve to better understand how particularly climate-vulnerable populations are experiencing the impacts of climate change and the related changes in their energy service needs. Uplifting the experiences of our customers, particularly those living within designated Disadvantaged Vulnerable Communities (DVCs), is critical to ensuring that the resilience investments we make on their behalf address grid issues in a manner that meets their needs and does not repeat patterns of historical inequity.

The Initiative convened community leaders across the PG&E service area, who represent their communities and are well-positioned to support effective, community-specific public engagement.

The Initiative formed Resilient Together Advisory Groups (RTAGs), which were composed of representatives from community-based organizations (CBOs) throughout PG&E's service area. RTAG members conducted community outreach and served as on-the-ground partners on behalf of PG&E. PG&E is deeply grateful to our RTAG members for their patience, trust, and partnership, as well as the substantive community feedback they were able to gather. The CBOs that participated in the RTAGs are listed in Appendix C (note that some CBOs did not participate in the entirety of the engagement). To learn more about the Initiative beyond this summary, including the scope of and approach to engagement, the role of the RTAGs, and the full accounting of the findings of the Initiative, see Appendix C.

2.2 Integrating Feedback from Communities into the CAVA

The Resilient Together initiative directly supported the development of PG&E's CAVA by doing the following:

- Sharing information with the communities we serve about how climate change may affect the resilience of the energy system.
- Learning how our most vulnerable customers are experiencing the impacts of increasingly frequent and severe climate-driven hazards.
- Uplifting community insights and recommendations into the CAVA and our ongoing climate adaptation work.

An inherent challenge in the development and implementation of the CAVA CEP is that the CAVA analysis is focused on the performance of physical assets and critical operations relative to conditions in 2050, whereas the customers we serve are understandably focused primarily on their current lived experiences and needs.

Additionally, the chain of impact from the Initiative to an actual on-the-ground resilience project is long and complex—from gathering community feedback on climate resilience issues related to the energy service they receive from PG&E, to incorporating those findings into the CAVA assessment on physical infrastructure and operations required to provide these services, to translating CAVA findings into CPUC risk and investment filings, and taking action to improve the resilience of the grid for our customers. To support transparent dialogue, the PG&E presentations to the RTAGs explained this chain of impact and its timeline.

PG&E partnered with the RTAGs to ensure that feedback through the Initiative would be fully represented in the CAVA. This integration of the feedback and recommendations from the Initiative extends beyond the CAVA, and PG&E is committed to sharing the findings internally at PG&E. For example, PG&E's Climate Resilience Team has met with and shared findings from the Initiative with many internal PG&E groups. Additionally, the Climate Resilience Team conducted a preliminary gap analysis to identify actions that the company can take to address the top resilience recommendations from community members.

The Initiative's process also produced an Equity Framework, informed by RTAG members and expert third-party community engagement specialists, as a tool to elevate environmental and social equity considerations within PG&E's decision-making processes, including considering adaptation investments in DVCs (see Appendix C).

Finally, PG&E's Climate Resilience Team is a member of PG&E's Environmental and Social Justice Working Group, led by PG&E's full-time Environmental and Social Justice Policy Manager, which continues to advocate for and integrate environmental and social justice best practices into PG&E's business practices, consistent with the Company's Environmental and Social Justice Policy.

PG&E is aware that more work needs to be done to connect highly technical, engineering- and operations-based, future-looking climate vulnerability analysis with the present-day, energy-related needs of our customers. In future CAVA filings, PG&E is considering the inclusion of analyses, such as power-flow models, to investigate direct impacts on customers resulting from climate change impacts on vulnerable infrastructure. PG&E also is actively involved in efforts to better quantify the total social cost of outages to customers, which is information that will be critical in prioritizing how and where to build grid resilience.

In the near term, PG&E intends to share the findings of the CAVA and the Initiative with local governments, tribal governments, community partners, and other California energy policy stakeholders to continue to advance the shared goal of a climate-resilient energy system.

2.3 The Adaptive Capacity of Communities

Assessments of adaptive capacity are critical to understanding the climate change vulnerability of communities. These assessments evaluate the readiness of communities to respond to the short-term shocks and long-term stresses induced by climate change. While almost all communities in California are exposed to one or more climate-driven natural hazards, adaptive capacity can vary greatly between communities, leading to much better or worse outcomes for those affected by a hazard. As directed by the CPUC, the development and implementation of the CEP includes an assessment of the adaptive capacity of DVCs.[1] To assess adaptive capacity, the CAVA used the Baseline Resilience Indicators for Communities (BRIC) index.[2] BRIC is a publicly available and academically vetted index pulling from federal government data developed to better understand and measure resilience across U.S. counties. The methodology and full results of the BRIC analysis can be found in Appendix C.

Bay Area Region

The Bay Area Region has the greatest adaptive capacity, compared with other regions, due to higher social, economic, and infrastructural resilience. However, regional scoring frameworks often gloss over pockets of the greater San Francisco Bay Area that are severely economically distressed and lack access to affordable housing. A high social score reflects a large and growing number of highly educated, high-income people living in the Bay Area, but does not capture the high levels of income inequality and homelessness that also are prevalent in the region.

Central Valley Region

The Central Valley Region has the lowest adaptive capacity relative to other regions. While the Central Valley Region has high social resilience, it scores low on infrastructural and environmental resilience. These findings are consistent with community concerns about low-quality and underdeveloped housing stock and infrastructure, as well as water stress and high energy use due to high heat.

Sierra Region

The Sierra Region has higher social and environmental resilience but lower community capital and infrastructural resilience scores. Access to the outdoors is a key community asset; however, this region has suffered from a lack of broadband access and connection to services and resources.

North Coast Region

The North Coast Region is the second lowest scoring region overall, despite having the highest community capital and environmental resilience. This is due to its low economic, institutional, and infrastructural resilience. Although North Coast Region communities have the strong social attributes of resilience, as well as strong environmental resources, such as water and open space, the region is less affluent and consistent with RTAG input, it lacks sufficient investment in housing and communication infrastructure. As a highly remote region, the North Coast lacks the access to goods and services that support adaptive capacity.

[1] Decision 20-08-046: 346285534.PDF (ca.gov)

[2] FEMA. “Community Resilience.” National Risk Index. https://hazards.fema.gov/nri/community-resilience

Central Coast Region

The Central Coast Region has the highest institutional resilience but scores low on community capital and infrastructural resilience. Findings indicate that governments are coordinating on climate resilience efforts but are not necessarily reaching community members with accessible information and resources. The low community capital score does not reflect the RTAG's findings that suggest the existence of strong community networks, particularly among low-income farmworker communities that may be isolated and not connected to external networks.

2.4 The Impacts of Climate Change on Our Communities

As noted above, the chain of impact connecting this community feedback to material changes to the energy system on the ground is long and complex. To that end, PG&E is committed not only to sharing community feedback in this report but also ensuring that this information remains available and visible internally so that it may inform other decision-making.

Through the Resilient Together initiative, the RTAGs solicited community members about the greatest impacts they experience or are most concerned about during extreme heat, power outages, wildfires, flooding, and sea level rise. This section provides a high-level summary of the RTAGs' findings on what the communities reported through the Initiative (see Appendix C for the complete findings).

Feedback provided by communities through the RTAGs is reflected in PG&E's assessment of adaptive capacity capabilities (see Section 1: Introduction to the Vulnerability Assessment).

Bay Area Region

The Bay Area Region RTAG reports the following impacts of climate hazards as described by communities.

Extreme Heat

RTAG members report that transportation to cooler places is not accessible to many people. Many households lack air conditioning, and for those who do have access, many indicated that they are unwilling to use it because of the high cost of electricity, resulting in an increased risk of heat illness.

Power Outages

RTAG members report that power outages are disruptive to daily life, affecting everything from transportation, to communication, and childcare and work. Low-income communities that already struggle financially are further strained by higher energy bills and the costs associated with power outages, such as food spoilage. Power outages are of particular concern for elderly residents and people with disabilities, who rely on medical equipment or refrigerated medicine.

Wildfires

RTAG members report community concerns about the health impacts from wildfire smoke, particularly for low-income communities, communities of color, and outdoor workers who lack access to personal or household safety equipment, such as air filters and N95 masks.

Central Valley Region

Central Valley Region RTAG reports the following impacts of climate hazards as described by communities.

Extreme Heat

RTAG members report that, in urban areas, the heat island effect, combined with the lack of tree canopy, exacerbates the heat impacts. These impacts include more people going to the hospital due to dehydration and other heat illnesses, higher energy bills, and worsened air quality. Coupled with high utility bills, extreme heat creates a financial strain for low-income communities and is the top concern for the region. Heat impacts may be more prominent due to the prevalence of poor housing stock that is difficult to weatherize. In remote parts of the region, many residents lack cooling centers and other resources, services, and information on how to keep themselves safe during these hazard events. In urban areas, the heat island effect, combined with the lack of tree canopy, exacerbates the heat impacts. These impacts include more people going to the hospital due to dehydration and other heat illnesses, higher energy bills, and worsened air quality.

The Impact on Agricultural Industry

Agricultural industry is highly vulnerable to climate hazards and is already experiencing the impacts of climate change. RTAG members report that the health of farmworkers, the quantity of crop yields, and the productivity of livestock are all negatively affected by sustained drought and the increasing frequency of extreme heat or flooded fields, resulting in unsafe working conditions and reduced working hours. Although these farmworkers experience the harshest economic impacts from climate events in the region, their immigration status prevents them from accessing unemployment benefits.

Sierra Region

The Sierra Region RTAG reports the following impacts of climate hazards as described by communities.

Extreme Heat

RTAG members report that, in the urban areas of the region, such as Sacramento, extreme heat is the main hazard of concern. RTAG members report that, increasingly, residents require air conditioning, especially those living in poorly insulated homes. However, many residents on fixed incomes indicated that they cannot afford the cost of running air conditioners. Some residents indicated that they had to sell their long-time homes and downsize to apartments in order to afford their higher electric bills. Without family to help them, seniors are isolated at home due to the few transportation resources in the region, which is exacerbated by lack of a phone or internet access.

Wildfires

In rural areas, which are most affected by wildfires, RTAG members reported community concerns about getting stranded in wildfire zones during active fires due to limited evacuation routes, lack of communication, and lack of adequate transportation infrastructure. Another key impact of concern with regard to wildfires is community displacement. Residents indicated that they are being permanently priced out of their community due to the housing crisis, which drives up housing prices and pushes development into fire-prone areas, where wildfires destroy homes and communities.

North Coast Region

The North Coast Region RTAG reports the following impacts of climate hazards as described by communities.

Power Outages

RTAG members report that power outages often last for long periods and that communities feel this region is marked by both poor transmission infrastructure and high wildfire risk. Most households are not equipped with backup power generation or batteries during power outages, resulting in residents who are “trapped at home” in remote areas without access to food and water.

Extreme Heat

RTAG members report that power outages compound the impact of heat waves, which have become more frequent and pose a particular risk to elderly, low-income, and unhoused communities. Most households lack air conditioning due to historically moderate temperatures.

Sea Level Rise and Flooding

RTAG members report that evacuations and post-disaster recovery are particularly fraught in the region. Rural communities in the region have few routes into or out of the area and are cut off from these roads when flooding occurs, thus restricting access to food and resources.

Wildfires

RTAG members report that many residents have been dropped by their home insurance companies and have faced the unexpected costs related to hotel/motel rates during evacuations in a region that lacks sufficient emergency shelters and other resources, support, or aid from governmental organizations or PG&E. The housing crisis and gentrification have compounded climate hazards and have led to the creation of “tent cities” and permanent displacement of community members. Those who do rebuild are concerned about having mortgages well into retirement and other community members have been displaced. Compounding and cascading disasters in the highly rural, heavily forested region have resulted in widespread devastation across PG&E’s service areas.

Central Coast Region

The Central Coast Region RTAG reports the following impacts of climate hazards as described by communities.

Extreme Heat

RTAG members report that lack of air conditioning and poor housing stock exacerbate extreme heat impacts for low-income communities throughout the Central Coast Region. Farmworkers in the region experience health risks from working outside in the heat and heightened exposure to wildfire smoke. Additionally, the financial well-being of farmworker communities is affected by changing growing conditions, which affect working hours and the demand for labor.

Wildfires

Mountainous communities are more prone to fire hazards and subsequent mudslides. RTAG members report that the key challenge for mountainous communities is that they lack reliable evacuation routes and struggle to find adequate housing post-evacuation. Wildfires are compounded by housing pressures and a lack of coordination and planning at the local government level, resulting in an overreliance on community organizations to provide emergency resources and services.

Sea Level Rise and Flooding

RTAG members report that primarily low-income Black and Latinx communities in low-lying areas have experienced historical flooding and face elevated risk from sea level rise. This flooding further contributes to dilapidated or unhealthy housing, as well as water contamination and groundwater intrusion.

2.5 The Resilient Together Initiative's Top Recommendations to Build Customer and Community Resilience

The following recommendations were collected and synthesized by the RTAGs and detail how the communities we serve would like to see PG&E support their energy-related climate resilience.

PG&E provides this summary of community recommendation as we heard from our communites, and continues to evaluate which, if any, we can or will pursue.

PG&E reviewed the RTAGs' recommendations against existing PG&E and PG&E-supported or promoted programs to understand our existing capacity to meet changing customer expectations. The existing initiatives listed below each recommendation may not be comprehensive as this work is ongoing at the time of filing. Some needs expressed by the RTAGs' recommendations can be met with governmental or other programs.

Throughout the RTAG process, the affordability of energy services was a consistent theme underlying much of the discussion. PG&E recognizes the challenges of energy affordability and is committed to making energy bills more affordable.

More information about supportive PG&E programs can be found at www.PGE.com.

Household Resilience Strategies

Home Improvements

Expand weatherization programs to provide highly subsidized or no-cost home improvements that make homes more resilient to a variety of climate hazards.

The Resilient Together initiative identified opportunities to provide homes with solar, battery storage, backup generation, air conditioning, heat pumps, and other household safety and cooling equipment that would protect households during a hazard event. Home improvements should be made affordable and accessible to achieve higher enrollment in home retrofit or appliance rebate programs and more equitable resilience outcomes. Many community members do not have the authority to implement home improvements that would improve household safety and were concerned about asking their landlords to make improvements out of fear of their rent being raised or being evicted amid a housing crisis. Home retrofit and hardening programs that serve renters are important.

Existing initiatives:

- Low Income Home Energy Assistance Program (LIHEAP)[3]
- Energy-saving programs[4]

---

[3] PG&E. "Low Income Home Energy Assistance Program (LIHEAP)." https://www.pge.com/en/account/billing-and-assistance/financial-assistance/low-income-home-energy-assistance-program.html

[4] PG&E. "Energy-Saving Programs." https://www.pge.com/en/save-energy-and-money/energy-saving-programs.html

- Portable Battery Program[5]
- Residential Storage Initiative[6]
- Self-Generation Incentive Program (SGIP).[7]

Direct Payments

Provide direct reimbursements for the costs associated with power outages.

RTAG members suggested that PG&E could provide more direct financial relief to customers affected by power outages and shared that the cost of energy services is too high. Cash payments for low-income households, who are affected by power outages, can help residents recover from lost income due to food spoilage, loss of work, and other disruptions that occur as a result of hazard events.

Existing initiatives:

- Storm Inconvenience Bill Credit (a part of PG&E's Safety Net Program)[8]
- See below for PG&E's income-eligible programs that help reduce energy costs.

Customer Programs

Increase the accessibility of PG&E programs and sustain funding for PG&E programs.

RTAG members suggested that PG&E can revise program income eligibility requirements to take into consideration inflation and the cost of living (not just income) and remove upfront capital investment requirements. Also, they suggested that PG&E can consider long-term funding availability when developing financial relief programs (not just income-qualified programs).

Existing initiatives:

- We are here to help our customers save energy and money by helping them find the best rate plan for their household or business, sharing free and low-cost actions to help them reduce energy usage and better manage monthly bills, and offering bill assistance programs to income-eligible customers.
- Income-eligible programs include California Alternate Rates for Energy (CARE),[9] which offers a discount of 30 percent or more each month on energy bills; Family Electric Rate

---

[5] PG&E. "Portable Battery Program." https://www.pge.com/en/account/billing-and-assistance/financial-assistance/portable-battery-program.html

[6] PG&E. "Residential Storage Initiative." https://www.pge.com/en/outages-and-safety/outage-preparedness-and-support/general-outage-resources/residential-storage-initiative.html

[7] PG&E. "Self-Generation Incentive Program (SGIP)." https://www.pge.com/en/save-energy-and-money/rebates-and-incentives/self-generation-incentive-program.html#:~:text=Currently%2C%20the%20rebate%20is%2015-20%25%20of%20the%20average,EV2A%20EVB%20TOU-C%20%28only%20for%20Medical%20Baseline%20Customers%29

[8] PG&E. "Storm Inconvenience Bill Credit." https://www.pge.com/en/outages-and-safety/outage-preparedness-and-support/general-outage-resources/outage-compensation-programs.html

[9] California Alternate Rates for Energy (CARE) (pge.com).

Assistance(FERA)[10], which offers a monthly discount of 18 percent on electricity bills for households of three or more people, Energy savings Assistances (ESA)[11], which provides energy-savings improvements at no charge, and Relief for Energy Assistance through Community Help (REACH)[12], which is a one-time energy credit for up to $500 to help with sudden financial hardship.

Increase outreach and education on PG&E programs.

RTAG members recommended that PG&E continue partnering with CBOs to organize and participate in community information and resource fairs; expand the geographic reach and frequency of informational meetings, particularly in rural or remote areas and highly impacted areas; and present multilingual information at existing community meetings rather than separate PG&E meetings.

Safety Resources Distribution

Provide for the distribution of free safety resources that improve household resilience.

RTAG members promoted ensuring the distribution of masks, air purifiers, water, battery packs, fans, and other safety resources to help households prepare for and better withstand climate hazards and related power outages. It is important that households have clear communication about where and how to access these resources. Additionally, it is important for low-income households to access these safety resources free of charge. The distribution of safety resources should be prioritized in areas with low “social” and “economic” resilience categories in the BRIC framework.

Community Resilience Strategies

Community Resilience Centers and Cooling Centers

Provide financial support for the development and sustained operation of community resilience centers.

Community resilience centers and cooling centers are key services for increasing resilience in the face of extreme heat or wildfires. For more details regarding successfully resourced cooling centers, see Appendix C.

Existing initiatives:

- Resilience Hubs Grant Program[13]

---

[10] *Ibid.*
[11] Energy-saving programs (pge.com).
[12] Relief for Energy Assistance through Community Help (pge.com).
[13] PG&E. “Resilience Hubs Grant program.” https://www.pge.com/en/about/giving-locally/resilience-hubs-grant-program.html

Infrastructure Improvements and Grid Modernization

Replace aging infrastructure and improve grid reliability; enable the expansion of distributed energy resources to help minimize power outages in DVCs.

All regions advocated for increased investment in and access to distributed energy resources, which include distributed generation, energy efficiency, energy storage, electric vehicles, and demand response technologies connected at the distribution level.

RTAG members across regions understood the importance of replacing aging infrastructure and improving grid reliability by better balancing energy supply and demand to reduce power outages that affect their communities.

Existing initiatives:

- Infrastructure improvements and grid modernization (these are core aspects of PG&E's work)
- Community microgrids[14]
- Distributed Energy Resources Partnership Pilot[15]
- Enabling customer solutions: Customer energy efficiency[16]
- Enabling customer solutions: Vehicle electrification[17]
- Enabling customer solutions: Demand response[18]

Communication, Education, and Outreach

Improve emergency notifications and community education on hazards and resources.

Access to information about when power will be shut off or return, where and how to access resources, and how to prepare for emergencies is critical for ensuring that communities can prepare for and recover from climate shocks and stresses. RTAG members suggested that PG&E educate customers by using traditional methods, such as mailers, radio ads, and billboards, alongside more innovative methods, such as push notifications, text alerts, WhatsApp voice messages, Subtext, and 211 to reach non-English speaking communities. PG&E can continue to partner with CBOs to reach historically marginalized communities and underrepresented

---

[14] PG&E. "Community Microgrids." https://www.pge.com/en/save-energy-and-money/rebates-and-incentives/community-microgrids.html#tabs-4fb119b8f0-item-711304528b-tab

[15] PG&E. "Distributed Energy Resources Partnership Pilot." https://www.pge.com/en/save-energy-and-money/energy-saving-programs/distributed-energy-resources.html

[16] PG&E. 2023. "Customer Energy Efficiency." Corporate Sustainability Report. https://www.pgecorp.com/assets/pgecorp/localized/en/sustainability/corporate-responsibility-sustainability/reports/2023/planet/enabling-customer-solutions/customer-energy-efficiency/

[17] PG&E. 2023. "Vehicle Electrification." Corporate Sustainability Report. https://www.pgecorp.com/assets/pgecorp/localized/en/sustainability/corporate-responsibility-sustainability/reports/2023/planet/enabling-customer-solutions/vehicle-electrification/

[18] *Ibid*.

populations, especially communities that speak Indigenous languages and have difficulty understanding written materials.

Existing initiatives:

- PG&E Online Safety Action Center[19]
- PG&E Emergency Preparedness and Response, including emergency notifications required by the CPUC

Forest Health, Vegetation Management, and Urban Greening

Expand urban greening and forest management programs and investments.

In regions where extreme heat was the primary identified climate hazard, RTAG members recommended developing tree planting programs in low-income areas that lacked tree canopy and are shown to have significantly less canopy than more affluent areas. In fire-prone areas, RTAG members elevated forest health and vegetation management strategies, and specifically advocated for increased funding for defensible space mitigation, wood management, and community chipping programs to process brush at residences.

Existing initiatives:

- Better Together Nature Positive Innovation Grant Program[20]
- Fuels Reduction Partnership Program[21]
- Forest Resilience Bond Partnership[22]

Transportation Services

Accessible and affordable transportation options can support community members who need to evacuate or move to cooler places to avoid experiencing climate impacts.

Existing initiatives:

- PG&E works with counties to locate community resilience centers to ensure accessibility.

---

[19] PG&E. "Safety Action Center." https://www.safetyactioncenter.pge.com/

[20] PG&E. "Better Together Nature Positive Innovation Grant Program." https://www.pge.com/en/about/giving-locally/nature-postive-innovation-grant.html

[21] PG&E. 2023. "Land & Habitat." 2023 Corporate Sustainability Report. https://www.pgecorp.com/assets/pgecorp/localized/en/sustainability/corporate-responsibility-sustainability/reports/2023/planet/environmental-stewardship/land-and-habitat/

[22] Blue Forest. 2024. "Blue Forest Launches New Forest Resilience Bond (FRB) to Address Catastrophic Wildfire Threat in the Upper Mokelumne River Watershed." PR Newswire. https://www.prnewswire.com/news-releases/blue-forest-launches-new-forest-resilience-bond-frb-to-address-catastrophic-wildfire-threat-in-the-upper-mokelumne-river-watershed-302062398.html?tc=eml_cleartime

Workforce Development

Invest in and expand existing workforce development programs.

RTAG members across the regions advocated for PG&E to continue to invest in workforce development programs that support low-income community members being hired for high-quality jobs, including jobs that support clean energy economy (solar installation) and community resilience activities (e.g., forest management).

Specifically in forest management programs, workforce development could include PG&E training and hiring of local residents to perform inspections, remove vegetation under and around power lines, haul wood from customers' property, and staff biomass facilities. Implementation and increased funding of these programs and projects should be done in partnership with Fire Safe Councils. In urban areas, PG&E should partner with CBOs, local governments, and philanthropic foundations to expand tree planting programs in areas that lack tree canopy and are susceptible to extreme heat. As PG&E does not have a tree replacement program, it should evaluate, with input from CBO partners, whether to develop a proprietary tree replacement program, such as those of other investor-owned utilities, or dedicate funding to support existing programs.

Existing initiatives:

- PG&E's PowerPathway™, which educates and prepares individuals from all backgrounds for impactful roles at PG&E and in the utility industry at large[23]
- PG&E Remediation Local Hire Program[24]
- PG&E supported the Tribal EcoRestoration Alliance (TERA) with a 140-hour ecological restoration workforce development curriculum for 13 Lake County tribal members, centered around traditional ecological knowledge and native leadership.[25]

Broadband Access

Rural areas need greater investments in regional broadband access to support emergency communications.

RTAG members emphasized that when there is not internet, people cannot communicate because there are large areas that lack cell service. Rural areas need greater investments in regional broadband access to support emergency communications.

---

[23] PG&E. "PowerPathway." https://jobs.pge.com/power-pathway

[24] PG&E. 2021. "Corporate Sustainability Report." p. 120. https://www.pgecorp.com/content/dam/pgecorp/language-masters/en/sustainability/corporate-responsibility-sustainability/reports/2021/assets/PGE_CRSR_2021.pdf

[25] PG&E. 2022. "Corporate Sustainability Report." p. 129. https://www.pgecorp.com/content/dam/pgecorp/language-masters/en/sustainability/corporate-responsibility-sustainability/reports/2022/assets/PGE_CSR_2022.pdf

State Advocacy

State policy advocacy for improving emergency evacuations and improving transportation access to cooling centers.

RTAG members across all regions felt that PG&E needs to take a more active role in state policy advocacy and communicate publicly PG&E's policy goals. Advocacy may include policies that mitigate climate change through decarbonization and electrification, greater investment in solar and wind energy, and reducing regulatory barriers to distributed energy and community microgrids.

Furthermore, state policy advocacy can include the support of services, regulations, or topics that are outside of PG&E's direct control. RTAG members specifically call for more accessible and affordable transportation services, enforced workplace safety standards, and broadband access.

Existing initiatives:

- Climate Strategy Report[26]
- Participation in the Alliance of Regional Collaboratives for Climate Adaptation (ARCCA) Adaptation Policy Working Group (APWG), which advocates for supportive climate resilience policy from the governor and state legislature

2.6 Elevating Community Perspectives in the CAVA

At the outset of the Resilient Together Initiative, PG&E established a number of process- and outcome-focused goals for the partnership that were subsequently vetted with RTAG members.[27] One of PG&E's most important Resilient Together commitments is to include the final Resilient Together Initiative report in its entirety in this CAVA so that PG&E, the CPUC, interested stakeholders, and the community members themselves have a shared and candid view of energy resilience needs in DVCs.

Developing Actionable Recommendations

In the same spirit of transparency, the following section summarizes the recommendations elevated by DVC representatives through Resilient Together. Customers in the communities we serve are acutely feeling the effects of climate-driven hazards and are requesting new and different types of support from PG&E, as well as from other critical service providers and local governments.

---

[26] PG&E. 2022. "PG&E Climate Strategy Report." https://www.pge.com/content/dam/pge/docs/about/corporate-responsibility-and-sustainability/pge-climate-strategy-report.pdf

[27] See Appendix C: Resilient Together Initiative.

Honoring Input and Advancing Community Engagement at PG&E

Two other important goals of the Resilient Together initiative were to respect the value of participants' time and to advance PG&E's community engagement in line with established best practices.

To the first point, PG&E committed to ensuring that the hard-earned community input gathered over the course of Resilient Together would not just "sit on a shelf." PG&E has shared the Resilient Together findings widely with internal teams and has developed recommendations for integrating the data gathered into PG&E's data systems of record. This internal data-sharing may not seem meaningful at first glance; however, it is an important foundational step toward ensuring that community perspectives are directly integrated into decision-making at PG&E.

With regard to advancing the state of PG&E's community engagement practices, the Initiative also produced an Equity Framework, which is a tool for evaluating how climate hazards affect climate-vulnerable communities and how PG&E might address negative impacts. The Equity Framework has been shared with PG&E's Environmental and Social Justice Working Group, led by PG&E's designated Environmental and Social Justice Policy Manager, as an input to broader company guidance about how to embed equity in decision-making.

Connecting Technical Analysis and Community Preferences

A key learning from the 2024 CAVA and Resilient Together initiative is that there is more work to be done to connect long-term, asset-focused climate hazard analysis with the energy service needs and preferences of customers today. However, the primary manner in which PG&E supports community climate resilience remains unchanged—reliably and safely providing the energy that powers everyday life in California. To that end, outside of the CAVA context, PG&E is already taking significant steps to meet the energy resilience needs of customers in the face of climate change—from the activities outlined in PG&E's Wildfire Mitigation Plan to climate-informed forecasting of hydroelectric generation availability.

However, as the CAVA demonstrates, much more remains to be done. PG&E deeply appreciates the community recommendations as critical guidance in their work to provide safe, clean, affordable, and reliable energy now and into a more challenging climate future.

2.7 Resilient Together: A Beginning, Not an Ending

Delivering for our hometowns—for the families, friends, and neighbors we are privileged to serve—is at the heart of what we do at PG&E. The initial Resilient Together initiative conducted in support of the 2024 CAVA presented an opportunity to center people's lived experiences at the heart of a complex technical analysis. Doing so is only appropriate given that the purpose of understanding the climate vulnerability of the energy system is to build the necessary resilience to meet customer needs.

With this focus on people in mind, two of PG&E's process goals for Resilient Together were to "deepen existing relationships with community-based organizations" and "build trust with the customers we serve." Resilient Together was intended, from the outset, to be an ongoing forum for PG&E and representatives of the most vulnerable communities we serve to come together to understand one another better and solve problems.

PG&E is proud that this first iteration of Resilient Together made progress toward the goals stated above, according to feedback from RTAG participants conducted at the end of each RTAG regional engagement period. Remarkably, eight out of 10 participants reported that RTAG participation expanded their networks and deepened their understanding of climate hazards in their regions. Two-thirds of RTAG participants stated that it was "very likely" they would partner with RTAG member organizations on future projects. Regarding continuing to stay in touch, 88 percent of participants indicated a preference for continued CAVA updates, and 67 percent reported interest in continued quarterly meetings (Appendix C).

Climate resilience is a shared goal, one that will require more coordination and partnership than ever before to achieve. The Resilient Together initiative demonstrates the types of supportive relationships that can be developed when adequate time is provided to raise and address issues, build trust, make space for all voices at the table.

While PG&E has much more to accomplish regarding issues of social equity, the Resilient Together initiative was a valuable experience in the effort to move from extractive engagement toward more inclusive engagement methods.

PG&E intends to maintain the Resilient Together structure, both to continue to engage with CAVA 2024 Resilient Together participants and to support community engagement for PG&E's next CAVA filing in 2028.

Finally, we wish to again thank each and every RTAG participant for their patience, trust, effort, and expertise. This would not have been possible without you.

Section 3.1: Infrastructure and Assets

Table of Contents

Introduction

This CAVA analyzes PG&E-owned and -managed infrastructure and assets organized by PG&E's main utility asset types, electric, gas, and power generation, as well as enterprisewide facilities and IT assets.

Utility Asset Types

PG&E's energy system assets, operations, and engineering are grouped in electric (Section 3.1.1), gas (Section 3.1.2), and power generation (Section 3.1.3) utility asset types. The CAVA assesses the impacts of climate change to PG&E-owned infrastructure and assets within these utility asset types. The CAVA does not extend to non-PG&E-owned or non-PG&E-maintained energy system assets or operations within and outside of PG&E's service area.

Enterprisewide

Enterprisewide infrastructure and asset (Section 3.1.4) includes facilities and IT categories:

Facilities: PG&E's facilities include office buildings, service centers, and other facilities that house critical infrastructure and assets, contact or call centers, and customer services offices.

IT: PG&E's IT assets operations enable and support PG&E's daily operations, including work execution, grid control, customer support, emergency response, and asset management, and also plays a critical role in allowing the Company to operate its electric and gas infrastructure. IT operations also support business administration and productivity functions, including facilitating remote work that is necessary for the Company's 23,000 employees.

Section 3.1.1: Electric

Table of Contents

3.1.1.a Electric Transmission

Asset Family Introduction

PG&E's electric transmission system is the backbone of the electric grid, transmitting large quantities of power from the point of generation (or from outside the service area) across long distances to the distribution system where it will be used. PG&E's transmission system consists of medium- to high-voltage (60 kV to 500 kV) conductors, structures, and other supporting components. This chapter focuses specifically on transmission lines and supporting structures. Electric substation equipment is addressed in Section 3.1.1.b; electric distribution is addressed is Section 3.1.1.c.

Electric transmission lines are primarily overhead and supported by wood poles or steel structures; however, in some locations, they are underground. Transmission infrastructure carries power from its source to transmission substations where it is either routed for distribution or rerouted into another transmission line to serve load elsewhere in the system.

The transmission system has a significant amount of redundancy. In accordance with North American Electric Reliability Corporation (NERC) standards, PG&E maintains sufficient redundancy in its transmission system to allow for a single point of failure. Dropping load to avoid overloading lines can be part of contingency planning.

PG&E's transmission infrastructure supports both PG&E-owned transmission and distribution circuits and third-party conductor lines, as well as other third-party communication lines. These co-located assets may have the same climate exposure and potential vulnerability as described below. Although dependent on this physical co-location, third-party assets are beyond the scope of this climate vulnerability analysis and are not considered. PG&E-owned IT infrastructure is addressed in Section 3.1.4: Enterprisewide.

Key Findings

Climate Hazard	Climate Change Risk and Potential Adaptation Measures
Temperature	Moderate
	• Portions of PG&E's transmission system may experience temperature conditions by 2050 that meet or exceed ambient operational reference temperatures. • Rising temperatures are expected to increase load (e.g., air conditioning), which is an important contributing factor to increased conductor load profile. • Higher projected temperatures may degrade the condition of the conductor and associated components at an increased rate, as well as create regulatory clearance violations due to increased conductor sag. • Upcoming implementation of FERC Order (FO) 881 (2025) for dynamic line ratings and ambient adjusted ratings may affect line ratings. An analysis of the potential impacts of FO 881 implementation on the sensitivity to and vulnerability of the electric transmission conductor to changes in temperature driven by climate change is not within the scope of this CAVA. • Adaptation options include, but are not limited to, updated ambient temperature assumptions in maximum conducting conductor temperature calculations, plan for climate-informed capacity projects, and implement real-time conductor temperature monitoring.
Flooding and Precipitation	Moderate
	• More frequent and powerful storms could result in an increased risk of flooding and damage to transmission support structures. • Adaptation options include, but are not limited to, ensure climate-informed siting and design of new construction and harden vulnerable structures.
Sea Level Rise	Moderate
	• More frequent and higher levels of exposure to water levels and flood conditions outside of the expected design standards, which do not formally account for future sea level rise, could result in a range of chronic and acute impacts on supporting structures. • Adaptation options include, but are not limited to, ensure climate-informed siting and design of new construction and apply corrosion-resistant coatings.

3.1.1.a Electric Transmission

Wildfire	**High**
	• Overhead electric transmission equipment is sensitive to wildfire, both in terms of the potential for electrical equipment to cause ignitions and the potential that assets will sustain damage from wildfire. • PG&E's Wildfire Mitigation Plan (WMP) presents PG&E's current wildfire mitigation strategy for utility-caused wildfire ignitions. Elements of the WMP also support the resilience of transmission assets to wildfire damage regardless of the ignition source. Long-term adaptation planning and operational options to increase this resilience in the face of projected increases in wildfire activity include, but are not limited to, the replacement of wood poles with more resilient support structures.
Drought-Driven Subsidence	Low (off-ramped)
	• Historically, drought-driven subsidence has not been a major concern for most of PG&E's service area, except for the Central Valley Region. PG&E has experienced impacts on a few wood support structures due to subsidence exposing wood piles to decay. PG&E monitors for potential impacts and can repair them if needed. Drought-driven subsidence is not considered to be a climate change issue for electric transmission assets at this time.

Climate Hazards

This section describes climate hazards that may affect transmission line assets, including temperature, flooding and precipitation, sea level rise, wildfire, and drought-driven subsidence.

Temperature

Higher temperatures create two types of risks to the electric transmission system:

1. The temperature rise will result in increased loading on the conductors and the load profile. This increased load may cause operational constraints.
2. Higher projected temperatures will mean that PG&E's transmission lines are exposed to higher ambient temperatures that affect the temperature of the conductor. This can cause deterioration of the physical asset and operational constraints.

Exposure and Sensitivity

Both high ambient temperatures and heat generated by electrical current—which increases with increased load—can increase the temperature of overhead transmission conductors and transmission equipment. Consecutive heat waves or extended high temperatures without nighttime cooling can be particularly damaging.

The temperature of underground transmission conductor is related to the thermal resistivity of the surrounding soils. Thermal cycling is included in the design of underground transmission planning and increased soil temperatures are not expected to be a climate change issue for underground conductor.

When overhead conductor temperatures are high, the amount of power that the conductor can safely carry decreases, leading to reduced capacity. PG&E has historically used a coastal and interior designation to indicate portions of the service area during April–October that are generally cooler in the summer and in the warmer months of fall. The geographic division of coastal and interior zones can be visualized in the Electric Transmission Regional Reports subsection below. PG&E maintains a standard for conductor temperatures that assumes a maximum ambient temperature (with sun) of 109°F in the interior district and 99°F in the coastal district during the summer months of April–October. For the winter months of November–March, PG&E uses a 60°F value across the service area (i.e., no interior/coastal difference). These standards provide ampacities for both "normal" and "emergency" operational conditions. Transmission lines can be operated for short periods at emergency ampacities. PG&E's transmission system is therefore designed with the assumption of maximum ambient temperature at a certain frequency over the life of the conductor. For more information regarding this, see Adaptive Capacity and Climate Change Risk below.

If climate change results in higher and more frequent maximum temperatures, there is an increase in the level of conductor and splice degradation and loss of asset life. Conductor degradation can lead to increased sag due to annealing, which reduces clearance with the ground and objects. A higher load, potentially due to increased use of air conditioning, is managed by the transmission planning process.

During the 2020 heat wave event, PG&E's transmission lines avoided any direct heat-related failures. However, the outages and load-shedding that occurred on the distribution system during these events contributed to load reduction on the transmission system.

Upcoming implementation of FERC Order 881 for dynamic line ratings (DLR) and ambient adjusted ratings (AAR) may affect line ratings. An analysis of the potential impacts of FO 881 implementation on the sensitivity to and vulnerability of the electric transmission conductor to changes in temperature driven by climate change is not in the scope of this CAVA.

Climate Change Vulnerability

The transmission ambient reference temperature assumptions described above do not necessarily mean that PG&E thinks the temperature is always 109°F/99°F/60°F or less during those months but instead these thresholds are used for planning purposes and work with other heat balance equation assumptions/variables, such as wind speed, to determine conductor temperature limits. Full analysis of heat balance equation assumptions for conductor material, projected ambient and other environmental temperatures, and projected changes to load is beyond the scope of this CAVA. The ambient reference temperature thresholds serve only as a benchmark at which exceedance over time can be used as a measure of exposure to high heat and projected potential vulnerability.

Analytical Metrics

For this CAVA, we use the summer temperature month thresholds of 99°F (coastal zone)/109°F (interior zone) for our analyses. (Future studies on projected changes in all reference temperatures and heat balance equations could be incorporated into sensitivity analyses.)

Note that, as of this writing, PG&E is developing updated standards in order to no longer use a distinction between the "coastal" versus "interior" designation for design and conductor selection of new capacity-related projects. Impacted projects will use "interior" ambient temperature assumptions for design regardless of their location but operationally will continue to use "interior" versus "coastal" assumptions.

To understand exposure at very high temperatures, the specific analytical metric used is the 98th percentile ambient temperatures that exceed current relevant temperature thresholds and report out line-miles that are exposed to these conditions for 7 or more total days during a typical year. Periods of high temperature without a period of cooling off in the evenings is a concern as current standard design criteria assume that the peak load is for a short duration and there exists a cooling-off period in the evening.

3.1.1.a Electric Transmission

Results

Portions of PG&E's transmission system are projected to experience temperatures for 7 or more total days during a typical year that meet or exceed PG&E's transmission ambient reference temperature assumptions (Table 3.1.1-1).

In the near term (2030), the number of conductor line-miles that are exposed to these temperatures is relatively low in all regions but increases substantially in most regions by 2050, especially in the Central Valley and Sierra Regions (Table 3.1.1-1). By 2080, nearly all line-miles in the Central Valley and Sierra Regions will be exposed to temperatures that exceed interior design thresholds (Table 3.1.1-1). This may indicate a greater vulnerability of assets in these regions to high temperatures. See the Electric Transmission Regional Reports below for details on specific geographic areas of exposure of transmission conductor to high temperatures.

Table 3.1.1-1. Overhead transmission conductor line-miles by region exposed to temperatures at or above the exposure metric for 7 or more total days for the coastal zone.

Region	**Baseline**		**2030**		**2050**		**2080**	
	Coastal	Interior	Coastal	Interior	Coastal	Interior	Coastal	Interior
Bay Area	0 (0%)	0 (0%)	154 (0.8%)	0 (0%)	302 (1.7%)	0 (0%)	605 (3.3%)	959 (5.3%)
Central Valley	N/A	0 (0%)	N/A	2,097 (11.5%)	N/A	5,288 (29.1%)	N/A	6,209 (34.2%)
Sierra	43 (0.2%)	0 (0%)	87 (0.5%)	960 (5.3%)	87 (0.5%)	4,361 (24.0%)	87 (0.5%)	4,980 (27.4%)
North Coast	218 (1.2%)	0 (0%)	375 (2.1%)	51 (0.3%)	558 (3.1%)	197 (1.1%)	646 (3.6%)	784 (4.3%)
Central Coast	0 (0%)	0 (0%)	361 (2.0%)	169 (0.9%)	483 (2.7%)	495 (2.7%)	1,036 (5.7%)	900 (5.0%)
Total	**261 (1.4%)**	**0 (0%)**	**977 (5.4%)**	**3,277 (18%)**	**1,430 (8%)**	**10,341 (56.9%)**	**2,374 (13.1%)**	**13,832 (76.2%)**

Notes:

- *Values represent a sum of the total line segment lengths for all lines that, at any location along the line, experience conditions at or above the ratings for their location. The Central Valley Region does not have any area within the coastal zone.*
- *Reference threshold temperature for coastal zone is 99°F for the months of April–October.*
- *Reference threshold temperature for interior zone is 109°F for the months of April–October.*
- *Percentages are relative to total transmission conductor line-miles within the PG&E service area.*

Adaptive Capacity and Climate Change Risk

PG&E has the following capacities for managing potential vulnerabilities of this exceedance.

Planning Capacities

- **Increase the physical clearance of conductor:** When projects are executed, the conductor's clearances are increased to meet PG&E clearance requirements, which meet or exceed General Order (GO) 95 requirements.
- **Reliability standards:** PG&E requires transmission to plan for contingency, therefore most lines operated under normal configuration are well below 100 percent normal capacity. In accordance with NERC standards, PG&E maintains sufficient redundancy in its transmission system such that it can reroute flow in certain scenarios and avoid overloads.
- **If more capacity is needed,** PG&E ensures that there is a process to develop a project to increase the capability of the system. PG&E works with CAISO to scope these projects.

Operational Capacities

- **Transmission planning process:** The grid operator's scan will reroute or de-energize circuits that may become overloaded.
- **Line health monitoring:** PG&E assets are inspected on a routine basis; if an issue is found during the inspection process, the asset receives a maintenance notification.

In 2022, FERC issued FO 881, which includes a requirement for transmission operators to develop ambient adjusted ratings for a minimum of four seasonal line ratings, updated annually. As part of FO 881 implementation, PG&E is revisiting the conductor temperature assumptions of 109°F/99°F/60°F and the assumptions will be re-established in 2025 when the order is in effect for planning purposes (actual operations will use live temperature data). Seasonal line ratings are required to be updated every year. An analysis of the impact of FO 881 implementation on capacity, reliability, or resilience is not in the scope of this CAVA.

The adaptive capacity of transmission conductor to future temperatures in exceedance of the reference temperatures is considered to be moderate. Further analysis would be needed to understand the impacts of climate change on current adaptive capacity over time, including implementation of policies such as FO 881.

The climate change risk to transmission assets due to high heat is considered to be **moderate** given the projected increase of transmission conductor exposed to temperatures above reference temperatures, future load changes, and the unknown results of FO 881 implementation.

Potential Adaptation and Resilience Measures

FO 881 will require the use of dynamic line ratings, which vary based on weather conditions. However, an analysis of the potential impacts of FO 881 implementation on the sensitivity to and vulnerability of electric transmission conductor to changes in temperature driven by climate change, as well as the impacts on PG&E's existing adaptive capacity to plausible changes in temperature driven by climate change, is not in the scope of this CAVA.

PG&E may consider the following resilience measures to reduce vulnerabilities of transmission equipment to high temperatures related to climate change.

Planning Options

- **Update temperature assumptions in maximum conductor loading calculations:** PG&E can reduce temperature risks to transmission conductors by updating PG&E design standards around maximum conductor loading for new construction to accommodate increases in the frequency and severity of extreme temperature events.
- **Implement real-time temperature conductor monitoring:** Sensors installed on vulnerable spans of conductor line can inform real-time operational needs and track deterioration/condition over time. The condition monitoring over time allows for asset health information to be collected to contribute to long-term strategy building.
- **Plan for climate-informed capacity projects:** Incorporate future temperature trends into forecasting capacity projects.
- **Implement demand response and non-wires solutions:** Effective demand reduction is frequently a viable substitute for capacity additions, and PG&E can consider trends and opportunities associated with both voluntary demand reduction and distributed energy resources in reducing peak demand on electric assets.

Operational Options

- **Implement real-time temperature conductor monitoring:** Sensors installed on vulnerable spans of conductor line can inform real-time operational needs and track deterioration/condition over time. The information obtained can then inform operators of flexibility that is available on the line capacity, as well as plan for future capacity work.

Flooding and Precipitation

PG&E transmission systems face potential increased exposure to flooding as a result of climate-driven changes in precipitation, higher frequency and consecutive duration of extreme storms, and other hydrologic changes, such as high snowmelt that results in flooding.

Exposure and Sensitivity

Heavier and more frequent extreme precipitation, including precipitation from atmospheric rivers, could result in flood exposure to transmission system assets within floodplains, including assets that rely on flood protection from non-PG&E-owned or maintained structures that may be at risk of overtopping or failure due to projected changes in precipitation. For example, large sections of the Central Valley Region exist within floodplains and several areas rely on non-PG&E-owned or maintained levees for protection from floodwater, particularly in the Sacramento-San Joaquin Delta.

An increased frequency of extreme precipitation presents an increased vulnerability to supporting structures because structures are more vulnerable when soil is saturated with water.

3.1.1.a Electric Transmission

Exposure to water levels and flood conditions outside of design and construction parameters could result in chronic and acute impacts on transmission equipment, including the following:

- **Scouring or destabilization of the ground surface:** Erosion of earth surrounding the base of transmission poles or towers could lead to reductions in structural integrity and, in worst cases, tower or pole collapse. This is particularly relevant where supporting structures are proximal to flowing bodies of water that may increase in extent and flow and when ground is saturated with water over multiple days or consecutive storms.
- **Deterioration of assets:** Flooding can lead to water intrusion and entrapment in aboveground structural elements (e.g., foundation rebar, crack concrete spalling) and deteriorate the assets in a more rapid process due to corrosion or freeze-thaw cycles.
- **Difficulties in access and repair:** Changes in ground condition can make routine inspection and repair more difficult. Inspections and repairs during emergencies may be more difficult, too, if roads or site conditions are made inaccessible. Additional boardwalks may be required for reliable access.
- **Risk of clearance issue:** If the level of standing water decreases the distance between the surface level and conductor, there is a potential risk of clearance violations.

Standing water is not normally an issue for transmission underground conductor as it is designed to be fully submerged.

Climate Change Vulnerability

FEMA floodplain designations are currently the best available metric to understand vulnerability to flooding although they are backward-looking and may not be accurate in predicting the frequency and severity of future flood risks.

Analytical Metrics

The number of transmission towers and poles within FEMA 100-year and 500-year floodplains and the location of line-miles within high landslide risk areas is used as a benchmark to understand climate change vulnerability.

Results

All regions in the service areas have conductor line-miles within both FEMA 100-year and 500-year floodplains, with more line-miles in the Bay Area, Central Valley, and Sierra Regions (Table 3.1.1-2). The percentage of total line-miles in FEMA 100-year and 500-year floodplains is 13.81 percent and 20.75 percent, respectively, indicating that vulnerability is moderately low (Table 3.1.1-2).

Table 3.1.1-2. Number of transmission towers and poles in FEMA 100-year and 500-year floodplains, by region.

Region	FEMA 100-year	FEMA 500-year
Bay Area	1,547 (1.04%)	2,048 (1.38%)
Central Valley	8,116 (5.45%)	12,473 (8.38%)
Sierra	7,597 (5.10%)	10,936 (7.35%)
North Coast	1,544 (1.04%)	1,875 (1.26%)
Central Coast	1,754 (1.18%)	3,554 (2.39%)
Total	**20,558 (13.81%)**	**30,886 (20.76%)**

Note: Percentages are relative to total transmission towers and poles within the PG&E service area.

Towers and other transmission assets in the Sacramento Delta area (Central Valley Region) may be more vulnerable to the risk of catastrophic flooding due to overtopping or failure of levees that provide flood protection, which is a risk that is likely to increase due to climate change. Levees are existing water management infrastructure that are outside of PG&E's management.

Poles and towers in areas of high landslide risk may be exposed to damage, especially during high rain events. Overall, about 8.5 percent of transmission poles and towers are located in areas of high landslide risk, most of these are in the North Coast Region (Table 3.1.1-3). Vulnerability to this hazard will depend on the construction material of the support structure.

Table 3.1.1-3. Number of transmission towers and poles in high landslide risk zones, by region.

Region	Towers and Poles in High Landslide Risk Zone
Bay Area	2,319 (1.56%)
Central Valley	749 (0.50%)
Sierra	877 (0.59%)
North Coast	8,417 (5.65%)
Central Coast	1,275 (0.86%)
Total	**13,637 (8.57%)**

Note: Percentages are relative to total transmission towers and poles within the PG&E service area.

See the Electric Transmission Regional Reports for details on specific geographic areas of exposure of transmission conductor to landslide risk and plausible future increases in high precipitation events.

Dry Spells and Electrical Flashover

In addition to vulnerability from extreme precipitation, contaminants such as bird guano, dust, or ash on insulators have been linked to increased risk of electrical flashover, which can result in the ignition of wood poles. The risks may be particularly high during very light rainfall events or heavy fog following a long dry spell, when contaminants have had the chance to accumulate on insulators and moisture provides the catalyst for the arcing event.

Adaptive Capacity and Climate Change Risk

Specific factors affecting the adaptive capacity of transmission assets to withstand the impact of pluvial or fluvial flooding include the following.

Planning Capacities

- **Existing flood design basis of equipment:** CPUC's GO 95, Rule 37[1] outlines requirements for minimum clearance using annual flood levels. PG&E refers to FEMA flood maps and any knowledge of site-specific information for design elevations for new construction. Many of PG&E's transmission lines were built 50–100 years ago, so the FEMA flood maps have been updated since their construction; the clearances on these lines may be addressed during significant infrastructure updates.
- **Support structure foundation design:** Concrete foundations or pile caps are generally designed to be higher in areas subject to flooding.
- **Redundancy of transmission lines:** Areas with multiple transmission lines in different physical locations that serve the same customers have less of a chance of total loss of transmission connection in a single contingency failure situation. Not all transmission customers have redundant lines.

Operational Capacities

- **Emergency response plans:** PG&E's geosciences team and the Hazard Awareness and Warning Center (HAWC) coordinate with Emergency Preparedness and Response (EP&R) and the Event Operations Center (EOC) to issue debris flow/landslide watches and warnings, as appropriate, during severe storms.

The adaptive capacity of transmission conductor to fluvial and pluvial flooding is considered to be moderate given that PG&E applies best practices in design and monitoring for flood conditions and has system redundancy to buffer against the impacts on customers. Further analysis would be needed to understand the impacts of climate change on current adaptive capacity over time.

Given the risk of impacts on supporting structures within floodplains from damage from flooding and increased water flow during high precipitation events and the available adaptive capacity, the climate change risk for impacts from future flooding on transmission assets is considered to be **moderate**.

---

[1] General Order 95, Section III, Rule 37. "Requirements for All Lines." https://ia.cpuc.ca.gov/gos/GO95/go_95_rule_37.html

Potential Adaptation and Resilience Measures

Potential adaptation and resilience measures that PG&E may consider for transmission equipment include the following.

Planning Options

- **Ensure climate-informed siting and design of new construction:** Steel structure and foundations design standard requires a structure's location to be reviewed for any potential hazard (e.g., flooding) and must be designed to mitigate the hazard. Given the criticality and longevity of transmission infrastructure, future transmission siting can avoid structures within floodplains or use forward-looking precipitation data and hydrologic studies in consideration of siting and design.
- **Harden vulnerable structures:** A risk-based retrofit of existing vulnerable assets can be considered to increase stabilization.

Operational Options

- **Develop emergency response plans:** PG&E may assess certain highlighted locations to develop operational emergency response plans if a high precipitation or flooding event were to occur.

Sea Level Rise

Exposure and Sensitivity

As sea level rises, the number of miles of PG&E coastal transmission lines (overhead and underground) exposed to inundation from a 100-year coastal storm event is projected to increase. Noting that most, if not all, coastal assets within an inundation event during a 100-year storm also are within a coastal FEMA 100-year flood zone, this section specifically focuses on PG&E's understanding of risk specific to inundation due to rising sea level. However, given the natural overlap with the flooding and precipitation evaluation, flood exposure on the coast should be considered holistically.

Key concerns associated with sea level rise (SLR) are similar to the sensitivities described in the flooding and precipitation section above. With regard to SLR, sensitivities include the following:

- **Accelerated corrosion:** Steel tower structures in coastal and tidal areas can rust and corrode because of exposure to saltwater, either due to inundation or to exposure to spray action when high water splashes above concrete tower bases and encounters steel lattice. This is already a known problem for towers located within San Francisco Bay. It is relevant both for towers whose bases are already submerged but may be subject to higher water levels, as well as for poles or towers that are newly exposed to floodwaters. Corrosion from exposure to saltwater necessitates increased maintenance.
- **Scouring or destabilization of the ground surface:** Erosion of earth surrounding the base of transmission poles or towers can lead to reductions in structural integrity and, in worst cases, tower collapse. This is particularly relevant where transmission towers are in areas subject to natural geomorphic changes, such as in tidal marsh or similar habitats.

Climate Change Vulnerability

Analytical Metrics

For SLR inundation exposure in the future, a key metric of exposure is location in areas of coastal inundation extent over time during a 100-year storm event, with a focus on 2050. Notably, the exposure of overhead transmission lines to coastal flooding is defined as exposure of supportive pole or tower footings.

Results

All CAVA regions have transmission line-miles (and therefore supporting structures) in tidally influenced or coastal areas, with the Bay Area Region having the greatest number, reflecting a potentially higher vulnerability over time due to SLR. However, the percentage of towers and poles potentially exposed to SLR over time remains very small, and by 2080, only 3.3 percent of all towers and poles could be exposed to inundation (Table 3.1.1-4), indicating that vulnerability is low. See Electric Transmission Regional Reports for more details.

Table 3.1.1-4. Number of transmission conductor towers and poles exposed to inundation during a 100-year coastal storm event over time and by region due to plausible changes in sea level.

Region	Baseline	2030	2050	2080
Bay Area	364 (0.24%)	683 (0.46%)	934 (0.63%)	1,496 (1.01%)
Central Valley	504 (0.34%)	1,479 (0.99%)	1,573 (1.06%)	2,165 (1.45%)
Sierra	29 (0.02%)	47 (0.03%)	106 (0.07%)	221 (0.15%)
North Coast	390 (0.26%)	451 (0.30%)	534 (0.36%)	662 (0.44%)
Central Coast	110 (0.07%)	190 (0.13%)	207 (0.14%)	375 (0.25%)
Total	**1,397 (0.93%)**	**2,850 (1.91%)**	**3,354 (2.26%)**	**4,919 (3.3%)**

Note: Percentages are relative to total transmission conductor towers and poles within the PG&E service area.

Towers and other transmission assets in the Sacramento Delta area (Central Valley Region) may be more vulnerable to the risk of catastrophic flooding due to overtopping or the failure of levees that provide flood protection, which is a risk that is likely to increase due to increased sea levels. Levees are existing water management infrastructure that is outside of PG&E's management.

Adaptive Capacity and Climate Change Risk

Specific factors that affect the adaptive capacity of transmission assets to SLR include the following.

Planning Capacities

- **Existing flood design basis of equipment:** CPUC's GO 95 Rule 37 outlines the requirements for minimum clearance and indicates that the annual flood level of a body of water is required for clearance minimums.[2] For supporting structures, PG&E refers to FEMA flood maps when designing transmission equipment. Recently, the transmission line tower foundation standard was modified to increase the foundation height based on potential SLR.

- **Redundancy of transmission lines:** Areas with multiple transmission lines in different physical locations that serve the same customers have a reduced chance of total loss of transmission connection given a single contingency failure.

The adaptive capacity is considered to be moderate given the opportunity for future climate-informed considerations to enhance capabilities. Further analysis would be needed to understand the impacts of climate change on current adaptive capacity over time. The number of assets exposed to increased SLR inundation over time remains relatively low; however, the incorporation of SLR planning into support structure design is for new build and not for existing assets. The climate change risk is therefore considered to be **moderate**.

Potential Adaptation and Resilience Measures

Many potential adaptation and resilience measures to mitigate impacts of sea level rise will be similar to those described for Flooding and Precipitation. Specifically for sea level rise:

Planning Options

- **Ensure climate-informed siting and design of new construction:** Given the criticality and longevity of this infrastructure, future siting can avoid structures within coastal floodplains or use forward-looking sea level rise data and hydrologic studies in consideration of siting and design.
- **Apply corrosion-resistant coatings:** Concerns related to occasional saltwater exposure and associated corrosion of coastal steel tower components may be mitigated through the application of corrosion-resistant tapes or other coatings to towers at heightened risk of saltwater flooding or spray action.
- **Harden vulnerable structures:** Poles and towers in areas subject to destabilization may be hardened with deepened foundations and strengthened towers, and/or ground stabilization with drainage improvements.

Operational Options

- **Develop emergency response plans:** PG&E may assess certain highlighted locations to develop operational emergency response plans to the potential SLR.

Wildfire

The focus of this CAVA is to understand the vulnerability of assets due to wildfire, rather than hardening the system to reduce the risk of wildfire ignitions from PG&E equipment.

---

[2] General Order 95, Section II, Rule 37, "Minimum Clearances of Wires above Railroads, Thoroughfares, Buildings, Etc." https://ia.cpuc.ca.gov/gos/GO95/go_95_rule_37.html

3.1.1.a Electric Transmission

Exposure and Sensitivity

Transmission equipment located in the path of wildfires could be damaged or destroyed. Transmission lines are likely to be somewhat less sensitive to wildfire exposure than distribution lines. This is because they are fewer in number and it is easier to maintain defensible space around them, and they have a higher percentage of steel assets as opposed to wood. Still, wildfires have the potential to damage conductor and other transmission assets.

Climate Change Vulnerability

Analytical Metrics

Wildfire risk is and will continue to be greatest in the high fire risk areas (HFRAs); the number of transmission line-miles in HFRAs is the metric for future transmission line exposure to wildfires from any source.

Results

The North Coast, Central Coast, and Sierra Regions have the greatest number and percentage of total transmission conductor line-miles in HFRAs (Table 3.1.1-5), indicating that assets in these regions may have greater vulnerability to impacts from wildfires. Thirty-one percent of line-miles are within HFRAs (Table 3.1.1-5), although vulnerability also will depend on the construction material of the supporting structures.

Table 3.1.1-5. Number of transmission conductor line-miles in HFRAs by region.

Region	Transmission Line-Miles in HFRAs
Bay Area	667 (3.71%)
Central Valley	748 (4.16%)
Sierra	1,898 (10.55%)
North Coast	1,233 (6.85%)
Central Coast	1,080 (6.0%)
Total	**5,627 (31.26%)**

Note: Percentages are relative to total transmission conductor line-miles within the PG&E service area.

See Electric Transmission Regional Reports for details.

Adaptive Capacity and Climate Change Risk

It is PG&E's goal to ensure customer safety and reduce the wildfire risk associated with its equipment. PG&E is implementing a multifaceted strategy to reduce wildfire risk in the immediate term and is developing a parallel strategy for minimizing wildfire risk in the long term.

While a full accounting of this strategy is beyond the scope of this CAVA, PG&E's wildfire mitigation strategy is described in PG&E's most recent WMP.[3] Core elements of this strategy that relate most closely with reducing the damage to the conductor and the supporting structures from wildfire include the following:

- **Vegetation management inspections:** PG&E conducts a Second Patrol aerial LiDAR inspection in HFRAs of the Company's system at the height of the vegetation growing season, which coincides with the beginning of what is historically the most active part of the California fire season. This patrol allows PG&E to conduct a supplemental assessment of potential tree growth following seasonal rain to reduce the potential for ignitions.
- **Wood pole replacement program:** When deteriorated wood poles are replaced, they are typically replaced with steel poles. Steel poles are more resistant to wildfire damage.

PG&E's WMPs are robust, and the adaptive capacity of utility-caused ignitions is considered to be high. Many of the utility-caused wildfire risk reduction strategies described in PG&E's WMP are likely to also reduce equipment damage during a wildfire regardless of the cause. However, the risk of wildfire from any source in PG&E's service area is expected to increase due to climate change and exogenous factors, such as lightning and human activity; historical forest management practices are beyond PG&E's control. The climate change risk of damage from wildfires is therefore considered to be **high**.

Potential Adaptation and Resilience Measures

PG&E's WMP presents the Company's current wildfire mitigation strategy for utility-caused ignitions. As described above, elements of the WMP also support the resilience of transmission assets to wildfire damage. Long-term adaptation planning and operational options to increase this resilience in the face of the projected increase in wildfire activity regardless of ignition source includes supporting and enhancing the efforts described above, including, but not limited to, the replacement of wood poles with more resilient support structures.

Drought-Driven Subsidence

Exposure and Sensitivity

Historically, drought-driven subsidence has not been a major concern for most of PG&E's service area, except for the Central Valley Region. PG&E has experienced impacts on a few wood support structures due to subsidence exposing wood piles to decay.

Climate Change Vulnerability

Changes in vulnerability to the impacts of subsidence due to climate change are likely to continue to be greatest with regard to support structures located in the Central Valley Region.

---

[3] PG&E. "2023–2025 Wildfire Mitigation Plan." pge.com/assets/pge/docs/outages-and-safety/outage-preparedness-and-support/2023-wildfire-mitigation-plan.pdf

Adaptive Capacity and Climate Change Risk

PG&E's ability to adapt to subsidence impacts on transmission towers is driven primarily by the following:

- **Design:** Subsidence is integrated into tower foundation designs, specifically for angle or dead-end structures that will have uneven loading, as this could cause significant lean on the structure.
- **Monitoring and inspections:** PG&E monitors for differential settlement due to subsidence, inspects support structures for damage, and makes repairs as needed.

Because PG&E monitors for potential impacts and can make repairs if needed, the adaptive capacity is considered to be high. PG&E considers the risk of climate-driven subsidence to transmission structures to be **low** and the climate hazard is **off-ramped**.

Electric Transmission Regional Reports

Bay Area Region

Summary

In the Bay Area Region, PG&E has approximately 2,000 miles of transmission conductor—97 percent is overhead and 3 percent is underground (Figure 3.1.1-1).

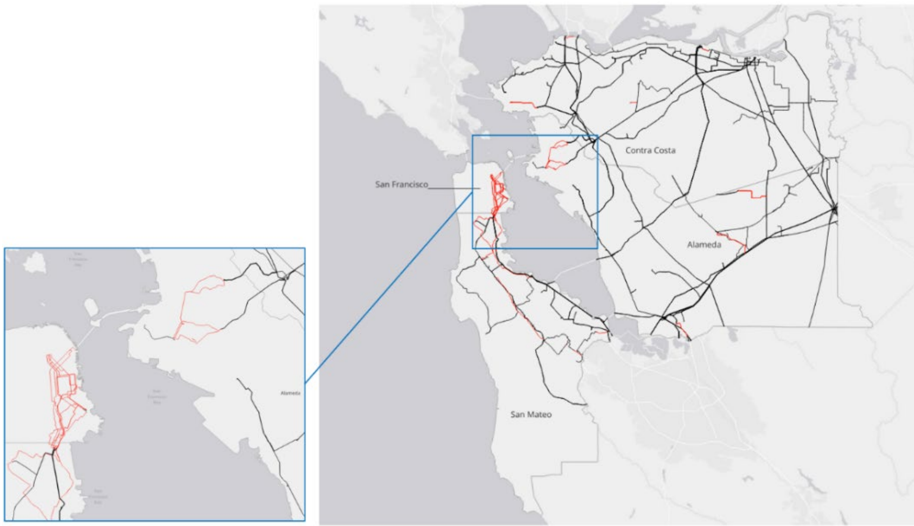


Figure 3.1.1-1. Overhead and underground transmission lines in the Bay Area Region.

Climate Hazard: Temperature

The number of overhead transmission line-miles in the Bay Area Region projected to be exposed to temperatures that meet or exceed the exposure metric increases in both coastal and interior zones over time, although the numbers are very low through 2080 (Table 3.1.1-6).

Table 3.1.1-6. Overhead transmission conductor line-miles in the Bay Area Region exposed to temperatures at or above the exposure metric for coastal and interior zones.

	Baseline		**2030**		**2050**		**2080**	
	Coastal	Interior	Coastal	Interior	Coastal	Interior	Coastal	Interior
Overhead	0 (0%)	0 (0%)	154 (0.8%)	0 (0%)	302 (1.7%)	0 (0%)	605 (3.3%)	959 (5.3%)

Notes:

- *Values represent a sum of the total line segment lengths for all lines that, at any location along the line, experience conditions at or above the ratings for their location.*
- *Reference threshold temperature for coastal zone is 99°F for the months of April–October.*
- *Reference threshold temperature for interior zone is 109°F for the months of April–October.*
- *Percentages are relative to total transmission conductor line-miles within the PG&E service area.*

3.1.1.a Electric Transmission

While detailed power flow analysis would be required to precisely assess the most vulnerable conductor segments, a plausible increase in vulnerability by 2050 is concentrated in the eastern portion and the coastal areas of Contra Costa and Alameda counties, and in the southern portion of San Mateo County (Figure 3.1.1-2).

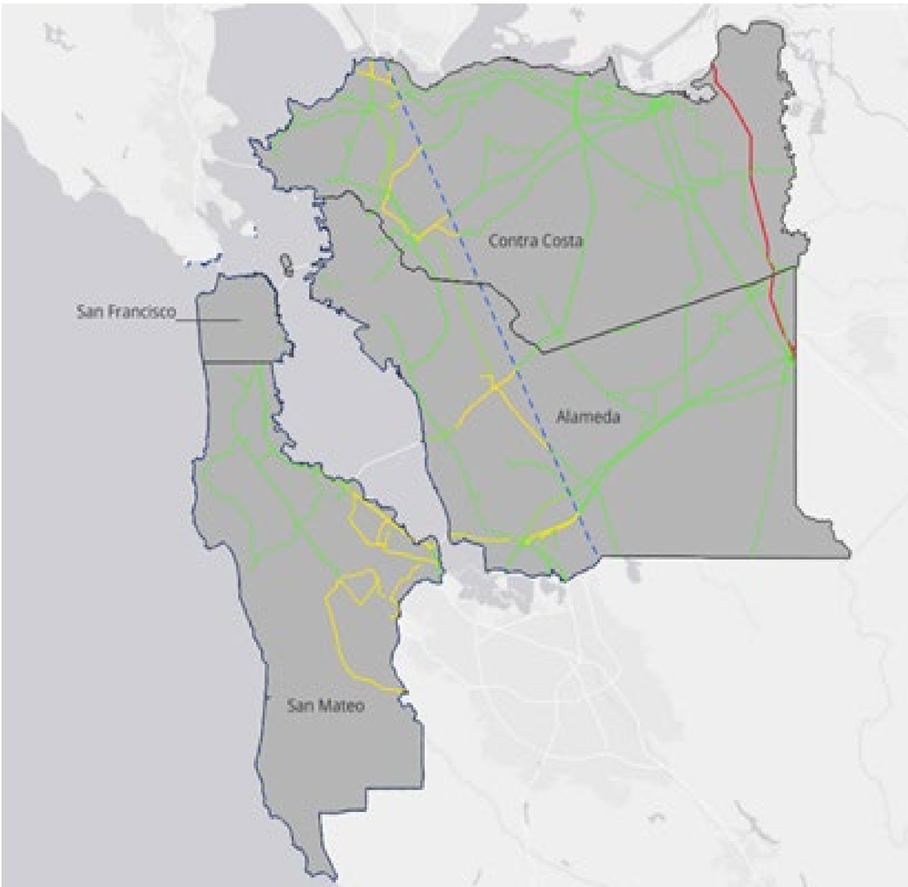


Figure 3.1.1-2. Overhead transmission conductor in the Bay Area Region exposed to temperatures at or above the exposure metric for the coastal (yellow) and interior zone (red) in 2050. Conductor in green is not exposed. The boundary between the coastal and interior zones is indicated as a blue dashed line.

Climate Hazard: Flooding and Precipitation

In the Bay Area Region, 1,547 miles of transmission towers and poles are within the FEMA 100-year floodplain and 2,048 are within the FEMA 500-year floodplain, representing 1.04 percent and 1.38 percent of total poles and towers, respectively (Table 3.1.1-2). Flood-related threats to towers and poles in this region are likely to be focused along the San Francisco Bay shoreline (Figure 3.1.1-3) and also be more chronic than acute, with the corrosion of towers exposed to increased saltwater from coastal flooding (see the Sea Level Rise section below).

3.1.1.a Electric Transmission

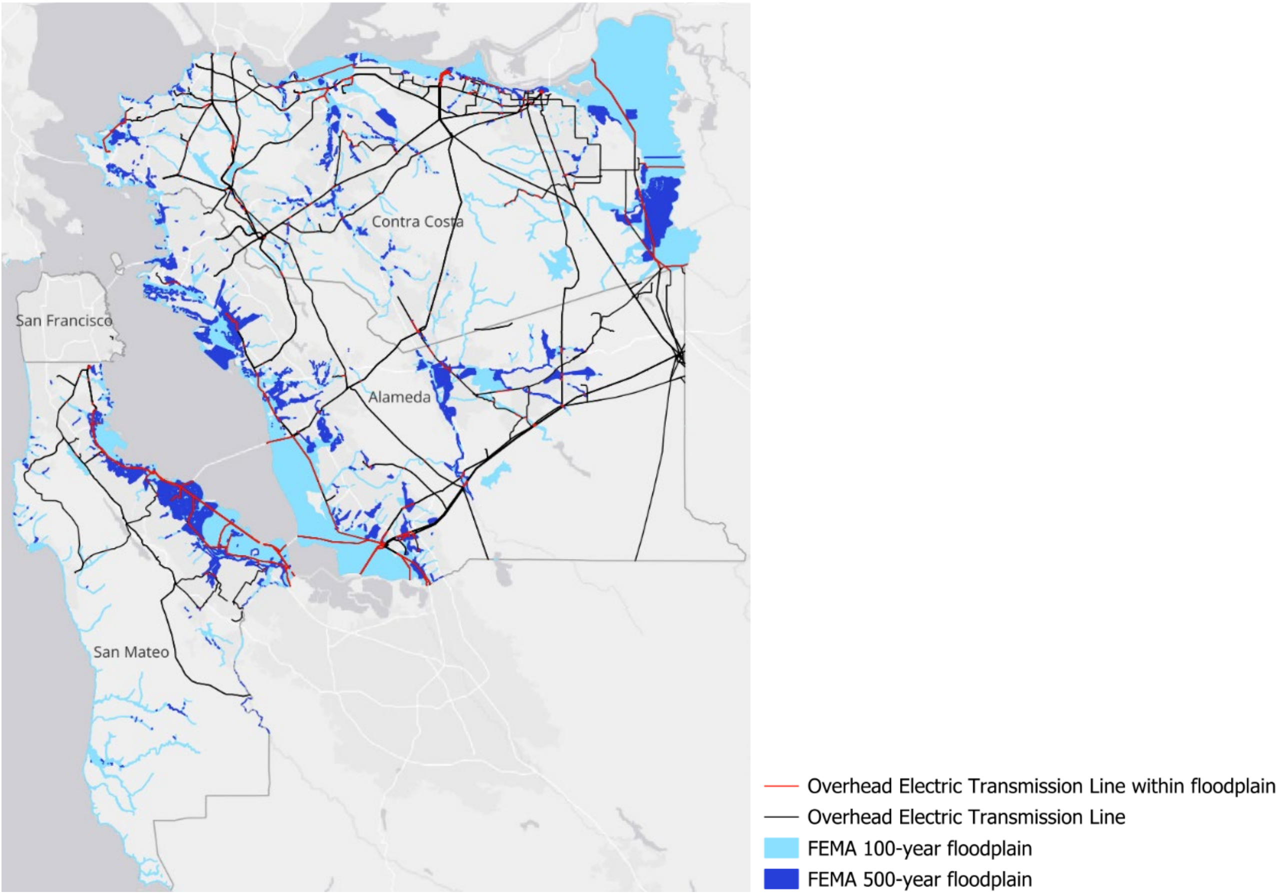


Figure 3.1.1-3. Overhead electric transmission lines in the Bay Area Region exposed to FEMA 100-year floodplains (light blue) and FEMA 500-year floodplains (dark blue). Transmission lines in red are located in a FEMA floodplain, black are not.

Landslides/mudslides pose a risk to transmission poles and towers in this region, especially during heavy rain. In 2017, a precipitation-driven mudslide in Orinda (Contra Costa County) threatened a PG&E transmission tower. Although the threat required an emergency shoring up of the tower, no customer outages occurred.

There are 2,319 transmission poles and towers in a high landslide incidence zone, which represents 1.56 percent of the total transmission structures in the service area (Table 3.1.1-3). Areas with a transmission conductor in the Bay Area Region that may be more vulnerable to increased landslide risk and plausible increases in high precipitation, include where transmission conductor line, and presumably supporting structures, pass through these areas, including portions of Contra Costa County and San Mateo County (Figure 3.1.1-4).

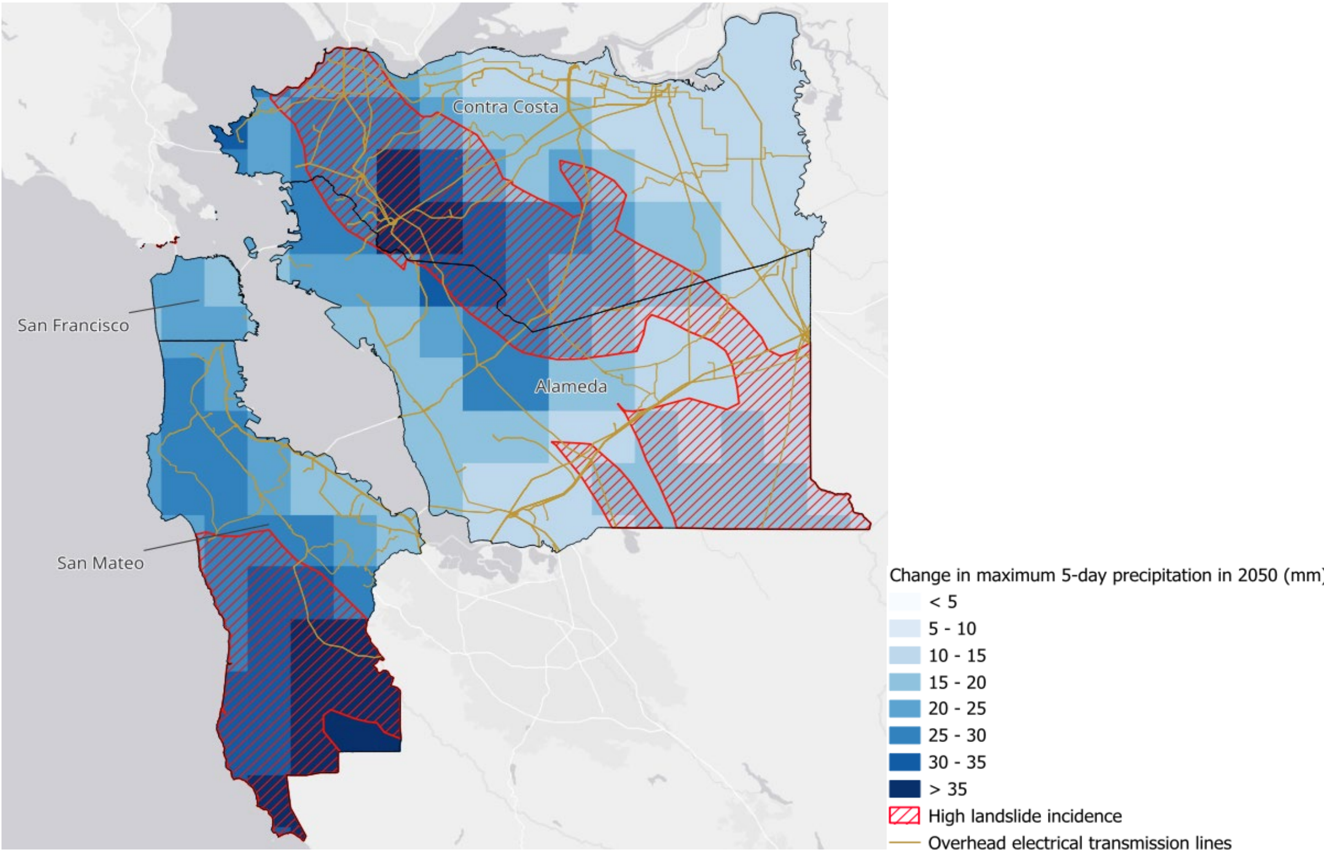


Figure 3.1.1-4. Projected change in 5-day maximum precipitation event by 2050 relative to the historical baseline, overlaid with areas of historical high landslide incidence and overhead transmission lines.

Climate Hazard: Sea Level Rise

As sea level rises and coastal storm events become more frequent and severe, the number of miles of PG&E transmission lines (overhead and underground) exposed to inundation from a 100-year coastal storm event is projected to increase over time (Table 3.1.1-4). This vulnerability is concentrated along the San Francisco Bay shoreline in San Mateo County and small portions of Contra Costa and Almeda Counites (Figure 3.1.1-5).

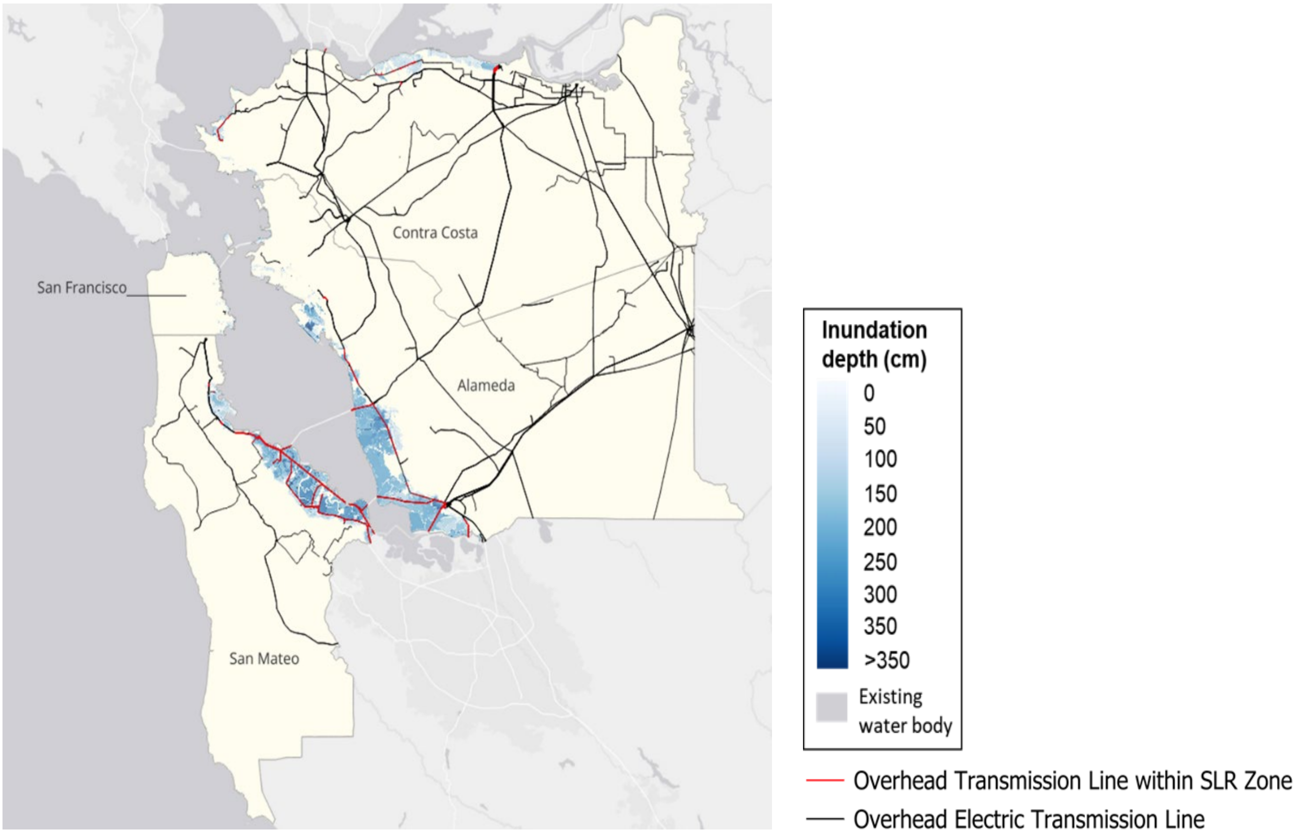


Figure 3.1.1-5. Exposure of overhead transmission conductor in the Bay Area Region under 0.5 m of sea level and a 100-year storm.

Climate Hazard: Wildfire

The vulnerability of wildfire damage to transmission conductor line (and supporting structures) in the Bay Area Region represents about a 3 percent vulnerability for PG&E's service area (Table 3.1.1-7). Contra Costa County has the greatest number of line-miles within HFRAs, indicating that the vulnerability of transmission conductor line and supporting structures may be greater in this county (Table 3.1.1-7, Figure 3.1.1-6).

Table 3.1.1-7. Transmission line-miles in HFRAs, by county, in the Bay Area Region.

County	Transmission Line-Miles in HFRAs
San Francisco	0 (0%)
Contra Costa	430 (2.39%)
Alameda	176 (0.98%)
San Mateo	61 (0.34%)
Total	**667 (3.71%)**

Note: Percentages are relative to total transmission line-miles within the PG&E service area.

3.1.1.a Electric Transmission

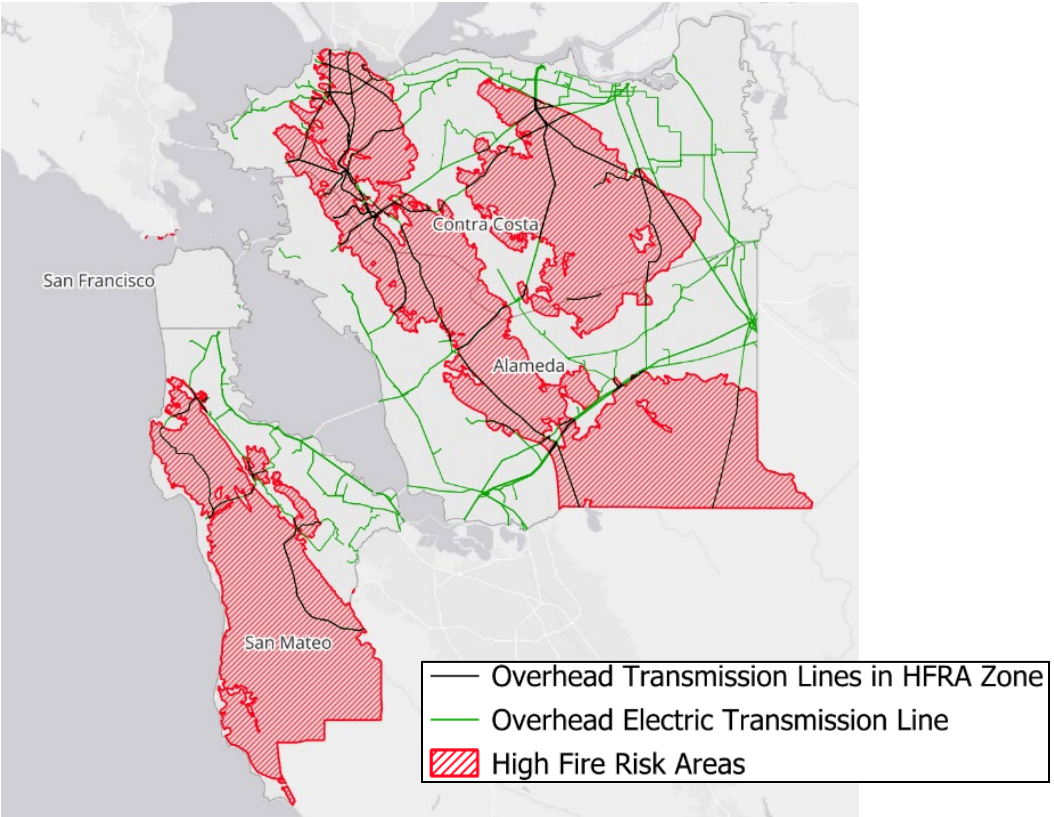


Figure 3.1.1-6. Overhead electric transmission line located in HFRAs.

Climate Hazard: Drought-Driven Subsidence

Drought-driven subsidence is not considered to be a climate change issue for transmission assets at this time.

Central Valley Region

Summary

In the Central Valley Region, PG&E has approximately 6,700 miles of transmission conductor, virtually all of which are overhead (Figure 3.1.1-7).

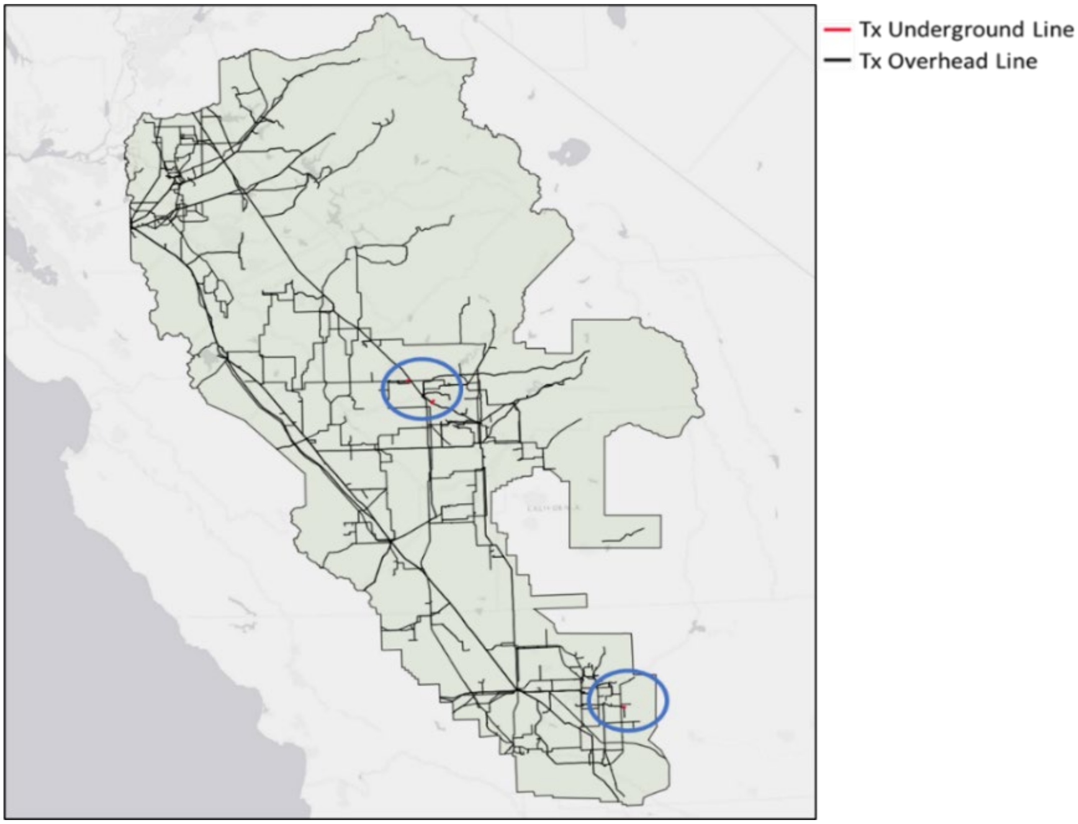


Figure 3.1.1-7. Underground and overhead transmission conductors (Tx) in the Central Valley Region. Areas where some very short lengths of underground conductors are present are circled in blue.

Climate Hazard: Temperature

The Central Valley Region does not have any area within the coastal zone designation; all transmission conductors use a transmission ambient reference temperature. By 2050, 5,288 overhead line-miles, or 29.1 percent of all PG&E transmission conductor line-miles, are projected to be exposed to temperatures that exceed the interior reference temperature of 109°F (Table 3.1.1-8).

Table 3.1.1-8. Overhead transmission conductor line-miles in the Central Valley Region exposed to temperatures at or above the exposure metric for the interior zone at the baseline, by 2030, 2050, and 2080.

	Baseline (1976–2005)	2030	2050	2080
Line-Miles	0 (0%)	2,097 (11.5%)	5,288 (29.1%)	6,209 (34.2%)

Notes:

- *Values represent a sum of the total line segment lengths for all lines that, at any location along the line, experience conditions at or above the ratings for their location.*
- *Reference threshold temperature for coastal zone is 99°F for the months of April–October.*
- *Reference threshold temperature for interior zone is 109°F for the months of April–October.*
- *Percentages are relative to total transmission conductor line-miles within the PG&E service area.*

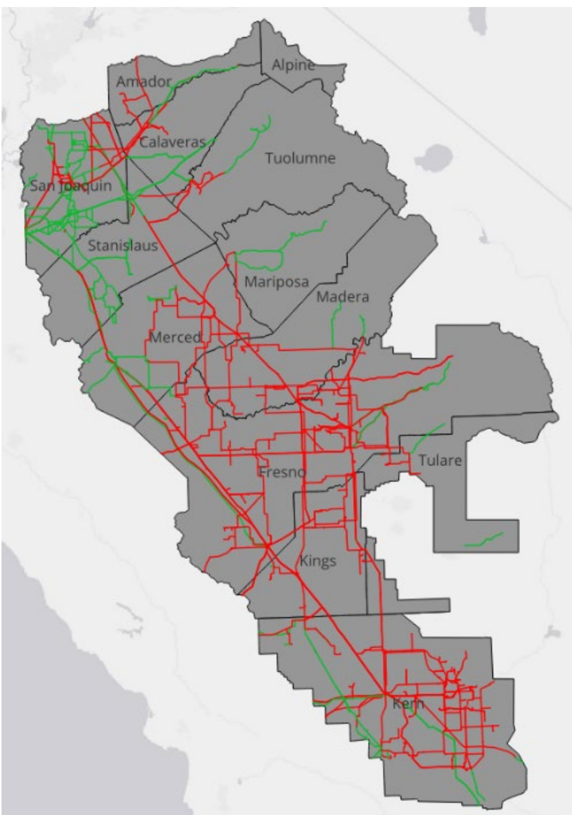


Figure 3.1.1-8. Overhead transmission conductor in the Central Valley Region exposed to temperatures at or above the exposure metric for the interior zone (red) in 2050. Conductor in green is not exposed. The Central Valley Region does not have areas in the coastal zone.

By 2080, nearly all of the transmission conductor line-miles within the Central Valley Region are exposed to temperatures at or in exceedance of temperature assumptions (Figure 3.1.1-8). While detailed power flow analysis would be required to precisely assess the most vulnerable conductor segments, this analysis indicates a high potential for increasing vulnerability to high heat events over time for most of the Central Valley Region counties (Figure 3.1.1-8).

Climate Hazard: Flooding and Precipitation

Approximately 5.31 percent of transmission poles and towers in the Central Valley Region are located within FEMA 100-year floodplains, while 7.3 percent are located within the FEMA 500-year floodplains (Table 3.1.1-9). Vulnerability may be greatest in Fresno, Kern, Madera, Merced, and San Joaquin counties (Table 3.1.1-9).

Table 3.1.1-9. Number of transmission towers and poles in FEMA 100-year and 500-year floodplains in the Central Valley Region, by county.

Region	FEMA 100-year	FEMA 500-year
Amador	19 (0.01%)	19 (0.01%)
Calaveras	32 (0.02%)	44 (0.03%)
Fresno	1,171 (0.79%)	1,723 (1.16%)
Kern	1,712 (1.15%)	1,975 (1.33%)
Kings	588 (0.40%)	609 (0.41%)
Madera	1,104 (0.74%)	1,105 (0.74%)
Mariposa	5 (0.003%)	5 (0.003%)
Merced	1,370 (0.92%)	1,428 (0.96%)
San Joaquin	1,775 (1.19%)	5,014 (3.37%)
Stanislaus	124 (0.08%)	190 (0.13%)
Tulare	215 (0.14%)	360 (0.24%)
Tuolumne	1 (0.001%)	1 (0.001%)
Total	**8,846 (5.31%)**	**12,563 (7.39%)**

Note: Percentages are relative to total transmission towers and poles within the PG&E service area.

3.1.1.a Electric Transmission

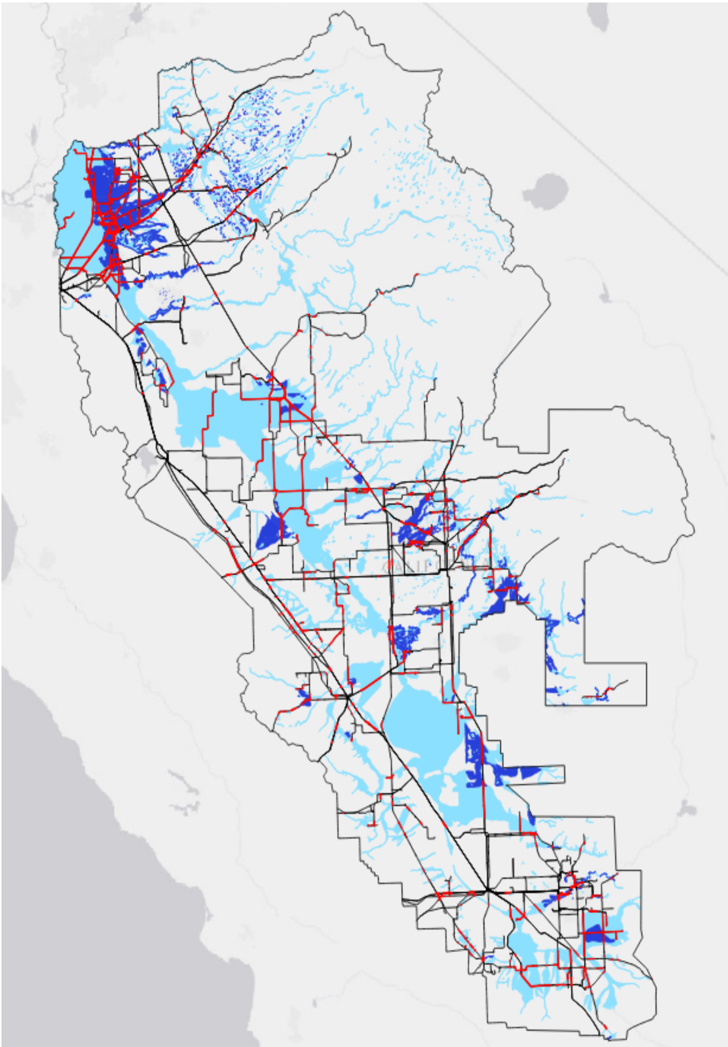


Figure 3.1.1-9. Overhead electric transmission lines in the Central Valley Region exposed to FEMA 100-year floodplains (light blue) and FEMA 500-year floodplains (dark blue). Transmission lines in red are located in a FEMA floodplain, black are not.

Transmission conductors in the Central Valley Region pass through very few, if any, areas that have a plausible high change in maximum precipitation events in 2050; they also pass through no areas of high landslide risk (Figure 3.1.1-10). This indicates that vulnerability to precipitation and flood events based on intense precipitation events alone and potential cascading events may be lower in the Central Valley Region. This analysis does not include increases in flooding related to snowmelt from the Sierra Mountains, which is likely a source of future vulnerability.

3.1.1.a Electric Transmission

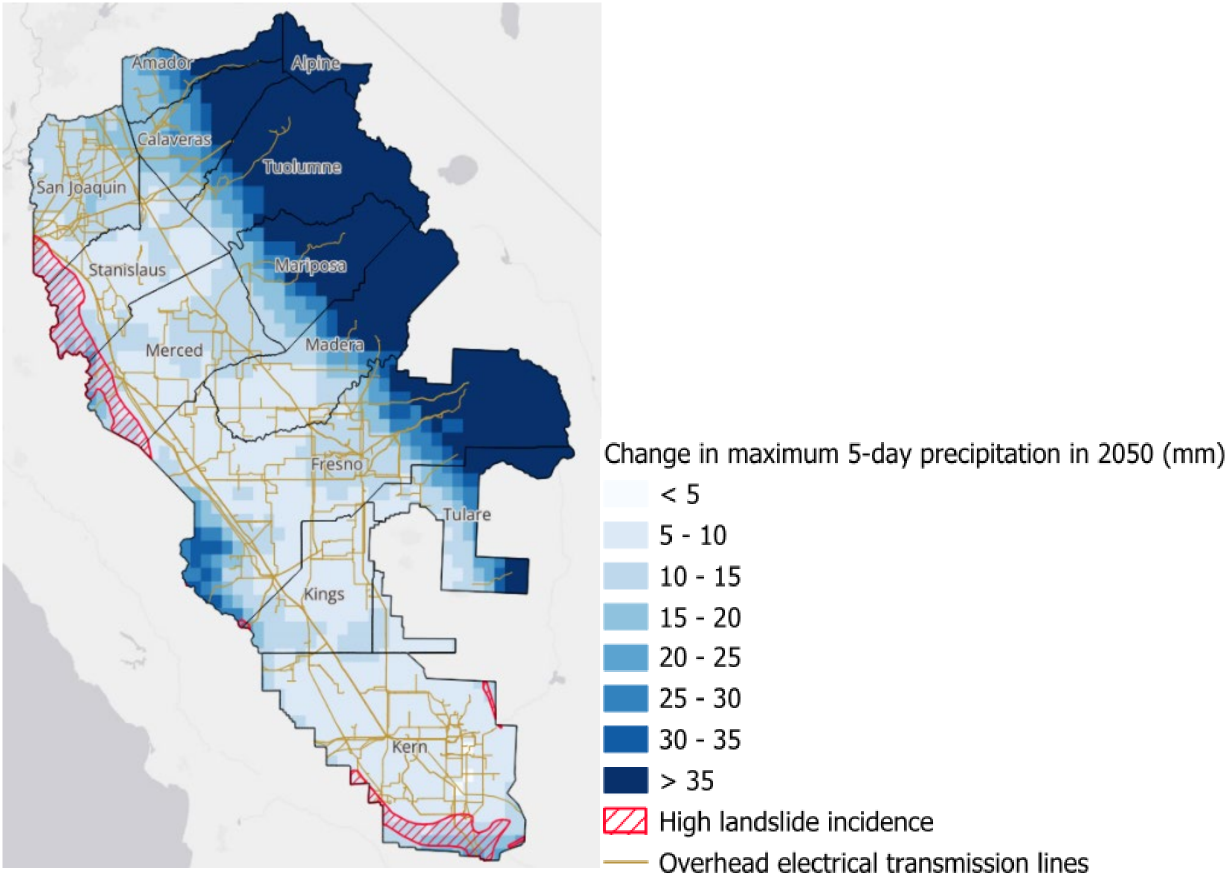


Figure 3.1.1-10. Electric transmission conductor in relation to projected change in 5-day maximum precipitation event by 2050 relative to the historical baseline, overlaid with areas of high landslide incidence.

Climate Hazard: Sea Level Rise

Rising sea levels, coupled with changing runoff patterns, may increase inflows into the Sacramento-San Joaquin Delta, subjecting the system of levees along the Delta to increased stresses and increasing the likelihood of levee overtopping. Projected expansion of flooding extent in the Delta due to levee overtopping is projected to increase the number of transmission poles and towers exposed to floodwaters over time (Figure 3.1.1-11). The vulnerability is relatively low through 2080; however, 2,165 poles and towers representing 1.45 percent of total PG&E transmission poles and towers may be exposed to flooding in 2080 (Table 3.1.1-4).

In addition to levee overtopping, the levee breach presents an exposure threat that may be exacerbated by climate change. This risk is more difficult to model and could be considered in addition to the overtopping analysis.

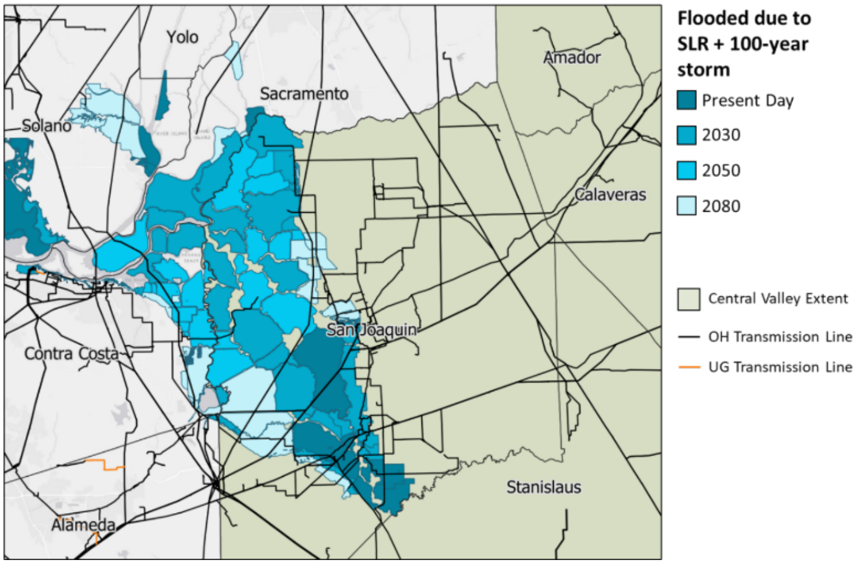


Figure 3.1.1-11. Projected Delta flood extents during the 100-year flood under climate change, considering only the potential for levee overtopping and the location of overhead (OH) and underground (UG) transmission lines.

Climate Hazard: Wildfire

More than 700 transmission line-miles in the Central Valley Region are in HFRAs. This represents about 4 percent of vulnerability in PG&E's service area. Calaveras and Fresno counties have the greatest line mileage in HFRAs (Table 3.1.1-10, Figure 3.1.1-12).

Table 3.1.1-10. Transmission conductor line-miles in the Central Valley Region within HFRAs.

County	Transmission Line-Miles in HFRAs
Alpine	0 (0%)
Amador	93 (0.52%)
Calaveras	169 (0.94%)
Fresno	207 (1.15%)
Kern	31 (0.17%)
Kings	17 (0.09%)
Madera	33 (0.19%)
Mariposa	58 (0.32%)
Merced	18 (0.10%)
San Joaquin	0 (0%)
Stanislaus	21 (0.12%)
Tulare	23 (0.13%)
Tuolumne	77 (0.43%)
Total	**748 (4.16%)**

Note: Percentages are relative to total transmission conductor line-miles within the PG&E service area.

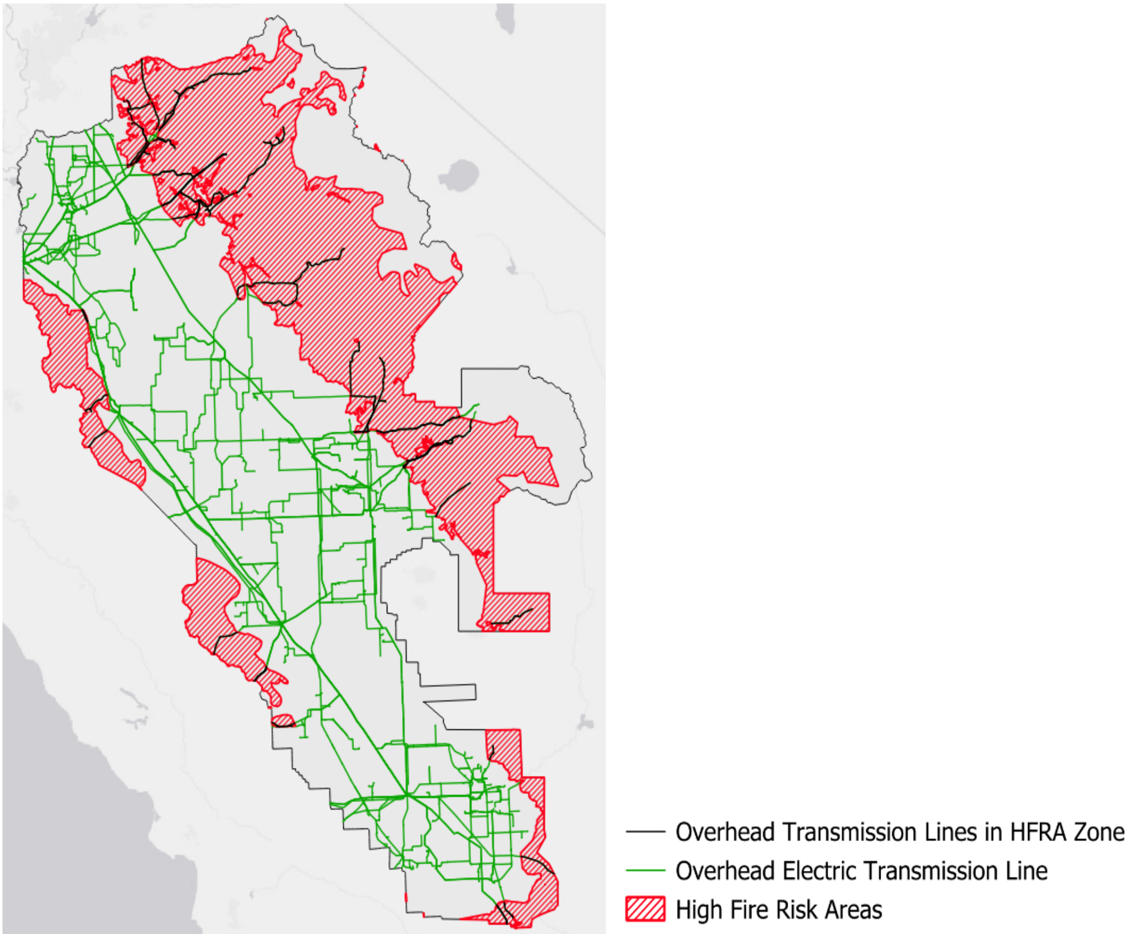


Figure 3.1.1-12. Overhead transmission lines in HFRAs in the Central Valley Region.

Climate Hazard: Drought-Driven Subsidence

PG&E has many transmission assets in the Central Valley Region that are located in areas of high historical subsidence associated with groundwater withdrawals; this trend is likely to continue into the future as climate change stresses water availability. PG&E has experienced impacts on a few wood support structures due to subsidence exposing wood piles to decay. PG&E monitors for potential impacts and can make repairs if needed.

Drought-driven subsidence is not considered to be a climate change issue for transmission assets at this time.

Sierra Region

Summary

In the Sierra Region, PG&E has approximately 5,000 miles of transmission conductor, virtually all of which is overhead (Figure 3.1.1-13).

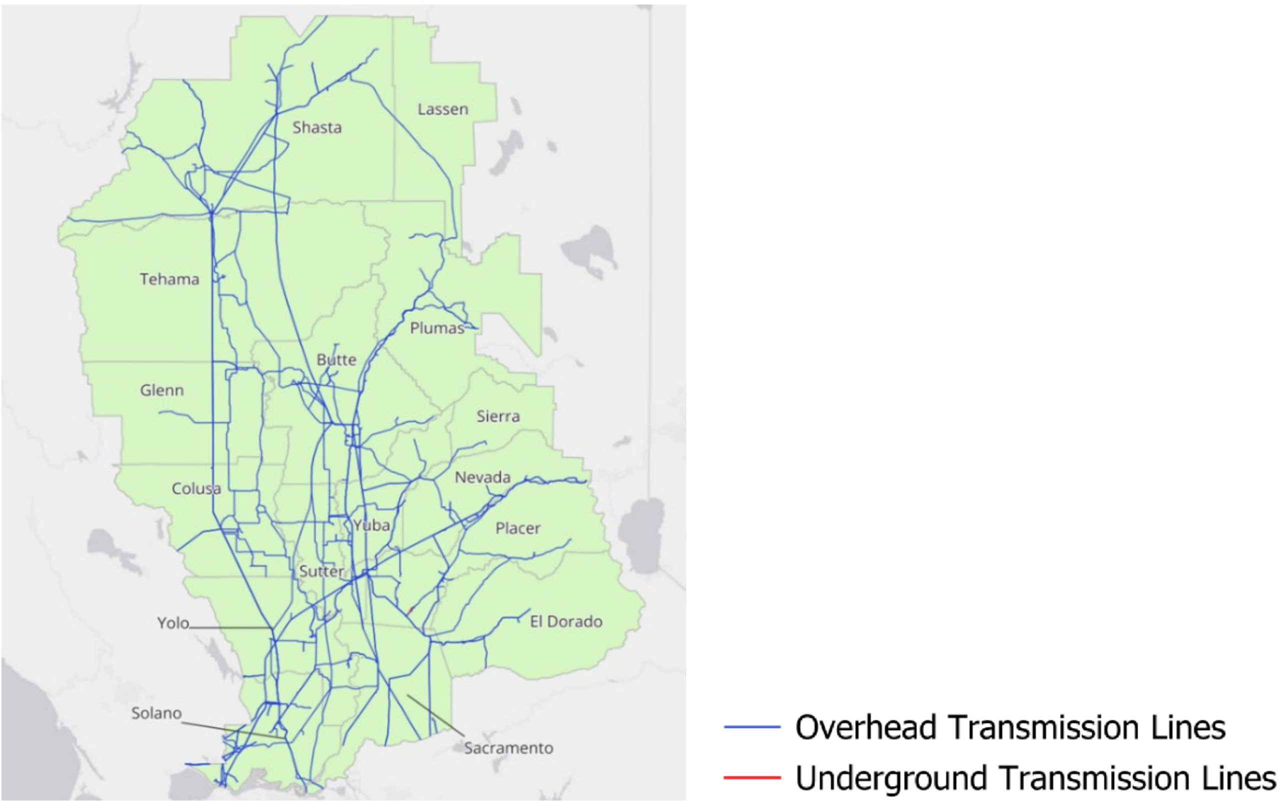


Figure 3.1.1-13. Overhead and underground transmission lines in the Sierra Region.

Climate Hazard: Temperature

The majority of the Sierra Region falls within the interior zone; however, a small portion falls within the coastal zone (Figure 3.1.1-14). The number of transmission line-miles in the coastal and interior designations that are exposed to temperatures that meet or exceed PG&E's transmission ambient reference temperatures of 99°F (coastal zone) and 109°F (interior zone) for 7 or more total days during a typical year increases over time, although for transmission line-miles in the coastal zone, this increase is small and only occurs by 2030 (Table 3.1.1-11). By 2050, the interior line-miles exposed to temperatures at or above the reference temperature increases from 0 percent to 24 percent, indicating a substantial increase in potential vulnerability (Table 3.1.1-11, Figure 3.1.1-14).

Table 3.1.1-11. Overhead transmission conductor line-miles within the Sierra Region exposed to temperatures at or above the exposure metric for the coastal and interior zones at baseline, by 2030, 2050, and 2080.

Line-Miles (% of Total Line-Miles)	**Baseline**		**2030**		**2050**		**2080**	
	Coastal	Interior	Coastal	Interior	Coastal	Interior	Coastal	Interior
	43 (0.2%)	0 (0%)	87 (0.5%)	960 (5.3%)	87 (0.5%)	4,361 (24.0%)	87 (0.5%)	4,980 (27.4%)

Notes:

- *Values represent a sum of the total line segment lengths for all lines that, at any location along the line, experience conditions at or above the ratings for their location.*
- *Reference threshold temperature for coastal zone is 99°F for the months of April–October.*
- *Reference threshold temperature for interior zone is 109°F for the months of April–October.*
- *Percentages are relative to total transmission conductor line-miles within the PG&E service area.*

While detailed power flow analysis would be required to precisely assess the most vulnerable conductor segments, this analysis indicates the potential for increasing vulnerability to high heat events over time in many counties in the region (Figure 3.1.1-14).

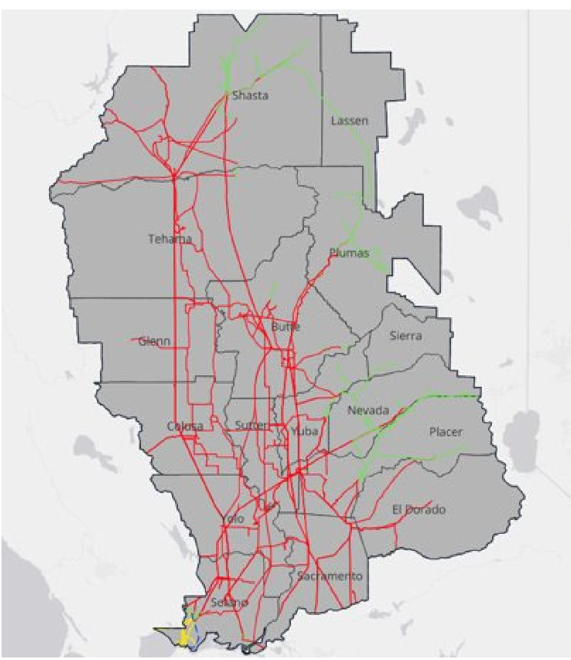


Figure 3.1.1-14. Overhead transmission conductor in the Sierra Region exposed to temperatures at or above the exposure metric for the coastal (yellow) and interior zone (red) in 2050. Conductor in green is not exposed. The boundary between the coastal and interior zones is indicated as a blue dashed line.

Climate Hazard: Flooding and Precipitation

A small portion of transmission towers and poles are located within FEMA 100-year and 500-year floodplains, with higher numbers in Sutter and Yolo counties (Table 3.1.1-12, Figure 3.1.1-15).

Table 3.1.1-12. PG&E Sierra Region transmission lines, by county, and the level of inundation by FEMA 100-year and 500-year flood plains.

Region	FEMA 100-year	FEMA 500-year
Butte	771 (0.52%)	1,320 (0.89%)
Colusa	722 (0.49%)	1,638 (1.10%)
El Dorado	1 (0.00%)	2 (0.00%)
Glenn	627 (0.42%)	711 (0.48%)
Lassen	53 (0.04%)	56 (0.04%)
Nevada	7 (0.00%)	7 (0.00%)
Placer	158 (0.11%)	179 (0.12%)
Plumas	75 (0.05%)	136 (0.09%)
Sacramento	382 (0.26%)	692 (0.46%)
Shasta	221 (0.15%)	259 (0.17%)
Sierra	2 (0.00%)	2 (0.00%)
Solano	652 (0.44%)	780 (0.52%)
Sutter	1,715 (1.15%)	2,377 (1.60%)
Tehama	193 (0.13%)	194 (0.13%)
Yolo	1,476 (0.99%)	1,504 (1.01%)
Yuba	542 (0.36%)	1,079 (0.72%)
Total	**8,940 (4.58%)**	**11,266 (7.03%)**

Note: Percentages are relative to total transmission line-miles within the PG&E service area.

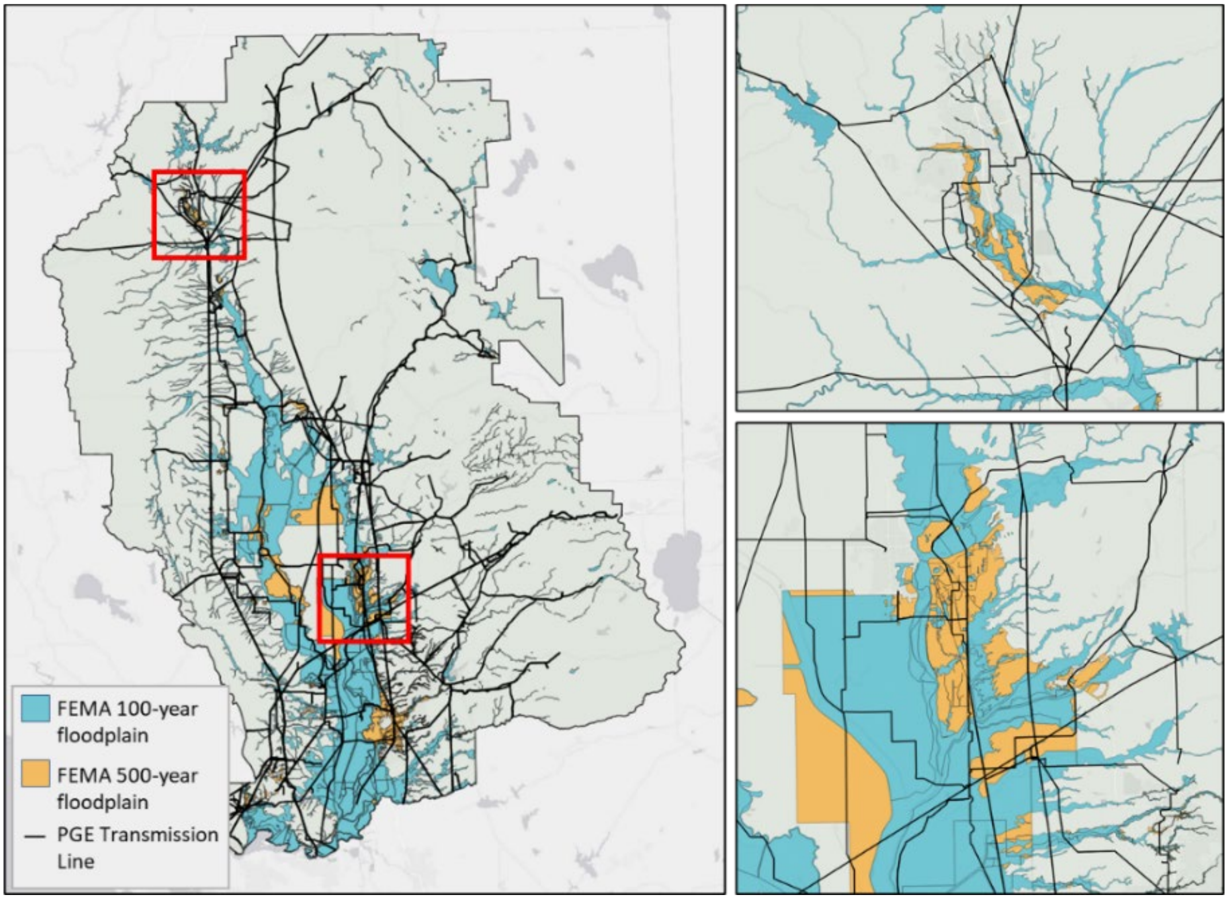


Figure 3.1.1-15. Transmission lines overlayed on FEMA 100-year and 500-year floodplains in the Sierra Region.

Increased precipitation intensity under future climate conditions may result in an increased risk of landslides and debris flows that could affect transmission equipment. Small portions of the Sierra Region are subject to high landslide incidence that may also see increased precipitation (Figure 3.1.1-16). Transmission conductor only passes through small portions of these areas (Figure 3.1.1-16). Only 877 transmission poles and towers in the Sierra Region are located within a high landslide incidence area, which represents 0.59 percent of the total transmission supporting structures in the service area (Table 3.1.1-3). This indicates that vulnerability to landslide risk is very low for transmission structures in this region. This analysis does not include increases in flooding related to snowmelt from the Sierra Mountains, which is likely a source of future vulnerability.

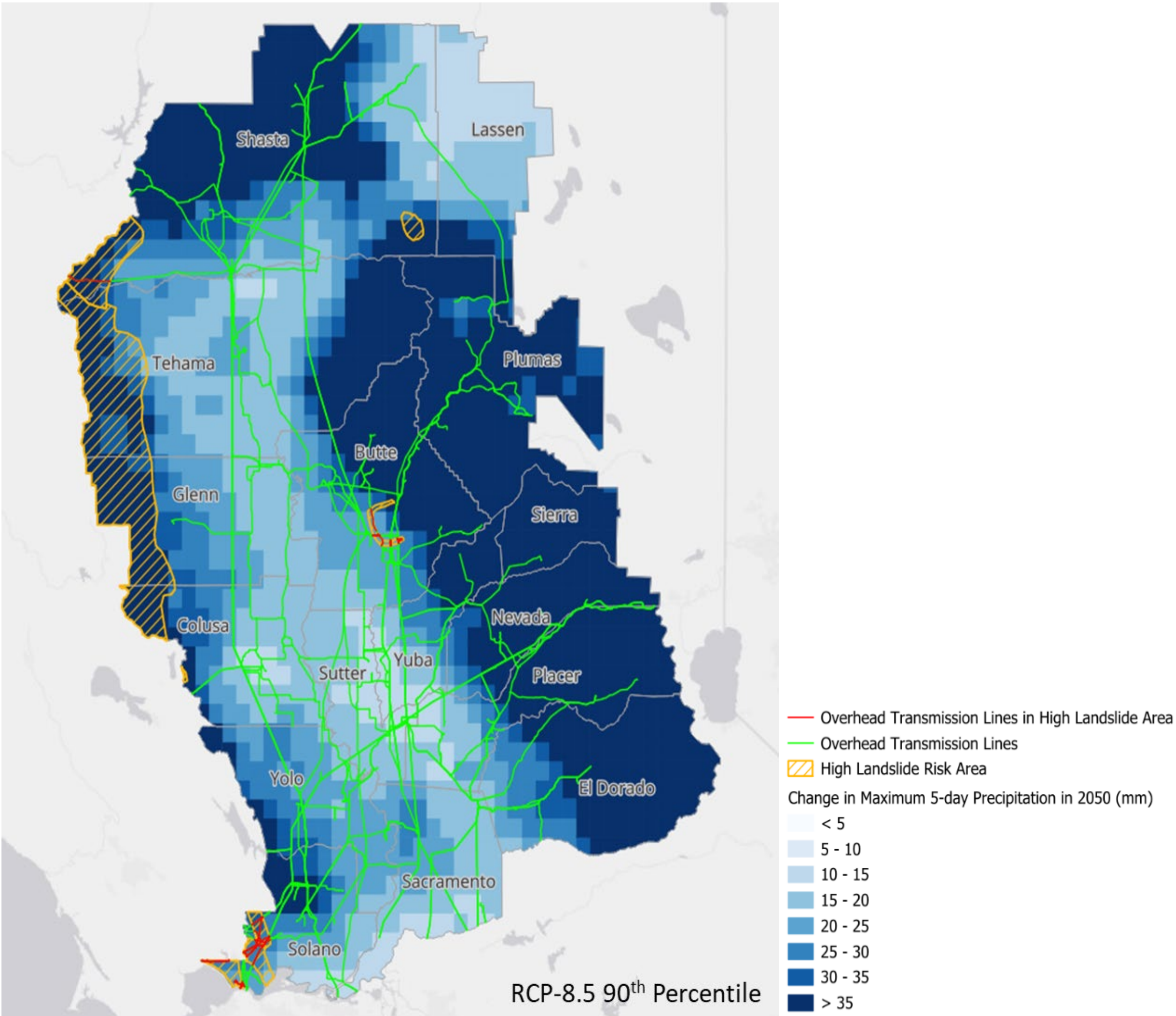


Figure 3.1.1-16. Projected change in 5-day maximum precipitation event by 2050 relative to the historical baseline, overlaid with areas of historical high landslide incidence/susceptibility and PG&E transmission infrastructure.

Climate Hazard: Sea Level Rise

The southwestern portion of the Sierra Region borders the San Pablo and Suisun Bays of the greater San Francisco Bay. By 2050, 106 miles, or 0.07 percent of all transmission conductor miles, are projected to be exposed to SLR (Table 3.1.1-4).

Climate Hazard: Wildfire

Almost 2,000 transmission line-miles in the Sierra Region are in HFRAs. This represents about 10 percent of vulnerability in PG&E's service area (Table 3.1.1-13). Shasta County has the greatest number of such line-miles (Table 3.1.1-13, Figure 3.1.1-17).

Table 3.1.1-13. Transmission conductor line-miles in the Sierra Region within HFRAs shown by county.

County	Transmission Line-Miles in HFRAs
Butte	271 (1.50%)
Colusa	25 (0.14%)
El Dorado	98 (0.55%)
Glenn	4 (0.02%)
Lassen	40 (0.22%)
Nevada	187 (1.04%)
Placer	171 (0.95%)
Plumas	157 (0.87%)
Sacramento	0 (0%)
Shasta	556 (3.09%)
Sierra	12 (0.07%)
Solano	92 (0.51%)
Sutter	0 (0%)
Tehama	180 (1%)
Yolo	10 (0.05%)
Yuba	94 (0.52%)
Total	**1,898 (10.55%)**

Note: Percentages are relative to total transmission conductor line-miles within the PG&E service area.

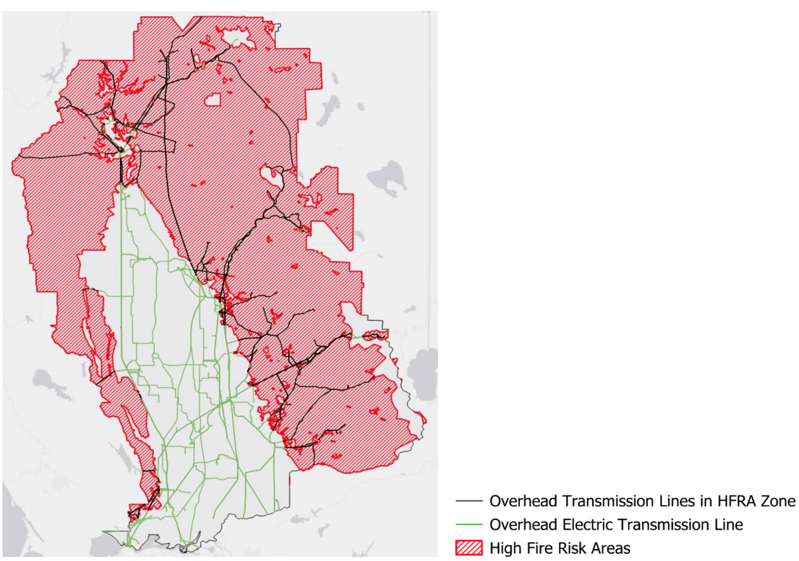


Figure 3.1.1-17. Overhead transmission lines in HFRAs in the Sierra Region.

Climate Hazard: Drought-Driven Subsidence

Drought-driven subsidence is not considered to be a climate change issue for transmission assets at this time.

North Coast Region

Summary

In the North Coast Region, PG&E has approximately 3,000 miles of transmission conductor, 99 percent of which is installed overhead (Figure 3.1.1-18).

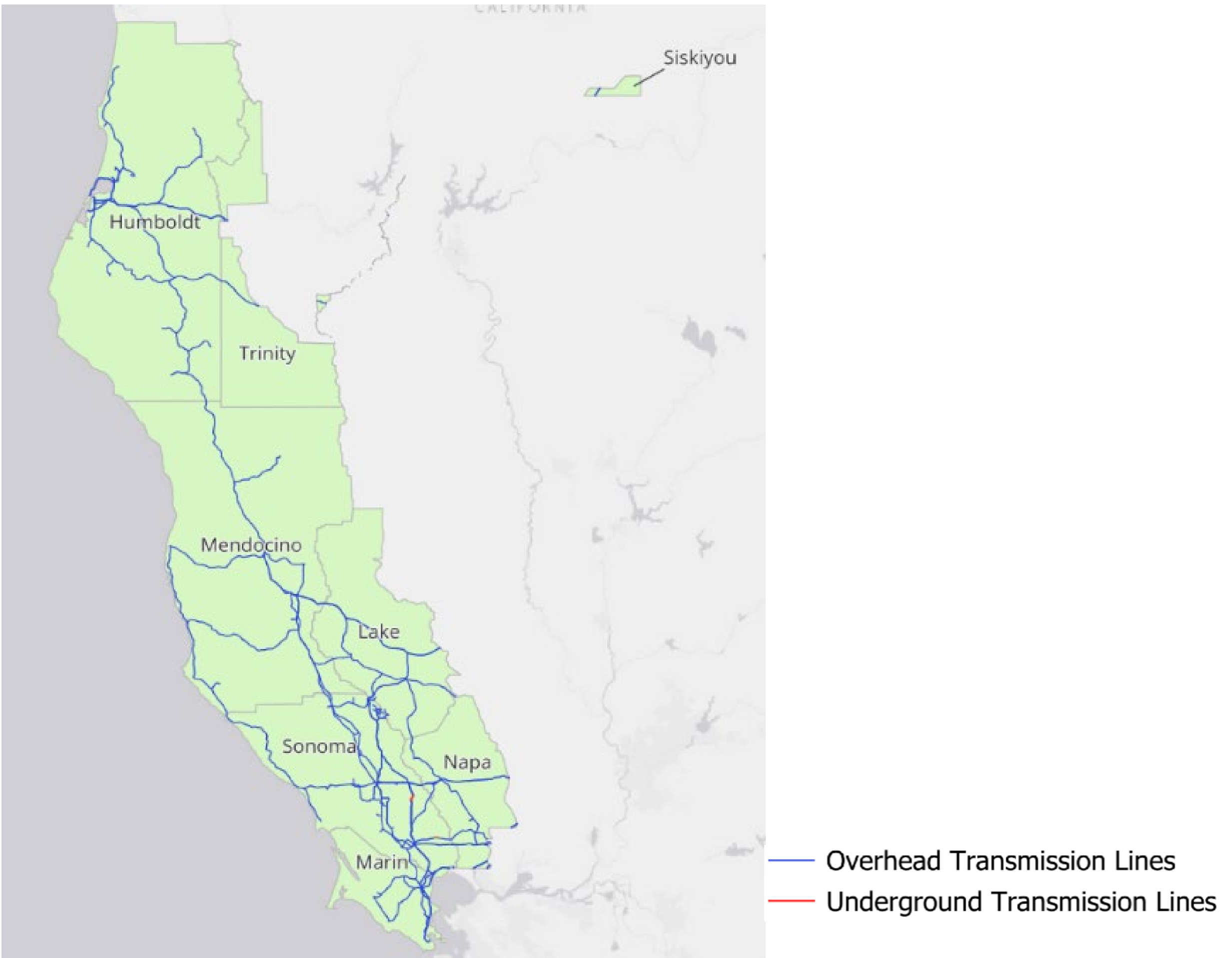


Figure 3.1.1-18. Overhead and underground electric transmission lines in the North Coast Region.

Climate Hazard: Temperature

The number of overhead transmission line-miles in the North Coast Region projected to be exposed to temperatures that meet or exceed the exposure metric increases in both coastal and interior zones over time, although the numbers are very low through 2080 (Table 3.1.1-14).

Table 3.1.1-14. Overhead transmission conductor line-miles within the North Coast Region exposed to temperatures at or above the exposure metric for the coastal and interior zones at baseline, by 2030, 2050, and 2080.

	Baseline		**2030**		**2050**		**2080**	
	Coastal	Interior	Coastal	Interior	Coastal	Interior	Coastal	Interior
Overhead	218 (1.2%)	0 (0%)	375 (2.1%)	51 (0.3%)	558 (3.1%)	197 (1.1%)	646 (3.6%)	784 (4.3%)

Notes:

- *Values represent a sum of the total line segment lengths for all lines that, at any location along the line, experience conditions at or above the ratings for their location.*
- *Reference threshold temperature for coastal zone is 99°F for the months of April–October.*
- *Reference threshold temperature for interior zone is 109°F for the months of April–October.*
- *Percentages are relative to total transmission conductor line-miles within the PG&E service area.*

While detailed power flow analysis would be required to precisely assess the most vulnerable conductor segments, this analysis indicates the potential for increasing vulnerability to high heat events over time in all North Coast Region counties (Figure 3.1.1-19).

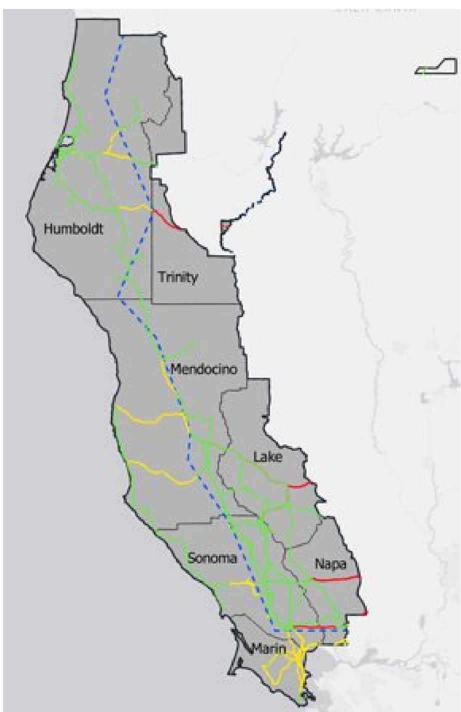


Figure 3.1.1-19. Overhead transmission conductor in the North Coast Region exposed to temperatures at or above the exposure metric for the coastal (yellow) and interior zone (red) in 2050. Conductor in green is not exposed. The boundary between the coastal and interior zones is indicated as a blue dashed line.

Climate Hazard: Flooding and Precipitation

A small portion of transmission towers and poles are located within FEMA 100-year and 500-year floodplains, with higher numbers in Humboldt and Sonoma counties (Table 3.1.1-15, Figure 3.1.1-20).

Table 3.1.1-15. Transmission towers and poles within FEMA 100-year and 500-year floodplains in the North Coast Region, by county.

County	FEMA 100-year	FEMA 500-year
Humboldt	403 (0.27%)	419 (0.28%)
Lake	108 (0.07%)	117 (0.08%)
Marin	284 (0.19%)	415 (0.28%)
Mendocino	142 (0.10%)	156 (0.10%)
Napa	123 (0.08%)	152 (0.10%)
Sonoma	484 (0.33%)	616 (0.41%)
Total	**1,544 (1.04%)**	**1,875 (1.25%)**

Note: Percentages are relative to total transmission towers and poles within the PG&E service area.

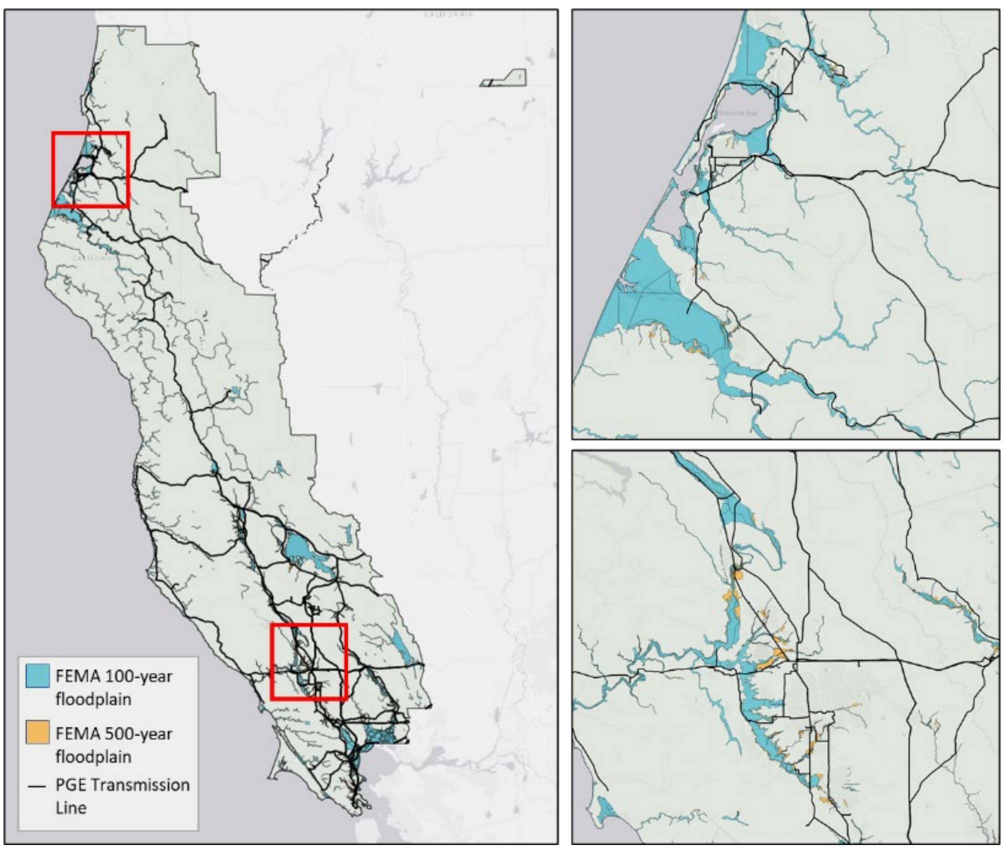


Figure 3.1.1-20. Transmission lines overlayed on FEMA 100-year and 500-year floodplains in the North Coast Region.

3.1.1.a Electric Transmission

Transmission conductor in the North Coast Region passes through areas of high landside incidence; some of these areas may see projected increases in maximum 5-day precipitation in 2050, including areas in Mendocino County and Sonoma County, indicating that assets in these areas may be at greater future vulnerability (Figure 3.1.1-21).

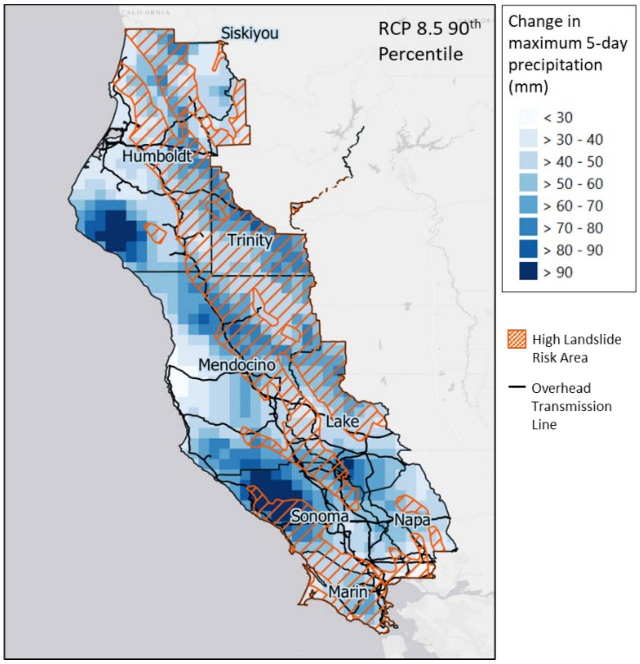


Figure 3.1.1-21. Projected change in 5-day maximum precipitation event by 2050 relative to the historical baseline, overlaid with areas of historical high landslide incidence/susceptibility and PG&E transmission infrastructure.

Climate Hazard: Sea Level Rise

As sea level rises and coastal storm events become more frequent and severe, the number of PG&E transmission towers and poles exposed to inundation from a 100-year coastal storm event in the North Coast Region is projected to increase over time, although numbers and proportions in relation to all towers and poles remain very low over time (Table 3.1.1-16), indicating a low vulnerability.

Table 3.1.1-16. Number of PG&E transmission towers and poles exposed to inundation from a 100-year coastal storm event in the North Coast Region.

County	Baseline	2030	2050	2080
Humboldt	279 (0.19%)	295 (0.20%)	306 (0.21%)	323 (0.22%)
Marin	56 (0.04%)	96 (0.06%)	165 (0.11%)	258 (0.17%)
Napa	0 (0.000%)	2 (0.001%)	5 (0.003%)	12 (0.008%)
Sonoma	55 (0.04%)	58 (0.04%)	58 (0.04%)	69 (0.05%)
Total	**390 (0.27%)**	**451 (0.301%)**	**534 (0.363%)**	**662 (0.448%)**

Note: Percentages are relative to total transmission towers and poles within the PG&E service area.

3.1.1.a Electric Transmission

This vulnerability is concentrated in Humboldt Bay (Humboldt County) and along the San Francisco Bay shoreline (Marin and Sonoma counties) (Figure 3.1.1-22).

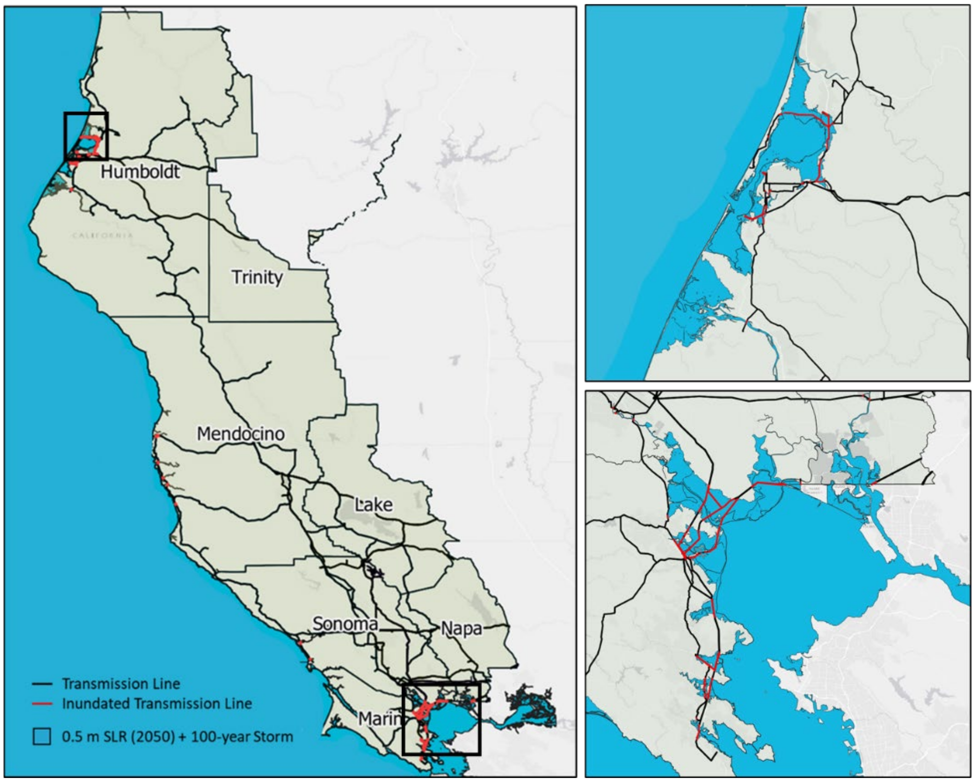


Figure 3.1.1-22. Exposure of PG&E transmission lines in the North Coast Region under 0.5 m of SLR and a 100-year storm.

Climate Hazard: Wildfire

About 6 percent of transmission line-miles in the North Coast Region are within HFRAs, with higher line-miles in Mendocino and Sonoma counties (Table 3.1.1-17, Figure 3.1.1- 23).

Table 3.1.1-17. Transmission line-miles in HFRAs in the North Coast Region, by county.

County	Transmission Line-Miles in HFRAs
Del Norte	0 (0%)
Humboldt	217 (1.20%)
Lake	176 (0.98%)
Marin	67 (0.37%)
Mendocino	304 (1.69%)
Napa	94 (0.52%)
Siskiyou	2 (0.01%)
Sonoma	355 (1.97%)
Total	**1,233 (6.85%)**

Note: Percentages are relative to total transmission line-miles within the PG&E service area.

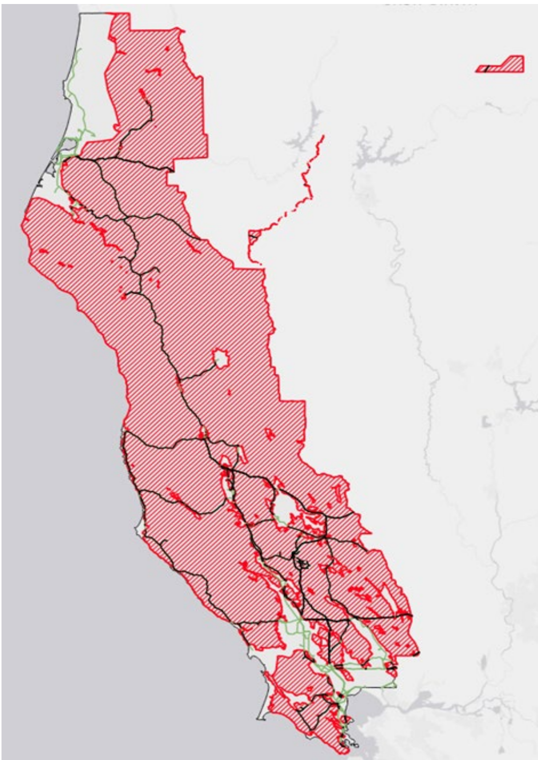


Figure 3.1.1- 23. Overhead transmission lines in HFRAs in the

Climate Hazard: Drought-Driven Subsidence

Drought-driven subsidence is not considered to be a climate change issue for transmission assets at this time.

Central Coast Region

Summary

PG&E has approximately 2,500 miles of transmission conductor in the Central Coast Region, 99.8 percent of which is overhead and 0.2 percent is underground (Figure 3.1.1-24).

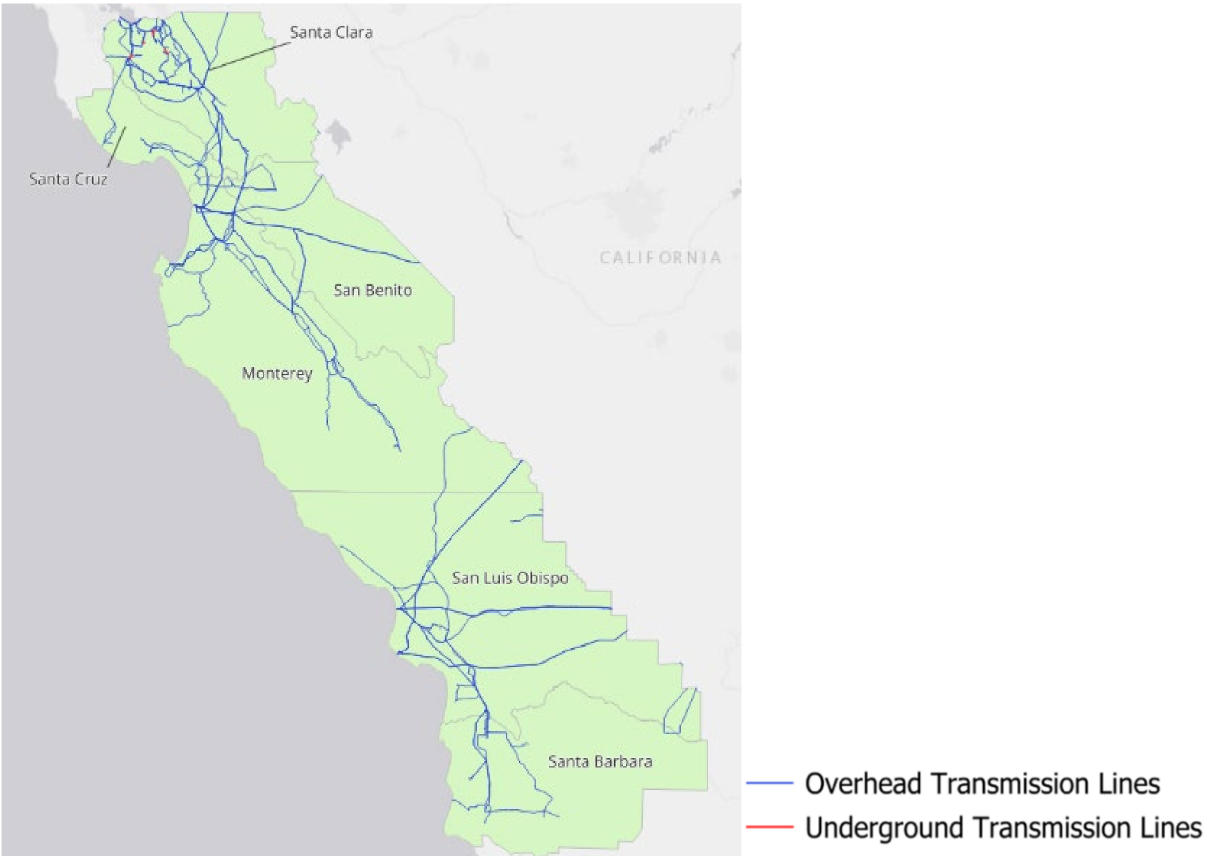


Figure 3.1.1-24. Overhead and underground electric transmission lines in the Central Coast Region.

Climate Hazard: Temperature

The number of overhead transmission line-miles in the Bay Area Region projected to be exposed to temperatures that meet or exceed the exposure metric increases in both coastal and interior areas over time through 2050 when vulnerability may increase in both coastal and interior areas (Table 3.1.1-18).

Table 3.1.1-18. Overhead transmission conductor line-miles within the Central Coast Region exposed to temperatures at or above the exposure metric for the coastal and interior zone at baseline, by 2030, 2050, and 2080.

	Baseline		2030		2050		2080	
	Coastal	Interior	Coastal	Interior	Coastal	Interior	Coastal	Interior
Overhead	0 (0%)	0 (0%)	361 (2.0%)	169 (0.9%)	483 (2.7%)	495 (2.7%)	1,036 (5.7%)	900 (5.0%)

Notes:

- *Values represent a sum of the total line segment lengths for all lines that, at any location along the line, experience conditions at or above the ratings for their location.*
- *Reference threshold temperature for coastal zone is 99°F for the months of April–October.*
- *Reference threshold temperature for interior zone is 109°F for the months of April–October.*
- *Percentages are relative to total transmission conductor line-miles within the PG&E service area.*

While detailed power flow analysis would be required to precisely assess the most vulnerable conductor segments, this analysis indicates the potential for increasing vulnerability to high heat events over time, especially in Santa Clara, Monterey, and San Luis Obispo counties (Figure 3.1.1-25).

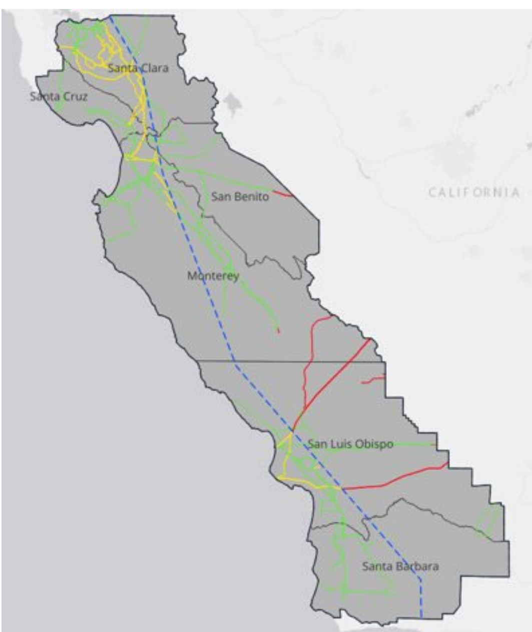


Figure 3.1.1-25. Overhead transmission conductor in the Central Coast Region exposed to temperatures at or above the exposure metric for the coastal (yellow) and interior zone (red) in 2050. Conductor in green is not exposed. The boundary between the coastal and interior zones is indicated as a blue dashed line.

Climate Hazard: Flooding and Precipitation

A small portion of transmission towers and poles are located within FEMA 100-year and 500-year floodplains with higher numbers in Santa Clara and Monterey counties (Table 3.1.1- 19, Figure 3.1.1- 26).

Table 3.1.1- 19. Transmission towers and poles within FEMA 100-year and 500-year floodplains in the Central Coast Region.

Region	FEMA 100-year	FEMA 500-year
Monterey	562 (0.38%)	1,216 (0.82%)
San Benito	45 (0.03%)	45 (0.03%)
San Luis Obispo	132 (0.09%)	144 (0.10%)
Santa Barbara	285 (0.19%)	329 (0.22%)
Santa Clara	681 (0.46%)	1,754 (1.18%)
Santa Cruz	49 (0.03%)	66 (0.04%)
Total	**1,754 (1.18%)**	**3,554 (2.39%)**

Note: Percentages are relative to total transmission towers and poles within the PG&E service area.

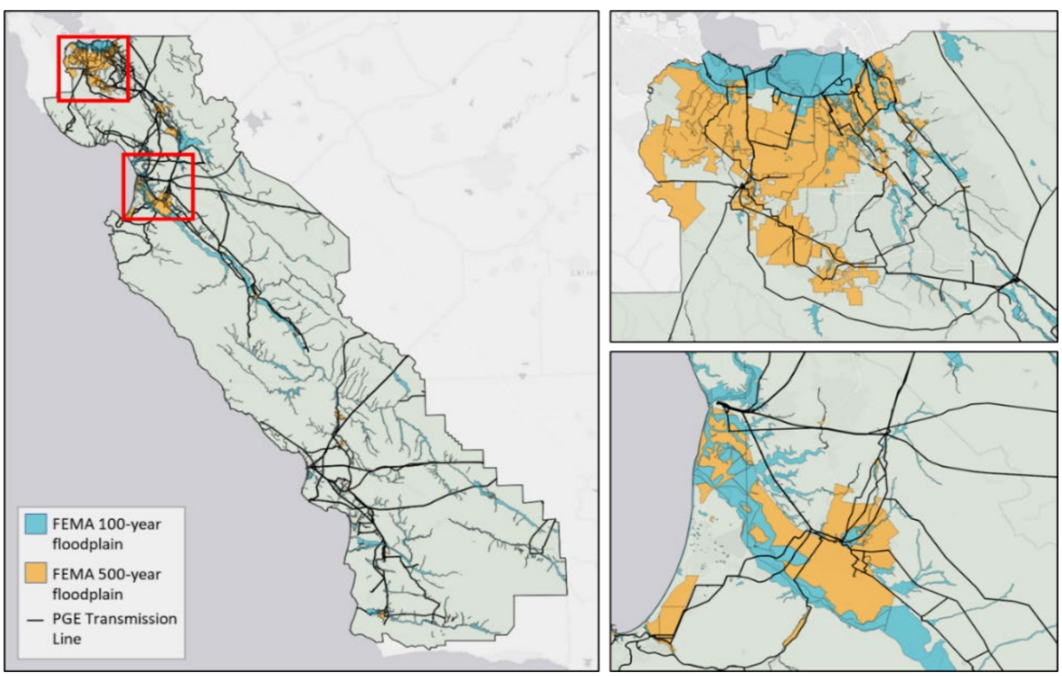


Figure 3.1.1- 26. Transmission lines overlayed on FEMA 100-year and 500-year floodplains in the Central Coast Region.

3.1.1.a Electric Transmission

Transmission conductor in the Central Coast Region passes through areas of high landslide incidence; some of these areas may see projected increases in maximum 5-day precipitation in 2050, including areas in Santa Cruz and San Luis Obispo counties, indicating that assets in these areas may be at greater future vulnerability (Figure 3.1.1-27).

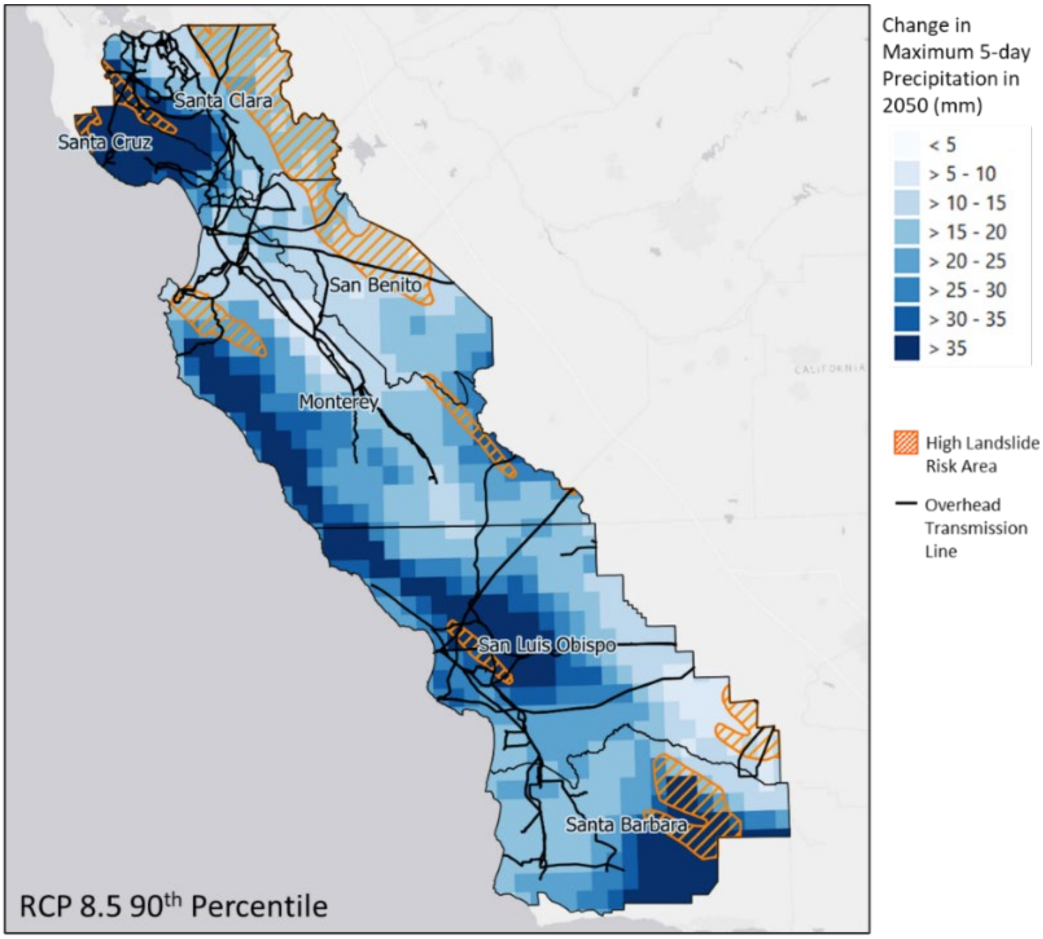


Figure 3.1.1-27. Projected change in 5-day maximum precipitation event by 2050 relative to the historical baseline, overlaid with areas of historical high landslide risk and electric transmission overhead lines in the Central Coast Region.

Climate Hazard: Sea Level Rise

As sea level rises and coastal storm events become more frequent and severe, the number of PG&E transmission towers and poles exposed to inundation from a 100-year coastal storm event in the Central Coast Region is projected to increase over time, although numbers and proportions in relation to all towers and poles remain very low over time (less than 0.3 percent by 2080) (Table 3.1.1-4), indicating a low vulnerability. This vulnerability is concentrated in Santa Clara and Monterey counties (Figure 3.1.1-28).

3.1.1.a Electric Transmission

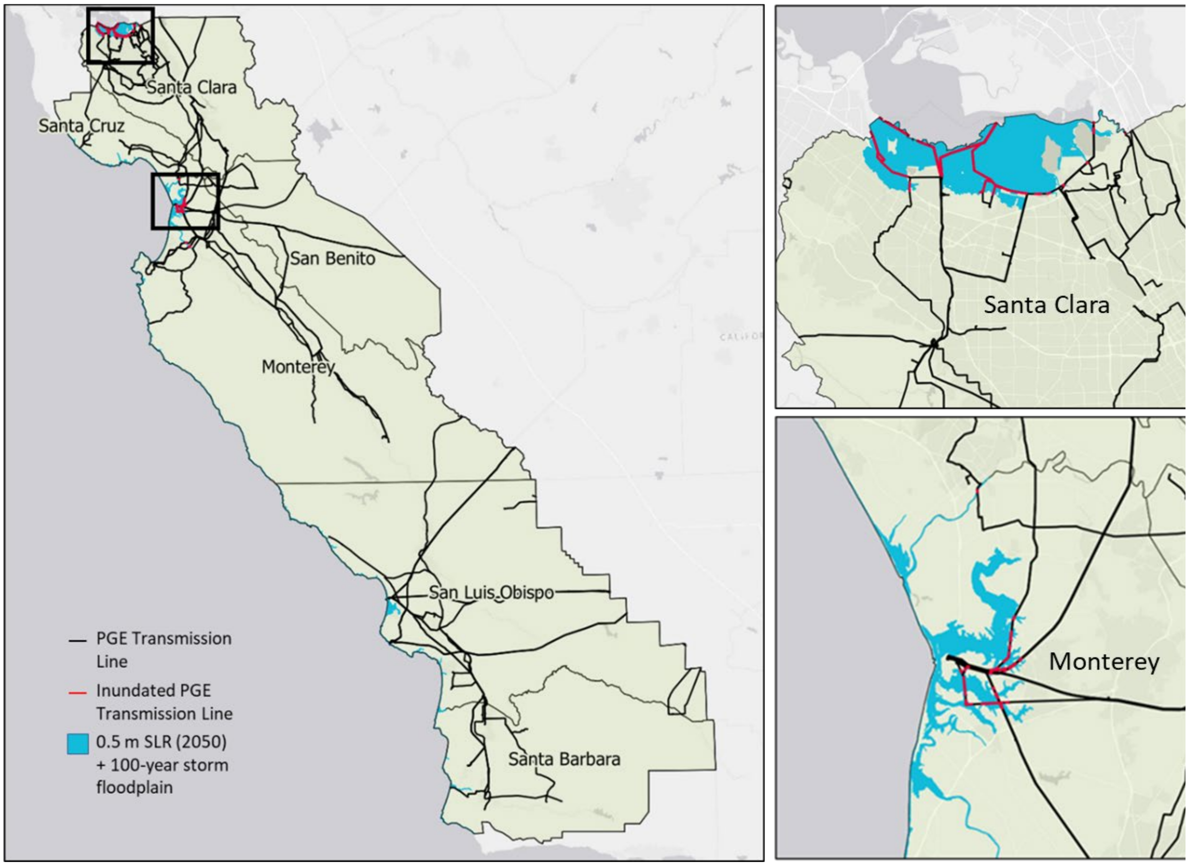


Figure 3.1.1-28. Exposure of PG&E transmission lines in the Central Coast Region under 0.5 m of sea level + a 100-year storm.

Climate Hazard: Wildfire

Six percent of transmission line-miles in the Central Coast Region are within HFRAs with higher line-miles in San Luis Obispo (Table 3.1.1-20, Figure 3.1.1- 29).

Table 3.1.1-20. Transmission line-miles in HFRAs by Central Coast Region county.

County	Transmission Line-Miles in HFRAs
Monterey	179 (0.99%)
San Benito	98 (0.55%)
San Luis Obispo	446 (2.48%)
Santa Barbara	63 (0.35%)
Santa Clara	226 (1.26%)
Santa Cruz	68 (0.38%)
Total	**1,080 (6.0%)**

Note: Percentages are relative to total transmission line-miles within the PG&E service area.

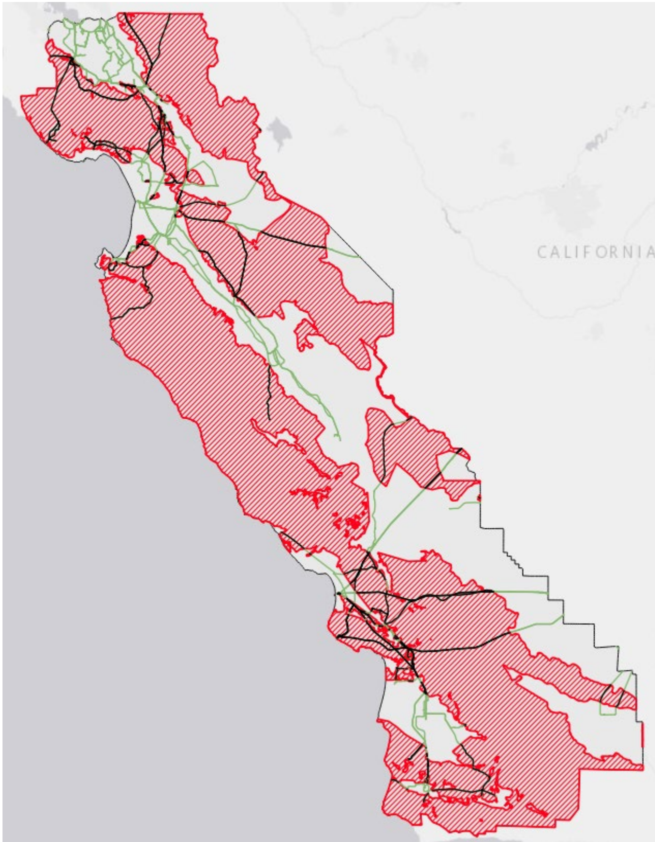


Figure 3.1.1- 29. Overhead transmission lines in HFRAs in the Central Coast Region.

Climate Hazard: Drought-Driven Subsidence

Drought-driven subsidence is not considered to be a climate change issue for transmission assets at this time.

3.1.1.b Electric Substation

Asset Family Introduction

Substations are important hubs in PG&E's system for transmitting electricity. They serve as the interface between the transmission system and the distribution grid, transforming voltages from high to low or low to high for transmission and distribution substations. Substations vary in size and load served. They fall into two main categories:

1. **Transmission substations** transmit electricity at high voltages (60 kV to 500 kV) from large power plants to distribution substations.
2. **Distribution substations** reduce high-voltage electricity to medium voltages (34.5 kV and below), making it suitable for supplying customers.

Substations contain equipment such as power transformers, circuit breakers, switches, switchgears, protective relays, batteries, bus structures, and voltage-regulating equipment.

Key Findings

Climate Hazard	Climate Change Risk and Potential Adaptation Measures
Temperature	Moderate
	• High temperatures, coupled with temperature-driven load increases, could result in reduced equipment life and potential impacts on reliability during heat events. Transformers are one of the most critical substation assets that are vulnerable to heat-related impacts. • Many substations may experience temperatures in 2050 that meet or exceed the equipment ambient operational reference temperatures. • Rising temperatures are expected to increase load (e.g., air conditioning), which may decrease equipment life. • Potential adaptation measures include, but are not limited to, provide additional cooling, plan for climate-informed capacity projections, provide additional monitoring, and adopt updated design standards.
Flooding and Precipitation	Moderate
	• Flooding can damage substation equipment and overload drainage systems that are not equipped to handle high levels of flooding and can create hazards to the environment and operations. The design, siting, and operation of substations for flood damage prevention are based on FEMA flood maps, which are based on past climate data rather than projections of future change. • Potential adaptation measures include, but are not limited to, increase measures to prevent flooding, improve drainage and pumping capacity, elevate critical equipment, and waterproof.
Sea Level Rise	Moderate
	• Coastal flooding can damage substation equipment and overload drainage systems not equipped to handle high levels of flooding. • Potential adaptation measures include, but are not limited to, ensure climate-informed siting and design of new construction and apply corrosion-resistant coatings.

3.1.1.a Electric Substation

Wildfire	Moderate
	• PG&E's WMP represents the measures that PG&E will implement to reduce utility-caused wildfire ignitions. The WMP is focused primarily on addressing ignition risk initiated by PG&E rather than the risk of wildfire damage to PG&E assets caused by external factors, such as lightning and arson. • Long-term adaptation planning can seek to understand what additional measures may be needed to reduce the risk of wildfire damage to equipment. For example, PG&E will continue to evaluate and implement appropriate mitigation activities to reduce wildfire risk at substations, such as PG&E's Defensible Space Program.
Drought-Driven Subsidence	Low (off-ramped)
	Drought-driven subsidence is unlikely to cause major impacts on substation equipment due to substations' constrained physical footprints. The climate change risk to substations is low. Drought-driven subsidence is not considered to be a climate change issue for substations at this time.

Climate Hazards

This section describes climate hazards that may affect substation sites, substation equipment, or other infrastructure within substations, including temperature, flooding and precipitation, SLR, wildfire, and drought-driven subsidence.

Temperature

Climate projections indicate that PG&E substations will be exposed to rising temperatures over time, including increases in ambient temperatures, extreme temperatures, and heat waves.

There are two temperature-related risks to substation assets and operations:

- Higher projected temperatures will mean that substation assets and equipment are exposed to higher ambient temperatures that affect equipment temperature.
- The temperature rise also will result in an increased loading, which may cause operational constraints.

Exposure and Sensitivity

Substation equipment, such as transformers, circuit breakers, and capacitors, is designed for expected operating conditions. However, higher temperatures increase the risk of transformers and other equipment operating in excess of their rated capacity. Consecutive heat waves or extended high temperatures without nighttime cooling can be particularly damaging.

If substation enclosures, such as control buildings, do not have air conditioning systems, high temperatures can degrade the life expectancy of indoor equipment, such as relays, batteries, and electronic communications equipment.

PG&E has planning and operational processes in place during high heat conditions to avoid impacts on equipment and operations; see the Adaptive Capacity and Climate Change Risk section below for more details. The key sensitivities of substation electrical equipment to temperatures that exceed planning assumptions and operational practice capabilities include the following:

- **Reduced equipment life:** High ambient temperatures increase the internal operating temperatures of equipment, including transformers. This accelerates the aging of paper insulation, which is an integral component of the transformer, and can shorten the operating life of transformers by months or even years.
- **Acute failure:** Deteriorated transformer insulation is more likely to break down in higher temperatures, which can lead to transformer failure.
- **Customer impact:** High temperatures may result in customer outages if distribution substation equipment fails or preventive load-shedding occurs to avoid overloaded equipment. Direct impacts on customers are less likely if transformer substation equipment is compromised due to higher temperatures; however, impacts on equipment may reduce system reliability.

3.1.1.a Electric Substation

PG&E has experienced some substation-related outages during heat waves. During the 2006 heat wave, PG&E substations performed relatively well overall; however, there were a few instances in which substation transformers failed or PG&E initiated load-shedding, resulting in customer outages. In June 2019, more than 22,000 customers in Fresno and Clovis lost power because a substation circuit breaker overheated,[4] and in June 2021, 5,900 customers around Auburn lost power due to a substation transformer bank that required emergency replacement during a heat wave.[5]

Climate Change Vulnerability

PG&E has historically used "coastal" and "interior" zones to indicate parts of the service area that are relatively cooler or warmer during the summer months of April–October. The approximate geographic division of coastal and interior zones can be seen in the Electric Substation Regional Reports section below.

Until recently, PG&E substation design standards indicated an assumed maximum temperature of 109°F in interior zones and 99°F in coastal zones for the summer months of April–October. In 2020, PG&E updated the interior temperature maximum from 109°F to 118°F. This change applies only to new build and replacement work on substations and not retroactively to all substations.

Analytical Metrics

Vulnerability to very high temperatures is based on a 3-day weighted daily maximum temperature at or above substation design standards. This weighted metric accounts for the fact that multiday heat events—when equipment gets progressively hotter over time and higher nighttime temperatures do not allow for evening cooling—are some of the most damaging to electrical equipment. This metric is examined under a projected 1-in-2-year and a 1-in-10-year heat event, over time, with a focus on 2050. Because high heat conditions also can be expected to be associated with significantly elevated 24-hour average temperatures, the 3-day weighted daily maximum temperature metric is used as a proxy for other high heat metrics and serves as a benchmark for assessing climate change vulnerability.

Results

Many of PG&E's substations throughout the service area are projected to be exposed to temperatures exceeding ambient temperature design assumptions during a 1-in-2-year (Table 3.1.1-21a) and 1-in-10-year (Table 3.1.1-21b) heat event, with the number of substations exposed increasing over time. By 2050, many of these substations are within the Central Valley and Sierra Regions (Table 3.1.1-21a and Table 3.1.1-21b). Over time, exceedance in the interior

---

[4] ABC30 Action News. 2019. "Fresno, Clovis power outage causes mayhem for graduates, guests." https://abc30.com/fresno-clovis--power-outage-causes-mayhem-for-graduates/5333240/

[5] Newell, T. 2021. "Auburn area loses power during heatwave; another round of outages expected." Gold Country Media. https://goldcountrymedia.com/news/189944/auburn-area-loses-power-during-heatwave-another-round-of-outages-expected/

designation is greater for the legacy standard assumption (109°F) than for the updated standard used for new substations or major rebuilds (118°F). For example, by 2050, during a 1-in-10-year heat event, almost 64 percent of substations would experience heat above legacy standards for the interior designation (109°F), whereas only 12 percent of substations are projected to be vulnerable if designed with an updated interior temperature designation (118°F) that is applied to all existing substations (Table 3.1.1-21b). This indicates that the updated temperature assumption used for new substations or rebuilds/major work is likely to moderate future vulnerability to very high heat.

Many substations in PG&E's coastal zone are exposed to heat above the design assumptions by 2050, 19 percent in a 1-in-2-year heat wave and 29 percent in a 1-in-10-year heat wave by 2050, with the majority of these substations being in the Bay Area and Central Coast Regions (Table 3.1.1-21a and Table 3.1.1-21b). This indicates that substations in the coastal zone are likely to see increasing vulnerability over time.

See the Electric Substation Regional Reports section for analyses and discussion on geographic differences in vulnerability.

Table 3.1.1-21. Substation count over time in the coastal, legacy interior, and updated interior zones, over time for (a) 1-in-2-year and (b) 1-in-10-year heat event. Note that the Central Valley Region does not have any area within the coastal zone.

a) 1-in-2-year heat event

Region	Baseline			2030			2050			2080		
	Coastal	Legacy Interior	Updated Interior	Coastal	Legacy Interior	Updated Interior	Coastal	Legacy Interior	Updated Interior	Coastal	Legacy Interior	Updated Interior
Bay Area	2 (0.22%)	0	0	29 (3.17%)	8 (0.87%)	0	62 (6.78%)	33 (3.61%)	0	95 (10.38%)	45 (4.92%)	0
Central Valley	N/A	0	0	N/A	234 (25.57%)	0	N/A	266 (29.07%)	0	N/A	280 (30.60%)	47 (5.14%)
Sierra	5 (0.55%)	13 (1.42%)	0	6 (0.66%)	121 (13.22%)	0	6 (0.66%)	149 (16.28%)	0	6 (0.66%)	181 (19.78%)	44 (4.81%)
North Coast	7 (0.77%)	0	0	20 (2.19%)	3 (0.33%)	0	22 (2.40%)	19 (2.08%)	0	29 (3.17%)	45 (4.92%)	0
Central Coast	12 (1.31%)	0	0	58 (6.34%)	4 (0.44%)	0	85 (9.29%)	9 (0.98%)	0	105 (11.48%)	17 (1.86%)	1 (0.11%)
Total	**26 (2.84%)**	**13 (1.42%)**	**0 (0%)**	**113 (12.35%)**	**370 (40.44%)**	**0 (0%)**	**175 (19.13 %)**	**476 (52.02%)**	**0 (0%)**	**235 (25.68%)**	**568 (62.08%)**	**92 (10.05%)**

Notes:

- *Assumed maximum temperature for coastal zone is 99°F for the months of April–October*
- *Assumed maximum temperature for legacy interior zone is 109°F for the months of April–October*
- *Assumed maximum temperature for updated interior zone is 118°F for the months of April–October*
- *Percentages are relative to total substations within the PG&E service area.*

Table 3.1.1-22. Continued

b) 1-in-10- year heat event

Region	Baseline			2030			2050			2080		
	Coastal	Legacy Interior	Updated Interior	Coastal	Legacy Interior	Updated Interior	Coastal	Legacy Interior	Updated Interior	Coastal	Legacy Interior	Updated Interior
Bay Area	37 (4.04%)	0	0	109 (11.91%)	40 (4.37%)	0	120 (13.11%)	46 (5.03%)	0	129 (14.10%)	47 (5.14%)	25 (2.73%)
Central Valley	N/A	82 (8.96%)	0	N/A	273 (29.84%)	0	N/A	279 (30.49%)	52 (5.68%)	N/A	284 (31.04%)	257 (28.09%)
Sierra	6 (0.66%)	84 (9.18%)	0	6 (0.66%)	167 (18.25%)	20 (2.19%)	6 (0.66%)	187 (20.44%)	56 (6.12%)	6 (0.66%)	199 (21.75%)	154 (16.83%)
North Coast	28 (3.06%)	4 (0.44%)	0	31 (3.39%)	47 (5.14%)	0	31 (3.39%)	49 (5.36%)	1 (0.11%)	36 (3.93%)	52 (5.68%)	25 (2.73%)
Central Coast	92 (10.05%)	1 (0.11%)	0	109 (11.91%)	17 (1.86%)	0	109 (11.91%)	22 (2.40%)	1 (0.11%)	109 (11.91%)	25 (2.73%)	9 (0.98%)
Total	**163 (17.81%)**	**171 (18.69%)**	**0 (0%)**	**255 (27.87%)**	**544 (59.45%)**	**20 (2.19%)**	**266 (29.07%)**	**583 (63.72%)**	**110 (12.02%)**	**280 (30.60%)**	**607 (66.34%)**	**470 (51.37%)**

Notes:

- *Assumed maximum temperature for coastal zone is 99°F for the months of April–October*
- *Assumed maximum temperature for legacy interior zone is 109°F for the months of April–October*
- *Assumed maximum temperature for updated interior zone is 118°F for the months of April–October*
- *Percentages are relative to total substations within the PG&E service area.*

Adaptive Capacity and Climate Change Risk

PG&E has current capacities in planning and operations to manage high heat events, including the following.

Planning Capacities

- **Design:** In 2020, PG&E updated its assumptions for interior district substation ambient temperature from 109°F to 118°F. These updated design standards may bolster the climate resilience of substations that are built or updated to this standard (Table 3.1.1-21a, Table 3.1.1-21b).

Operational Capacities

- **Temperature monitoring:** In addition to operational data, site-specific monitoring of ambient conditions using electronic sensors and diagnostic equipment allows PG&E to monitor substation equipment conditions in real time.
- **Hot bank report:** When transformers exceed normal operating temperatures, the event is documented with a hot bank report that records the transformer top oil and hot spot temperatures and submits the event for internal review to determine a course of action based on exceeded established limits.
- **Load-shedding:** PG&E identifies whether action is needed and, in some cases, identifies opportunities to increase capacity or divert load. However, load-shedding is operationally undesirable.
- **Systemwide demand response programs:** Voluntary demand reduction programs on high-temperature/high-load days may reduce the vulnerability to high heat.
- **Maintenance practices:** In preparation for seasonal changes (summer and winter preparedness), PG&E conducts inspections, equipment apparatus checks, and confirmation of protection and automation systems.
- **Mobile transformer units:** PG&E uses mobile transformer units to provide restoration capacity in the event that a transformer fails or, in some cases, as substitute capacity during capital transformer replacement projects where necessary for clearances. PG&E maintains a range of sizes adequate to cover the transformer fleet, thereby increasing the ability of substations to support transformers that may overheat.
- **Capitalized Emergency Material (CEM) transformers:** PG&E's CEM transformer fleet typically works together with mobile transformers as the permanent capacity installation in the event of a transformer failure. PG&E will replace the failed unit with another from CEM, which is the Company's supply of spare transformer equipment. PG&E also considers replacing the failed unit with a larger size transformer from the CEM fleet if additional capacity is necessary.

PG&E substations may be exposed to future extreme heat conditions that tax equipment above adaptive capacity, which is considered to be moderate. Further analysis would be needed to understand the impacts of climate change on current adaptive capacity over time.

Although the adaptive capacity described above mitigates the impacts from many high heat events, an analysis that evaluates which processes and plans could be strengthened with climate-informed adaptation measures could be used to improve resilience to near- and long-term increases in temperature and frequency of extreme heat events. The climate change risk to substations from high temperatures is considered to be **moderate**.

Potential Adaptation and Resilience Measures

Adaptation options that PG&E may consider to mitigate the impacts of high heat on substation assets may include the following.

Planning Options

- **Provide additional cooling:** Exposure to higher temperatures can be reduced by installing air conditioning at new substations that may be more vulnerable to future temperature increases and retrofitting vulnerable, non-air-conditioned substation enclosures with air conditioning systems.
- **Adopt updated design standards**: Interior substations that are updated to meet the recently updated 118°F design standard will likely be protected against more projected extreme heat events (See Section 3.1.1b). Similar updated standards for substations in the coastal zone may also be considered.
- **Implement demand response and non-wires solutions:** Effective demand reduction is frequently a viable substitute for capacity additions, and PG&E can consider trends and opportunities associated with both voluntary demand reduction and distributed energy resources in reducing peak demand on substations and electric assets.
- **Plan for climate-informed capacity projects:** Incorporate future temperature trends into forecasting capacity projects.

Operational Options

- **Increase the safety margin in transformer loading:** Reducing planned transformer loading levels during heat events—particularly for transformers with high top oil and hot spot temperatures—could provide an increased margin of safety against high equipment temperatures during unprecedented conditions.
- **Provide additional monitoring:** In addition to collecting operational data, adding site-specific monitoring of ambient conditions using electronic sensors and diagnostic equipment allows PG&E to monitor substation equipment conditions in real time.
- **Increase the availability of mobile transformer and CEM units:** Mobile transformers and CEM units can improve emergency response capabilities during high-heat events.

Flooding and Precipitation

PG&E substations face potential increased exposure to flooding as a result of climate-driven changes in precipitation, extreme storms, and other hydrologic changes, such as high snowmelt that results in flooding. As a result of these potential changes, substations in floodplains may see higher and more frequent flood levels or flood exposures at sites that have not previously experienced them.

3.1.1.a Electric Substation

Exposure and Sensitivity

Outdoor equipment is designed to be exposed to the elements. Substations have site-level flood mitigation in place and PG&E has operational practices to prevent and respond to flooding to lessen the impacts on equipment. Substations face the following potential sensitivities associated with water incursion beyond these assumptions, capabilities, and operational procedures:

- **Equipment damage from flooding:** Standing or moving water can cause damage to transformer auxiliary systems and transformer windings from moisture intrusion. Grade-level circuit breakers and other outdoor control equipment also may be damaged by flooding. Furthermore, substation control rooms contain relays, batteries, electronic communications equipment, controls, and other sensitive equipment that could result in damage or asset failure if exposed to water. Underground installations, such as conduits and control rooms (which may or may not be underground), communications equipment, and electrical equipment in cable basements,[6] are particularly vulnerable to water inundation. Equipment may be particularly vulnerable if gaskets or sealing are damaged or not entirely effective.[7] Notably, damaged substation equipment may take significant time to restore or repair; preventing impacts is far better than treating them.
- **Affected or insufficient drainage systems:** Floodwater may affect drainage systems, including silting drains, flooding oil separation tanks, or gathering in trenches.[8]
- **Undermined soil stability:** Infiltration of floodwater into unstable ground can cause heavy equipment, such as transformers, to tilt if the foundations are insufficiently stable, potentially resulting in compromised operation or tipping over. Erosion also may expose the ground grid and accelerate its fragmentation, with associated risks to equipment,[9] and may leave substation perimeters vulnerable to physical security events.
- **Environmental hazard:** Substation transformers contain oil, and substantial measures are in place to ensure that this oil is not released into the environment. Infiltration of floodwaters into oil containment walls, asset failure, or inundation/tipping over of transformers could result in local environmental contamination.
- **Hazards to operators:** Water within the footprint of an electrical substation poses an electrical hazard to any PG&E personnel within the substation. Contaminated floodwaters and/or equipment exposed to contaminants (e.g., fungal or microbial contamination, rust) may pose safety hazards to operators. Additionally, flood-related erosion may expose the

[6] CIGRE. 2015. "Air Insulated Substation Design for Severe Climate Conditions." Working Group B3.31, Report 14. https://www.e-cigre.org/publications/detail/elt-280-5-air-insulated-substation-design-for-severe-climate-conditions.html
[7] *Ibid*.
[8] *Ibid*.
[9] *Ibid*.

ground grid and pose a safety hazard to operators[10] or physical harm to employees if a physical attack were to occur.

- **Operational shutdown protocols:** PG&E's current protocols dictate that substations must be shut down during significant inundation events.

PG&E's operational protocols require substations to be de-energized if sufficient floodwater to trigger the Spill Prevention, Control, and Countermeasure (SPCC) rule is present on the floor of the substation. Substations contain bulk oil storage containers and oil-filled electrical equipment, such as transformers, regulators, circuit breakers, and capacitors. Should one of these components suffer a failure and subsequent oil leak, an SPCC Plan prevents the discharge of oil into or upon "navigable waters," such as protected waterways, per U.S. Environmental Protection Agency regulations (40 Code of Federal Regulations Part 112).

The requirements and procedures for establishing and implementing an SPCC Plan are contained within PG&E's established design criteria. Should a substation flood with enough water to fill spill retention ponds or other countermeasures, a potential component oil leak, concurrent with a flooding event, would likely result in the uncontrolled release of oil into nearby water as the floodwater recedes. Energized equipment is much more likely to suffer catastrophic failure and a subsequent oil leak. To mitigate the risk of an uncontained release of hazardous substances, PG&E would take the affected substation offline for the duration of any flooding event and would need to wait until water has receded to reenergize equipment.

Due to heavy rains in early January 2023, the Morro Bay Substation (Central Coast Region), which is in a FEMA 100-year floodplain, was de-energized, causing power outages to 11,300 residents in the Morro Bay and Los Osos area. The facility was inundated with 3–4 ft of water due to floodwaters from the neighboring creek overtopping the facility retaining wall. The floodwaters also flowed into the underground control room, which was completely submerged.

Due to the greater than normal snowpack melt in early 2023, the Tulare Lake Basin in the Central Valley Region flooded and put three PG&E substations in the area at risk, requiring emergency mitigation, including temporary flood walls and trenches.

In addition to acute impacts from extreme events, substations also may be subject to chronic damage from inundation. The exposure of underground or aboveground cables and other equipment to repeated inundation can result in accelerated corrosion and degradation.

Flooding may make it difficult to access substations. Flooding, damage to roads, or debris left by floodwaters can prevent or limit access to assets, increasing the difficulty of and time required for repair work in inundated areas.

---

[10] CIGRE. 2015. "Air Insulated Substation Design for Severe Climate Conditions." Working Group B3.31, Report 14. https://www.e-cigre.org/publications/detail/elt-280-5-air-insulated-substation-design-for-severe-climate-conditions.html

High precipitation events also can lead to cascading impacts from landslides, which could affect substations by directly damaging them or damaging the infrastructure on which they depend.

Changing precipitation dynamics and SLR also may increase the likelihood of levee overtopping or failure; this may expose substations in the Sacramento Delta area to flooding. Levees are existing water management infrastructure that are outside of PG&E's management, and therefore the risk of flooding to assets due to an overtopping or breach scenario is beyond the scope of this assessment.

Climate Change Vulnerability

FEMA floodplain designations are currently the best available metric to understand vulnerability to flooding, although they are backward-looking and may not be accurate in predicting the frequency and severity of future flood risks.

Analytical Metrics

The key metrics used in this climate vulnerability assessment for the exposure of substations to flooding are their location in FEMA 100-year and 500-year floodplains and the percentage increase in precipitation at substation locations with high landslide risk as an overlay.

Results

Eleven percent and 22 percent of all PG&E substations are within FEMA 100-year and 500-year floodplains (Table 3.1.1-22). The Central Valley and Sierra Regions have the greatest number of substations in FEMA floodplains (Table 3.1.1-22), which may indicate higher vulnerability to flooding in these regions. See the Electric Substation Regional Reports section for details regarding specific geographic areas of interest.

Table 3.1.1-23. Substation counts by region within FEMA 100-year and 500-year floodplains.

Region	FEMA 100-year	FEMA 500-year
Bay Area	15 (2%)	24 (3%)
Central Valley	38 (4%)	69 (8%)
Sierra	28 (3%)	48 (5%)
North Coast	14 (2%)	17 (2%)
Central Coast	9 (1%)	40 (4%)
Total	**104 (11%)**	**198 (22%)**

Note: Percentages are relative to total substations within the PG&E service area.

Substations in areas with high landslide risk and the greatest projected increases in precipitation may be more vulnerable to impacts from landslides. These areas include substations in parts of Sonoma and Marin counties (Bay Area Region), Trinity and Humboldt counties (North Coast Region), and Santa Barbara County (South Coast Region). See the Electric Substation Regional Reports section for details.

Adaptive Capacity and Climate Change Risk

Several key factors influence the adaptive capacity of substations to flooding.

3.1.1.a Electric Substation

Planning Capacities

- **Existing flood protection measures:** Flood protection measures managed by PG&E at substations are implemented on a site-by-site basis, with equipment elevation and yard design considering FEMA 100-year floodplains. Substation site drainage designs assume a historical 25-year return period precipitation event.
- **Pumping capacity:** Some PG&E substations, especially those located in flood-prone areas, are equipped with pumping capacity designed to remove water from the substation during flood events.

Operational Capacities

- **Redundancy:** In many cases, load that is diverted from a de-energized substation may be picked up by other substations that can serve the same load.
- **Temporary flood barriers:** Temporary flood barriers, such as those added to two of the three potentially affected substations after the Tulare Basin flood event in 2023, may be used to reduce the severity of flooding into a substation, although not blocking it completely because of underground water seepage. Additional dewatering can be implemented to further reduce water levels within the substation due to seepage. Because none of the threatened substations were subjected to actual flooding, the effectiveness of the temporary flood barriers has not been proven.

While substations are generally well protected against flooding, the adaptive capacity described above is based on historical flood conditions that are not climate-informed. Large rain events in January 2023 caused flooding and de-energization at the Morro Bay Substation, and excessive snowmelt caused flooding in the Tulare Basin that threatened three substations in the Central Valley Region. The adaptive capacity for fluvial/pluvial flooding is therefore considered to be moderate. Further analysis would be needed to understand the impacts of climate change on current adaptive capacity over time. Given the established vulnerabilities and historical precedents of the impact, the climate change risk is considered to be **moderate**.

Potential Adaptation and Resilience Measures

PG&E may consider a range of potential adaptation options for vulnerable substations, including the following.

Planning Options

- **Increase measures to prevent flooding:** Example measures include permanent flood barriers, elevating critical equipment, applying enhanced waterproofing, and expanding measures to substations in 500-year floodplain areas. Nature-based adaptation options can be used to reduce flooding risk to vulnerable substations.
- **Improve drainage and pumping capacity:** Measures to add additional drainage channels or increase the capacity of existing drainage structures can reduce flood heights in some cases. Nature-based adaptation options can be particularly effective at improving drainage capabilities.

- **Install or improve pumping capacity:** Sump pumps, which may be activated manually or by float switches that detect water incursion, can be effective in removing smaller amounts of water from substation floors or from underground facilities.
- **Elevate critical equipment:** Elevating transformers, transformer containment walls, control rooms, batteries, battery chargers, and other critical equipment can be an effective strategy for mitigating impacts when water incursion into the substation cannot be prevented. This adaptation measure would need to be balanced against potential seismic risk at each site.
- **Implement waterproofing:** Waterproofing of underground conduits can help minimize equipment damage when inundation cannot be avoided.
- **Relocate vulnerable facilities:** For highly vulnerable substations, total relocation of a substation to higher ground may eliminate vulnerability.

Operational Options

- **Temporary (deployable) flood barriers:** Deployable flood barriers (e.g., sandbags, inflatable “tiger dams”) can reduce flood inundation levels during extreme events. However, these measures may not provide total protection and are effective only if an event can be anticipated and prepared for in advance.

PG&E also may consider whether larger scale adaptation projects in collaboration with state or local entities on mutually beneficial flood mitigation strategies are warranted (see the Ravenswood Substation Case Study Highlight in the Sea Level Rise section below).

Sea Level Rise

PG&E substations face potential increased exposure to flooding, especially during coastal storms as a result of climate-driven changes in sea level. Noting that most, if not all, coastal assets within an inundation event during a 100-year storm also are within a coastal FEMA 100-year flood zone, this section specifically focuses on PG&E’s understanding of risk specific to inundation due to rising sea level. However, given the natural overlap with the flooding and precipitation evaluation, flood exposure on the coast should be considered holistically.

Exposure and Sensitivity

The same sensitivities of substations to coastal inundation exacerbated by SLR described above in the Flooding and Precipitation section apply here. Additional sensitivities to flooding specific to SLR include the following:

- **Corrosion damage:** Saltwater within a substation can cause corrosion damage, which can persist for years after a flood event.

Climate Change Vulnerability

Analytical Metrics

Recognizing the overlap with FEMA floodplains in coastal areas, as described above in the Flooding and Precipitation section, the metric of exposure specifically for SLR is the location of a substation in areas of current and future coastal inundation extent during a 100-year storm event.

Results

As sea level rises, coastal substations and those near tidally influenced waters are likely to be exposed to increased flood exposure over time during coastal storm events, although the numbers remain quite low through 2080 (Table 3.1.1-23). The Bay Area Region has the highest number of coastal substations exposed to coastal inundation, indicating greater vulnerability (Table 3.1.1-23). As sea level rises and Delta inflows increase, driven by climate change, more substations in the Central Valley Region may be at risk of Delta flooding due to levee overtopping. See the Electric Substation Regional Reports section for details on specific geographies.

Table 3.1.1-24. Substation counts exposed to increased flood exposure during coastal storm events by region.

Region	Baseline	2030	2050	2080
Bay Area	2 (0.2%)	4 (0.4%)	6 (0.7%)	15 (1.6%)
Central Valley	2 (0.2%)	6 (0.7%)	8 (0.9%)	14 (1.5%)
Sierra	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
North Coast	2 (0.2%)	2 (0.2%)	3 (0.3%)	7 (0.8%)
Central Coast	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (0.2%)
Total	**6 (0.7%)**	**12 (1.3%)**	**17 (1.9%)**	**38 (4.2%)**

Note: Percentages are relative to total substations within the PG&E service area.

Adaptive Capacity and Climate Change Risk

PG&E's current adaptive capacity for the impacts of coastal flooding is similar to that described above in the Flooding and Precipitation section. The following relates specifically to SLR.

Planning Capacities

- **Existing flood protection measures:** Design guidance to account for SLR is provided for new substations or substations undergoing major work. This guidance is based on projections provided by the 2018 Ocean Protection Council Sea Level Rise Guidance[11] following the medium risk aversion category. Flood protection measures managed by PG&E at substations are implemented on a site-by-site basis, with equipment elevation and yard design considering FEMA 100-year floodplains, including coastal floodplains.

This guidance applies to the design of new substations or for substations underdoing major work, and currently no guidance is provided for all other substations. The adaptive capacity to

[11] California State Lands Commission. March 2018. "State of California Sea Level Rise Guidance: 2018 Update." https://www.opc.ca.gov/webmaster/ftp/pdf/agenda_items/20180314/Item3_Exhibit-A_OPC_SLR_Guidance-rd3.pdf

SLR is therefore considered to be moderate. Further analysis would be needed to understand the impacts of climate change on current adaptive capacities over time.

The overall climate change risk of future flooding to substations due to SLR is considered to be moderate due to the relatively low level of exposure and vulnerability.

Potential Adaptation and Resilience Measures

Many potential adaptation and resilience measures to mitigate impacts of sea level rise will be similar to those described for Flooding and Precipitation. Specifically for sea level rise:

Planning Options

- **Ensure climate-informed siting and design of new construction:** Future siting can avoid structures within coastal floodplains or use forward-looking sea level rise data and hydrologic studies in consideration of siting and design.
- **Apply corrosion-resistant coatings:** Concerns related to occasional saltwater exposure and associated corrosion of coastal components may be mitigated through the application of corrosion-resistant tapes or other coatings to towers at heightened risk of saltwater flooding or spray action.

Operational Options

- **Develop emergency response plans:** PG&E may assess certain highlighted locations to develop operational emergency response plans to the potential sea level rise.

Case Study Highlight: Ravenswood Substation

PG&E had the opportunity to detail the climate change vulnerability of SLR to a PG&E substation through a federal pre-disaster mitigation funding opportunity. PG&E's Ravenswood Substation (Figure 3.1.1-30) is a 230-kV transmission-level substation located on the shore of the San Francisco Bay in the city of Menlo Park. The substation feeds five distribution-level substations, which, in turn, provide electricity for the cities and communities of Menlo Park, Palo Alto, Redwood City, Belmont, East Palo Alto, San Carlos, and Atherton. The Don Edwards National Wildlife Refuge directly abuts the Ravenswood Substation and includes two historic salt ponds—ponds R1 and R2—that are surrounded by a berm that is owned and managed by the U.S. Fish and Wildlife Service (USFWS).

These berms currently protect the salt ponds and Ravenswood Substation from tidal influence. The salt ponds may be restored to tidal influence per the programmatic goals of the South Bay Salt Pond Restoration Project.[12] In February 2020, the outermost levee around pond R1 suffered damage from a high tide/high wind event. USFWS made repairs to the levee and informed PG&E that repairs are expected to last the next 3–5 years, making the substation vulnerable to both near- and long-term tidal inundation.

---

[12] South Bay Salt Pond Restoration Project. https://www.southbayrestoration.org/page/restoration-project

3.1.1.a Electric Substation

Figure 3.1.1-30. Case Study Highlight: Ravenswood Substation.

In fall 2020, PG&E partnered with the city of Menlo Park, the San Francisquito Creek Joint Powers Authority, and Meta to apply for a FEMA Building Resilient Infrastructure and Communities (BRIC) grant, which is a pre-disaster mitigation program administered by FEMA. The project was funded and, when constructed, will protect the Ravenswood Substation, as well as 9 miles of neighboring shoreline. The project will not only mitigate flood damage to the substation and the resulting risk of power loss to communities but will also provide flood protection to surrounding communities and allow for habitat restoration of more than 550 acres of former salt ponds.

The application for the FEMA BRIC grant afforded PG&E a unique opportunity to analyze the sensitivity of a transmission substation to coastal flooding and detail the impacts of such flooding to the substation components, PG&E operations, and impacts on customers. The FEMA application required an extensive FEMA-directed benefit-cost analysis (BCA) to demonstrate the benefit of providing flood protection up to 2050. The BCA had two main components: (1) the expected amount of inundation at the substation under different flooding scenarios in current and future SLR projections, and (2) the expected impacts on the substation, resulting loss of power, and number of customers affected. PG&E conducted research and interviews with experts at Ravenswood Substation to assess how flooding would damage equipment, estimate the time to repair and reenergize the substation, and quantify the impact on customers.

The following flood events were modeled for the BCA analysis: 10-, 25-, 50-, and 100-year recurrence intervals in existing conditions and at 3.5 feet of SLR, which approximates the expected SLR in 2050 for the San Francisco Bay. Expected flooding at the substation in these flood scenarios ranged from 1 to 2 feet of flood inundation on the substation yard.

Key Results and Takeaways

De-energization of the Ravenswood Substation would be required during a flooding event that triggers the SPCC rule at the substation, which would occur at about 1 ft of flooding. This amount of flooding would overwhelm the retention barriers (Figure 3.1.1- 31) and the substation would be de-energized to prevent possible oil spills from leaving the substation and entering nearby waterways.

Figure 3.1.1- 31. Ravenswood Substation spill retention pond (left) and oil-filled circuit breakers (right).

The batteries and battery chargers that are essential to substation function are vulnerable and highly sensitive to flooding due to their location on the substation floor. A flood event greater than 1 foot would likely enter the battery room, which is located on the ground level of the substation and contains the DC batteries and battery chargers (Figure 3.1.1-32). Two feet or

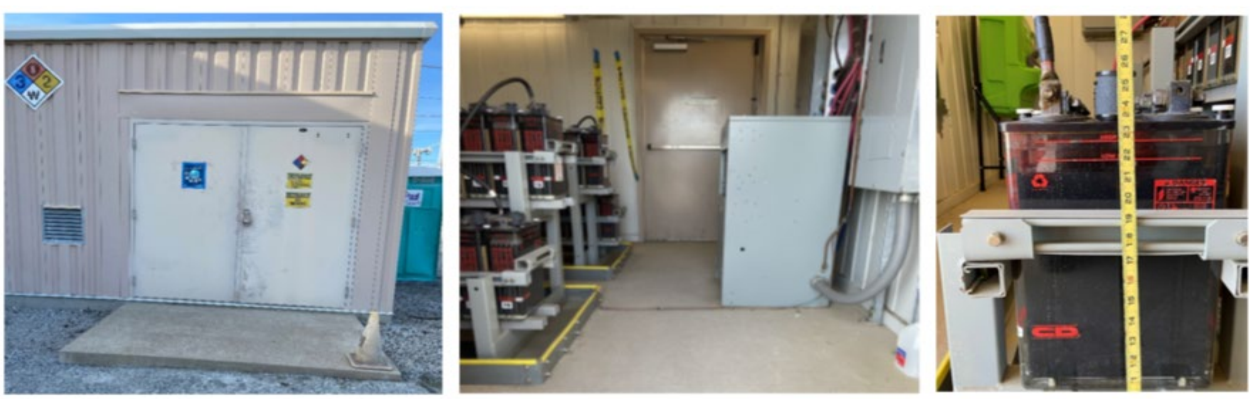


Figure 3.1.1-32. (left) Battery room in the Ravenswood Substation; (middle) inside the battery room with the battery charger on the right, ground level, and DC batteries on the left; and (right) batteries showing the height from ground level inside the battery room. The vent is the tall round cylinder behind the measuring tape.

more of flooding would destroy the main DC battery system because the height of the batteries from the floor is 23.5 inches. With flooding above 23.5 inches, water would enter the batteries through the sponge vent. These batteries direct power to critical equipment and are essential for the substation to function.

If flooding destroyed the battery charger or both the battery charger and the DC batteries, PG&E would procure an emergency battery trailer that could provide temporary power to the DC battery system. PG&E has three emergency battery trailers in the San Francisco Bay area, and it would take approximately 1 day to assess any damage to the battery charger, order an emergency trailer, and secure the trailer in the substation. Once the emergency battery trailer is installed and tested, the substation could be reenergized.

Cleanup will be required. Access may be impaired, which would delay repair and reenergization of the substation. A major flood is expected to damage equipment due to water inundation and bring mud and debris onto the site. Additionally, nearby roads may be damaged, which could delay the delivery of the battery trailer or the availability of personnel to support cleanup and restoration efforts.

If the substation were de-energized due to a flood event, an estimated 300,000 customers would lose power for approximately 4–10 days. The total loss of service time depends on the length of the flood event, the time required for water to drain out of the substation area, and the repair and cleanup time.

Estimates of damage, repair time, and customer impact are likely conservative. Estimating the repair time and customer impacts is difficult and subject to uncertainty. The number of days for repair depends on the condition of nearby roads and the personnel available to return the substation to normal operating conditions. During an extreme storm event, PG&E's system is likely to experience multiple instances of damaged equipment beyond the Ravenswood Substation. The repair time assumes that enough engineers are available to work on repairing the station and that flooding damage to nearby roads (such as Highway 84) does not prevent access to the substation. While a large storm may reduce the availability of personnel who can conduct repairs at the Ravenswood Substation, work would be prioritized at the Ravenswood Substation given its criticality to the system.

Wildfire

The focus of this CAVA is to understand the vulnerability of assets to wildfires rather than hardening the system to reduce the risk of wildfire ignitions from PG&E equipment.

Exposure and Sensitivity

Given their single-point locations, substations have generally lower exposure and sensitivity to wildfires as point locations can much more easily be protected and controlled than large spans of power lines. Substation equipment and infrastructure are fire-resistant and set apart from potentially flammable landscape elements. However, substations can still be subject to site damage from externally caused wildfires. Substations are included in PG&E's WMP mitigation efforts focused on reducing wildfire risk caused by ignition from a substation.

Climate Change Vulnerability

Analytical Metrics

Areas in PG&E's service area that are located in HFRAs are projected to be at highest risk for wildfires. Substations in HFRAs are exposed to wildfire risk and may see the greatest increased risk in the future. Substations in close proximity to vegetation may be more likely to be exposed to wildfire, although PG&E initiated a robust Defensible Space Program in 2019 (described below in the Adaptive Capacity and Climate Change Risk section). The key metric for projected future exposure to wildfires is location within HFRAs.

Results

Just over 20 percent of PG&E substations are located in HFRAs (Table 3.1.1- 24), with the Central Valley, Sierra, and North Coast Regions having the largest number. See Electric Substation Regional Reports section for more details.

Table 3.1.1- 25. Substations by region within HFRAs.

Region	Substations Within HFRAs
Bay Area	13 (1.42%)
Central Valley	40 (4.37%)
Sierra	81 (8.85%)
North Coast	38 (4.15%)
Central Coast	19 (2.07%)
Total	**191 (20.87%)**

Note: Percentages are relative to total substations within the PG&E service area.

Adaptive Capacity and Climate Change Risk

PG&E aims to ensure customer safety and reduce the wildfire risk associated with its equipment. The Company is implementing a multifaceted strategy to reduce wildfire risk in the immediate term and is developing a parallel strategy for minimizing wildfire risk in the long term.

While a full accounting of this strategy is beyond the scope of this CAVA, PG&E's wildfire mitigation strategy is described in PG&E's most recent WMP.[13] Core elements of this strategy that relate most closely with reducing the damage from wildfires to substations include the following:

- **Defensible space and nonflammable construction materials**. Defensible space is a crucial strategy for wildfire prevention and management that serves as a proactive

[13] PG&E. "2023–2025 Wildfire Mitigation Plan." pge.com/assets/pge/docs/outages-and-safety/outage-preparedness-and-support/2023-wildfire-mitigation-plan.pdf

measure to safeguard both properties and the surrounding environment. It acts as a buffer against inbound fire by reducing the fuel available to the approaching flames. Simultaneously, it curtails the risk of outbound fires by preventing ember spread and reducing the risk of spot fires that can ignite structures further downwind. Historically, PG&E's vegetation management activities included vegetation removal within the substation fence and the surrounding perimeter without defined parameters based on fuel consideration. In 2019, PG&E established the Defensible Space Program at each site to remove flammable fuels or vegetation, aligned with the California Public Resource Code (CPRC) Section 4291 guidelines, which define parameters of 100 feet surrounding equipment or structures to include a 30-foot Clean Zone and 70-foot Reduced Fuel Zone. New (permanent) wood pole installations are not permitted within substations.
- **Additional protective measures**, such as less flammable insulating fluids or enclosed (rather than open-air) switchgear.

In addition, beginning in 2019, PG&E began performing supplemental inspections of substations in HFRAs to minimize the risk of wildfire ignitions. These inspections include ground-based visual, drone-based aerial, and infrared inspections to identify risks for mitigation.

Additionally, the WMP requires extensive protections at all substations against fires generated in the substation.

PG&E's WMPs are robust, and the adaptive capacity of utility-caused ignitions is considered to be high. Many of the utility-caused wildfire risk reduction strategies described in PG&E's WMP are likely to also reduce equipment damage during a wildfire regardless of the cause. As described above, protections are in place against ignitions caused by substations and many of these processes also will help prevent damage from exogenous wildfires; adaptive capacity to damage from wildfires to substations is also considered to be high. The risk of wildfires from any source in PG&E's service area is expected to increase due to climate change, and exogenous factors, such as lightning and human activity, and historical forest management practices are beyond PG&E's control. The climate change risk of damage from wildfires to substations is considered to be **moderate**.

Potential Adaptation and Resilience Measures

PG&E's WMP presents PG&E's current wildfire mitigation strategy. Given that future wildfire potential in HFRAs will likely intensify, the plans described in the WMP largely represent the measures that PG&E should consider for reducing ignition risk in the face of long-term climate change. The WMP is focused primarily on ignition risk and the reduction of Public Safety Power Shutoffs (PSPS) rather than the risk of wildfire damage to PG&E assets. Long-term adaptation planning can seek to understand what additional measures may be needed to reduce the risk of wildfire damage to equipment. For example, PG&E will continue to evaluate and implement appropriate mitigation activities to reduce wildfire risk at substations, such as PG&E's Defensible Space Program. Areas where 100 percent defensible space cannot be achieved are typically due to customer refusal and/or landscape limitations. Otherwise, achieving 100 percent defensible space means full completion according to the guidelines provided in CPRC Section 4291 (Defensible Space).

Drought-Driven Subsidence

Some substations in the Central Valley Region are located in areas of historical subsidence associated with groundwater withdrawals. However, this subsidence is unlikely to cause major impacts on substation equipment in the future due to substations' constrained physical footprints. The climate change risk to substations in PG&E's service area is considered to be **low** and the climate hazard is **off-ramped**.

Electric Substation Regional Reports

Bay Area Region

Summary

PG&E has 176 electric substations in the Bay Area Region (Table 3.1.1-33).

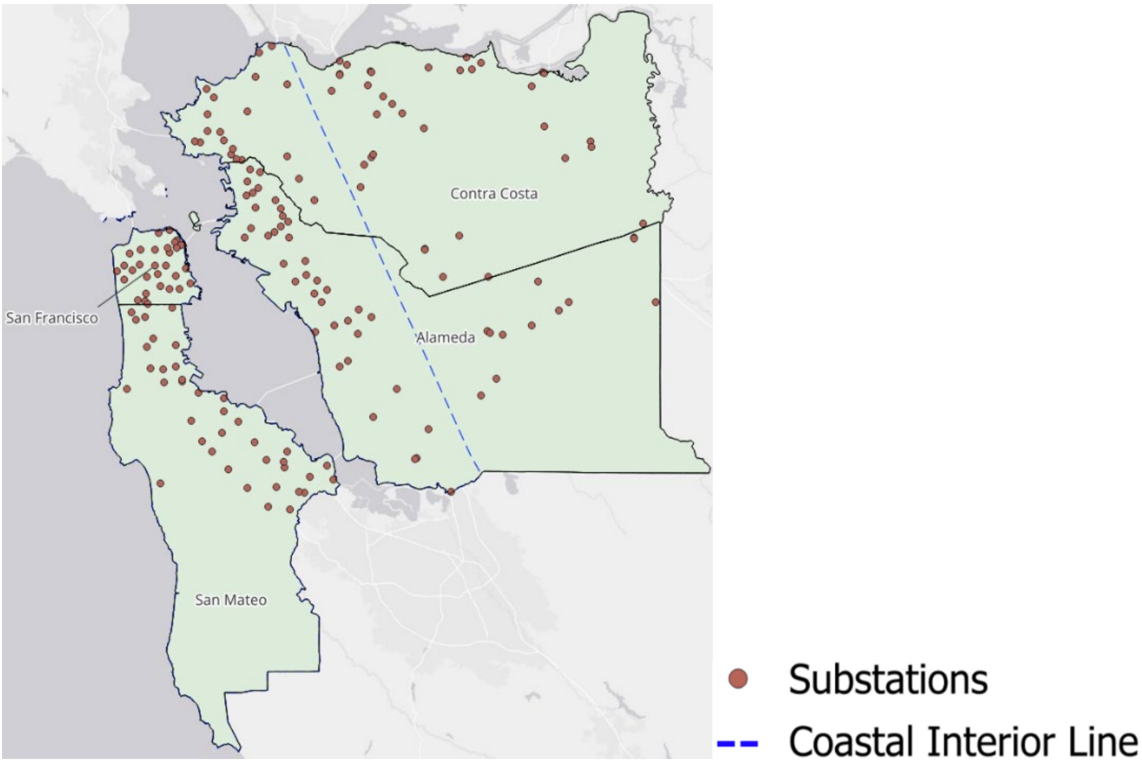


Figure 3.1.1- 33. PG&E substations in the Bay Area Region.

Climate Hazard: Temperature

In the Bay Area Region, the number of substations exposed to temperatures that exceed design assumptions (from the summer months of April–October) will increase in the coming decades (Table 3.1.1-25).

Table 3.1.1-26. Bay Area Region Substation count over time in the coastal, legacy interior, and updated interior zones, over time for 1-in-2-year and 1-in-10-year heat events.

Heat Event	Baseline			2030			2050			2080		
	Coastal	Legacy Interior	Updated Interior	Coastal	Legacy Interior	Updated Interior	Coastal	Legacy Interior	Updated Interior	Coastal	Legacy Interior	Updated Interior
1-in-2-year	2 (0.22 %)	0	0	29 (3.17 %)	8 (0.87 %)	0	62 (6.78 %)	33 (3.61 %)	0	95 (10.38%)	45 (4.92 %)	0
1-in-10-year	37 (4.04 %)	0	0	109 (11.91%)	40 (4.37 %)	0	120 (13.11%)	46 (5.03 %)	0	129 (14.10%)	47 (5.14 %)	25 (2.73 %)

Notes:

- *Assumed maximum temperature for coastal zone is 99°F for the months of April–October*
- *Assumed maximum temperature for legacy interior zone is 109°F for the months of April–October*
- *Assumed maximum temperature for updated interior zone is 118°F for the months of April–October*
- *Percentages are relative to total substations within the PG&E service area.*

Air conditioning may be a key driver of heat-related load increases. In the Bay Area Region, in particular, the growth in air conditioning use is an important variable given that the proportion of households with air conditioning has been historically low and is likely to rise over time.

Climate Hazard: Flooding and Precipitation

Fifteen PG&E substations in the Bay Area Region are within the FEMA 100-year floodplain and 24 are within the FEMA 500-year floodplain (Table 3.1.1-34). Many of these substations are within coastal and tidally influenced floodplains, such as around the San Francisco Bay or upstream from major waterways (Table 3.1.1-34).

3.1.1.a Electric Substation

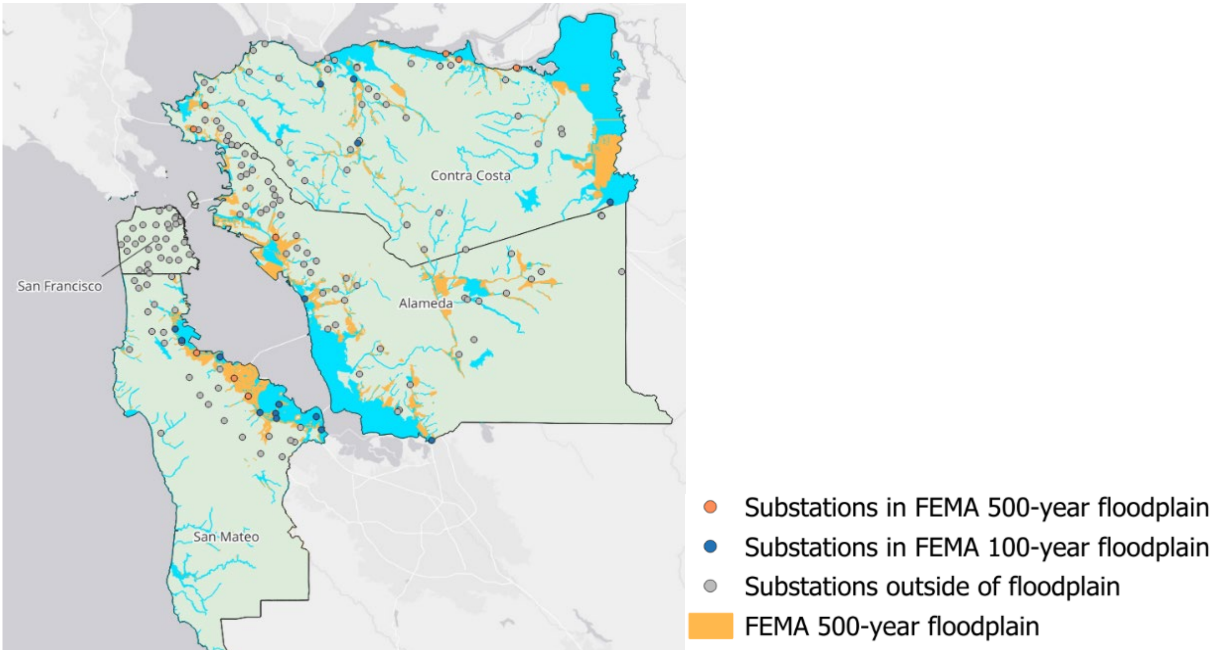


Figure 3.1.1- 34. Substations in the Bay Area Region located in FEMA 100-year and 500-year floodplains.

Substations in the Bay Area Region that are within high landslide risk areas are mostly concentrated in Contra Costa County, and small portions of this area may see increasing amounts of high precipitation in the future (Figure 3.1.1- 35).

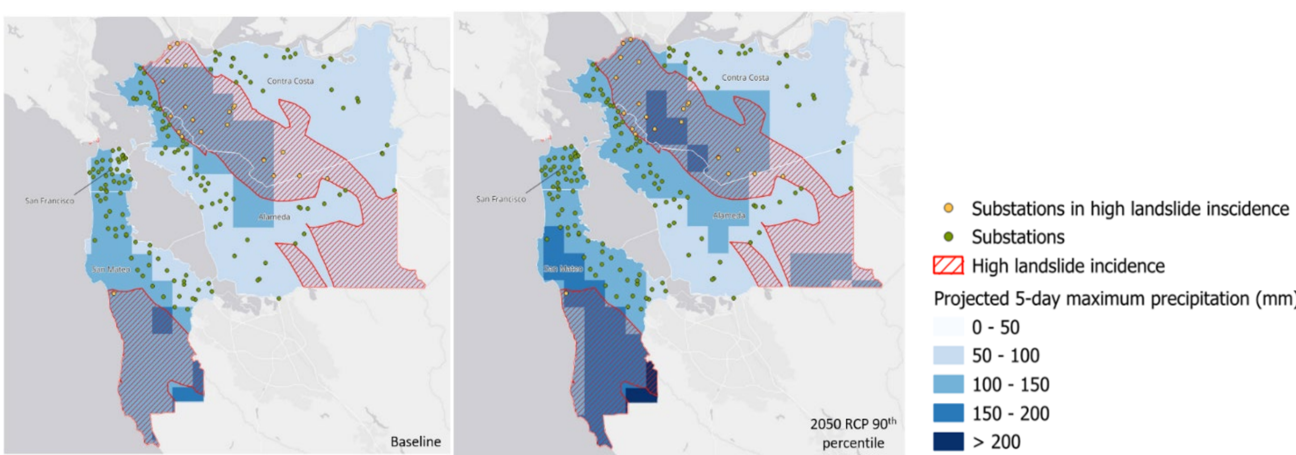


Figure 3.1.1- 35. Substations in the Bay Area Region located in high landslide risk areas. Projected 5-day maximum precipitation (in millimeters) by 2050, compared with the baseline overlayed.

3.1.1.a Electric Substation

Climate Hazard: Sea Level Rise

The number of PG&E substations potentially inundated by a 100-year coastal storm is projected to increase from two (0 m SLR) to four by 2030 (0.25 m SLR), to four by 2050 (0.5 m SLR) and to 12 by 2080 (1.25 m SLR) (Figure 3.1.1- 36,). Most of these substations are along the San Francisco Bay shoreline, especially concentrated in San Mateo County (Figure 3.1.1- 36).

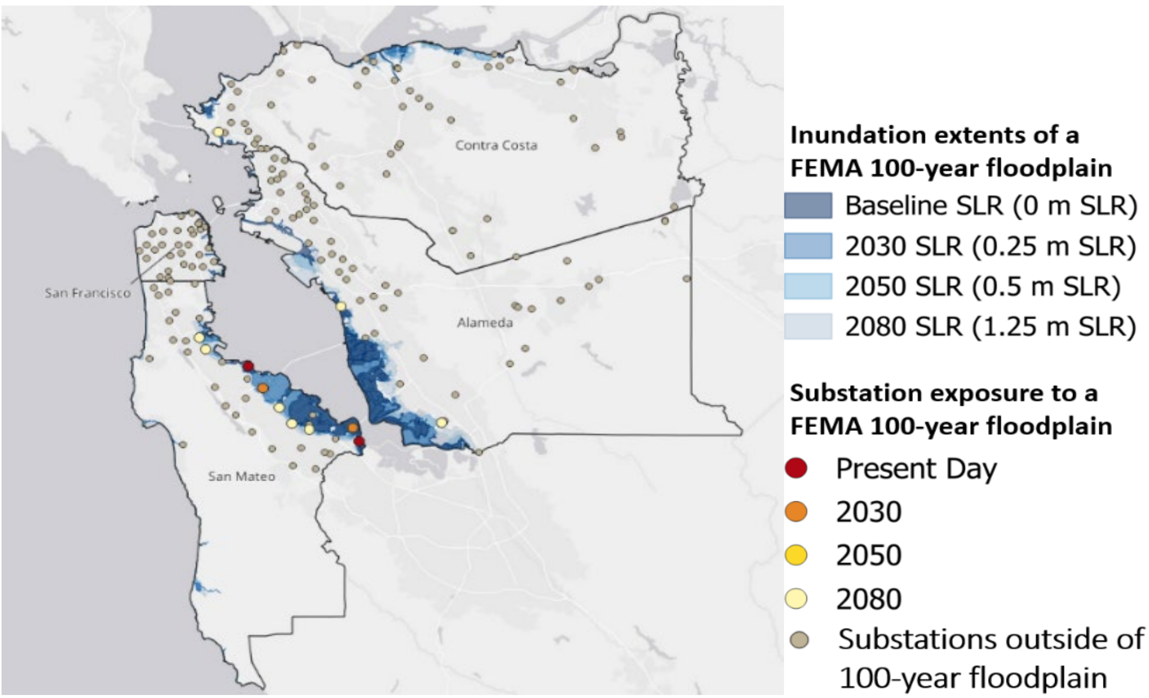


Figure 3.1.1- 36. Bay Area Region substation inundation during a 100-year storm event under potential 2030, 2050, and 2080 SLR extents.

The San Francisco Bay area is undergoing focused regional, county, and other municipal and community-led SLR adaptation planning. Many of PG&E's substations are behind flood protection that is not owned or managed by PG&E. Further site-specific analysis on flood risk and exogenous current and planned shoreline flood protection will be required to fully assess the climate change risk to substations.

3.1.1.a Electric Substation

Climate Hazard: Wildfire

There are 12 substations in HFRAs; most are in Contra Costa County (Figure 3.1.1- 37).

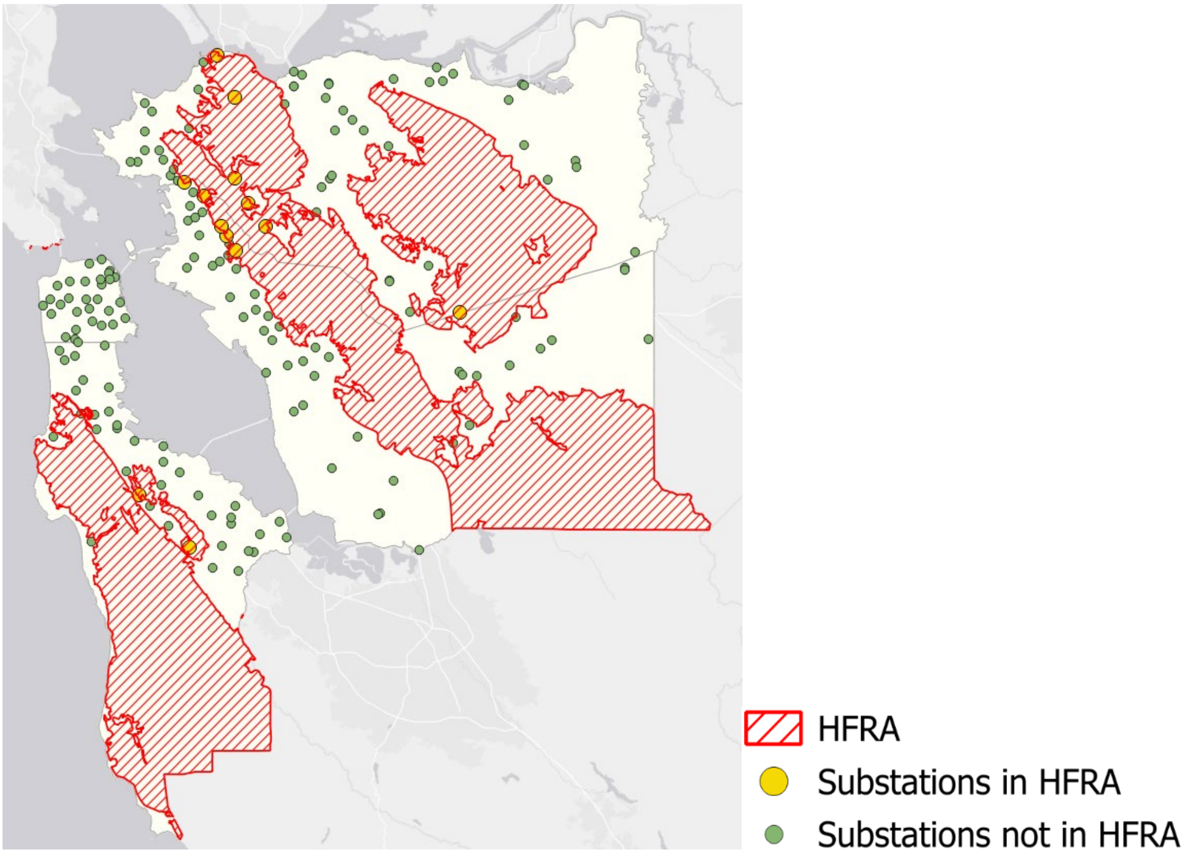


Figure 3.1.1- 37. Substations in the Bay Area Region located in HFRAs.

Climate Hazard: Drought-Driven Subsidence

Drought-driven subsidence is not considered to be a current or future climate change issue for substations.

Central Valley Region

Summary

PG&E has 291 electric substations throughout the Central Valley Region (Figure 3.1.1- 38).

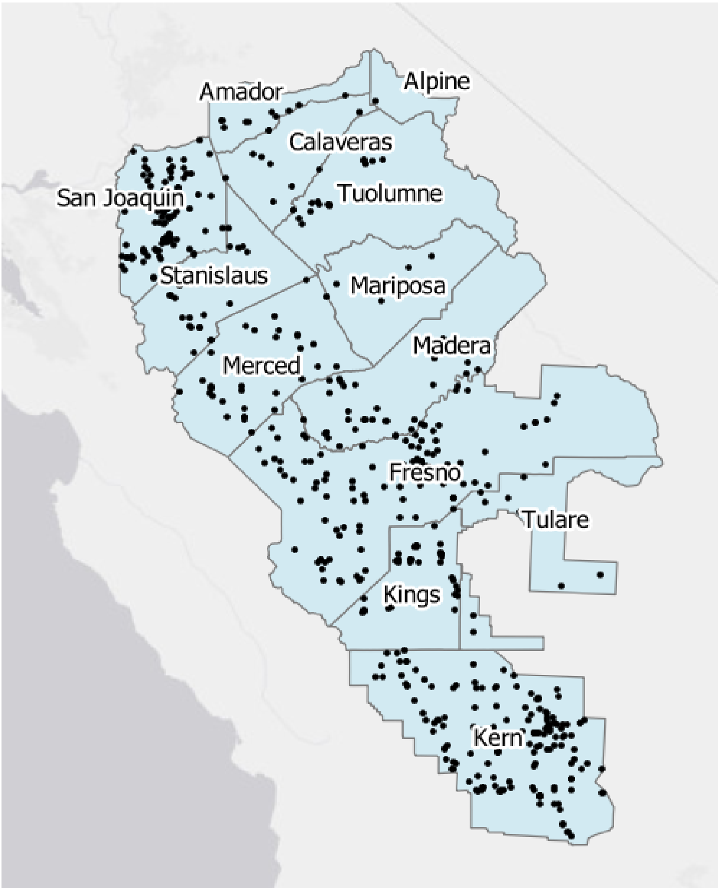


Figure 3.1.1- 38. PG&E substations in the Central Valley Region.

Climate Hazard: Temperature

In the Central Valley Region, the number of substations exposed to temperatures that exceed design assumptions (for the summer months of April–October) will increase in the coming decades (Table 3.1.1-26).

Table 3.1.1-27. Table 3.1.1-28. Central Valley Region substation count over time in the coastal, legacy interior, and updated interior zones, over time for 1-in-2-year and 1-in-10-year heat events. Note that there is no coastal zone designated area in the Central Valley Region.

Heat Event	Baseline			2030			2050			2080		
	Coastal	Legacy Interior	Updated Interior	Coastal	Legacy Interior	Updated Interior	Coastal	Legacy Interior	Updated Interior	Coastal	Legacy Interior	Updated Interior
1-in-2-year	N/A	0	0	N/A	234 (25.57%)	0	N/A	266 (29.07%)	0	N/A	280 (30.60%)	47 (5.14%)
1-in-10-year	N/A	82 (8.96%)	0	N/A	273 (29.84%)	0	N/A	279 (30.49%)	52 (5.68%)	N/A	284 (31.04%)	257 (28.09%)

Notes:

- *Assumed maximum temperature for coastal zone is 99°F for the months of April–October*
- *Assumed maximum temperature for legacy interior zone is 109°F for the months of April–October*
- *Assumed maximum temperature for updated interior zone is 118°F for the months of April–October*
- *Percentages are relative to total substations within the PG&E service area.*

For the 1-in-10-year heat event, the number of substations exposed to temperatures above both design assumptions is greater than that for a 1-in-2-year event. By 2050, some substations in the updated interior zone are exposed to temperatures above the updated design assumption (118°F) in a 1-in-10-year heat event; this number increases substantially by 2080. These results indicate that substations using legacy design assumptions become increasingly vulnerable to high heat events over time, especially in a 1-in-10-year heat event, although the number of affected substations is lower when assuming updated interior standards. The updated standard will thus likely moderate the risk to these substations from future high heat events.

Climate Hazard: Flooding and Precipitation

Sixty-one substations in the Central Valley Region are within the FEMA 100-year floodplain and 98 are within the FEMA 500-year floodplain (Figure 3.1.1- 39). As a result of projected increases in extreme precipitation, substations in floodplains may be exposed to more frequent flooding in the future.

3.1.1.a Electric Substation

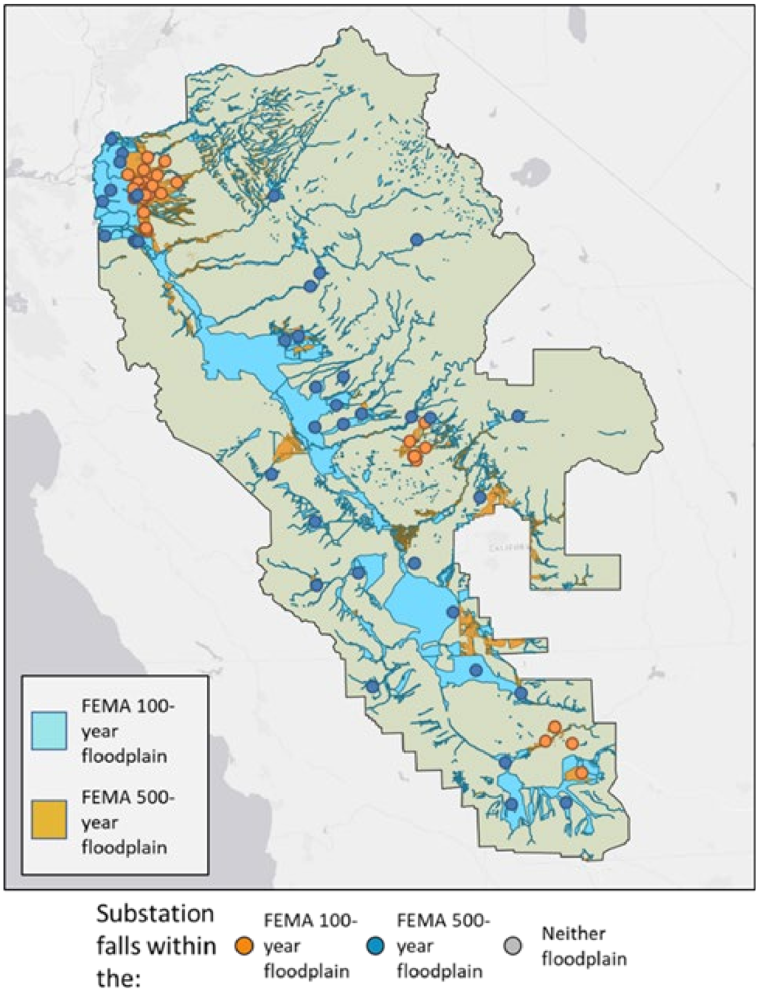


Figure 3.1.1- 39. Exposure of Central Valley Region PG&E substations to FEMA 100-year and 500-year floodplains.

In the Central Valley Region, heavy rain events are projected to see the highest increases in 2050 in the mountainous regions of the southern Sierra Mountains, compared with the Central Valley Region where much of the region is within designated floodplains and where more of the substations are located (Figure 3.1.1- 39). Few substations are located in areas of high landslide risk (Figure 3.1.1- 40). This analysis does not include increases in flooding related to snowmelt from the Sierra Mountains, which is likely a source of future vulnerability. For example, in spring 2023, three substations were threatened in the Tulare Lake area due to heavy snowmelt leading to flooding.

3.1.1.a Electric Substation

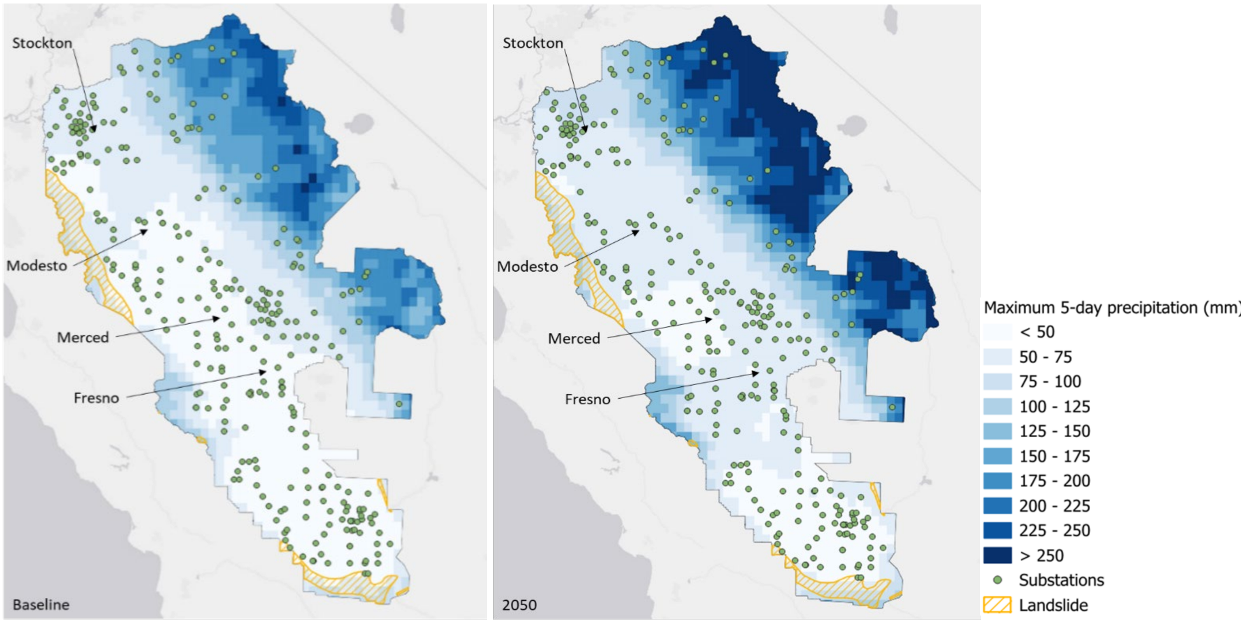


Figure 3.1.1- 40. Substations in the Central Valley Region located in high landslide risk areas. Projected 5-day maximum precipitation (in millimeters) by 2050, compared with the baseline overlayed.

Climate Hazard: Sea Level Rise

The number of substations is projected to increase from three under present-day conditions to nine by 2030, to 10 by 2050, and to 17 by 2080 (Figure 3.1.1- 41).

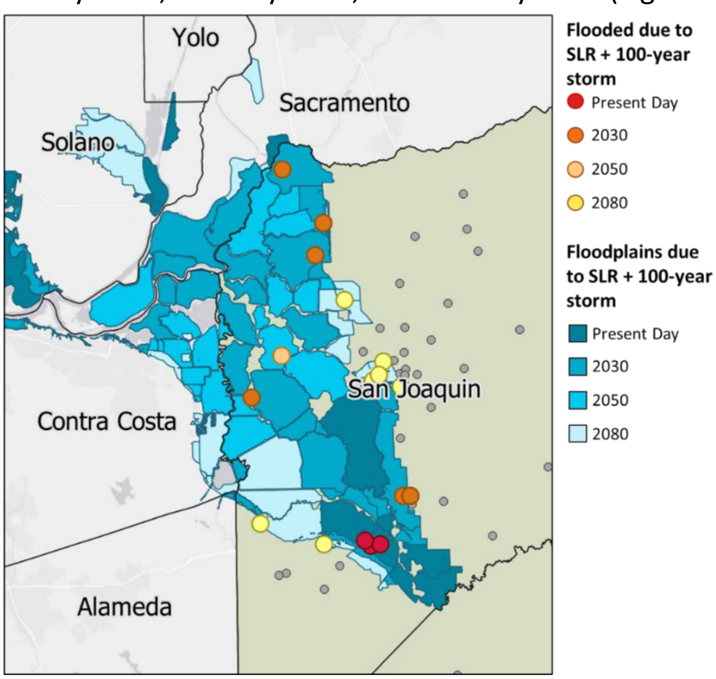


Figure 3.1.1- 41. Central Valley Region substations currently or projected to be in Delta flooding exposure zones in historical, 2030, 2050, and 2080 periods.

3.1.1.a Electric Substation

In addition to levee overtopping, the breach of levees along the Delta presents an exposure threat that may be exacerbated by climate change, although this risk is more difficult to model.

Climate Hazard: Wildfire

Thirty-nine substations are located within HFRAs, which are concentrated in the mountainous portions of the Central Valley Region (Figure 3.1.1- 42).

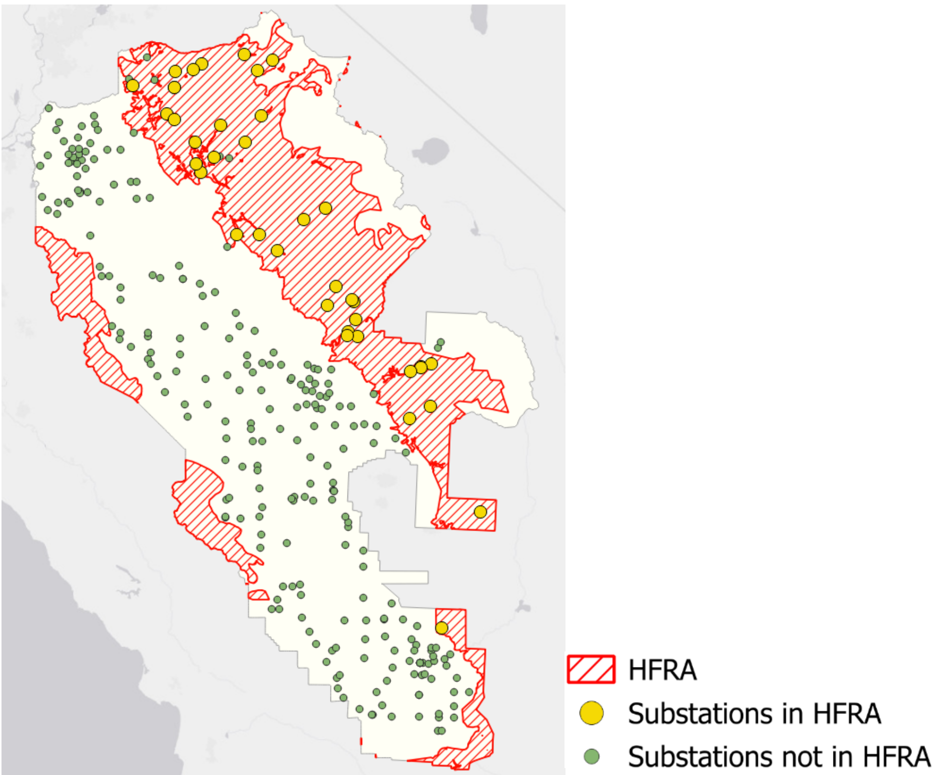


Figure 3.1.1- 42. Locations of Central Valley Region substations in HFRAs.

Climate Hazard: Drought-Driven Subsidence

PG&E has many substations in the Central Valley Region that are located in areas of high historical subsidence associated with groundwater withdrawals; this trend is likely to continue into the future as climate change stresses water availability. However, this subsidence is unlikely to cause major impacts on substation equipment due to substations' constrained physical footprints. To date, no impacts from subsidence to PG&E substations have been recorded. Drought-driven subsidence is not considered to be a climate change issue for substations at this time.

3.1.1.a Electric Substation

Sierra Region

Summary

PG&E has 209 electric substations throughout the Sierra Region (Figure 3.1.1- 43).

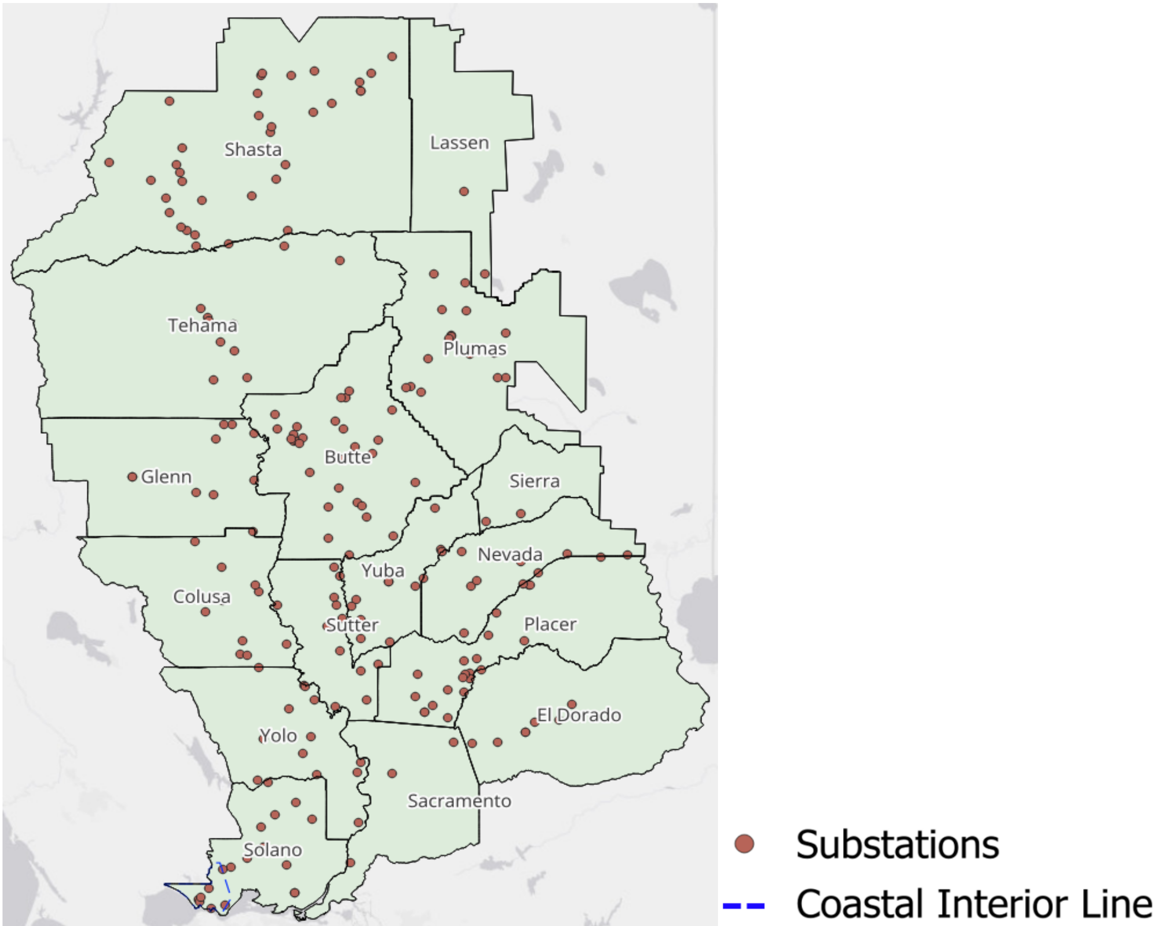


Figure 3.1.1- 43. PG&E substations in the Sierra Region.

Climate Hazard: Temperature

In the Sierra Region, the number of substations exposed to temperatures that exceed design assumptions (for the summer months of April–October) will increase in the coming decades (Table 3.1.1-27).

Table 3.1.1-29. Sierra Region substation count over time in the coastal, legacy interior, and updated interior zones, over time for 1-in-2-year and 1-in-10-year heat events.

Heat Event	Baseline			2030			2050			2080		
	Coastal	Legacy Interior	Updated Interior	Coastal	Legacy Interior	Updated Interior	Coastal	Legacy Interior	Updated Interior	Coastal	Legacy Interior	Updated Interior
1-in-2-year	5 (0.55%)	13 (1.42%)	0	6 (0.66%)	121 (13.22%)	0	6 (0.66%)	149 (16.28%)	0	6 (0.66%)	181 (19.78%)	44 (4.81%)
1-in-10-year	6 (0.66%)	84 (9.18%)	0	6 (0.66%)	167 (18.25%)	20 (2.19%)	6 (0.66%)	187 (20.44%)	56 (6.12%)	6 (0.66%)	199 (21.75%)	154 (16.83%)

Notes:

- *Assumed maximum temperature for coastal zone is 99°F for the months of April–October*
- *Assumed maximum temperature for legacy interior zone is 109°F for the months of April–October*
- *Assumed maximum temperature for updated interior zone is 118°F for the months of April–October*
- *Percentages are relative to total substations within the PG&E service area.*

By 2030, the number of substations exposed to temperatures above the legacy interior assumptions increases substantially in both a 1-in-2-year and 1-in-10-year heat wave. These numbers remain relatively lower under the updated design standard, indicating that the updated standard likely will moderate the risk to these substations from future high heat events. The number of affected substations is higher for a 1-in-10-year heat wave compared with a 1-in-2-year heat wave, indicating that substations in this region may be more vulnerable to higher temperatures in the future.

Climate Hazard: Flooding and Precipitation

Twenty-eight substations in the Sierra Region are within the FEMA 100-year floodplain and 48 are within the FEMA 500-year floodplain (Figure 3.1.1- 44).

3.1.1.a Electric Substation

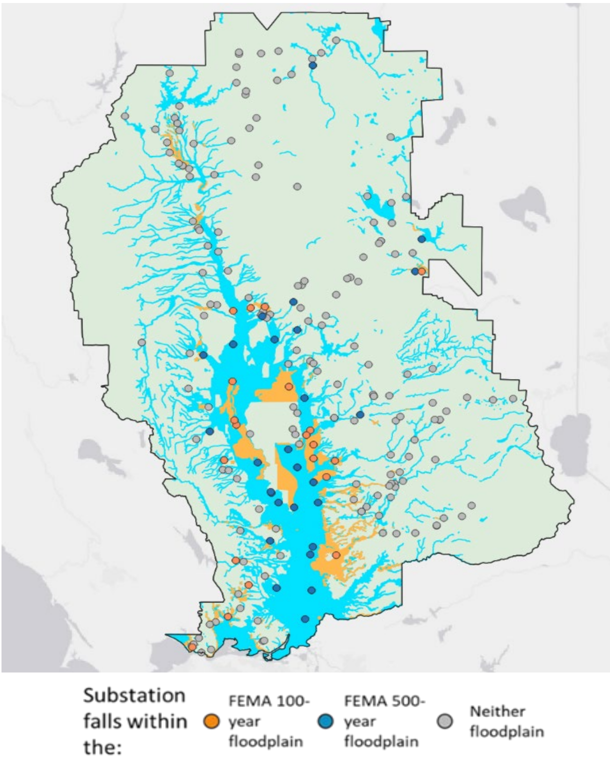


Figure 3.1.1- 44. Locations of Sierra Region substations in FEMA 100-year and 500-year

High precipitation events are projected to increase by 2050 for much of the Sierra Region and for many substation locations; however, few substations are within high landslide risk areas (Figure 3.1.1- 45). This analysis does not include the increase in flooding related to snowmelt from the Sierra Mountains, which is likely a source of future vulnerability.

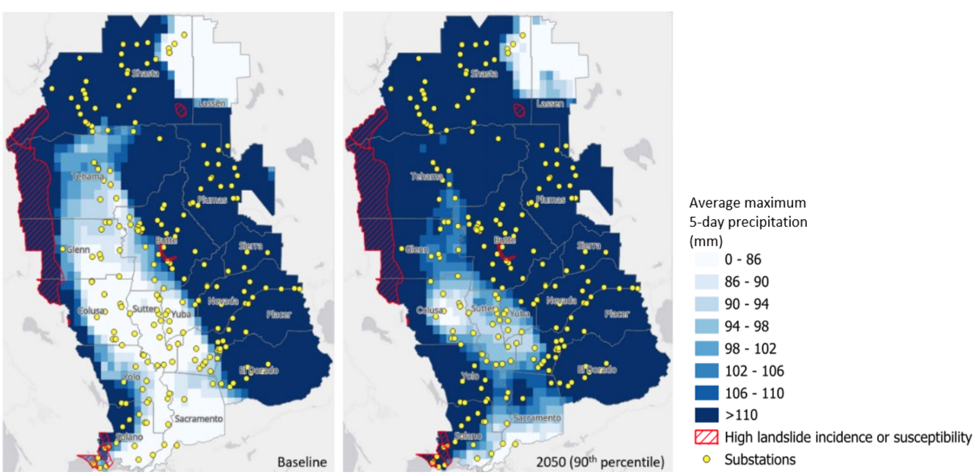


Figure 3.1.1- 45. Substations in the Sierra Region located in high landslide risk areas. Projected 5-day maximum precipitation (in millimeters) by 2050, compared with the baseline overlayed.

3.1.1.a Electric Substation

Climate Hazard: Sea Level Rise

No substations in the coastal area of the Sierra Region are located in current or projected (through 2080) Delta flooding exposure zones due to SLR.

Climate Hazard: Wildfire

There are 80 substations within HFRAs (Figure 3.1.1- 46).

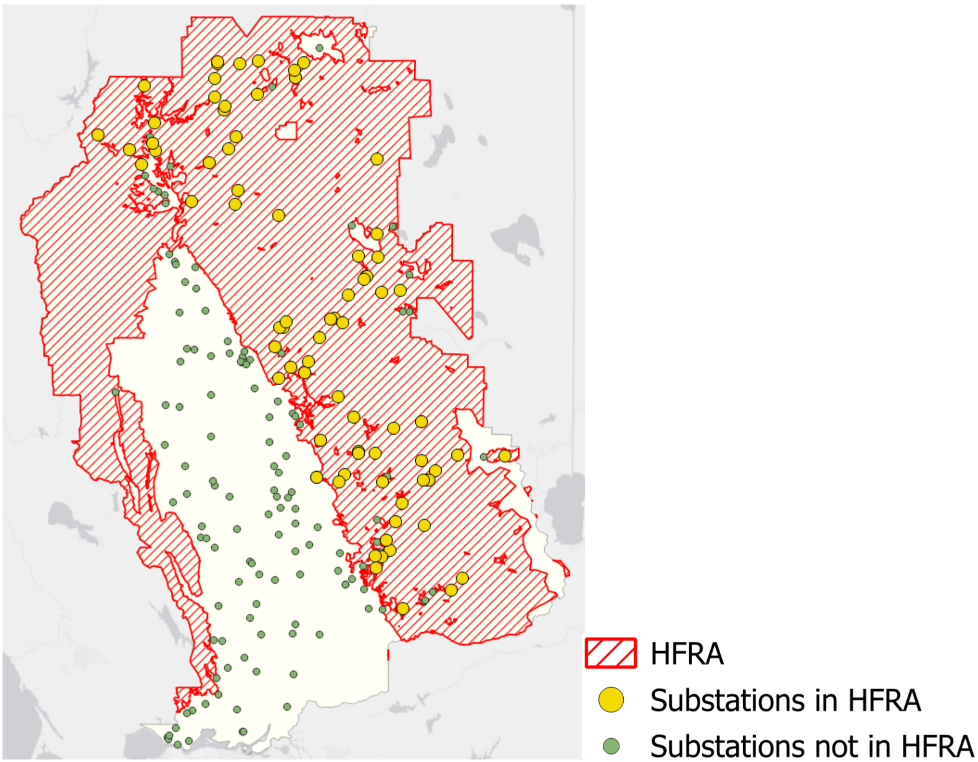


Figure 3.1.1- 46. Locations of Central Valley Region substations in HFRAs.

Climate Hazard: Drought-Driven Subsidence

PG&E has five substations in the Sierra Region in an area of historical subsidence associated with groundwater withdrawals. These substations are located within the Sacramento Valley in the towns of Woodland and Davis. However, this subsidence is unlikely to cause major impacts on substation equipment due to substations' constrained physical footprints. Drought-driven subsidence is not considered to be a climate change issue for substations at this time.

North Coast Region

Summary

PG&E has 104 electric substations throughout the North Coast Region (Figure 3.1.1- 47).

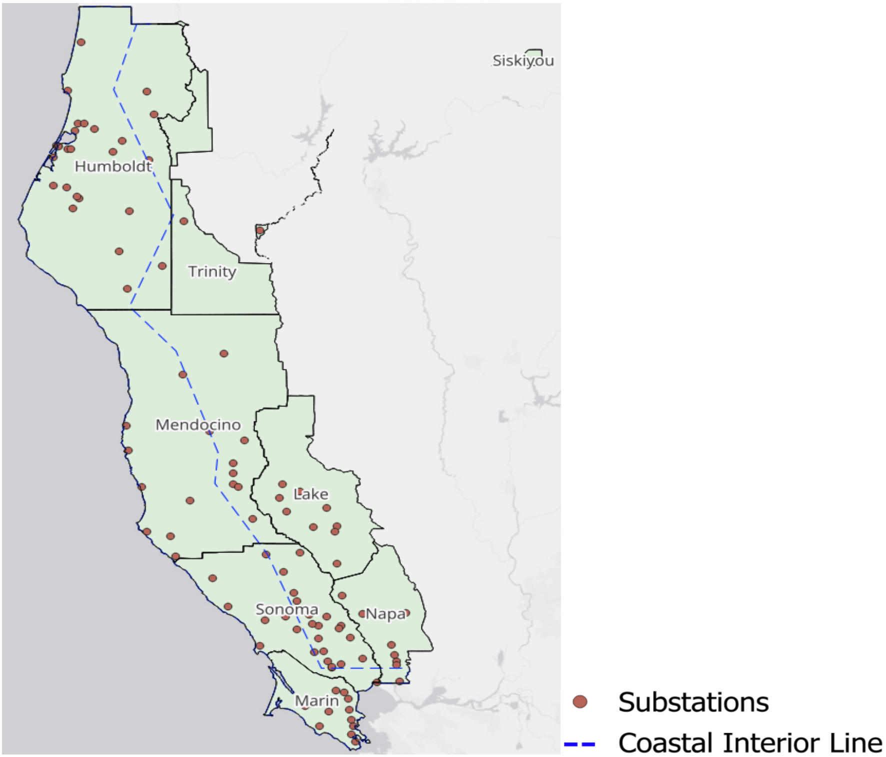


Figure 3.1.1- 47. North Coast Region substations in the interior zone (light green) and coastal zone (dark green). Line separating the interior and coastal zones is shown in blue.

Climate Hazard: Temperature

In the North Coast Region, the number of substations exposed to temperatures that exceed design assumptions (for the summer months of April–October) in both coastal and interior areas (Figure 3.1.1- 47) will increase in the coming decades (Table 3.1.1-28).

Substations in both coastal and interior zones will be exposed to temperatures exceeding assumed temperature thresholds over the coming decades. However, no interior substations would be exposed to temperatures that exceed the updated temperature design standard during a 1-in-2-year heat wave (Table 3.1.1-28). The design standard update will thus likely moderate the risk to these substations from future high heat events. Some substations will be exposed to temperatures that exceed the updated temperature assumptions under a 1-in-10-year heat wave (Table 3.1.1-28), indicating that substations in this region may be more vulnerable to higher temperatures in the future.

3.1.1.a Electric Substation

Table 3.1.1-30. North Coast Region substation count over time in the coastal, legacy interior, and updated interior zones, over time for 1-in-2-year and 1-in-10-year heat events..

Heat Event	Baseline			2030			2050			2080		
	Coastal	Legacy Interior	Updated Interior	Coastal	Legacy Interior	Updated Interior	Coastal	Legacy Interior	Updated Interior	Coastal	Legacy Interior	Updated Interior
1-in-2-year	7 (0.77%)	0	0	20 (2.19%)	3 (0.33%)	0	22 (2.40%)	19 (2.08%)	0	29 (3.17%)	45 (4.92%)	0
1-in-10-year	28 (3.06%)	4 (0.44%)	0	31 (3.39%)	47 (5.14%)	0	31 (3.39%)	49 (5.36%)	1 (0.11%)	36 (3.93%)	52 (5.68%)	25 (2.73%)

Notes:

- *Assumed maximum temperature for coastal zone is 99°F for the months of April–October*
- *Assumed maximum temperature for legacy interior zone is 109°F for the months of April–October*
- *Assumed maximum temperature for updated interior zone is 118°F for the months of April–October*
- *Percentages are relative to total substations within the PG&E service area.*

Climate Hazard: Flooding and Precipitation

Fourteen substations in the North Coast Region are within the FEMA 100-year floodplain and 17 are within the FEMA 500-year floodplain (Figure 3.1.1- 48).

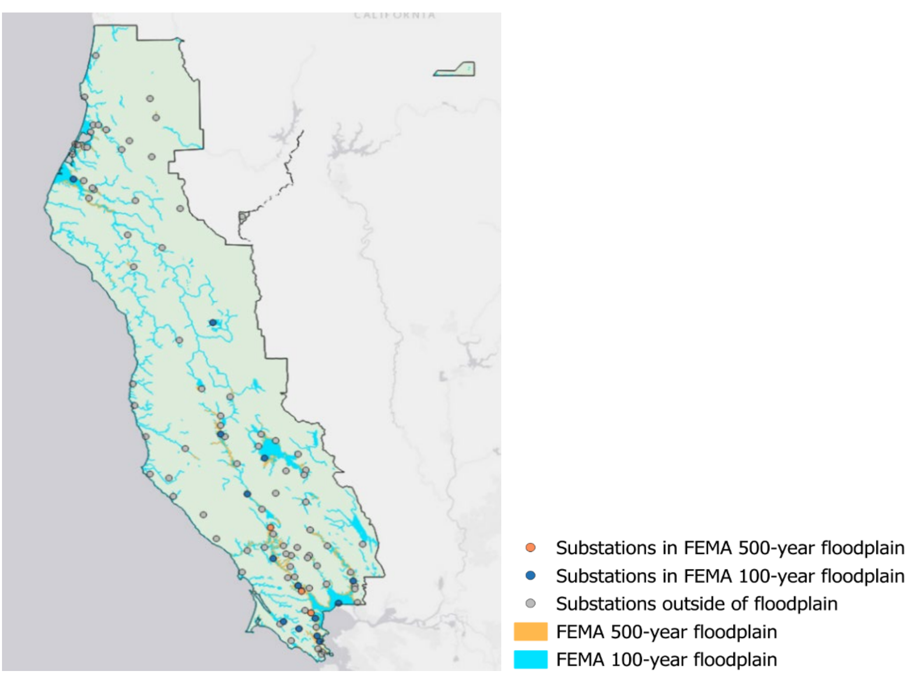


Figure 3.1.1- 48. Locations of substations in the FEMA 100-year and 500-year floodplains.

3.1.1.a Electric Substation

Heavy precipitation is projected to increase by 2050 along the coastal and central portions of the North Coast Region, including some areas of high landslide incidence where substations are located (Figure 3.1.1- 49).

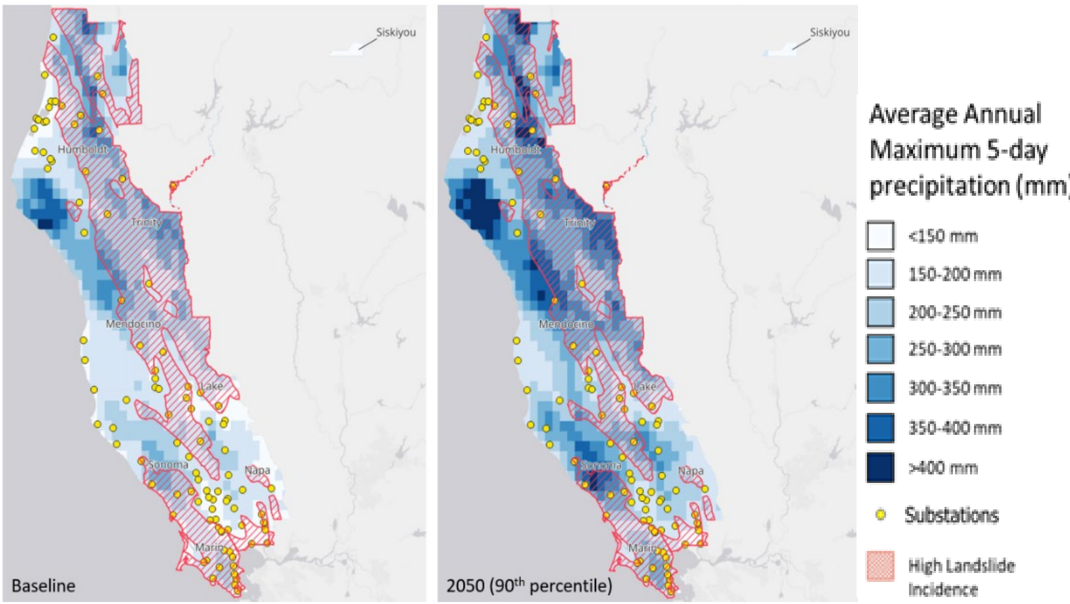


Figure 3.1.1- 49. Substations in the North Coast Region located in high landslide risk areas. Projected 5-day maximum precipitation (in millimeters) by 2050, compared with the baseline overlayed.

Climate Hazard: Sea Level Rise

As sea levels rise, driven by climate change, coastal substations along San Pablo Bay in Sonoma and Marin counties and by Humboldt Bay may be at increased risk of coastal flooding (Figure 3.1.1- 50). The number of PG&E substations potentially inundated by a 100-year coastal storm will increase from two (0 m SLR) to three by 2030 (0.25 m SLR), to four by 2050 (0.5 m SLR), and to eight by 2080 (1.25 m SLR) (Figure 3.1.1- 50).

3.1.1.a Electric Substation

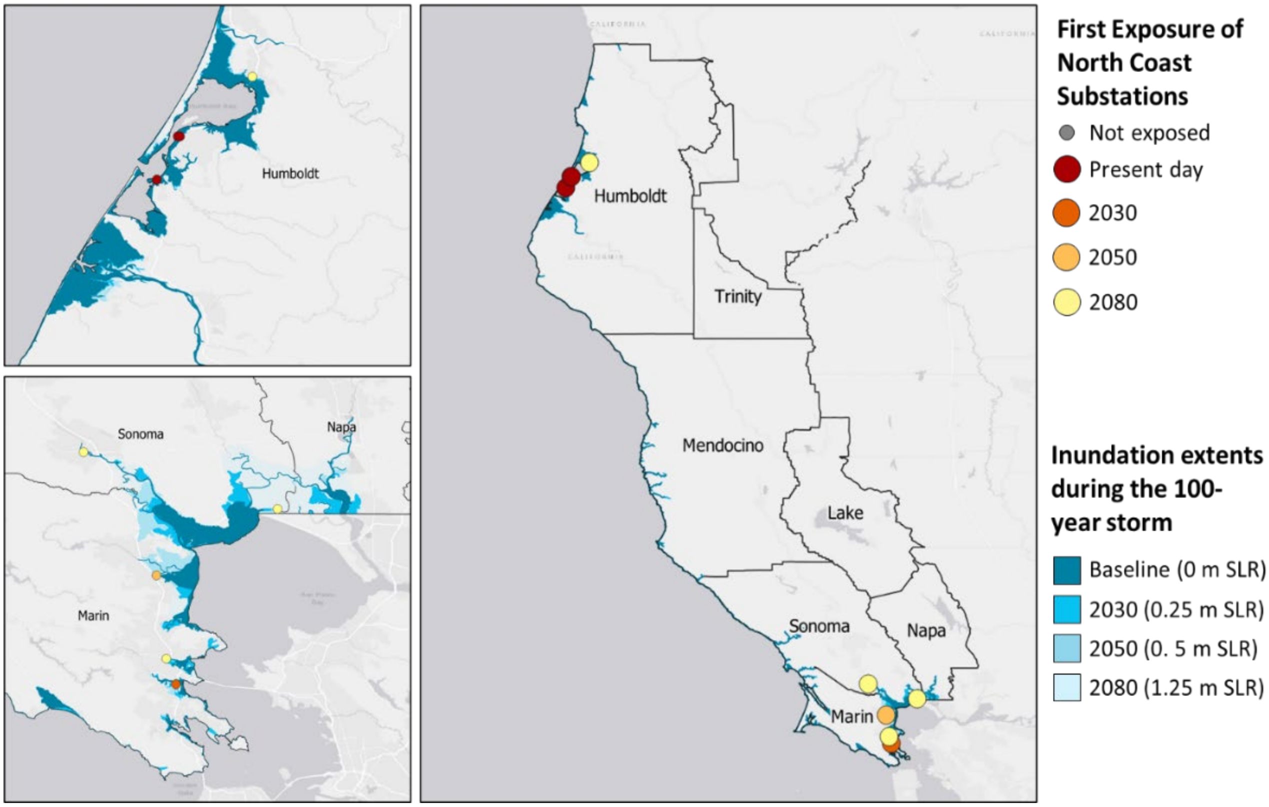


Figure 3.1.1- 50. North Coast Region substation inundation during a 100-year storm event under the baseline and potential 2030, 2050, and 2080 SLR extents.

The San Francisco Bay area, at the southern portion of the North Coast Region, is undergoing focused regional, county, and other municipal and community-led SLR adaptation planning. Many of PG&E's substations are behind flood protection that is not owned or managed by PG&E. Further site-specific analysis on flood risk and exogenous current and planned shoreline flood protection will be required to fully assess the climate change risk to substations.

3.1.1.a Electric Substation

Climate Hazard: Wildfire

There are 38 substations within HFRAs in the North Coast Region (Figure 3.1.1- 51).

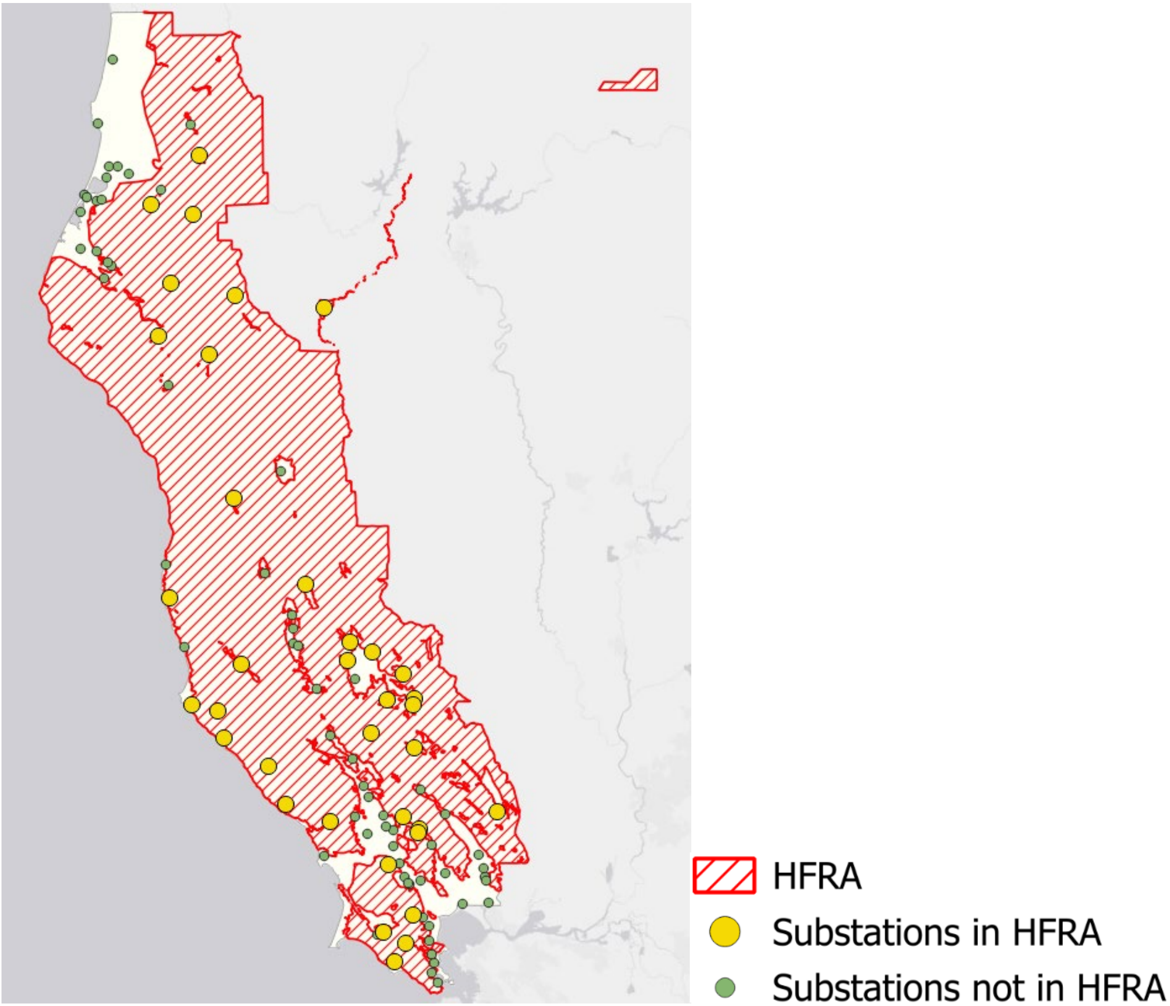


Figure 3.1.1- 51. Locations of North Coast Region substations in HFRAs.

Climate Hazard: Drought-Driven Subsidence

Drought-driven subsidence is not considered to be a climate change issue for substations at this time.

Central Coast Region

Summary

PG&E has 135 electric substations throughout the Central Coast Region (Figure 3.1.1- 52).

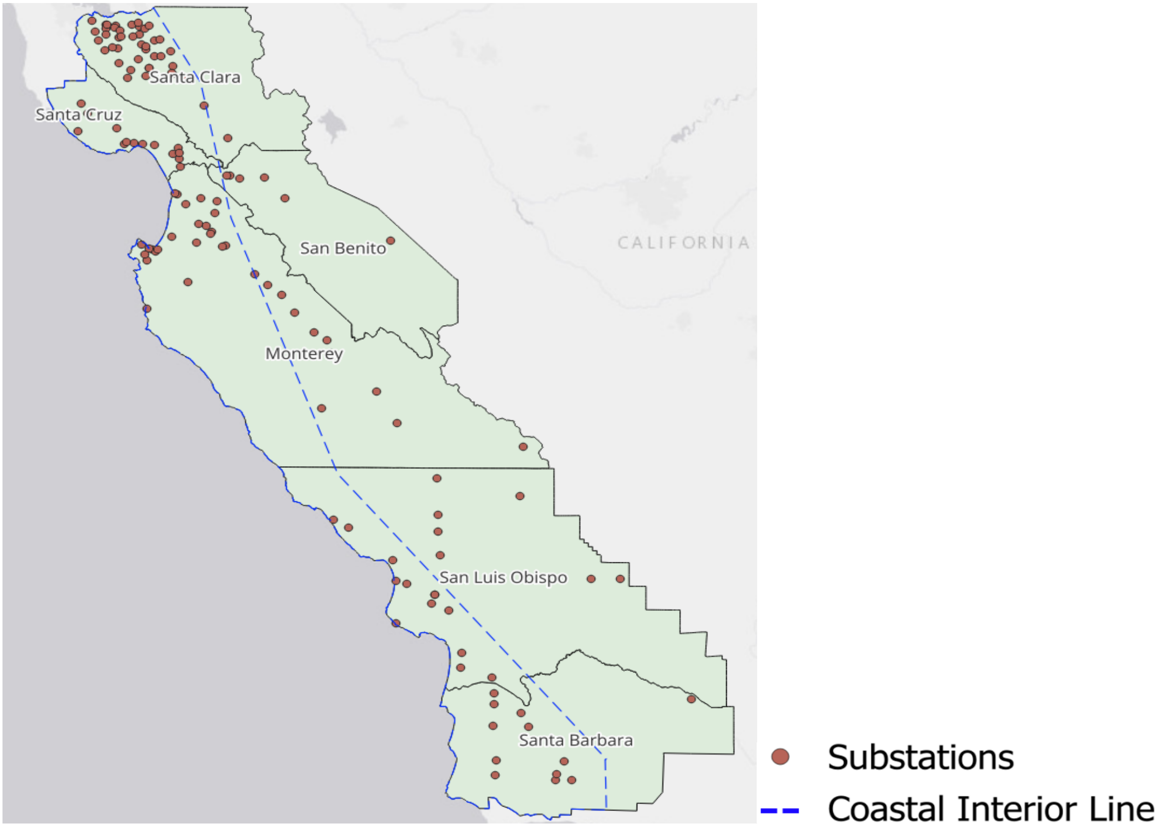


Figure 3.1.1- 52. PG&E substations in the Central Coast Region.

Climate Hazard: Temperature

In the Central Coast Region, the number of substations exposed to temperatures that exceed design assumptions (for the summer months of April–October) in both coastal and interior areas (Figure 3.1.1- 52) will increase in the coming decades (Table 3.1.1-29).

Substations in both coastal and interior zones will be exposed to temperatures exceeding assumed temperature thresholds over the coming decades. However, no interior substations are exposed to temperatures that exceed the updated temperature design standard during a 1-in-2-year heat wave until 2080 (Table 3.1.1-29). The updated design standard will thus likely moderate the risk to these substations from future high heat events. The number of substations exposed to temperatures that exceed the updated temperature design standard are higher in a 1-in-10-year heat wave (Table 3.1.1-29), indicating that substations in this region may be more vulnerable to higher temperatures in the future.

Table 3.1.1-31. Central Coast Region substation count over time in the coastal, legacy interior, and updated interior zones, over time for 1-in-2-year and 1-in-10-year heat events.

Heat Event	Baseline			2030			2050			2080		
	Coastal	Legacy Interior	Updated Interior	Coastal	Legacy Interior	Updated Interior	Coastal	Legacy Interior	Updated Interior	Coastal	Legacy Interior	Updated Interior
1-in-2-year	12 (1.31%)	0	0	58 (6.34%)	4 (0.44%)	0	85 (9.29%)	9 (0.98%)	0	105 (11.48%)	17 (1.86%)	1 (0.11%)
1-in-10-year	92 (10.05%)	1 (0.11%)	0	109 (11.91%)	17 (1.86%)	0	109 (11.91%)	22 (2.40%)	1 (0.11%)	109 (11.91%)	25 (2.73%)	9 (0.98%)

Notes:

- *Assumed maximum temperature for coastal zone is 99°F for the months of April–October*
- *Assumed maximum temperature for legacy interior zone is 109°F for the months of April–October*
- *Assumed maximum temperature for updated interior zone is 118°F for the months of April–October*
- *Percentages are relative to total substations within the PG&E service area.*

Climate Hazard: Flooding and Precipitation

Nine substations in the Central Coast Region are within the FEMA 100-year floodplain and 40 are within the FEMA 500-year floodplain, mostly concentrated in the northern portion of the region and inland along major waterways (Figure 3.1.1- 53).

3.1.1.a Electric Substation

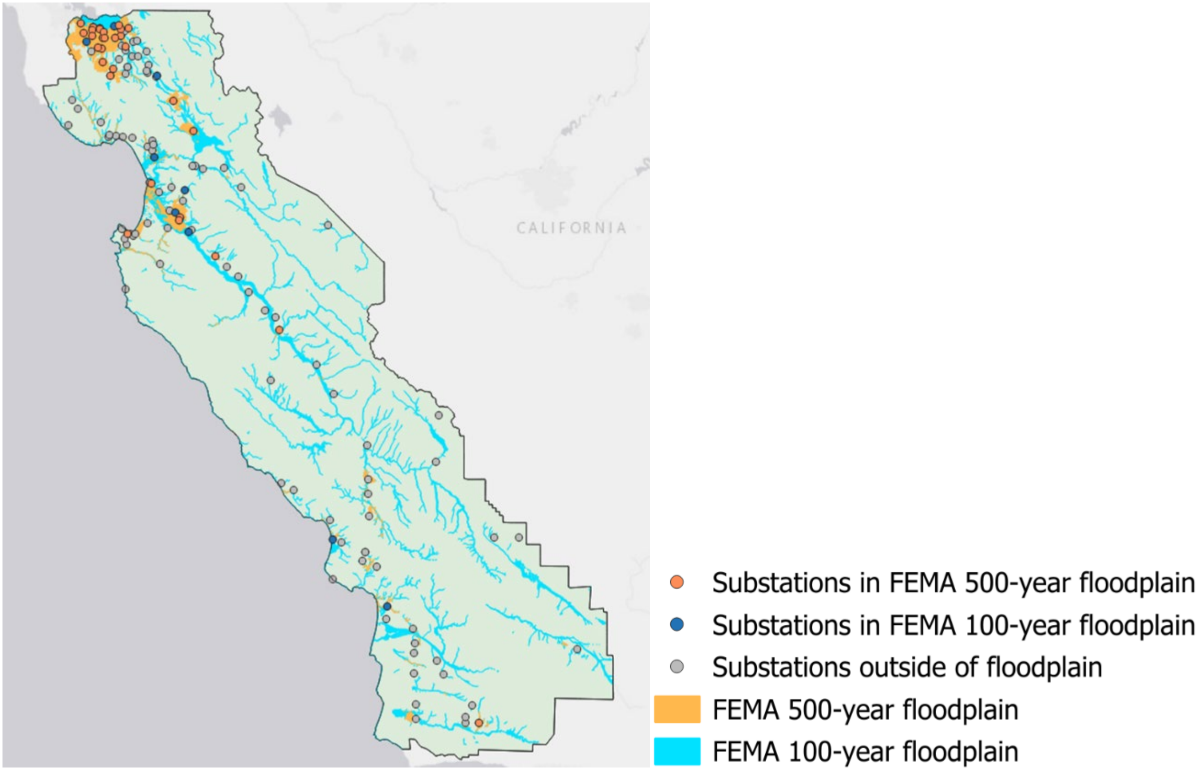


Figure 3.1.1- 53. Exposure of Central Coast Region PG&E substations to FEMA 100-year and 500-year floodplains.

Most of the Central Coast Region is not projected to see major increases in high precipitation by 2050, although areas around Santa Cruz and Santa Barbara—including some within high landslide risk areas—may be more vulnerable to increased rain events; few substations are within these locations (Figure 3.1.1- 54).

3.1.1.a Electric Substation

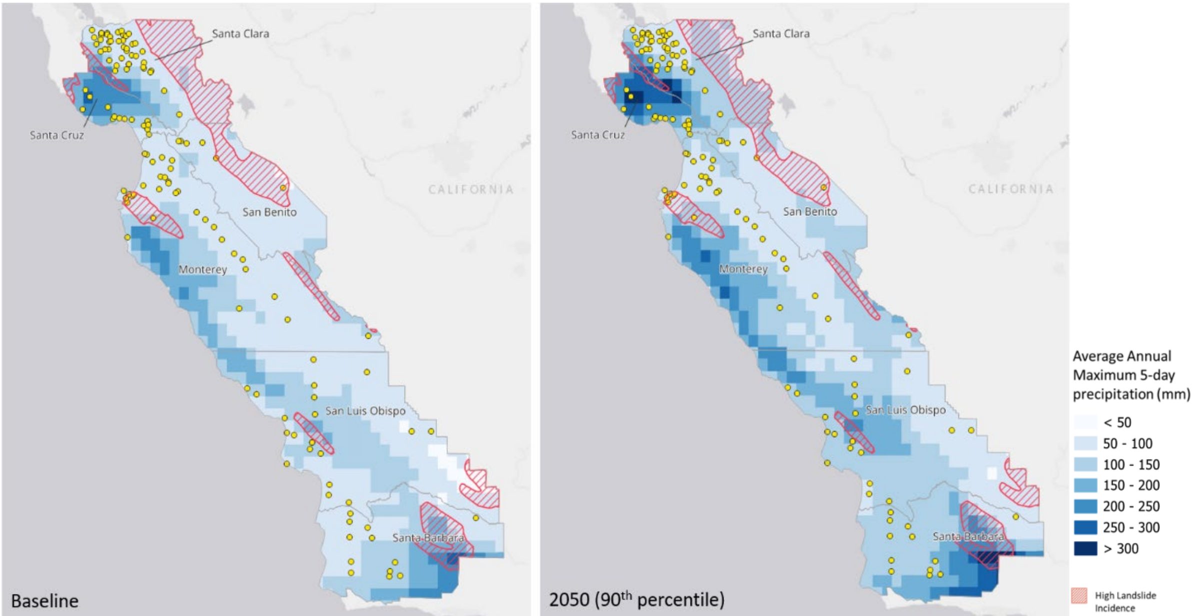


Figure 3.1.1- 54. Substations in the Central Coast Region located in high landslide risk areas. Projected 5-day maximum precipitation (in millimeters) by 2050, compared with the baseline overlayed.

Climate Hazard: Sea Level Rise

One PG&E substation in Palo Alto is already projected to be at risk of inundation by a 100-year coastal storm, and four in Monterey and northern Santa Clara are projected to be at risk with 1.25 m higher sea levels by 2080 under severe climate change (Figure 3.1.1- 55).

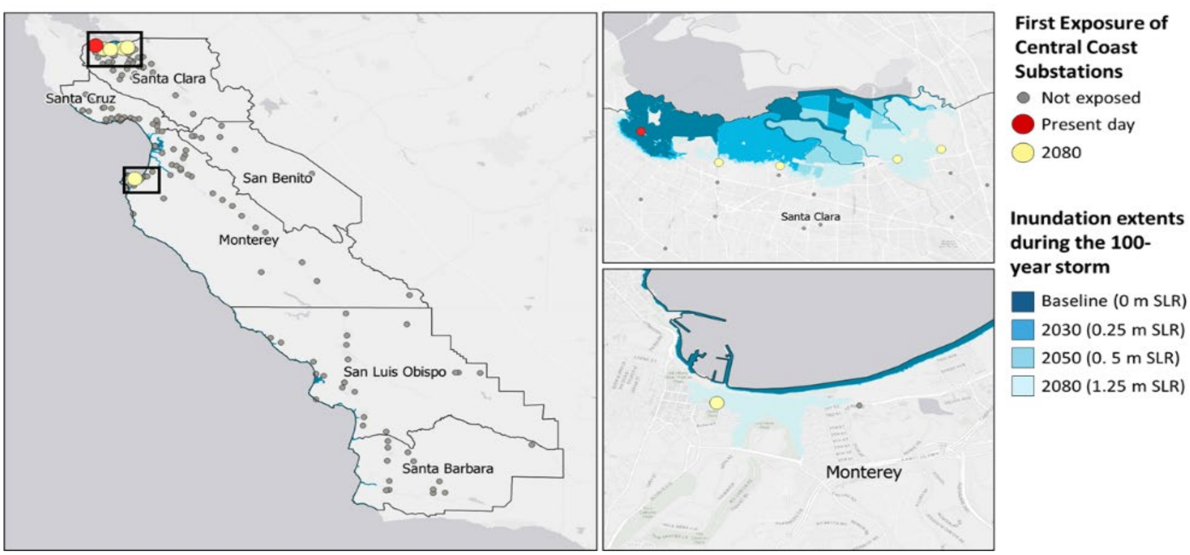


Figure 3.1.1- 55. Central Coast Region substation inundation during 100-year storm event under the baseline and potential 2080 SLR extents.

3.1.1.a Electric Substation

Climate Hazard: Wildfire

There are 19 substations within HFRAs, concentrated along the coast of Monterey Bay and also the southern portion of the region (Figure 3.1.1- 56).

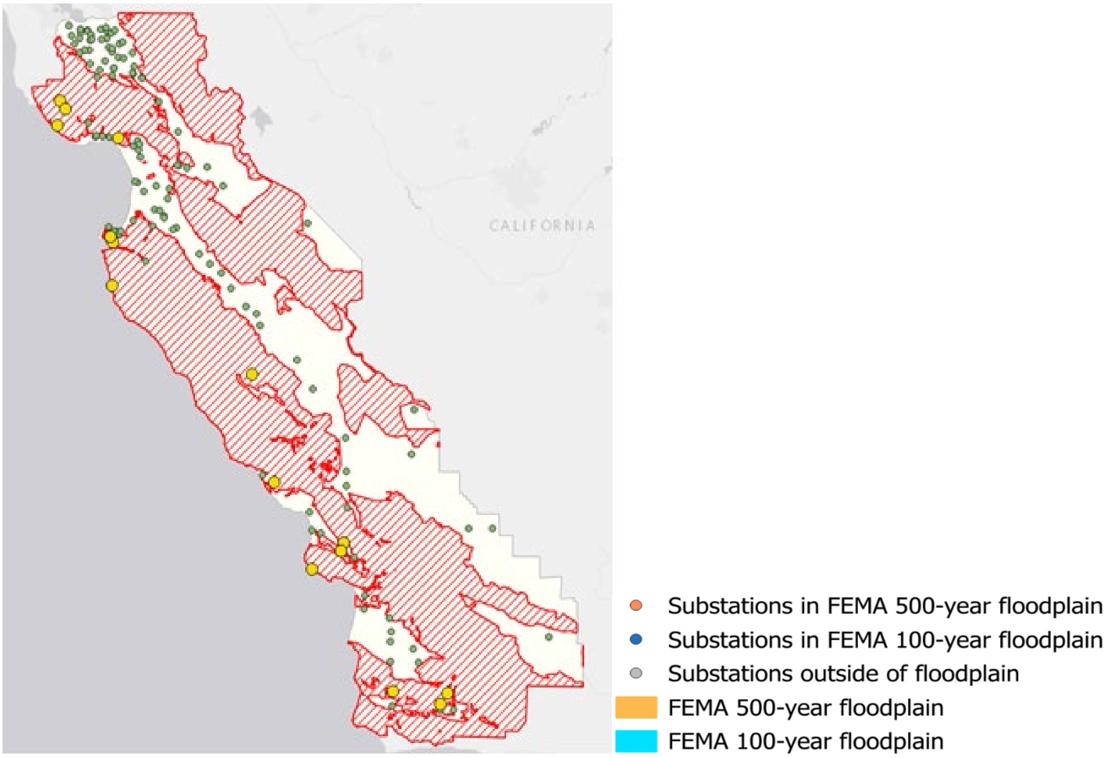


Figure 3.1.1- 56. Locations of Central Valley Region substations in HFRAs.

Climate Hazard: Drought-Driven Subsidence

Drought-driven subsidence is not considered to be a climate change issue for substations at this time.

3.1.1.c Electric Distribution

Asset Family Introduction

PG&E’s electric distribution system carries electricity from substations that convert transmission-level voltage (60 kV and higher) to distribution primary voltage (4 kV through 34.5 kV) and then to service voltage (120 V/240 V; 120 V/208 V; 277 V/480 V), at which point it is delivered to end-use customers. The components of the distribution system include overhead and underground conductors, distribution transformers, switches, interrupters, capacitors, and regulators. Equipment comes in in three configurations: pole-bolted, pad-mounted, and subsurface equipment. Pad-mounted and subsurface equipment are classified as Underground Assets, while Overhead Assets are those installed on poles. Electric Rule No. 16 requires pad-mounting, where feasible. Subsurface radial distribution equipment is the smallest classification by volume/number and is not used as widely as pole- and pad-mounted equipment. Not all equipment is available in every configuration.

Key Findings

Climate Hazard	Climate Change Risk and Potential Adaptation Measures
Temperature	High
	• Ambient temperatures, coupled with added electrical load, can accelerate the aging of equipment and can lead to asset component failure in certain cases. • Incorporate forward-looking climate projections into load forecasts, accelerate asset lifecycle replacement, plan for climate-informed capacity projects, update line ratings, and increase installation of transformer temperature sensors.
Flooding and Precipitation	Moderate
	• Distribution assets that are most likely to be sensitive to flooding are those at ground level. Supportive poles and overhead structures face the possibility of being structurally undermined during flooding. Subsurface equipment is insulated and is not sensitive to flooding. Flooding may make access to any distribution asset for maintenance and repairs more difficult. • Adaptation options include, but are not limited to, further elevate pad-mounted equipment and increase targeted sectionalization.
Sea Level Rise	Moderate
	• The distribution assets most likely to be exposed to coastal flooding are pad-mounted assets in coastal or tidally influenced locations. • Adaptation options include, but are not limited to, ensure climate-informed siting and design of new construction and apply corrosion-resistant coatins.
Wildfire	High
	• Overhead distribution lines and supportive structures are vulnerable to wildfire damage. • PG&E has initiated an extensive strategy to reduce wildfire risk focused primarily on ignition risk and PSPS reduction. These measures can substantially reduce the risk of catastrophic wildfires associated with PG&E equipment and also damage to assets.
Drought-Driven Subsidence	Low (off-ramped)
	• To date, PG&E has not experienced major impacts from ground subsidence on its distribution system. Ground subsidence is not considered to be a climate change issue for distributions assets at this time and the climate hazard is **off-ramped**.

Climate Hazards

This section describes climate hazards that may affect distribution assets, including temperature, flooding and precipitation, sea level rise, and wildfires.

Temperature

The electric distribution system faces two temperature-related risks:

1. The temperature rise will result in increased loading on the conductors, transformers, and the load profile. This increased load may cause operational constraints.
2. Higher projected temperatures will expose PG&E's distribution lines, transformers, and other equipment to higher ambient temperatures, affecting the equipment temperature. This can cause deterioration of the physical asset.

Exposure and Sensitivity

Both high ambient temperatures and heat generated by electrical current—which increases with increased load—can increase the temperature of distribution equipment, including conductor, transformers, and other assets. Distribution transformers are some of the most sensitive distribution equipment to higher heat and are the focus of analysis for this CAVA. Consecutive heat waves or extended high temperatures without nighttime cooling can be particularly damaging.

If temperatures or resulting loads exceed operational processes (see the section on adaptive capacity below), the transformer may age more quickly. Distribution transformers are sized based on the estimated connected load served by the transformer, along with additional capacity factors applied to account for specific climate conditions and loading profiles. The loss of transformer life or the need for replacement can be driven by multiple causes, primarily internal coil failure and corrosion. High heat events can cause accelerated degradation. Heat waves, especially those lasting more than 3 consecutive days, can prevent transformers from cooling adequately, causing accelerated degradation. A 2017 heat wave resulted in nearly 400,000 customer outages[14] associated with the failure of distribution transformers across PG&E's service area.

Climate Change Vulnerability

Analytical Metrics

A metric for the vulnerability of distribution transformers to high heat is exposure to projected temperatures during a 3-day weighted average maximum temperature, as this metric factors in the tendency of electrical equipment to accumulate heat over multiple, consecutive hot days.

---

[14] PG&E. 23 June 2017. "PG&E Neared Record-Setting Electricity Demand During Historic Heat Wave; Thanks Customers for Conservation Efforts." https://investor.pgecorp.com/news-events/press-releases/press-release-details/2017/PGE-Neared-Record-Setting-Electricity-Demand-During-Historic-Heat-Wave-Thanks-Customers-for-Conservation-Efforts/default.aspx

3.1.1.c Electric Distribution

The 3-day weighted average maximum temperature is analyzed for a 1-in-10-year heat event in 2050 and focuses on spatial trends in the vulnerability of distribution transformers.

Results

To varying degrees, transformers across the service area will be exposed to higher temperatures during a 1-in-10-year heat event in 2050 (Figure 3.1.1- 57).

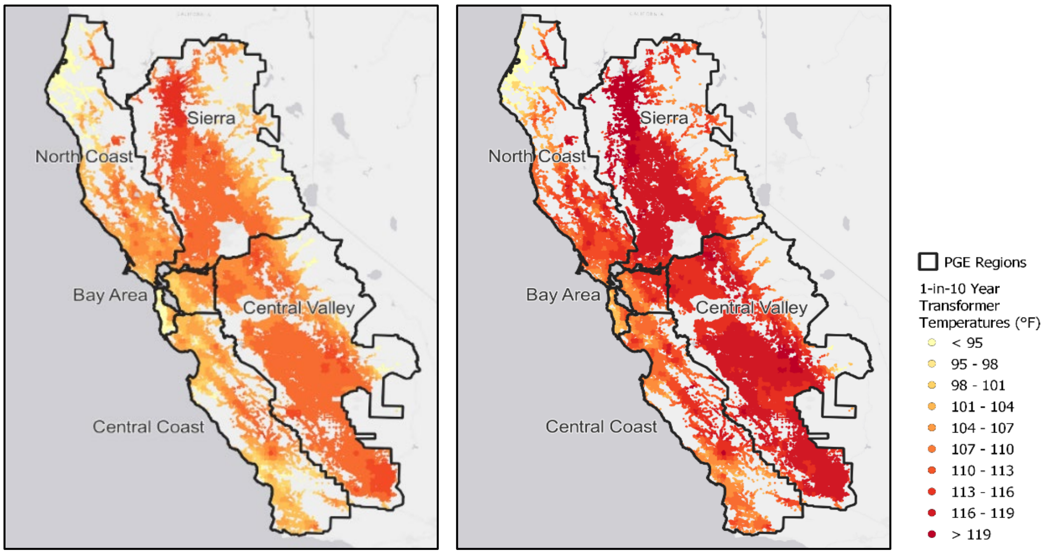


Figure 3.1.1- 57. 1-in-10-year highest temperatures at (a) baseline conditions (left) and 2050 (right) at distribution transformer locations in PG&E's service area.

Vulnerability may increase for transformers in the Central Valley and Sierra Regions because these areas are projected to be exposed to the highest future temperatures and increased use of air conditioning is expected. Transformers in the coastal areas of the North Coast, Bay Area, and Central Coast Regions may be particularly vulnerable to future high heat events due to legacy design standards that assume cooler operating environments and historically low air conditioning use that is likely to increase over time. See Electric Distribution Regional Reports for more geographic details.

Adaptive Capacity and Climate Change Risk

Several elements influence the adaptive capacity of PG&E's electric distribution system to higher temperatures.

Planning Capacities

- **Revised distribution transformer capability model:** Following the 2006 heat wave, PG&E revised its guidance documents to reference the Institute of Electrical and Electronics Engineers (IEEE) Standards Association Electrical Loading Guides (C57.12.91). PG&E's revised distribution transformer capability model uses ambient temperature, load profiles from electric rates, and locational aggregates from the 2006 heat wave to inform the revised standard. Transformer engineering material specifications (EMS 82, 86, and 91) were updated in 2012 such that new transformers use natural ester, rather than mineral oil, significantly improving the equipment's ability to sustain high temperatures.

- **Updated temperature assumptions:** In 2023, PG&E updated temperature assumptions for transformer capacity calculations using climate-informed data.
- **Transformer replacements:** PG&E's transformer replacement program replaces aging and overloaded transformers.
- **Load forecasting:** PG&E's current practice of using historical heat events (e.g., the 2006 heat wave for transformer sizing; the historical 1-in-10-year heat event for load forecasting) as proxies for potential future heat events may require updating to ensure preparedness for more extreme climate futures.

Operational Capacities

- **Distribution planning:** Forecasts what extreme load peaks are expected and develops projects to address the forecasted overloads. In scenarios where the project will not be built in time, distribution planning alerts operations to the forecasted overload so real-time plans to manage these overloads can be developed.
- **Outage prediction and restoration capabilities:** PG&E's Storm Outage Prediction Project model helps the Company anticipate where outages are most likely to occur during a projected weather event, and PG&E can strategically position restoration crews to minimize outage times.

Distribution transformers are projected to be exposed to future extreme heat conditions that likely will tax equipment above the current adaptive capacity capabilities, which are considered to be moderate. Further analysis would be needed to understand the impacts of climate change on current adaptive capacity over time. In many cases, such as the failure of a single distribution transformer, the number of customer outages from a single equipment failure would be relatively small and have quick restoration times. However, distribution system outages during geographically widespread and persistent heat events could affect larger numbers of customers if there is increased failure of equipment or systemic undercapacity. Over time, the vulnerability of distribution assets to higher temperatures is considered likely to increase throughout much of the service area and the climate change risk is considered to be **high**.

Potential Adaptation and Resilience Measures

The following measures may increase the resilience of its distribution assets associated with increased temperatures and extreme heat events.

Planning Options

- **Incorporate forward-looking climate projections into load forecasts:** PG&E's internal load forecasting methods have traditionally relied on historical weather data to model potential maximum temperatures and associated load profiles. PG&E can identify opportunities to incorporate climate projection data into the company's internal forecast and work with the California Energy Commission to further the consideration of climate change impacts in future Integrated Energy Policy Reports, which form the basis for PG&E's distribution capacity outlook.

- **Accelerate asset lifecycle replacement:** An asset replacement strategy for replacing equipment designed to older standards with equipment designed to new standards can be evaluated.
- **Move vulnerable lines underground:** Undergrounded lines would be protected from increases in ambient air temperatures and heat waves. Undergrounding done for wildfire purposes could also reduce the exposure and vulnerability of assets from extreme heat and other hazards and could be a secondary justification for this type of wildfire risk reduction investment.
- **Plan for climate-informed capacity projects:** Incorporate future temperature trends into forecasting capacity projects.
- **Implement demand response and non-wires solutions:** Effective demand reduction is frequently a viable substitute for capacity additions, and PG&E can consider trends and opportunities associated with both voluntary demand reduction and distributed energy resources in reducing peak demand on electric assets.

Operational Options

- **Update line ratings:** eliminate coastal ratings on a going-forward basis for distribution line equipment to avoid overloading equipment during heatwaves.
- **Reduce wind speed ratings** on certain sizes of overhead distribution conductors.
- **Transformer temperature sensors:** Increase the installation of underground and overhead temperature sensors to monitor for potential overloading and overheating during heatwaves. Operations can take proactive measures such as removing debris from vaults or temporarily reducing load to prevent transformer failure.

Flooding and Precipitation

Distribution assets in PG&E's service area in interior and coastal floodplains are projected to be exposed to increased flooding due to projected increases in the severity of or the number of heavy precipitation events.

Exposure and Sensitivity

The primary concern associated with heavy rainfall is flooding and associated impacts, such as landslides. Distribution assets that are most likely to be sensitive to flooding are pad-mounted assets at ground level. Exposure to water levels and flood conditions outside of the design and construction parameters could result in chronic and acute impacts on equipment, including the following:

- **Pad-mounted equipment:** Pad-mounted equipment is typically mounted on an approximately 6-inch curb to protect it from low-level flooding. This elevation could prove to be insufficient under future flood conditions, depending on the area. PG&E's current standard for pad-mounted transformers features a dead-front design, which features more protection of voltage-bearing components than a live-front design but is still not designed to be fully submersible.

- **Overhead equipment:** Flooding may damage support structures to which equipment, such as transformers, is attached.
- **Subsurface equipment:** All of PG&E's subsurface distribution equipment is designed to be submersible (i.e., waterproof). As a result, the exposure of underground assets is not likely to be a concern. However, damage, such as cracks in conduit elbows and connectors, may make submersible equipment vulnerable to impacts from flooding.
- **Sectionalizing switches:** Sectionalizing switches serve to segment PG&E's distribution system, allowing for the isolation of portions of the system such that the number of customers affected by an outage event is limited to the greatest extent possible. These sectionalizing switches may be located overhead, underground, or on pad mounts. In many cases, these switches require manual access by PG&E crews to initiate sectionalization. If floodwaters prevent PG&E crews from accessing sectionalizing switches, maintenance and restoration operations may be impaired.
- **Damage from landslides and debris flow:** During very heavy rain, the resulting landslides or debris flow may directly damage pad-mounted equipment, undermine ground conditions, or damage support structures for overhead equipment.

Climate Change Vulnerability

Analytical Metrics

Existing FEMA floodplain designations are currently the best metrics to provide insight into the potential vulnerability of distribution assets to flooding. The key metrics of exposure to flooding are the number of pad-mounted transformers and overhead transformers within FEMA 100-year and 500-year floodplains.

Results

Overall, 6.9 percent and 22.8 percent of pad-mounted transformers are within the FEMA 100-year and 500-year floodplains, respectively (Table 3.1.1-30), indicating that the vulnerability to flooding may be greatest during very large and low-probability flood events. The greatest number of pad-mounted transformers within the FEMA 100-year and 500-year floodplains are in the Central Valley and Sierra Regions (Table 3.1.1-30).

Table 3.1.1-32. Pad-mounted transformer count in the FEMA 100-year and FEMA 500-year floodplains by region.

Region	FEMA 100-year	FEMA 500-year
Bay Area	1,385 (1.0%)	5,337 (4.0%)
Central Valley	2,090 (1.6%)	9,099 (6.8%)
Sierra	2,694 (2.0%)	5,603 (4.2%)
North Coast	1,187 (0.9%)	1,928 (1.4%)
Central Coast	1,926 (1.4%)	8,625 (6.4%)
Total	**9,282 (6.9%)**	**30,592 (22.8%)**

Note: Percentages are relative to total pad-mounted transformers within the PG&E service area.

Overall, 9 percent and 17.5 percent of overhead transformers are within the FEMA 100-year and 500-year floodplains, respectively (Table 3.1.1-31), indicating that the vulnerability to flooding may be greatest during very large and low-probability flood events. The greatest number of overhead transformers within the FEMA 100-year and 500-year floodplains are in the Central Valley and Sierra Regions (Table 3.1.1-31). Vulnerability to flooding will depend on the construction specifics of the supporting structure.

Table 3.1.1-33. Overhead transformer count by region in the FEMA 100-year and 500-year floodplains.

Region	FEMA 100-year	FEMA 500-year
Bay Area	3,615 (0.5%)	8,403 (1.3%)
Central Valley	23,488 (3.5%)	47,369 (7.1%)
Sierra	18,313 (2.7%)	27,759 (4.2%)
North Coast	7,406 (1.1%)	9,469 (1.4%)
Central Coast	7,357 (1.1%)	23,706 (3.6%)
Total	**60,179 (9.0%)**	**116,706 (17.5%)**

Note: Percentages are relative to total transformers within the PG&E service area.

See Electric Distribution Regional Reports for more details about geographic vulnerability to flood and landslide risk.

Adaptive Capacity and Climate Change Risk

The ability of PG&E's distribution system to withstand the potential impacts of flood events is related to the following adaptive capacity.

Planning Capacities

- **Elevation of pad-mounted equipment:** The standard height of a concrete pad on which equipment is mounted is 6 inches in order to protect it from low-level flooding.

Operational Capacities

- **Ability to sectionalize the grid:** During flood conditions, circuits equipped with automated fault location isolation and service restoration schemes will automatically detect a fault, isolates it, and restore affected customers.
- **Outage prediction and preparedness:** PG&E uses sophisticated models to predict outage locations based on weather conditions, such as its Storm Outage Prediction Project model. Information from the model allows PG&E to prepare and dispatch its crews to restore service more rapidly in areas where outages are likely to occur.

This adaptive capacity is considered to be moderate, as assets and the system are designed or prepared for potential flooding; however, there are no specific plans for plausible worsening conditions. The climate change risk of flooding is considered to be **moderate**.

Potential Adaptation and Resilience Measures

PG&E may consider the following further measures to increase the resilience of its distribution system to flooding.

Planning Options

- **Further elevate pad-mounted equipment:** In flood-prone areas, increasing the height of the concrete pad on which pad-mounted equipment is located could reduce the exposure of pad-mounted equipment to flooding.
- **Accelerate or target replacement of live-front transformers with dead-front/submersible designs for pad-mounted transformers:** Accelerated replacement and/or targeted lifecycle replacement of existing live-front/non-submersible transformers in flood-prone areas could reduce transformer vulnerability.

Operational Options

- **Increase targeted sectionalization:** Increased sectionalization of distribution networks that are at heightened future flooding risk, alongside increased capability to remotely control sectionalization, may offer accelerated restoration during future flood-related outage events. PG&E may also consider placing more manual switches in high-ground locations near the boundaries of flood zones that will be accessible to crews during flooding events.

Sea Level Rise

Distribution assets in PG&E's service area are projected to be exposed to increased flooding due to SLR in coastal and tidally influenced areas. Noting that most, if not all, coastal assets within an inundation event during a 100-year storm also are within a coastal FEMA 100-year flood zone, this section specifically focuses on PG&E's understanding of risk specific to inundation due to rising sea level. However, given the natural overlap with the flooding and precipitation evaluation, flood exposure on the coast should be considered holistically.

Exposure and Sensitivity

Many of the sensitivities to flooding described above apply to coastal distribution assets, especially during large storms where heavy rain may cause more flooding. Sensitivities are similar to those described above, with the addition of the following:

- **Corrosion:** Pad-mounted and overhead electrical equipment may be vulnerable to accelerated corrosion, especially in the case of coastal (i.e., salt/brackish water) flooding.
- **Groundwater:** SLR can cause increases in groundwater levels along the coast and in the San Francisco Bay Area. Higher groundwater levels can introduce higher salinity or contaminated water to subsurface equipment.

Vulnerability

Analytical Metrics

The projected extent of coastal inundation over time due to SLR is the benchmark at which PG&E examines the exposure of SLR to coastal and tidally influenced distribution assets.

3.1.1.c Electric Distribution

Results

By 2050, 2.46 percent of pad-mounted distribution transformers are projected to be exposed to flooding due to SLR, with the majority of these assets being within the Bay Area Region (Table 3.1.1-32), indicating that the vulnerability to SLR is relatively low.

Table 3.1.1-34. Pad-mounted distribution transformer count exposed to SLR and Delta levee overtopping.

Region	Baseline	2030	2050	2080
Bay Area	107 (0.08%)	1,501 (1.12%)	1,942 (1.45%)	3,598 (2.69%)
Central Valley	25 (0.02%)	754 (0.56%)	786 (0.59%)	1,420 (1.06%)
Sierra	6 (0.004%)	26 (0.02%)	29 (0.02%)	58 (0.04%)
North Coast	161 (0.12%)	306 (0.23%)	424 (0.32%)	743 (0.55%)
Central Coast	22 (0.02%)	62 (0.05%)	115 (0.09%)	490 (0.37%)
Total	**321 (0.24%)**	**2,649 (1.98%)**	**3,296 (2.46%)**	**6,309 (4.71%)**

Note: Percentages are relative to total pad-mounted distribution transformers within the PG&E service area.

By 2050, 0.96 percent of overhead distribution transformers are projected to be exposed to flooding due to SLR, with the majority of these assets being within the Bay Area and North Coast Regions (Table 3.1.1-33), indicating that the vulnerability to SLR is relatively low.

Table 3.1.1-35. Overhead distribution transformer count exposed to SLR and Delta levee overtopping.

Region	Baseline	2030	2050	2080
Bay Area	217 (0.03%)	1,005 (0.15%)	1,846 (0.28%)	3,246 (0.49%)
Central Valley	1,004 (0.15%)	2,469 (0.37%)	2,767 (0.42%)	4,948 (0.74%)
Sierra	198 (0.03%)	564 (0.08%)	672 (0.10%)	929 (0.14%)
North Coast	570 (0.09%)	845 (0.13%)	1,034 (0.16%)	1,554 (0.23%)
Central Coast	36 (0.01%)	59 (0.01%)	76 (0.01%)	331 (0.05%)
Total	**2,025 (0.30%)**	**4,942 (0.74%)**	**6,395 (0.96%)**	**11,008 (1.65%)**

Note: Percentages are relative to total overhead distribution transformers within the PG&E service area.

See the Central Valley Region report in Electric Distribution Regional Reports for details on the vulnerability of Central Valley Region assets due to levee overtopping.

Adaptive Capacity and Climate Change Risk

As described in Flooding and Precipitation Adaptive Capacity, PG&E has the capacity to ensure that vulnerable assets are not exposed to or damaged by flooding. However, PG&E does not have specific plans to address plausible worsening conditions for assets along coastal and tidally influenced areas. The adaptive capacity for SLR is considered to be moderate. Further analysis would be needed to understand the impacts of climate change on current adaptive capacity over time. The climate change risk of future flooding to distribution assets due to SLR in 2050 is considered to be **moderate.**

Potential Adaptation and Resilience Measures

Many potential adaptation and resilience measures to mitigate impacts of sea level rise will be similar to those described for Flooding and Precipitation. Specifically for sea level rise:

Planning Options

- **Ensure climate-informed siting and design of new construction:** Future siting can avoid structures within coastal floodplains or use forward-looking sea level rise data and hydrologic studies in consideration of siting and design.
- **Apply corrosion-resistant coatings:** Concerns related to occasional saltwater exposure and associated corrosion of coastal steel tower components may be mitigated through the application of corrosion-resistant tapes or other coatings to towers at heightened risk of saltwater flooding or spray action.

Operational Options

- **Develop emergency response plans:** PG&E may assess certain highlighted locations to develop operational emergency response plans to the potential sea level rise.

Wildfire

Climate change will continue to increase the potential for wildfires in PG&E's service area.

Exposure and Sensitivity

The greatest wildfire risk is in HFRAs. The number of distribution line-miles in HFRAs is the metric for future electric distribution system exposure to and vulnerability from wildfires. This reflects the potential for PG&E equipment to sustain damage from wildfires of any origin, as well as the potential for lines to cause ignitions or be subject to distribution-related PSPS (not considering other mitigation actions that PG&E is taking as described below).

Non-hardened overhead electric distribution equipment should be considered highly sensitive to wildfire, both in terms of the potential of electrical equipment to sustain damage from wildfires and the potential to cause ignitions in wildfire-prone areas. Hardened overhead lines are sensitive to wildfires in certain situations.

Overhead or ground-mounted distribution equipment located in the path of major wildfires has a high likelihood of being damaged or destroyed. The sensitivity of poles and wires to wildfire exposure depends on both the materials used—concrete, steel, and composite poles are more fire-resistant—and the severity of the fire. Underground infrastructure, such as cables, risers, and enclosures, is much less sensitive to wildfires.

Vulnerability

Analytical Metrics

The number of line-miles of distribution overhead conductor within HFRAs is used to assess potential future exposure to wildfires.

Results

Overall, 41.5 percent of overhead distribution line-miles are located in HFRAs, with a slight majority of these line-miles being in the Sierra Region, although vulnerability to wildfire risk is fairly even throughout the regions, except in the Bay Area Region, which only represents 1.85 percent of the line-miles in HFRAs (Table 3.1.1-34).

Table 3.1.1-36. Distribution line-miles in HFRAs by region.

Region	Overhead Distribution Line-Miles (% Within the Region) in HFRAs
Bay Area	1,152 (1.85%)
Central Valley	5,831 (9.36%)
Sierra	8,948 (14.36%)
North Coast	5,693 (9.14%)
Central Coast	4,256 (6.83%)
Total	**25,880 (41.53%)**

Note: Percentages are relative to total distribution line-miles within the PG&E service area.

Adaptive Capacity and Climate Change Risk

PG&E has initiated an extensive strategy to reduce wildfire risk and adaptive capacity is considered to be **high**. Although a full accounting of this strategy is beyond the scope of this document, it is detailed in PG&E's Third Revised 2023–2025 Wildfire Mitigation Plan (2023–2025 WMP).[15] Core elements of this strategy that relate most closely with reducing the damage from wildfires to assets include the following:

- **Undergrounding and hardening of distribution equipment:** PG&E has announced a plan to underground 10,000 miles of distribution conductor in HFRAs of its service territory. PG&E also employs other hardening measures in HFRAs, including covered conductor for overhead lines, use of remote grids, replacing existing primary line equipment such as fuses/cutouts and switches with equipment that has been certified as low fire risk, replacing overhead distribution line transformers, and installing animal protection upgrades.
- **Vegetation management (VM):** Under the Tree Removal Inventory Program, PG&E is removing or re-inspecting trees identified in the legacy Enhanced VM Program. Based on this ongoing re-inspection and evaluation work, PG&E will develop annual risk-ranked work plans and mitigate the highest risk-ranked circuit segments. PG&E also is implementing the Focused Tree Inspection Program, which is a new transitional program for 2023 stemming

[15] PG&E. "Community Wildfire Safety Program R3." pge.com/assets/pge/docs/outages-and-safety/outage-preparedness-and-support/pge-wmp-r3-092723.pdf

from the conclusion of the Enhanced VM Program. The program focuses VM efforts to address high-risk areas that have experienced higher volumes of vegetation damage during PSPS events, outages, and/or ignitions.

- **Improved situational awareness of ignitions and high-risk conditions:** PG&E is maximizing the use of cameras and weather stations to identify potential wildfire ignitions and risk, thus expanding its situational awareness capabilities.

PG&E's WMPs are robust, and the adaptive capacity of utility-caused ignitions is considered to be high. Many of the utility-caused wildfire risk reduction strategies described in PG&E's WMP are likely to also reduce equipment damage during a wildfire regardless of the cause. However, the risk of wildfires from any source in PG&E's service area is expected to increase due to climate change and exogenous factors, such as lightning and human activity; historical forest management practices are beyond PG&E's control. The climate change risk of damage from wildfires is therefore considered to be **high**.

Potential Adaptation and Resilience Measures

PG&E's 2023–2025 Wildfire Mitigation Plan[16] describes PG&E's plans for reducing ignition risk and reducing reliance on PSPS. PG&E WMPs are likely to reduce ignition risk related to climate change.

Long-term adaptation planning can evaluate additional measures that may be needed to reduce the risk of wildfire damage to PG&E's assets. PG&E's Fire Rebuild Design Guidance for System Hardening considers the resilience of assets to withstand a wildfire. For example, the scoping process for system hardening work considers whether a hardened overhead system provides enough resilience for the public and first responders.

Drought-Driven Subsidence

To date, PG&E has not experienced major impacts from ground subsidence to its distribution system, including in portions of the Central Valley Region, where ground subsidence is severe. The overhead distribution system has sufficient structural flexibility (i.e., low rigidity) to be relatively insensitive to vertical ground movement and the resulting horizontal stresses. Underground conduit is somewhat more rigid and could theoretically experience increased horizontal stresses. Such stresses have not been observed to date. Ground subsidence is considered to be a **low** climate change issue at this time and this climate hazard is **off-ramped**.

---

[16] PG&E. 27 March 2023. "Wildfire Mitigation Plan." pge.com/assets/pge/docs/outages-and-safety/outage-preparedness-and-support/2023-wildfire-mitigation-plan.pdf

Electric Distribution Regional Reports

Bay Area Region

Summary

The distribution system in the Bay Area Region comprises approximately 6,400 miles of primary overhead infrastructure and 7,600 miles of primary underground infrastructure Figure 3.1.1-58). Additionally, the system includes approximately 78,000 overhead distribution transformers, 24,000 pad-mounted transformers, and 331,000 subsurface features.

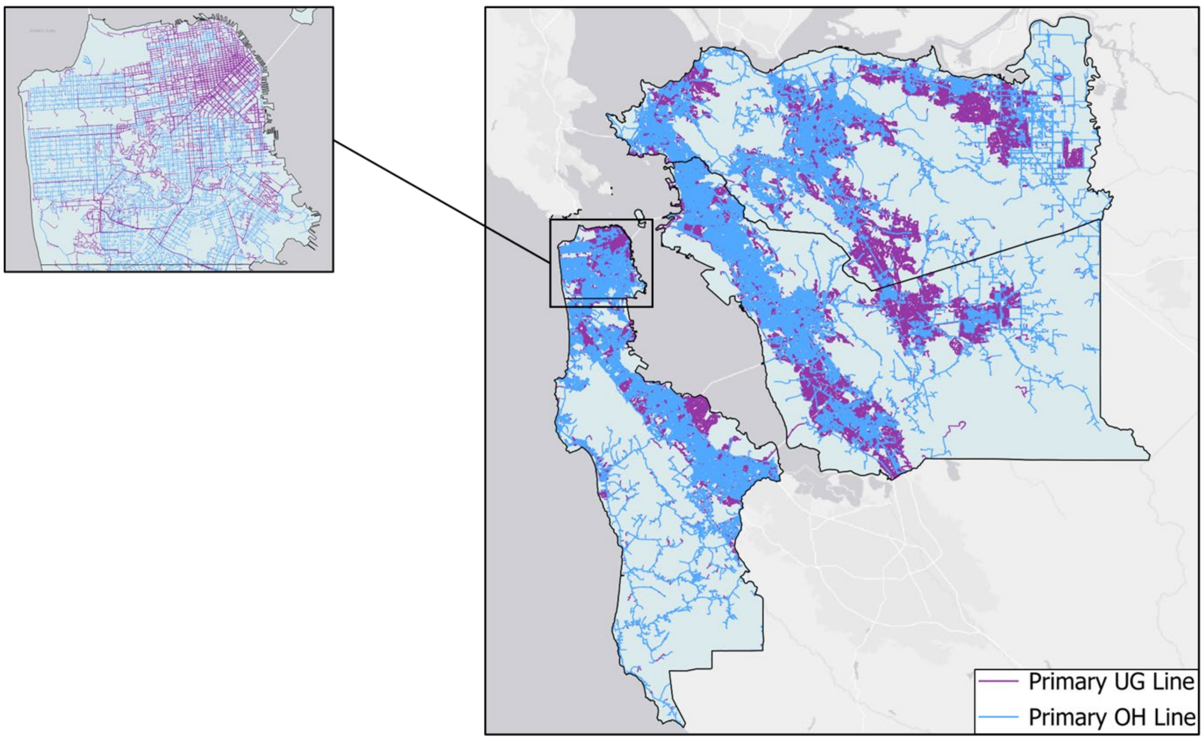


Figure 3.1.1- 58. Primary overhead (OH) and underground (UG) conductor locations throughout the Bay Area Region.

Climate Hazard: Temperature

Much of the Bay Area Region is coastal and cooler than much of the PG&E service area, and therefore historically has had less air conditioning use. Distribution assets in this region may therefore be more vulnerable to the chronic impacts of heat as load increases over time, as well as to acute impacts during heat waves. Temperature increase is projected to be higher in the eastern part of this region, although areas in the southern San Francisco Peninsula also are projected to increase (Figure 3.1.1- 59).

3.1.1.c Electric Distribution

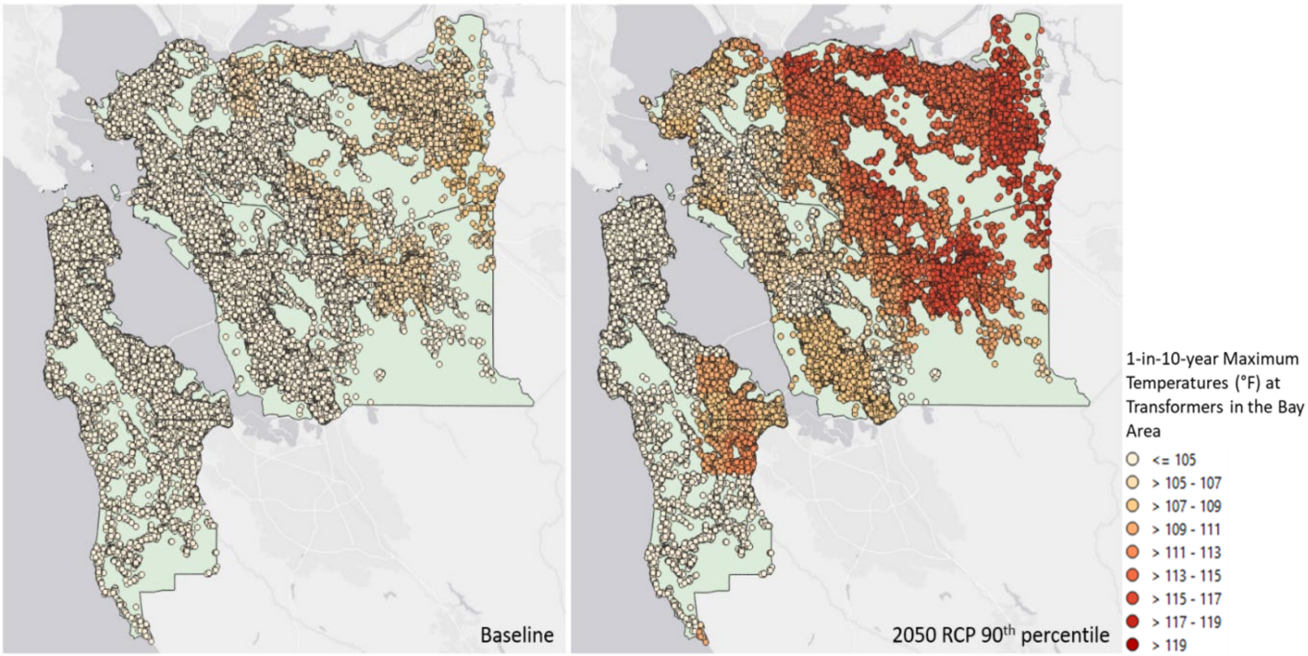


Figure 3.1.1- 59. Baseline and projected 1-in-10-year ambient temperatures at transformer locations throughout the Bay Area Region.

Climate Hazard: Flooding and Precipitation

Overall, 0.6 percent and 1.7 percent of Bay Area Region pad-mounted and overhead transformers are within the FEMA 100-year and 500-year floodplains, respectively, representing very small proportions of these assets in total (Table 3.1.1-35), indicating that the vulnerability to flooding may be greatest during very large and low-probability flood events. Vulnerability to flooding will depend on the construction specifics of the supporting structure.

Table 3.1.1-37. Counts of PG&E electric distribution assets located within FEMA 100-year or 500-year floodplains.

Assets	FEMA 100-year	FEMA 500-year
Pad-Mounted Transformers	1,385 (1.0%)	5,337 (4.0%)
Overhead Transformers	3,615 (0.5%)	8,403 (1.3%)
Total	**5,000 (0.6%)**	**13,740 (1.7%)**

Note: Percentages are relative to total electric distribution assets within the PG&E service area.

The greatest number of overhead line-miles within areas of high landslide risk is in Contra Costa County (Table 3.1.1-36).

Table 3.1.1-38. Overhead and pad-mounted transformers in the high landslide risk zone, by county.

County	Overhead	Pad-Mounted
Alameda	2,271 (0.34%)	1,148 (0.86%)
Contra Costa	12,124 (1.82%)	3,339 (2.49%)
San Francisco	0 (0%)	0 (0%)
San Mateo	2,515 (0.38%)	299 (0.22%)
Total	**16,910 (2.54%)**	**4,786 (3.57%)**

Note: Percentages are relative to total overhead and pad-mounted transformers within the PG&E service area.

Climate Hazard: Sea Level Rise

By 2050, 1.45 percent of pad-mounted transformers and 0.28 percent of overhead distribution transformers are projected to be exposed to flooding due to SLR, with the majority of these assets being within San Mateo County (Table 3.1.1-37).

Table 3.1.1-39. Total count of electric distribution pad-mounted and overhead transformers projected to be exposed to SLR during the 100-year storm over time across counties in the Bay Area Region.

County	SLR + Delta [Pad-Mounted Count (%)]			
	Baseline	**2030**	**2050**	**2080**
Alameda	17 (0.01%)	32 (0.02%)	84 (0.06%)	594 (0.44%)
Contra Costa	3 (0.002%)	37 (0.03%)	187 (0.13%)	780 (0.58%)
San Francisco	3 (0.002%)	7 (0.005%)	9 (0.007%)	107 (0.08%)
San Mateo	84 (0.06%)	1,425 (1.06%)	1,662 (1.24%)	2,117 (1.58%)
Total	**107 (0.08%)**	**1,501 (1.12%)**	**1,942 (1.45%)**	**3,598 (2.69%)**
County	**SLR + Delta [Overhead Count (%)]**			
	Baseline	**2030**	**2050**	**2080**
Alameda	18 (0.003%)	48 (0.007%)	99 (0.01%)	422 (0.06%)
Contra Costa	17 (0.003%)	100 (0.02%)	662 (0.10%)	927 (0.14%)
San Francisco	0 (0%)	0 (0%)	8 (0.001%)	61 (0.01%)
San Mateo	182 (0.03%)	857 (0.13%)	1,077 (0.16%)	1,836 (0.28%)
Total	**217 (0.03%)**	**1,005 (0.15%)**	**1,846 (0.28%)**	**3,246 (0.49%)**

Note: Percentages are relative to total distribution pad-mounted and overhead transformers within the PG&E service area.

Climate Hazard: Wildfire

The number of overhead line-miles in HFRAs are relatively even among Alameda, Contra Costa, and San Mateo counties, with no line-miles in San Francisco County (Table 3.1.1-38).

Table 3.1.1-40. Distribution line-miles in HFRAs in the Bay Area Region, by county.

County	Overhead Distribution Line-Miles in HFRAs
Alameda	346 (0.55%)
Contra Costa	439 (0.70%)
San Francisco	0 (0%)
San Mateo	367 (0.59%)
Total	**1,152 (1.85%)**

Note: Percentages are relative to total overhead distribution line-miles within the PG&E service area.

Climate Hazard: Drought-Driven Subsidence

Drought-driven subsidence is not considered to be a climate change issue for distribution assets at this time.

Central Valley Region

Summary

The distribution system in the Central Valley Region comprises approximately 30,800 total miles of primary overhead infrastructure and approximately 6,700 total miles of primary underground infrastructure (Figure 3.1.1- 60). Additionally, the system includes approximately 227,000 overhead distribution transformers, 39,000 pad-mounted transformers, and 218,000 subsurface features.

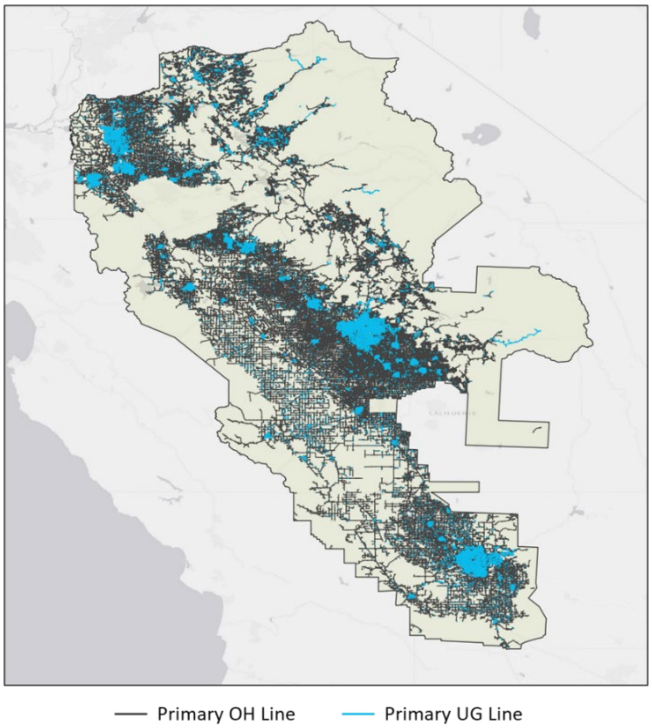


Figure 3.1.1- 60. Primary overhead (OH) and underground (UG) conductor locations throughout the Central Valley Region.

Climate Hazard: Temperature

Much of PG&E's electric distribution in the Central Valley Region, as represented by transformer location, is projected to be exposed to higher temperatures by 2050 during a 1-in-10-year heat wave (Figure 3.1.1- 61), indicating that distribution systems throughout the region may be vulnerable to impacts of high heat.

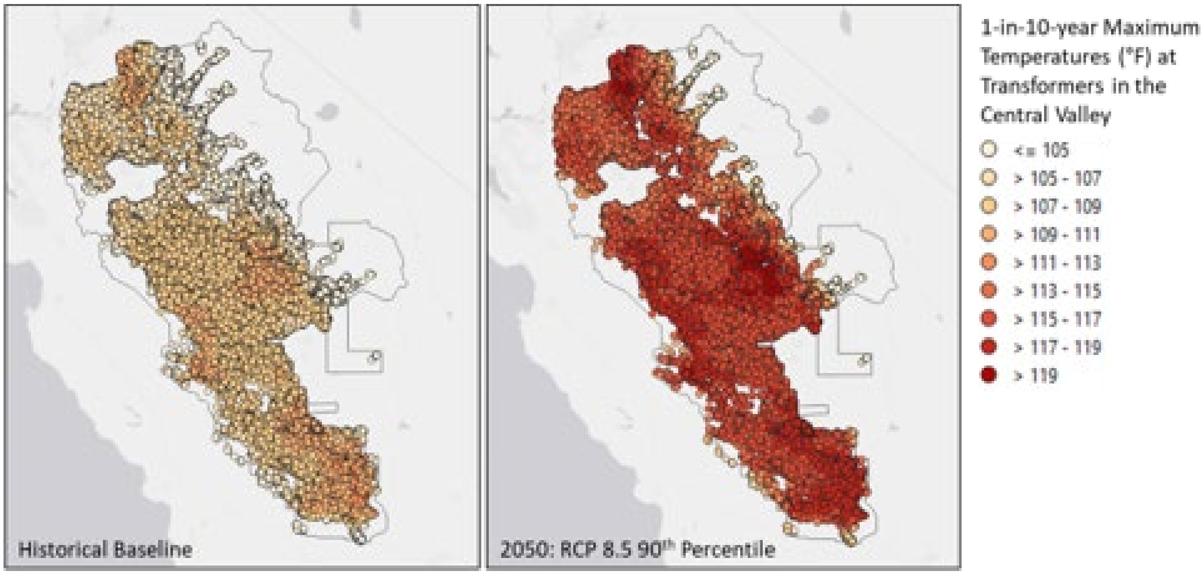


Figure 3.1.1- 61. Baseline and projected 1-in-10-year ambient temperatures, 3three-day-weighted average maximum temperature at the baseline and projected 1-in-10-year ambient temperatures at transformer locations in the Central Valley Region.

Currently, air conditioning use in warmer months and heat waves are common in the region and air conditioning adoption is expected to rise as temperatures increase in the future. More prolonged and extreme periods of high heat also may increase demand among customers already using in-home air conditioning in the Central Valley Region, contributing to both chronic and acute impacts on the system during high heat and high load periods.

Climate Hazard: Flooding and Precipitation

Overall, 3.2 percent and 7.1 percent of Central Valley Region pad-mounted and overhead transformers are within the FEMA 100-year and 500-year floodplains, respectively, representing relatively small proportions of these assets in total (Table 3.1.1-39) and indicating that the vulnerability to flooding may be greatest during very large and low-probability flood events. Vulnerability to flooding will depend on the construction specifics of the supporting structure.

Table 3.1.1-41. Counts of PG&E electric distribution assets located within FEMA 100-year or 500-year floodplains.

Assets	FEMA 100-year	FEMA 500-year
Pad-Mounted Transformers	2,090 (1.6%)	9,099 (6.8%)
Overhead Transformers	23,488 (3.5%)	47,369 (7.1%)
Total	**25,578 (3.2%)**	**56,468 (7.1%)**

Note: Percentages are relative to total electric distribution assets within the PG&E service area.

Aside from Kern County, overhead and pad-mounted exposure to landslides is relatively low or does not exist in most counties. (Table 3.1.1-40).

Table 3.1.1-42. Overhead and pad-mounted transformers in the high landslide risk zone, by county.

County	Overhead	Pad-Mounted
Alpine	0 (0%)	0 (0%)
Amador	0 (0%)	0 (0%)
Calaveras	0 (0%)	0 (0%)
Fresno	0 (0%)	0 (0%)
Kern	420 (0.06%)	58 (0.04%)
Kings	0 (0%)	0 (0%)
Madera	0 (0%)	0 (0%)
Mariposa	0 (0%)	0 (0%)
Merced	10 (0.002%)	1 (0.001%)
San Joaquin	25 (0.004%)	1 (0.001%)
Stanislaus	20 (0.003%)	1 (0.001%)
Tulare	0 (0%)	0 (0%)
Tuolumne	0 (0%)	0 (0%)
Total	**475 (0.07%)**	**61 (0.05%)**

Note: Percentages are relative to total overhead and pad-mounted transformers within the PG&E service area.

Climate Hazard: Sea Level Rise

By 2050, 0.44 percent of pad-mounted transformers and overhead distribution transformers are projected to be exposed to flooding due to SLR, due to levee overtopping in the Central Valley Region (Table 3.1.1-41).

Table 3.1.1-43. Total count of electric distribution pad-mounted and overhead transformers projected to be exposed to SLR during the 100-year storm over time across counties in the Central Valley Region.

Asset	Baseline	2030	2050	2080
Pad-Mounted Transformers	25 (0.02%)	754 (0.56%)	786 (0.59%)	1,420 (1.06%)
Overhead Transformers	1,004 (0.15%)	2,469 (0.37%)	2,767 (0.42%)	4,948 (0.74%)
Total	**1,029 (0.13%)**	**3,223 (0.40%)**	**3,553 (0.44%)**	**6,368 (0.80%)**

Note: Percentages are relative to total pad-mounted and overhead transformers within the PG&E service area.

Climate Hazard: Wildfire

Overall, 9.36 percent of all overhead distribution line-miles in HFRAs are in the Central Valley Region (Table 3.1.1- 42). The number of overhead line-miles in HFRAs in the Central Valley Region are greatest in Calaveras and Tuolumne counties (Table 3.1.1- 42).

Table 3.1.1- 44. Distribution line-miles in HFRAs by Central Valley Region county.

County	Overhead Distribution Line-Miles (% Within the County) in HFRAs
Alpine	4 (0.01%)
Amador	754 (1.21%)
Calaveras	1,275 (2.05%)
Fresno	877 (1.41%)
Kern	122 (0.20%)
Kings	0 (0%)
Madera	846 (1.36%)
Mariposa	850 (1.36%)
Merced	9 (0.01%)
San Joaquin	2 (0.004%)
Stanislaus	7 (0.01%)
Tulare	84 (0.14%)
Tuolumne	1,000 (1.60%)
Total	**5,831 (9.36%)**

Note: Percentages are relative to distribution line-miles within the PG&E service area.

Climate Hazard: Drought-Driven Subsidence

Drought-driven subsidence is not considered to be a climate change issue for distribution assets at this time.

Sierra Region

Summary

The distribution system in the Sierra Region comprises approximately 20,600 total miles of primary overhead infrastructure and approximately 4,500 total miles of primary underground infrastructure (Figure 3.1.1- 62). Additionally, the system includes approximately 165,000 overhead distribution transformers, 31,000 pad-mounted transformers, and 144,000 subsurface features.

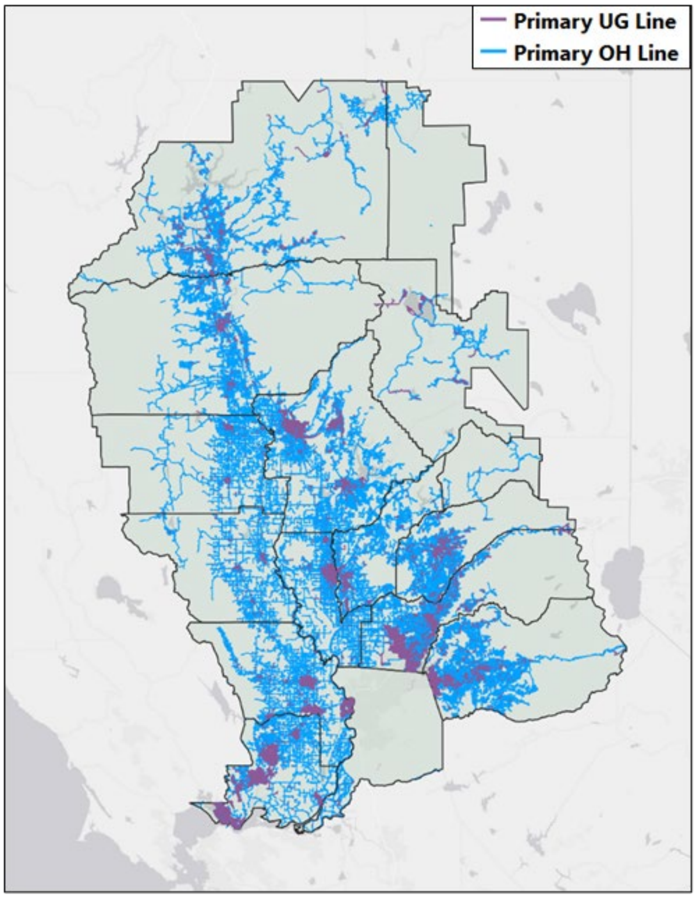


Figure 3.1.1- 62. Primary overhead (OH) and underground (UG) conductor locations throughout the Sierra Region.

Climate Hazard: Temperature

Much of PG&E's electric distribution in the Sierra Region, as represented by transformer location, is projected to be exposed to much higher temperatures by 2050 during a 1-in-10-year heat wave (Figure 3.1.1- 63), indicating that distribution systems throughout the region may be vulnerable to the impacts of high heat.

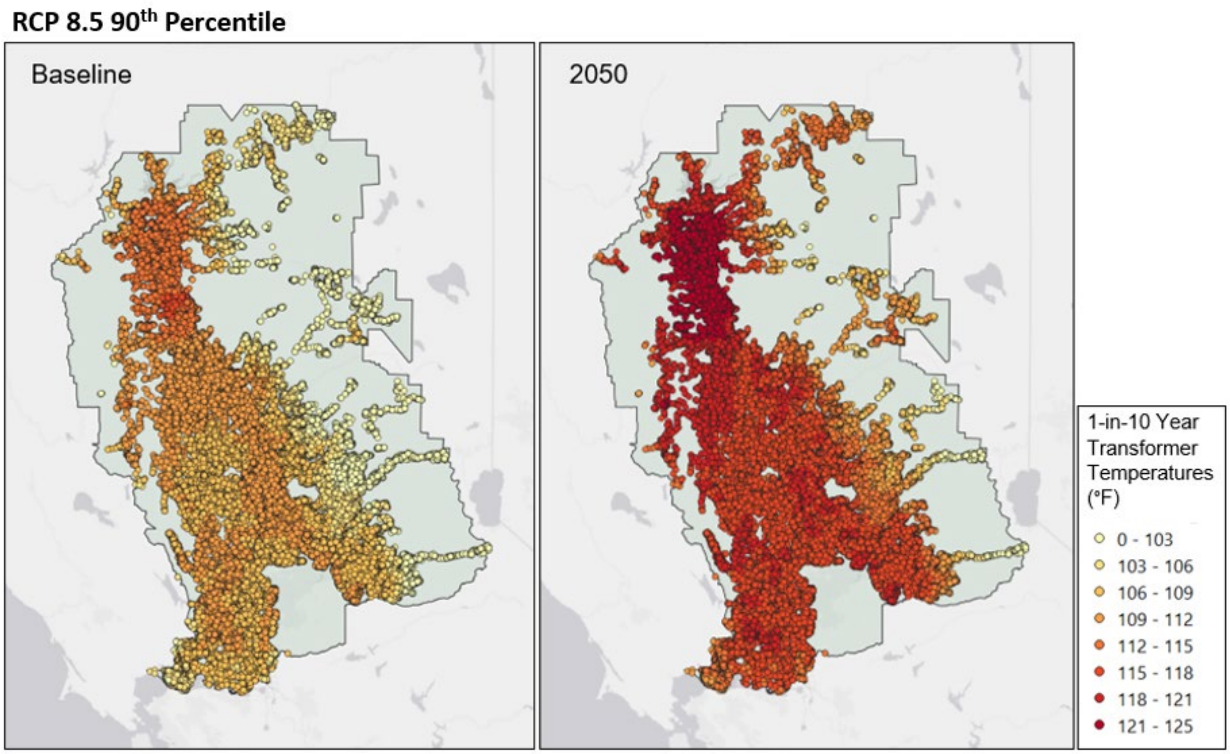


Figure 3.1.1- 63. Baseline and projected 3-day weighted, 1-in-10-year ambient temperatures at transformer locations throughout the Sierra Region.

Climate Hazard: Flooding and Precipitation

Overall, 2.6 percent and 4.2 percent of the Sierra Region pad-mounted and overhead transformers are within the FEMA 100-year and 500-year floodplains, respectively, representing relatively small proportions of these assets in total (Table 3.1.1-43) and indicating a low vulnerability to flooding that may be greater during very large and low-probability flood events. Vulnerability to flooding will depend on the construction specifics of the supporting structure.

Table 3.1.1-45. Counts of PG&E electric distribution assets located within FEMA 100-year or 500-year floodplains.

Asset	FEMA 100-year	FEMA 500-year
Pad-Mounted Transformers	2,694 (2.0%)	5,603 (4.2%)
Overhead Transformers	18,313 (2.7%)	27,759 (4.2%)
Total	**21,007 (2.6%)**	**33,362 (4.2%)**

Note: Percentages are relative to total electric distribution assets within the PG&E service area.

Aside from Solano County, overhead and pad-mounted transformer exposure to landslides is relatively low or does not exist in most counties (Table 3.1.1-44).

Table 3.1.1-46. Overhead and pad-mounted transformers in the high landslide risk zone, by county.

County	Overhead	Pad-Mounted
Butte	699 (0.10%)	103 (0.08%)
Colusa	92 (0.01%)	2 (0.001%)
El Dorado	0 (0%)	0 (0%)
Glenn	21 (0.003%)	1 (0.001%)
Lassen	0 (0%)	0 (0%)
Nevada	0 (0%)	0 (0%)
Placer	0 (0%)	0 (0%)
Plumas	0 (0%)	0 (0%)
Sacramento	0 (0%)	0 (0%)
Shasta	48 (0.01%)	3 (0.002%)
Sierra	0 (0%)	0 (0%)
Solano	2,272 (0.34%)	1,001 (0.75%)
Sutter	0 (0%)	0 (0%)
Tehama	9 (0.003%)	0 (0%)
Yolo	0 (0%)	0 (0%)
Yuba	0 (0%)	0 (0%)
Total	**3,111 (0.47%)**	**1,110 (0.83%)**

Note: Percentages are relative to total overhead and pad-mounted transformers within the PG&E service area.

Climate Hazard: Sea Level Rise

Overall, the total number of assets projected to be inundated by SLR flooding is low (Table 3.1.1-45).

Table 3.1.1-47. Total count of electric distribution pad-mounted and overhead transformers projected to be exposed to SLR during the 100-year storm over time across counties in the Sierra Region.

Asset	Baseline	2030	2050	2080
Pad-Mounted Transformers	6 (0.004%)	26 (0.02%)	29 (0.02%)	58 (0.04%)
Overhead Transformers	198 (0.03%)	564 (0.08%)	672 (0.10%)	929 (0.14%)
Total	**204 (0.03%)**	**590 (0.07%)**	**701 (0.09%)**	**987 (0.12%)**

Note: Percentages are relative to total pad-mounted and overhead transformers within the PG&E service area.

Climate Hazard: Wildfire

Overall, 14.36 percent of all overhead distribution line-miles in HFRAs are in the Sierra Region (Table 3.1.1-46). The number of overhead line-miles in HFRAs in the Sierra Region are greatest in Butte, El Dorado, Nevada, and Shasta counties (Table 3.1.1-46).

Table 3.1.1-48. Distribution line-miles in HFRAs by Sierra Region county.

County	Overhead Distribution Line-Miles (% Within the County) in HFRAs
Butte	1,090 (1.75%)
Colusa	33 (0.05%)
El Dorado	2,098 (3.37%)
Glenn	67 (0.11%)
Lassen	61 (0.1%)
Nevada	1,365 (2.19%)
Placer	956 (1.53%)
Plumas	251 (0.4%)
Sacramento	0 (0%)
Shasta	1,629 (2.61%)
Sierra	100 (0.16%)
Solano	139 (0.22%)
Sutter	0 (0%)
Tehama	684 (1.1%)
Yolo	19 (0.03%)
Yuba	456 (0.73%)
Total	**8,983 (14.36%)**

Note: Percentages are relative to total distribution line-miles within the PG&E service area.

Climate Hazard: Drought-Driven Subsidence

Drought-driven subsidence is not considered to be a climate change issue for distribution assets at this time.

North Coast Region

Summary

The distribution system in the North Coast Region comprises approximately 10,500 total miles of primary overhead conductor and approximately 2,400 total miles of primary underground cable (Figure 3.1.1- 64). Additionally, the system includes approximately 91,000 overhead distribution transformers, 13,000 pad-mounted transformers, and 100,000 subsurface features.

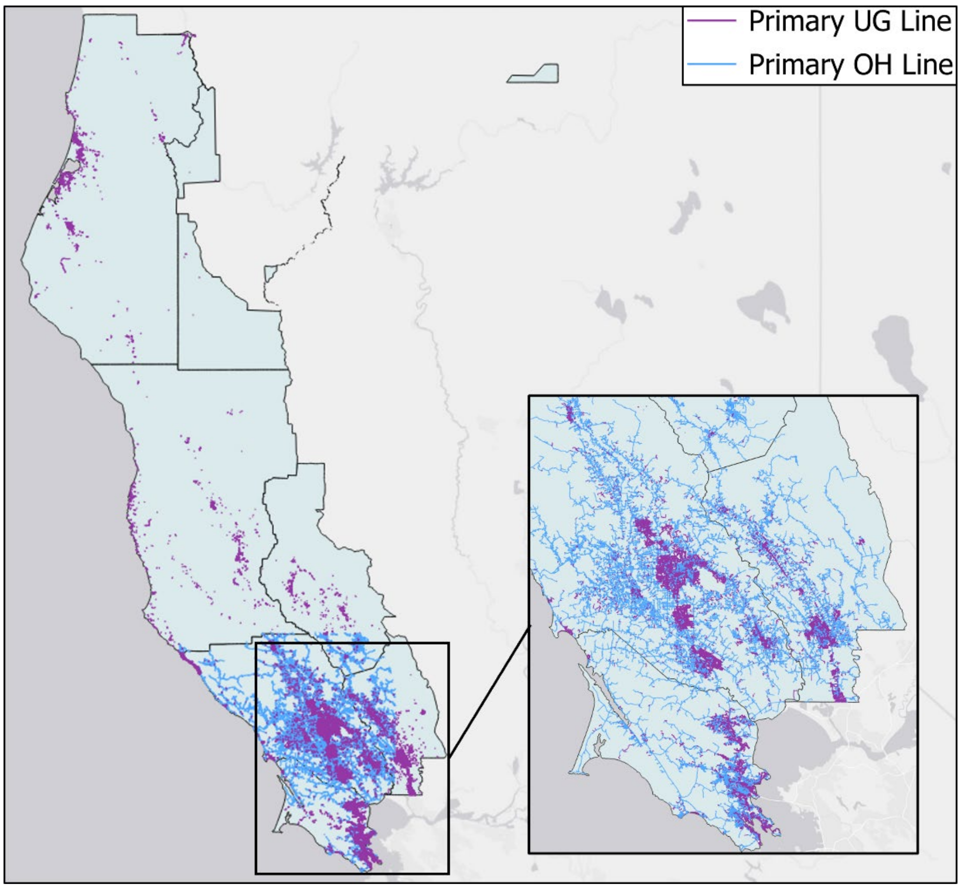


Figure 3.1.1- 64. Primary overhead (OH) and underground (UG) conductor locations throughout the North Coast Region.

Climate Hazard: Temperature

Temperature increase in the future is projected to be higher in southern parts of the North Coast Region, indicating that distribution assets in these areas may be more vulnerable to future high heat impacts (Figure 3.1.1- 65). Increasing average temperatures are expected to drive steady increases in cooling demand across the system over time. In addition, sustained high temperatures and peak loads that occur during future heat waves may have the most significant impacts on electric distribution assets.

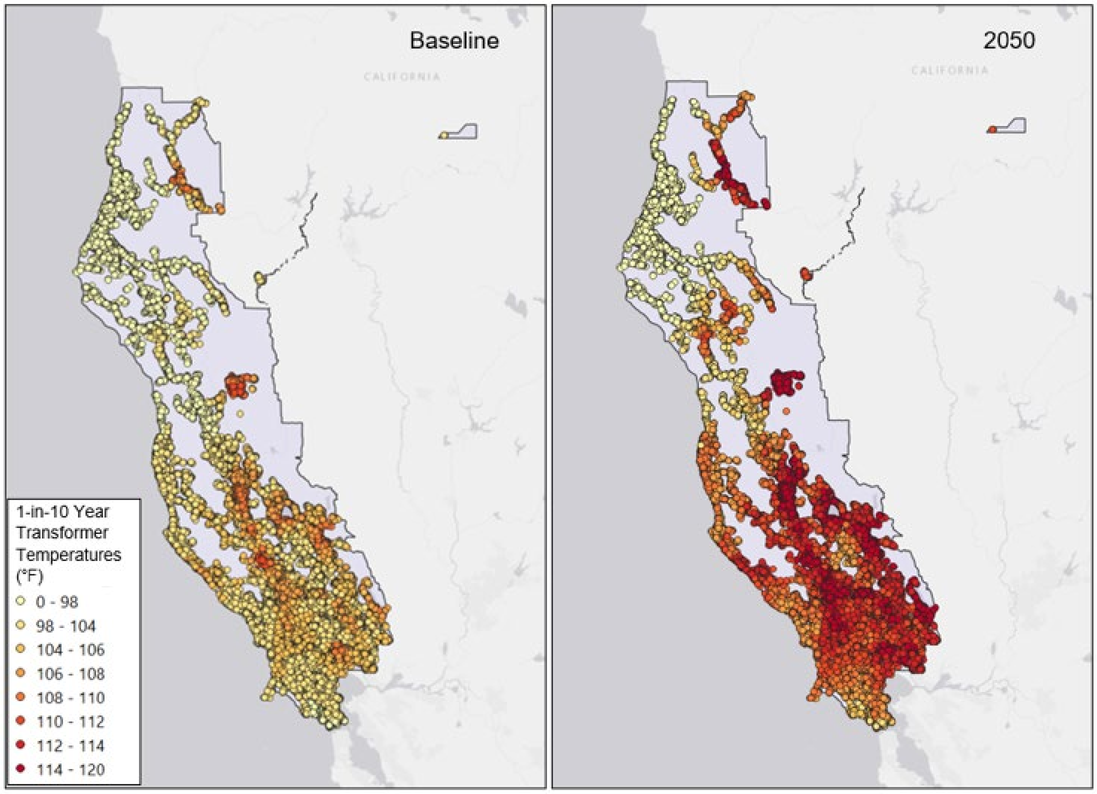


Figure 3.1.1- 65. Baseline and projected 1-in-10-year ambient temperatures at transformer locations throughout the North Coast Region.

Climate Hazard: Flooding and Precipitation

Overall, 1.1 percent and 1.4 percent of the North Coast Region pad-mounted and overhead transformers are within the FEMA 100-year and 500-year floodplains, respectively, representing relatively small proportions of these assets in total (Table 3.1.1-47) and indicating low vulnerability to flooding even during very large and low-probability flood events. Vulnerability to flooding will depend on the construction specifics of the supporting structure.

Table 3.1.1-49. Counts of PG&E electric distribution assets located within FEMA 100-year or 500-year floodplains.

Asset	FEMA 100-year	FEMA 500-year
Pad-Mounted Transformers	1,187 (0.9%)	1,928 (1.4%)
Overhead Transformers	7,406 (1.1%)	9,469 (1.4%)
Total	**8,593 (1.1%)**	**11,397 (1.4%)**

Note: Percentages are relative to total electric distribution assets within the PG&E service area.

Aside from Marin and Sonoma counties, overhead and pad-mounted transformer exposure to landslides is relatively low in most counties (Table 3.1.1-48).

Table 3.1.1-50. Overhead and underground distribution line-miles in the high landslide risk zone, by county.

County	Overhead	Pad-Mounted
Humboldt	2,326 (0.35%)	144 (0.11%)
Lake	2,868 (0.43%)	234 (0.17%)
Marin	9,929 (1.49%)	2,132 (1.59%)
Mendocino	4,310 (0.65%)	202 (0.15%)
Napa	2,632 (0.39%)	937 (0.70%)
Trinity	840 (0.13%)	8 (0.01%)
Siskiyou	20 (0.003%)	6 (0.004%)
Sonoma	9,845 (1.48%)	1,286 (0.96%)
Trinity	840 (0.13%)	8 (0.01%)
Total	**32,770 (4.92%)**	**4,949 (3.69%)**

Note: Percentages are relative to total distribution line-miles within the PG&E service area.

Climate Hazard: Sea Level Rise

By 2050, 0.18 percent of pad-mounted transformers and overhead distribution transformers are projected to be exposed to flooding due to SLR in the North Coast Region, indicating very low vulnerability to SLR inundation over time (Table 3.1.1-49).

Table 3.1.1-51. Total count of electric distribution pad-mounted and overhead transformers projected to be exposed to SLR during the 100-year storm over time across counties in the North Coast Region.

Asset	Baseline	2030	2050	2080
Pad-Mounted Transformers	161 (0.12%)	306 (0.23%)	424 (0.32%)	743 (0.55%)
Overhead Transformers	570 (0.09%)	845 (0.13%)	1,034 (0.16%)	1,554 (0.23%)
Total	**731 (0.09%)**	**1,151 (0.14%)**	**1,458 (0.18%)**	**2,297 (0.29%)**

Note: Percentages are relative to total pad-mounted and overhead transformers within the PG&E service area.

Climate Hazard: Wildfire

Overall, 9.14 percent of all overhead distribution line-miles are in HFRAs in the North Coast Region (Table 3.1.1-50). The number of overhead line-miles in are greatest in Mendocino and Sonoma counties (Table 3.1.1-50).

Table 3.1.1-52. Distribution line-miles in HFRAs by North Coast Region county.

County	Overhead Distribution Line-Miles in HFRAs
Humboldt	813 (1.30%)
Lake	699 (1.12%)
Marin	529 (0.85%)
Mendocino	1,460 (2.34%)
Napa	539 (0.86%)
Siskiyou	5 (0.01%)
Sonoma	1,481 (2.38%)
Trinity	168 (0.27%)
Total	**5,693 (9.14%)**

Note: Percentages are relative to total distribution line-miles within the PG&E service area.

Climate Hazard: Drought-Driven Subsidence

Drought-driven subsidence is not considered to be a climate change issue for distribution assets at this time.

Central Coast Region

Summary

The distribution system in the Central Coast Region comprises approximately 12,500 total miles of primary overhead infrastructure and approximately 5,400 total miles of primary underground infrastructure (Figure 3.1.1- 66). Additionally, the system includes approximately 105,000 overhead distribution transformers, 27,000 pad-mounted transformers, and 233,000 subsurface features.

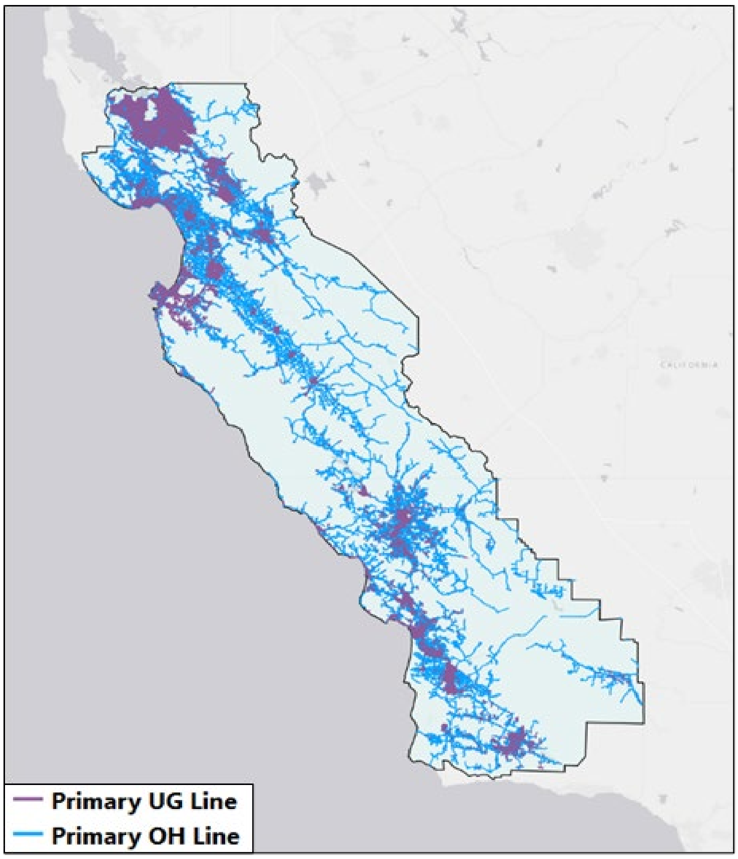


Figure 3.1.1- 66. Primary overhead (OH) and underground (UG) conductor locations throughout the Central Coast Region.

Climate Hazard: Temperature

Temperature increase in the future is projected to be higher throughout the Central Coast Region, indicating that distribution assets throughout may be vulnerable to the impacts of high heat (Figure 3.1.1- 67). Increasing average temperatures are expected to drive steady increases in cooling demand across the system over time. In addition, sustained high temperatures and peak loads that occur during future heat waves may have the most significant impacts on electric distribution assets.

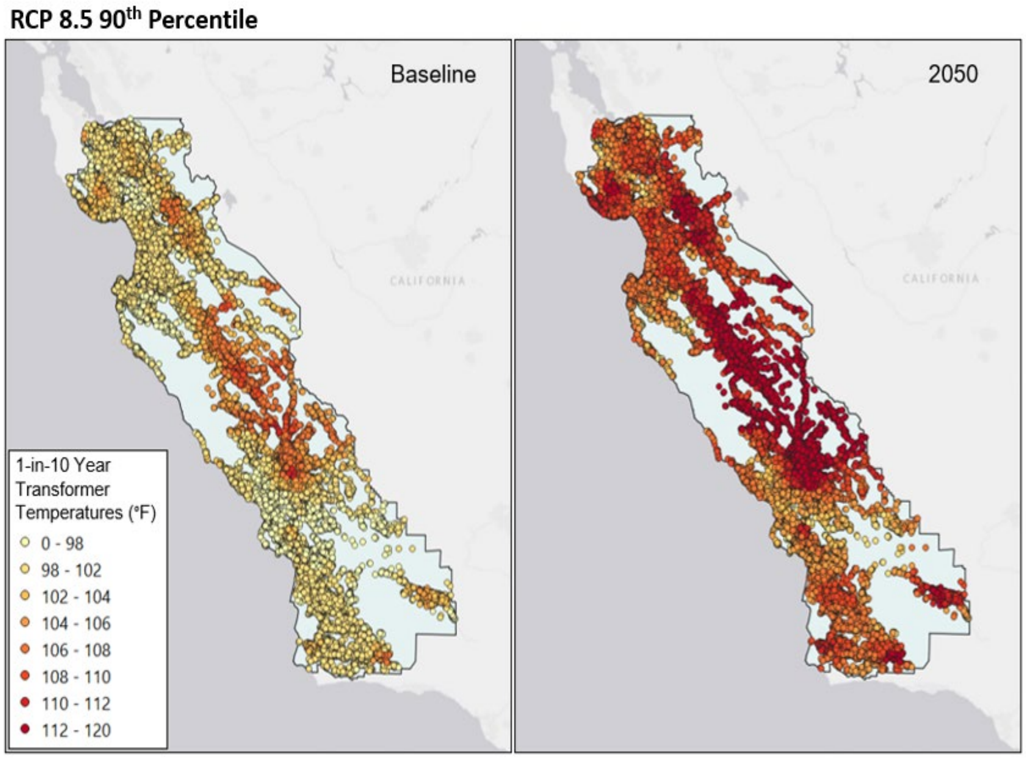


Figure 3.1.1- 67. Baseline and projected 3-day weighted, 1-in-10-year ambient temperatures at transformer locations throughout the Central Coast Region.

Climate Hazard: Flooding and Precipitation

Overall, 1.2 percent and 4.0 percent of the Central Coast Region pad-mounted and overhead transformers are within the FEMA 100-year and 500-year floodplains, respectively, representing relatively small proportions of these assets in total (Table 3.1.1-51) and indicating low vulnerability to flooding that may be greatest during very large and low-probability flood events. Vulnerability to flooding will depend on the construction specifics of the supporting structure.

Table 3.1.1-53. Counts of PG&E electric distribution assets located within FEMA 100-year or 500-year floodplains.

Asset	FEMA 100-year	FEMA 500-year
Pad-Mounted Transformers	1,926 (1.4%)	8,625 (6.4%)
Overhead Transformers	7,357 (1.1%)	23,706 (3.6%)
Total	**9,283 (1.2%)**	**32,331 (4.0%)**

Note: Percentages are relative to total electric distribution assets within the PG&E service area.

Overhead and pad-mounted transformer exposure to landslides is concentrated in Santa Clara and Monterey counties and is very low or nonexistent in others (Table 3.1.1-52).

Table 3.1.1-54. Overhead and underground distribution line-miles in the high landslide risk zone, by county.

County	Overhead	Pad-Mounted
Monterey	2,488 (0.37%)	976 (0.73%)
San Benito	398 (0.06%)	26 (0.02%)
San Luis Obispo	122 (0.02%)	11 (0.01%)
Santa Barbara	13 (0.002%)	0 (0%)
Santa Clara	1,077 (0.16%)	58 (0.04%)
Santa Cruz	224 (0.03%)	28 (0.02%)
Total	**4,322 (0.65%)**	**1099 (0.82%)**

Note: Percentages are relative to total distribution line-miles within the PG&E service area.

Climate Hazard: Sea Level Rise

By 2050, 0.02 percent of pad-mounted transformers and overhead distribution transformers are projected to be exposed to flooding due to SLR in the Central Coast Region, indicating very low vulnerability to SLR inundation over time (Table 3.1.1-53).

Table 3.1.1-55. Total count of electric distribution pad-mounted and overhead transformers projected to be exposed to SLR during the 100-year storm over time across counties in the Central Coast Region.

Asset	Baseline	2030	2050	2080
Pad-Mounted Transformers	22 (0.02%)	62 (0.05%)	115 (0.09%)	490 (0.37%)
Overhead Transformers	36 (0.01%)	59 (0.01%)	76 (0.01%)	331 (0.05%)
Total	**58 (0.01%)**	**121 (0.02%)**	**191 (0.02%)**	**821 (0.10%)**

Note: Percentages are relative to total pad-mounted and overhead transformers within the PG&E service area.

Climate Hazard: Wildfire

Overall, 6.83 percent of all overhead distribution line-miles in HFRAs are in the Central Coast Region (Table 3.1.1-54). The number of overhead line-miles in HFRAs are greatest in San Luis Obispo County (Table 3.1.1-54).

Table 3.1.1-56. Distribution line-miles in HFRAs by Central Coast Region county.

County	Overhead Distribution Line-Miles in HFRAs
Monterey	766 (1.23%)
San Benito	221 (0.36%)
San Luis Obispo	1,316 (2.11%)
Santa Barbara	476 (0.76%)
Santa Clara	597 (0.96%)
Santa Cruz	879 (1.41%)
Total	**4,256 (6.83%)**

Note: Percentages are relative to total distribution line-miles within the PG&E service area.

Climate Hazard: Drought-Driven Subsidence

Drought-driven subsidence is not considered to be a climate change issue for distribution assets at this time.

Section 3.1.2: Gas

Table of Contents

3.1.2 Gas

3.1.2 Gas

3.1.2.a Gas Transmission

Asset Family Introduction

The gas transmission system transports natural gas over long distances. Pressure in the system is increased by compressor stations and reduced by regulator stations. This section considers only the linear gas transmission pipelines themselves. Compressors and regulator stations are distinct asset families and are discussed in Section 3.1.2.c: Gas Compression and Processing, and Storage and Section 3.1.2.d: Gas Measurement and Control Stations.

Gas transmission pipelines consist of the pipe itself and major components, such as valves and fittings. PG&E’s gas transmission pipelines are generally buried approximately 3 feet belowground, including pipelines that cross through waterways and steep terrain.

Key Findings

Climate Hazard	Climate Change Risk and Potential Adaptation Measures
Temperature	Low (off-ramped)
	• PG&E's gas transmission pipelines are made of steel and are buried underground; they are not sensitive to changes in underground temperature. Higher ambient or extreme tempeartures are not considered a climate change issue at this time and the climate hazard is off-ramped.
Flooding and Precipitation	Moderate
	• Although buried gas transmission pipelines are mostly protected from risks related to surface flooding, some portions of PG&E's transmission pipeline network have been threatened by landslides or debris flows due to heavy rain. Vulnerability may increase in areas of higher future heavy rain. • Adaptation options include, but are not limited, to system hardening in areas of highest landside risk.
Sea Level Rise	Low (off-ramped)
	• The number of line-miles of gas transmission pipelines exposed to SLR-related inundation is very low; sensitivity to water intrusion and corrosion is also low. SLR is not considered a climate change issue at this time and the climate hazard is off-ramped.
Wildfire	Low (off-ramped)
	• Because gas transmission pipelines are buried underground, the exposure to extreme heat from wildfires is minimal. The erosion risk from fire-scarred areas is a more relevant risk to gas transmission pipelines than the risk of extreme heat from wildfires; however, transmission pipelines have not experienced erosion events related to wildfire scar areas in recent years. • Because few miles of pipeline are exposed to wildfire threats and the likelihood of damage is low, the climate change risk is considered to be low and the climate hazard is off-ramped.

3.1.2.a Gas Transmission

Drought-Driven Subsidence	Low (off-ramped)
	• Although impacts from subsidence on transmission pipelines are possible, subsidence is not a concern for the majority of PG&E’s service area. PG&E has the capacity to monitor subsidence where it does occur and adapt to changes. The climate change risk to gas transmission of drought-driven subsidence is low and the climate hazard is off-ramped.

Climate Hazards

This section describes climate hazards that may affect gas transmission assets, including temperature, flooding and precipitation, sea level rise (SLR), wildfire, and drought-driven subsidence.

Temperature

Nearly all of PG&E's gas transmission pipelines are buried, on average, 3 feet underground. Most transmission pipes are made of steel,[1] which is generally resistant to fluctuations in ground temperature, and thus gas transmission pipeline infrastructure should not be affected by higher air temperatures within the plausible ranges projected in 2050. The climate change risk to gas transmission of high ambient or extreme air temperatures is **low** and the climate hazard is **off-ramped**.

Flooding and Precipitation

Exposure and Sensitivity

Gas transmission pipelines in all FEMA 100-year and 500-year floodplains may see increased exposure to flooding because heavy precipitation events are projected to become more frequent in many parts of the service area.

Given that gas transmission pipelines are buried underground and are constructed to withstand water inundation, gas transmission pipelines are not very sensitive to heavy rain and the resulting flooding; they also have low sensitivity to corrosion. Sensitivity to flooding and precipitation hazards may include the following:

- **Damage from landslides and erosion:** Buried pipelines may be sensitive to landslides, scour near waterways, and erosion hazards, which can cause permanent ground displacement and may result in a gas leak or pipeline rupture.[2] Due to very heavy rain in March 2023, PG&E's geosciences team determined that two gas transmission pipelines in Novato, California, were at risk due to a landslide and PG&E promptly rerouted the service. PG&E monitors creek and riverbed erosion proximal to gas transmission pipelines.
- **Buoyancy impacts:** Water-saturated ground, either during prolonged or more frequent rain or flooding, may buoy buried gas transmission pipelines. This buoyancy effect only affects pipes that are more than 12 inches in diameter because smaller pipes are neutrally buoyant. In some areas, PG&E has installed anchors to mitigate the impacts of pipe buoyancy.

[1] A few short miles (~6.8 miles) of 60-psi transmission pipelines in PG&E's service area are plastic.
[2] Marinos et al. 2017. "Landslide Geohazard for Pipelines of Natural Gas Transport." https://www.researchgate.net/publication/318734820_LANDSLIDE_GEOHAZARD_FOR_PIPELINES_OF_NATURAL_GAS_TRANSPORT#:~:text=Landslides%20represent%20a%20significant%20hazard,long%20periods%20of%20service%20disruption.&text=Pre%2Dexisting%20landslide%20on%20the,where%20a%20pipeline%20route%20runs

3.1.2.a Gas Transmission

Climate Change Vulnerability

Analytical Metrics

Key vulnerability metrics for plausible changes in future flooding and precipitation hazards are (1) the number of miles of gas transmission pipelines in FEMA 100-year and 500-year floodplains, and (2) the locations of transmission pipelines in areas of high landslide risk, overlayed with areas projected to see the greatest increase in heavy precipitation by 2050.

Results

Overall, 13.6 percent and 22.1 percent of gas transmission pipeline-miles are in FEMA 100-year and 500-year floodplains, respectively (Table 3.1.2-1). Future vulnerability to flooding and precipitation-related hazards may be highest in areas with more pipeline-miles in current floodplains, including the Central Valley and Sierra Regions (Table 3.1.2-1). In the future, gas transmission pipelines in the Sacramento-San Joaquin Delta (Central Valley Region) may have increased vulnerability to flooding due to the risk of levee overtopping and breaching.

Table 3.1.2-1. Number of pipeline-miles in FEMA 100-year and 500-year floodplains, by region.

Region	100-year	500-year
Bay Area	65 (1.0%)	114 (1.8%)
Central Valley	215 (3.4%)	369 (6.2%)
Sierra	409 (6.4%)	605 (9.5%)
North Coast	86 (1.3%)	105 (1.6%)
Central Coast	92 (1.4%)	220 (3.4%)
Total	**867 (13.6%)**	**1,413 (22.1%)**

Notes:

- *The FEMA 500-year floodplain miles are in addition to (i.e., are outside of) the FEMA 100-year floodplain miles but are in a FEMA 500-year floodplain.*
- *Percentages are relative to total pipeline-miles within the PG&E service area.*

Counties through which gas transmission pipeline-miles pass that also have high landslide risk and higher projected increases in high precipitation by 2050 include Contra Costa County (Bay Area Region), Tehama and Solano counties (Sierra Region), and Trinity and Humboldt counties (North Coast Region).

See the Gas Transmission Regional Reports section for more details regarding the vulnerabilities of specific geographies.

Adaptive Capacity and Climate Change Risk

PG&E's adaptive capacity to flooding and precipitation-related risks to gas transmission is influenced by the following factors.

3.1.2.a Gas Transmission

Planning Capacities

- **Modeling landslide and debris flow:** PG&E uses the Tactical Analysis Mapping Integration (TAMI) application, which incorporates a rainfall algorithm and uses statistical estimates of landslide and debris flow triggers based on historical events. TAMI can assess overall slope failure potential for specific pipeline segments during and following major rainstorms.[3] This assessment provides PG&E with enhanced situational awareness such that action can be taken to prevent or mitigate the impacts of ground movement events.
- **Redundancy:** Redundancy provides resilience to gas operation services because service could continue along other routes if damage to transmission pipelines or impacts on operations occur.

Operational Capacities

- **Monitoring:** PG&E relies on the use of the Gas Transmission Geographic Information System, light detection and ranging (LiDAR) data, landslide monitoring, and National Oceanic and Atmospheric Administration precipitation forecasts to enhance its response preceding and following a significant rainfall event.[4]
- **Pipeline patrols to identify ground movements:** Ground-based and aerial pipeline patrol personnel inspect stream crossings and areas with a high risk of landslides to identify and potentially mitigate landslide or debris problems before damage to gas transmission pipelines occurs. Patrol findings are incorporated into PG&E's modeling.[5]
- **Emergency response capability:** PG&E has a robust portable liquefied natural gas (LNG)/compressed natural gas (CNG) operation that can respond during emergencies to reduce outage size and duration. The types of events contemplated in this assessment also may affect transportation infrastructure (highways and roads), which could impede the use of this emergency portable LNG/CNG equipment. Since 2011, PG&E has installed automated valves throughout the service area that can remotely shut off gas flow and isolate portions of its system, reducing the consequence of loss of containment.[6]

Although plans and processes are in place to mitigate and respond to flood events, recent extreme weather events indicate that PG&E has an opportunity to incorporate more extreme weather scenario conditions, which are projected to occur at greater intensities and frequencies by 2050, into its future mitigation plans. This adaptive capacity is considered to be moderate and the climate change risk of flooding and precipitation to gas transmission pipelines is considered to be **moderate**.

---

[3] PG&E. 2020. Utility Procedure TD-4814P-01: Gas Transmission Heavy Rainfall Preparation and Response.
[4] *Ibid*.
[5] *Ibid*.
[6] Dell, S. 2016. "PG&E Completes 11th Safety Recommendation from NTSB by Installing 235 Automatic, Remote Shutoff Valves." PG&E. https://investor.pgecorp.com/news-events/press-releases/press-release-details/2016/PGE-Completes-11th-Safety-Recommendation-from-NTSB-by-Installing-235-Automatic-and-Remote-Shut-Off-Valves/default.aspx.

Potential Adaptation and Resilience Measures

Actions to further mitigate flooding and precipitation risk to gas transmission pipelines could include the following.

Planning Options

- **System hardening:** In areas of highest landslide risk, PG&E may consider further increasing transmission pipeline resilience to landslide damage through physical measures that expand on the current work in PG&E's geohazards program, such as valve automation, pipeline strain monitoring, or landslide monitoring. Additional measures to address flood-related risks include installing anchors on large-diameter pipelines in the Sacramento-San Joaquin Delta area subject to buoyancy-related risks, increasing erosion control, installing riverbank erosion control systems, installing concrete mats, and relocating pipes below anticipated scour or erosion depths.

Sea Level Rise

Exposure and Sensitivity

As sea level rises, coastal assets may be exposed to increasing coastal inundation, especially during large storms.

Gas transmission pipelines may be sensitive to the impacts of SLR in the following ways:

- **Buoyancy impacts:** Rising coastal water tables may buoy buried gas transmission pipelines. This buoyancy effect adds stress on the pipeline and could move the pipeline toward the surface; as noted above, this effect only occurs with pipe that is more than 12 inches in diameter (smaller pipe is neutrally buoyant).

Gas transmission pipelines have low sensitivity to corrosion because the pipes are protected with coatings and impressed current cathodic protection or galvanic cathodic protection.

Rising sea levels may increase inflows into the Sacramento-San Joaquin Delta, subjecting levee systems to increased stress and increasing the likelihood of levee overtopping, which could cause damage to buried transmission pipelines.

Climate Change Vulnerability

Analytical Metrics

The potential vulnerability is analyzed using the number of miles of gas transmission pipelines in the zone of coastal inundation during a 100-year storm, over time, as well as in the Delta inundation zone under different SLR scenarios.

Results

The number of gas pipeline-miles that are projected to be exposed to coastal flooding or are in inundation zones of levee overtopping (Central Valley Region) is low, representing 2.8 percent of pipeline-miles by 2050 (Table 3.1.2-2). See the Gas Transmission Regional Reports section for more details.

Table 3.1.2-2. Gas pipeline-miles exposed to coastal flooding or in an inundation zone, by region.

Region	Baseline	2030	2050	2080
Bay Area	2 (0.03%)	10 (0.2%)	29 (0.5%)	54 (0.8%)
Central Valley	11 (0.2%)	37 (0.6%)	56 (0.9%)	65 (1.0%)
Sierra	10 (0.2%)	28 (0.5%)	57 (0.9%)	71 (1.1%)
North Coast	22 (0.3%)	25 (0.4%)	27 (0.4%)	36 (0.6%)
Central Coast	3 (0.05%)	7 (0.1%)	8 (0.1%)	17 (0.3%)
Total	**48 (0.8%)**	**107 (1.7%)**	**177 (2.8%)**	**243 (3.8%)**

Note: Percentages are relative to total pipeline-miles within the PG&E service area.

Adaptive Capacity and Climate Change Risk

Specific to the potential vulnerabilities of gas transmission pipelines to the exposure of inundation due to SLR, PG&E has the following adaptive capacities, which are considered to be high.

Planning Capacities

- **Redundancy:** Redundancy provides resilience to gas operation services because service could continue along other routes if a flood or precipitation event damages some pipeline segments.

Operational Capacities

- **Emergency response capability:** PG&E has a robust portable LNG/CNG operation that can respond during emergencies to reduce the size and duration of the outage.

Given the low percentage of pipeline-miles potentially exposed to plausible future inundation due to SLR and a high adaptive capacity, the climate change risk is considered to be **low** and the climate hazard is **off-ramped**.

Wildfire

Exposure and Sensitivity

Because gas transmission pipelines are buried underground, they are not generally exposed directly to wildfires. Higher temperatures during a wildfire are unlikely to damage the pipeline or pipeline coating.

The primary concern regarding wildfires and buried pipelines is damage caused by soil erosion or debris flow after a wildfire on steeper slopes in wildfire-scarred areas. Wildfire-scarred landscapes can be more prone to landslides or erosion, which can put buried gas pipelines located on or near sloped areas at risk. However, as described below, the gas transmission pipeline risk model incorporates wildfire scars as a component of vulnerability to cascading impacts. Additionally, no damage to buried transmission pipelines has been identified from recent, large wildfire activity in 2017, 2018, and 2020.

Climate Change Vulnerability

Analytical Metrics

The number of pipeline-miles in high fire risk areas (HFRAs).

Results

Overall, almost 12 percent of all gas transmission pipeline-miles are in HFRAs, with the highest number of miles in the Sierra Region (Table 3.1.2-3). See the Gas Transmission Regional Reports section for more details.

Table 3.1.2-3. Miles of gas transmission pipelines, by region.

Region	Gas Transmission Pipeline-Miles in HFRAs
Bay Area	100 (1.74%)
Central Valley	49 (0.85%)
Sierra	254 (4.44%)
North Coast	141 (2.45%)
Central Coast	143 (2.49%)
Total	**686 (11.97%)**

Note: Percentages are relative to total pipeline-miles within the PG&E service area.

Adaptive Capacity and Climate Change Risk

PG&E's adaptive capacity to wildfire-related risks to natural gas transmission is influenced by the following.

Planning Capacities

- **The gas transmission risk model** incorporates wildfire scars into the landslide model from the susceptibility to damage perspective.

Operational Capacities

- **Hazard Awareness and Warning Center (HAWC):** Operated under PG&E's Community Wildfire Safety Program, the HAWC monitors the PG&E service area for increased likelihood of debris flows in wildfire-scarred areas during storm events. If debris flows are predicted to occur, there is a process for responding to and addressing any severe weather conditions.
- **Fire monitoring and system isolation:** PG&E monitors fire conditions and has a process for responding to and addressing any conditions that may damage gas assets or service and can isolate the gas system in the area of a wildfire.
- **Post-fire visual inspection:** PG&E conducts inspections after fires to assess any potential damage to the system.

This adaptive capacity is considered to be high, and, overall, the climate change risk associated with wildfires is considered to be **low** and the climate hazard is **off-ramped**.

Drought-Driven Subsidence

Exposure and Sensitivity

Historically, drought-driven subsidence has not been a major concern for most of PG&E's service area and there is no significant indication that it will become a major issue in the coming decades. However, drought-driven subsidence has been an issue in the Central Valley Region. Gas transmission pipelines can be sensitive to high magnitudes of ground displacement caused by subsidence.

Climate Change Vulnerability

Analytical Metrics

See the Central Valley Region report below for more information.

Results

Only the Central Valley Region has gas transmission pipelines located in areas of subsidence. However, the California Energy Commission states that "the risk to gas pipelines [from subsidence] is typically due to horizontal rather than vertical ground displacement gradients resulting from subsidence."[7]

See the Central Valley Region report for more details.

Adaptive Capacity and Climate Change Risk

PG&E's ability to adapt to subsidence impacts on gas transmission pipelines is driven primarily by the following.

Operational Capacities

- **Monitoring:** Effective monitoring of subsidence and its impact on gas transmission pipelines through the use of LiDAR technology allows PG&E to mitigate damage before it presents elevated risks. PG&E incorporates the mapping of potential subsidence risk areas into its gas transmission risk management activities.

This adaptive capacity is considered to be high. Because PG&E monitors subsidence in the Central Valley Region and has the capability to mitigate any potential damage, the climate change risk to gas transmission of drought-driven subsidence is considered to be **low** and the climate hazard is **off-ramped**.

[7] California Energy Commission. 2023. "Impact of Drought-related Subsidence on Gas Infrastructure in California." CEC-500-2023-029. https://www.energy.ca.gov/sites/default/files/2023-05/CEC-500-2023-029.pdf

Gas Transmission Regional Reports

Bay Area Region

Summary

The Bay Area Region has approximately 800 line-miles of gas transmission pipelines (Figure 3.1.2- 1).

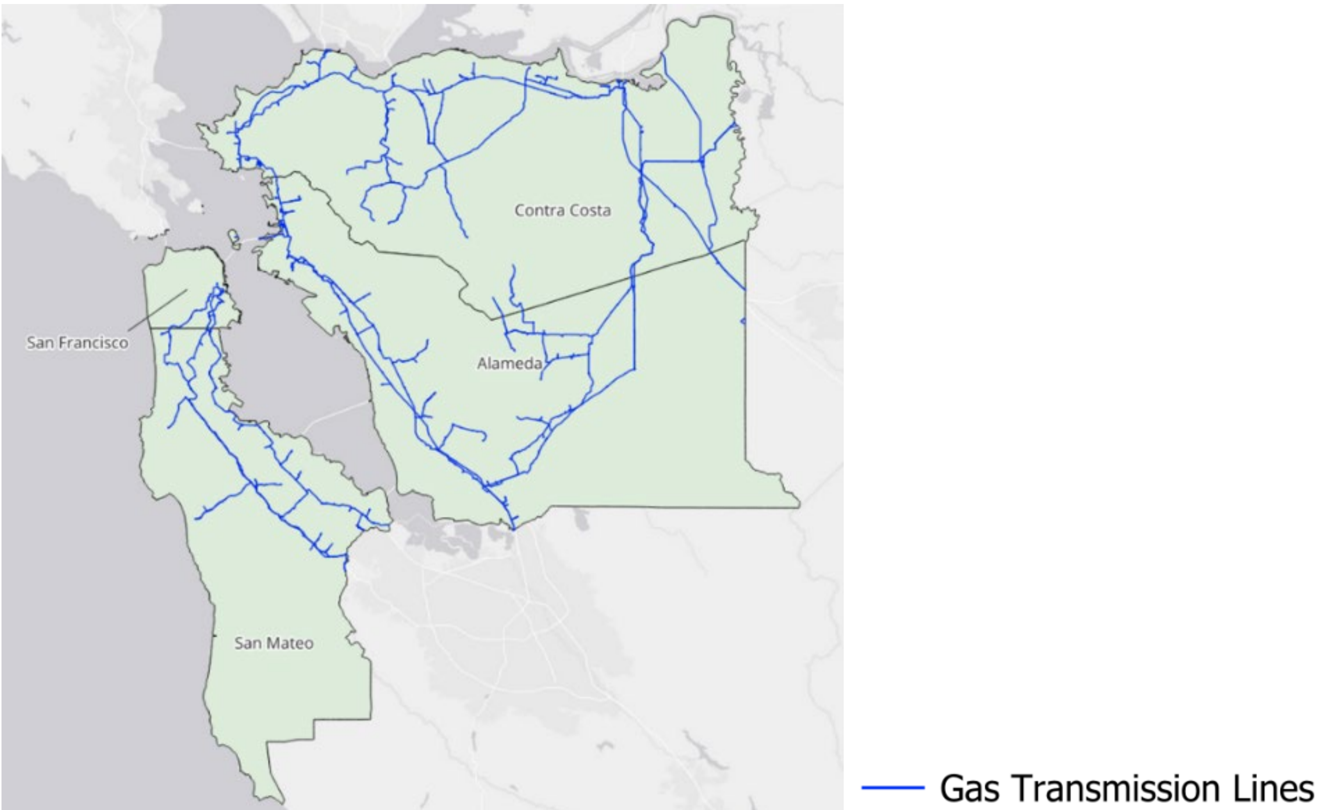


Figure 3.1.2- 1. PG&E gas transmission pipelines in the Bay Area Region.

Climate Hazard: Temperature

Higher temperatures are not considered to be a climate change issue for gas transmission assets at this time.

Climate Hazard: Flooding and Precipitation

In the Bay Area Region, PG&E has 65 miles of gas transmission pipelines in a FEMA 100-year floodplain and 49 additional miles of pipelines in a FEMA 500-year floodplain.

3.1.2.a Gas Transmission

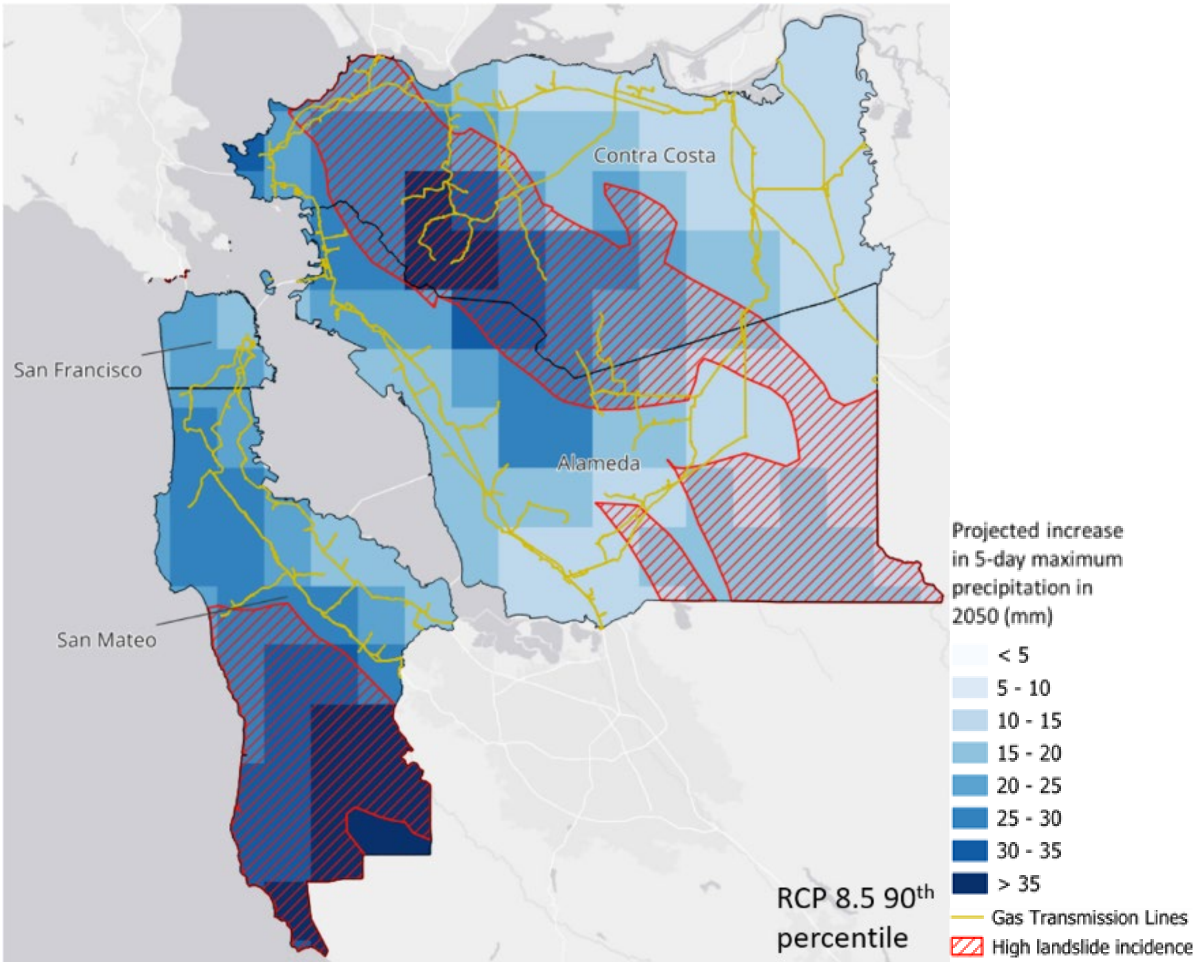


Figure 3.1.2-2. PG&E gas transmission lines, landslide areas, and projected increases in average annual 5-day maximum precipitation by 2050.

A total of 276 gas transmission pipeline-miles in the Bay Area Region are located in areas considered to have high landslide risk. Pipelines in Contra Costa County may have the greatest vulnerability due to overlapping with projected increases in heavy precipitation events (Figure 3.1.2-2).

Climate Hazard: Sea Level Rise

As sea level rises and coastal storm events become more frequent and severe, the number of miles of PG&E's gas transmission pipelines located in areas exposed to inundation from a 100-year coastal storm event is projected to increase along the shoreline of San Mateo, Contra Costa, and Alameda counties (Figure 3.1.2-3). SLR is not considered to be a climate change issue for gas transmission assets at this time.

3.1.2.a Gas Transmission

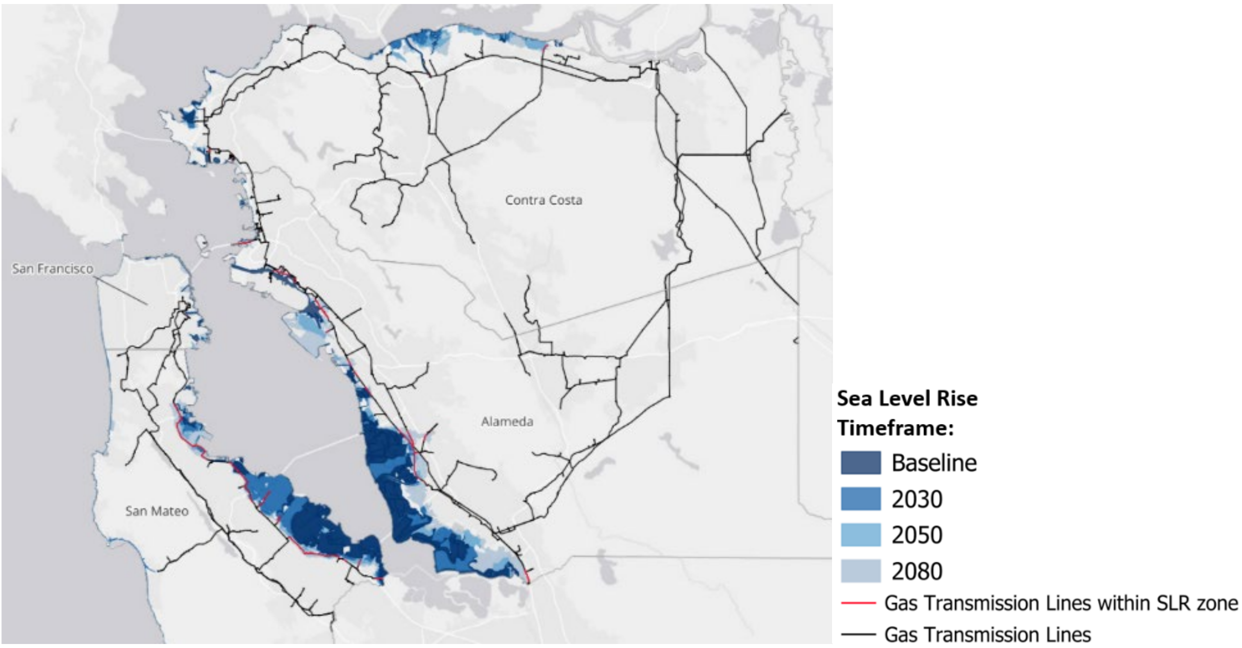


Figure 3.1.2-3. Projected impact of SLR on future land area and gas transmission pipeline exposures during a 100-year storm.

Climate Hazard: Wildfire

Most of the gas transmission pipeline-miles in HFRAs in the Bay Area Region are located in Contra Costa County (Table 3.1.2-4). Damage from wildfire is not considered to be a climate change issue for gas transmission assets at this time.

Table 3.1.2-4. Gas transmission pipeline-miles exposed to HFRAs, by county in the Bay Area Region.

County	Gas Transmission Pipeline-Miles in HFRAs
Alameda	15 (0.27%)
Contra Costa	66 (1.15%)
San Francisco	0 (0%)
San Mateo	18 (0.31%)
Total	**100 (1.74%)**

Note: Percentages are relative to total pipeline-miles within the PG&E service area.

Climate Hazard: Drought-Driven Subsidence

Drought-driven subsidence is not considered a current or future climate change issue for gas transmission assets.

Central Valley Region

Summary

The Central Valley Region has approximately 2,000 miles of gas transmission pipelines (Figure 3.1.2-4). The majority of gas transmission pipelines in the Central Valley Region are in the relatively flat valley region between the Southern Coast Range (west of Merced and Fresno Counties) and the Sierra Nevada Mountain range and foothills (eastern counties of Tuolumne to Tulare).

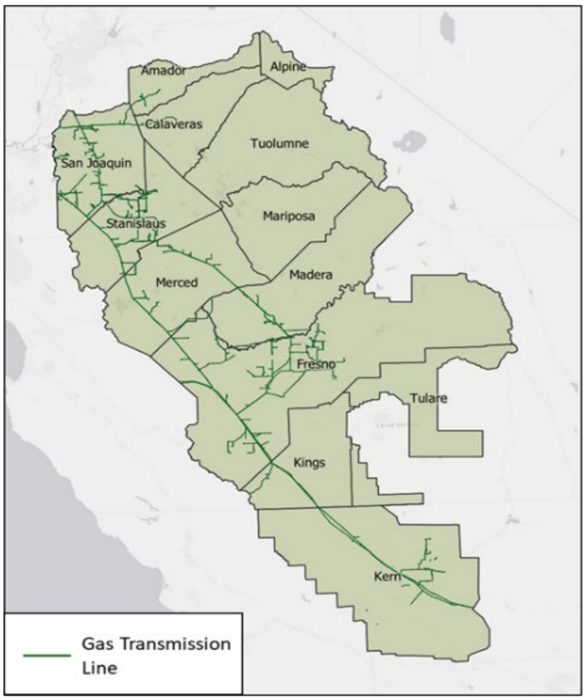


Figure 3.1.2-4. PG&E gas transmission pipelines in the Central Valley Region.

Climate Hazard: Temperature

Higher temperatures are not considered to be a climate change issue for gas transmission assets at this time.

Climate Hazard: Flooding and Precipitation

In the Central Valley Region, 215 miles of gas transmission pipelines are located in a FEMA 100-year floodplain and 49 additional miles of pipelines are located in a FEMA 500-year floodplain.

Climate change exacerbates the risk that floodwaters will breach levees along the Sacramento-San Joaquin Delta. This risk is more difficult to model and should be considered in addition to the overtopping analysis as described below in the discussion on SLR. Higher water levels associated with SLR and changing runoff patterns may increase hydrostatic pressures on levees and increase the probability of levee breaches. The Central Valley Flood Protection Plan prepared by the state of California indicates that several older flood protections in the Delta already face a high probability of failure.[8]

Landslides are not considered a hazard for gas transmission pipelines in the Central Valley Region as no pipelines pass through areas of elevated landslide risk.

In addition to gas transmission pipelines located in the PG&E service area in the Central Valley Region, PG&E also owns and operates transmission pipelines stretching from southern Kern County to the Arizona border. Some small sections of lines cross through FEMA 100-year and 500-year floodplains.

Climate Hazard: Sea Level Rise

Rising sea levels may increase inflows into the Sacramento-San Joaquin Delta, subjecting levee systems to increased stress and increasing the likelihood of levee overtopping, and may increase future vulnerability to flood impacts, for example, to gas transmission pipelines running to PG&E's major natural gas storage facility at McDonald Island (Figure 3.1.2-5) (See Section 3.1.2.c regarding the McDonald Island Gas Storage Facility). SLR is not considered to be a climate change issue for gas transmission assets at this time.

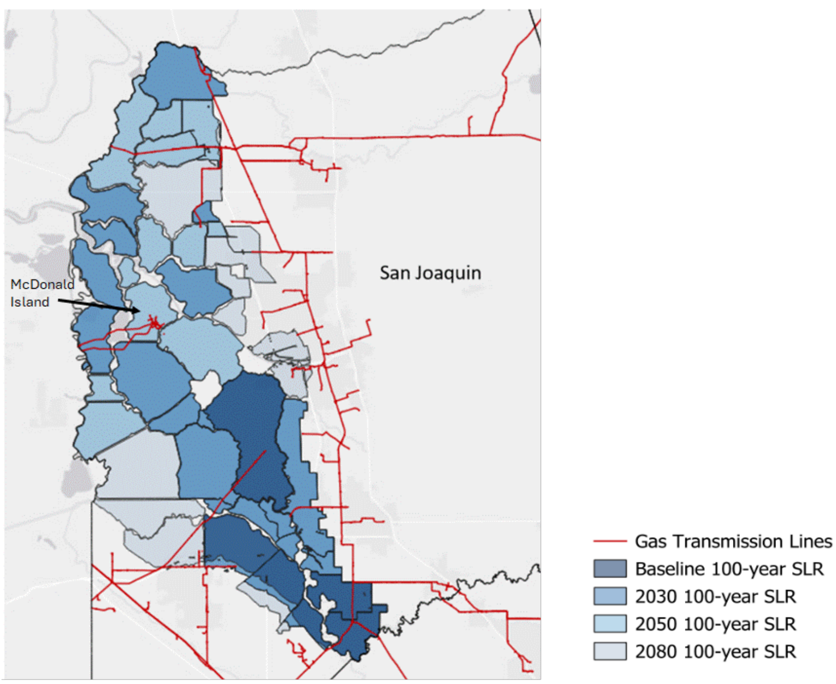


Figure 3.1.2-5. Projected Delta flood extents during a FEMA 100-year floodplain under climate change, considering only the potential for levee overtopping.

[8] California Department of Water Resources. 2017. "Central Valley Flood Protection Plan." https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Flood-Management/Flood-Planning-and-Studies/Central-Valley-Flood-Protection-Plan/Files/2017-CVFPP-Update-FINAL_a_y19.pdf

3.1.2.a Gas Transmission

Climate Hazard: Wildfire

PG&E has 49 miles of gas transmission pipelines (< 1 percent of all pipeline-miles) located in HFRAs in the Central Valley, with most of these miles located in Amador and Calaveras counties (Table 3.1.2-5). Damage from wildfire is not considered to be a climate change issue for gas transmission assets at this time.

Table 3.1.2-5. Gas transmission pipeline-miles exposed to HFRAs, by county in the Central Valley Region.

County	Gas Transmission Pipeline-Miles in HFRAs
Alpine	0 (0%)
Amador	14 (0.25%)
Calaveras	19 (0.33%)
Fresno	0 (0%)
Kern	8 (0.14%)
Kings	7 (0.12%)
Madera	0 (0%)
Mariposa	0 (0%)
Merced	0 (0%)
San Joaquin	1 (0.01%)
Stanislaus	0 (0%)
Tulare	0 (0%)
Tuolumne	0 (0%)
Total	**49 (0.85%)**

Note: Percentages are relative to total pipeline-miles within the PG&E service area.

Climate Hazard: Drought-Driven Subsidence

Drought-driven subsidence is an issue in the Central Valley Region, specifically in Madera, Kern, Kings, and Tulare counties (Figure 3.1.2-6). Most sections of PG&E's gas transmission pipelines in the region do not coincide with areas of historically high subsidence. Some pipelines in Madera County experienced 3 feet of subsidence between 2015 and 2018; however, there was no adverse impact on pipelines. The California Energy Commission states that "the risk to gas pipelines [from subsidence] is typically due to horizontal rather than vertical ground displacement gradients resulting from subsidence."[9] Drought-drive subsidence is not considered to be a climate change issue for gas transmission assets at this time.

[9] California Energy Commission. 2023. "Impact of Drought-related Subsidence on Gas Infrastructure in California." CEC-500-2023-029. https://www.energy.ca.gov/sites/default/files/2023-05/CEC-500-2023-029.pdf

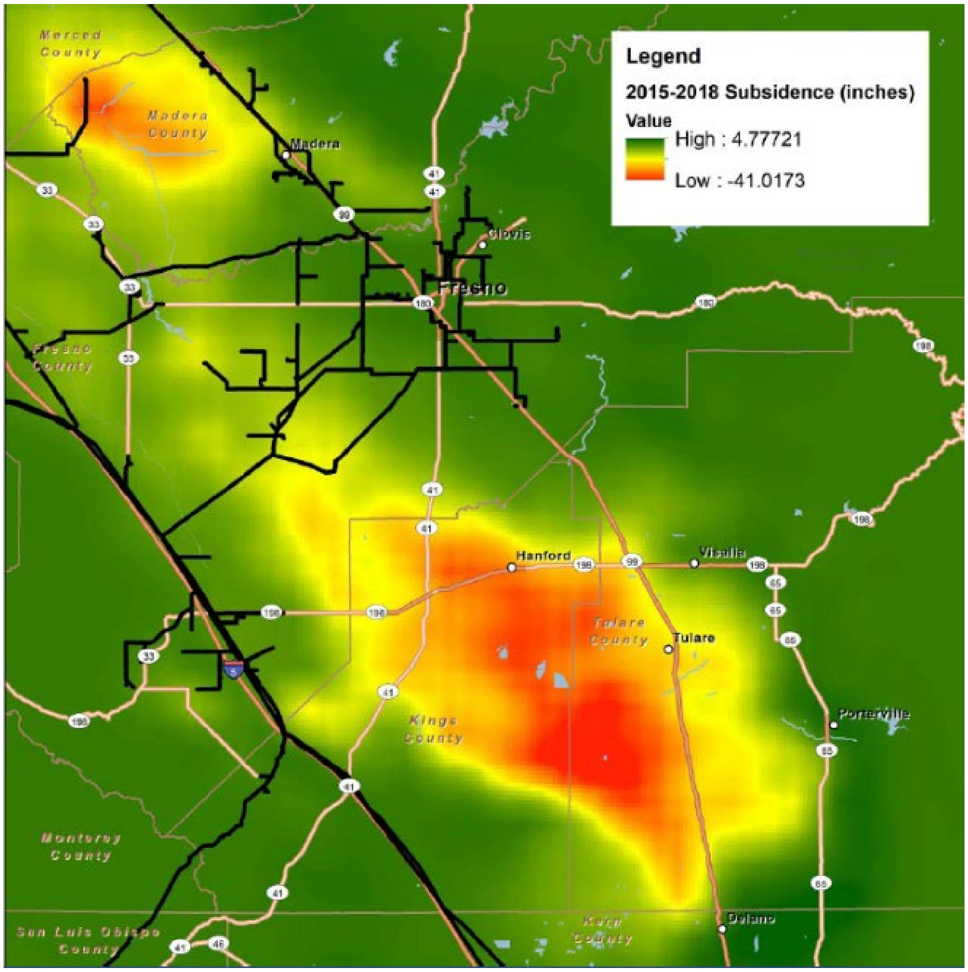


Figure 3.1.2-6. Recorded subsidence in the southern portion of the Central Valley Region from 2015 to 2018. Black lines are gas transmission pipeline.

Sierra Region

Summary

The Sierra Region has approximately 2,100 miles of gas transmission pipelines (Figure 3.1.2-7). The majority of gas transmission pipelines in the Sierra Region fall in the relatively flat Sacramento Valley, which is defined by the Sierra Nevada Mountain range to the east, the Siskiyou Mountains to the north, and the North Coast Range to the west.

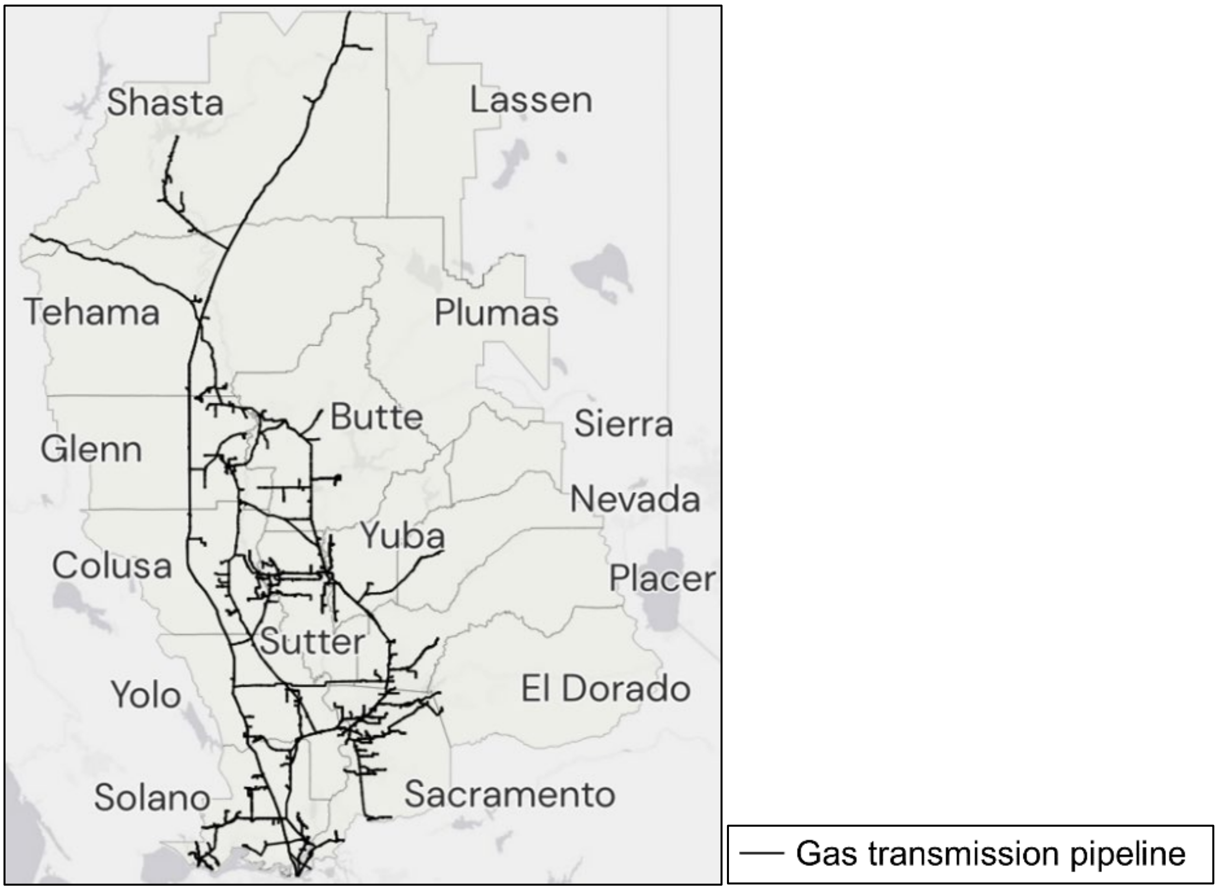


Figure 3.1.2-7. PG&E gas transmission pipelines in the Sierra Region.

Climate Hazard: Temperature

Higher temperatures are not considered to be a climate change issue for gas transmission assets at this time.

Climate Hazard: Flooding and Precipitation

In the Sierra Region, 409 gas transmission pipeline-miles are in a FEMA 100-year floodplain, with an additional 196 miles in a 500-year floodplain.

Most pipeline-miles that exist in a FEMA 100-year floodplain are located in the center of Sacramento Valley (Figure 3.1.2-8).

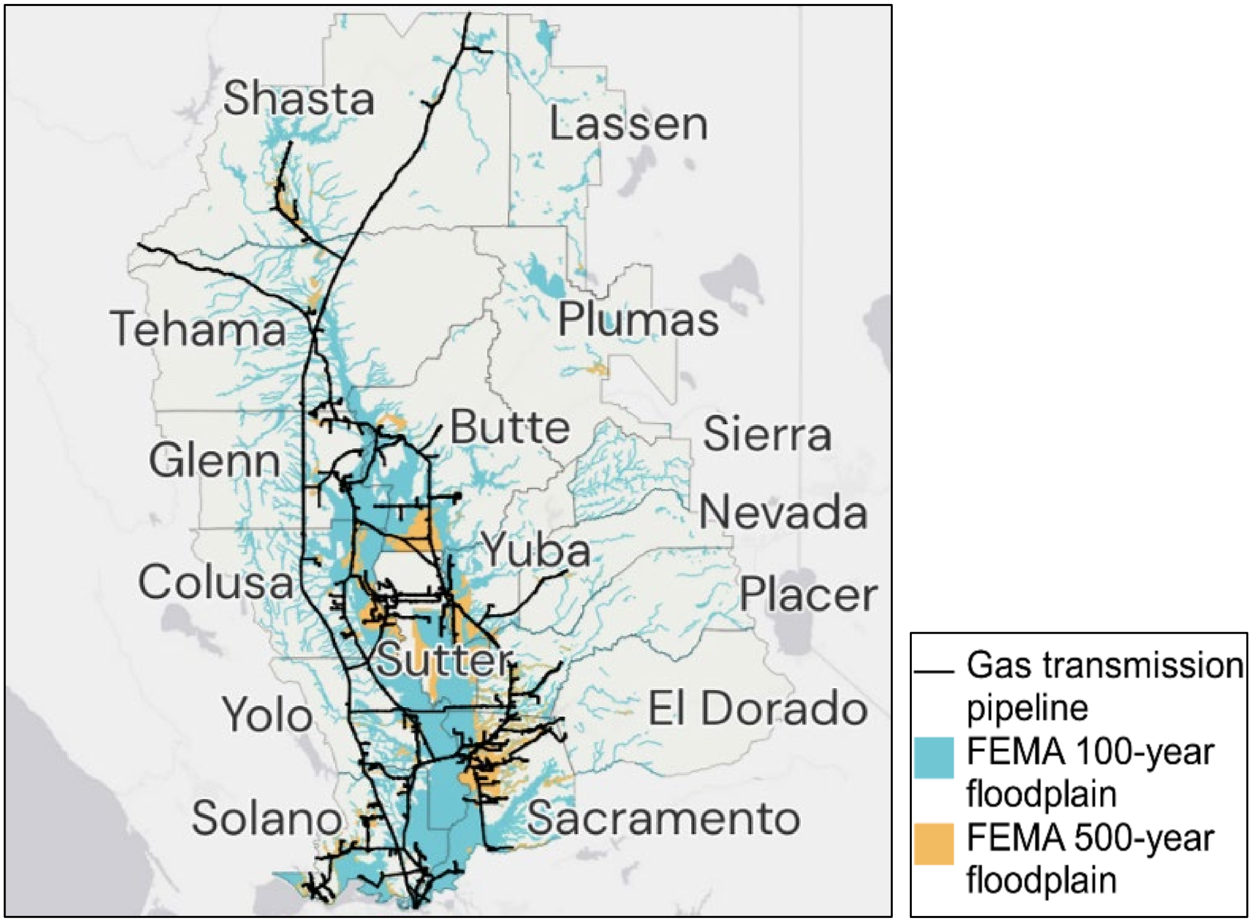


Figure 3.1.2-8. Sierra Region gas transmission system and FEMA 100-year and 500-year floodplains.

Some gas transmission pipelines run through areas of projected increase in high-precipitation events and also high landslide risk areas, such as Tehama and Solano counties (Figure 3.1.2-9).

Vertical and lateral river scour—or erosion of the riverbed and the riverbank, respectively—is of concern in the Sierra Region given that PG&E operates gas transmission pipelines that cross many creeks and rivers, including the Sacramento and Feather rivers. High-precipitation events, such as atmospheric rivers, may significantly increase flow rates in these rivers and their tributaries, resulting in increased severity and extent of river scour.

3.1.2.a Gas Transmission

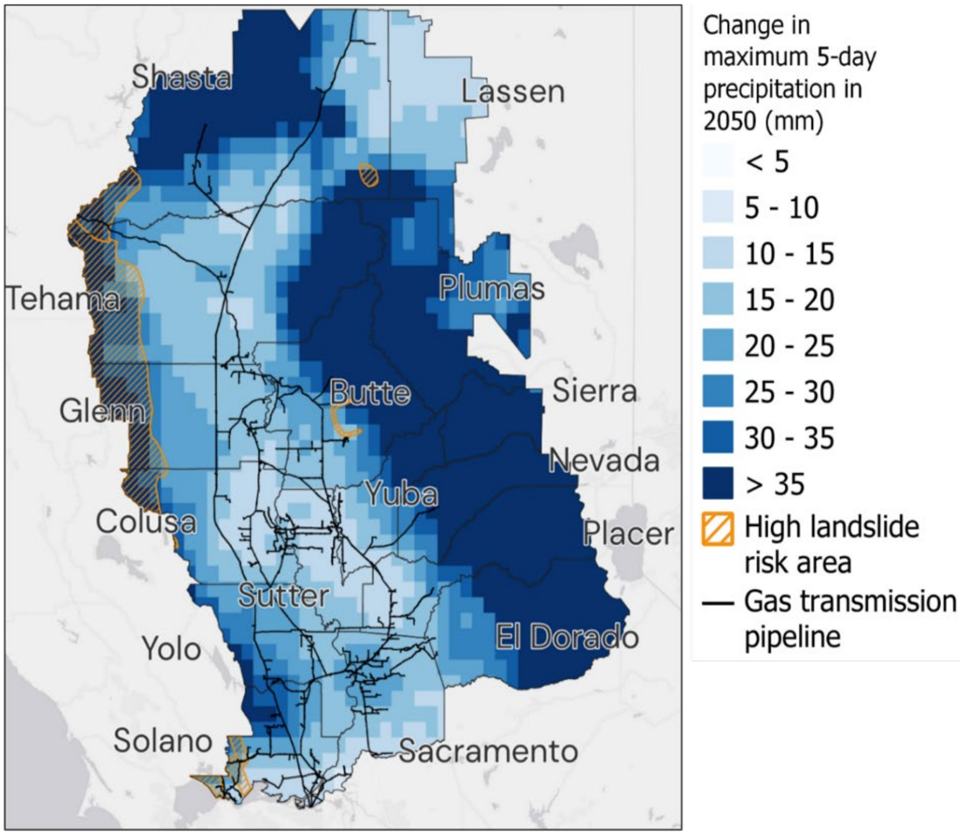


Figure 3.1.2-9. PG&E gas transmission lines, landslide areas, and projected increase in average annual 5-day maximum precipitation by 2050.

Climate Hazard: Sea Level Rise

As sea level rises and storm surge events become more frequent and severe in coastal Solano County, the number of PG&E's gas transmission pipeline-miles exposed to inundation from a 100-year coastal storm event and SLR is projected to increase from a historical baseline of 2 miles to 9 miles by 2080 (3 percent of total county pipeline-miles). SLR is not considered to be a climate change issue for gas transmission assets at this time.

Climate Hazard: Wildfire

In the Sierra Region, there are 254 miles of gas transmission pipelines (4.4 percent of all pipelines) located in HFRAs, with the largest number of HFRA miles located in Shasta County (Figure 3.1.2-10). Damage from wildfire is not considered to be a climate change issue for gas transmission assets at this time.

3.1.2.a Gas Transmission

Table 3.1.2-6. Gas transmission pipeline-miles exposed to HFRAs, by Sierra Region county.

County	Gas Transmission Pipeline-Miles in HFRAs
Butte	8 (0.14%)
Colusa	0 (0%)
El Dorado	0 (0%)
Glenn	0 (0%)
Lassen	0 (0%)
Nevada	14 (0.24%)
Placer	6 (0.10%)
Plumas	0 (0%)
Sacramento	0 (0%)
Shasta	150 (2.63%)
Sierra	0 (0%)
Solano	0 (0%)
Sutter	0 (0%)
Tehama	73 (1.27%)
Yolo	0 (0%)
Yuba	2 (0.04%)
Total	**254 (4.44%)**

Note: Percentages are relative to total pipeline-miles within the PG&E service area.

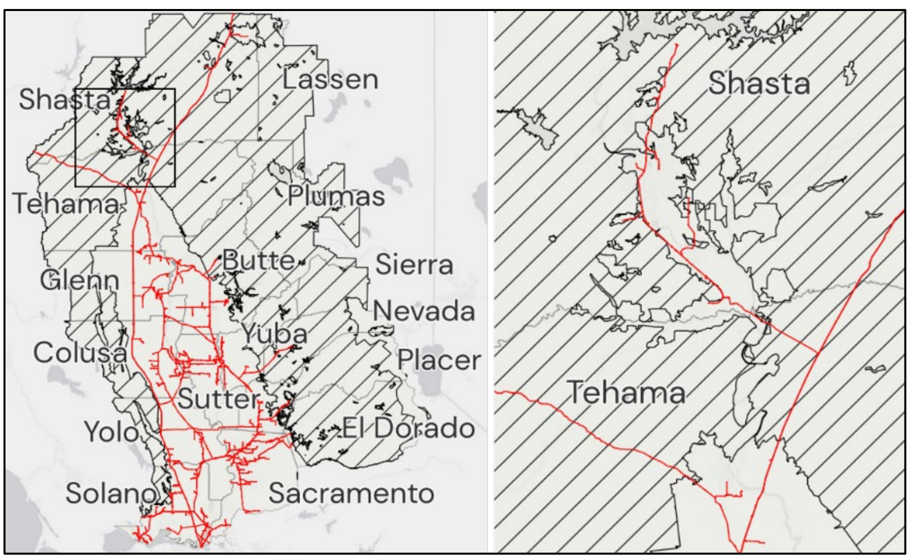


Figure 3.1.2-10. Gas transmission pipelines and HFRAs, with details showing northern Tehama and western Shasta counties.

Climate Hazard: Drought-Driven Subsidence

Drought-drive subsidence is not considered to be a climate change issue for gas transmission assets at this time.

North Coast Region

Summary

The North Coast Region has approximately 700 miles of gas transmission pipelines (Figure 3.1.2-11).

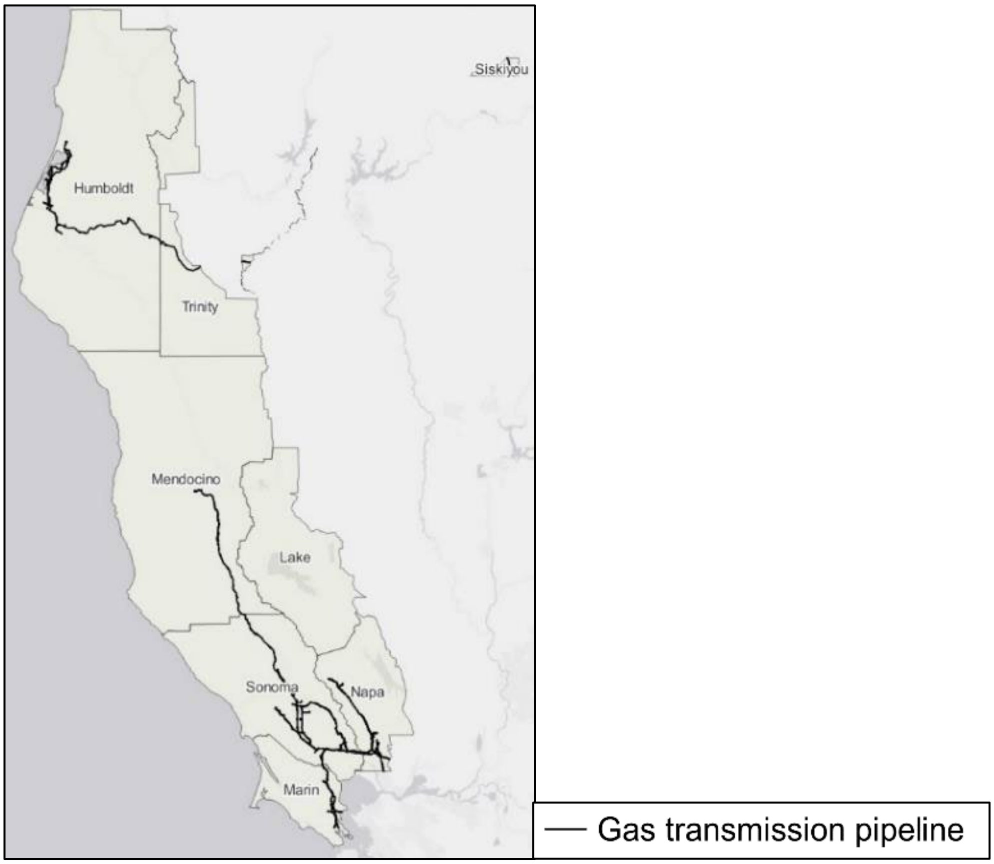


Figure 3.1.2-11. PG&E gas transmission pipelines in the North Coast Region.

Climate Hazard: Temperature

Higher temperatures are not considered to be a climate change issue for gas transmission assets at this time.

Climate Hazard: Flooding and Precipitation

The North Coast Region has 86 transmission pipeline-miles in a FEMA 100-year floodplain and an additional 19 miles in a FEMA 500-year floodplain. All miles in current floodplains fall in Humboldt, Mendocino, Sonoma, Napa, and Marin counties (Figure 3.1.2-12).

Many of the pipeline-miles in a FEMA 100-year floodplain are located near the coast (Figure 3.1.2-12). See below for details on risks from SLR.

3.1.2.a Gas Transmission

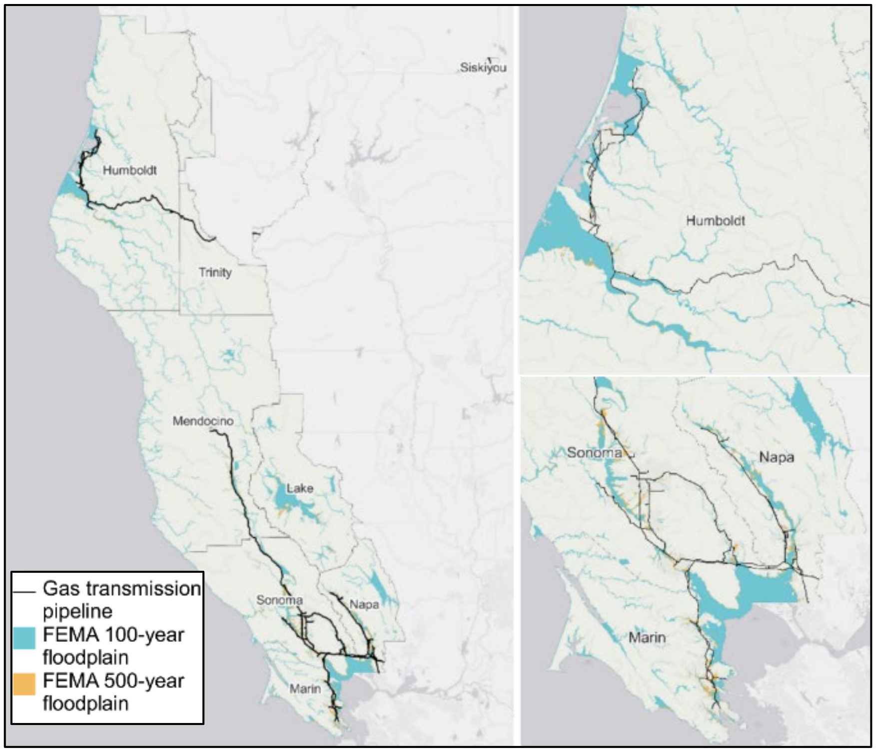


Figure 3.1.2-12. North Coast gas transmission system and FEMA 100-year and 500-year floodplains.

Pipelines located in Trinity County and western Humboldt County are already exposed to areas of historical high landslide incidence and susceptibility, and are likely to see a substantial increase in the 5-day average annual maximum precipitation event by 2050, which may further exacerbate landslide exposure (Figure 3.1.2-13).

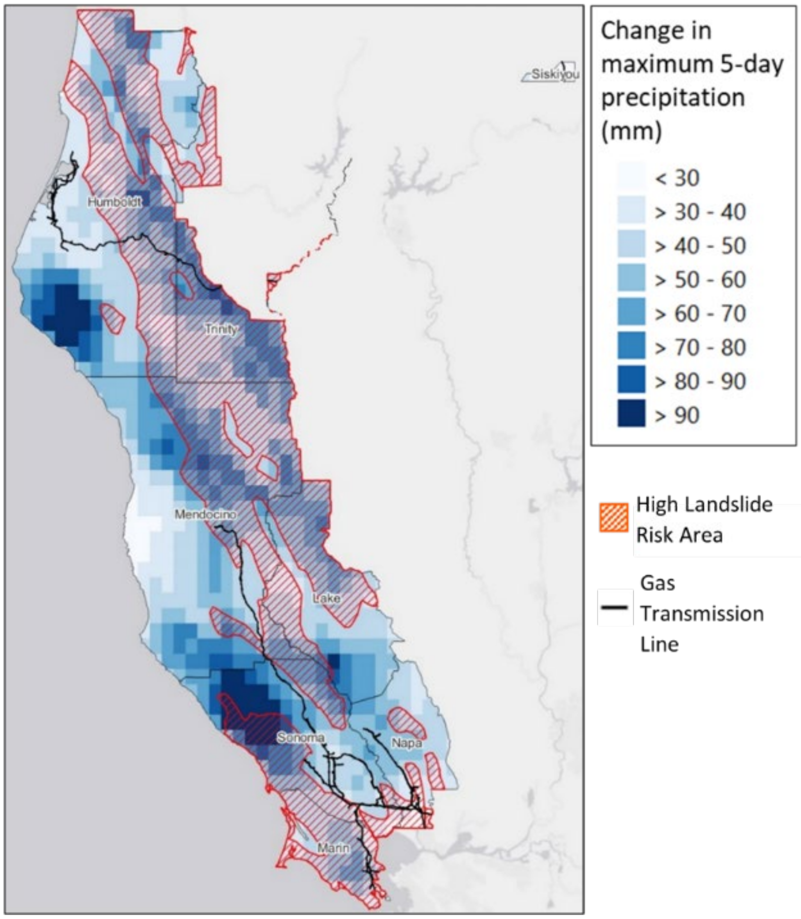


Figure 3.1.2-13. PG&E gas transmission lines, landslide areas, and projected increase in average annual 5-day maximum precipitation by 2050.

Climate Hazard: Sea Level Rise

As sea level rises and coastal storm events become more frequent and severe, the number of PG&E's gas transmission pipeline-miles exposed to inundation from a 100-year coastal storm event and SLR is projected to increase from a historical baseline of 22 miles to 25 miles by 2030, 27 miles by 2050, and 36 miles by 2080. Humboldt County has the majority of the potentially exposed transmission infrastructure (Figure 3.1.2-14). SLR is not considered to be a climate change issue for gas transmission assets at this time.

3.1.2.a Gas Transmission

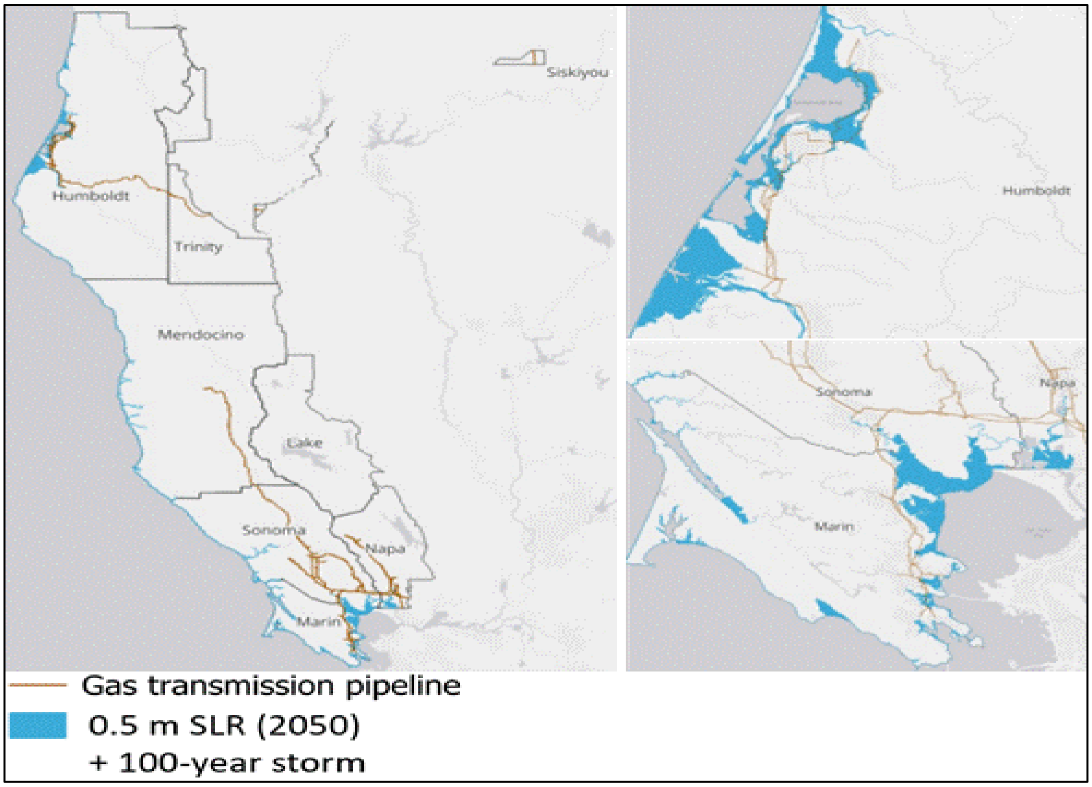


Figure 3.1.2-14. Exposure of PG&E gas transmission lines in the North Coast Region under 0.5 m of SLR (2050) and a 100-year storm.

Climate Hazard: Wildfire

In the North Coast, 141 gas transmission pipeline-miles are in HFRAs, with the largest numbers in Mendocino, Sonoma, and Trinity counties (Table 3.1.2-7, Figure 3.1.2-15). Damage from wildfire is not considered to be a climate change issue for gas transmission assets at this time.

Table 3.1.2-7. Gas transmission pipeline-miles exposed to HFRAs, by county in the North Coast Region, and the percentage of total pipeline-miles in the PG&E service area.

County	Gas Transmission Pipeline-Miles in HFRAs
Humboldt	35 (0.62%)
Lake	0 (0%)
Marin	14 (0.25%)
Mendocino	24 (0.43%)
Napa	5 (0.09%)
Siskiyou	11 (0.19%)
Sonoma	29 (0.50%)
Trinity	22 (0.38%)
Total	**141 (2.45%)**

Note: Percentages are relative to total pipeline-miles within the PG&E service area.

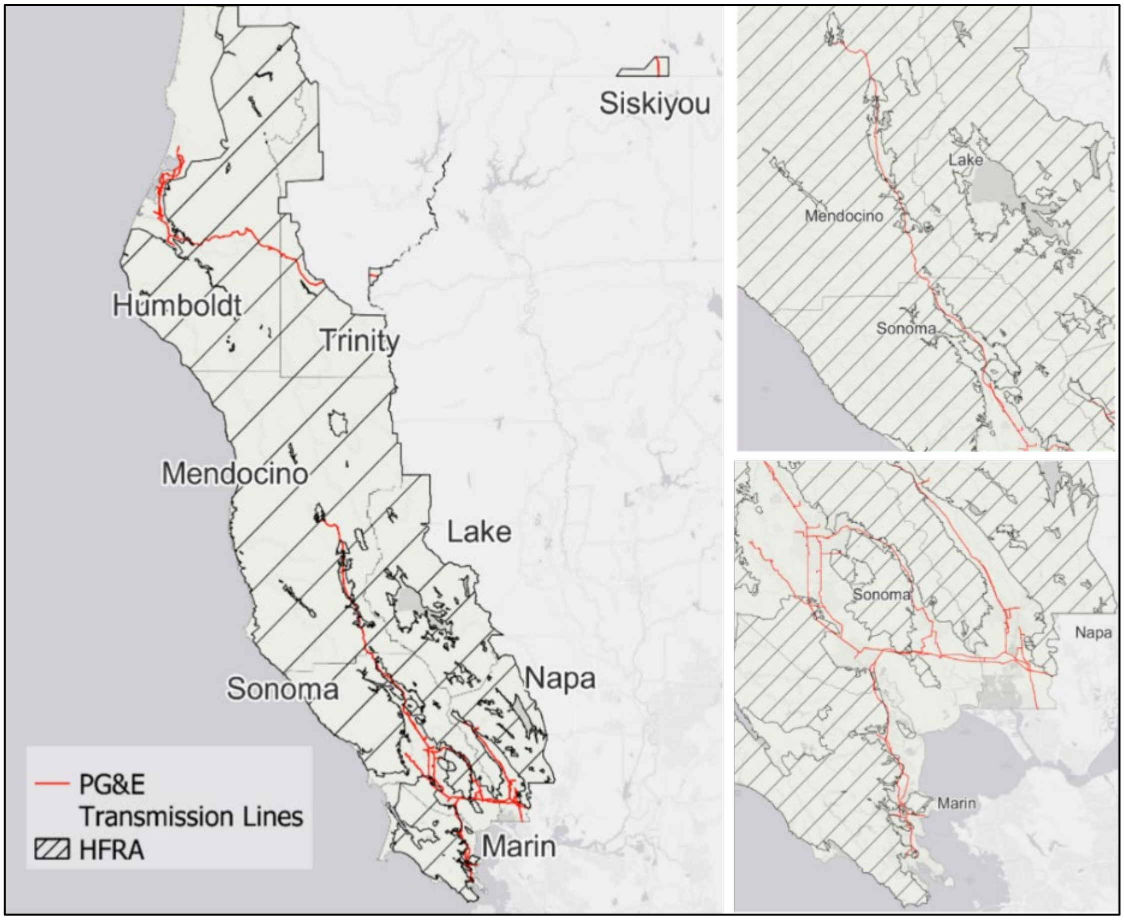


Figure 3.1.2-15. Gas transmission pipelines and HFRAs, with details showing northern Sonoma and southern Mendocino counties.

Climate Hazard: Drought-Driven Subsidence

Drought-drive subsidence is not considered to be a climate change issue for gas transmission assets at this time.

Central Coast Region

Summary

The Central Coast Region has approximately 900 miles of gas transmission pipelines (Figure 3.1.2-16). Most gas transmission pipelines in the Central Coast Region fall in Santa Clara, San Benito, and Monterey counties. In Monterey County, most miles fall in the relatively flat Salinas

Figure 3.1.2-16. PG&E gas transmission pipelines in the Central Coast Region.

Valley, with the Santa Lucia range to the west and the Gabilan Mountains to the east. The pipelines in the Santa Clara Valley also are located in the flat area surrounded by the Diablo Range.

Climate Hazard: Temperature

Higher temperatures are not considered to be a climate change issue for gas transmission assets at this time.

Climate Hazard: Flooding and Precipitation

In the Central Coast Region, 92 gas transmission pipeline-miles are located in a FEMA 100-year floodplain and an additional 128 are located in a FEMA 500-year floodplain. All miles in current floodplains fall in Santa Clara, Monterey, San Benito, and Santa Cruz counties and many of the pipeline-miles that exist in a coastal FEMA 100-year floodplains (Figure 3.1.2-17).

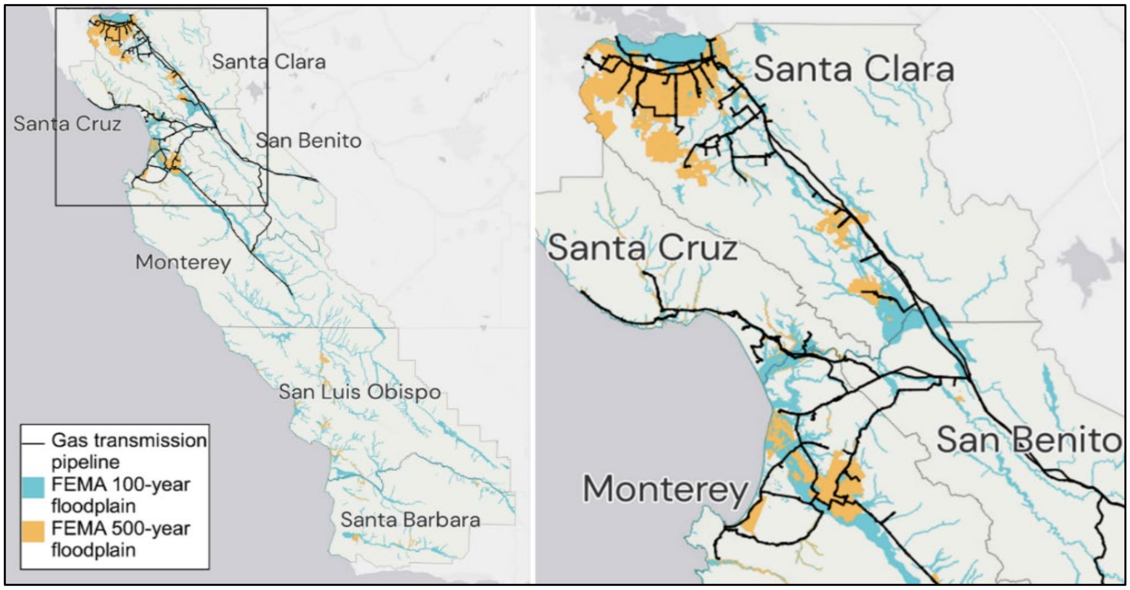


Figure 3.1.2-17. Central Coast Region gas transmission system and the FEMA 100-year and 500-year floodplains.

Few miles of pipeline are in regions of high landslide risk (Figure 3.1.2-18).

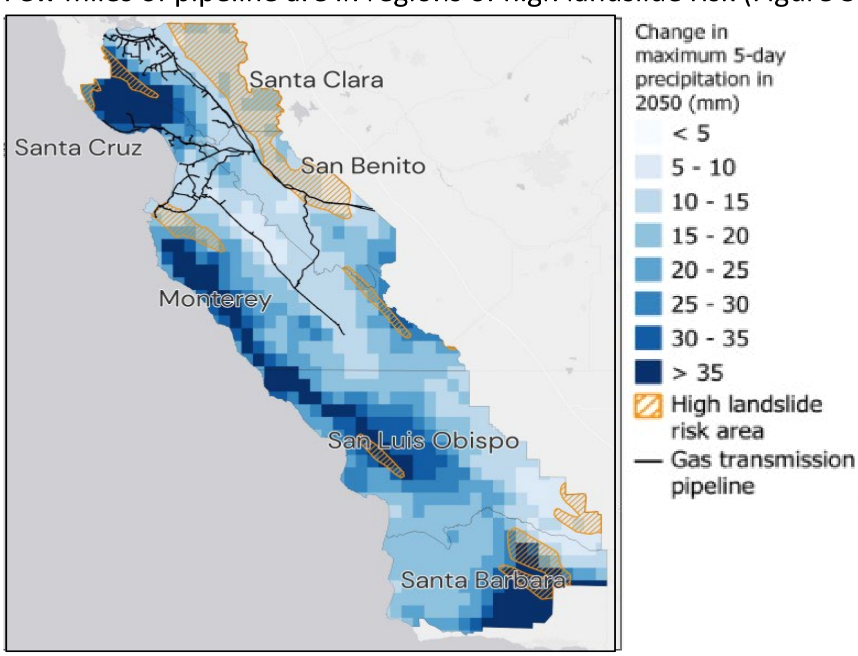


Figure 3.1.2-18. PG&E gas transmission lines, landslide areas, and projected increase in average annual 5-day maximum precipitation by 2050.

Climate Hazard: Sea Level Rise

As sea level rises and coastal storm events become more frequent and severe, the number of PG&E's gas transmission pipeline-miles exposed to inundation from a 100-year coastal storm event and SLR is projected to increase from a historical baseline of 3 miles to 7 miles by 2030, 8 miles by 2050, and 17 miles by 2080. The exposed sections of pipelines are mostly in Santa Clara and Monterey counties (Figure 3.1.2-19). SLR is not considered to be a climate change issue for gas transmission assets at this time.

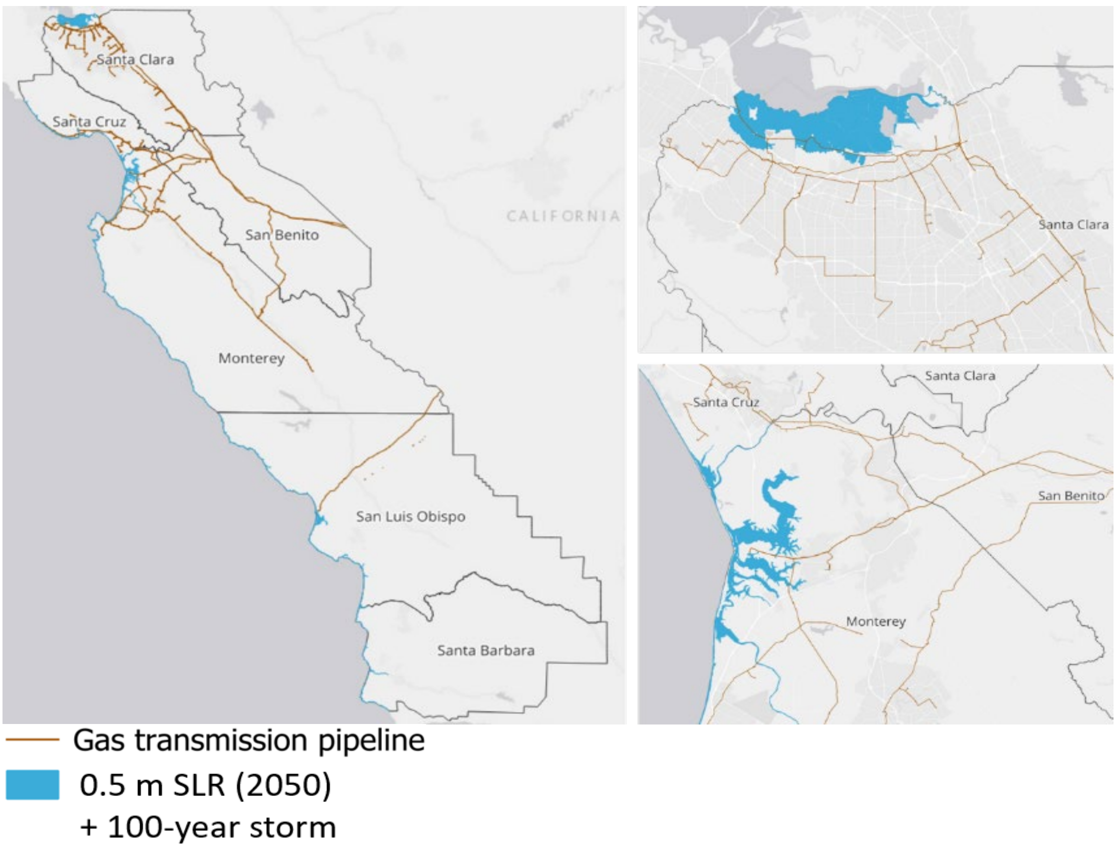


Figure 3.1.2-19. Exposure of PG&E gas transmission lines in the Central Coast Region under 0.5 m of sea level rise (2050) and a 100-year storm.

Climate

3.1.2.a Gas Transmission

Hazard: Wildfire

In the Central Coast Region, 143 pipeline-miles are located in HFRAs, with San Benito County having the greatest number (Table 3.1.2-8). These pipeline-miles are located primarily in non-coastal areas and in the hills of the Diablo Range (Figure 3.1.2-20). Damage from wildfire is not considered to be a climate change issue for gas transmission assets at this time.

Table 3.1.2-8. Gas transmission pipeline-miles exposed to HFRAs, by county in the Central Coast Region.

County	Gas Transmission Pipeline-Miles in HFRAs
Monterey	22 (0.39%)
San Benito	72 (1.26%)
San Luis Obispo	12 (0.21%)
Santa Barbara	0 (0%)
Santa Clara	23 (0.40%)
Santa Cruz	13 (0.23%)
Total	**143 (2.49%)**

Note: Percentages are relative to total pipeline-miles within the PG&E service area.

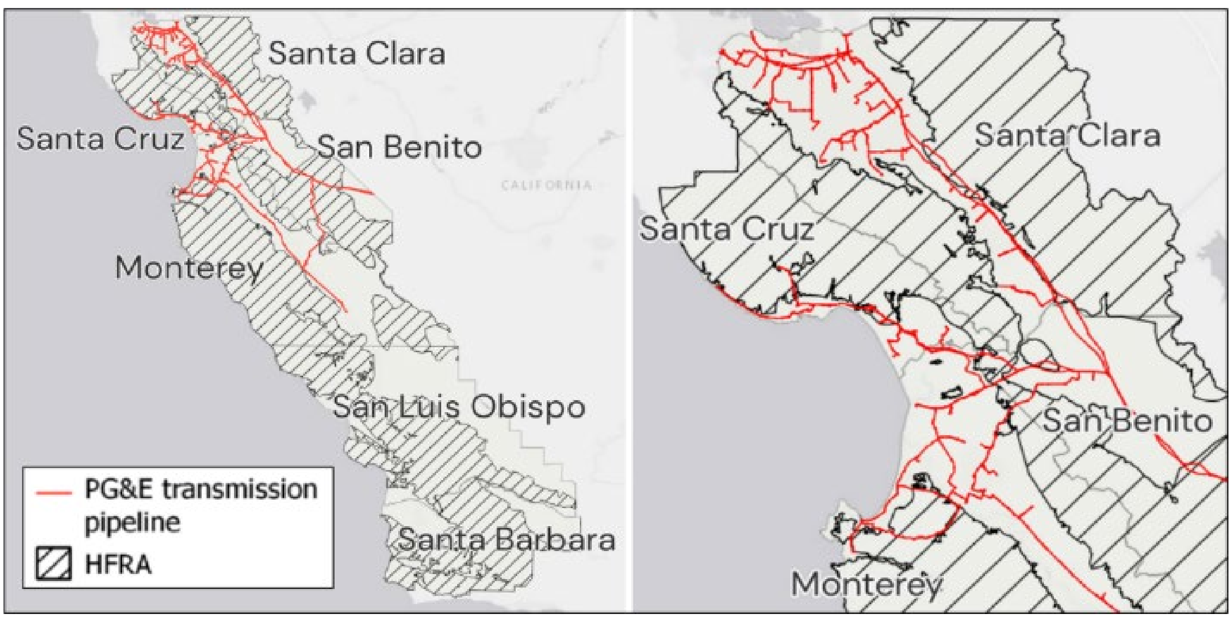


Figure 3.1.2-20. Gas transmission pipelines and HFRAs, with details showing Santa Cruz, Santa Clara, northern Monterey, and northern San Benito counties.

Climate Hazard: Drought-Driven Subsidence

Drought-drive subsidence is not considered to be a climate change issue for gas transmission assets at this time.

3.1.2.b Gas Distribution

Asset Family Introduction

PG&E's gas distribution system is responsible for transporting natural gas to customers throughout the service area. Gas distribution mains connect to transmission pipes via regulator stations on the upstream pipe, and these distribution mains deliver gas to customer meters via service lines.

Distribution mains and services consist of pipes, while customer-connected equipment is composed of meters, regulator(s), shutoff valves, piping, and fittings that connect gas distribution services to customers. Adverse impacts on the gas distribution mains and services could have consequences for customers, public safety, PG&E's reputation, and the environment, with impacts ranging from interrupted service to, in the worst case, gas leaks and ignition. Distribution-level regulators and other stations along distribution lines are covered in the Gas Measurement and Control Stations Regional Reports section.

Key Findings

Climate Hazard	Climate Change Risk and Potential Adaptation Measures
Temperature	Low (off-ramped)
	• Gas distribution pipelines are buried underground and have limited sensitivity to increased air temperatures. While elevated ground temperatures could reduce the ductile strength of Aldyl-A pipes, issues such as tree roots and differential settlement have more significant impacts on the potential for reduced Aldyl-A pipe performance than do ground temperatures. No heat-related failures of Aldyl-A pipes have been confirmed to date, even in hot regions. • PG&E has an established plan to accelerate the replacement of pre-1985 Aldyl-A pipes and, based on the planned replacement rates, would replace all pre-1985 pipe with more resilient polyethylene material by the mid-2050s. The climate change risk to gas distribution pipelines of high temperatures in the future is therefore low and is off-ramped.
Flooding and Precipitation	Moderate
	• Given that distribution pipelines are buried underground and are constructed to withstand inundation from floodwater, distribution pipelines are not sensitive to high-precipitation events and the resulting surface flooding. However, gas pipelines may incur damage from cascading impacts from landslides and erosion/scouring. • PG&E requires company-owned gas regulating systems serving customers to terminate above reasonable flood level and has a flood monitoring program to monitor flood levels along specific rivers where flooding may present a risk to gas distribution infrastructure. However, water intrusion can occur in aboveground assets, namely gas regulators. • Adaptation options include, but are not limited to, pipeline design measures to decrease the risk of damage from ground displacement in areas of highest landside risk.
Sea Level Rise	Low (off-ramped)
	• The number of line-miles of distribution pipelines exposed to SLR is low and sensitivity is also low. SLR is not considered to be a climate change issue for gas distribution assets at this time and the climate hazard is off-ramped.

3.1.2.b Gas Distribution

Wildfire	Moderate
	• Wildfires can damage aboveground distribution assets, such as risers, service pipe, and/or meters, and indirectly damage underground distribution pipe due to soil displacement and cause loss of service to customers. This represents a continued operational risk. • Adaptation options include, but are not limited to, reducing the size of a gas shutdown zone.
Drought-Driven Subsidence	Low (off-ramped)
	• Gas distribution pipe segments typically have short spans and, consequently, are not likely to be significantly affected by subsidence events. Drought-driven subsidence is not considered to be a climate change issue for gas distribution assets at this time and the climate hazard is off-ramped.

Climate Hazards

This section describes climate hazards that may affect gas distribution assets, including temperature, flooding and precipitation, sea level rise, wildfire, and drought-driven subsidence.

Temperature

Exposure and Sensitivity

PG&E's natural gas distribution mains and service pipes are generally installed a minimum of 24 inches and 12–18 inches belowground, respectively. Ground temperatures below the surface are somewhat insulated from temperature extremes given the thermal inertia of soil; the relationship between air temperature and ground temperature is complex and is mediated by multiple factors, such as soil moisture and resistivity, sunlight, and the depth below the surface. While rising average and extreme temperatures under climate change are projected for PG&E's service area, currently available climate model data do not project future ground temperatures in PG&E's service area, therefore this exposure analysis is directional rather than specific.

Plastic gas distribution pipe may experience some degree of reduced performance as a result of elevated ground temperatures, depending on the material used.[10] Newer distribution pipe materials (primarily polyethylene) are likely to be more robust with regard to increases in ground temperature. Older distribution pipelines may be subject to greater heat sensitivity, particularly pipe made from Aldyl-A plastic that was installed prior to 1985.

Aldyl-A pipes were installed widely in the 1960s through the 1980s. Since then, studies and experience have shown that Aldyl-A pipes are subject to elevated rates of "brittle-like" cracking, and that elevated ground temperatures can exacerbate this risk. The manufacturer of Aldyl-A, DuPont Chemical Company, has stated that ground temperature surrounding the pipe has an impact on expected service life, and PG&E uses ground temperature in modeling Aldyl-A risks.[11]

At PG&E, damage to Aldyl-A pipes has not been linked to ambient or ground temperature conditions. Other factors, such as tree roots, differential settlement, and rock impingement, have much more significant impacts on the potential for reduced pipe performance, compared with temperature.

Other types of pipe also may experience the accelerated aging associated with elevated temperatures; for example, some polyethylene pipes have a design limit of 100°F, which is a very high value for ground temperature.

---

[10] Haine, S., and Palermo, G. 2014. "Hazard Analysis and Mitigation Report on Aldyl A Polyethylene Gas Pipelines in California." CPUC. [8947-ra-doc-10-aldyla.pdf (ca.gov)]

[11] Avista Utilities Asset Management. 2013. "Protocol for Managing Select Aldyl A Pipe in Avista Utilities' Natural Gas System."

As described further in the Adaptive Capacity and Climate Change Risk section below, PG&E is continuing the process of replacing Aldyl-A pipes with more resilient materials and therefore sensitivity and vulnerability are low with regard to projected future increases in temperature.

Rubber goods inside of regulators and meters, which are aboveground, could theoretically be sensitive to increases in high ambient temperatures; however, this sensitivity is likely negligible and not recommended for future analyses.

Climate Change Vulnerability

As noted above, Aldyl-A is present throughout the service area. However, ground temperature should be understood as a potential contributing factor to the failure of Aldyl-A pipes and not a primary cause of incidents. Any potential impacts of increased ground temperature on Aldyl-A pipes due to increasing air temperatures are forecast to be resolved by the mid-2050s, with the completion of the Aldyl-A replacement program as described below. No vulnerability analysis was conducted.

Adaptive Capacity and Climate Change Risk

PG&E is replacing Aldyl-A pipes with more resilient pipes so that limited Aldyl-A pipes will remain by the mid-2050s. PG&E's program to replace Aldyl-A pipes in the coming years provides the company with a high adaptive capacity with regard to higher temperatures in the future. The climate risk is **low** and the hazard is **off-ramped**.

Flooding and Precipitation

Exposure and Sensitivity

Increased intensity of flooding and precipitation may expose PG&E's gas distribution assets to increasing frequency and severity of both flood inundation and landslides. In areas with more flooded distribution pipelines, customer meters and regulators also may face an increased likelihood of flood exposure.

Given that distribution pipelines are buried underground and are constructed to withstand inundation from floodwater, distribution pipe generally has low sensitivity to surface flooding and precipitation hazards. Gas distribution pipelines have low sensitivity to corrosion because pipes are protected with coatings and impressed current cathodic protection or galvanic cathodic protection. Aboveground assets also are protected with coatings and regulatory-required inspections for atmospheric corrosion.

However, the gas distribution system still may be subject to several key sensitivities related to flooding:

- **Water intrusion:** In general, the gas distribution pipelines are sufficiently pressurized so that they are is resistant to water intrusion. However, some portions of PG&E's system contain older low-pressure distribution mains, which are known to be vulnerable to water intrusion. Customer meters and regulators that are aboveground, if inundated, may be damaged by flooding and provide an entry point for water. This can result in elevated regulator pressure and, in the worst case, line rupture. Heavy snow—especially in low-elevation areas that are not historically prepared for heavy snow, such as seen in 2022 in Southern California—also can bury gas regulators, causing erratic regulator pressure.

- **Damage from landslides and erosion/scouring:** Gas infrastructure and operations may be affected by landslides, scour near waterways, and erosion hazards. Landslides and other ground movement or erosion may cause serious damage to pipelines.

Climate Change Vulnerability

Analytical Metrics

Customer meters and regulators may have the greatest vulnerability to future flooding. This analysis considers line-miles of distribution pipes exposed as a proxy for exposed customer meters, given the high density of customer meters throughout the gas distribution system (rather than considering the millions of customer meters on an individualized basis).

The key metric for exposure analysis is miles of distribution pipelines in FEMA 100-year and 500-year floodplains. Because increased precipitation intensity under future climate conditions also may result in the cascading effects of increased risk of landslides and debris flows, which could affect gas distribution equipment, the location of pipelines in areas of high landslide risk and areas of projected future high increases in rain events by 2050 is another vulnerability metric.

Results

Five percent and 23 percent of distribution pipeline-miles are in FEMA 100-year and 500-year floodplains, respectively (Table 3.1.2-9). Vulnerability to the future impacts of heavy precipitation and flooding is likely greater for the Sierra Region, although the percentage of total pipeline-miles in the Sierra Region is relatively low (Table 3.1.2-9). See the Gas Distribution Regional Reports section for more details regarding vulnerability.

Table 3.1.2-9. Miles of gas distribution pipelines, by CAVA region, in FEMA 100-year and 500-year floodplains.

Region	100-year Floodplain (miles and the percentage of miles in each region)	500-year Floodplain (miles and the percentage of miles in each region)
Bay Area	320 (0.7%)	1,156 (2.7%)
Central Valley	398 (0.9%)	2,770 (6.4%)
Sierra	926 (2.1%)	3,169 (7.3%)
North Coast	243 (0.6%)	429 (1.0%)
Central Coast	412 (1.0%)	2,615 (6.1%)
Total	**2,299 (5.3%)**	**10,139 (23.5%)**

Note: Percentages are relative to total pipeline-miles within the PG&E service area.

Adaptive Capacity and Climate Change Risk

PG&E's adaptive capacity to flooding and precipitation-related risks to natural gas distribution is considered **moderate** according to the following.

Planning Capacities

- **Elevation of equipment in known flood zones:** PG&E requires vents for all regulator and monitor diaphragms to terminate above reasonable flood level. The Distribution Integrity Management Program may implement actions in targeted areas to raise vent lines on regulator assets where flooding has been identified through PG&E's Corrective Action Program. In the past, PG&E has elevated meter vents following flood impacts in an area.

Operational Capacities

- **Monitoring:** PG&E monitors flood stage levels at specific rivers where flooding may present a risk to gas infrastructure in order to provide advance warning in areas where assets may be at risk from riverine flooding. PG&E's Distribution Integrity Management Program includes flood monitoring of river gauges on specific waterways that have at-risk distribution assets.

The overall climate change risk of flooding and precipitation to gas distribution infrastructure in the service area is considered to be moderate. Vulnerability may increase over time because of changing precipitation and flood dynamics, although the impacts may be isolated to specific geographies as detailed in the Gas Distribution Regional Reports section.

Potential Adaptation and Resilience Measures

Actions to further mitigate flooding and precipitation risk to distribution equipment could include the following.

Planning Options

- **Pipeline design measures to decrease risk of damage from ground displacement**: In areas of highest landslide risk, PG&E may consider increasing distribution pipeline resilience to landslide damage through physical measures. Effective earthquake resilience measures may prove informative in this case, including installing flexible joints and backfilling trenches with lower-density material.[12]

Operational Options

- **Monitoring for landslide risk:** Measures to detect ground movement, indicating potential landslide conditions, may be useful for providing an early warning to allow for geohazard mitigation or infrastructure strengthening.

---

[12] Gantes, C.J., and Melissianos, V.E. 2016. "Evaluation of Seismic Protection Methods for Buried Fuel Pipelines Subjected to Fault Rupture." *Frontiers in Built Environment, 2*. https://www.frontiersin.org/articles/10.3389/fbuil.2016.00034/full

Sea Level Rise

Exposure and Sensitivity

Increased intensity of coastal flooding from storms, exacerbated by SLR, may expose PG&E's low-lying coastal gas distribution assets to increasing frequency and severity of flood inundation. Rising groundwater tables due to SLR may result in the exposure of some underground pipes in coastal areas to higher and potentially more saline groundwater.

The sensitivity of gas pipelines and components to SLR is similar to that described above in the Flooding and Precipitation section. However, SLR presents an additional consideration:

- **Corrosion:** PG&E's gas distribution mains have relatively low sensitivity to corrosion, given that pipes are either plastic (which has no corrosion sensitivity) or steel wrapped with impressed current cathodic protection. This latter method applies an electrical charge to the metal pipe to halt chemical reactions that cause corrosion.[13]

Climate Change Vulnerability

Analytical Metrics

This analysis considers line-miles of distribution pipes exposed as a proxy for exposed customer meters, given the high density of customer meters throughout the gas distribution system (rather than considering the millions of customer meters on an individualized basis). The exposure metric is the location of distribution pipelines in areas of coastal inundation during a 100-year storm, over time, with a focus on 2050.

Results

The number of line-miles of exposed distribution pipes to SLR-related inundation is very low throughout the service area (1.4 percent by 2050), indicating a low vulnerability to SLR through 2080 (Table 3.1.2-10).

Table 3.1.2-10. Miles of gas distribution pipelines, by CAVA region, exposed to coastal flooding and Delta levee overtopping (Central Valley Region).

Region	Historical Baseline	2030	2050	2080
Bay Area	23 (0.1%)	226 (0.5%)	298 (0.7%)	585 (1.4%)
Central Valley	19 (0.04%)	227 (0.5%)	236 (0.5%)	446 (1.0%)
Sierra	1 (0.0%)	7 (0.02%)	7 (0.02%)	11 (0.03%)
North Coast	33 (0.07%)	56 (0.1%)	74 (0.2%)	127 (0.3%)
Central Coast	3 (0.0%)	5 (0.01%)	9 (0.02%)	46 (0.1%)
Total	**79 (0.2%)**	**521 (1.2%)**	**624 (1.4%)**	**1,215 (2.8%)**

Note: Percentages are relative to total pipeline-miles within the PG&E service area.

[13] MATCOR, Inc. 2020. "Benefits of Impressed Current CP Systems." https://www.matcor.com/impressed-current-cathodic-protection/

Adaptive Capacity and Climate Change Risk

PG&E's adaptive capacity for SLR-related flooding inundation of gas distribution pipelines is considered to be moderate and includes the following.

Planning Capacities

- **Elevation of equipment in known flood zones:** PG&E requires vents for all regulator and monitor diaphragms to terminate above reasonable flood level. The Distribution Integrity Management Program may implement actions in targeted areas to raise vent lines on regulator assets where flooding has been identified through PG&E's Corrective Action Program. In the past, PG&E has elevated meter vents following flood impacts in an area.

The very low exposure to the future impacts of SLR-related inundation, along with PG&E's adaptive capacity, suggests that the overall climate change risk of SLR in 2050 is considered to be **low** and the climate hazard is **off-ramped**.

Wildfire

Exposure and Sensitivity

In general, gas distribution infrastructure has moderate sensitivity to wildfire. The primary sensitivities of the natural gas distribution system to wildfire are as follows:

- **Damage to risers, service pipe, and/or meters:** Aboveground or near-surface equipment at the point of customer connection may be damaged or destroyed by wildfires. PG&E has experienced the destruction of these equipment types during recent fire seasons.
- **Potential direct and indirect damage to distribution pipe:** Because of their underground location, PG&E's distribution pipelines are less sensitive to wildfire events but may still be damaged in some cases (e.g., in the event that heat is projected belowground via tree roots or joint trench occupants, such as electric and communications circuits). Heat transfer or damage to co-located electric circuits could result in gas ignition, damaging gas facilities. Wildfires also can compromise the structural integrity of aboveground pipeline spans via heat radiation.[14] Additionally, wildfire events can undermine soil strength, resulting in erosion and debris flow, which could, in turn, result in damage to aboveground and underground distribution pipelines.
- **Pre-emptive shutoffs during wildfire events:** In the event of a wildfire evacuation, PG&E recommends that customers shut off gas and electricity to prevent any further damage. In some cases, PG&E may proactively shut off gas service due to wildfires. Upon returning home after an evacuation, customers must contact PG&E or another qualified professional to perform a thorough assessment of damaged infrastructure and an onsite safety inspection before restoring gas service. When natural gas service to customers is turned off, PG&E must purge the pipeline system to remove any air before natural gas is resupplied to the line. As the wildfire risk becomes more severe and widespread,

---

[14] Basco, A. et al. 2016. "How Drought Is Affecting Wildfire Related Risks for Natural Gas Pipeline." XXXIX Meeting of the Italian Section of the Combustion Institute. http://www.combustion-institute.it/proceedings/XXXIX-ASICI/papers/39proci2016.X2.pdf.

customers may be more likely to experience prolonged gas outages related to wildfire evacuation and associated shutoffs and disruptions in service.

Climate Change Vulnerability

Analytical Metrics

Climate projections suggest that HFRAs capture the areas in PG&E's service area where intensified, climate-driven risk will be most severe. The location of gas distribution assets in HFRAs is therefore the key exposure metric for potential exposure to wildfires.

Results

About 5 percent of gas distribution pipeline-miles are in HFRAs, indicating relatively low exposure throughout the service area (Table 3.1.2-11). See the Gas Distribution Regional Reports section for more details.

Table 3.1.2-11. Miles of gas distribution pipelines in HFRAs, by CAVA region.

Region	Gas Distribution Pipeline-Miles in HFRAs
Bay Area	751 (1.73%)
Central Valley	12 (0.03%)
Sierra	566 (1.30%)
North Coast	607 (1.40%)
Central Coast	484 (1.11%)
Total	**2,420 (5.56%)**

Note: Percentages are relative to total pipeline-miles within the PG&E service area.

Adaptive Capacity and Climate Change Risk

PG&E currently employs several strategies for mitigating impacts, supporting customers, and ensuring timely restoration of gas service after a wildfire-caused outage.

Operational Capacities

- **System isolation procedures:** PG&E's procedures for emergency response to wildfire activity in proximity to gas distribution assets include procedures for isolating the flow of gas to distribution networks that may be at risk of exposure to wildfires.[15]
- **Situational awareness:** PG&E's HAWC facility operates 24/7 and uses PG&E's network of weather stations and cameras to monitor for wildfire risk conditions, including both wildfire ignitions and post-event debris flows and landslides. This situational awareness enhances PG&E's ability to mitigate emerging risks.
- **Portable natural gas for critical infrastructure:** After the 2018 Camp Fire, PG&E provided portable natural gas to critical infrastructure in the town of Paradise before gas mains were

[15] TD-4911P-01: Gas Distribution Wildfire Response.

restored, including the Paradise police and fire stations, town hall, and the Adventist Health Center.[16]

- **Mutual-aid agreements to assist in restoring customers after gas outages:** PG&E manages mutual assistance agreements with other utilities through the California Utilities Emergency Association, Western Region Mutual Assistance Agreement, Edison Electric Institute, and American Gas Association. Through these agreements, PG&E has access to more than 80 percent of the public utility industry across the United States and Canada. Mutual assistance is an effective tool used by utilities to provide emergency response assistance. During an emergency, mutual assistance allows PG&E to access additional personnel, equipment, and materials to supplement internal resources and increase the speed of restoration for communities. Mutual assistance can be used only in emergencies and when restoration cannot be completed by PG&E personnel in a reasonable timeframe.[17]

Two types of risks are associated with wildfires: (1) the loss of assets due to destruction by wildfires, which is the focus of this CAVA; and (2) wildfire ignition caused by loss of containment. PG&E's HAWC provides real-time intelligence on wildfire dynamics that informs gas emergency response planning, resulting in the ability to depressurize gas pipes to prevent loss of containment. Loss of assets due to destruction from a wildfire, the focus of this CAVA and what is reported here, represents a financial and operational risk and is considered to be a **moderate** climate change risk in HFRAs.

Potential Adaptation and Resilience Measures

Given that PG&E's response to wildfire threat involves isolating gas distribution infrastructure and shutting off service, further adaptation may include the following.

Operational Adaptations

- **Reduce the size of gas shutdown zones:** PG&E is already enhancing its ability to use smaller gas emergency shutdown zones to reduce the impact on customers from shutdowns. PG&E may consider further focusing these efforts in high wildfire risk areas.

Drought-Driven Subsidence

Gas distribution pipe segments typically have short spans, and consequently are not likely to be significantly affected by subsidence events. To date, PG&E has not experienced significant impacts associated with drought-driven subsidence on its gas distribution networks, and for most of PG&E's service area, drought-driven subsidence has not been a major concern. The climate change risk is considered to be **low** and the climate hazard is **off-ramped**.

---

[16] PG&E. 2019. "PG&E Restores Gas Service to Nearly All Paradise Customers Able to Receive It." https://investor.pgecorp.com/news-events/press-releases/press-release-details/2019/PGE-Restores-Gas-Service-to-Nearly-All-Paradise-Customers-Able-to-Receive-It/default.aspx

[17] PG&E. 2021. "2021 Wildfire Mitigation Plan Errata, Rulemaking 18-10-007." https://www.pge.com/content/dam/pge/docs/outages-and-safety/outage-preparedness-and-support/2021-Wildfire-Safety-Plan-Errata.pdf

Gas Distribution Regional Reports

Bay Area Region

Summary

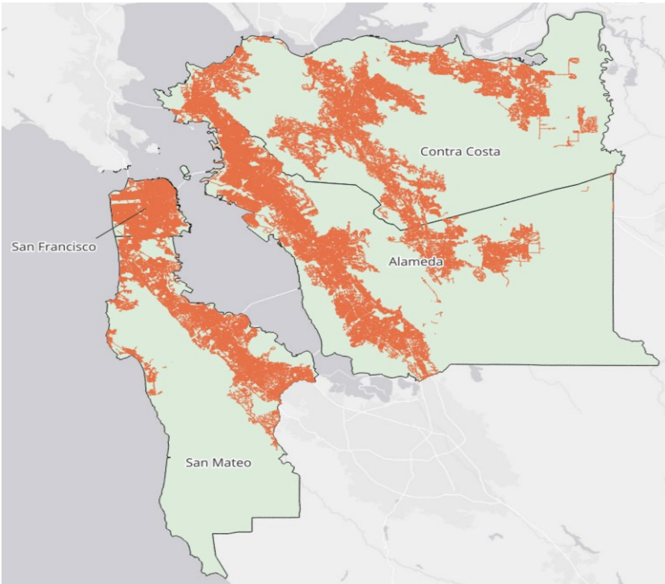


Figure 3.1.2-21. PG&E gas distribution pipelines in the Bay Area Region.

The Bay Area Region has approximately 20,000 line-miles of distribution pipes and approximately 2.5 million customer meters (Figure 3.1.2-21).

Climate Hazard: Temperature

Higher temperatures are not considered to be a climate change issue for gas distribution assets at this time.

Climate Hazard: Flooding and Precipitation

In the Bay Area Region, PG&E has approximately 320 miles of distribution pipelines in a FEMA 100-year floodplain and 427 miles of distribution pipelines in a FEMA 500-year floodplain, representing 0.7 percent and 2.7 percent, respectively, of all distribution pipelines in the floodplains (Table 3.1.2-12).

Table 3.1.2-12. Miles of distribution pipelines located in FEMA 100-year and 500-year floodplains by county in the Bay Area Region.

County	100-year Floodplain	500-year Floodplain
Alameda	108 (0.25%)	462 (1.07%)
Contra Costa	98 (0.23%)	267 (0.62%)
San Francisco	0 (0.00%)	0 (0.00%)
San Mateo	114 (0.26%)	427 (0.99%)
Total	**320 (0.74%)**	**1,156 (2.68%)**

Note: Percentages are relative to total pipeline-miles within the PG&E service area.

3.1.2.b Gas Distribution

Vulnerability to the impacts of landslides may be higher in portions of Contra Costa County (Figure 3.1.2-22).

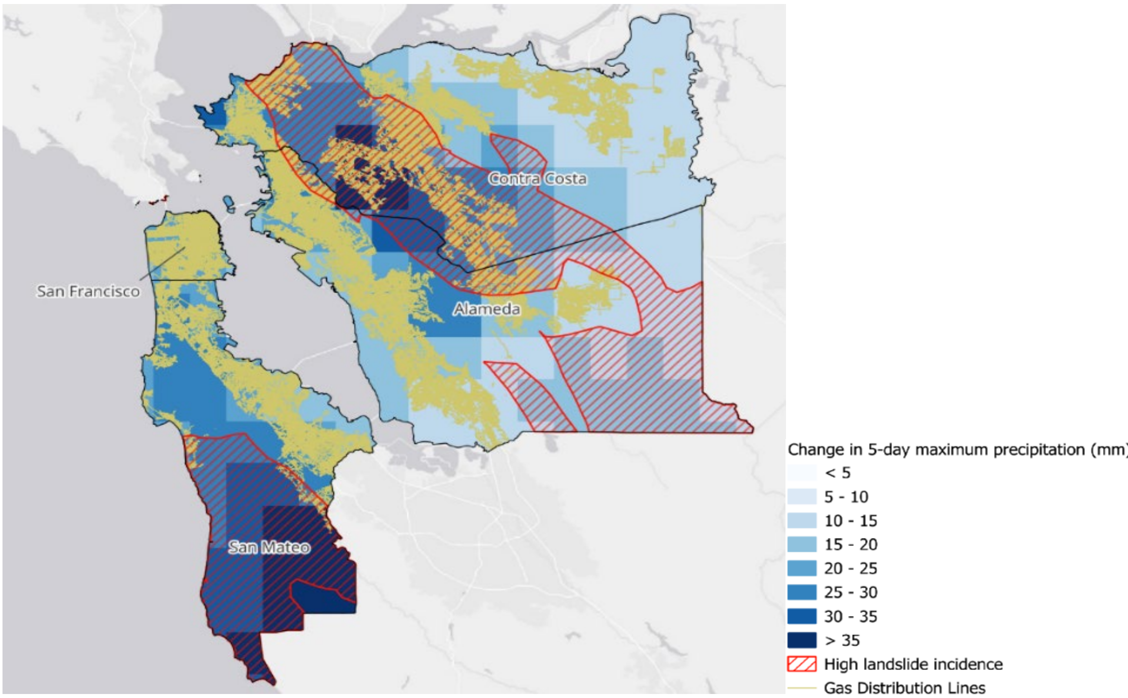


Figure 3.1.2-22. Landslide potential, precipitation change (2050), and PG&E gas distribution lines in the Bay Area Region.

Climate Hazard: Sea Level Rise

SLR is not considered to be a climate change issue for gas distribution assets at this time.

Climate Hazard: Wildfire

PG&E has 751 pipeline-miles located in HFRAs in the Bay Area Region, with no pipeline-miles located in San Francisco County (Table 3.1.2-13).

Table 3.1.2-13. Gas distribution pipeline-miles exposed to HFRAs, by Bay Area Region county.

County	Gas Distribution Pipeline-Miles in HFRAs
Alameda	323 (0.74%)
Contra Costa	270 (0.62%)
San Francisco	0 (0%)
San Mateo	157 (0.36%)
Total	**751 (1.73%)**

Note: Percentages are relative to total pipeline-miles within the PG&E service area.

Climate Hazard: Drought-Driven Subsidence

Drought-driven subsidence is not considered to be a climate change issue for gas distribution assets at this time.

3.1.2.b Gas Distribution

Central Valley Region

Summary

The Central Valley Region has approximately 10,300 miles of distribution pipelines and approximately 967,000 customer meters (Figure 3.1.2-23).[18]

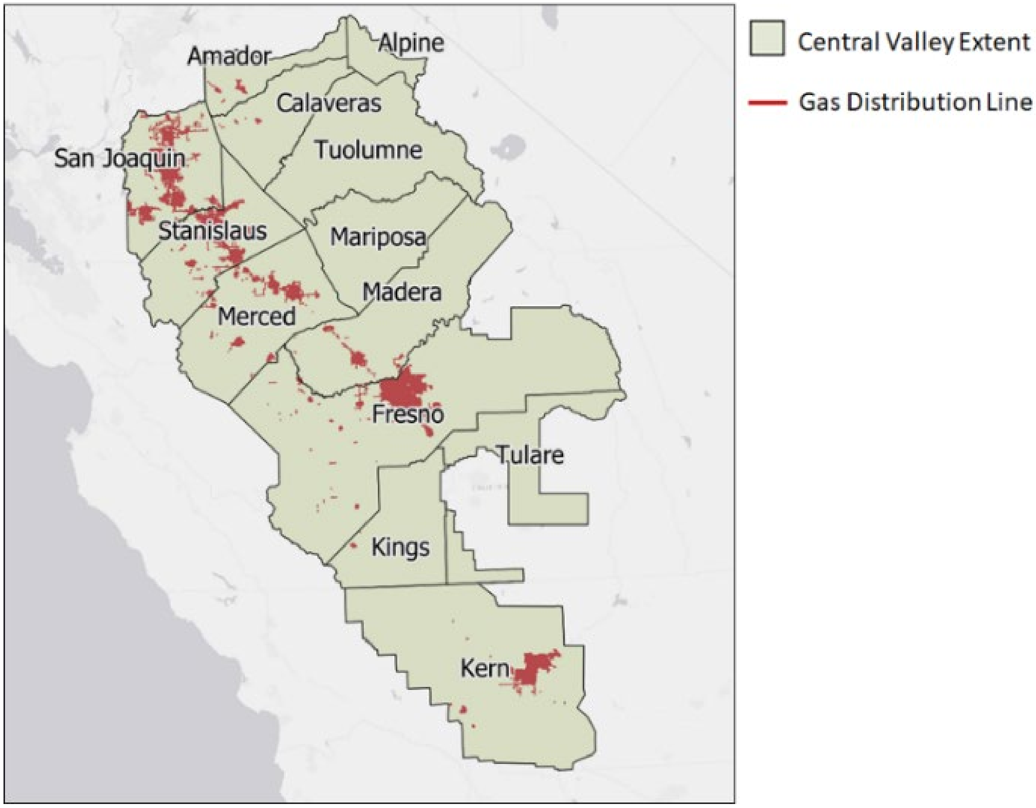


Figure 3.1.2-23. PG&E gas distribution lines in the Central Valley Region.

Climate Hazard: Temperature

Higher temperatures are not considered to be a climate change issue for gas distribution assets at this time.

Climate Hazard: Flooding and Precipitation

In the Central Valley Region, 398 distribution pipeline-miles are located in a FEMA 100-year floodplain and 2,770 are located in a FEMA 500-year floodplain, with greater numbers in Merced and San Joaquin counties (Table 3.1.2-14).

[18] PG&E also owns and operates some distribution pipelines in the region stretching from Kern County to the Arizona border. These pipelines may face similar hazards to those identified here. The exposure of these assets to FEMA 100-year and 500-year floodplains and HFRAs is provided in the Flooding and Precipitation section below; these exposures are not reflected in total asset exposure numbers (e.g., total pipeline-miles in FEMA floodplains in the Central Valley Region).

3.1.2.b Gas Distribution

Table 3.1.2-14. Miles of distribution pipelines located in FEMA 100-year and FEMA 500-year floodplains by county in the Central Valley Region.

County	100-year Floodplain	500-year Floodplain
Amador	5.3 (0.01%)	9.0 (0.02%)
Calaveras	0.5 (0.00%)	1.0 (0.00%)
Fresno	30 (0.07%)	666 (1.54%)
Kern	5.7 (0.01%)	60 (0.14%)
Kings	0.1 (0.00%)	17 (0.04%)
Madera	25 (0.06%)	58 (0.13%)
Merced	188 (0.44%)	217 (0.50%)
San Joaquin	119 (0.28%)	1,624 (3.76%)
Stanislaus	24 (0.06%)	118 (0.27%)
Total	**398 (0.92%)**	**2,770 (6.41%)**

Note: Percentages for total are relative to total pipeline-miles within the PG&E service area.

No distribution pipelines pass through areas of elevated landslide risk (Figure 3.1.2-24).

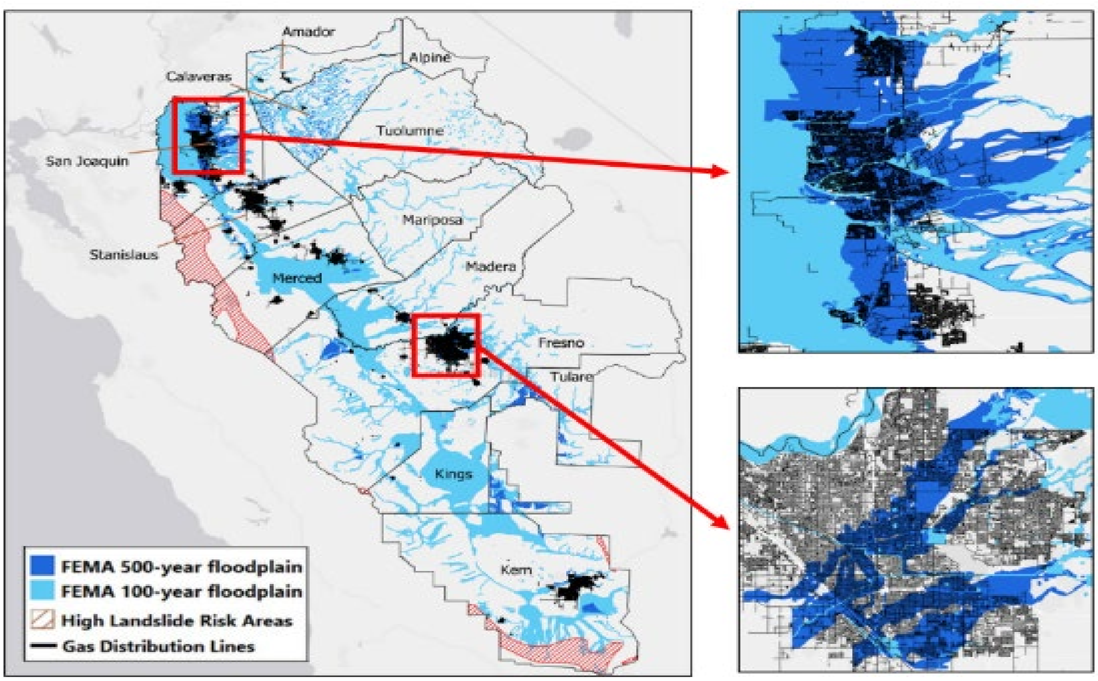


Figure 3.1.2-24. Distribution pipelines located in the Central Valley Region FEMA 100-year and 500-year floodplains.

3.1.2.b Gas Distribution

In addition to assets located in the PG&E service area in the Central Valley Region, there are limited areas of gas distribution service in Kern and San Bernadino counties. Some of these gas pipeline-miles cross through FEMA 100-year and 500-year floodplains.

Climate Hazard: Sea Level Rise

SLR is not considered to be a climate change issue for gas distribution assets at this time.

Climate Hazard: Wildfire

In the Central Valley Region, 12 miles of gas distribution pipelines (0.3 percent of distribution pipeline-miles) are located in HFRAs (Table 3.1.2-15).

Table 3.1.2-15. Gas distribution pipeline-miles exposed to HFRAs, by county in the Central Valley Region.

County	Gas Distribution Pipeline-Miles in HFRAs
Alpine	0 (0%)
Amador	8 (0.02%)
Calaveras	4 (0.01%)
Fresno	0 (0%)
Kern	0 (0%)
Kings	0 (0%)
Madera	0 (0%)
Mariposa	0 (0%)
Merced	0 (0%)
San Joaquin	0 (0%)
Stanislaus	0 (0%)
Tulare	0 (0%)
Tuolumne	0 (0%)
Total	**12 (0.03%)**

Note: Percentages are relative to total pipeline-miles within the PG&E service area.

Climate Hazard: Drought-Driven Subsidence

Drought-driven subsidence is not considered to be a climate change issue for gas distribution assets at this time.

3.1.2.b Gas Distribution

Sierra Region

Summary

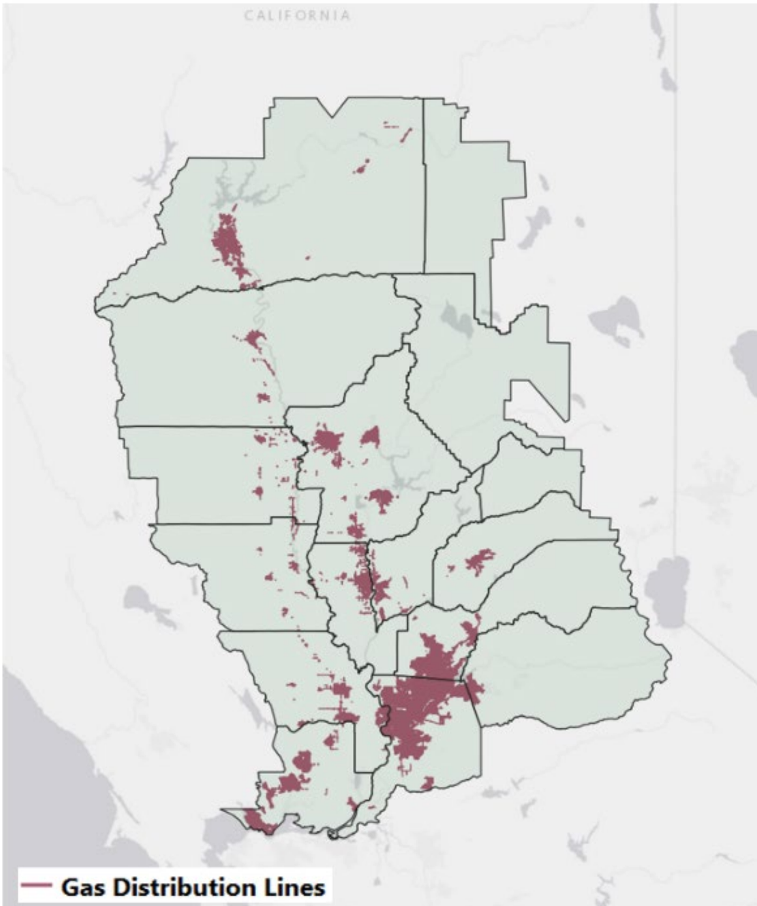


Figure 3.1.2-25. PG&E gas distribution pipelines in the Sierra Region

The Sierra Region has approximately 11,463 line-miles of distribution pipes (Figure 3.1.2-25).

Climate Hazard: Temperature

Higher temperatures are not considered to be a climate change issue for gas distribution assets at this time.

Climate Hazard: Flooding and Precipitation

There are 926 pipeline-miles in the Sierra Region in a FEMA 100-year floodplain and 3,169 pipeline-miles in a FEMA 500-year floodplain, with most of these pipeline-miles located in Sacramento and Yolo counties (Table 3.1.2-16).

3.1.2.b Gas Distribution

Table 3.1.2-16. Miles of distribution pipelines by county in the Sierra Region located in FEMA 100-year and 500-year floodplains.

County	100-year Floodplain (miles and the percentage of miles in each county)	500-year Floodplain (miles and the percentage of miles in each county)
Butte	54 (0.13%)	285 (0.66%)
Colusa	12 (0.03%)	85 (0.20%)
El Dorado	0.3 (0.00%)	0.7 (0.00%)
Glenn	1.2 (0.00%)	32 (0.07%)
Nevada	1.2 (0.00%)	2.8 (0.01%)
Placer	15 (0.03%)	21 (0.05%)
Sacramento	387 (0.90%)	1,744 (4.04%)
Shasta	25 (0.06%)	94 (0.22%)
Solano	66 (0.15%)	259 (0.60%)
Sutter	36 (0.08%)	50 (0.12%)
Tehama	28 (0.06%)	42 (0.10%)
Yolo	249 (0.58%)	289 (0.67%)
Yuba	25 (0.06%)	240 (0.56%)
Total	**926 (2.14%)**	**3,169 (7.34%)**

Note: Percentages for total are relative to total pipeline-miles within the PG&E service area.

3.1.2.b Gas Distribution

Vulnerability to the impacts of landslides or debris flow may be higher in the southern part of Solano County (Figure 3.1.2-26).

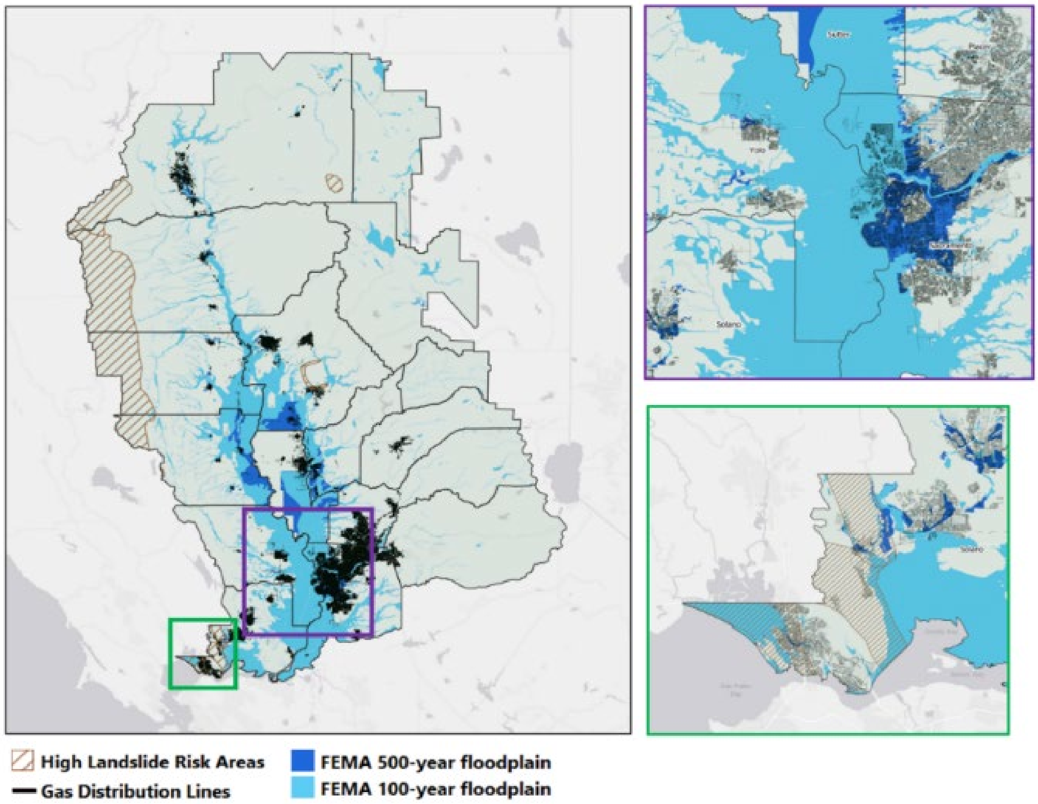


Figure 3.1.2-26. Gas distribution lines overlayed with high landslide risk areas and FEMA 100-year and 500-year floodplains.

Climate Hazard: Sea Level Rise

SLR is not considered to be a climate change issue for gas distribution assets at this time.

Climate Hazard: Wildfire

The Sierra Region has 565 miles of distribution pipelines (1.3 percent of distribution pipeline-miles) located in HFRAs, with Bute, Nevada, and Shasta counties having the highest number of miles (Table 3.1.2-17, Figure 3.1.2-27).

3.1.2.b Gas Distribution

Table 3.1.2-17. Gas distribution pipeline-miles exposed to HFRAs, by county in the Sierra Region.

County	Gas Distribution Pipeline-Miles in HFRAs
Butte	138 (0.32%)
Colusa	0 (0%)
El Dorado	21 (0.05%)
Glenn	0 (0%)
Lassen	0 (0%)
Nevada	104 (0.24%)
Placer	58 (0.13%)
Plumas	0 (0%)
Sacramento	0 (0%)
Shasta	213 (0.49%)
Sierra	0 (0%)
Solano	28 (0.06%)
Sutter	0 (0%)
Tehama	3 (0.01%)
Yolo	0 (0%)
Yuba	0 (0%)
Total	**566 (1.30%)**

Note: Percentages are relative to total pipeline-miles within the PG&E service area.

3.1.2.b Gas Distribution

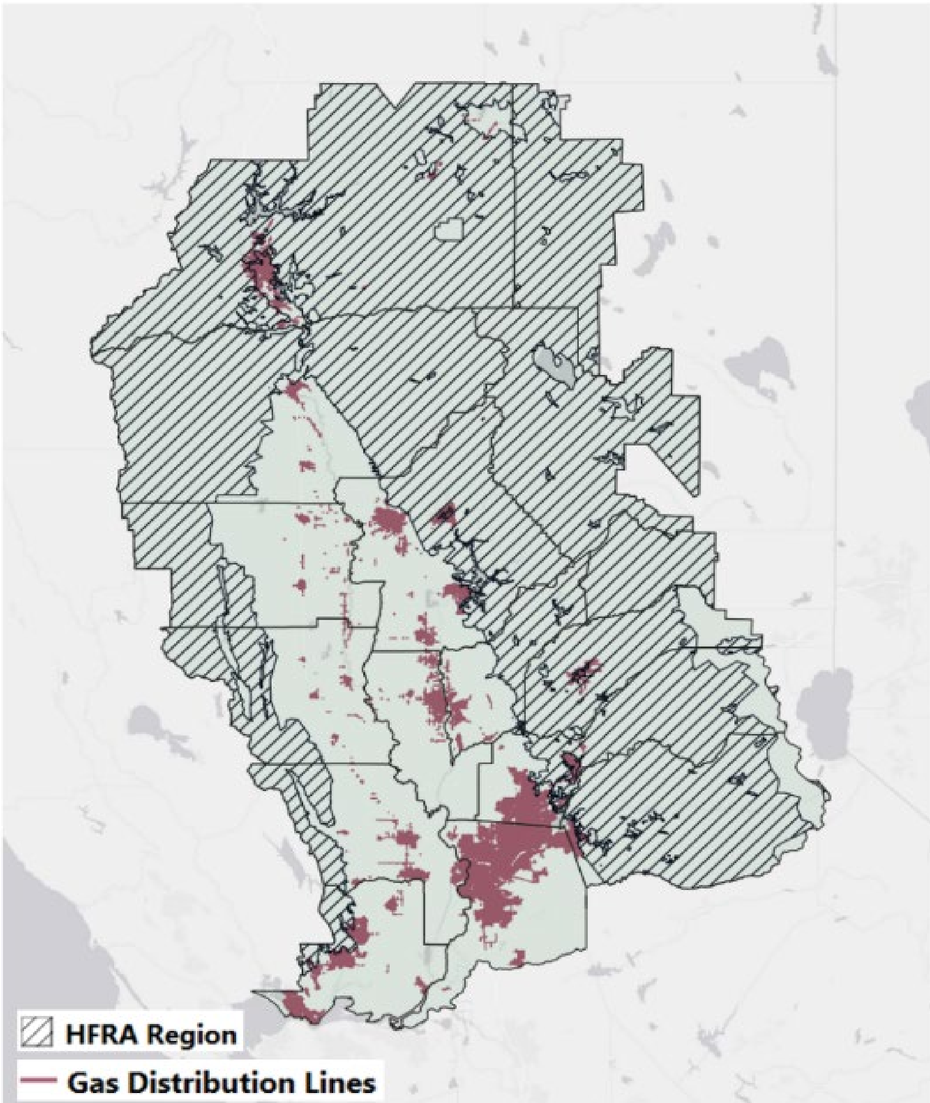


Figure 3.1.2-27. Sierra Region gas distribution pipelines in HFRAs.

Climate Hazard: Drought-Driven Subsidence

Drought-driven subsidence is not considered to be a climate change issue for gas distribution assets at this time.

North Coast Region

Summary

The North Coast Region has approximately 3,966 line-miles of distribution pipes (Figure 3.1.2-28).

Figure 3.1.2-28. PG&E gas distribution mains in the North Coast Region.

Climate Hazard: Temperature

Higher temperatures are not considered to be a climate change issue for gas distribution assets at this time.

Climate Hazard: Flooding and Precipitation

The North Coast has 243 miles of distribution pipelines in a FEMA 100-year floodplain and 429 miles of distribution pipelines in a FEMA 500-year floodplain, representing 0.6 percent and 1.0 percent of total pipeline-miles, respectively (Table 3.1.2-18). Marin County has the greatest number of pipeline-miles in both floodplain designations (Table 3.1.2-18).

3.1.2.b Gas Distribution

Table 3.1.2-18. Miles of distribution pipelines located by county in the North Coast Region in FEMA 100-year and 500-year floodplains.

County	100-year Floodplain	500-year Floodplain
Humboldt	29 (0.07%)	32 (0.07%)
Marin	122 (0.28%)	224 (0.52%)
Mendocino	19 (0.04%)	26 (0.06%)
Napa	33 (0.08%)	58 (0.13%)
Sonoma	40 (0.09%)	89 (0.21%)
Total	**243 (0.56%)**	**429 (0.99%)**

Note: Percentages are relative to total pipeline-miles within the PG&E service area.

Vulnerability to the impacts of landslides or debris flow may be higher in areas of Marin, Sonoma, and Mendocino counties (Figure 3.1.2-29).

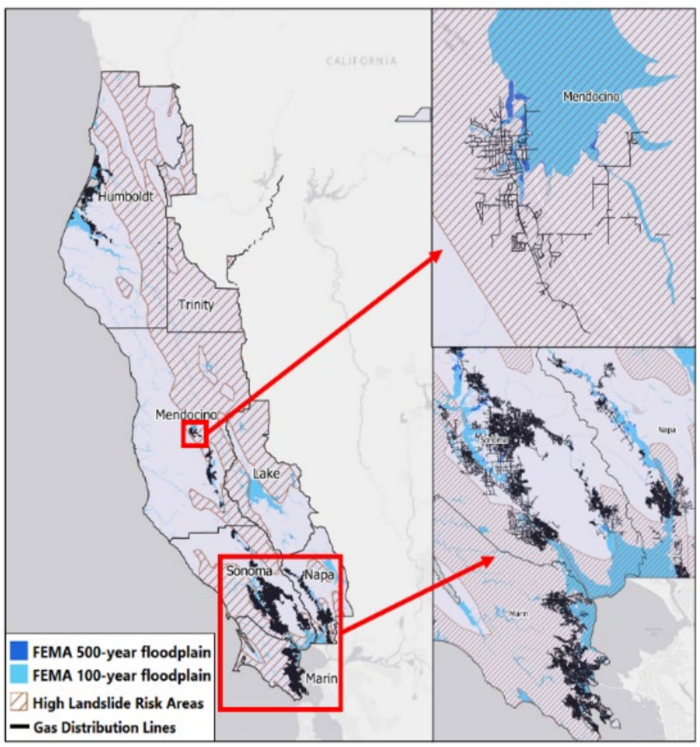


Figure 3.1.2-29. Gas distribution lines overlayed with high landslide risk areas and FEMA 100-year and 500-year floodplains in the North Coast Region.

Climate Hazard: Sea Level Rise

SLR is not considered to be a climate change issue for gas distribution assets at this time.

Climate Hazard: Wildfire

The North Coast Region has 607 miles of distribution pipelines (1.4 percent of distribution pipeline-miles) located in HFRAs, with Marin County having the greatest number of pipeline-miles (Table 3.1.2-19, Figure 3.1.2-30).

3.1.2.b Gas Distribution

Table 3.1.2-19. Gas distribution pipeline-miles exposed to HFRAs, by North Coast Region county.

County	Gas Distribution Pipeline-Miles in HFRAs
Humboldt	10 (0.02%)
Lake	0 (0%)
Marin	324 (0.74%)
Mendocino	47 (0.11%)
Napa	48 (0.11%)
Siskiyou	0 (0%)
Sonoma	176 (0.41%)
Trinity	2 (0.004%)
Total	**607 (1.40%)**

Note: Percentages are relative to total pipeline-miles within the PG&E service area.

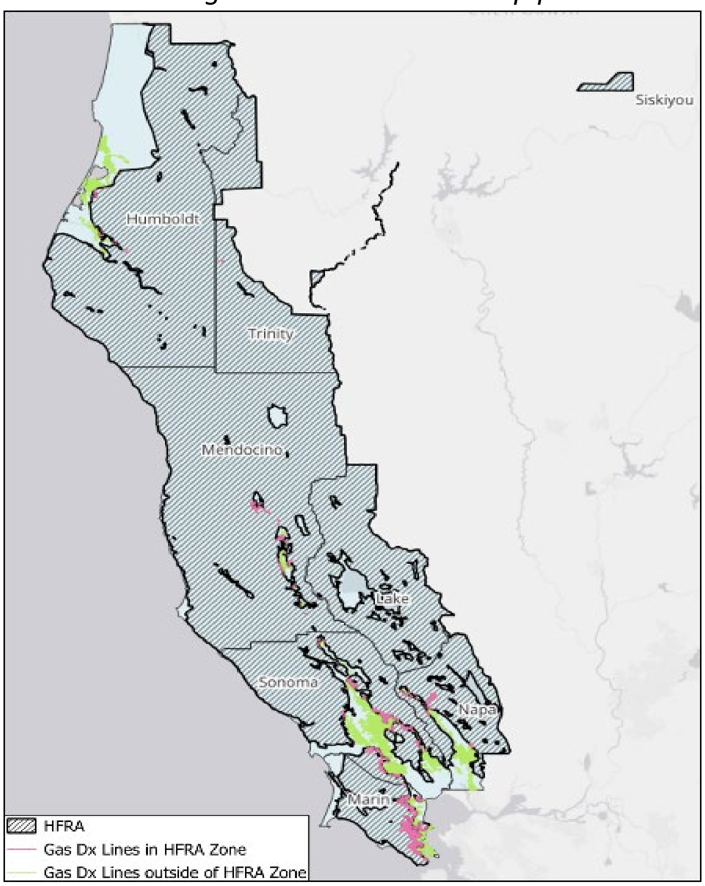


Figure 3.1.2-30. North Coast Region gas distribution pipelines in HFRAs.

Climate Hazard: Drought-Driven Subsidence

Drought-driven subsidence is not considered to be a climate change issue for gas distribution assets at this time.

Central Coast Region

Summary

The Central Coast Region has approximately 6,898 line-miles of distribution pipes (Figure 3.1.2-31).

Figure 3.1.2-31. PG&E gas distribution mains in the Central Coast Region.

Climate Hazard: Temperature

Higher temperatures are not considered to be a climate change issue for gas distribution assets at this time.

Climate Hazard: Flooding and Precipitation

The Central Coast Region has 413 miles (1 percent of total pipeline-miles) of distribution pipelines in a FEMA 100-year floodplain and 2,616 miles (6.1 percent) of pipelines in a FEMA 500-year floodplain, with Santa Clara County having the greatest number of pipeline-miles (Table 3.1.2-20).

3.1.2.b Gas Distribution

Table 3.1.2-20. Miles of distribution pipelines by county in the Central Coast Region located in FEMA 100-year and 500-year floodplains.

County	100-year Floodplain	500-year Floodplain
Monterey	42 (0.10%)	492 (1.14%)
San Benito	12 (0.03%)	15 (0.03%)
San Luis Obispo	1 (0.00%)	1 (0.00%)
Santa Clara	307 (0.71%)	2,042 (4.73%)
Santa Cruz	51 (0.12%)	65 (0.15%)
Total	**413 (0.96%)**	**2,615 (6.05%)**

Note: Percentages are relative to total pipeline-miles within the PG&E service area.

Vulnerability to the impacts of landslides or debris flow may be higher in the northern part of Monterey County (Figure 3.1.2-32).

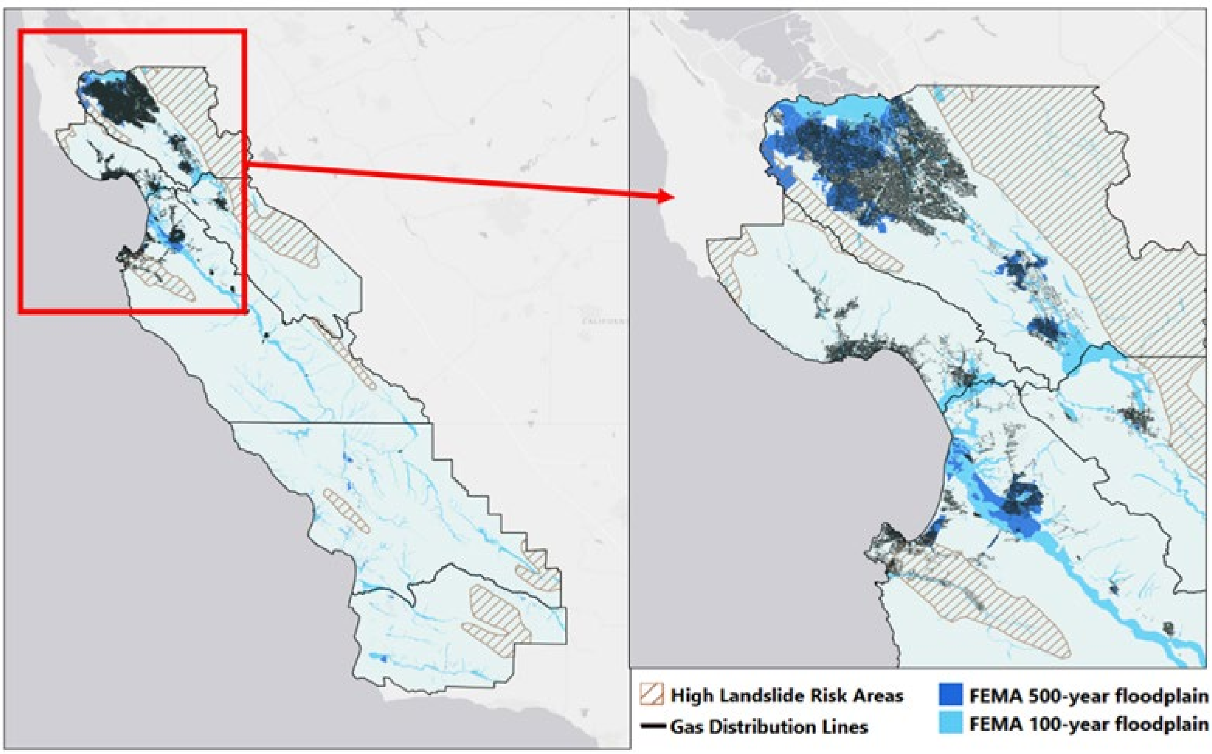


Figure 3.1.2-32. High landslide risk areas and FEMA 100-year and 500-year floodplains with PG&E's Central Coast Region gas distribution lines.

Climate Hazard: Sea Level Rise

SLR is not considered to be a climate change issue for gas distribution assets at this time.

Climate Hazard: Wildfire

The Central Coast Region has 484 miles of distribution pipelines (1.11 percent of total distribution pipeline-miles) located in HFRAs. Monterey, Santa Clara, and Santa Cruz counties all have higher numbers (Table 3.1.2-21, Figure 3.1.2-33).

3.1.2.b Gas Distribution

Table 3.1.2-21. Gas distribution pipeline-miles in HFRAs, by county in the Central Coast Region.

County	Gas Distribution Pipeline-Miles in HFRAs
Monterey	187 (0.43%)
San Benito	13 (0.03%)
San Luis Obispo	0 (0%)
Santa Barbara	0 (0%)
Santa Clara	150 (0.34%)
Santa Cruz	135 (0.31%)
Total	**484 (1.11%)**

Note: Percentages are relative to total pipeline-miles within the PG&E service area.

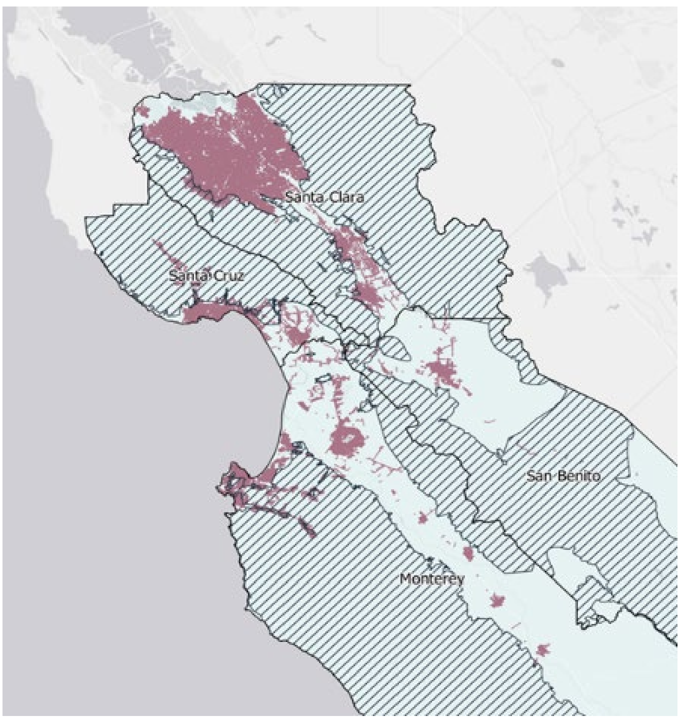


Figure 3.1.2-33. Central Coast Region gas distribution pipelines in HFRAs.

Climate Hazard: Drought-Driven Subsidence

Drought-driven subsidence is not considered to be a climate change issue for gas distribution assets at this time.

3.1.2.c Gas Compression and Processing, and Storage

Asset Family Introduction

PG&E's natural gas Compression and Processing (C&P) and Storage asset families encompass assets that are installed at PG&E's nine compressor stations located on transmission pipelines and at PG&E's three underground gas storage facilities.[19]

C&P assets include compressor units and associated equipment installed at compressor stations, as well as compressor units and gas processing equipment installed at underground storage facilities.

- The function of gas compression equipment on transmission pipelines is to meet customer demands by moving gas from receipt points to customer delivery locations, and the function of compression equipment at underground storage facilities is to inject gas into the reservoirs via underground gas storage wells.
- The function of gas processing equipment located at underground gas storage facilities is to provide gas that is free from particulates, dehydrated, and odorized to meet gas quality requirements.
- Storage assets include wells and reservoirs, as well as surface facilities and pipelines at underground storage facilities. C&P and Storage assets are co-located at the three underground storage facilities.

The locations of the nine gas compressor stations and three underground gas storage facilities are shown in Figure 3.1.2-34.

[19] PG&E maintains a 25 percent interest in the Gill Ranch storage facility, which is operated by Gill Ranch Storage, LLC. PG&E does not have direct responsibility for the operations and maintenance (O&M) of this facility beyond its contractual obligation to provide funding for a share of the O&M costs. Therefore, this facility has not been included in this assessment.

3.1.2.c Gas Compression and Processing, and Storage

Figure 3.1.2-34. Locations of PG&E gas compressor stations (black dots) and underground storage facilities (yellow dots) in California.

Key Findings

Climate Hazard	Climate Change Risk and Potential Adaptation Measures
Temperature	Low (off-ramped)
	• While higher temperatures have the potential to tax existing cooling equipment at compressor stations and affect the facilities' ability to rely on the electrical grid, it is unlikely that higher temperatures will result in damage to facility equipment. And, given the high adaptive capacity in the form of backup power generation capability and/or the ability of the gas system to cope with short-duration compressor station outages, the potential consequences for customers due to high heat are understood to be limited. • High temperature is not considered a climate change issue at this time and the climate hazard is **off-ramped**.
Flooding and Precipitation	High
	• The risk of impactful flooding is considered low for all compressor stations and underground storage facilities, with the exception of the McDonald Island natural gas storage facility, which is considered to be at **high** risk. The McDonald Island facility is located on an artificial island in the Sacramento-San Joaquin Delta, and it is protected by levees surrounding the island. In the event of a severe flood event due to a levee breach or overtopping, PG&E would likely need to cease injection and withdrawal operations at the facility for an extended period. • Adaptation options include, but are not limited to, incorporate low-probability flood events into overtopping and failure risk assessments of delta levee infrastructure that protects the McDonald Island Gas Storage Facility.
Sea Level Rise	High
	• The risk associated with SLR is considered low for all compressor stations and underground storage facilities, with the exception of the McDonald Island natural gas storage facility, which is considered to be at **high** risk. Higher water levels associated with SLR and changing runoff patterns may increase hydrostatic pressures on levees and increase the probability of levee breaches. • Adaptation options include, but are not limited to, incorporate sea level rise projections into overtopping and failure risk assessments of delta levee infrastructure that protects the McDonald Island Gas Storage Facility.

3.1.2.c Gas Compression and Processing, and Storage

Wildfire	Moderate
	• The Burney compressor station is the only station that is located in an HFRA and could be at risk in the event of a nearby wildfire. PG&E has already taken steps to reduce wildfire risk to the station through mitigating defensible space surrounding the station, as well as at other stations. The overall risk can be considered to be **moderate**. • Adaptation options include, but are not limited to, evaluating wildfire safety measures to consider a potential increase in wildfire hazard conditions.
Drought-Driven Subsidence	Low (off-ramped)
	• None of PG&E's compressor stations or gas storage facilities are located in areas where drought-driven subsidence effects are likely to be sufficient to affect assets. These facilities do not have identified sensitivities to the type of landscape-scale subsidence that may be driven by changing groundwater conditions, given their relatively compact footprints relative to the scale of subsidence. The risk is considered to be low and is insufficient to warrant recommended mitigations at this time. Drought-driven subsidence is not considered a climate change issue at this time and the hazard is **off-ramped**.

Climate Hazards

Temperature

Exposure and Sensitivity

Increases in average and extreme high temperatures are projected in many areas of PG&E's service area. High temperatures are unlikely to result in damage to compressor station or underground storage facility equipment; however, specific types of equipment at these facilities may have the following sensitivities:

- **Increased need for cooling:** PG&E's compressor stations rely on gas coolers to reduce the temperature of the gas leaving the station, due to the temperature increase that occurs as a result of compression. Existing cooling equipment may have insufficient cooling capacity considering the heightened ambient temperatures, coupled with the elevated demand for gas on the hottest days. For example, the compressor station at the Los Medanos storage facility (Bay Area Region) has already experienced instances when hot weather has reduced the station's cooling capacity, resulting in reduced injection capacity at the compressor station.
- **Dependence on the electrical grid:** Most of PG&E's compressor stations draw power from PG&E's electrical grid. When very high temperatures result in insufficient electricity supply, compressor stations may face load-shedding. In these cases, some, but not all, compressor stations have the ability to run on natural gas generators as a backup.

Climate Change Vulnerability

Analytical Metrics

The 98th percentile daily maximum temperature in 2030, 2050, and 2080 is used to explore the potential exposure to very high temperatures at each facility.

Results

The daily maximum temperature is projected to increase over time at all facilities (Table 3.1.2-22), indicating that vulnerability to the high heat of equipment at these facilities is likely to increase over time. However, continued analyses of high-temperature thresholds and the effects on cooling systems and connected electrical assets would be required to fully understand potential increases in vulnerability.

3.1.2.c Gas Compression and Processing, and Storage

Table 3.1.2-22. The 98th percentile daily maximum temperature (in °F) at PG&E's compressor stations and underground storage facilities at historical, 2030, 2050, and 2080 timeframes.

Facility	Historical Baseline (1976–2005)	2030	2050	2080
Bethany	100°F	104°F	107°F	111°F
Burney	97°F	101°F	104°F	108°F
Delevan	103°F	107°F	110°F	114°F
Gerber	106°F	110°F	113°F	116°F
Hinkley	100°F	103°F	106°F	109°F
Kettleman	104°F	108°F	110°F	115°F
Los Medanos	99°F	104°F	106°F	110°F
McDonald Island	101°F	105°F	108°F	112°F
Santa Rosa	96°F	100°F	102°F	106°F
Tionesta	94°F	99°F	102°F	107°F
Topock	109°F	112°F	115°F	118°F

Adaptive Capacity and Climate Change Risk

The adaptive capacity of PG&E's compressor stations and gas storage facilities to temperature change varies by facility; however, in general, it is influenced by the following factors:

- **Backup generation capability:** PG&E has the capability of running some compressor stations on natural gas generators in the absence of grid electricity. For example, in the Sierra Region, the Tionesta, Burney, and Gerber compressor stations are all equipped with backup generators; however, the Delevan compressor station does not have sufficient backup generation capacity to support gas compression.
- **System-level adaptive capacity:** In many cases, a loss of compression at a single station would not have widespread or long-term impacts because other stations could compensate.

The adaptive capacity of the compressor stations and gas storage facilities to projected increases in high temperatures is considered to be high. Considering backup power generation capabilities and/or the ability of the system to cope with short-duration station outages, the potential consequences for customers due to very high heat are understood to be limited. The overall risk of high heat over time to the gas compressor stations and storage facilities is considered to be **low** and the climate hazard is **off-ramped**.

Flooding and Precipitation

Exposure and Sensitivity

PG&E's assets located in floodplains face potential increased exposure to flooding as a result of climate-driven changes in precipitation, extreme storms, and other hydrological changes.

PG&E's gas compressor stations and underground storage facilities face the following sensitivities to flooding and precipitation-related hazards:

- **Overfilling of drainage systems:** Heavy downpours or other flood inundation may overfill compressor station drainage systems.
- **Potential overflow of storage ponds:** The Hinkley and Topock gas compressor stations rely on water in their evaporation ponds as part of their cooling systems. The increased variability of precipitation may strain pond capacity.
- **Impacts on the operations:** The McDonald Island natural gas storage facility is protected by levees surrounding the island. If the island were to flood due to a significant levee breach or overtopping, PG&E expects that it could lose the ability to perform injection/withdrawal operations at the facility for an extended period.
- **Damage from landslides and erosion:** The Los Medanos gas storage facility is located within and beneath hilly terrain, in an area of elevated historical landslide incidence. Heavier downpours could increase the risk of landslide events at this location, potentially damaging the facility. Also, the Topock compressor station is located on a desert hillside that could face impacts associated with precipitation-driven soil erosion.

Climate Change Vulnerability

Analytical Metrics

The metrics used to identify potential future exposure to flooding and precipitation risks are (1) the location of a facility in FEMA 100-year and 500-year floodplains, (2) the location within the Sacramento-San Joaquin Delta flood risk zone, and (3) projected high (5-day annual maximum) precipitation amounts in 2030, 2050, and 2080.

Results

The McDonald Island natural gas storage facility is the only one located in a FEMA 100-year floodplain. None of the other compressor stations or underground storage facilities are located in FEMA 100-year or FEMA 500-year floodplains. While the Los Medanos facility is not located in FEMA floodplains, it may be more vulnerable to landslide risks due to the nature of the surrounding terrain. Similarly, the terrain surrounding the Topock station has the potential to result in impacts on the station.

McDonald Island also is the only facility located in the Sacramento-San Joaquin Delta flood risk zone (water inundation due to potential levee overtopping).

Plausible changes in high precipitation indicate increases at all facility locations[20] over time (Table 3.1.2-23), indicating that all facilities have some level of increasing vulnerability to climate change-driven precipitation impacts. Additional studies would be required to identify thresholds of impact from heavy rain.

[20] Because they are outside the CAVA geographical area, Hinkley and Topock are not included in detailed downscaled climate projections.

Table 3.1.2-23. The 5-day annual maximum precipitation (in millimeters) projections at PG&E's compressor stations and underground storage facilities at historical, 2030, 2050, and 2080 timeframes.

Facility	Historical (1976–2005)	2030	2050	2080
Bethany	50	58	60	68
Burney	95	111	116	121
Delevan	81	96	101	101
Gerber	99	118	116	121
Kettleman	48	58	56	61
Los Medanos	87	105	107	122
McDonald Island	58	66	69	74
Santa Rosa	160	206	207	236
Tionesta	50	60	63	66

Adaptive Capacity and Climate Change Risk

The local reclamation district is responsible for flood protection for the McDonald Island natural gas storage facility, including seeing that contingency plans and risk reduction measures are in place (see the Potential Adaptation and Resilience Measures section below). However, these measures may not be sufficient to prevent impacts on gas storage operations at the McDonald Island facility during a major flooding event.[21]

If McDonald Island were to flood due to levee overtopping or failure, PG&E would likely not be able to continue injection or withdrawal operations at the facility because many critical components are not configured appropriately and/or would not function underwater. The adaptive capacity for the McDonald Island facility in the event of flooding is therefore considered to be low.

Because none of the other facilities are located in FEMA floodplains, and the gas system overall has the ability to cope with short-term disruptions, the adaptive capacity with regard to heavy precipitation and flooding for all other facilities is considered to be high.

While the climate change risk associated with flooding and precipitation is considered to be low for all other compressor stations and gas storage facilities, the climate change risk associated with flooding and precipitation is considered to be **high** for the McDonald Island natural gas storage facility.

[21] San Joaquin County Office of Emergency Services. 2015. "Annex A – McDonald Island Flood Contingency Map." RD 2030 McDonald Island Map.pdf (sjmap.org)

If McDonald Island were to flood due to a significant levee breach or overtopping, PG&E expects that it could lose the ability to perform injection or withdrawal operations at the facility for a year.

Potential Adaptation and Resilience Measures

Planning Options

- **Incorporate low-probability flood events** into overtopping and failure risk assessments of Delta levee infrastructure that protects the McDonald Island natural gas storage facility.

PG&E is currently studying factors that could influence levee failure and is exploring potential mitigation options, as well as contingency plans, in the event of high water or levee failure. The results of these efforts are expected to inform a more detailed understanding of the risks, the feasibility of mitigation options, and an understanding of potential mitigation benefits relative to cost. PG&E can incorporate climate change considerations into any levee overtopping and failure risk assessments.

PG&E is represented on the board of the Water Reclamation District, which has responsibility for the operations and maintenance of the levee system for McDonald Island. The district has developed an emergency operations plan as a basis for an emergency response to flood events.[22] The district also performs routine preparedness actions (e.g., inspection of levees) and monitors conditions throughout flood season to determine whether additional actions beyond preparedness activities are warranted.

Sea Level Rise

Exposure and Sensitivity

SLR may increase the likelihood of McDonald Island flooding due to a significant levee breach or overtopping. As noted above, the McDonald Island facility faces potential impacts on operations in the event of a severe flood; the facility could lose the ability to perform injection or withdrawal operations for an extended period.

No other compressor stations or underground gas storage facilities are in coastal areas or near tidally influenced waters.

Climate Change Vulnerability

SLR is projected to increase the risk of levee overtopping or failure.[23]

Adaptive Capacity and Climate Change Risk

Refer to the Flooding and Precipitation section for details.

[22] San Joaquin Operational Area. 2015. Reclamation District 2030: McDonald Island. https://rd2030.com/wp-content/uploads/2021/12/RD-2030-McDonald-Island-EOP.pdf

[23] Delta Stewardship Council. 2021. "Delta Adapts: Creating a Climate Resilient Future." https://deltacouncil.ca.gov/pdf/council-meeting/meeting-materials/2021-06-26-June-2021-Delta-Adapts-Vulnerability-Assessment.pdf

While the climate change risk of inundation due to SLR is low for all other facilities, it is considered to be **high** for the McDonald Island natural gas storage facility. SLR increases the risk of a levee breach or overtopping, and the adaptive capacity of the facility in the event of flooding is limited.

Planning Options

Incorporate sea level rise projections into overtopping and failure risk assessments of Delta levee infrastructure that protects the McDonald Island natural gas storage facility. Refer to Flooding and Precipitation section for details.

Wildfire

Exposure and Sensitivity

Facilities in HFRAs face projected increases in wildfire activity. Compressor stations and underground gas storage facilities face the following sensitivities to wildfire events:

- **Fire risk within the vicinity of a site:** If a fire were to occur in the vicinity of a compressor station or storage facility, it would pose a risk for safe access and operation of the site.
- **Public Safety Power Shutoff (PSPS) events:** The primary issue that compressor stations may face as a result of wildfires is power outages resulting from PSPS events. Most compressor stations, however, have backup generation capabilities.

Vulnerability

Analytical Metrics

The locations of gas compressor stations and gas storage facilities in HFRAs are the key exposure metrics for potential vulnerability to wildfires.

Results

Because wildfires can affect the ability to safety access and operate gas facilities, those facilities can be considered vulnerable to wildfires. However, only one of the compressor stations or gas storage facilities is located in HFRAs—the Burney compressor station in the Sierra Region.

Adaptive Capacity and Climate Change Risk

Isolation plans are in place at the Burney compressor station to mitigate wildfire risk to the station. PG&E's adaptive capacity to wildfire events is further affected by the following:

- **Station isolation:** In the event of imminent fire risk at a compressor station, PG&E may take action to isolate and blowdown the station.
- **System coping capacity:** While wildfire impacts on one station may reduce gas transmission pipeline capacity, other stations could potentially compensate.

The adaptive capacity of the compressor stations and gas storage facilities is considered to be moderate.

In 2014, PG&E warned that wildfire risk to the Burney station from nearby fires could result in a station shutdown without notice, reducing the capacity of the Redwood Path pipeline.[24] The station has had its defensible space mitigated,[25] and this space also undergoes maintenance.

Climate projections suggest that climate-driven wildfire risk will increase the most in HFRAs. Therefore, the risk of wildfire damage or pre-emptive shutdown due to wildfires is considered to be **moderate** at this location. The climate change risk for all other stations is considered to be **low**.

Potential Adaptation and Resilience Measures

Planning Options

- **Evaluate wildfire safety measures**: Actions to further mitigate wildfire-related risk to compressor stations and underground gas storage facilities include evaluating and potentially strengthening wildfire safety measures in anticipation of potentially increasing wildfire hazard conditions.

Drought-Driven Subsidence

None of PG&E's compressor stations or gas storage facilities are located in areas where drought-driven subsidence effects are likely to be sufficient to impact assets. Also, these facilities do not have identified sensitivities to the type of landscape-scale subsidence that may be driven by changing groundwater conditions, given their relatively compact footprints relative to the scale of subsidence. Drought-driven subsidence is not considered a climate change issue at this time and the climate hazard is **off-ramped**.

[24] PG&E. 2014. "California Gas Report Index." https://www.pge.com/pipeline/en/reference-library/regulatory/cgr.html

[25] Utility Procedure TD-4550P-02.

Gas Compression and Processing, and Storage Regional Reports

Bay Area Region

Summary

In the Bay Area Region, PG&E owns and operates the Bethany compressor station in Contra Costa County and the Los Medanos storage facility, also in Contra Costa County.

The Los Medanos gas storage facility is PG&E's second largest gas storage site, with 22 wells and a capacity of 17.9 billion cubic feet.[26] The facility includes processing equipment for cleaning withdrawal gas before it enters the pipeline, as well as a compressor station used to compress gas into the storage field at high pressure.

Climate Hazard: Temperature

High temperatures at the two facilities are projected to increase over the coming decades (Table 3.1.2-24).

Table 3.1.2-24. The 98th percentile daily maximum temperature (in °F) at Bay Area Region compressor and storage facilities at historical, 2030, 2050, and 2080 timeframes.

Facility	Historical (1976–2005)	2030	2050	2080
Bethany	100°F	104°F	107°F	111°F
Los Medanos	99°F	104°F	106°F	110°F

High temperatures are not considered to be a climate change issue for gas compression and processing or storage facilities, at this time.

Climate Hazard: Flooding and Precipitation

None of the Bay Area Region facilities are located in FEMA 100-year or 500-year floodplains or projected flood zones associated with coastal storms. However, the Los Medanos gas storage facility is located within and beneath hilly terrain. Heavier downpours could increase the risk of landslide events at this location.

The primary relevant exposure to flooding that these stations would experience is through the increasing intensity of precipitation. Heavy precipitation in the vicinity of Los Medanos could increase by as much as 20 mm by 2050 (23 percent over the historical baseline) during the most significant 5-day rainfall event in a typical year (Table 3.1.2-25).

[26] PG&E. "Gas Systems." https://www.pge.com/en_US/safety/gas-safety/natural-gas-storage.page.

3.1.2.c Gas Compression and Processing, and Storage

Table 3.1.2-25. The 1-day and 5-day annual maximum precipitation projections at PG&E's Bay Area Region compressor stations.

Facility	5-day Annual Maximum Precipitation (in millimeters)			
	Historical (1976-2005)	2030	2050	2080
Bethany	50	58	60	58
Los Medanos	87	105	107	122

Climate Hazard: Sea Level Rise

None of the assessed Bay Area Region facilities are located in FEMA 100-year or 500-year floodplains or projected flood zones associated with coastal storms.

Climate Hazard: Wildfire

None of the Bay Area Region facilities are located in HFRAs; therefore, the potential for direct exposure to catastrophic wildfires is considered to be low.

The Los Medanos storage facility has experienced multiple grass fires in the vicinity of the site in recent years, with at least one on the facility property. Site equipment is generally set back from grass with paving or gravel surfaces, so it is unlikely to be at high risk for damage. However, fire does pose a risk for the safe operation of the site and access; the site has an operator on-site 24 hours per day. If fire were severe, PG&E has the ability to blowdown the compressor station portion of the facility.

Climate Hazard: Drought-Driven Subsidence

Drought-driven subsidence is not considered to be a climate change issue for gas compression and processing or storage facilities, at this time.

Central Valley Region

Summary

In the Central Valley Region, PG&E owns and operates the McDonald Island natural gas storage facility in San Joaquin County and the Kettleman compressor station in Kings County. The Hinkley compressor station in San Bernardino County and the Topock compressor station in Nevada County also are included in this region, although they fall outside of the PG&E service area.

McDonald Island is PG&E's largest gas storage facility and has a maximum capacity of 82 billion cubic feet.[27] The facility is located on McDonald Island, which is an artificial island in a scarcely populated agricultural area in the Sacramento-San Joaquin Delta. The facility includes 87 total wells, 81 of which operate for injection and withdrawal and six of which operate as observation wells. McDonald Island is capable of providing 25 percent of Northern California's winter peak-day gas demand.

Climate Hazard: Temperature

Summer high temperatures at all locations are projected to increase over the coming decades, particularly under a severe climate change scenario (Table 3.1.2-26).

Table 3.1.2-26. The 98th percentile daily maximum temperature (in °F) at Central Valley Region compressor and storage facilities at historical, 2030, 2050, and 2080 timeframes.

Facility	Historical Baseline (1976–2005)	2030	2050	2080
Kettleman	104°F	108°F	110°F	115°F
McDonald Island	101°F	105°F	108°F	112°F

Because they are outside of PG&E's service area, Hinkley and Topock were not included in the detailed downscaled climate projections used for this vulnerability assessment.[28, 29]

---

[27] PG&E. "Gas Systems." https://www.pge.com/en_US/safety/gas-safety/natural-gas-storage.page.
[28] These two stations do not fall within the geographical area evaluated for this CAVA, and projections were taken from publicly available data from Climate Toolbox. This data source uses a different downscaling technique, different baseline, and presents the results as the mean of all models. While these estimates do not align with the estimates used for the other stations, the takeaway is the indication of change.
[29] Hegewisch, K.C., Abatzoglou, J.T., Chegwidden, O., and Nijssen, B. "Climate Mapper tool." Climate Toolbox. https://climatetoolbox.org/tool/climate-mapper

Table 3.1.2-27. Daily maximum temperatures averaged across the summer months (June, July, and August) for Hinkley and Topack compressor stations at historical, 2030, 2050, and 2080 timeframes.

Facility	Historical Baseline (1971–2000)	2030	2050	2080
Hinkley	100°F	103°F	106°F	109°F
Topock	109°F	112°F	115°F	118°F

High temperatures are not considered to be a climate change issue for gas compression and processing or storage facilities, at this time.

Climate Hazard: Flooding and Precipitation

PG&E's gas C&P and Storage assets on McDonald Island face potential increased exposure to flooding as a result of climate-driven changes in precipitation and Sacramento-San Joaquin Delta inflows, as well as from SLR, which could impact Delta water levels. McDonald Island is protected by levees that may see increased stress as a result of climate change. SLR and changes in hydrological patterns may increase flood elevations in the Delta, reducing levee freeboard in the near- to mid-term and potentially resulting in levee overtopping or failures in the mid- to long-term.[30]

By 2050, the average annual precipitation event across large portions of the Central Valley Region may increase in intensity by 2 inches or more. McDonald Island is located in a FEMA 100-year floodplain, indicating that C&P and Storage assets on the island may see higher and more frequent flood levels with increasing extreme precipitation.

In addition, heavy rainfall in the Sierra Nevada mountain range, which is the watershed for the Sacramento and San Joaquin rivers flowing into the Delta, could also increase Delta inflows. The effects of these increased inflows could be compounded by rising sea levels and changing runoff patterns, potentially increasing the likelihood of levee overtopping or failure.

C&P and Storage assets on McDonald Island are projected to be exposed to Delta flooding from levee overtopping in a 1-in-100-year storm event by 2050. Rising high water levels mean that impacts could plausibly occur with increasing probability, even in earlier decades (e.g., 2030), under a storm more severe than the 1-in-100-year event.

The Central Valley Flood Protection Plan prepared by the state of California indicates that several older flood protections in the Delta already face a high probability of failure.[31] Severe flooding of McDonald Island due to a levee breach or overtopping would almost certainly affect

[30] Delta Stewardship Council. 2021. "Delta Adapts: Creating a Climate Resilient Future." https://deltacouncil.ca.gov/pdf/delta-plan/2021-06-25-delta-adapts-vulnerability-assessment.pdf

[31] California Department of Water Resources. 2017. "Central Valley Flood Protection Plan: 2017 Update." https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Flood-Management/Flood-Planning-and-Studies/Central-Valley-Flood-Protection-Plan/Files/2017-CVFPP-Update-FINAL_a_y19.pdf

the gas storage facility located on the island. However, the risk of a levee breach and overtopping are beyond the scope of this vulnerability assessment.

The Kettleman, Hinkley, and Topock compressor stations are not located in FEMA 100-year or 500-year floodplains or the Delta flood risk zone.

Precipitation extremes: Table 3.1.2-28 shows projected changes in extreme precipitation at the Kettleman and McDonald Island station locations.

Table 3.1.2-28. The 5-day annual maximum precipitation projections at PG&E's Central Valley Region compressor stations.

Facility	**5-day Annual Maximum Precipitation (in millimeters)**			
	Historical (1976–2005)	2030	2050	2080
Kettleman	48	58	56	61
McDonald Island	58	66	69	74

The Hinkley and Topock compressor stations are both expected to see more variable precipitation in the coming decades with extreme drought and extreme precipitation.[32] Average annual precipitation also is projected to increase from a historical baseline of 5.5 inches to 5.8 inches by late century.[33] Increases in precipitation have the potential to affect these compressor stations. Topock compressor station, in particular, is located on a desert hillside that can experience soil erosion due to precipitation; this has resulted in impacts on the station in the past (e.g., damage to pipe supports).

Landslide Risks

None of PG&E's C&P and Storage assets in the Central Valley Region are located in high landslide risk areas.

Climate Hazard: Sea Level Rise

Refer to the exposure analysis above.

[32] Bedsworth, L., Cayan, D., Franco, G., Fisher, L., and Ziaja, S. California Governor's Office of Planning and Research, Scripps Institution of Oceanography, California Energy Commission, and the California Public Utilities Commission. 2018. "California's Fourth Climate Change Assessment." https://www.energy.ca.gov/data-reports/reports/californias-fourth-climate-change-assessment

[33] Hegewisch, K.C., Abatzoglou, J.T., Chegwidden, O., and Nijssen, B. "Climate Mapper tool." Climate Toolbox. https://climatetoolbox.org/tool/climate-mapper

3.1.2.c Gas Compression and Processing, and Storage

Climate Hazard: Wildfire

None of the facilities in the Central Valley Region are located in HFRAs; therefore, their potential for direct exposure to wildfires is considered to be low. In the event of imminent fire exposure risk at a station, PG&E has procedures in place to isolate and blowdown the station.

The primary issue that the Central Valley Region facilities may face as a result of wildfires is power outages resulting from PSPS events. However, the compressor stations in the Central Valley Region are unlikely to be affected in the event of a PSPS-driven outage: The Kettleman compressor station has a natural gas-fired generator, and the Hinkley and Topock stations both generate their own electrical power. The McDonald Island natural gas storage facility has backup generation that is capable of supporting withdrawal.

Climate Hazard: Drought-Driven Subsidence

Drought-driven subsidence is not considered to be a climate change issue for gas compression and processing or storage facilities, at this time.

Sierra Region

Summary

In the Sierra Region, PG&E operates the Delevan, Gerber, and Burney compressor stations, as well as the Tionesta compressor station to the north of the Sierra Region.[34]

Climate Hazard: Temperature

Summer high temperatures at all locations are projected to increase over the coming decades, particularly under a severe climate change scenario (Table 3.1.2-29).

Table 3.1.2-29. The 98th percentile daily maximum temperature (in °F) for the Sierra Region compressor stations at historical, 2030, 2050, and 2080 timeframes.

Facility	Historical (1976–2005)	2030	2050	2080
Burney	97°F	101°F	104°F	108°F
Delevan	103°F	107°F	110°F	114°F
Gerber	106°F	110°F	113°F	116°F
Tionesta	94°F	99°F	102°F	107°F

High temperatures are not considered to be a climate change issue for gas compression and processing or storage facilities, at this time.

Climate Hazard: Flooding and Precipitation

None of the PG&E's compressor stations in the Sierra Region are located in FEMA 100-year or 500-yearfloodplains. Thus, the primary relevant exposure for stations in this region is extreme precipitation. Table 3.1.2-30 shows projected change in extreme precipitation at the four station locations.

[34] PG&E previously operated the Pleasant Creek storage facility in Yolo County but has executed a purchase and sale agreement for the sale of the storage field and is awaiting CPUC approval. The compressor has been isolated from the storage field and is not currently in use. Screening indicates that no assets at the facility are located in or adjacent to floodplains or wildfire risk areas; therefore, the facility is not considered to face any notable climate hazards.

Table 3.1.2-30. The 5-day annual maximum precipitation projections at PG&E's Sierra Region compressor stations.

Facility	5-day Annual Maximum Precipitation (in millimeters)			
	Historical (1976–2005)	2030	2050	2080
Burney	95	111	116	121
Delevan	81	96	101	101
Gerber	99	118	116	121
Tionesta	50	60	63	66

None of the PG&E's compressor stations in the Sierra Region are located in high landslide risk areas.

Climate Hazard: Sea Level Rise

None of the PG&E's compressor stations in the Sierra Region are within the projected extent of future coastal inundation.

Climate Hazard: Wildfire

The Burney compressor station is located in an HFRA; it is surrounded by coniferous forest (Figure 3.1.2-35), and as a result, it could conceivably be at risk in the event of a nearby wildfire. In 2014, PG&E warned that the wildfire risk to the station could result in a station shutdown without notice, reducing the capacity of the Redwood Path pipeline.[35] The station has had its defensible space mitigated, and this space also undergoes maintenance.

Climate projections suggest that climate-driven wildfire risk will increase the most in HFRAs. Therefore, the risk of wildfire damage or pre-emptive shutdown due to wildfires is considered to be **high** at this location.

[35] PG&E. 2014. "California Gas Report Index." https://www.pge.com/pipeline/en/reference-library/regulatory/cgr.html

3.1.2.c Gas Compression and Processing, and Storage

Figure 3.1.2-35. Burney compressor station satellite imagery (Google, 2022).

PG&E's Delevan, Gerber, and Tionesta compressor stations are not located in HFRAs; therefore, their potential for direct exposure to catastrophic wildfires is considered to be low. However, due to the consequences associated with the facilities, their defensible space also has undergone evaluation and maintenance.

The overall risk of wildfire-related hazards to gas compressor stations in the Sierra Region are considered to be **moderate**. The Burney compressor station may be vulnerable to direct impacts in the event of a wildfire affecting the site; however, isolation plans are in place to mitigate gas ignition risk and impacts on the overall system are mitigated by the ability of other compressor stations to partially compensate. However, a wildfire event affecting the compressor station would be costly and detrimental to the system.

Climate Hazard: Drought-Driven Subsidence

Drought-driven subsidence is not considered to be a climate change issue for gas compression and processing or storage facilities, at this time.

North Coast Region

In the North Coast Region, PG&E owns and operates the Santa Rosa compressor station in Sonoma County.

Climate Hazard: Temperature

High temperatures at the Santa Rosa compressor station are projected to increase over the coming decades (Table 3.1.2-31).

Table 3.1.2-31. The 98th percentile daily maximum temperature (in °F) at the Santa Rosa compressor station at historical, 2030, 2050, and 2080 timeframes.

Facility	Historical (1976–2005)	2030	2050	2080
Santa Rosa	96°F	100°F	102°F	106°F

High temperatures are not considered to be a climate change issue for gas compression and processing or storage facilities, at this time.

Climate Hazard: Flooding and Precipitation

The Santa Rosa compressor station is not located in a FEMA 100-year or 500-year floodplain.

Climate Hazard: Sea Level Rise

The Santa Rosa compressor station is not located in a coastal or tidally influenced area.

Climate Hazard: Wildfire

The Santa Rosa compressor station is not located in an HFRA.

Climate Hazard: Drought-Driven Subsidence

Drought-driven subsidence is not considered to be a climate change issue for gas compression and processing or storage facilities, at this time.

3.1.2.c Gas Compression and Processing, and Storage

Central Coast Region

PG&E does not own or operate any gas compressor stations or underground gas storage facilities in the Central Coast Region.

3.1.2.d Gas Measurement and Control Stations

Asset Family Introduction

PG&E's natural gas Measurement and Control (M&C) assets monitor, measure, and control pressure and flow within the gas transmission and distribution systems. These assets play a role in system safety and reliability by protecting downstream assets from system pressure excursions and gas quality degradation.

These assets are generally installed at gas regulator stations and regulator sets. PG&E owns and operates multiple types of regulating facilities, including both complex and simple transmission stations, transmission large-volume customer (LVC) facilities, distribution district regulator stations, and farm tap regulator sets. Counts of the facilities[36] that have been reviewed through the analysis presented in this chapter[37] and the percentage that they represent across the system are shown in Table 3.1.2-32. Table 3.1.2-33 and Table 3.1.2-34 show counts and percentages, respectively, of facility types by region.

Table 3.1.2-32. Counts and percentages of M&C facilities across the PG&E gas system.

Facility Type	Count	Percentage
Complex transmission stations	125	3%
Simple transmission stations	252	5%
Transmission LVC facilities	406	9%
Distribution district regulator stations[38]	2,189	46%
Farm tap regulator sets	1,614	34%
Low-pressure district regulator stations	186	4%
Total	**4,772**	**100%**

[36] The terms *station* and *facility* are used interchangeably throughout this document; however, these terms may have general or very specific meanings in other PG&E documents, federal and state codes and regulations, and industry standards and design codes.
[37] Facility counts are as of 2020.
[38] Includes high- and semi-high-pressure distribution district regulator stations and HPR-type stations. Subsequent tables follow a similar convention unless otherwise noted.

Table 3.1.2-33. Counts of M&C facilities across the PG&E gas system, by region.

Facility Type	Bay Area	Central Valley	Sierra	North Coast	Central Coast	Total
Complex transmission stations	30	36	28	9	22	125
Simple transmission stations	40	88	73	23	28	252
Transmission LVC facilities	44	181	115	14	52	406
Distribution district regulator stations	410	508	553	361	357	2,189
Farm tap regulator sets	169	299	427	445	274	1,614
Low-pressure district regulator stations	92	62	14	2	16	186
Total	**785**	**1,174**	**1,210**	**854**	**749**	**4,772**

Table 3.1.2-34. Percentages of M&C facilities across the PG&E gas system, by region.

Facility Type	Bay Area	Central Valley	Sierra	North Coast	Central Coast
Complex transmission stations	24%	29%	22%	7%	18%
Simple transmission stations	16%	35%	29%	9%	11%
Transmission LVC facilities	11%	45%	28%	3%	13%
Distribution district regulator stations	19%	23%	25%	16%	16%
Farm tap regulator sets	10%	19%	26%	17%	17%
Low-pressure district regulator stations	49%	33%	1%	9%	9%
Total	**16%**	**25%**	**25%**	**18%**	**16%**

Distinguishing characteristics of the different types of gas regulating facilities are described as follows:

- Complex transmission stations are those that contain controller-operated valves to regulate pressure, as well as complex controls. They may have a programmable logic controller or a remote terminal unit (RTU) that provides control and/or data transmission. The complex transmission stations include PG&E's three gas terminals.
- Simple transmission stations have simple controls and operation. They may include instrumentation and RTUs provided that they are not primarily for control. These stations have regulators with self-contained controls.
- Transmission LVC facilities are defined by their gas delivery flow capacity; they include both LVC regulator sets and LVC meter sets.
- Distribution district regulator stations typically receive gas from the high-pressure transmission system. Approximately 90 percent of these stations regulate gas in local

distribution systems at a pressure no higher than 60 pounds per square inch gauge (psig). The remaining 10 percent of these stations regulate gas into what are called "low-pressure distribution systems" that have operating pressures below 1 psig. These stations are referred to a "low-pressure stations." All district regulator stations serve two or more service lines (typically hundreds to thousands of customers). PG&E uses two types of regulators at these stations: "pilot-operated" and "spring-operated." Spring-operated regulators are referred to as high-pressure regulators (HPRs).

- Farm taps are service lines that are connected directly from a gathering or transmission line to serve customers other than an LVC. Farm tap regulator sets are pressure regulator sets that control pressure to a service line.

Key Findings

Climate Hazard	Climate Change Risk
Temperature	Low (off-ramped)
	• M&C assets are generally considered to have low sensitivity to high heat; significant negative impacts are not expected with projected increases in ambient and extreme temperatures. • High temperatures is not considered a climate change issue to M&C assets at this time and the climate hazard is off-ramped.
Flooding and Precipitation	Moderate
	• M&C assets face potential increased exposure to flooding because of future plausible changes in extreme flooding and precipitation. Stations and regulator sets are located both belowground (often vaulted) and aboveground; both types are susceptible to damage from flooding, depending on the type of equipment installed at the facility. • Adaptation options include, but are not limited to, prioritize physical protection measures at stations in flood-prone areas and review vent heights for low-pressure stations located in flood-prone areas.
Sea Level Rise	Low (off-ramped)
	• Specific types of regulator stations are susceptible to damage from flooding due to precipitation or SLR. • The number of sensitive facilities that may be exposed to inundation in a 100-year storm in the greater Bay Area Region is currently assessed to be very low. • SLR is not considered a climate change issue to M&C assets at this time and the climate hazard is off-ramped.
Wildfire	Low (off-ramped)
	• Specific types of M&C assets at pressure regulating facilities are sensitive to wildfires. • While approximately 9 percent of pressure-regulating facilities are located in PG&E's HFRAs, between 3 percent and 6 percent of sensitive facilities are exposed. • PG&E has tailored adaptive capacity measures in place, which reduces the risk to potentially exposed facilities. • Damage from wildfire is not considered to be a climate change issue at this time and the climate hazard is off-ramped.

3.1.2.e Liquefied Natural Gas and Compressed Natural Gas

Drought-Driven Subsidence	Low (off-ramped)
	• M&C assets do not have identified sensitivities to the type of landscape-scale subsidence that may be driven by changing groundwater conditions, given their relatively compact footprints relative to the scale of subsidence. The risk is considered to be low and is insufficient to warrant recommended mitigations at this time. Drought-driven subsidence is not considered to be a climate change issue at this time and the climate hazard is off-ramped.

Climate Hazards

This section describes climate hazards that may affect gas M&C assets, including temperature, flooding and precipitation, sea level rise, wildfire, and drought-driven subsidence.

Temperature

While average and extreme temperatures across the service area are projected to increase, gas M&C assets generally have low sensitivity to higher ambient temperatures. Electronic equipment located at some complex transmission stations can be heat-sensitive; however, such equipment is often located in climate-controlled rooms. Temperature-related risks to M&C stations are considered to be **low** and the climate hazard is **off-ramped**.

Flooding and Precipitation

Exposure and Sensitivity

PG&E's M&C assets face potential increased exposure to flooding because of future plausible changes in extreme flooding and precipitation. Stations and regulator sets are located both belowground (often vaulted) and aboveground; both types are susceptible to damage from flooding.

- **Submersion of station equipment:** Different station types vary in their sensitivity to submersion-related damage:
  - Low-pressure distribution regulator stations are the most sensitive to and thus the most vulnerable to flooding if exposed. Inundation of vents can result in increased pressure on regulator diaphragms, potentially leading to an overpressure event. The vast majority of low-pressure stations across the system are belowground in vaults, which also affects their sensitivity to submersion. Vaulted stations, however, have vent lines raised aboveground, meaning that flooding in a vault itself does not necessarily present an overpressure risk.
  - Complex transmission station valves are mainly buried belowground; however, control and other equipment, such as electric actuators, controllers, supervisory control and data acquisition (SCADA), and batteries, are susceptible to damage and malfunction from flooding. Damage to and/or the failure of station equipment can result in overpressure or underpressure events.
  - Other station types are not as sensitive to impacts from submersion, compared with the low-pressure distribution stations and the complex transmission stations. As an example, flooding is less likely to result in an overpressure event at distribution district regulator stations due to their operating pressures; many of these stations are also equipped with secondary overpressure protection (as are all low-pressure distribution stations). Also, while extended submersion can result in corrosion, this is unlikely to immediately affect the station's ability to regulate gas pressure.

- **Damage from hydrodynamic force:** Fast-flowing water, debris, or scour can potentially damage sensitive station equipment, such as sensing lines. Damage to station sensing lines can result in an overpressure event; however, the risk of this occurring is lower at pilot-operated stations where slam-shut devices have been installed. Impact damage is anticipated to be limited to aboveground assets.

Changes in high-precipitation events due to climate change may result in increased exposure to landslides.

Climate Change Vulnerability

Analytical Metrics

The key metric for vulnerability to flooding is a station's location with regard to FEMA 100-year and FEMA 500-year floodplains.

Results

PG&E's low-pressure stations are located predominantly in the Bay Area and Central Valley Regions, which include 49 percent and 33 percent of the low-pressure station population, respectively. However, the potential exposure of low-pressure stations to flooding in the future is anticipated to be relatively low in the Bay Area Region (with only 2 percent of the region's low-pressure stations in a FEMA 500-year floodplain), compared with other regions, especially the Sierra and Central Valley Regions (Table 3.1.2-35). Approximately 57 percent of the low-pressure stations in the Sierra Region are in a FEMA 500-year floodplain, as are approximately 48 percent of the low-pressure stations in the Central Valley Region (Table 3.1.2-35).

Table 3.1.2-35. Low-pressure stations in FEMA 100-year and 500-year floodplains, by region.

Region	Total Stations		In a FEMA 100-year Floodplain		In a FEMA 500-year Floodplain	
	Count	Percentage	Count	Percentage	Count	Percentage
Bay Area	92	49%	0	0%	2	2%
Central Valley	62	33%	3	5%	30	48%
Sierra	14	8%	0	0%	8	57%
North Coast	2	1%	0	0%	0	0%
Central Coast	16	9%	2	13%	5	31%
Total	**186**	**100%**	**5**	**3%**	**45**	**24%**

Greater proportions of the complex transmission stations are located in a FEMA 100-year floodplain than the low-pressure stations, and thus may have greater vulnerability to flooding (Table 3.1.2-36). The potential for the vulnerability of complex transmission stations is not limited to any specific region(s); the percentage of stations in a FEMA 500-year floodplain ranges from 19 percent to 32 percent across all regions (Table 3.1.2-36).

3.1.2.e Liquefied Natural Gas and Compressed Natural Gas

Table 3.1.2-36. Complex transmission stations in FEMA 100-year and 500-year floodplains, by region.

Region	Total Stations		In a FEMA 100-year Floodplain		In a FEMA 500-year Floodplain	
	Count	Percentage	Count	Percentage	Count	Percentage
Bay Area	30	24%	7	23%	8	27%
Central Valley	36	29%	1	3%	7	19%
Sierra	28	22%	4	14%	7	25%
North Coast	9	7%	2	22%	2	22%
Central Coast	22	18%	4	18%	7	32%
Total	**125**	**100%**	**18**	**14%**	**31**	**25%**

None of the terminals are located in a FEMA 100-year floodplain, and Milpitas Terminal (in the Bay Area Region) is the only terminal that is located in a FEMA 500-year floodplain.

Adaptive Capacity and Climate Change Risk

PG&E's adaptive capacity to mitigate the impacts associated with flooding and precipitation at M&C assets is influenced by the following.

Planning Capacities

- **Installation of secondary overpressure protection devices:** In 2018, PG&E began installing secondary overpressure protection devices on pilot-operated regulator stations because both the regulator and monitor (primary overpressure protection) devices at these stations have a common failure mode.[39] The installation of these devices reduces overpressure risk at these stations, which makes an overpressure scenario in the event of flooding at these stations even less likely.

Operational Capacities

- **Monitoring and emergency response:** PG&E is prepared to take emergency action to isolate or reduce pressure at potentially flood-affected stations, based on the monitoring of flooding and system conditions. Stations that suffer a loss of visibility as a result of flood impacts may still be monitored via system impacts registered by SCADA equipment located outside the flood zone.

This adaptive capacity is considered to be moderate because of the emergency response measures that PG&E has in place. The climate change risk of impacts from future flooding to sensitive M&C assets is considered to be **moderate** due to the number of potentially exposed

[39] *Common failure mode* refers to the default failure modes of pressure-regulating equipment in a station's design. For example, at distribution district regulator stations, the station design may be such that both the primary regulating device and the monitoring regulating device (which is the primary overpressure protection) are designed to fail in the "open" position. Secondary overpressure protection devices essentially add a "closed" position failure mode to station equipment.

assets and the potential consequences, including overpressure, underpressure/loss of service, and loss of containment.

Potential Adaptation and Resilience Measures

PG&E may consider the following adaptation measures to further reduce the risk from flooding.

Planning Adaptations

- **Prioritize physical protection measures at stations in flood-prone areas:** PG&E may re-evaluate the location of specific equipment at stations in flood-prone areas when relocating the entire station is neither feasible nor prudent.
- **Relocate stations in flood-prone areas:** PG&E may consider relocating specific stations to areas that are less likely to be exposed to future flooding.
- **Review vent heights for low-pressure stations located in floodplains:** PG&E may consider assessing whether the vent heights of low-pressure stations located in floodplains are sufficiently conservative to reflect the potential for more severe future floods.

Operational Adaptations

- **Continue to invest in system monitoring:** Continuing to improve SCADA visibility (through the installation of additional SCADA devices) would increase the number of points through which stations and the overall system can be monitored.

Sea Level Rise

Exposure and Sensitivity

As sea levels rise, M&C assets in coastal or tidally influenced areas may face an increased risk of flooding, especially during a large storm event. Also, as Sacramento-San Joaquin Delta inflows increase, driven by climate change, more stations in the Central Valley Region may be at risk of flooding. As discussed in the section above on Flooding and Precipitation, stations and regulator sets vary in their vulnerability to flood-related damage based on the type of equipment they contain. Two facility types were identified as being the most sensitive to flood-related impacts: (1) complex transmission stations, and (2) low-pressure distribution regulator stations.

Climate Change Vulnerability

Analytical Metrics

The key metric for vulnerability to flooding due to SLR is the number of facilities that are projected to be exposed to coastal flooding during a 100-year storm.

Results

None of PG&E’s low-pressure distribution regulator stations are expected to be inundated by a 100-year storm by 2030, 2050, or 2080, indicating that PG&E’s gas regulator stations and regulator sets are not projected to be vulnerable to flooding due to SLR. Additionally, only three of the complex transmission stations are projected to be exposed as of 2080. (None are considered exposed as of 2050.) Those three stations represent 6 percent of the 50 complex transmission stations evaluated,[40] indicating likely low future vulnerability.

Adaptive Capacity and Climate Change Risk

PG&E's adaptive capacity to mitigate the impacts associated with flooding and precipitation at M&C assets is influenced by the following.

Planning Capacities

- **Installation of secondary overpressure protection devices:** In 2018, PG&E began installing secondary overpressure protection devices on pilot-operated regulator stations because both the regulator and monitor (primary overpressure protection) devices at these stations have a common failure mode. The installation of these devices reduces overpressure risk at these stations, which makes an overpressure scenario in the event of flooding at these stations even less likely.

Operational Capacities

- **Monitoring and emergency response:** PG&E is prepared to take emergency action to isolate or reduce pressure at potentially flood-affected stations, based on the monitoring of flooding and system conditions. Stations that suffer a loss of visibility as a result of flood impacts may still be monitored via system impacts registered by SCADA equipment located outside the flood zone.

This adaptive capacity is considered to be moderate because of the emergency response measures that PG&E has in place. The climate change risk associated with future flooding, specifically due to SLR at M&C facilities, is considered to be **low** due to the small number of sensitive assets that are also potentially exposed and the climate hazard is **off-ramped**.

Wildfire

Exposure and Sensitivity

Facilities in HFRAs face projected increases in wildfire activity, and wildfire events have the potential to negatively affect certain M&C assets. Wildfires can affect regulating facilities through burning vegetation or debris coming into contact with components at the facility or through the impacts of high temperatures on sensitive components. Sensitive equipment at facilities includes the following.

- **Pilot-operated equipment:** Certain types of gas regulating equipment rely on internal "soft goods" (e.g., rubber diaphragms) that are rated only up to specific temperatures. Should these components fail under high heat conditions, the equipment may "fail open" and result in an overpressure event, depending on the other type(s) of overpressure protection installed at the facility. The facility types that are most susceptible to this type of

[40] Facilities in the greater Bay Area Region were evaluated for potential flooding due to sea level rise. A total of 30 complex transmission stations in the Bay Area Region were reviewed, and all three exposed facilities were in this set of 30 facilities.

overpressure scenario are pilot-operated distribution district regulator stations[41] and simple transmission stations (which are also pilot-operated) because these facility types have regulation equipment and primary overpressure protection that can both “fail open.”

- **Electrical equipment:** Complex transmission station valves are mainly buried belowground; however, control and other equipment, such as electric actuators, controllers, SCADA, and batteries, are susceptible to damage and malfunction in extreme heat conditions. The design failure modes for control valves in the PG&E system vary by manufacturer. Damage to and/or the failure of electrical equipment at complex transmission stations can result in overpressure or underpressure events, as well as the potential for loss of visibility at the station.

Other facility types are not as sensitive to potential wildfire impacts, compared with the pilot-operated stations and complex transmission stations. Many spring-operated facilities utilizing high-pressure regulators (including farm tap regulator sets) are configured with a relief device that would relieve pressure in the event that it is subjected to high gas pressure or extreme heat. The most recent design standard for these facilities specifies shutoff valves for overpressure protection.

Climate Change Vulnerability

Analytical Metrics

The key metric for vulnerability to the impacts from wildfires is a station’s location in an HFRA.

Results

The North Coast Region has the highest overall count (140) and percentage (16 percent) of facilities in HFRAs (Table 3.1.2-37). In terms of the more sensitive facilities, the North Coast and Central Coast Regions have the highest percentages of vulnerable simple transmission stations, and relatively small percentages of pilot-operated district regulator stations are exposed across all the regions (Table 3.1.2-38). Very few complex transmission stations (6 percent) are located in HFRAs, with the North Coast Region having the highest percentage of stations in HFRAs within a region (33 percent, representing three stations) (Table 3.1.2-39).

[41] Low-pressure district regulator stations are excluded in this case because they already have secondary overpressure protection installed. Approximately 50 percent of the high- and semi-high-pressure distribution district regulator stations that are pilot-operated also currently have secondary overpressure protection.

3.1.2.e Liquefied Natural Gas and Compressed Natural Gas

Table 3.1.2-37. Regulating facilities in HFRAs, by region.

Region	Total Facilities	In HFRAs	
		Count	Percentage
Bay Area	785	50	6%
Central Valley	1,174	47	4%
Sierra	1,210	85	7%
North Coast	854	140	16%
Central Coast	749	93	12%
Total	**4,772**	**415**	**9%**

Table 3.1.2-38. Regulating facilities in HFRAs by region—simple transmission stations and pilot-operated distribution district regulator stations.

Region	Simple Transmission Stations			Pilot-Operated Distribution District Regulator Stations		
	Total	In HFRAs		Total	In HFRAs	
		Count	Percentage		Count	Percentage
Bay Area	40	3	8%	373	11	3%
Central Valley	88	2	2%	275	3	1%
Sierra	73	3	4%	321	12	4%
North Coast	23	3	13%	142	9	6%
Central Coast	28	4	14%	213	10	5%
Total	**252**	**15**	**6%**	**1,324**	**45**	**3%**

Table 3.1.2-39. Regulating facilities in HFRAs by region—complex transmission stations.

Region	Total Facilities	In HFRAs	
		Count	Percentage
Bay Area	30	1	3%
Central Valley	36	0	0%
Sierra	28	1	3%
North Coast	9	3	33%
Central Coast	22	2	9%
Total	**125**	**7**	**6%**

Vulnerability is dependent on the type of equipment present, combined with the facility's location with regard to HFRAs. Vulnerability at individual facilities varies, based on factors such as the extent of defensible space, the types of vegetation in the surrounding areas, the status of vegetation management and/or other hardening measures, and whether the facility is aboveground or belowground.

Adaptive Capacity and Climate Change Risk

PG&E currently employs several strategies for managing wildfire impacts at M&C stations.

Planning Capacities

- **Install and maintain secondary overpressure protection devices:** PG&E has a program to install secondary overpressure protection devices at pilot-operated distribution district regulator stations where both the regulator and monitor (primary overpressure protection) can “fail open” (i.e., have a common failure mode).

Operational Capacities

- **Perform vegetation inspections and management:** PG&E has implemented defensible space principles in and around specific regulating facilities according to Utility Procedure TD-4550P-02, “Wildfire Defensible Space for Gas Facilities.” Identified facilities have been inspected and referred for vegetation management.
- **Maintain standby power generation at selected facilities:** As a preventive measure against a loss-of-power event (as may occur in a PSPS scenario), some stations are equipped with standby power generation. Typically, if a station is equipped with a standby power generator, a transfer switch will automatically start the standby generator, disconnect the utility power supply, and connect the essential facility loads to the generator. In the event that a station is not equipped with an automatic transfer switch or standby power generation does not activate during a loss-of-power event, valves at the station will typically operate under monitor control.
- **Conduct active fire monitoring:** PG&E monitors changes to fire conditions, including changes to the fire perimeter, weather forecast, wind direction, and wind speed. Monitoring can help PG&E determine the need for aerial leak surveys, proactive brush clearing, tree felling, or fire retardant in potential fire growth areas.
- **Perform post-fire visual inspection:** After a fire area is determined to be safe, appropriate field personnel and engineers inspect the assets for heat damage and physical damage should there be a need for repairs.

While approximately 9 percent of pressure regulating facilities are located in PG&E’s HFRAs, between 3 percent and 6 percent of sensitive facilities are exposed. PG&E has tailored adaptive capacity measures. The adaptive capacity is considered to be high, and while there is a potential risk of overpressure and underpressure/loss of service, the climate change risk is considered to be **low** and the climate hazard is **off-ramped**.

Drought-Driven Subsidence

M&C assets do not have identified sensitivities to the type of landscape-scale subsidence that may be driven by changing groundwater conditions, given their relatively compact footprints relative to the scale of subsidence. Drought-driven subsidence is not foreseen to be a climate-change issue. The climate change risk is considered to be **low** and the climate hazard is **off-ramped**.

Gas Measurement and Control Stations Regional Reports

Bay Area Region

Summary

In the Bay Area Region, M&C assets are located at 785 gas regulator stations or regulator sets (Figure 3.1.2-36). These represent 16 percent of the total regulator stations and regulator sets across PG&E's service area. Breakdowns by transmission and distribution and by facility type are shown in Table 3.1.2-40 and Table 3.1.2-41, respectively.

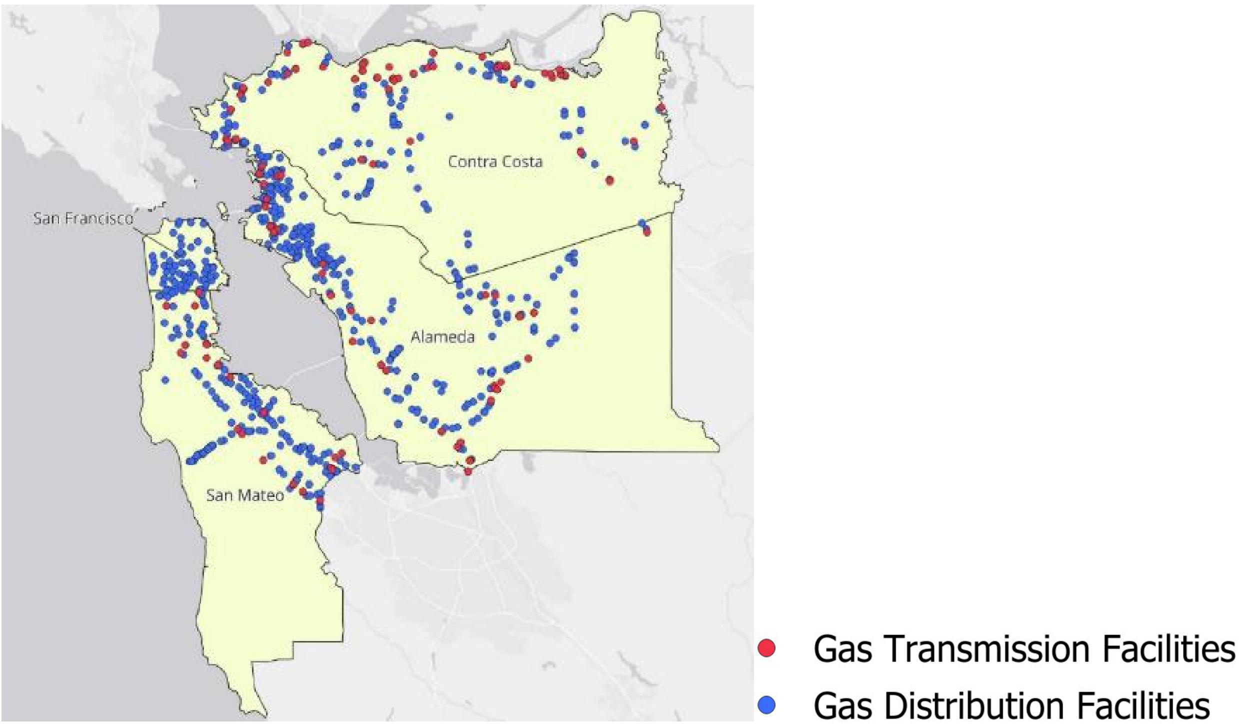


Figure 3.1.2-36. PG&E's M&C assets in the Bay Area Region.

Table 3.1.2-40. Regulating facilities in the Bay Area Region, by transmission and distribution.

Classification	Count in the Region	Count Systemwide	Percentage Systemwide	Transmission-Distribution Proportion in the Region	Transmission-Distribution Proportion Systemwide
Transmission	114	783	15%	15%	16%
Distribution	671	3,989	17%	85%	84%
Total	**785**	**4,772**	**16%**	**100%**	**100%**

Table 3.1.2-41. Regulating facilities in the Bay Area Region, by facility type.

Facility Type	Count	Percentage of Facility Type In the Region	Percentage of Facility Type with Regard to total Facility Types in System
Complex transmission stations	30	4%	24%
Simple transmission stations	40	5%	16%
Transmission LVC facilities	44	6%	11%
Distribution district regulator stations[42]	410	52%	19%
Farm tap regulator sets	169	22%	10%
Low-pressure district regulator stations	92	12%	49%

Climate Hazard: Temperature

With the possible exception of electronic equipment located at certain complex transmission stations, high temperatures are not considered to be a climate change issue at this time for M&C stations.

Climate Hazard: Flooding and Precipitation

San Mateo County contains the highest percentage of facilities that are exposed to both the FEMA 100-year and 500-year floodplains (Table 3.1.2-42).

However, it is important to consider the sensitivity of specific facility types. The two facility types that are most sensitive to flooding, namely complex transmission stations and low-pressure district regulator stations, are highly represented in the Bay Area Region (Table 3.1.2-43). A higher percentage of complex transmission stations (23 percent) are located in a FEMA 100-year floodplain than any other facility types in the Bay Area Region. However, the percentage in a FEMA 500-year floodplain (27 percent) is on par with several other facility types (Table 3.1.2-43).

The low-pressure distribution stations are almost entirely excluded from FEMA 100-year and 500-year floodplains; only two stations are located in a FEMA 500-year floodplain. Relatively few low-pressure stations can be expected to face severe flood exposure, even under potentially more severe precipitation conditions.

[42] Includes high- and semi-high-pressure stations, as well as HPR-type district regulator stations. Low-pressure district regulator stations are shown separately. A similar convention is followed in subsequent tables.

3.1.2.e Liquefied Natural Gas and Compressed Natural Gas

Table 3.1.2-42. Regulating facilities in the Bay Area Region, floodplain exposure by county.

County	Total Facilities	In a FEMA 100-year Floodplain		In a FEMA 500-year Floodplain	
		Count	Percentage	Count	Percentage
Alameda	315	20	6%	63	20%
Contra Costa	205	18	9%	29	14%
San Francisco	67	0	0%	0	0%
San Mateo	198	29	15%	56	28%
Total	**785**	**67**	**9%**	**148**	**19%**

Table 3.1.2-43. Regulating facilities in the Bay Area Region, floodplain exposure by facility type.

Facility Type	Total Facilities	In a FEMA 100-year Floodplain		In a FEMA 500-year Floodplain	
		Count	Percentage	Count	Percentage
Complex transmission stations	30	7	23%	8	27%
Simple transmission stations	40	3	8%	10	25%
Transmission LVC facilities	44	7	16%	11	25%
Distribution district regulator stations	410	36	9%	84	20%
Farm tap regulator sets	169	14	8%	33	20%
Low-pressure district regulator stations	92	0	0%	2	2%
Total	**785**	**67**	**9%**	**148**	**19%**

3.1.2.e Liquefied Natural Gas and Compressed Natural Gas

The location of complex gas transmission facilities and low-pressure distribution stations related to FEMA floodplains is provided in Figure 3.1.2-41.

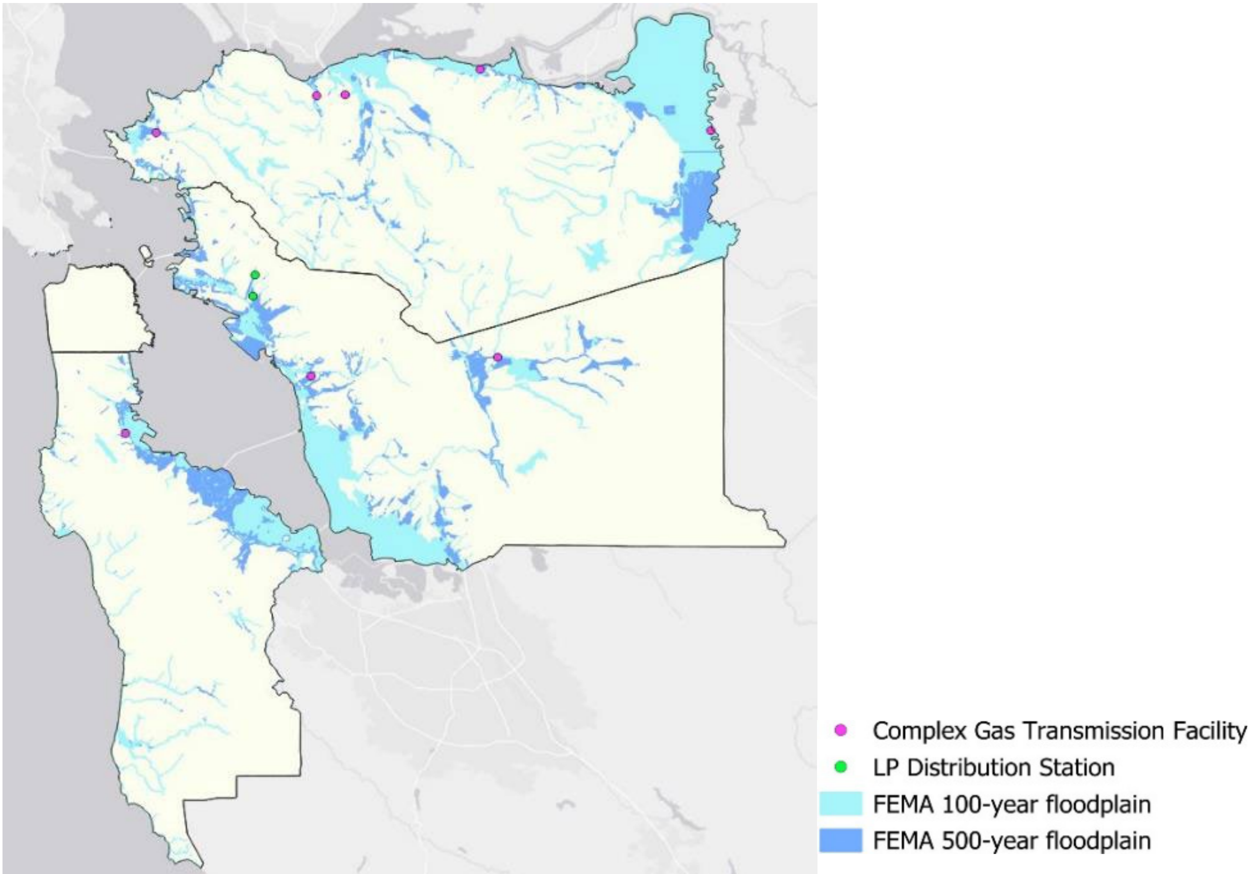


Figure 3.1.2-37. Regulating facilities within the Bay Area Region.

Climate Hazard: Sea Level Rise

No complex transmission stations or low-pressure district regulator stations are expected to be exposed to coastal flooding during a 100-year storm by 2050 (Table 3.1.2-44).

3.1.2.e Liquefied Natural Gas and Compressed Natural Gas

Table 3.1.2-44. Regulating facilities in the Bay Area Region, SLR exposure by facility type.

Facility Type	Total	Baseline	2030	2050	2080	
		0 m SLR	0.25 m SLR	0.5 m SLR	1.25 m SLR	
	Count	Count	Count	Count	Count	Percentage
Complex transmission stations	30	0	0	0	3	10%
Simple transmission stations	40	0	0	0	0	0%
Transmission LVC facilities	44	0	0	0	4	9%
Distribution district regulator stations	410	2	7	14	23	6%
Farm tap regulator sets	169	0	1	3	15	9%
Low-pressure district regulator stations	92	0	0	0	0	0%
Total	**785**	**2**	**8**	**17**	**45**	**6%**

SLR is not considered to be a climate change issue at this time for M&C stations.

Climate Hazard: Wildfire

Six percent of regulating facilities in the Bay Area Region are located in HFRAs (Table 3.1.2-45), with distribution district regulator facilities and farm tap regulator sets representing more of these facilities in HFRAs (Table 3.1.2-46). The distribution district regulator facilities are pilot-operated and considered to be sensitive to wildfires; however, the farm tap regulator sets are considered to be less sensitive because they are spring-operated.

Table 3.1.2-45. Regulating facilities in the Bay Area Region, HFRA exposure by county.

County	Total Facilities	In HFRAs	
		Count	Percentage
Alameda	315	13	4%
Contra Costa	205	20	10%
San Francisco	67	0	0%
San Mateo	198	17	9%
Total	**785**	**50**	**6%**

3.1.2.e Liquefied Natural Gas and Compressed Natural Gas

Table 3.1.2-46. Regulating facilities in the Bay Area Region, HFRA exposure by facility type.

Facility Type	Total Facilities	In HFRAs	
		Count	Percentage
Complex transmission stations	30	1	3%
Simple transmission stations	40	3	8%
Transmission LVC facilities	44	1	2%
Distribution district regulator stations	410	16	4%
Farm tap regulator sets	169	29	17%
Low-pressure district regulator stations	92	0	0%
Total	**785**	**50**	**6%**

Damage from wildfire is not considered a current or future climate change issue for gas measurement and control stations.

Climate Hazard: Drought-Driven Subsidence

Drought-driven subsidence is not considered to be a climate change issue at this time for M&C stations.

Central Valley Region

Summary

In the Central Valley Region, M&C assets are located at 785 gas regulator stations or regulator sets (Figure 3.1.2-38). These represent 16 percent of the total regulator stations and regulator sets across PG&E's service area. Breakdowns by transmission and distribution and by facility type are shown in Table 3.1.2-47 and Table 3.1.2-48, respectively.

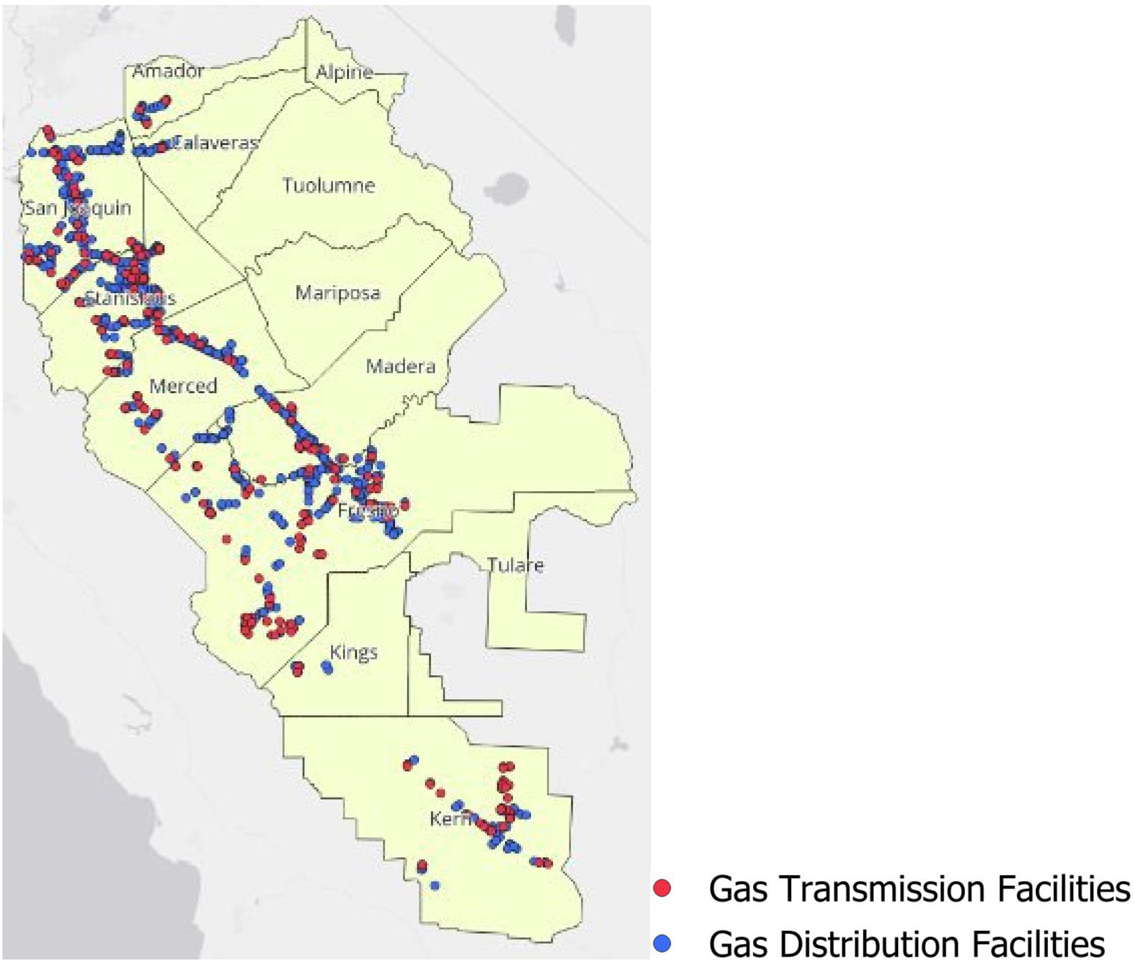


Figure 3.1.2-38. PG&E's M&C assets within the Central Valley Region.

The proportion of transmission facilities in the Central Valley Region (26 percent) is higher than the proportion across the overall system (Table 3.1.2-47); the region includes 39 percent of the transmission regulating facilities across the entire system (Table 3.1.2-47). While only 3 percent of the facilities in the region are complex transmission stations, these represent 29 percent of the complex transmission stations across the system (Table 3.1.2-48). The region also includes 35 percent of the simple transmission stations across the system, as well as a significant percentage of LVC facilities (45 percent). The region also includes 33 percent of the low-pressure stations across the system.

3.1.2.e Liquefied Natural Gas and Compressed Natural Gas

Table 3.1.2-47. Regulating facilities in the Central Valley Region, by transmission and distribution.

Classification	Count In the Region	Count Systemwide	Percentage Systemwide	Transmission-Distribution Proportion In the Region	Transmission-Distribution Proportion Systemwide
Transmission	305	783	39%	26%	16%
Distribution	869	3,989	22%	74%	84%
Total	**1,174**	**4,772**	**25%**	**100%**	**100%**

Table 3.1.2-48. Regulating facilities in the Central Valley Region, by facility type.

Facility Type	Count	Percentage In the Region	Percentage with Regard to the System
Complex transmission stations	36	3%	29%
Simple transmission stations	88	7%	35%
Transmission LVC facilities	181	15%	45%
Distribution district regulator stations[43]	508	43%	23%
Farm tap regulator sets	299	25%	19%
Low-pressure district regulator stations	62	5%	33%
Total	**1,174**		

Climate Hazard: Temperature

With the possible exception of electronic equipment located at certain complex transmission stations, high temperatures are not considered to be a climate change issue at this time for M&C stations.

Climate Hazard: Flooding and Precipitation

Complex transmission stations and low-pressure district regulator stations are considered to be the most sensitive to damage from flooding. While relatively low percentages of these facility types (3 percent and 5 percent, respectively) are in a FEMA 100-year floodplain, higher percentages (19 percent and 48 percent, respectively) are in a FEMA 500-year floodplain. The complex transmission station percentages are on par with other facility types; however, the low-pressure stations may be more exposed during extreme precipitation events.

[43] Includes high- and semi-high-pressure stations, as well as HPR-type district regulator stations. Low-pressure district regulator stations are shown separately. A similar convention is followed in subsequent tables.

3.1.2.e Liquefied Natural Gas and Compressed Natural Gas

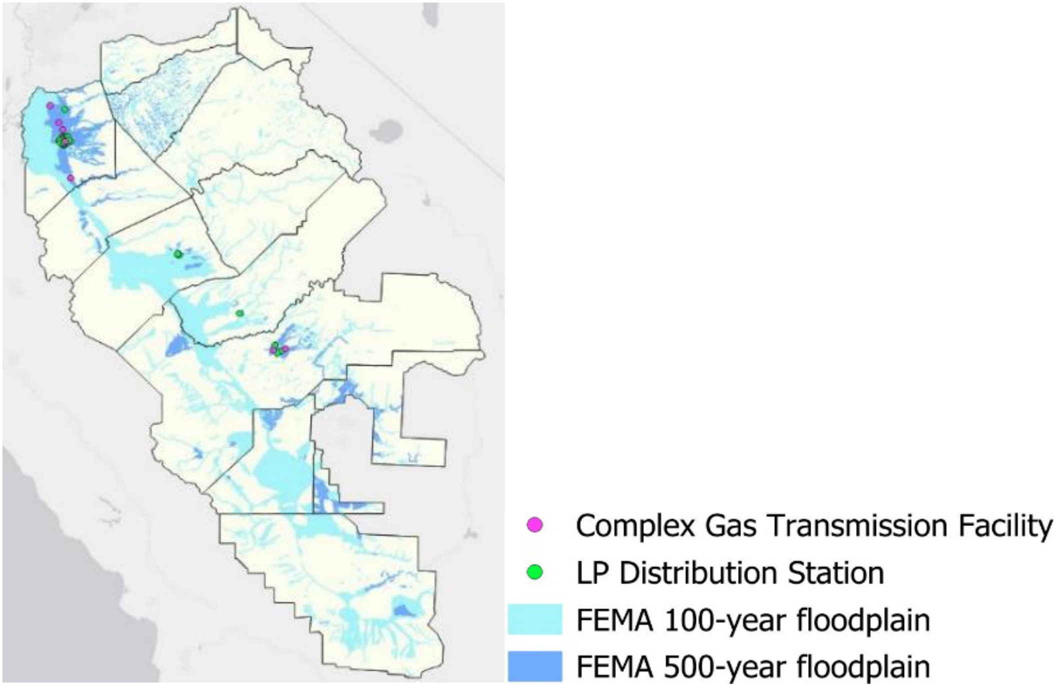


Figure 3.1.2-39. Regulating facilities in FEMA 100-year and 500-year floodplains in the Central Valley Region.

Table 3.1.2-49 shows the number of regulating facilities in the Central Valley Region that are in the present-day FEMA floodplains by facility type. Figure 3.1.2-39 shows the locations of sensitive facilities in floodplains.

Table 3.1.2-49. Regulating facilities in the Central Valley Region, floodplain exposure by facility type.

Facility Type	Total Facilities	In a FEMA 100-year Floodplain		In a FEMA 500-year Floodplain	
		Count	Percentage	Count	Percentage
Complex transmission stations	36	1	3%	7	19%
Simple transmission stations	88	12	14%	16	18%
Transmission LVC facilities	181	8	4%	18	10%
Distribution district regulator stations	508	45	9%	124	24%
Farm tap regulator sets	299	42	14%	60	20%
Low-pressure district regulator stations	62	3	5%	30	48%
Total	**1,174**	**111**	**9%**	**255**	**22%**

3.1.2.e Liquefied Natural Gas and Compressed Natural Gas

Climate Hazard: Sea Level Rise

Analysis of facilities for potential exposure to flooding due to SLR was performed only for the greater Bay Area Region. Additional analysis is required to better understand the impacts on the Central Valley Region facilities, due to changes in the Delta because of SLR and should consider overtopping and levee breach scenarios.

Climate Hazard: Wildfire

Table 3.1.2-50 presents the number of regulating facilities in the Central Valley Region that are located in HFRAs by facility type.

Table 3.1.2-50. Regulating facilities in the Central Valley Region, HFRA exposure by facility type.

Facility Type	Total Facilities	In HFRAs	
		Count	Percentage
Complex transmission stations	36	0	0%
Simple transmission stations	88	2	2%
Transmission LVC facilities	181	3	2%
Distribution district regulator stations	509	12	2%
Farm tap regulator sets	299	30	10%
Low-pressure district regulator stations	62	0	0%
Total	**1,174**	**47**	**4%**

The facility types that are most vulnerable to wildfires are the complex transmission stations and the pilot-operated stations (simple transmission stations and distribution district regulator stations). None of the complex transmission stations in the Central Valley Region have been identified as being in HFRAs, and only 2 percent of the pilot-operated stations have been identified as potentially exposed.

The facilities that have been identified as being in HFRAs are concentrated in Calaveras County; 27 of the 47 facilities are located there. The remaining facilities are concentrated in Amador County (13 facilities) and Kern County (6 facilities).

Damage from wildfire is not considered a current or future climate change issue for gas measurement and control stations.

Climate Hazard: Drought-Driven Subsidence

Drought-driven subsidence is not considered to be a climate change issue at this time for M&C stations.

Sierra Region

Summary

In the Sierra Region, M&C assets are located at 1,210 gas regulator stations or regulator sets (Figure 3.1.2-40). These represent 25 percent of the total regulator stations and regulator sets across PG&E's territory. Breakdowns by transmission and distribution and by facility type are shown in Table 3.1.2-51 and Table 3.1.2-52, respectively.

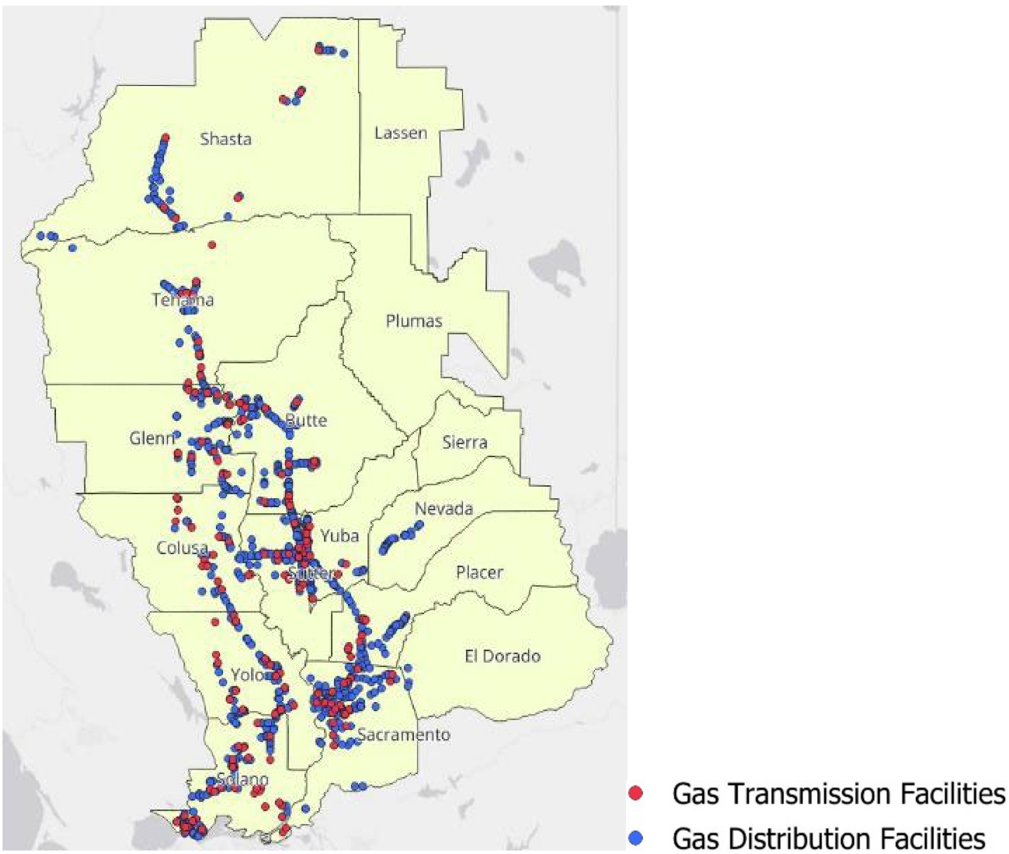


Figure 3.1.2-40. PG&E's M&C assets within the Sierra Region.

Table 3.1.2-51. Regulating facilities in the Sierra Region, by transmission and distribution.

Classification	Count In the Region	Count Systemwide	Percentage Systemwide	Transmission-Distribution Proportion In the Region	Transmission-Distribution Proportion Systemwide
Transmission	216	783	28%	18%	16%
Distribution	994	3,989	25%	82%	84%
Total	**1,210**	**4,772**	**25%**	**100%**	**100%**

Table 3.1.2-52. Regulating facilities in the Sierra Region, by facility type.

Facility Type	Count	Percentage In the Region	Percentage with Regard to the System
Complex transmission stations	28	2%	22%
Simple transmission stations	73	6%	29%
Transmission LVC facilities	115	10%	28%
Distribution district regulator stations[44]	553	46%	25%
Farm tap regulator sets	427	35%	26%
Low-pressure district regulator stations	14	1%	8%
Total	**1,210**	**100%**	

Climate Hazard: Temperature

With the possible exception of electronic equipment located at certain complex transmission stations, high temperatures are not considered to be a climate change issue at this time for M&C stations.

Climate Hazard: Flooding and Precipitation

The Sierra Region has a higher percentage of facilities in floodplains, compared with the other regions. Complex transmission stations and low-pressure district regulator stations are considered to be the most sensitive to damage from flooding. The percentages of exposed complex transmission stations are the lowest of all the facility types; however, the low-pressure stations may be more exposed during extreme precipitation events (Table 3.1.2-53).

Table 3.1.2-53. Regulating facilities in the Sierra Region, floodplain exposure by facility type.

Facility Type	Total Facilities	In a FEMA 100-year Floodplain		In a FEMA 500-year Floodplain	
		Count	Percentage	Count	Percentage
Complex transmission stations	28	4	14%	7	25%
Simple transmission stations	73	14	19%	21	29%
Transmission LVC facilities	115	24	21%	46	40%
Distribution district regulator stations	553	84	15%	171	31%
Farm tap regulator sets	427	107	25%	153	36%
Low-pressure district regulator stations	14	0	0%	8	57%
Total	**1,210**	**233**	**19%**	**406**	**34%**

[44] Includes high- and semi-high-pressure stations, as well as HPR-type district regulator stations. Low-pressure district regulator stations are shown separately. A similar convention is followed in subsequent tables.

3.1.2.e Liquefied Natural Gas and Compressed Natural Gas

The location of complex gas transmission facilities and low-pressure distribution stations related to FEMA floodplains is provided in Figure 3.1.2-41.

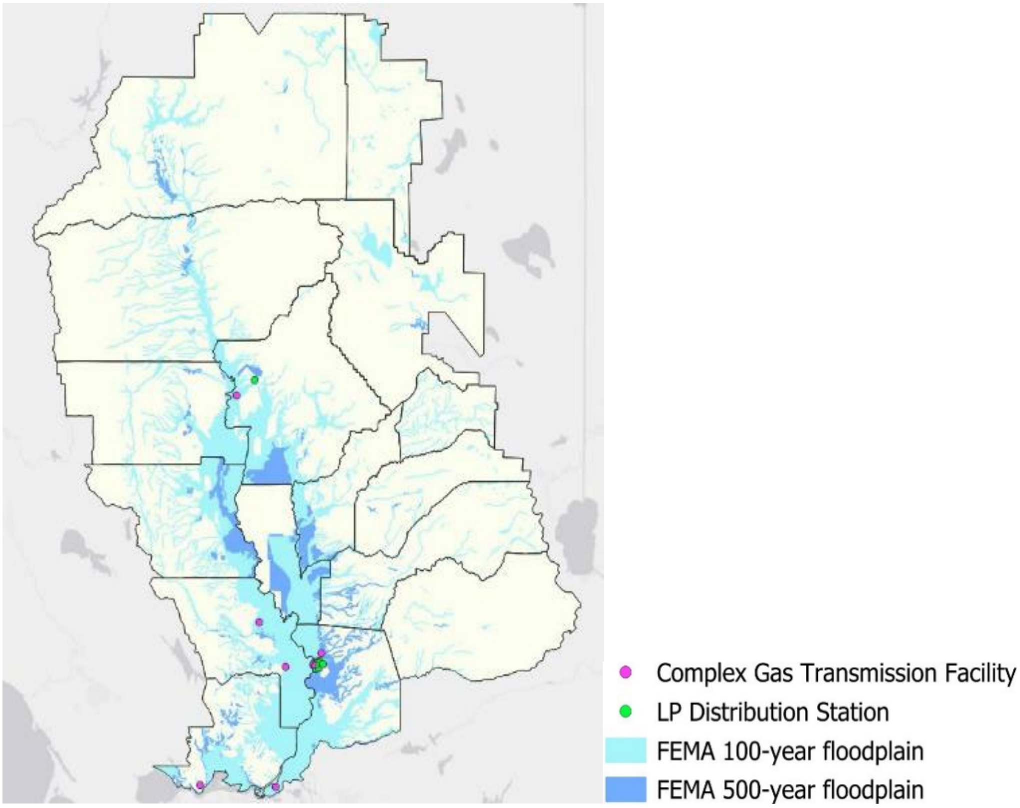


Figure 3.1.2-41. Regulating facilities in FEMA 100-year and 500-year floodplains in the Sierra Region.

Climate Hazard: Sea Level Rise

An analysis of facilities for potential exposure to flooding due to SLR was performed only for the greater Bay Area Region. Additional analysis is required to better understand the impacts on the Central Valley Region facilities, due to changes in the Delta because of SLR and should consider overtopping and levee breach scenarios.

3.1.2.e Liquefied Natural Gas and Compressed Natural Gas

Climate Hazard: Wildfire

Table 3.1.2-54 presents the number of regulating facilities in the Sierra Region that are located in HFRAs, by facility type.

Table 3.1.2-54. Regulating facilities in FEMA 100-year and 500-year floodplains in the Sierra Region, by facility type.

Facility Type	Total Facilities	In HFRAs	
		Count	Percentage
Complex transmission stations	28	1	4%
Simple transmission stations	373	3	4%
Transmission LVC facilities	115	2	2%
Distribution district regulator stations	553	46	8%
Farm tap regulator sets	427	33	8%
Low-pressure district regulator stations	14	0	0%
Total	**1,210**	**85**	**7%**

The facility types that are most sensitive to wildfires are the complex transmission stations and the pilot-operated stations (simple transmission stations and distribution district regulator stations). Only one of the complex transmission stations in the Sierra Region has been identified as being in an HFRA, and between 4 percent and 8 percent of the pilot-operated stations have been identified as potentially exposed (Table 3.1.2-54).

The facilities that have been identified as being in HFRAs are concentrated in Shasta County; 29 of the 85 facilities are located there. Most of the remaining facilities are concentrated in Nevada County (17 facilities) and Placer County (16 facilities). Butte and Tehama counties, as well as several other counties in the region, contain the remainder.

Damage from wildfire is not considered a current or future climate change issue for gas measurement and control stations.

Climate Hazard: Drought-Driven Subsidence

Drought-driven subsidence is not considered to be a climate change issue at this time for M&C stations.

North Coast Region

Summary

In the North Coast Region, M&C assets are located at 854 gas regulator stations or regulator sets (Figure 3.1.2-42). These represent 18 percent of the total regulator stations and regulator sets across PG&E's territory. Breakdowns by transmission and distribution and by facility type are shown in Table 3.1.2-55 and Table 3.1.2-56, respectively.

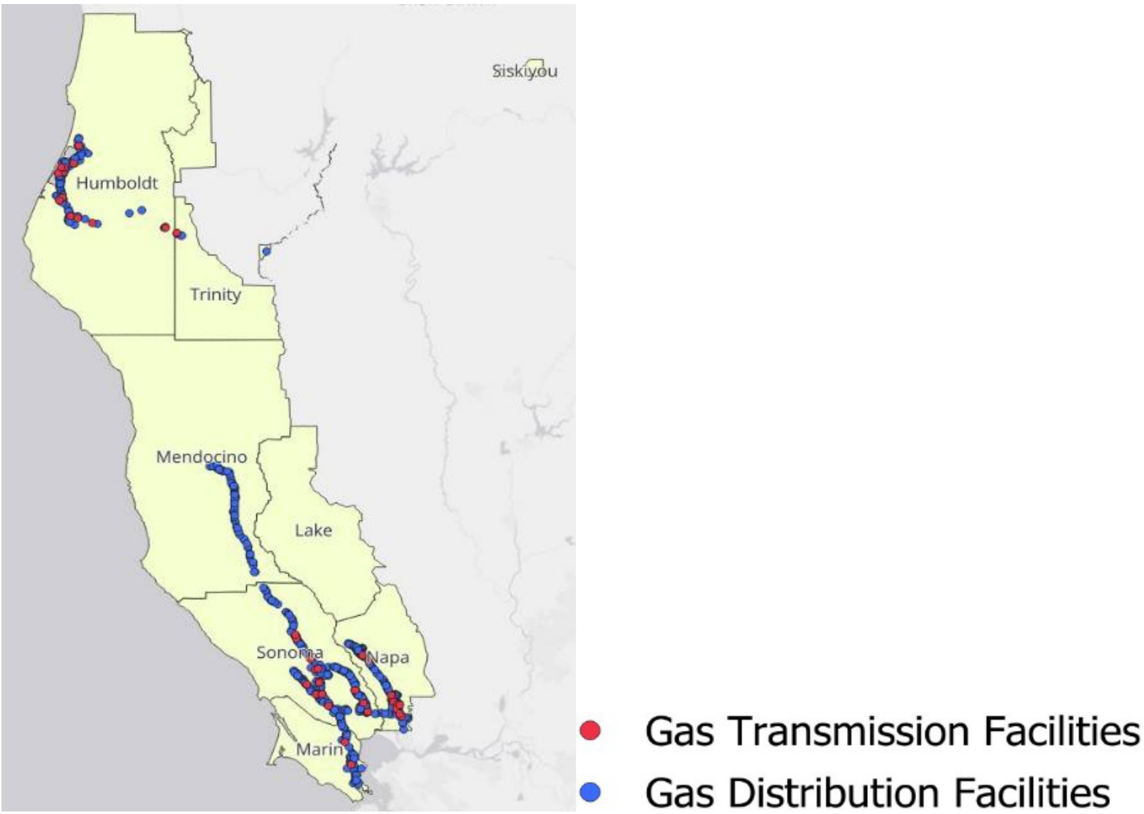


Figure 3.1.2-42. PG&E's M&C assets within the North Coast Region.

Table 3.1.2-55. Regulating facilities in the North Coast Region, by transmission and distribution.

Classification	Count In the Region	Count Systemwide	Percentage Systemwide	Transmission-Distribution Proportion In the Region	Transmission-Distribution Proportion Systemwide
Transmission	46	783	6%	5%	16%
Distribution	808	3,989	20%	95%	84%
Total	**854**	**4,772**	**18%**	**100%**	**100%**

Table 3.1.2-56. Regulating facilities in the North Coast Region, by facility type.

Facility Type	Count	Percentage in the Region	Percentage with Regard to the System
Complex transmission stations	9	1%	7%
Simple transmission stations	23	3%	9%
Transmission LVC facilities	14	2%	3%
Distribution district regulator stations[45]	361	42%	16%
Farm tap regulator sets	445	52%	28%
Low-pressure district regulator stations	2	0%	1%
Total	**854**	**100%**	

Climate Hazard: Temperature

With the possible exception of electronic equipment located at certain complex transmission stations, high temperatures are not considered to be a climate change issue at this time for M&C stations.

Climate Hazard: Flooding and Precipitation

The complex transmission stations and low-pressure district regulator stations are considered to be the most sensitive to damage from flooding. The North Coast Region does not contain any low-pressure stations, and there are only two complex transmission stations that are potentially exposed in the region (Table 3.1.2-57).

Table 3.1.2-57. Regulating facilities in the North Coast Region, floodplain exposure by facility type.

Facility Type	Total Facilities	In a FEMA 100-year Floodplain		In a FEMA 500-year Floodplain	
		Count	Percentage	Count	Percentage
Complex transmission stations	9	2	22%	2	22%
Simple transmission stations	23	6	26%	6	26%
Transmission LVC facilities	14	1	7%	1	7%
Distribution district regulator stations	361	43	12%	54	15%
Farm tap regulator sets	445	62	14%	88	20%
Low-pressure district regulator stations	2	0	0%	0	0%
Total	**854**	**114**	**13%**	**151**	**18%**

[45] Includes high- and semi-high-pressure stations, as well as HPR-type district regulator stations. Low-pressure district regulator stations are shown separately. A similar convention is followed in subsequent tables.

3.1.2.e Liquefied Natural Gas and Compressed Natural Gas

The location of complex gas transmission facilities and low-pressure distribution stations related to FEMA floodplains is provided in Figure 3.1.2- 43.

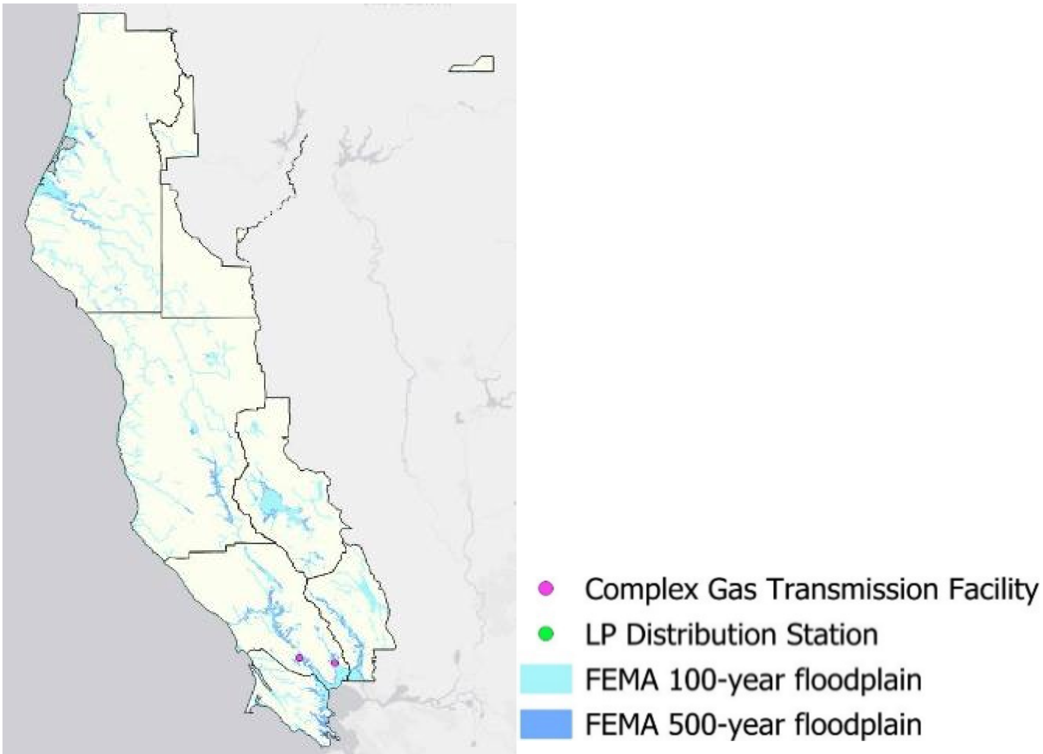


Figure 3.1.2- 43. Regulating facilities in FEMA 100-year and 500-year floodplains in the North Coast Region.

Climate Hazard: Sea Level Rise

An analysis of facilities for potential exposure to flooding due to SLR was performed for the greater Bay Area Region (southern part of the North Coast Region). No sensitive facilities were identified as exposed in the North Coast Region. SLR is not considered to be a climate change issue at this time for M&C stations.

3.1.2.e Liquefied Natural Gas and Compressed Natural Gas

Climate Hazard: Wildfire

Table 3.1.2-58 presents the number of regulating facilities in the North Coast Region that are located in HFRAs by facility type.

Table 3.1.2-58. Regulating facilities in the North Coast Region, HFRA exposure by facility type.

Facility Type	Total Facilities	In HFRAs	
		Count	Percentage
Complex transmission stations	9	3	33%
Simple transmission stations	23	3	13%
Transmission LVC facilities	14	1	7%
Distribution district regulator stations	361	43	12%
Farm tap regulator sets	445	90	20%
Low-pressure district regulator stations	2	0	0%
Total	**854**	**140**	**16%**

The facility types that are most vulnerable to wildfires are the complex transmission stations and the pilot-operated stations (simple transmission stations and distribution district regulator stations). Three of the complex transmission stations in the North Coast Region are located in HFRAs, and between 12 percent and 13 percent of the pilot-operated stations have been identified as also being potentially exposed.

The facilities that have been identified as being in HFRAs are concentrated in Sonoma, Mendocino, and Napa counties (with 54, 35, and 27 facilities, respectively). However, the majority of these facilities are farm tap regulator sets, which are not as vulnerable to wildfires as other facility types.

Damage from wildfire is not considered a current or future climate change issue for gas measurement and control stations.

Climate Hazard: Drought-Driven Subsidence

Drought-driven subsidence is not considered to be a climate change issue at this time for M&C stations.

Central Coast Region

Summary

In the Central Coast Region, M&C assets are located at 749 gas regulator stations or regulator sets (Figure 3.1.2-44). These represent 16 percent of the total regulator stations and regulator sets across PG&E's territory. Breakdowns by transmission and distribution and by facility type are shown in Table 3.1.2-59 and Table 3.1.2-60, respectively.

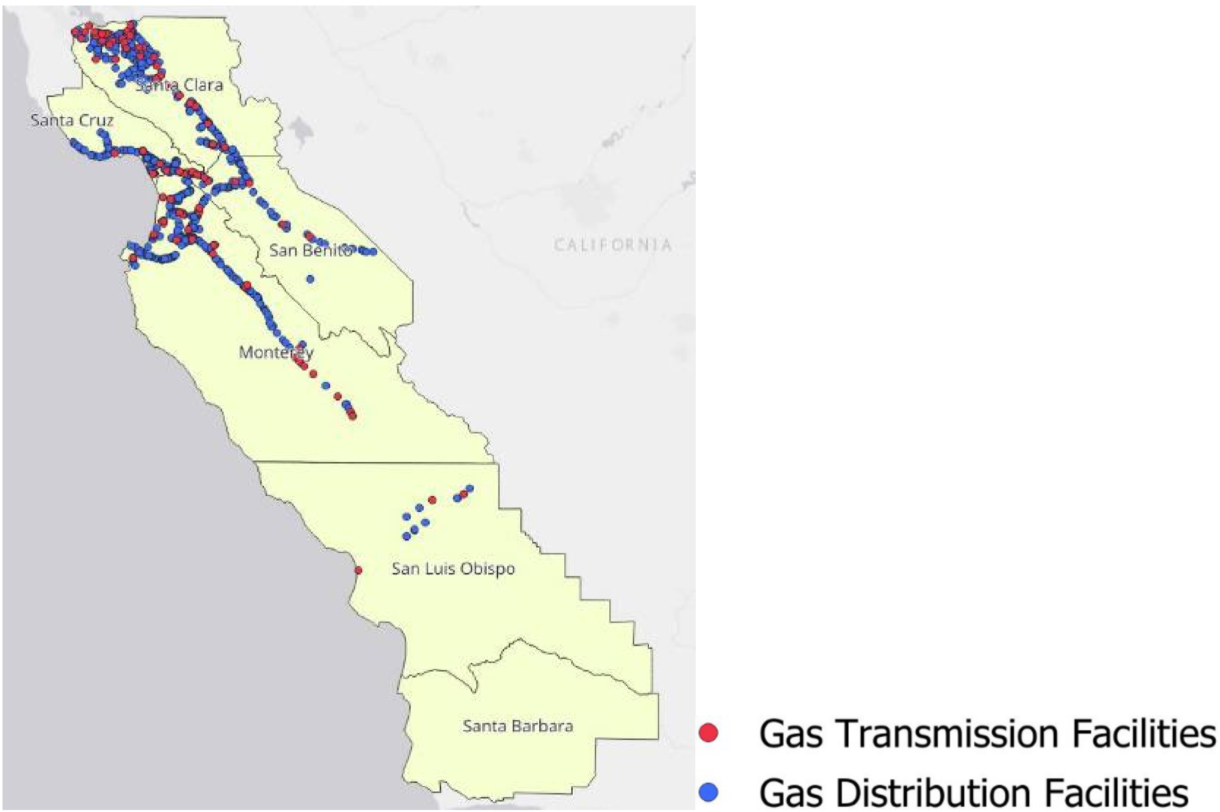


Figure 3.1.2-44. PG&E's M&C assets within the Central Coast Region.

Table 3.1.2-59. Regulating facilities in the Central Coast Region, by transmission and distribution.

Classification	Count in the Region	Count Systemwide	Percentage Systemwide	Transmission-Distribution Proportion in the Region	Transmission-Distribution Proportion Systemwide
Transmission	102	783	13%	14%	16%
Distribution	647	3,989	16%	86%	84%
Total	**749**	**4,772**	**16%**	**100%**	**100%**

Table 3.1.2-60. Regulating facilities in the Central Coast Region, by facility type.

Facility Type	Count	Percentage in the Region	Percentage with Regard to the System
Complex transmission stations	22	3%	18%
Simple transmission stations	28	4%	11%
Transmission LVC facilities	52	7%	13%
Distribution district regulator stations[46]	357	48%	16%
Farm tap regulator sets	274	37%	17%
Low-pressure district regulator stations	16	2%	9%
Total	**749**	**100%**	

Climate Hazard: Temperature

With the possible exception of electronic equipment located at certain complex transmission stations, high temperatures are not considered to be a climate change issue at this time for M&C stations.

Climate Hazard: Flooding and Precipitation

Overall, the Central Coast Region has a higher percentage of facilities in FEMA 100-year and 500-year floodplains, compared with other regions. As previously discussed, the complex transmission stations and low-pressure district regulator stations are considered to be the most sensitive to damage from flooding. The Central Coast Region includes a total of 12 complex transmission stations and low-pressure stations in a FEMA 500-year floodplain (Figure 3.1.2-45, Table 3.1.2-61).

[46] Includes high- and semi-high-pressure stations, as well as HPR-type district regulator stations. Low-pressure district regulator stations are shown separately. A similar convention is followed in subsequent tables.

3.1.2.e Liquefied Natural Gas and Compressed Natural Gas

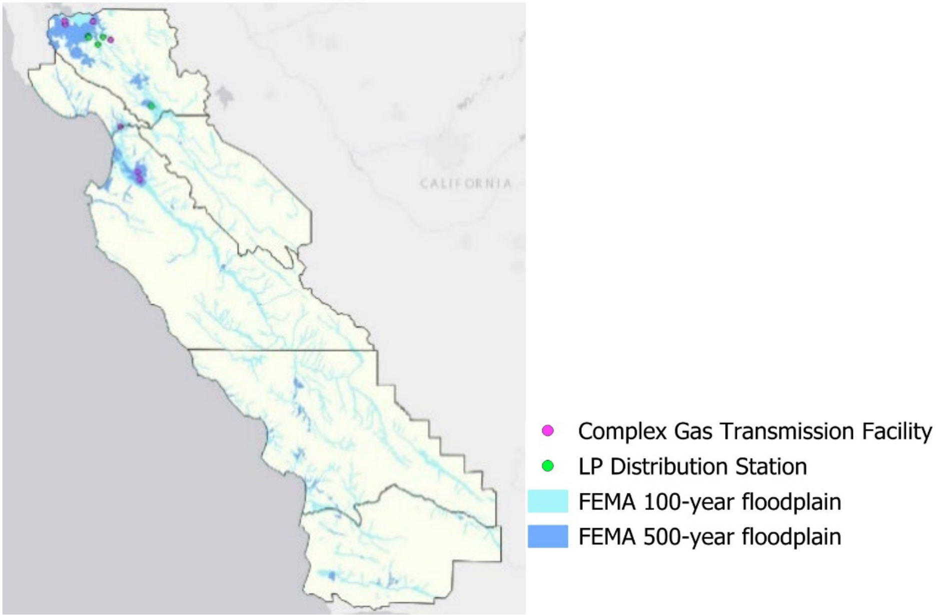


Figure 3.1.2-45. Regulating facilities in FEMA 100-year and 500-year floodplains in the Central Coast Region.

Table 3.1.2-61. Regulating facilities in the Central Coast Region, floodplain exposure by facility type.

Facility Type	Total Facilities	In a FEMA 100-year Floodplain		In a FEMA 500-year Floodplain	
		Count	Percentage	Count	Percentage
Complex transmission stations	22	4	18%	7	32%
Simple transmission stations	28	2	7%	12	43%
Transmission LVC facilities	52	11	21%	16	31%
Distribution district regulator stations	357	39	11%	128	36%
Farm tap regulator sets	274	31	11%	70	26%
Low-pressure district regulator stations	16	2	13%	5	31%
Total	**749**	**89**	**12%**	**238**	**32%**

Climate Hazard: Sea Level Rise

SLR is not considered to be a climate change issue at this time for M&C stations.

Climate Hazard: Wildfire

The facility types that are most vulnerable to wildfires are the complex transmission stations and the pilot-operated stations (simple transmission stations and distribution district regulator stations). Two of the complex transmission stations in the Central Coast Region are located in HFRAs; however, a larger number and percentage of pilot-operated facilities are potentially exposed (Table 3.1.2-62).

Table 3.1.2-62. Regulating facilities in the Central Coast Region, HFRA exposure by facility type.

Facility Type	Total Facilities	In HFRAs	
		Count	Percentage
Complex transmission stations	22	2	9%
Simple transmission stations	28	4	14%
Transmission LVC facilities	52	1	2%
Distribution district regulator stations	357	41	11%
Farm tap regulator sets	274	45	16%
Low-pressure district regulator stations	16	0	0%
Total	**749**	**93**	**12%**

Damage from wildfire is not considered a current or future climate change issue for gas measurement and control stations.

Climate Hazard: Drought-Driven Subsidence

Drought-driven subsidence is not considered to be a climate change issue at this time for M&C stations.

3.1.2.e Liquefied Natural Gas and Compressed Natural Gas

Asset Family Introduction

PG&E's Liquefied Natural Gas and Compressed Natural Gas (LNG/CNG) asset family consists of both portable and fixed-location assets. Portable assets consist of approximately 300 assets that constitute the system that stores, transports, and delivers natural gas supplies by truck trailer to offset or supplement pipeline flowing supplies for planned outages, winter peak-load shaving, unplanned outages, and emergency situations. Fixed-location assets consist of 32 stationary CNG stations that supply natural gas fuel to PG&E and third-party vehicles and provide high-pressure gas supply to fill the portable equipment. Thus, we analyzed the individual locations not the Regions themselves.

Of the 32 stationary CNG assets, 10 are in the Bay Area Region, four are in the Central Coast Region, seven are in the Central Valley Region, three are in the North Coast Region, and eight are in the Sierra Region. Because the portable assets are, by definition, not confined to a fixed location, no location-specific analyses were conducted.

Key Findings

Climate Hazard	Climate Change Risk and Potential Adaptation Measures
All Hazards	Low (off-ramped)
	• PG&E’s LNG/CNG assets have very low vulnerability to climate hazards. • Given the portable nature of PG&E’s LNG/CNG assets, the overall vulnerability of these assets to climate hazards is considered to be low. Minimizing the vulnerability to climate hazards simply requires informed siting of portable operations, consistent with departmental policies and practices on these operations. • Given the availability and flexibility of numerous portable units, LNG/CNG portable operations have a high adaptive capacity to cope with the projected changes in all climate change hazards, even if a single stationary fueling station were to face temporary closure. • Of the 32 fixed-location LNG/CNG station assets in the territory, three are in a FEMA 100-year floodplain and an additional 10 are in a FEMA 500-year floodplain. One station is in a high landslide risk area, although a site evaluation suggests that it is located a sufficiently safe distance from the nearest potentially landslide-prone slope. Disruption to operations at a single station can be accommodated through service available at other nearby stations in PG&E’s network, as well as third-party CNG fueling stations. • Demand for portable operations could increase as a result of changes in extreme weather events due to climate change; however, this increase would likely be within the capabilities of LNG/CNG to expand its service capacity, and therefore is considered to be manageable.

Climate Hazards

Here we provide the results of PG&E's assessment of potential vulnerabilities from exposure to and the risks from changes in environmental conditions in 2050 due to climate change. The risks are low for LNG/CNG across all hazards and the service area, and the key findings are summarized below.

Exposure and Sensitivity

The overall exposure of the portable LNG/CNG assets to climate hazards is low. While portable assets may be temporarily sited in locations that are at risk of hazards, LNG/CNG operations can adjust to remove assets from exposed locations, and hazards are usually avoided when siting is designed.

The overall exposure of the CNG station assets to climate hazards is also low. Of the 32 CNG station assets across the service area, three are in a FEMA 100-year floodplain; an additional 10 are in a FEMA 500-year floodplain; and one, in San Rafael, is in a high landslide risk zone (Table 3.1.2-63). However, preliminary site-specific evaluation of these sites suggests that the San Rafael facility is located a sufficiently safe distance away from the nearest potentially landslide-prone slope and is elevated relative to potential flood conditions.

Only two CNG stations are vulnerable to coastal storm flooding and these are not projected to be exposed to flooding by a 100-year storm until 2080 Table 3.1.2-63).

3.1.2.e Liquefied Natural Gas and Compressed Natural Gas

Table 3.1.2-63. Exposure of stationary CNG station assets in the PG&E service area to flooding and landslides.

Station	PG&E Region	FEMA 500-year Floodplain	FEMA 100-year Floodplain	2030 SLR + 100-year Storm	2050 SLR + 100-year Storm	2080 SLR + 100-year Storm	Landslide Hazard
Cupertino	Central Coast	X					
Fresno	Central Valley	X					
Manteca	Central Valley	X					
Marysville	Sierra	X					
Merced	Central Valley	X	X				
Modesto	Central Valley	X					
Oakland	Bay Area	X				X	
Sacramento	Sierra	X					
Salinas	Central Coast	X					
San Carlos Belmont	Bay Area	X	X			X	
San Jose Cinnabar	Sierra	X					
San Rafael	North Coast	X	X				X
Stockton	Central Valley	X					
20 Additional Stations	No Identified Exposures						

Overall, LNG/CNG operations are not sensitive to any climate hazard. Extreme events, such as flooding, landslides, or wildfires, may cause physical damage to assets, but only in cases where portable assets are sited in a vulnerable location (very rare) and cannot be relocated (also a very rare situation) or where stationary assets are in high hazard areas (also only for a few sites). While the impact on stations could result in temporary closures, the redundancy inherent in the larger LNG/CNG asset family, as well as the presence of third-party CNG fueling stations, means that such closures would have a minimal impact on operational performance.

Portable assets deployed to support operations across the service area could, in principle, be flooded or affected by landslides; however, siting decisions for portable operations effectively consider and avoid these threats. However, hazard events, such as wildfires, flooding, or landslides, may limit the ability of LNG/CNG portable assets to access gas pipelines under some circumstances.

Climate Change Vulnerability

Both CNG station assets and portable LNG/CNG assets and operations are not expected to be vulnerable to future changes in climate hazards. Several CNG station assets are exposed to the 2080 SLR + 100-year storm scenario, although the long lead time associated with this hazard means that PG&E will be able to protect and/or relocate the exposed stations to protected locations before exposure occurs.

Adaptive Capacity and Climate Change Risk

PG&E's portable operations siting criteria currently include the proximity to vegetation and the risk of wildfire as part of the assessment of siting risks. Impacts from wildfires could result in damage to portable assets, so portable operations personnel monitor wildfire threats when equipment is deployed and take action to relocate equipment and personnel away from wildfire threats, if appropriate. PG&E's portable operations team also considers the risks associated with electrical storms. Future adaptation to climate change will require maintaining the current practices for situational awareness of multiple hazards.

In the event of hazard impacts on CNG station assets, the larger network of CNG stations should be able to satisfactorily sustain service to support CNG vehicle fueling and LNG/CNG portable operations, such that the impacts would be limited to a single station.

Overall, the climate risks associated with LNG/CNG are considered to be **low**, given the low exposure and sensitivity and high adaptive capacity. All hazards are not considered to be a climate change issue at this time for LNG/CNG assets or operations and all climate hazards are **off-ramped**.

Section 3.1.3: Power Generation

Table of Contents

3.1.3.a Hydropower Generation

Asset Family Introduction

PG&E's hydroelectric (also referred to as "hydro") power generation system provides safe, reliable, and clean energy and has roughly 3,900 megawatts (MW) of power generation capacity. The system uses water from more than 100 reservoirs, most of which are in the higher elevations of California's Sierra Nevada and Cascade Mountains.

PG&E's hydro operations rely on a system of assets maintained by PG&E, including the following:

- **Dams:** Barriers constructed to impound or divert water, forming a reservoir used for electricity generation and water supply.
- **Powerhouses:** Structures containing turbines and generating equipment.
- **Switchyards:** Also known as substations, switchyards transform power from generation voltages to transmission voltages for delivery to the electrical grid and consumption by power users.
- **Switching Centers:** Staffed buildings (often co-located with powerhouses) that serve as control centers for PG&E's hydro system.
- **Spillways:** Passages for excess water from a reservoir, usually for releases during flood and high flow conditions.
- **Water Conveyance:** Artificial waterways constructed to convey water for consumptive and non-consumptive uses.
- **Culverts:** Structures made of pipe, reinforced concrete, or other material, typically buried under a road or similar obstruction, through which water flows from one side to the other.
- **Penstocks:** Pressurized pipes that deliver water to a powerhouse for electric power generation.
- **Access Roads and Bridges:** Structures that provide vehicle or pedestrian access to hydropower assets.

3.1.3.a Hydropower Generation

PG&E's hydro operations depend on facilities that collect and store rainfall and snowmelt runoff from large hydrologic basins. Four major hydrologic basins (also known as water basins) encompass most of PG&E's hydropower assets in the Sierra Nevada and Cascade Mountains and span the CAVA Central Valley and Sierra Regions: (1) the North Fork Mokelumne River (NFMR) Basin, (2) North Fork Kings River (NFKR) Basin, (3) Pit River Basin, and (4) the North Fork Feather River (NFFR) Basin (Figure 3.1.3-1). Figure 3.1.3-2 and Figure 3.1.3-3 show the Central Valley Region and Sierra Valley Regions, respectively, and associated hydropower assets.

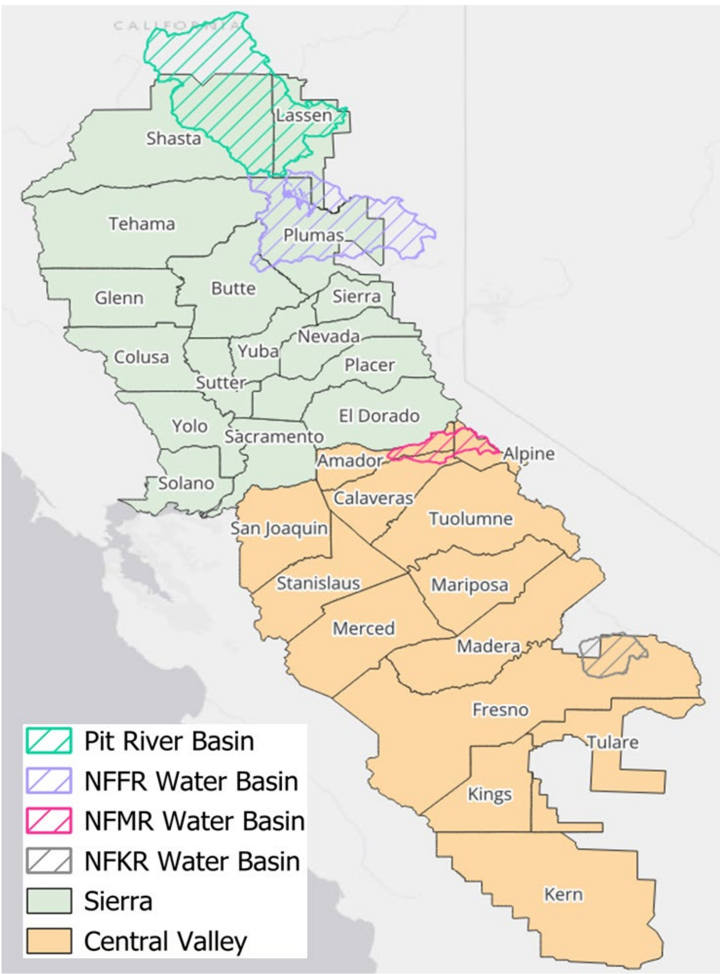


Figure 3.1.3-1. Hydrologic basins serving PG&E's hydropower assets.

Figure 3.1.3-2 and Figure 3.1.3-3 show the Central Valley Region and Sierra Valley Regions, respectively, and associated hydropower assets.

PG&E also operates hydropower assets in areas near and outside of these basins in the following counties: Shasta, Tehama, Butte, Nevada, Placer, and Alpine, as well as along the Eel River (Humboldt County, North Coast Region).

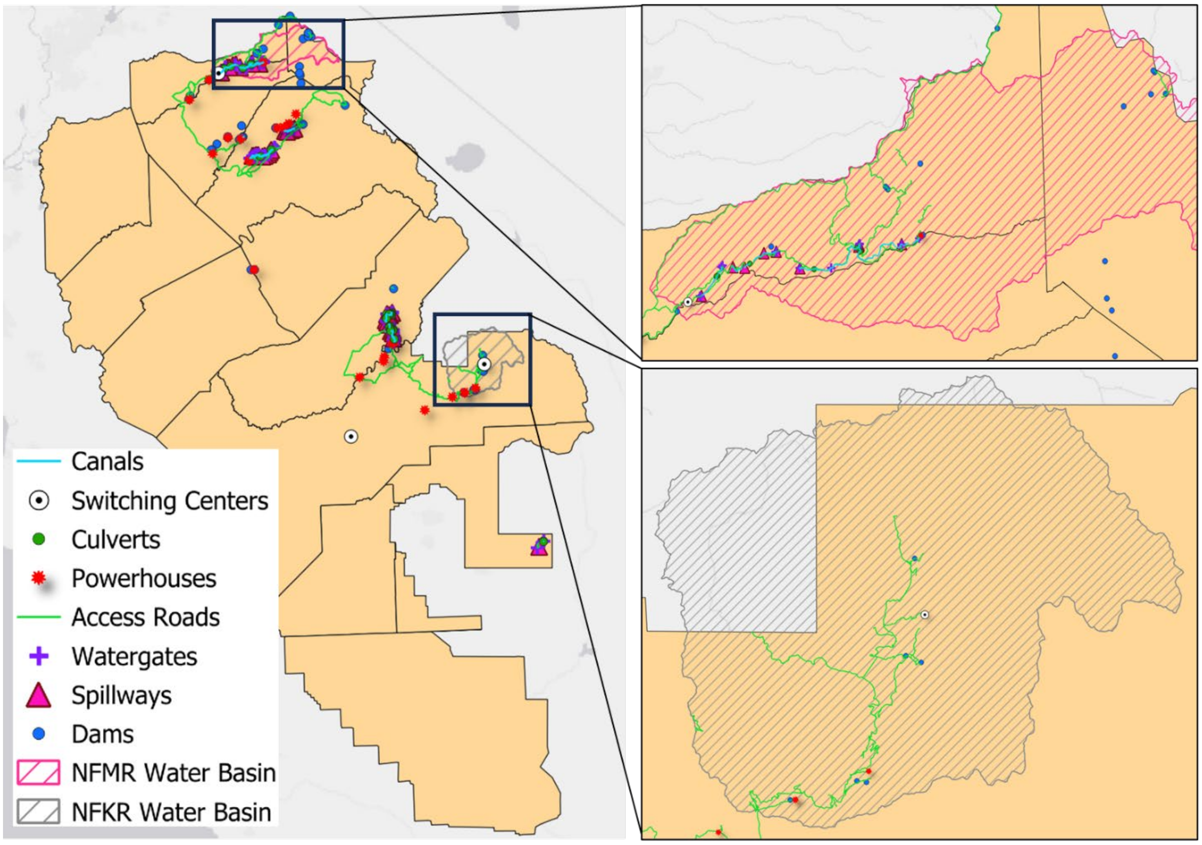


Figure 3.1.3-2. The Central Valley Region and associated hydropower assets. Zoomed-in areas show the NFMR (top right) and NFKR (bottom right) basins. The visual is intended to illustrate the spread and diversity of hydroassets along waterways; not all dams and assets shown are owned by PG&E.

3.1.3.a Hydropower Generation

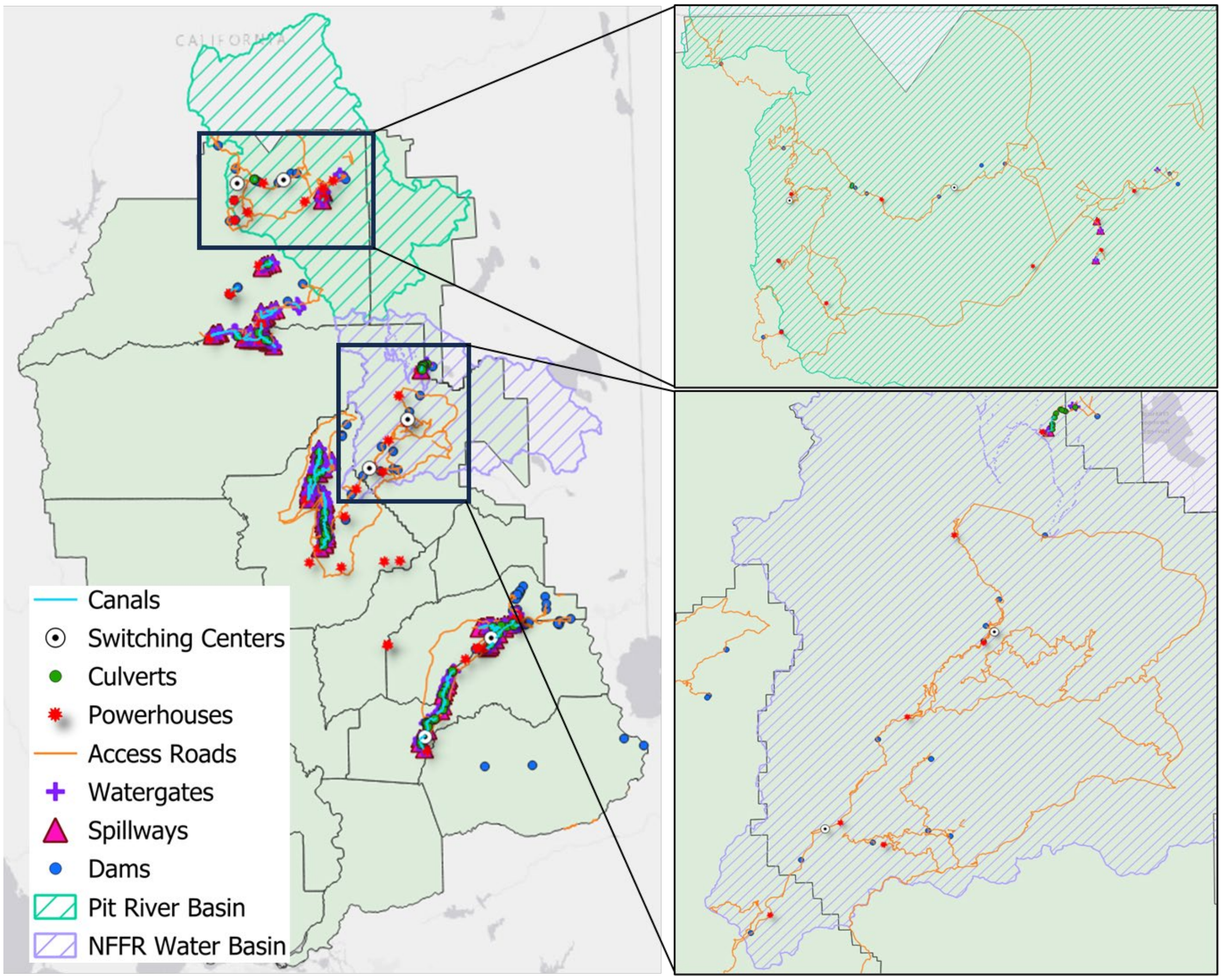


Figure 3.1.3-3. The Sierra Valley Region and associated hydropower assets. Zoomed-in areas show the Pit River (top right) and NFFR (bottom right) basins. Visual is intended to illustrate spread and diversity of hydroassets along waterways; not all dams and assets shown are owned by PG&E.

Key Findings

Climate Hazard	Climate Change Risk and Potential Adaptation Measures
Temperature	Low (off-ramped)
	• Hydropower assets are generally not sensitive to extreme heat and are unlikely to be significantly affected by predicted future increases in air temperature. Certain power equipment (e.g., transformers) and electrical equipment in switchyards and powerhouses may be affected by increased temperatures. However, PG&E's hydro assets are typically located at higher elevations, where predicted high temperatures in the future would be less impactful. Potential higher temperatures and heat waves are not considered to be a climate change issue at this time and the climate hazard is off-ramped.
Flooding and Precipitation	High (non-dam assets) Moderate (Federal Energy Regulatory Commission [FERC] high and significant hazard dams)
	• Both the higher frequency of intense storms and increased snowmelt may increase the risk of extreme water flows and flood events, putting some hydropower assets at risk for damage and failure. • Because they are already designed to pass extreme floods, high and significant hazard dams are believed to have a moderate risk. According to the FERC classification, low hazard dams have a high risk due to lower flood design requirements. • Adaptation options include, but are not limited to, develop preliminary risk rating and identify vulnerable assets and system hardening of vulnerable assets.
Sea Level Rise	Not assessed
	No hydropower assets or operations are sited in coastal or tidally influenced areas.

Wildfire	High
	• Potential direct impacts from wildfires include damage to communication and control equipment and other system components that are combustible or sensitive to damage from heat and smoke. Concrete and earth structures, including dams and canals, are not generally susceptible to direct impacts from wildfires. However, wooden flumes, power and communication lines, and ancillary structures are vulnerable to direct wildfire impacts. • Potential indirect impacts from wildfires are generally greater and include soil displacement and debris flows that can affect access roads and water conveyance facilities. Woody wildfire debris can be mobilized during subsequent flood events and block spillways and other water control structures. Increased sediment loading in wildfire areas also can affect dams and water conveyance systems. • Adaptation options include, but are not limited to, installation of debris catchment basins and water conveyance carry-overs to reduce debris flow.
Drought-Driven Subsidence	Not assessed
	No hydropower assets are located in areas of historical or potential drought-driven subsidence.

Climate Hazards

This section describes climate hazards that may affect PG&E's hydroelectric generation system. Where appropriate, the results are provided by water basin rather than by CAVA region.

Temperature

Most of PG&E's hydroelectric assets are not considered to be sensitive to high temperatures. This includes dams and appurtenance structures (spillways and low-level outlets), water conveyance facilities, roadways, powerhouses, penstocks, culverts, and switchyards.

PG&E's hydroelectric powerhouses and switchyards include some assets, such as power systems equipment (e.g., transformers) and other electrical equipment, which may be sensitive to higher temperatures. Powerhouse mechanical and electrical components, such as bearings, generators, and transformers, have design standards that require overtemperature protection. Should the temperatures of these components begin to rise above the allowable range, protection schemes have been established to alert operators to increase cooling capacity. If there is insufficient cooling capacity, the protection system will automatically initiate a safe shutdown sequence to avoid damage.

Additionally, electrical and mechanical assets associated with hydroelectric operations are located at higher elevations in mountainous areas that generally experience lower ambient temperatures and are projected to continue to experience lower ambient temperatures over time, compared with lower elevations in PG&E's service area. For example, on average, in Plumas County (Figure 3.1.3-1), the annual average maximum temperature is projected to increase from 59.6°F to 65.6°F by 2050 and to 69.6°F by 2080, which as temperatures that are well below sensitivity thresholds for electric equipment through the near end of the century (see Section 3.1.1, Electric).

The climate change risk of high-temperature[1] impacts to hydropower generation assets is considered to be **low** and the climate hazard is **off-ramped**.

Flooding and Precipitation

Hydro assets are exposed to two potential precipitation- and flood-related risks associated with climate change:

1. **Increased flooding risks (the focus of the CAVA):** Although total precipitation, on average, is projected to remain stable through 2050, relative to the historical baseline, larger flood events are projected to occur more frequently. Expected changes include less snowpack, a larger proportion of precipitation in the form of rain versus snow, and more extreme precipitation events. These changes are expected to result in high water flows and an increased risk of flooding that can directly damage assets if the current design standards or assumptions are exceeded. Increased precipitation intensity also

[1] The high-temperature analysis conducted does not include the role of increased temperature on water availability and wildfire risk.

may lead to compounding issues, such as landslides and debris flows, which damage assets or impede operations.

2. **Changes in water availability:** Because of potential changes in precipitation and drought dynamics, reduced stream inflows to PG&E's reservoir system may negatively affect PG&E's power generation operations and revenue generation. This presents an operational and financial risk rather than a specific risk to assets and could be considered for future climate change vulnerability assessments.

Exposure and Sensitivity

The extreme wet scenario analyzed in the CAVA (RCP 8.5, 90th percentile) is projected to result in future heavier precipitation and reduced snowpack levels. This combination may result in more intense storms, increased runoff, and higher peak inflows into PG&E's reservoirs.

PG&E performed preliminary runoff modeling for four areas (NFMR, NFKR, Pit River, and NFFR) to better understand how potential storm runoff in the extreme wet scenario differs from the historical baseline scenario for 2030, 2050, and 2080. Details of the runoff modeling are described as follows:

- PG&E's hydropower operations depend on facilities that collect and store rainfall and snowmelt runoff from large hydrologic basins. Basin runoff modeling was performed for the four major water basins to reflect the anticipated changes to runoff patterns under a more extreme wet scenario (RCP 8.5, 90th percentile) due to climate change.
- Runoff is defined as the flow of water occurring on the ground surface from precipitation, meltwater, and other sources. Hydrologic variables, such as evapotranspiration, precipitation (rain and snow), and snowmelt (derived from the snow water equivalent present in the snowpack), were incorporated into the runoff estimation model. Each of these variables is affected by climate change. Runoff was estimated as the volume of water flowing into and out of model grid cells that make up the basin. The runoff calculations used localized constructed analogs' downscaled climate projections to drive the variable infiltration capacity (VIC) hydrologic model and calculate monthly projections of runoff. The VIC hydrologic model considers important hydrologic factors at the basin scale, including differences in geology. The resulting monthly runoff values were calculated for each individual grid cell and then summed across all grid cells in the NFMR, NFKR, Pit River, and NFFR water basins.
- The results of the preliminary runoff model are expressed as monthly, average peak runoffs for "observed runoff" (based on historical baseline data for 1976 through 2005) and projected runoff for 2030, 2050, and 2080 for each of the four basins.
- Changes in the share of precipitation that falls as rain versus snow, changes in snowpack, and the timing of snowmelt can influence both the timing and magnitude of stream inflows into PG&E's reservoir system. The results of the runoff modeling indicate average monthly peak runoff values in 2050 that are approximately two to five times higher than the average historical runoffs for November through June. By 2080, monthly peak inflows could increase by four to nine times over historical observations in January and February but decrease significantly in May and June.

PG&E notes that these preliminary analyses provide a basin-wide view of runoff patterns that can be used to obtain a general sense of how climate change can affect overall stream flows in the basins. The models do not address potential flows from individual storms. The modeling also does not provide sufficient details to estimate the potential impacts on individual dams and powerhouses. Studies to evaluate the potential impacts of climate change on individual dams and assets are beyond the scope of this CAVA.

The general exposure and sensitivity of PG&E's dams, water conveyance, and civil infrastructure to potential flood- and precipitation-related risks associated with climate change are described as follows:

Dams: PG&E actively manages flood flows using weather forecasts, reservoir storage capacity, releases through spillways and outlets, and coordination with upstream and downstream dam operators. Large floods are routed through spillways, which typically include a control structure and chute or channel that safely directs flows from the reservoir to the river system downstream of the dam. Ancillary spillway structures and equipment may include water control gates and debris barriers (e.g., log booms). Dams may be affected by increased runoff and changes in the timing of runoff in the following ways:

- **Dam overtopping:** Increased potential for extreme precipitation and more intense runoff can increase the likelihood (expressed as the annual probability of exceedance) that runoff inflows can exceed the storage and spill capacity of the reservoir. If there is not enough reservoir storage and spillway capacity to contain or pass the flood flow, the dam may be overtopped. Depending on the characteristics of the dam and its foundation, overtopping flows may cause erosion and failure of the dam and lead to an uncontrolled release of the reservoir. Dams classified as low hazard (according to FERC guidelines) are potentially more sensitive to potential flood risks because they are typically evaluated against less stringent flood capacity criteria than those applied to high and significant hazard dams.
- **Spillway blockage:** Large floods can mobilize and carry woody debris into reservoirs where it can potentially block spillways, especially if the spillways have narrow openings. Debris booms are installed at most of PG&E's dams to protect spillways from floating debris. However, debris booms can fail under debris loading and release accumulated debris toward the spillway. If the spillway becomes blocked, the reservoir level may rise and overtop the dam. An example of a log boom retaining debris is shown in Figure 3.1.3-4.

Because high and significant hazard dams are designed to pass more extreme floods, PG&E believes that they have moderate sensitivity to potential flood- and precipitation-related impacts. However, PG&E believes that low hazard dams have high sensitivity to such impacts.

Powerhouses, water conveyance, culverts, access roads, penstocks, and other hydro assets:

Powerhouses, water conveyance facilities, culverts, access roads, penstocks, and other hydro assets are typically less resilient to extreme flooding events and the secondary impacts associated with flooding, such as landslides, debris flows, and sedimentation buildup. These assets have the following potential sensitivities associated with increased precipitation and/or water flows, such as the following:

- **Overtopping of water conveyance structures:** Increased precipitation and runoff can exceed the design capacities of water conveyance assets, such as canals, flumes, spillways, and culverts.
- **Increased debris and flow blockage:** High levels of precipitation can cause rockslides and debris flows that deposit material into open canals and other water conveyance facilities. The debris can block the flow of water, leading to overtopping of the canal, broader flooding, erosion, and potential further damage to the facilities.
- **Slope instability:** Sustained and intense rainfall can saturate the soil near hydropower assets and cause slopes to become unstable. Slope instability can create an increased potential for landslides and debris flows that damage or undermine water conveyances, spillways, and other assets (Figure 3.1.3-4). Landslide impacts on access roads can affect the ability of operators to reach facilities and perform critical actions during and after high inflow conditions.
- **Damage to supportive electrical equipment:** Electrical equipment (control equipment, batteries, and instrumentation) contained within PG&E's powerhouses and switchyards is sensitive to water inundation. If flooded, the equipment may not be available to operate gates (120V AC and batteries) to control flows or the instrumentation needed to remotely monitor reservoir conditions as part of PG&E's supervisory control and data acquisition (SCADA) system.

Figure 3.1.3-4. Woody tree debris captured by log boom in 2017 at the Pit 6 dam (left); landslide damage to PG&E's water conveyance (right).

Climate Change Vulnerability

Runoff Modeling Results

The unit of measurement for runoff is millimeters and it is the sum of the millimeters of runoff across all grid cells in each basin (NKFR, NFMR, Pit River, and NFFR). As such, runoff is not a measurement of volume of water and can only be used for a relative comparison between the observed baseline and future projected years.

Under the extreme wet scenario (the 90th percentile projected values), peak monthly runoff in the NFKR water basin is projected to more than nearly double by 2050, compared with historical observations (Figure 3.1.3-5). This increase is due to higher precipitation totals and a greater proportion of precipitation falling as rain rather than snow. There also is a projected shift in the timing of stream flows, with more flows in the winter and early summer months (Figure 3.1.3-5), both of which could subject hydro assets to greater water levels and potentially increase the damage from flooding events. The models do not address potential flows from individual storms. If increased flow is spread out evenly over an entire month, the effect may not be as dramatic, compared with increased flow attributed to an individual storm.

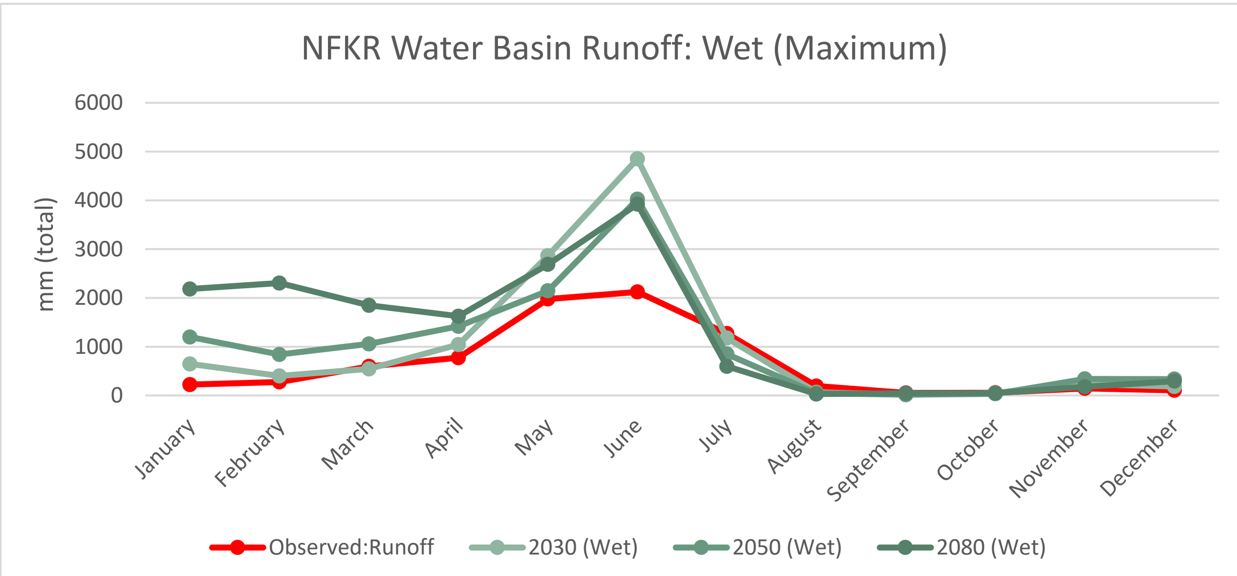


Figure 3.1.3-5. Wettest scenario (90th percentile) runoff projections for the NFKR water basin for 2030, 2050, and 2080.

Under the wettest high climate change scenario (the 90th percentile projected values), the peak monthly runoff values in the NFMR water basin are not expected to change significantly by 2050 (Figure 3.1.3-6). However, the changes in temperature and reduced snow and snowpack levels will result in a shift in the peak runoff from April and May to the early winter months. By 2080, changes in the make-up of precipitation and snowpack levels will result in the potential for much higher stream inflows as more precipitation falls as rain. This shift could subject hydro assets to a different timing of runoff inflows and potential changes in vulnerability to impacts from flooding events. The models do not address the potential flows from individual storms. If increased flow is spread out evenly over an entire month, the effect may not be as dramatic, compared with the increased flow attributed to an individual storm.

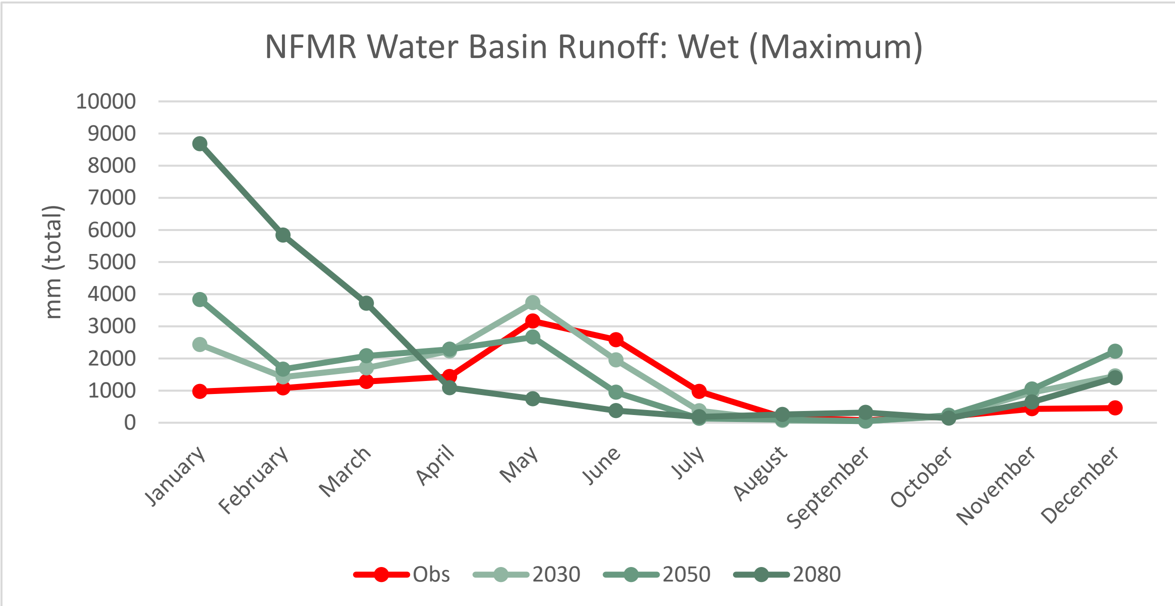


Figure 3.1.3-6. Wettest scenario (90th percentile) runoff projections for the NFMR water basin for 2030, 2050, and 2080.

Under the wettest high climate change scenario (the 90th percentile projected values), peak monthly runoff values increase at both the Pit River and NFFR basins, primarily in the winter months of December and January (Figure 3.1.3-7 and Figure 3.1.3-8, respectively). By 2050, peak runoff shifts from the spring to early winter due to increased precipitation totals and a greater proportion of precipitation falling as rain rather than snow in the mountains. Under the wettest high climate change scenario, peak runoff also is projected to increase substantially. These shifts in both the timing and volume of runoff could subject hydro assets to higher water levels and potentially increase the damage from flooding events. The models do not address potential flows from individual storms. If increased flow is spread out evenly over an entire month, the effect may not be as dramatic as that of increased flow attributed to an individual storm.

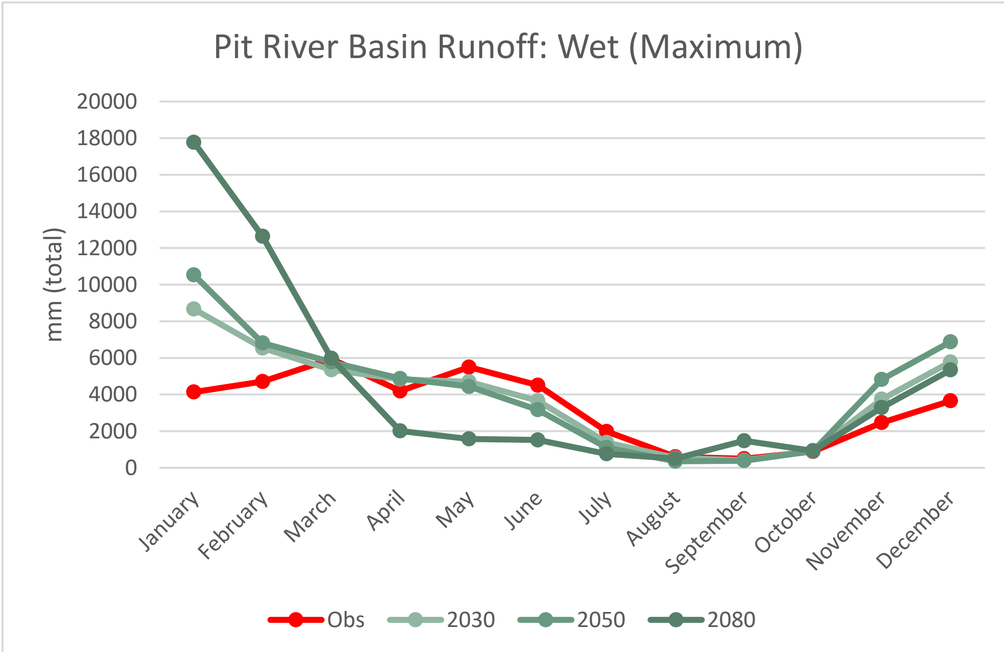


Figure 3.1.3-7. Wettest scenario (90th percentile) runoff projections for the Pit River Basin for 2030, 2050, and 2080.

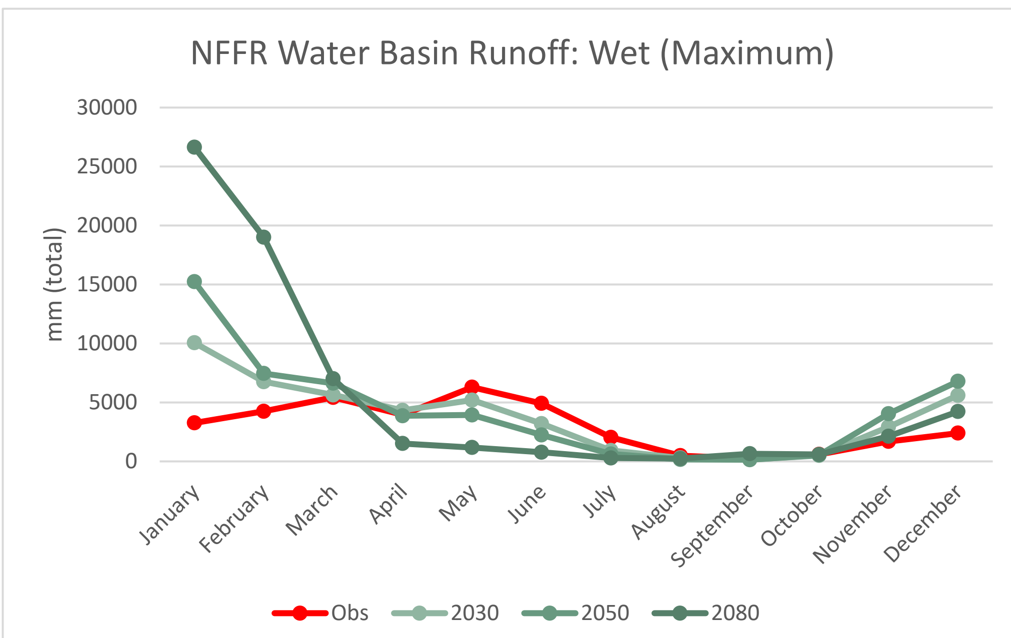


Figure 3.1.3-8. Wettest scenario (90th percentile) runoff projections for the NFFR basin for 2030, 2050, and 2080.

The Pit River basin and parts of the NFFR basin are in volcanic terrain with unusually high infiltration rates. The VIC hydrologic model considers important hydrologic factors at the basin scale, including differences in geology. PG&E adjusts probable maximum flood runoff models to calibrate the infiltration (and groundwater inflow) based on geological conditions.

Dams

PG&E has 165 dams in its inventory, of which 63 are classified as high or significant hazard structures and 96 are classified as low hazard structures, in accordance with FERC hazard classification criteria. The remaining six dams are not subject to FERC jurisdiction. As described in PG&E's 2024 Risk Assessment Mitigation Phase (RAMP) filing, floods are a major driver for the risk of large uncontrolled water release (LUWR), constituting approximately 62 percent of the total LUWR risk estimated using the RAMP model. The estimated total flood risk for the full LUWR portfolio of 60 high and significant hazard dams suggests that the annual probability of an incident leading to uncontrolled release in populated areas is approximately 0.013 (i.e., one in 77 years). The LUWR flood risk model does not currently account for the potential impacts of climate change.

The design flood capacity requirements can be used to define the CAVA threshold for a given dam. Spillway design capacity is based on a deterministic criterion called the Inflow Design Flood (IDF). The determination of IDF[2] is based on potential downstream consequences and is defined as the flood flow above which the incremental increase in water surface elevation from failure of a dam is no longer considered to present an unacceptable threat to downstream life (human life) and property. The upper limit for an IDF is the probable maximum flood, which is the largest flood that could theoretically occur at a given site. The lower limit is typically the 100-year flood, or a flood with an estimated annual probability of occurrence equal to 0.01. The IDF for many of PG&E's high and significant hazard dams, particularly those constructed of earthfill and rockfill, is the probable maximum flood. The IDF for PG&E's low hazard dams is typically the 100-year flood.

PG&E believes that increases in the magnitude and intensity of potential runoff could increase the vulnerabilities of PG&E's dams to flooding, particularly for low hazard dams that have lower flood design requirements. In addition to concerns regarding spillway capacity, increases in precipitation and runoff intensity can cause landslides, debris flows, and sediment accumulation that affect dams, reservoirs, and other hydro assets. With an increased potential for debris during large floods, reservoir spillways with smaller openings may be susceptible to blockages if debris booms fail to perform as needed to protect them.

Adaptive Capacity and Climate Change Risk

Adaptive capacity, which represents PG&E's current capabilities in planning and operations to manage the projected RCP 8.5, 90th percentile wet climate change scenario, is categorized as

[2] FERC. August 2015. "Engineering Guidelines for the Evaluation of Hydropower Projects, Chapter II: Selecting and Accommodating Inflow Design Floods for Dams." https://www.ferc.gov/sites/default/files/2020-04/chap2.pdf

low[3] to **moderate**.[4] Existing measures to address potential risks from flooding and extreme flow conditions at hydropower assets are described as follows.

Planning Capacities

- **Spillway improvement program:** As part of the long-term spillway Capital Improvement Program, PG&E is currently refurbishing spillways that are deteriorated and undersized in order to pass the IDF.

Operational Capacities

- **Weather forecasting and water management:** PG&E maintains a robust weather and runoff forecasting program with teams of meteorologists and hydrologists who monitor and evaluate weather conditions, snowpack, reservoir levels, and flow conditions in its hydro territory. Available monitoring, modeling, and forecasting tools can provide early warning of extreme flow conditions to allow for mitigating actions (e.g., drawing down reservoir levels and opening spillway gates in advance of major storms). The effectiveness of operational interventions is limited for longer-duration extreme storms, however, because available reservoir storage is limited and spillways would eventually be required to pass flood flows.
- **Frequent inspections:** PG&E implements a rigorous inspection program to monitor the health and condition of potentially vulnerable assets, including dams, spillways, and water conveyance facilities. For example, PG&E's Penstock Inspection Program includes walkdowns every other month for each penstock (more than 500 walkdowns per year). The walkdowns serve to check for undermining, erosion, cracking, dangerous debris, and other potential hazards. Each penstock is scheduled for a more robust geohazard inspection every 5 years, with engineers, geologists, and other subject matter experts. PG&E also inspects for woody debris in reservoirs and other water catchment areas and removes debris prior to winter storms. Debris booms, trash racks, and other protective features also are inspected to ensure that they are in good condition. PG&E's other water storage and conveyance facilities are subject to similar inspections.
- **Maintenance:** PG&E's operations teams collaborate with hydro schedulers to manage operations in winter and spring. Operations plans are based on forecasts and current system conditions. Operators conduct routine inspections to identify deficiencies, prioritize repairs, and actively remediate issues. For example, deteriorated or damaged debris booms are repaired or replaced as required. PG&E's operations crews also address debris accumulation in spillways, reservoirs, and/or at the dam to proactively maintain safe operations during floods. Winter operating plans also help manage high flow conditions and protect its water conveyance facilities from damage.

The higher frequency of intense storms and the increased potential for snowmelt that are predicted to result from climate change may increase the risk of extreme water flows and flood events, putting some hydropower assets at risk for damage and failure. The climate change

[3] Low category: PG&E has no or very few current capabilities.
[4] Moderate category: PG&E has some or many existing capabilities; however, there are opportunities to strengthen these, informed by projected changes in the hazard.

risks for flooding and precipitation are considered to be **high** for PG&E's powerhouses, water conveyance systems, culverts, access roads, penstocks, and other hydro assets. Because they are already designed to pass extreme floods, high and significant hazard dams are believed to have **moderate** climate change risk. The climate change risk for low hazard dams is considered to be **high** because of their lower flood design requirements.

Dams

Catastrophic dam failure, resulting in an LUWR, is the risk event with the greatest potential consequence associated with postulated climate change impacts. The failure of a high hazard dam would likely result in injuries and casualties among downstream populations, with the number and extent of losses dependent on the location of the dam and the timing and characteristics of the event. The failure of a dam also could result in the loss of significant hydroelectric energy and potential liabilities. As described in the Climate Change Vulnerability section above, flood is the largest risk driver for LUWR. Although failure of a low hazard dam is not expected to cause loss of life, there could be significant environmental and financial impacts associated with such a failure.

Powerhouses, Water Conveyance, Culverts, Access Roads, Penstocks, and Other Hydro Assets

Past major flooding events have caused substantial damage to the Company's hydroelectric assets. Under the wettest climate change scenario, peak runoff volumes are expected to double by 2050, relative to the historical averages, as more precipitation falls as rain and reduced snow water equivalent levels shift runoff to earlier in the year.

Increases in runoff can result in debris flows that could affect the operability of these hydro assets. Powerhouse basements can become flooded, affecting the turbine assets that are typically at the lowest point of the powerhouses. Runoff can affect debris flows and landslides in and around water conveyance systems; it also can plug culverts, which can lead to road flooding or, in extreme cases, road failure. When these storm events occur, hydro operations will increase patrols to these assets to monitor and respond when conditions change.

Increases in extreme precipitation and wind events soften soil and cause the falling of healthy trees. Trees frequently fall and cause damage to water conveyances and other water conveyance systems. Damage can include previously mentioned debris flow/blockage issues but also can include damage to water retention and even structural components. Occasionally, the root ball of fallen trees creates large voids directly adjacent to water-retaining structures. Such voids require careful repair to ensure the proper integrity of water conveyance features. Vegetation management activities inspect and remove dead and dying trees; however, some areas are difficult to access or traverse, and these activities do not prevent healthy trees from falling during extreme storm events.

Potential Adaptation and Resilience Measures

PG&E is considering the following measures to mitigate the risks from extreme precipitation and flooding conditions to hydropower generation assets.

Planning Options

- **Develop preliminary risk rating and identify vulnerable assets:** PG&E can continue to develop the preliminary risk rating for power generation assets at a more granular level. The risk rating can be estimated using available information (e.g., known areas that were impacted during larger historical storms).
- **System hardening:** Once PG&E completes the preliminary risk rating and identification of vulnerable assets, PG&E can identify which assets are most vulnerable to impacts of climate change and if these vulnerable assets could be retrofitted to handle the potential increase in flows.

Operational Options

- **Enhanced hydrologic forecasting and monitoring:** Weather forecasting, instrumentation (e.g., flow sensors and reservoir elevation sensors) and early warning systems can be expanded to more effectively notify impacted populations downstream of the dams during high flow conditions.
- **Enhanced monitoring of asset conditions:** Existing asset inspection programs could be expanded to identify assets with existing deficiencies or vulnerabilities that may be exacerbated by potential climate-driven changes.

Sea Level Rise

None of PG&E's hydro assets or operations are sited in coastal areas or in tidally influenced areas. Analyses of potential SLR as a climate hazard are not applicable to this CAVA.

Wildfire

Exposure and Sensitivity

Direct impacts on hydro generation assets from potential wildfires vary by the type of asset. Dams and powerhouses generally have limited exposure and sensitivity to the heat, flames, and smoke produced by wildfires. Water conveyance systems, culverts, and access roads have greater exposure and sensitivity to the direct impacts of wildfires.

Hydropower assets that may be exposed to direct and indirect impacts from wildfires include the following:

- **Communication towers and lines, SCADA equipment, power transmission and distribution lines, and other auxiliary support components:** These assets include combustible and heat- or smoke-sensitive components that are vulnerable to direct damage from wildfires.
- **Dams and water conveyance infrastructure:** Concrete and earth structures, including dams and canals, are not generally susceptible to the direct impacts from wildfires. However, wooden flumes, control buildings, and ancillary structures are vulnerable to direct wildfire impacts. Increased sediment loading in wildfire areas also can affect dams and water conveyance systems.
- **Spillways, culverts, drainage channels, and flow control structures:** Wildfires create increased potential for debris as dead trees and other burned vegetation can wash into rivers and streams. Wildfires also may predispose landscapes to landslides and debris flows

following periods of heavy precipitation. Increased debris loading in wildfire-impacted areas can cause the damage and blockage of assets directly and control the flow of water (Figure 3.1.3-9).

- **Access roads:** Access roads to hydropower assets may be blocked by fires, debris, and landslides, preventing safe access to perform the necessary maintenance or conduct operations.

Figure 3.1.3-9. In summer 2021, the River Fire in Nevada and Placer counties, California, in damaged PG&E's Bear River Canal. Impacts included damaged signage, trees, and other debris deposited into water conveyances and culverts, blocked roads and paths providing access to hydro assets, and increased slope stability issues.

Climate Change Vulnerability

Analytical Metrics

Power generation assets located in HFRAs are projected to be at the highest risk for potential impacts from current and future wildfire activity.

Results

Portions of the NFMR (55 percent) and NFKR (31 percent) water basins are in HFRAs (Figure 3.1.3-10), indicating the vulnerability of hydro assets in these areas to potential impacts from current and future wildfires.

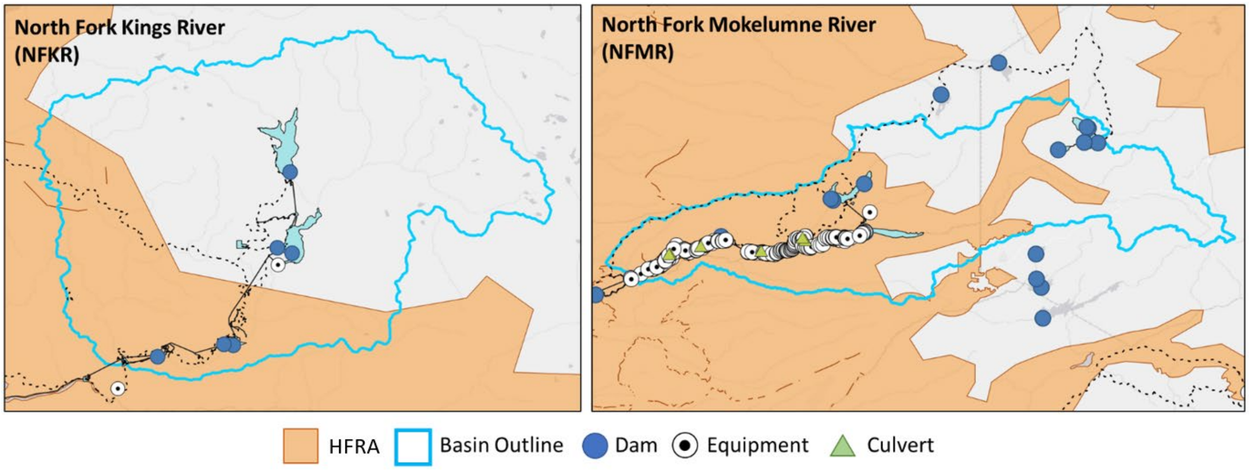


Figure 3.1.3-10. The HFRA region and basin outline used in runoff modeling for NFKR and NFMR. The visual is intended to illustrate the spread and diversity of hydroassets along waterways; not all dams shown are owned by PG&E.

Ninety percent of hydropower assets in the Sierra Region are located in HFRAs and nearly all of the Pit River (93 percent) and NFFR water basins (94 percent) are in HFRAs (see Figure 3.1.3-11).

Assets in HFRAs may be more vulnerable to potential impacts from current and future wildfires.

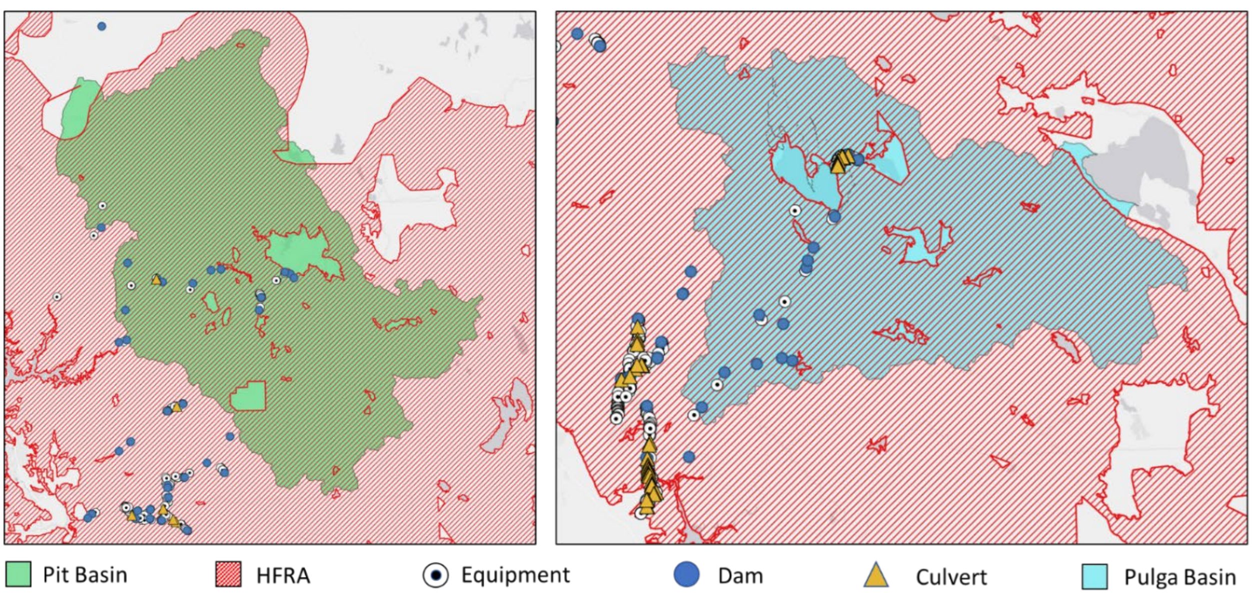


Figure 3.1.3-11. HFRAs overlap with the two Sierra Region basins: Pit River and NFFR. The visual is intended to illustrate the spread and diversity of hydro assets along waterways; not all dams shown are owned by PG&E.

Adaptive Capacity and Climate Change Risk

Wildfire prevention is the best mitigation to prevent damage to non-dam assets. However, post-wildfire inspections, prompt repairs, and debris management efforts can limit ongoing impacts from any incurred damage. The adaptive capacity of non-dam assets to wildfire damage is therefore considered to be **moderate**. PG&E has established programs and protective features to respond to and mitigate the potential impacts of wildfires on its hydro assets.

Planning Capacities

- **2023–2025 Wildfire Mitigation Plan (WMP):**[5] While a full accounting of PG&E's wildfire mitigation strategy is beyond the scope of this document, WMP activities, such as the Defensible Space initiative, are used to reduce the potential for utility-caused wildfires and mitigate the potential risks of wildfire damage to utility assets.
- **Debris booms:** Most of the spillways at PG&E's reservoirs are protected by debris booms. Debris booms are floating barriers that block floating debris from entering and potentially obstructing water flow through the spillway.

Operational Capacities

- **Remote monitoring:** Telemetering systems are installed throughout PG&E's hydro territory. These systems provide visibility to inflows and system performance, allowing operators to promptly detect and respond to changing conditions.
- **Asset condition surveillance and monitoring:** PG&E conducts regular inspections of the Company's dams, penstocks, and other water conveyance features. Inspection programs to monitor the condition of hydro assets and the surrounding areas can help identify locations where wildfires have directly damaged the facilities or have created an elevated risk of debris and other secondary wildfire impacts.
- **Debris clearing:** Following a wildfire at or near PG&E's hydro assets, PG&E conducts inspections and removes debris that pose the highest risk to those assets. Following the 2021 Dixie Fire event (Butte, Plumas, Lassen, Shasta, and Tehama counties), mitigation measures were deployed such as hydro mulch, k-rail installation, hazardous tree removal, and around-the-clock culvert inspection and cleaning to prevent asset impacts due to debris flows in burn scar areas above our assets.
- **Erosion control measures:** Following wildfires (e.g., the Dixie Fire event in 2021), PG&E installed erosion control measures, such as hydro mulch and gravel bag check dams, in areas of high concern. Examples of such measures in the Dixie Fire burn scar areas are shown in Figure 3.1.3-12. Erosion protection measures reduce the potential for debris to mobilize from wildfire-impacted slopes and plug drainage and water management features.

---

[5] PG&E. 2023. "2023–2025 Wildfire Mitigation Plan R3." https://www.pge.com/content/dam/pge/docs/outages-and-safety/outage-preparedness-and-support/pge-wmp-r3-092723.pdf

- **Asset restoration:** PG&E repairs or replaces damaged assets following wildfires. This includes replacing damaged components, restoring road access, and clearing landslide debris.

Figure 3.1.3-12. Examples of installed hydro mulch and gravel bag check dams (2021).

Debris from wildfires, including wildfire-related landslides and debris flows, can mobilize large quantities of woody material into rivers and streams. The debris can then cause operational impacts on PG&E's hydro facilities. For example, heavy debris loading can overwhelm debris booms and obstruct spillway flows, which can result in overtopping of the dam. The climate change risk is therefore considered to be **high**.

Potential Adaptation and Resilience Measures

PG&E is considering the following measures to address wildfires and associated debris flow risk for hydropower assets:

Planning Options

- **Debris catchment basins and water conveyance carry-overs:** Debris flow hazard may be reduced through physical measures to intercept and divert debris before it enters critical flow control structures (such as reservoir spillways). Alternatively, physical measures may deflect mobile debris so that it safely passes over or through the spillway or water conveyance system.
- **Debris booms:** PG&E can assess whether existing debris booms are sufficiently robust and in proper condition to successfully capture and retain high volumes of debris associated with potential wildfire and flood conditions.

Operational Options

- **Debris clearing:** Following a wildfire at or near PG&E's hydro assets, PG&E conducts inspections and removes debris that poses the highest risk to those assets. For example, after the 2021 Dixie Fire event, Power Generation deployed mitigation measures such as hydro mulch, k-rail installation, hazard tree removal, and around-the-clock culvert inspection and cleaning to prevent asset impacts due to debris flows in burn scar areas

above PG&E's assets. Inspection efforts may need to increase in number or level of effort due to future wildfire activity.
- **Asset restoration:** PG&E repairs or replaces damaged assets following wildfires. This includes replacing damaged components, restoring road access, and clearing landslide debris. Repair efforts may need to increase in number due to future wildfire activity.

Drought-Driven Subsidence

PG&E's hydro assets are outside areas of historical subsidence in the Sierra and Central Valley Regions. Analyses of drought-driven subsidence are not applicable to hydro assets.

3.1.3.b Natural Gas Generation

Asset Family Introduction

Natural gas fossil units are flexible, efficient, and reliable sources of generation and provide essential grid support in the transition toward grid decarbonization. The fossil units perform a crucial role in backstopping intermittent renewable resources (solar and wind) while new energy infrastructure (storage) is built out.

PG&E owns and operates three natural gas fossil generating units (Figure 3.1.3-13):

The **Humboldt Bay Generating Station** is a 163-MW facility with 10 dual-fuel reciprocating engine-generator sets located in Eureka, Humboldt County, in the North Coast Region.

The **Colusa Generating Station** is a 660-MW combined-cycle natural gas-fired facility located about 6 miles north of the community of Maxwell, Colusa County, in the Sierra Region.

The **Gateway Generating Station** is a 580-MW combined-cycle natural gas-fired facility located in Antioch, Contra Costa County, in the Central Valley Region.

Figure 3.1.3-13. The locations of PG&E's natural gas fossil generating units, with reference to the California counties in which they are located.

PG&E plans to decommission the three natural gas fossil units by 2042, consistent with state policy on natural gas facilities. As such, consideration and presentation of the results for climate change vulnerability and the climate change risk for the CAVA aligns with the assumed 2042 decommissioning. The ultimate timeline for decommissioning of the units will be determined by state energy policy as the dates approach.

Key Findings

Climate Hazard	Climate Change Risk and Potential Adaptation Measures
Temperature	Low (off-ramped)
	• The climate change risk of high temperatures to PG&E's three natural gas generating plants is not considered to be a climate change issue at this time and and this climate hazard is off-ramped.
Flooding and Precipitation	Low (off-ramped)
	• The climate change risk of flooding and precipitation is considered to be low due to very low exposure to facilities and the existing emergency response capabilities. The climate hazard is off-ramped.
Sea Level Rise	Low (off-ramped)
	• The climate change risk of SLR is considered to be low due to very low exposure to facilities and the existing emergency response capabilities. The climate hazard is off-ramped.
Wildfire	Low (off-ramped)
	• The Gateway, Colusa, and Humboldt Bay facilities are not directly exposed to wildfire risk. However, wildfire smoke particulate matter clogging intake filters may result in multiday shutdowns. Extra filters available onsite mitigate the risk. Damage from wildfire, including smoke, is not considered to be a climate change issue at this time and the climate hazard is off-ramped.
Drought-Driven Subsidence	Low (off-ramped)
	• Drought-driven subsidence is not considered to be a climate change issue at this time and the climate hazard is off-ramped.

Climate Hazards

Key findings and site-specific results for the vulnerability assessment are combined given that there are only three natural gas generation plants owned and operated by PG&E.

Temperature

Exposure and Sensitivity

Ambient and high temperatures at the locations of the natural gas generating units are projected to increase over time. Sensitivity to projected higher temperatures is dependent on the facility.

The Humboldt Bay facility is not considered to be sensitive to the higher temperatures plausible in future projections for 2040. The facility is located on the shores of Humboldt Bay, which remain cool due to the coastal influence.

The Colusa and Gateway facilities both require water-to-steam conversions that turn steam turbines to generate electricity. Higher ambient temperatures may reduce capacity (Figure 3.1.3-14).

Climate Change Vulnerability

Analytical Metrics

To analyze the potential future vulnerabilities of very high temperatures at the Colusa and Gateway facilities, this analysis uses days above 95°F during a 1-in-10-year heat event by 2050 and compares these values to known temperature/derate curves for combined-cycle natural gas-fired facilities (Figure 3.1.3-14). Values for the Humboldt Bay facility are provided for additional information

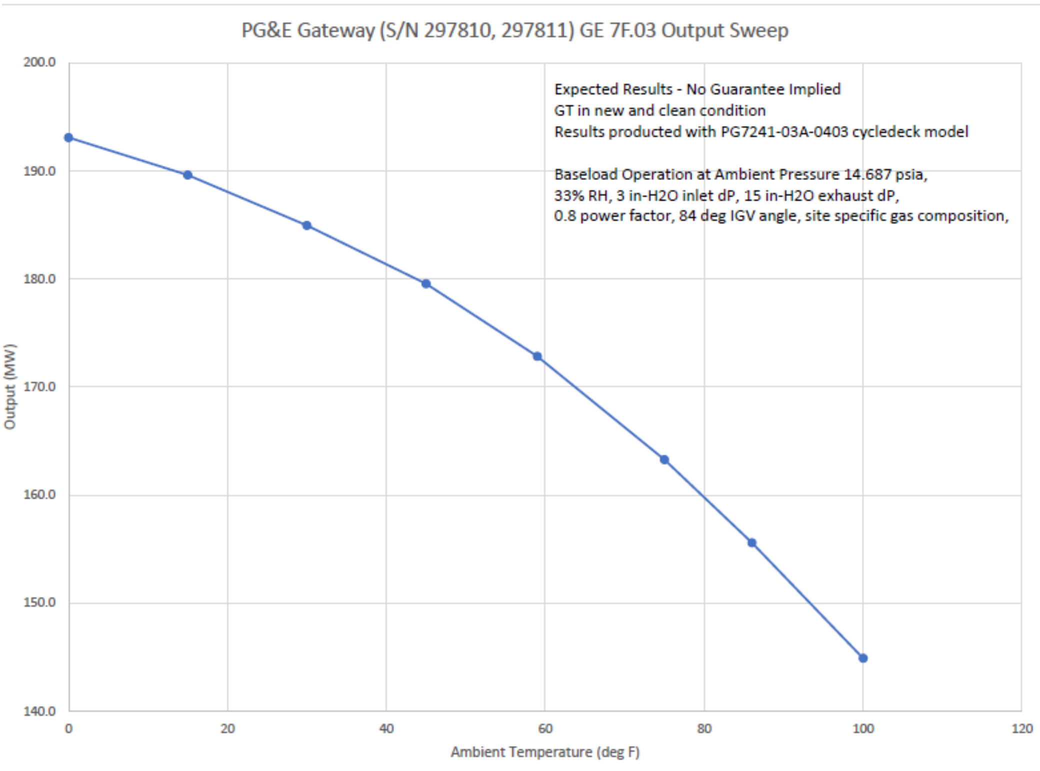


Figure 3.1.3-14. 7FA gas turbine (turbine type at Colusa and Gateway) temperature derate curve; output (in MW) in relation to ambient temperature (°F).

Results

The number of days above 95°F during a 1-in-10-year heat event are projected to increase at the Colusa and Gateway facilities by 2050 but not at the Humboldt Bay facility (Table 3.1.3-1).

Table 3.1.3-1. 1-in-10-year maximum annual days over 95°F.

Facility	Baseline	2050 – 90th percentile (proxy for 2042)
Humboldt Bay	0	0
Colusa	65	114
Gateway	41	91

The results indicate that both the Colusa and Gateway facilities may be exposed to high ambient temperatures more often in the future, which may affect output generation for Colusa and Gateway. The Colusa facility has evaporative cooling capabilities to mitigate some portion of the impacts during high-temperature periods; the Gateway facility does not have inlet cooling.

Adaptive Capacity and Climate Change Risk

Higher temperatures are expected to affect both the Colusa and Gateway facilities but not significantly in terms of power output (Table 3.1.3-1) and PG&E has the capability to mitigate impacts. The adaptive capacity of PG&E's natural gas power plants to high heat is therefore considered to be high.

Operational Capacities

- **Evaporative cooling:** The Colusa facility has evaporative cooling capabilities to mitigate impacts to output due to high heat.
- **Monitoring:** PG&E currently monitors the reduction in the amount of generation (derating) that plants experience due to heat events, as well as the efficiency and condition of station equipment (e.g., exchangers, boilers, turbines, lubricant oil, additional components).

The climate change risk of very high temperatures is therefore considered to be **low** and the climate hazard is **off-ramped**.

Flooding and Precipitation

Exposure and Sensitivity

Natural gas generation facilities may be sensitive to fluvial or pluvial flooding:

- **Direct sensitivity of the generating facility:** Significant exposure of key equipment to flood damage can cause natural gas-fired power plants to experience equipment damage, resulting in repair times of weeks to months. Heavy rain may overwhelm site drainage systems.
- **Impacts on electric substations:** Flooding may affect the operations of substations (see 3.1.1b Electric Substation) that service natural gas power plants.

Climate Change Vulnerability

Analytical Metrics

Facility location within the current FEMA 100-year and 500-year floodplains.

Results

The Humboldt Bay facility itself is not in a FEMA 100-year floodplain, although the facility is surrounded by areas that are in the floodplain. This indicates that facility equipment, including substation and other electrical equipment, is likely not vulnerable to flooding; however, access may be hindered during very large flood events.

The Colusa facility and the surrounding areas are not located in a FEMA 100-year or 500-year floodplain and are not projected to be vulnerable to future flooding impacts.

The Gateway facility is in a FEMA 500-year floodplain; however, the physical footprint of the facility is elevated out of the 500-year floodplain. This indicates that facility equipment, including substation and other electrical equipment, is likely not vulnerable to flooding; however, access may be hindered during very large flood events.

Adaptive Capacity and Climate Change Risk

The adaptive capacity of natural gas power plants to flooding and precipitation is considered to be high.

Operational Capacities

- **Weather monitoring:** Allows PG&E to anticipate very high rainfall events and potential fluvial flooding, and activate emergency response capabilities if needed.

The climate change risk of flooding and precipitation is considered to be **low** due to very low exposure to facilities and the existing emergency response capabilities. The climate hazard is **off-ramped**.

Sea Level Rise

Exposure and Sensitivity

SLR may increase the vulnerability of coastal assets to inundation, especially during a large storm event. Sensitivities to SLR are the same as described above in the Flooding and Precipitation section.

Climate Change Vulnerability

Analytical Metrics

Recognizing the overlap with FEMA floodplains in coastal areas as described above in the Flooding and Precipitation section, the metric of exposure specifically for SLR is the location of a facility in areas of current and future coastal inundation extent during a 100-year storm event.

Results

The Humboldt Bay facility is located along the shores of Humboldt Bay; however, the facility itself is not projected to be exposed to flooding (including access to the facility) due to SLR until about 4 to 5 feet of SLR, which is projected to occur from 2070 to 2090.[6] SLR is not considered to be a climate change issue for this facility.

The Colusa facility as is not located near the coast or near tidally influenced waters.

[6] California State Lands Commission. March 2018. "State of California Sea Level Rise Guidance: 2018 Update." https://www.opc.ca.gov/webmaster/ftp/pdf/agenda_items/20180314/Item3_Exhibit-A_OPC_SLR_Guidance-rd3.pdf

SLR increases the potential for site-level flooding at the Gateway facility due to the overtopping of shoreline flood protection. This potential for flooding is projected to occur near the end of the facility's operational life (Figure 3.1.3-15[7]).

Figure 3.1.3-15. 2040 SLR inundation for a 100-year storm (Source: Bay Conservation and Development Commission)

Adaptive Capacity and Climate Change Risk

The adaptive capacity of natural gas power plants to SLR is considered to be high.

Operational Capacities

- **Weather monitoring:** Allows PG&E to anticipate large storm events and activate emergency response capabilities, if needed, for the Gateway facility.

The climate change risk of SLR is considered to be **low** due to very low exposure to facilities and the existing emergency response capabilities. The climate hazard is **off-ramped**.

Wildfire

Exposure and Sensitivity

None of the facilities are located in HFRAs and therefore are not projected to be exposed to or sensitive to direct wildfire damage.

Both the Colusa and Gateway facilities use air filtration systems. The potential exists for wildfire smoke particulate matter to clog the inlet filters. For example, in 2018, there was a 10-day

---

[7] Image source: Bay Conservation and Development Commission East Contra Costa Shoreline Flood Explorer. https://eccexplorer.adaptingtorisingtides.org/

forced outage at the Gateway facility due to smoke particulate matter accumulating in the plant's intake filters and replacement filters were not readily available at that time.

The Humboldt Bay facility does not use a similar air filtration system and wildfire smoke is not expected to affect facility operations.

Climate Change Vulnerability

Analytical Metrics

The location within an HFRA does not provide an indication of future vulnerability to smoke, which can travel hundreds of miles. Wildfire smoke is considered to be a synoptic event and further research would be required to understand long-term changes in wildfire smoke concentration and direction due to climate change.

Results

Due to the projected increase in future wildfire activity, the Colusa and Gateway facilities are considered to be vulnerable to the impacts of wildfire smoke.

Adaptive Capacity and Climate Change Risk

The adaptive capacity of the Colusa and Gateway facilities to the impacts of wildfire smoke is considered to be high.

Operational Capacities

- **Air filter supplies:** After the 2018 impact of wildfire smoke on the Gateway facility, the facility has a sufficient supply of spare filters. Both facilities are able to respond to any possible smoke impacts.

The availability of replacement air filters onsite at the Colusa and Gateway facilities means that the future risks are considered to be **low** and the climate hazard is **off-ramped**.

Drought-Driven Subsidence

None of the facilities solar sites are located in areas of subsidence. The climate change risk is **low** and the climate hazard is **off-ramped**.

3.1.3.c Nuclear Generation

Asset Family Introduction

The Diablo Canyon [Nuclear] Power Plant (DCPP) sits on about 750 acres in Avila Beach, California, on the coast of the Pacific Ocean, and has been in operation since 1985. To generate electricity, DCPP uses two Westinghouse pressurized water reactors, which received California Public Utility Commission approval to extend operating the 2,250-MW power plant's two units by 5 years to 2029 and 2030, respectively. The site's nuclear storage waste facilities will continue to be used after 2030. The focus of this climate vulnerability assessment is therefore the potential vulnerability of DCPP's nuclear waste storage facilities to changes in climate variables in 2050, as well as a near-term assessment of the vulnerability to DCPP operations as scheduled to operate through 2030.

PG&E conducts and routinely updates a Final Safety Analysis Report (FSAR) for DCPP's waste storage facility, which includes a vulnerability review of current potential climate hazards. The findings presented below therefore rely on preexisting FSAR analysis to assess DCPP's future climate vulnerabilities and risk. FSAR falls under 10 Code of Federal Regulations 2.390 and is therefore not publicly disclosable.

Key Findings

Climate Hazard	Climate Change Risk
Temperature	Low (off-ramped)
	• High temperatures and extremes projected for Avila Beach for the 2030 timeframe are well below the design basis component temperatures and PG&E's FSAR indicates that high temperature is not a near- or long-term climate change concern at DCPP's waste storage facilities. Higher temperatures are not considered to be a climate change risk at this time and the climate hazard is off-ramped. • DCPP's coastal location provides a plentiful supply of water for its cooling systems. Extreme ambient temperatures are not predicted at the DCPP coastal site. In the unlikely event of an extreme high-temperature event, plant equipment and cooling systems are designed to operate for prolonged periods over 100°F and for short periods when temperatures exceed 110°F.
Flooding and Precipitation	Low (off-ramped)
	• Topography and the DCPP site arrangement limit flood design considerations to local floods from Diablo Creek. The canyon confining Diablo Creek remains intact and will pass any conceivable flood without hazard to the PG&E Design Class I equipment. Channel blockage from landslides downstream of the plant, sufficient to flood the plant yard, is not possible because of the topographic arrangement of the site. In addition to creek flooding, testing and analysis demonstrate that equipment and structures important to safety will remain operable in the event of a probable maximum tsunami, storm, or tide occurrence. • Flooding and heavy precipitation are not considered to be a climate change risk at this time and the climate hazard is off-ramped.
Sea Level Rise	Low (off-ramped)
	• DCPP nuclear waste storage facilities are located at more than 300 feet above mean sea level, and the plant itself is located approximately 85 feet above sea level; neither facilities face the risk of flooding from SLR. SLR is not considered to be a climate change issue at this time and the climate hazard is off-ramped.

Wildfire	Low (off-ramped)
	• The DCPP facility has a fully staffed 24/7 fire department available to respond immediately to fire threats. In addition, PG&E maintains a robust land stewardship program. The vegetation surrounding the facilities is primarily low-cover grazed grass, with no significant brush and no trees. PG&E conducts maintenance and controlled burns around the facility and adjacent lands to prevent uncontrolled vegetation growth, further reducing the risk of fire. No combustible materials are permitted to be stored within the nuclear waste area. PG&E also evaluated wildfire risk using a conservative wildfire model that considers a variety of factors to evaluate wildfire risk specific to the DCPP site. The results also indicate that a fire at the waste storage facility would not result in structural damage to any of the storage equipment. Consequently, wildfire risk at DCPP is low. • Damage from wildfire is not considered to be a climate change issue at this time and the climate hazard is off-ramped.
Drought-Driven Subsidence	Low (off-ramped)
	• Historically, drought-driven subsidence has not been a major concern at this site and there is no significant indication for it to become a major issue at the site in the coming decades. • Drought-driven subsidence is not considered to be a climate change issue at this time and the climate hazard is off-ramped.

Climate hazards are not projected to affect DCPP by 2030. If operations are further extended, potential vulnerabilities after 2030 will be analyzed in the next CAVA filing.

3.1.3.d Solar Generation

Asset Family Introduction

PG&E owns and operates 13 solar power plants, which are located in California's Central Valley and generate up to 152 MW of clean power.

Key Findings

Climate Hazard	Climate Change Risk and Potential Adaptation Measures
Temperature	Low (off-ramped)
	• Solar photovoltaic panels experience reduced efficiency with increasing temperatures. However, the reduction in solar panel efficiency that would occur at PG&E's solar sites under projected warming is not significant. • Higher temperatures are not considered to be a climate change issue at this time and the climate hazard is off-ramped.
Flooding and Precipitation	Low (off-ramped)
	• Although solar equipment can be sensitive to flood impacts, only the Guernsey and Cantua Creek sites are in the FEMA 100- and 500-year floodplains, and equipment at both sites is elevated 6 feet above ground, such that the risk of flood impacts is low. Flooding and precipitation are considered to be a climate change issue at this time and the climate hazard is off-ramped.
Sea Level Rise	Not assessed
	• None of PG&E's solar sites are located along coastal or tidally influenced areas.
Wildfire	Low (off-ramped)
	• None of PG&E's solar sites are located in HFRAs, indicating a low risk of direct damage from wildfires. • Wildfire smoke can travel far and reduce solar generation output. However, PG&E-owned solar generation represents a small portion of the broader generation facility mix and the risk to assets and operations is low. Damage from wildfire, including smoke, is not considered to be a climate change issue at this time and the climate hazard is off-ramped.

3.1.3.d Solar Generation

Drought-Driven Subsidence	Low (off-ramped)
	• Subsidence is not known or anticipated to have negative impacts on solar assets.

Climate Hazards

Temperature

Exposure and Sensitivity

Daily average and maximum temperatures are projected to increase at all of PG&E's solar array sites over time.

The main sensitivity of solar panels to high heat is as follows:

- **Decrease in efficiency:** The maximum potential efficiency (E_{max}) of solar panels, and thus the maximum generation capacity, may decrease with increasing temperatures. On average, E_{max} decreases by approximately 0.3 percent to 0.5 percent per 1°C above the standard test condition (normally 25°C), with the percentage reduction per degree referred to as the temperature coefficient (T_c). For a panel with a 20 percent E_{max} at 25°C and a T_c of 0.37, for example, temperatures of 35°C will reduce its E_{max} to 19.26 percent.[8]

Climate Change Vulnerability

Analytical Metrics

To analyze the potential vulnerability of PG&E's solar arrays to high heat, the exposure metric used is the projected average July daily maximum temperature and 95th percentile daily maximum temperature over time.

Results

Daily average and maximum temperatures are projected to increase at all of PG&E's solar array sites over time (Figure 3.1.3-16). At the Central Valley sites, the average daily maximum temperatures in July are projected to increase by approximately 6°F by 2050; temperatures on very hot days (95th percentile temperatures) also are projected to rise. The Vaca Dixon site is slightly cooler than the Central Valley sites but is projected to be exposed to a similar trend (Figure 3.1.3-16).

[8] Eco Green Energy. 2021. "Temperature Coefficient of Solar PV Module." https://www.eco-greenenergy.com/temperature-coefficient-of-solar-pv-module/; Boston Solar. 2019. "How Do Temperature and Shade Affect Solar Panel Efficiency?" https://www.bostonsolar.us/solar-blog-resource-center/blog/how-do-temperature-and-shade-affect-solar-panel-efficiency/

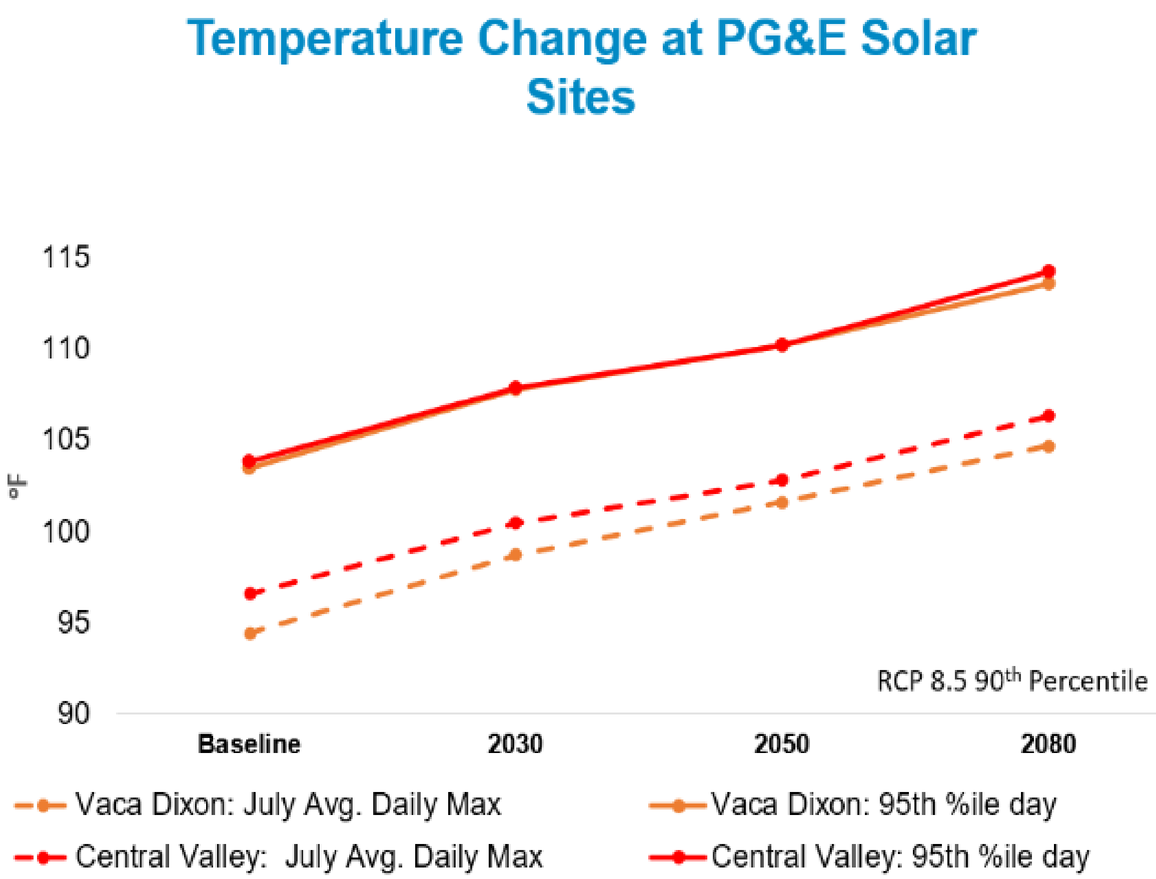


Figure 3.1.3-16. Baseline and projected temperatures at PG&E's Central Valley (red) and Vaca Dixon (orange) solar sites.

PG&E's experience with high temperatures to date suggests that the potential reduction of solar panel efficiency will have only a minor impact on solar generation output, and no direct impact on the assets themselves.

Adaptive Capacity and Climate Change Risk

PG&E's ability to address marginal efficiency losses in generation is high. High-temperature impacts on solar power arrays are unlikely to be a climate change issue; the climate change risk is **low** and the climate hazard is **off-ramped**.

Flooding and Precipitation

Exposure and Sensitivity

Both the Guernsey and Cantua Creek solar array sites are in the FEMA 100-year floodplains. Flooding across the Central Valley, where these sites are located, may become more severe with climate change as extreme precipitation is projected to increase.

Solar arrays that are exposed to flooding may experience direct damage to electrical equipment near ground level or experience erosion of the module support structures.[9] However, both the Guernsey and Cantua Creek sites are elevated on bases that position the panels at least 6 feet above the ground so that they have relatively low exposure and vulnerability to direct flood impacts.

No other solar array sites are in FEMA floodplains.

Climate Change Vulnerability

See above.

Adaptive Capacity and Climate Change Risk

- Both the Guernsey and Cantua Creek sites are elevated on bases that position the panels at least 6 feet above the ground and are out of the base flood elevation thresholds.
- Power lines at the solar sites are routed through waterproof conduits or are underground and are not anticipated to be vulnerable to flooding.
- If solar operations were affected due to heavy rain or flooding, the impacts on the grid due to the loss of generation would be minimal because PG&E-owned solar generation represents only a small portion of the generation mix.

This adaptive capacity to flooding impacts is considered to be high, and flooding and precipitation are not projected to be a climate change issue; the climate change risk is **low** and the climate hazard is **off-ramped**.

Sea Level Rise

None of PG&E’s solar sites are sited in coastal areas or in tidally influenced areas. Analyses of potential SLR as a climate hazard are **not applicable** to this CAVA.

Wildfire

Exposure and Sensitivity

None of PG&E’s utility-scale solar arrays are located in HFRAs (Figure 3.1.3-17); the solar arrays are not projected to be vulnerable to direct wildfire damage.

[9] International Finance Corporation. 2015. “Utility-Scale Solar Photovoltaic Power Plants: A Project Developer’s Guide.” https://documents1.worldbank.org/curated/en/690161467992462412/pdf/99396-WP-Box393199B-PUBLIC-IFC-Solar-Report-Web-08-05.pdf

Figure 3.1.3-17. The locations of PG&E's solar arrays and HFRAs.

Smoke from regional wildfire activity has affected solar generation in the past (e.g., at the Vaca Dixon site) and is likely to have increasing impacts on solar power generation in the future if wildfire activity continues to occur nearby. Wildfire smoke may travel significant distances, depending on the wind patterns.[10]

Particulate matter and ash generated by wildfires may inhibit solar panels' generation capacity by blocking sunlight and reducing the amount of electricity they can generate.[11] Both airborne smoke and particulates that land on solar arrays may reduce generation. PG&E's solar arrays do not have automatic cleaning systems.

Climate Change Vulnerability

Analytical Metrics

Vulnerability to direct damage from wildfires is indicated by the location in HFRAs. However, this does not provide an indication of vulnerability to smoke, which can travel hundreds of miles.

Results

Vulnerability to direct damage due to wildfires is low, given the location of solar sites outside of the HFRA, and the fact that they are generally buffered by large tracts of agricultural land.

The impacts of wildfire smoke on solar generation capacity, however, can be significant, as shown by the decline in generation associated with the late summer and early fires in 2020

---

[10] U.S. Energy Information Administration. 2020. "Smoke from California wildfires decreases solar generation in CAISO." https://www.eia.gov/todayinenergy/detail.php?id=45336

[11] International Finance Corporation. 2015. "Utility-Scale Solar Photovoltaic Power Plants: A Project Developer's Guide." https://documents1.worldbank.org/curated/en/690161467992462412/pdf/99396-WP-Box393199B-PUBLIC-IFC-Solar-Report-Web-08-05.pdf; U.S. Energy Information Administration. 2020. "Smoke from California wildfires decreases solar generation in CAISO." https://www.eia.gov/todayinenergy/detail.php?id=45336

throughout California including in Mendocino National Forest and Sierra National Forest (Figure 3.1.3-18). With wind moving wildfire smoke across the state, solar generation in CAISO declined almost 30 percent, compared with the average in July 2020.[12]

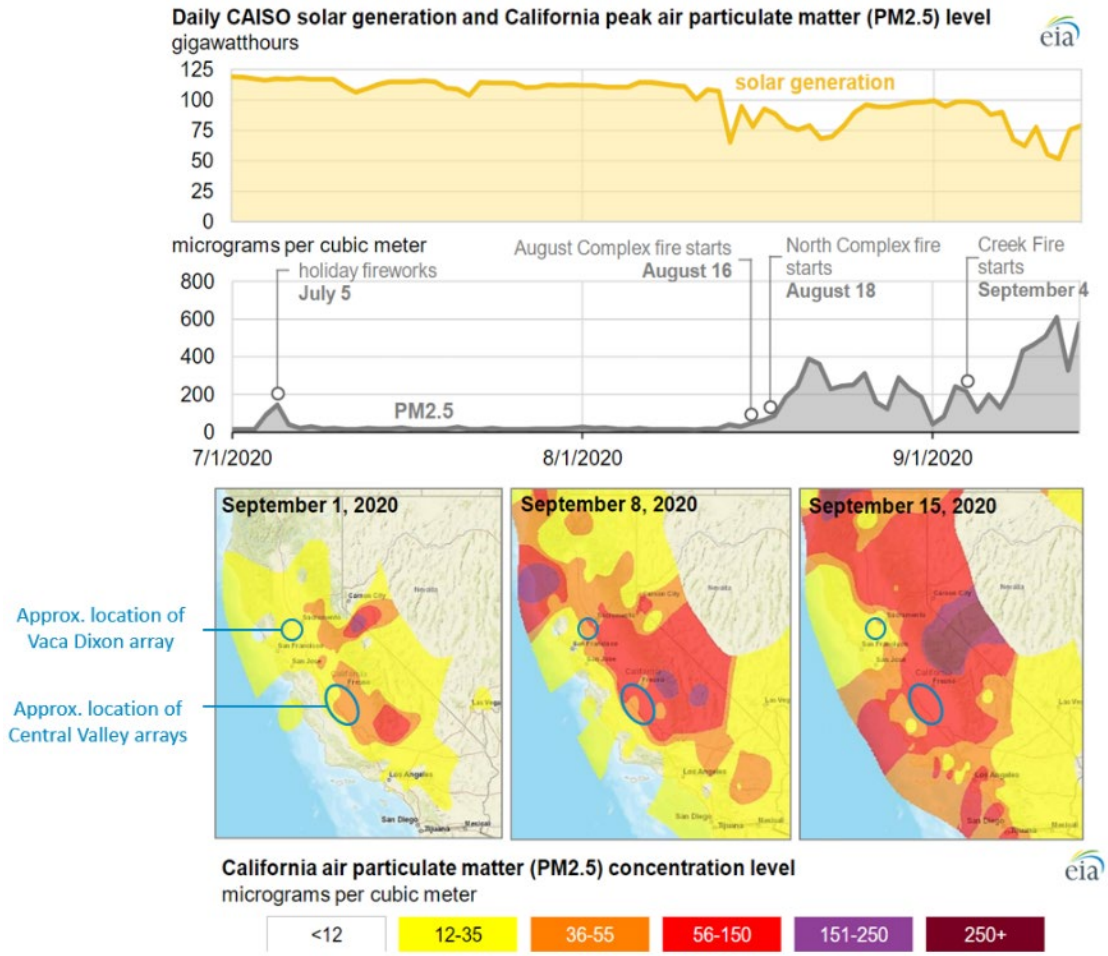


Figure 3.1.3-18. CAISO solar generation and California particulate matter (PM) 2.5 data (top) and the location of PM2.5 concentrations (bottom) during the 2020 Labor Day Fires. Figures adapted from the U.S. Energy Information Administration, 2020.

Adaptive Capacity and Climate Change Risk

PG&E's ability to cope with the potential for an increase in wildfire smoke due to plausible increases in wildfire activity is characterized by the ability to reduce the impacts from a loss in generation. Because the reduced output of PG&E-owned solar resources does not represent a critical generation shortfall at the grid scale, the adaptive capacity is considered to be high.

[12] U.S. Energy Information Administration. 2020. "Smoke from California wildfires decreases solar generation in CAISO." https://www.eia.gov/todayinenergy/detail.php?id=45336

The broader risks associated with smoke impacts to PG&E's solar facilities are relatively low, and the climate change risk is considered to be **low** given the relatively small scale of PG&E's solar resources within the broader grid. The climate hazard is **off-ramped**.

Drought-Driven Subsidence

PG&E's solar sites are located in areas that have seen moderate to high subsidence in recent years; however, regional subsidence is not known or anticipated to have negative impacts on solar generation. The climate change risk is **low** and the climate hazard is **off-ramped**.

Section 3.1.4: Enterprisewide

Table of Contents

Introduction

This section of the CAVA describes the impacts of climate hazards on PG&E's enterprisewide facilities and the physical IT assets, which are managed by the Corporate Real Estate Strategy and Services (CRESS) organization and the IT group, respectively.

Compared with the three main asset types (electric, gas, and power generation), there are significantly fewer corporate real estate and IT assets. Due to this more limited number of assets, the analysis conducted in this section was completed jointly for both IT- and CRESS-managed assets across PG&E's service territory.

Corporate Real Estate Strategy and Services

The CRESS organization is responsible for operating, planning, acquiring, designing, constructing, and maintaining 6.8 million square feet of facilities throughout PG&E's service area. These corporate-owned and corporate-managed real estate facilities include office buildings, service centers (including operations buildings, shops, warehouses, equipment yards, and vehicle maintenance garages), facilities that house critical operating infrastructure, and contact or call centers. The CRESS organization does not manage structures or facilities that are part of PG&E's electric, gas, power generation, and IT assets.

CRESS facilities are characterized as being within certain risk or hazard zones based on general risk maps developed by various agencies (e.g., FEMA flood maps). However, even if facilities are within a hazard map area, no local hazards may be evident or they may have been mitigated by building conditions that are required to obtain an occupancy permit. The CAVA analysis provides another view of risk identification and potential hazard mitigation when siting new facility locations or before significant improvements have been made to an existing facility.

As described below, adaptive capacity for all climate hazards is considered to be high and all climate hazards are off-ramped; PG&E's CRESS organization recognizes that ongoing diligence related to environmental hazards for all facilities is required for resilient and safe operations.

Table *3.1.4-1* includes the number of assets for each category of CRESS-managed facilities assessed for the CAVA.

Table 3.1.4-1. Categories of PG&E facilities used for the CAVA.

Facility Type	Number of Facilities
Headquarters and Regional Offices	24
Service Centers	93
Special-Purpose Sites	5
Critical Facilities	6
Material Warehouses	9
Other	31
Heliport (CRESS-managed)	4
Heliport (non-CRESS)	8
Total	**180**

Key Findings

- All categories of PG&E's facilities are exposed to at least one climate hazard, which represent future intensification of existing hazard conditions, as opposed to entirely new hazards. Existing and potential future intensification of hazard conditions is projected to be effectively managed through site-based assessments and existing business planning processes. All hazards are not considered to be climate change issues at this time, climate change risks are considered low, and all are **off-ramped.**
- The potential for storm-driven flooding is the most common location-based climate hazard, with 12.7 percent of the sites located in FEMA 100-year floodplains and 29.4 percent of the sites located in FEMA 500-year floodplains. CRESS-managed facilities had a flooding risk assessment for the 2020 Risk Assessment Mitigation Phase (RAMP) filing and were deemed to have low-risk exposure.
- Sea level rise does not pose near-term risks to CRESS facilities and only minimal risks over the long term. By 2050, only one facility will be exposed to sea level-driven flooding concerns during a 100-year storm.
- Much of PG&E's service area will experience increased ambient and extreme temperatures (Appendix B); CRESS-operated facilities overall will be subject to increased temperatures, thus increasing the importance of reliable cooling.

Vulnerability Assessment

Exposure and Sensitivity

CRESS facilities are distributed throughout PG&E's service area and are therefore exposed to different degrees of climate hazards based on their location. Facilities and assets will have different sensitivities to the different climate hazards, such as landslides, floodplains, and HFRAs, depending on whether they are enclosed or open, if the site is graded or has other flood mitigation measures, and the location in higher risk areas.

Vulnerability

All categories of facilities are exposed to at least one climate hazard (Table 3.1.4-2).

Table 3.1.4-2. 2050 exposure to each hazard by facility category.

Facility Type	High Landslide Risk Area	FEMA 100-year Floodplain	FEMA 500-year Floodplain	Coastal or Delta Flooding	Wildfire (HFRAs)
Headquarters and Regional Offices	1	3	9	0	0
Service Centers	10	10	25	1	5
Special-Purpose Sites	3	1	1	0	0
Critical Facilities	0	1	1	0	0
Material Warehouses	0	3	4	0	1
Other	1	5	13	0	1
Heliport (CRESS)	0	0	0	0	2
Heliport (non-CRESS)	0	0	0	0	6
Total	**15 (8.3%)**	**23 (12.7%)**	**53 (29.4%)**	**1 (0.5%)**	**15 (0.8%)**

Note: Percentages are relative to total number (180) of facilities.

The North Coast and Central Coast Regions have the highest proportions of facilities exposed to a climate hazard, while the Central Valley and Sierra Regions have the highest number of total exposed facilities (Table 3.1.4-3).

Table 3.1.4-3. 2050 exposure to each hazard by PG&E region.

Region	High Landslide Risk Area	FEMA 100-year Floodplain	FEMA 500-year Floodplain	Sea Level Rise + 100-year Storm*	Wildfire (HFRAs)	Total exposed in Region	Proportion of Facilities Exposed in Each Region (%)
Bay Area	5	1	5	0	0	11	36%
Central Valley	0	7	14	0	5	26	40%
Sierra	1	5	15	0	8	29	38%
North Coast	8	5	6	1	1	21	45%
Central Coast	1	5	13	0	1	20	61%

*Includes flood potential due to levee overtopping in the Sacramento Delta.

Higher Temperatures

Existing CRESS facilities have sufficient heating and cooling systems in place to meet existing cooling requirements. The CRESS organization plans to determine the needs for future facilities or retrofits to consider increased cooling demands due to the expected increase in the number of extreme heat days throughout the service area.

Flooding and Precipitation

Twenty-three of the 180 active CRESS assets and heliports (12.7 percent of the total) are located in the FEMA 100-year floodplain and 53 (29.4 percent of the total) are located in the FEMA 500-year floodplain (Table 3.1.4-2).

Fifteen of the 180 active CRESS assets and heliports (8.3 percent of the total) are located in high landslide risk areas. Most assets in high landslide risk areas are located in the Bay Area or North Coast Regions. No heliports or other critical facilities are exposed to landslides.

Sea Level Rise

None of the CRESS facilities or heliports are projected to be exposed to flooding at present and in 2030 under sea level rise conditions during a 100-year storm. Only one facility is projected to be exposed to flooding by 2050 (Table 3.1.4-2).

Wildfire

Fifteen CRESS-managed facilities are located in HFRAs, of which more than half are heliports. Because helicopters can often land at alternative sites, current site exposure to wildfires is not considered to be a major risk to PG&E helicopter operations. Additional CRESS assets in HFRAs include five service centers, one electric facility (Other), and one material warehouse. No critical facilities are located in HFRAs. Facilities in HFRAs currently have site-specific fire mitigation plans, such as brush clearing, which reduce their susceptibility to burning during a wildfire.

Sites that are proximate to or surrounded by HFRAs, even those that are not directly in HFRAs, could be subject to increasing future risk of secondary impacts from wildfires. These impacts may include access restrictions or evacuations during active wildfires, exposure of personnel to smoke, or Public Safety Power Shutoffs.

Drought-Driven Subsidence

Drought-driven subsidence is not considered a climate change issue for facilities.

Adaptive Capacity and Climate Change Risk

- PG&E's CRESS organization has a robust risk monitoring process that includes a Facilities Management Preventive Maintenance Program, Site Design Structural and Engineering Reviews, a Facility Inspection Program, and the siting of new facilities across PG&E's service area to identify and minimize exposure to floods, landslides, and other environmental hazards or events.
- The CRESS organization's development of new sites or renovation of existing sites is required to be compliant with local planning and development codes and ordinances related to mitigating local risks, including climate-based risks, such as floods, landslides, and seismic events, among other potential local risks.
- Site planning and emergency efforts include backup generation units in HFRAs.
- Current mitigation measures are in place to limit the disruption to Company operations through remote work options and backup sites for unexpected disruptions to existing CRESS-operated PG&E sites.
- Site-based mitigation and planning changes are easily implementable.

Adaptive capacity is considered to be high. Exposure to environmental hazards, such as floods and landslides, is already considered to be a low risk due to the site location and planning mitigation.[1] Plausible increases in future hazards due to climate change can be mitigated through PG&E's high adaptive capacity. Climate change risk to facilities is considered to be **low** for all hazards and all hazards are **off-ramped**.

[1] PG&E. 2020. "2020 Risk Assessment Mitigation Phase (RAMP) filing." https://www.cpuc.ca.gov/about-cpuc/divisions/safety-policy-division/risk-assessment-and-safety-analytics/risk-assessment-mitigation-phase/pg-and-e-ramp/pg-and-e-2020-ramp

Information Technology Operations

IT services, systems, and hardware and software assets are vital to PG&E operations. Across all functional areas, PG&E uses these assets to improve safety and reliability, meet compliance obligations, and engage with customers. These assets enable and support virtually all of PG&E's operations, including work execution, grid control, customer support, emergency response, and asset management.

IT operations support business administration and productivity functions, including facilitating the remote work that is necessary for the Company's 25,000 employees.

IT assets play a critical role in allowing the Company to operate its electric and gas infrastructure, interacting with monitoring and control equipment, enabled by fiber-optic cables and wireless transmitters that support long-distance communications. IT assets are a key part of the strategy for the future for continuing to deliver electricity and gas in a safe and reliable manner.

Within this broad scope of IT assets, the CAVA focuses on the infrastructure asset types that will most likely be exposed and vulnerable to climate change hazards.

These major IT asset categories include the following:

- **Data centers:** PG&E has two data centers located within the service area. These centers contain electronic storage for the data required for day-to-day PG&E operations or for archival purposes.
- **Telecommunications (telecom) rooms:** These are the rooms and locations where the IT assets and infrastructure used to support all of the PG&E operations and services are stored. These telecom rooms may be located within PG&E offices, substations, or other facilities. Many are located on mountain tops that provide communications paths for critical infrastructure.
- **Fiber-optic cable:** PG&E owns an extensive network of fiber-optic cable throughout its service territory, including both overhead and underground cable. This network supports PG&E's internal communications needs; in some cases, use of the cable is also leased to third parties.
- **Communications towers:** PG&E owns and operates many wireless communications towers, with equipment that includes radio repeaters and microwave transmitters. These towers facilitate wireless communications with remote equipment and work crews.
- **Remote telemetry, weather stations, and SCADA devices:** PG&E operates tens of thousands of devices across the system that provide remote monitoring of the system and ambient conditions, as well as remote control of system operations.

Key Findings

- Due to low climate hazard exposure, low vulnerability to climate hazards, and in-place mitigation and risk monitoring, no hazards are considered to be a climate change issue at this time. PG&E's IT operations, data centers, and fiber-optic cable are considered to be at **low** risk for all climate hazards and all climate hazards are **off-ramped.**
- Due to higher climate hazard exposure and vulnerability to climate hazards, communications towers and remote telemetry, weather stations, and SCADA devices may be more vulnerable to the future impacts of climate change.
- Most of PG&E's telecom network paths include built-in redundancy, supporting continued communication in the event of failures, and the IT group has an existing risk monitoring process in place.

Vulnerability Assessment

Exposure and Sensitivity

As a critical infrastructure operator, PG&E's standards for telecom reliability are higher than the typical standards for public networks, including for assets and operations serving remote areas. Given the critical role of IT equipment in maintaining the functionality of PG&E's system, major equipment failure could result in customer outages and potentially significant system disruptions.

Sensitivities to the climate change hazards of other IT assets do exist and include the following hazards. However, as described below, PG&E has sufficient adaptive capacity in siting and design processes, as well as risk identification to reduce or eliminate potential vulnerabilities.

Higher Temperatures

Telecom rooms (e.g., in substations) without air conditioning may be subject to overheating and potential electrical equipment damage (see Section 3.1.1.b, Electric Substation). While fiber-optic cable has generally low sensitivity to heat, heat could accelerate the failure of older portions of PG&E's fiber-optic network.

Flooding and Precipitation/Sea Level Rise

Under severe flooding conditions, telecom rooms could be inundated, equipment damaged, and communications towers or endpoint equipment could be compromised, resulting in major network failures. Landslides and debris flows can damage any exposed IT equipment.

Wildfire

Wildfire poses a significant risk to any exposed equipment type, including telecom rooms, overhead fiber, telecom towers, and weather stations.

Drought-Driven Subsidence

Drought-driven subsidence is not considered a climate change issue for IT assets.

Climate Change Vulnerability

At present, no telecom sites have been determined to have climate change vulnerability. As we design new sites, we will continue to consider factors such as landslides, flooding, and fire risk.

Adaptive Capacity and Climate Change Risk

In addition to siting and design processes lowering the exposure to environmental hazards, PG&E's IT group has robust capital budgeting and planning processes as part of the Company's general rate case (GRC) filings. The IT group also has an existing risk monitoring process in place, which includes a monthly review of risks to IT operations and assets. IT asset failure is part of the Company's Enterprise and Operational Risk Management Program risk oversight processes and was highlighted as a cross-cutting risk factor in the Company's 2024 RAMP filing.

Most of PG&E's telecom network paths include built-in redundancy, supporting continued communication in the event of failures. PG&E has conducted studies to identify single points of potential failure and has included potential mitigation measures to limit other operational risks in regulatory proceedings, such as the RAMP and GRC. Adaptive capacity for all climate hazards is considered to be high.

Climate change risk is considered to be **low** for all climate hazards and categories of IT assets and all climate hazards are **off-ramped**.

Section 3.2: Operations and Services

Table of Contents

3.2 Operations and Services

Introduction

Natural hazards affecting PG&E's service areas include earthquakes, high wind events, wildfires, climate change, and other catastrophic incidents. These natural hazards can affect PG&E's infrastructure, as well as operations and services. The focus of this section is on the potential impact on PG&E's operations and services from changes in natural hazards due to climate change. This analysis was conducted in compliance with D.20-08-046 from the CPUC Climate Adaptation Order Instituting Rulemaking to "conduct an exposure analysis on PG&E's operations and services as a means of identifying in this vulnerability assessment which operations and services shall be included for further analysis."[1]

Emergency Readiness and Planning

Emergency readiness and planning across PG&E is the Company's primary defense against emergent hazards, natural or otherwise, that exceed PG&E's existing adaptive capacity capabilities. PG&E's Emergency Preparedness and Response (EP&R) organization is responsible for identifying critical operations and services across the Company, identifying natural and other hazards that may affect the functioning of operations and services, and setting up plans to ensure business continuity in case of disruption.

The core tenets that drive EP&R's response to all hazards lie within the National Response Framework (NRF).[2] The NRF is a guide for how the nation responds to all types of disasters and emergencies. It is built on the scalable, flexible, and adaptable concepts identified in the National Incident Management System (NIMS)[3] in order to align key roles and responsibilities. Equally important is EP&R's alignment with California's Standardized Emergency Management System (SEMS).[4] SEMS is the cornerstone of California's emergency response system and the fundamental structure for the response phase of emergency management. The system unifies all elements of California's emergency management community into a single integrated system and standardizes the key elements of preparedness, response, and recovery from all hazard

---

[1] California Public Utilities Commission. 27 August 2020. Decision 20-08-046, "Decision on Energy Utility Climate Change Vulnerability Assessments and Climate Adaptation in Disadvantaged Communities (Phase 1, Topics 4 and 5)." 346285534.PDF (ca.gov)

[2] FEMA. 2019. "National Response Framework." U.S. Department of Homeland Security. https://www.fema.gov/sites/default/files/2020-04/NRF_FINALApproved_2011028.pdf

[3] FEMA. 2017. "National Incident Management System." U.S. Department of Homeland Security. https://www.fema.gov/sites/default/files/2020-07/fema_nims_doctrine-2017.pdf

[4] California Governor's Office of Emergency Services. "Standardized Emergency Management System." https://www.caloes.ca.gov/office-of-the-director/operations/planning-preparedness-prevention/planning-preparedness/standardized-emergency-management-system/

incidents. Lastly, but equally important, is CPUC's General Order (GO) No. 166.[5] The purpose of GO No. 166 is to ensure that jurisdictional electric utilities are prepared for emergencies and disasters in order to minimize damage and inconvenience to the public that may occur as a result of electric system failures, major outages, or hazards posed by damage to electric facilities.

A full description of EP&R's role at PG&E and coordination with major functional areas (electric, gas, and power generation) is provided at the end of this section.

PG&E Meteorology and Fire Science

The Meteorology and Fire Science organization plays a critical role in preparing the Company for upcoming extreme storms (e.g., heat, snow, rain, thunderstorms) and fire weather events. This involves developing, operationalizing, and using advanced weather, outage, and fire models that can assess the threat type and severity with up to a 2-week lead time. These forecasts drive operational decisions and mitigation directed by EP&R, such as activating local, regional, and Companywide emergency response centers, procuring equipment, and staging crews and resources before the events occur.

As storm and fire weather events trend more extreme in the future, the advanced warning and situational awareness capabilities of the Meteorology and Fire Science organization will continue to be a cornerstone of adaptive capacity capability.

Climate Change Vulnerability of PG&E Operations and Services

This Operations and Services section of the CAVA focuses specifically on PG&E operations and services in the context of EP&R operations and process identification and business continuity plans in the face of identified hazards. Operations and services, as related to PG&E infrastructure and assets, are discussed throughout Section 3.1 and there may be overlap in the identified operations and services described here.

EP&R identifies the risk to PG&E operations and processes using business impact analyses (BIAs). The BIA is an assessment conducted by EP&R as part of operational and emergency readiness planning across the Company. The BIA is a tool for identifying which PG&E processes, or operations, when disrupted, would most affect PG&E's risk areas of finance, reliability, compliance, trust, safety, and environmental impact.

Each business process in the BIA is assigned a maximum disruption score. This disruption impact is calculated using the frequency[6] of an outage and the disruption impact from the loss

---

[5] California Public Utilities Commission. 23 July 1998. Decision 00-05-022, "Standards for Operation, Reliability, and Safety During Emergencies and Disasters." https://docs.cpuc.ca.gov/published/General_order/3400.htm.

[6] The BIA assessed the impacts of a disruption in service, or outage, over two specified timeframes (4 hours and 2 weeks).

of each business process.[7] This scoring function created a ranked list that was used to categorize each business process as either mission critical, business critical, significant, or important.

The processes identified by the BIA fit the definition in the CPUC Climate Adaptation Order Instituting Rulemaking to identify operations and services that are "functions that, if interrupted, would result in the loss of an essential or critical process."[8] The 2020 BIA was used as the most recent list of BIA processes; as of the publication of this CAVA, the update to the 2020 BIA is in progress.

The BIA identifies business continuity plans (BCPs), which are the critical processes that PG&E would undertake to maintain essential services and infrastructure during a hazard event or other disaster. BCPs for each identified process in the BIA are developed to ensure operational reliability and continuity in the event of disruption, natural or otherwise.

A successful BCP, and therefore operation, has three key components:
1. Essential people to execute the process, along with backup personnel
2. Facility availability for process and identification of backups
3. IT capabilities and procedures for performing the process without technology (tech down plans).

Climate change exposure analyses are provided for critical PG&E facilities and IT assets in Section 3.1.4: Enterprisewide.

Operational Resilience Requires Essential People

Climate change may affect the availability or capabilities of essential people due to the impacts of climate change. For example, changes in climate hazards and conditions can affect safety or access during or after extreme weather events, such as storms, flooding, and wildfire evacuations, or cause power outages during storms or high-heat events. Direct impacts from climate hazard conditions may result in unsafe conditions or otherwise inaccessible facilities.

Furthermore, many essential people are those that are in the field to support these critical operations. PG&E identified 14 processes of the 71 that have field teams to support these operations. These include, but are not limited to, electric substation maintenance and construction, geosciences, a public safety specialist field team, electric dispatch and scheduling, gas dispatch and field services, gas damage prevention, and corporate security.

The vulnerability of essential people is therefore identified as the key climate change vulnerability to critical operational processes and further analyses specific to these impacts may improve the resilience of BCPs to climate change. Because those in the field will likely be most

[7] The BIA assessed the impact of a disruption using a seven-point scale: (1) Negligible, (2) Minor, (3) Moderate, (4) Major, (5) Extensive, (6) Severe, and (7) Catastrophic.
[8] Climate Adaption (ca.gov).

exposed to the impacts of extreme weather and other climate change hazards, further analysis specific to these impacts is recommended for those PG&E operations that have field teams. While climate change risk categories based on quantitative exposure analyses are assigned to the asset and hazard combinations detailed in Section 3.1, further analyses could include spatial and temporal vulnerabilities to extreme weather events, potential impacts of extreme weather events and changing conditions due to climate change on current operational adaptive capacity, and procedural safety improvements and hazard awareness of climate change impacts for employees, essential people, and field teams. As described below, employee health and safety and access to infrastructure are key considerations that could be further explored with climate change vulnerability analyses.

Employee Health and Safety

PG&E's stand is that everyone and everything will always be safe. The impacts of climate change have and will continue to challenge this commitment. PG&E's Enterprise Health and Safety organization includes health and safety professionals who lead PG&E's employee safety programs, including employee health and safety (EHS); this team managed EHS as an enterprise-level risk. PG&E's Enterprise Health and Safety organization includes a field safety organization led by five regional safety directors who partner with PG&E's major functional areas to advise on and facilitate health and safety program implementation and sustainability through the application of best safety practices in each region, along with ensuring consistency across PG&E.

The Enterprise Health and Safety organization is responsible for providing health and safety compliance program guidance and advisory oversight, which includes in-depth subject matter expertise on California Occupational Safety and Health Administration (CAL OSHA) and federal OSHA compliance requirements and standards. Both CAL OSHA[9]and OSHA[10] have in place robust standards for employee heat exposure, the most prominent climate hazard conditions affecting employees. There is an increased risk of heat injuries and illnesses during periods of higher-than-average temperatures. Ensuring that EHS programs are informed by near- and long-term climate change impacts is critical to ensuring overall operational resilience.

The Enterprise Health and Safety organization implements many programs that allow for the mitigation of climate hazard exposure to employees, both in the field and offices across PG&E. These include a variety of efforts, including, but not limited to, the following:

- PG&E Safety Excellence Management System
- SIF Capacity and Learning Model implementation
- Heat Illness Prevention in Outdoor Environments webinars
- Heat Illness Awareness: Safety and Health Tailboard

[9] State of California, Department of Industrial Relations. 2024. "Heat Illness Prevention." California OSHA. https://www.dir.ca.gov/dosh/HeatIllnessInfo.html.
[10] Occupational Safety and Health Administration. "Employer Responsibilities (OSHA Standard: General Duty Clause)." U.S. Department of Labor. https://www.osha.gov/heat-exposure/standards

- Work stoppages due to high heat advisories

Access to Infrastructure

Many operations at PG&E require access to PG&E's physical assets and infrastructure, which relies on a mixture of public thoroughfares and access roads, right-of-way agreements, and the Company's own network of infrastructure. PG&E-owned infrastructure includes roads, bridges, fire access trails, boardwalk structures, and other asset types. The climate vulnerability assessment of the electric, gas, and power generation infrastructure and equipment does not explicitly include these access roads as unique assets, so they are addressed in this section.

PG&E-owned access infrastructure can face the same risks from climate hazards as those faced by other physical assets, such as physical damage due to high heat, flooding (coastal, fluvial, or combined), landslides, wildfires, and drought-driven subsidence. These climate hazards may pose a direct impact on enterprise access due to physical damage to access roads. Climate hazards also may prevent or limit the access of PG&E personnel to perform preventive maintenance, corrective actions, and other risk mitigation activities. This constraint on access to PG&E's infrastructure and assets can therefore have a compounding effect in addition to the vulnerability of the assets themselves.

Without safe and reliable access, the risks to PG&E employees can be heightened when accessing assets. Given the mix of public and PG&E-owned infrastructure that must be accessed, this risk is an important consideration and may require further analysis to understand how access infrastructure can affect employee safety and how lack of access can compound the risk of climate change to PG&E assets and infrastructure.

Operational Resilience: Next Steps

As described throughout Section 3.1, PG&E has a wide range of adaptive capacity capabilities across planning and operations to ensure that assets and infrastructure are resilient to extreme weather events and plausible changes in these conditions due to climate change. EP&R and Enterprise Health and Safety are additional adaptive capacity capabilities that provide PG&E with critical planning and response capabilities to ensure that our operations are reliable and our coworkers are safe during extreme weather events. These capabilities are critical to meeting the needs of our customers and communities.

Opportunities exist to conduct further climate change vulnerability assessments and increase the capabilities of EP&R to account for the plausible changes in natural hazards caused by climate change in the near and long terms. PG&E's Business Continuity Program, which developed BCPs, ensures that the BIA is performed every 3 years across the Company and BCPs are updated. Training on BCPs occurs annually, and this process is structured in a way to reflect emergent threats from climate hazards as they develop. PG&E is currently exploring how potential changes in natural hazards (frequency, amplification, and long-term planning) can be formally included in the Business Continuity Program.

In addition to the BIA, EP&R recently completed a Threat and Hazard Identification and Risk Assessment (THIRA), which is a three-step assessment process that helps PG&E understand risk and how to address it by identifying threats and hazards that affect our service area and customers. The THIRA is predominantly used in emergency management to assess risk and is considered in addition to a BIA, which is broader across multiple areas of PG&E. The THIRA represents an initial effort to identify the greatest threats and hazards to the PG&E service area, the potential impacts of those threats and hazards on life and property, and the capabilities needed to address those impacts. As PG&E refines its approach to conducting risk and capability assessments, the THIRA will continue to evolve and improve. Subsequent iterations of the THIRA can incorporate the best available information and insights provided by key partners and stakeholders, while evaluating opportunities for mutual mitigation and threat reduction among cooperators and communities.

As discussed above, incorporating climate change considerations into Enterprise Health and Safety and access programs, as well as these threat reduction efforts, will further bolster employee safety and operational resilience.

The Role of EP&R at PG&E

EP&R works with PG&E's core functional areas (electric, gas, and power generation) to provide distinct core capabilities that are essential for responding to a catastrophic emergency, including the following:

- Implementing a clearly defined organizational structure for emergency response, with the associated secondary roles, staffing plans, operational boundaries, and executive involvement.
- Developing scalable restoration plans and systems that assist responders with situational awareness.
- Working closely with our Supply Chain and Corporate Real Estate organizations to strengthen our logistics and facilities for emergency response.
- Implementing critical technologies, such as resilient servers and enhanced basecamp communication systems, which enhance our ability to respond and coordinate with our customers and community partners.
- Partnering with our communications groups to develop and disseminate planned proactive communications to stakeholders.
- Working closely with Human Resources and other groups to train our employees to respond to emergencies and to ensure that appropriate mechanisms are in place to assist employees who are affected by a major disaster.
- Leading enterprisewide business continuity efforts, including BIAs and the maintenance of BCPs. This section outlines the need for appropriate maintenance and improvement of these capabilities.

Section 3.3: Third-Party Facility Contracts and Exposure to Climate Risk

Third-Party Facility Contracts and Exposure to Climate Risk

In compliance with D.20-08-046, Decision on Energy Utility Climate Change Vulnerability Assessments and Climate Adaptation in Disadvantaged Communities, PG&E contacted all owners or operators of facilities with which PG&E contracts for power, capacity, or reliability ("Third-Party Facility") to understand the exposure to climate risk for each facility. PG&E received feedback from 128 of the 322 Third-Party Facilities contacted, which included new contracts since 2022. PG&E contacted the Third-Party Facilities twice in an effort to obtain as much information as possible. Most contracts with PG&E's Third-Party Facilities contain no contractual obligation to provide information regarding long-term climate risk.

PG&E has summarized the responses received in Table 3.3-1.

Table 3.3-1. Summary of climate change feedback from Third-Party Facilities.

Climate Risk	Summary of Responses
Increased Temperature	• Many responses suggested that facilities were designed to operate between large temperature variances, some having upper bounds of 140°F. One Third-Party Facility stated, "The cooling equipment on the project (primarily the battery air conditioners) is designed for climatic conditions and duty cycle significantly worse than those at the project with an additional factor of safety applied on top which provides significant buffer for future variances." • High ambient temperatures affect inverter and battery performance and cooling efficiency. Mitigation measures include summer readiness preventive maintenance inspections to ensure filter cleanliness, fan operability, and cooling system functionality. • Generally, the facilities mentioned power output decreases with increased temperatures. One Third-Party Facility noted that solar module power output decreases, on average, 0.4% per degree Celsius increase. • Another Third-Party Facility noted that higher ambient temperature increases the backpressure of the wind turbine, leading to deterioration of component efficiencies and a reduction of the net power output.
Sea Level Rise	• Most Third-Party Facilities reported little to no risk involved with sea level rise, stating that their location is neither close to sea level nor in proximity to any shoreline. Mitigation measures for flood risk include elevated design during facility construction of a particular project, protecting the site from sea level rise. • Erosion and mild flooding also were communicated as impacts, with mitigation efforts that include regular maintenance of surrounding water ponds and erosion prevention measures as Company procedure.

Table 3.3-1. Summary of climate change feedback from Third-Party Facilities (continued).

Climate Risk	Summary of Responses
Precipitation	• Responses indicated that precipitation fluctuations primarily affect contracted hydro facilities, with the ability to generate hydro dependent on precipitation amounts annually. Risks include limited hydro energy production due to drought, with flooding and snowstorms creating operational challenges and impacts on infrastructure. • Snowpack melting, if accumulated too quickly, can lead to water bypassing the generation facility already operating at full capacity. Gradual snowmelt can extend a hydro project's generation further into the season than normal. • Floods have been found to be a risk to solar panel ground infrastructure, whereas drought conditions increase dust and debris accumulation on panels, resulting in an increased frequency of panel cleaning. One response stated a negligible to as high as a 15% decrease in solar production due to debris collection if drought conditions persist. • Mitigation measures include drainage ditch maintenance to prevent flooding. • Battery systems reported a minimal impact.
Increased Wildfire Exposure	• Responses were consistent regarding wildfire risk. Contracted facilities stated that they perform routine vegetation clearance and ground cover control at the facility powerhouses and transmission lines. • Responses included details on wildfire programs aimed at reducing dense brush and forest areas, creating defensible space borders and fuel breaks, and removing hazardous trees. Responses noted substantial activity with the California Department of Forestry and Fire Protection (CAL FIRE) and conservation organizations in planning multiyear programs. • Third-Party Facilities also stated that their facility locations were outside of elevated fire risk areas or that no wildfire risk assessments had been completed at this time.
Cascading Impacts	• Most Third-Party Facilities reported no significant risk of compounding incidents. • For facilities that did report concerns, the main responses pointed to a combination of wildfire, terrain slope, and precipitation risks. Landslides, erosion, and vegetation damage can cause a buildup of debris in canals and on solar panels. Erosion can cause stability issues for water pipes. • Mitigation efforts include proper erosion control and grading. • One response reported high concern regarding mudslides and mentioned that they currently do not have a plan to mitigate or prevent the risk.
Other	• Third-Party Facilities stated that they are taking actions to limit employee exposure to climate risks through updated safety training, remote work options, and onsite methods to prevent heat exhaustion. Third-Party Facilities also noted that they are performing asset assessments to continually monitor changing exposure levels to climate risks and subsequently update their mitigation plans.

Contingency planning in case of third-party asset failure due to climate change.

In general, PG&E has practices in place to mitigate the risk of potential failure or non-performance by a Third-Party Facility. PG&E's contracts have incentives in place for third parties to perform and limit potential failures, including, but not limited to, minimum performance thresholds and pay-per-performance standards. Non-compliance with such contractual requirements can result in financial damages owed by the seller to PG&E. Non-compliance also can result in termination of the contract. PG&E monitors its portfolio of contracts and manages its portfolio of products in order to ensure compliance. PG&E may replace project capacity, energy volumes, or any other product if any potential asset failures were to occur. PG&E notes that there are a variety of programs under which PG&E executes contracts and various mechanisms related to procurement authority. Thus, requirements, timing, and processes for securing replacement contracts also may differ.

Starting in 2022, PG&E has worked to identify climate change risks and obtain information from Third-Party Facilities when PG&E signs new 15-year (or more) contracts for power, capacity, or reliability.

D.20-08-046 requires that PG&E, for new long-term contracts of 15 years or more for power, capacity, or reliability starting in 2022, obtain acknowledgement that the Third-Party Facility has considered long-term climate risk. PG&E has added new language to its contract forms to address this requirement and all but one of the relevant contracts include such language.[1] Additionally, PG&E has modified its solicitation processes for such contracts in order to obtain information from Third-Party Facilities related to long-term climate risks prior to contract execution. As part of the offer submittal process, PG&E requests an attestation from the Third-Party Facilities that they have studied long-term climate risk with regard to the proposed facility, consistent with D.20-08-046.

D.20-08-046 also requires that PG&E, for these same new long-term contracts, includes a facility safety plan that considers climate risks, if available, when the relevant new contract is submitted to the CPUC for approval. Often, the safety plan is not available at the time of submission. This is because PG&E submits the contract for approval well in advance of final development, permitting, and construction of the facility. As such, in several of the relevant long-term contracts, PG&E has required Third-Party Facilities to have a written safety plan prior to the facility coming online that describes its engineering approach to reduce long-term climate risks, including the risks described in Ordering Paragraph 9 of D.20-08-046.

In Table 3.3-2, PG&E provides a list of the Third-Party Facilities with new signed contracts of 15 years or more since 2022 that have been filed with the CPUC,[2] whether they provided a safety plan, and the reason if they did not.

---

[1] The new language was inadvertently removed from one contract during contract negotiations.
[2] Contracts that PG&E has entered into, but not yet filed with the CPUC for approval, are not included in the table.

Table 3.3-2. Third-Party Facility contracts executed since 2022 (15 years or more) and the safety plan status.

Name of Third-Party Facility	Climate Safety Plan Provided?
RPCA Solar 6, LLC (Canyon Road Project)	Yes
RPCA Solar 8, LLC (Althea Avenue Project)	Yes
RPCA Solar 1, LLC (Phase 2 Project)	Yes
RPCA Solar 1, LLC (Phase 1 Project)	Yes
Geysers Power Company, LLC (West Ford Flat Storage)	Yes
Geysers Power Company, LLC (Bear Canyon Storage)	Yes
Sunlight Energy Storage II	No, will be provided closer to the facility online date according to the requirements in the contract.
Rio Vista RV and Boat Storage	No, not available at contract execution.
Northern Orchard (Battery Storage/Solar)	No, will be provided closer to the facility online date according to the requirements in the contract.
RuAnn Dairy Digester	Yes
Tesoro Commons, LLC	No, not available at contract execution.
Blue Mountain Electric Company	Yes
Sierra Pinta Energy Storage	No, will be provided closer to the facility online date according to the requirements in the contract.
Godinho Dairy Digester	Yes
Gateway Solar RV & Boat Storage, LLC	No, not available at contract execution.

Table 3.3-2 reflects PG&E's practice and understanding that the requirements of D.20-08-046 apply to new long-term contracts with Third-Party Facilities executed after 2022, and do not apply to existing contracts that were amended or restated.

Section 4: Adaptation and Resilience: Potential Measures and Next Steps

Table of Contents

4.1 Introduction

The CAVA provides potential climate adaptation options for asset categories for which climate change risks are identified as moderate or high. The climate adaptation options presented in each asset family are targeted toward individual future climate hazards. The aim of this effort is to ensure consistency with D.20-08-046, which asks for utilities to "describe possible solutions ranging from easy to difficult,"[1] and to highlight incremental steps that PG&E can evaluate in the future. These adaptation options are not fully developed projects, nor requests for funding, and may or may not be developed into future funding requests.

In considering potential options as "easy fixes" or "more difficult, longer-term mitigation,"[2] where appropriate the CAVA considers aligning potential adaptation options with existing PG&E planning and operational functional areas. The adaptation options identified in the CAVA are not ranked from easy to difficult. Two key factors limit the ability to readily determine the ease of any potential adaptation options: 1) The lack of a clear definition of "easy" or "difficult" adaption options, and 2) uncertainty around the feasibility and level of effort for implementation of any adaptation options presented within this report, without each option being individually considered in the Company's risk and investment planning processes.

Given the Company's understanding that the inclusion of potential adaption options was intended to develop a list of options to consider in future planning efforts, PG&E elected to present these adaptation options in two categories, planning or operational.

- Planning adaptation options are focused on internal processes, design and engineering standards used in future construction efforts, asset hardening, and how the Company plans future system operations.
- Operational adaptation options are focused on near-term measures, how PG&E operates the energy system day to day and week to week, and the Company's planning and response to emergency events.

These categories are more consistent with how PG&E manages its business. There are different levels of feasibility and ease of implementation in each category, and the categories should not be taken as substitutes for the "easy" or "hard" designations. Rather, this categorization is intended to align these climate adaptation options with how PG&E will evaluate them for potential implementation in the future.

Section 4.3 provides a summary of the detailed location- and asset-specific adaptation investments and programs presented throughout Section 3.

[1] California Public Utilities Commission. 27 August 2020. Decision 20-08-046. "Decision on Energy Utility Climate Change Vulnerability Assessments and Climate Adaptation in Disadvantaged Communities (Phase 1, Topics 4 and 5)." Page 117. https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M346/K285/346285534.PDF

[2] *Ibid*.

4.2 PG&E's Plans for Potential Next Steps

An increasing number of academic and private sector studies have found that proactive adaptation may have large benefits relative to more reactive strategies. PG&E agrees that organized, proactive climate adaptation will be safer and more affordable in the long run than reacting to climate hazards as they materialize. The following subsection details the next steps PG&E is taking or contemplating to address the vulnerabilities identified in this report in service of a safe and resilient energy system for all.

Evaluation of Adaptation Options

The adaptation options identified in the CAVA will be considered in the context of PG&E's existing risk-based planning processes. Adaptive action must be considered within PG&E's broader risk assessment and planning processes for PG&E to make informed decisions about the most effective use of limited customer dollars. The integration of climate risk and climate adaptation into the Company's overarching business processes is a key priority to ensure that appropriate investments are made with the total cost impact on customers in mind.

Many of PG&E's existing and contemplated adaptation efforts do not occur in isolation, but rather in collaboration with local, state, and federal entities. Given the scale of projected climate hazards, both geographically and financially, resilience is often a shared goal. PG&E hopes that the vulnerabilities and potential adaptation options in this CAVA will serve as a useful basis for additional resilience partnerships with the communities we serve, as well as state and federal entities, as they begin to assess and address their climate vulnerabilities.

CAVA Integration in Other Utility Proceedings

PG&E has included CAVA results into the Company's 2024 Risk Assessment Mitigation Phase (RAMP) filing. PG&E recognizes the importance and benefit of integrating the climate hazard analysis from the CAVA into the Company's other risk management processes. The climate risk rankings and existing adaptive capacity for asset families to different climate hazards are key considerations for areas of further study and the development of additional risk mitigation efforts in the future.

The results from the CAVA will be key inputs for PG&E's climate resilience-focused strategic business plan, helping to indicate which parts of the business should be prioritized for adaptative action or further study. PG&E is circulating the results of the CAVA and the identified climate resilience adaptation measures with the aim of developing climate adaptation investment proposals that can be included in the Company's future funding requests.

Community Partnership

Climate resilience is a shared goal between PG&E and the communities we serve. PG&E expects to conduct outreach to local, regional, tribal, and state governments to review CAVA results and discuss potential opportunities for partnered adaptation. PG&E plans to reconvene the Resilient Together initiative community advisory group members to review the final CAVA report and discuss feedback for community engagement in the next CAVA cycle.

Furthering Utility Climate-Informed Planning and Analysis

PG&E's commitment to creating a climate-resilient energy system is active and ongoing. Alongside this CAVA analysis and associated community engagement findings, PG&E continues to advance its understanding of physical climate hazards and how to adapt to them. These efforts include participation in the technical advisory committees for two highly relevant Electric Program Investment Charge research efforts:

- EPC-21-041, "Climate-Informed Load Forecasting & Electric Grid Modeling to Support a Climate Resilient Transition"; and
- EPC-21-037, "Climate-Informed Generation Capacity Modeling to Support a Climate Resilient Transition to a Clean Electricity System."

PG&E is a member of the Office of Planning and Research's Integrated Climate Resiliency and Adaptation Program and contributes to the development of tools such as the Cal-Adapt Analytics Engine and related climate risk data and analysis resources.

PG&E is also an original member of and an active participant in the Electric Power Research Institute's ongoing Climate Resilience and Adaptation Initiative (READi).[3] The Climate READi program is developing new guidance and best practices for conducting electric utility vulnerability assessments and integrating climate change impacts in electric system planning.

[3] https://www.epri.com/research/sectors/readi

4.3 Summary of Potential Adaptation and Resilience Options

The adaptation options presented in this section are not exhaustive. This section provides a summary of adaptation options, first discussed in Section 3, for asset families with moderate and high climate change risk rankings. PG&E will continue to evaluate and identify new climate adaptation options to consider including in future utility funding requests. As discussed in Section 2, the Resilient Together initiative produced an Equity Framework as a tool to elevate environmental and social equity considerations within PG&E's decision-making processes including consideration of adaptation investments in Disadvantaged and Vulnerable Communities (DVCs).

Electric

Temperature

Electric Transmission

Planning Options

- **Update temperature assumptions in maximum conductor loading calculations:** PG&E can reduce temperature risks to transmission conductors by updating PG&E design standards around maximum conductor loading for new construction to accommodate increases in the frequency and severity of extreme temperature events.
- **Implement real-time temperature conductor monitoring:** Sensors installed on vulnerable spans of conductor line can inform real-time operational needs and track deterioration/condition over time. The condition monitoring over time allows for asset health information to be collected to contribute to long-term strategy building.
- **Plan for climate-informed capacity projects:** Incorporate future temperature trends into forecasting capacity projects.
- **Implement demand response and non-wires solutions:** Effective demand reduction is frequently a viable substitute for capacity additions, and PG&E can consider trends and opportunities associated with both voluntary demand reduction and distributed energy resources in reducing peak demand on electric assets.

Operational Options

- **Implement real-time temperature conductor monitoring:** Sensors installed on vulnerable spans of conductor line can inform real-time operational needs and track deterioration/condition over time. The information obtained can then inform operators of flexibility that is available on the line capacity, as well as plan for future capacity work.

Electric Substation

Planning Options

- **Provide additional cooling:** Exposure to higher temperatures can be reduced by installing air conditioning at new substations that may be more vulnerable to future temperature increases and retrofitting vulnerable, non-air-conditioned substation enclosures with air conditioning systems.
- **Adopt updated design standards**: Interior substations that are updated to meet the recently updated 118°F design standard will likely be protected against more projected

extreme heat events (See Section 3.1.1b). Similar updated standards for substations in the coastal zone may also be considered.

- **Implement demand response and non-wires solutions:** Effective demand reduction is frequently a viable substitute for capacity additions, and PG&E can consider trends and opportunities associated with both voluntary demand reduction and distributed energy resources in reducing peak demand on substations and electric assets.
- **Plan for climate-informed capacity projects:** Incorporate future temperature trends into forecasting capacity projects.

Operational Options

- **Increase the safety margin in transformer loading:** Reducing planned transformer loading levels during heat events—particularly for transformers with high top oil and hot spot temperatures—could provide an increased margin of safety against high equipment temperatures during unprecedented conditions.
- **Provide additional monitoring:** In addition to collecting operational data, adding site-specific monitoring of ambient conditions using electronic sensors and diagnostic equipment allows PG&E to monitor substation equipment conditions in real time.
- **Increase the availability of mobile transformer and Capitalized Emergency Material (CEM) units:** Mobile transformers and CEM units can improve emergency response capabilities during high-heat events.

Electric Distribution

Planning Options

- **Incorporate forward-looking climate projections into load forecasts:** PG&E's internal load forecasting methods have traditionally relied on historical weather data to model potential maximum temperatures and associated load profiles. PG&E can identify opportunities to incorporate climate projection data into the company's internal forecast and work with the California Energy Commission to further the consideration of climate change impacts in future Integrated Energy Policy Reports, which form the basis for PG&E's distribution capacity outlook.
- **Accelerate asset lifecycle replacement:** An asset replacement strategy for replacing equipment designed to older standards with equipment designed to new standards can be evaluated.
- **Move vulnerable lines underground:** Undergrounded lines would be protected from increases in ambient air temperatures and heat waves. Undergrounding done for wildfire purposes could also reduce the exposure and vulnerability of assets from extreme heat and other hazards and could be a secondary justification for this type of wildfire risk reduction investment.
- **Plan for climate-informed capacity projects:** Incorporate future temperature trends into forecasting capacity projects.
- **Implement demand response and non-wires solutions:** Effective demand reduction is frequently a viable substitute for capacity additions, and PG&E can consider trends and opportunities associated with both voluntary demand reduction and distributed energy resources in reducing peak demand on electric assets.

4. Adaptation and Resilience: Potential Measures and Next Steps

Operational Options

- **Update line ratings:** eliminate coastal ratings on a going-forward basis for distribution line equipment to avoid overloading equipment during heatwaves.
- **Reduce wind speed ratings** on certain sizes of overhead distribution conductors.
- **Transformer temperature sensors:** Increase the installation of underground and overhead temperature sensors to monitor for potential overloading and overheating during heatwaves. Operations can take proactive measures such as removing debris from vaults or temporarily reducing load to prevent transformer failure.

Flooding and Precipitation

Electric Transmission

Planning Options

- **Ensure climate-informed siting and design of new construction:** Steel structure and foundations design standard requires a structure's location to be reviewed for any potential hazard (e.g., flooding) and must be designed to mitigate the hazard. Given the criticality and longevity of transmission infrastructure, future transmission siting can avoid structures within floodplains or use forward-looking precipitation data and hydrologic studies in consideration of siting and design.
- **Harden vulnerable structures:** A risk-based retrofit of existing vulnerable assets can be considered to increase stabilization.

Operational Options

- **Develop emergency response plans:** PG&E may assess certain highlighted locations to develop operational emergency response plans if a high precipitation or flooding event were to occur.

Electric Substation

Planning Options

- **Increase measures to prevent flooding:** Example measures include permanent flood barriers, elevating critical equipment, applying enhanced waterproofing, and expanding measures to substations in 500-year floodplain areas. Nature-based adaptation options can be used to reduce flooding risk to vulnerable substations.
- **Improve drainage and pumping capacity:** Measures to add additional drainage channels or increase the capacity of existing drainage structures can reduce flood heights in some cases. Nature-based adaptation options can be particularly effective at improving drainage capabilities.
- **Install or improve pumping capacity:** Sump pumps, which may be activated manually or by float switches that detect water incursion, can be effective in removing smaller amounts of water from substation floors or from underground facilities.
- **Elevate critical equipment:** Elevating transformers, transformer containment walls, control rooms, batteries, battery chargers, and other critical equipment can be an effective strategy

for mitigating impacts when water incursion into the substation cannot be prevented. This adaptation measure would need to be balanced against potential seismic risk at each site.

- **Implement waterproofing:** Waterproofing of underground conduits can help minimize equipment damage when inundation cannot be avoided.
- **Relocate vulnerable facilities:** For highly vulnerable substations, total relocation of a substation to higher ground may eliminate vulnerability.

Operational Options

- **Temporary (deployable) flood barriers:** Deployable flood barriers (e.g., sandbags, inflatable "tiger dams") can reduce flood inundation levels during extreme events. However, these measures may not provide total protection, and are effective only if an event can be anticipated and prepared for in advance.

Electric Distribution

Planning Options

- **Further elevate pad-mounted equipment:** In flood-prone areas, increasing the height of the concrete pad on which pad-mounted equipment is located could reduce the exposure of pad-mounted equipment to flooding.
- **Accelerate or target replacement of live-front transformers with dead-front/submersible designs for pad-mounted transformers:** Accelerated replacement and/or targeted lifecycle replacement of existing live-front/non-submersible transformers in flood-prone areas could reduce transformer vulnerability.

Operational Options

- **Increase targeted sectionalization:** Increased sectionalization of distribution networks that are at heightened future flooding risk, alongside increased capability to remotely control sectionalization, may offer accelerated restoration during future flood-related outage events. PG&E may also consider placing more manual switches in high-ground locations near the boundaries of flood zones that will be accessible to crews during flooding events.

Sea Level Rise

Electric Transmission, Substation, and Distribution

Many potential adaptation and resilience measures to mitigate impacts of sea level rise will be similar to those described for Flooding and Precipitation. Specifically for sea level rise:

Planning Options

- **Ensure climate-informed siting and design of new construction:** Future siting can avoid structures within coastal floodplains or use forward-looking sea level rise data and hydrologic studies in consideration of siting and design.
- **Apply corrosion-resistant coatings:** Concerns related to occasional saltwater exposure and associated corrosion of coastal steel tower components may be mitigated through the application of corrosion-resistant tapes or other coatings to towers at heightened risk of saltwater flooding or spray action.

4. Adaptation and Resilience: Potential Measures and Next Steps

Operational Options

- **Develop emergency response plans:** PG&E may assess certain highlighted locations to develop operational emergency response plans to the potential sea level rise.

Wildfire

Transmission, Substation, and Distribution

Recent wildfire seasons in California (2018–2020) have been the most intense, destructive, and costly in the state's recorded history. Wildfires across California have caused loss of life and property, disruption of daily life, and widespread degraded air quality. Fire seasons are projected to continue to increase in length and intensity as a result of a range of environmental factors, many of which are exacerbated by climate change. Wildfires of any size can be ignited by different causes—both anthropogenic and non-anthropogenic—while the resulting wildfire size, dynamics, and destructiveness have multiple underlying drivers that may or may not be directly impacted by climate change.

PG&E's 2023—2025 Wildfire Mitigation Plan (WMP) addresses the Company's wildfire safety programs and initiatives focused on reducing the potential for catastrophic wildfires related to electrical equipment. These initiatives include but are not limited to operational mitigations, system hardening, enhanced powerline safety settings, reducing public safety power shutoff impacts, and managing trees and vegetation near powerlines.[4]

The focus of the CAVA is on the impacts of wildfire, irrespective of cause of the wildfire, to PG&E infrastructure. Many of the utility-caused wildfire risk reduction strategies described in PG&E's WMP are likely to also reduce equipment damage during a wildfire regardless of the cause. However, the risk of wildfire from any source in PG&E's service area is expected to increase due to climate change and exogenous factors such as lightning, human activity, and historical forest management practices that are beyond PG&E's control. As described below, PG&E has an opportunity to help catalyze targeted community and forest resilience to reduce wildfire risks from all potential ignition sources.

Long-term adaptation planning and operational options to increase this resilience in face of projected increase in wildfire activity regardless of ignition source include supporting and enhancing the efforts described above, including but not limited to replacement of wood poles with more resilient support structures and continued evaluation of PG&E's defensible space program for substations.

PG&E's undergrounding efforts to bury 10,000 miles of powerlines in the highest wildfire risk areas will help reduce wildfire risk and improve reliability during severe weather. Undergrounding makes our system safer, stronger, and more affordable in the long run. Undergrounding helps prevent wildfires caused by powerlines or equipment, reduces power outages, improves reliability, decreases the need for future tree work (vegetation management), and protects the environment. Undergrounding vulnerable electric distribution

---

[4] PG&E. "Community Wildfire Safety Program." https://www.pge.com/en/outages-and-safety/safety/community-wildfire-safety-program.html.

lines is a climate adaptation option that PG&E is deploying today to build a more climate-resilient energy system as the risk of wildfires, regardless of source, increase due to the impacts from climate change.

Gas

Flooding and Precipitation

Gas Transmission

Planning Options

- **System hardening:** In areas of highest landslide risk, PG&E may consider further increasing transmission pipeline resilience to landslide damage through physical measures that expand on the current work in PG&E's geohazards program, such as valve automation, pipeline strain monitoring, or landslide monitoring. Additional measures to address flood-related risks include installing anchors on large-diameter pipelines in the Sacramento-San Joaquin Delta area subject to buoyancy-related risks, increasing erosion control, installing riverbank erosion control systems, installing concrete mats, and relocating pipes below anticipated scour or erosion depths.

Gas Distribution

Planning Options

- **Pipeline design measures to decrease risk of damage from ground displacement**: In areas of highest landslide risk, PG&E may consider increasing distribution pipeline resilience to landslide damage through physical measures. Effective earthquake resilience measures may prove informative in this case, including installing flexible joints and backfilling trenches with lower-density material.[11]

Operational Options

- **Monitoring for landslide risk:** Measures to detect ground movement indicating potential landslide conditions may be useful in providing early warning to allow for geohazard mitigation or infrastructure strengthening.

Gas Compression and Processing, and Storage

Planning Options

- **Incorporate low-probability flood events** into overtopping and failure risk assessments of delta levee infrastructure that protects the McDonald Island Gas Storage Facility.

Gas Measurement and Control

Planning Options

- **Prioritize physical protection measures at stations in flood-prone areas:** PG&E may re-evaluate the location of specific equipment at stations in flood-prone areas when relocating the entire station is not either feasible or prudent.
- **Relocate stations in flood-prone areas:** PG&E may consider relocating specific stations to areas that are less likely to be exposed to future flooding.

- **Review vent heights for low-pressure stations located in floodplains:** PG&E may consider assessing whether vent heights of low-pressure stations located in floodplains are sufficiently conservative to reflect potential for more severe future floods.

Operational Options

- **Continue to invest in system monitoring:** Continuing to improve SCADA visibility (through the installation of additional SCADA devices) would increase the number of points through which stations and the overall system can be monitored.

Sea Level Rise

Gas Compression and Processing, Storage

Planning Options

- **Incorporate sea level rise projections** into overtopping and failure risk assessments of delta levee infrastructure that protects the McDonald Island Gas Storage Facility.

Wildfire

Gas Distribution

Operational Options

- **Reduce the size of gas shutdown zones:** PG&E is already enhancing its ability to use smaller gas emergency shutdown zones to reduce customer impacts from shutdowns. PG&E may consider further focusing these efforts in high wildfire risk areas.

Gas Compression and Processing, and Storage

Planning Options

- **Evaluate wildfire safety measures**: Actions to further mitigate wildfire-related risk to compressor stations and underground gas storage facilities include evaluating and potentially strengthening wildfire safety measures in anticipation of potentially increasing wildfire hazard conditions.

Power Generation

Flooding and Precipitation

Hydropower

Planning Options

- **Develop preliminary risk rating and identify vulnerable assets:** PG&E can continue to develop the preliminary risk rating for power generation assets at a more granular level. The risk rating can be estimated using available information (e.g., known areas that were impacted during larger historical storms).
- **System hardening:** Once PG&E completes the preliminary risk rating and identification of vulnerable assets, PG&E can identify which assets are most vulnerable to impacts of climate change and if these vulnerable assets could be retrofitted to handle the potential increase in flows.

4. Adaptation and Resilience: Potential Measures and Next Steps

Operational Options

- **Enhanced hydrologic forecasting and monitoring:** Weather forecasting, instrumentation (e.g., flow sensors and reservoir elevation sensors), and early warning systems can be expanded to more effectively notify impacted populations downstream of the dams during high-flow conditions.
- **Enhanced monitoring of asset conditions:** Existing asset inspection programs could be expanded to identify assets with existing deficiencies or vulnerabilities that may be exacerbated by potential climate-driven changes.

Wildfire

Hydropower

Planning Options

- **Debris catchment basins and water conveyance carry-overs:** Debris flow hazard may be reduced through physical measures to intercept and divert debris before it enters critical flow control structures (such as reservoir spillways). Alternatively, physical measures may deflect mobile debris so that it safely passes over or through the spillway or water conveyance system.
- **Debris booms:** PG&E can assess whether existing debris booms are sufficiently robust and in proper condition to successfully capture and retain high volumes of debris associated with potential wildfire and flood conditions.

Operational Options

- **Debris clearing:** Following a wildfire at or near PG&E's hydro assets, PG&E conducts inspections and removes debris that poses the highest risk to those assets. For example, after the 2021 Dixie Fire event, Power Generation deployed mitigation measures such as hydro mulch, k-rail installation, hazard tree removal, and around-the-clock culvert inspection and cleaning to prevent asset impacts due to debris flows in burn scar areas above PG&E's assets. Inspection efforts may need to increase in number or level of effort due to future wildfire activity.
- **Asset restoration:** PG&E repairs or replaces damaged assets following wildfires. This includes replacing damaged components, restoring road access, and clearing landslide debris. Repair efforts may need to increase in number due to future wildfire activity.

Operations and Services

PG&E's Emergency Preparedness and Response (EP&R) department is responsible for identifying critical operations and services across the Company, identifying natural and other hazards that may impact the functioning of operations and services, and setting up plans to ensure business continuity in case of disruption. These capabilities are critical to meeting the needs of our customers and communities.

Climate change may affect the availability or capabilities of essential people due to impacts of climate change. For example, changes in climate hazards and conditions can impact safety or access during or after extreme weather events such as storms, flooding, and wildfire evacuations, or cause power outages during storms or high-heat events. Direct impacts from climate hazard conditions may result in unsafe conditions or otherwise inaccessible facilities. Furthermore, many essential people are those that are in the field to support these critical operations; these field teams are likely to be most exposed to the impacts of extreme weather and other climate change hazards. Further analysis specific to these impacts is recommended for those PG&E operations that have field teams.

PG&E is currently exploring how potential changes in natural hazards due to climate change can be formally included in risk identification, hazard assessment, and business continuity plans to ensure operational resilience.

The Meteorology and Fire Science department plays a critical role in preparing the organization for upcoming extreme storms (e.g., heat, snow, rain, thunderstorm) and fire weather events. As storm and fire weather events trend more extreme in the future, the advanced warning and situational awareness capabilities of the meteorology and fire science team will continue to be a cornerstone adaptive capacity capability.

Green and Sustainable Remedies for Vulnerable Infrastructure

Green and sustainable remedies have the dual benefit of enhancing the resilience of the energy system while also promoting the health and safety of communities and the environment, and ideally are cost-effective options to increase resilience to climate change while providing these co-benefits. PG&E has already participated in some nature-based and sustainable remedies to reduce vulnerability to climate change. Opportunities for nature-based, green, or sustainable remedies are called out in appropriate sections of the CAVA findings for potential resilience adaptation options. Many green and sustainable remedies for vulnerable infrastructure also have community co-benefits, which are highlighted in the Resilient Together initiative findings in Appendix C.

Flood Mitigation

The CAVA identified flooding as a climate hazard that presents a risk to many components of PG&E's energy infrastructure. Flood protection methods and built infrastructure are often constructed using traditional or "gray" infrastructure, such as perimeter flood walls, flood gates, and flood-proofed building facades. Nature-based solutions offer alternatives to gray infrastructure and can be deployed to reduce flood risk while providing many co-benefits to ecosystem health and diversity and community wellbeing. These solutions do not have to be purely nature-based but can instead combine elements of traditionally gray infrastructure and can fall within any area of the gray-green spectrum of options.

PG&E provided non-federal match funds to the city of Menlo Park, California, for an application to a FEMA funding opportunity for flood protection along almost four miles of vulnerable San Francisco Bay Area shoreline.[5] When constructed, this levee will protect PG&E's Ravenswood substation, a transmission substation that directly serves almost 300,000 customers, as well as

[5] FEMA. 2023. "California: Menlo Park Safer Bay Project." https://www.fema.gov/case-study/california-menlo-park-safer-bay-project.

provide critical flood protection for communities and other infrastructure such as roads. The construction of the levee will include a mix of traditional and horizontal levees (also known as ecotone levees). The horizontal levee will expand a much-needed tidal marsh wetland transition zone along the shoreline, reducing the risk of flooding while also providing opportunities for more full-scale tidal marsh wetland restoration programs run by the South Bay Salt Pond Restoration Project. Expansion of the transition zone allows for progress toward tidal marsh habit restoration.

Flood protection to site-specific assets such as substations can also be enhanced through larger scale watershed management including wetland restoration, riparian vegetation restoration, natural channel design, floodplain restoration, coastal dune restoration, and detention/retention/infiltration basins.[6] These solutions help to control stream grades, absorb and detain floodwaters, enhance water quality, and reduce erosion from storms and waves. These strategies can be implemented at a smaller scale, too, as evidenced by bioswales (rain gardens that use vegetation to slow stormwater). Bioswales are a great example of site-specific flood mitigation strategies as they capture stormwater runoff while also removing debris and pollutants.

PG&E will consider integrating these flood mitigation strategies at appropriate locations to help provide co-benefits to neighboring areas.

Wildfire Mitigation

Approximately 53 percent of PG&E’s service area lies in high fire threat districts as defined by the CPUC map. Within these areas there is a wide range of microclimates experiencing differing levels of wildfire risk potential based on terrain, weather patterns, and fuel treatments. As wildfire risk is elevated during red flag warning (RFW) and hot, dry summer days, PG&E has developed a Fire Potential Index (FPI) that provides the company a spatial and temporal assessment of the risk on any given day looking ahead seven days.

PG&E’s Wildfire Mitigation Plan has aggressively focused on the reduction of ignitions from PG&E assets, and the response and protection of communities in the PG&E service area from catastrophic wildfires via our emergency preparedness annexes.

Differing parts of PG&E's service area have differing locational wildfire risk drivers, which include fuel loading, ingress/egress, and varying degrees of suppression capacity. Therefore, PG&E has an opportunity to help catalyze targeted community and forest resilience aligned with perceived locational risk drivers as an additional tactic in its wildfire risk mitigation portfolio, reducing wildfire risks from all potential ignition sources.

This tactic can take many forms. Lake County is an economically disadvantaged county which has been wracked by wildfires over many years and which has relatively lower local capacity for suppression and proactive mitigation. In 2023, PG&E piloted a new approach, partnering with a local non-profit and fire district as part of a new Hometown Wildfire Safety Collaborative for

[6] Louisiana Watershed Initiative. “LWI and Nature-Based Solutions.” https://watershed.la.gov/nature-based-solutions.

Lake County, supporting higher pay and more staffing for a crew that can help fight wildfires when necessary, and when not fighting fires can reduce fuels or respond to other emergencies. Wildfire pathways modeling supported by PG&E identifies likely pathways wildfire could take to threaten the community during high-risk conditions and is helping to target highest value fuels treatment locations. Initial crew funding can be further stretched by state reimbursements for firefighting, future grant funding, and/or voluntary carbon revenues.

In other locations, fuel loading increases catastrophic wildfire risk. Through another pilot, PG&E is supporting the American Forest Foundation, a national non-profit focused on improving the health of family forests, and Blue Forest, an environmental conservation non-profit that develops and finances forest restoration on U.S. Forest Service land. PG&E funding is complementing CAL FIRE grants received by both organizations. PG&E is collaborating with these organizations to learn how to help drive localized landscape-scale treatment in fuels-driven risk locations, specifically in Tuolumne County and the Upper Mokelumne Watershed, respectively. Such landscape-scale work has potential to drive wildfire risk down across high-risk areas near PG&E customers and assets while creating many societal and environmental co-benefits.

Other forms of resilience partnerships that PG&E could pilot in the future include facilitating fuels management within utility rights of way along likely wildfire pathways threatening communities, creating expanded fuel breaks beyond designated rights of way (following models pioneered by SMUD and Liberty Utility) to improve community and forest wildfire defenses, facilitating or co-funding roadside clearing under rights of way along key ingress/egress routes, facilitating collaborative wood management partnerships, conducting or funding resilience project down-selection and valuation analytics, funding high-value resilience project planning, providing matching funding for high-value grant applications, recruiting resilience project co-funding from aligned third parties, and providing working capital or matching funding for landscape-scale projects.

Based on preliminary analysis, targeted resilience partnerships are capable of increasing public wildfire safety and provide community-wide resilience. Fuel treatments can also create environmental benefits including those related to carbon emissions criteria and smoke pollution, water availability, and biodiversity. The financial valuation of such resilience partnerships can make targeted partnership projects investable by PG&E and benefit stakeholders.

PG&E wildfire resilience partnerships directly support state policy goals including several stated in California’s Wildfire and Forest Resilience Action Plan, Nature-Based Solutions Targets, and 2022 Scoping Plan.

4. Adaptation and Resilience: Potential Measures and Next Steps

Corporate Sustainability

PG&E is committed to a net-zero energy system in 2040.[7] As part of PG&E's climate goals, PG&E is working to reduce the carbon footprint of our operations. Many of these efforts will be complementary to overall goals of a climate-resilient energy infrastructure. The strategic focus of this effort includes reduction of methane emissions from the gas system, electrification of PG&E's vehicle fleet, reduction of emissions from buildings and facilities, and reduction of sulfur hexafluoride (SF_6) emissions from the electric system.[8]

PG&E's commitment to a net-zero energy system by 2040 extends to the procurement of climate adaptation products and services. PG&E has implemented sustainable solutions on business-as-usual projects such as using recycled steel for protective bollards and reusing pipes instead of sourcing new materials.[9] Since 2007, PG&E has worked with suppliers to reduce the environmental impact of purchased products and services.[10]

PG&E is also committed to a climate- and nature-positive energy system by 2050, meaning that PG&E will work to reduce and remove more greenhouse gases than we emit and help enable our customers and hometowns to shrink their carbon footprint, as well.

Many of PG&E's commitments to a net-zero energy system in 2040 and becoming nature-positive by 2050 are likely to have complementary benefits to reducing current and future climate change vulnerabilities of assets and infrastructure.

---

[7] PG&E. June 2022. "PG&E Climate Strategy Report." https://www.pge.com/content/dam/pge/docs/about/pge-systems/PGE-Climate-Strategy-Report.pdf

[8] PG&E. 2023. "Reducing our Carbon Footprint." https://www.pgecorp.com/assets/pgecorp/localized/en/sustainability/corporate-responsibility-sustainability/reports/2023/planet/reducing-our-carbon-footprint/.

[9] PG&E. 2021. "Corporate Sustainability Report." pgecorp.com/content/dam/pgecorp/language-masters/en/sustainability/corporate-responsibility-sustainability/reports/2021/assets/PGE_CRSR_2021.pdf.

[10] PG&E. "Supply Chain Responsibility." https://www.pgecorp.com/assets/pgecorp/localized/en/sustainability/corporate-responsibility-sustainability/reports/2023/prosperity/supply-chain-responsibility/.

4. Adaptation and Resilience: Potential Measures and Next Steps

4.4 Reflections on Assessing a Utility's Climate Change Vulnerability

Understanding and measuring the potential impacts of climate change on utility assets and operations is highly complex. The process of climate change vulnerability analysis, identification of adaptive capacities, and understanding of climate change risks allowed PG&E to identify data and research gaps to be addressed going forward. Discussed throughout the CAVA, these concepts are summarized below as potential areas of further study that could be accommodated by the next CAVA or other initiatives.

As climate projections continue to improve and climate hazard analysis matures, additional hazard variables may become available that could be incorporated into scenario analyses. For example, when climate change analysis on wind variables is appropriately mature, how extreme winds may change as a result of climate change can be considered as a unique hazard as well as in context of extreme storms and wildfire potential.

Future CAVAs could incorporate non-environmental factors when appropriate. For example, a full understanding of flood risk potential in the Sacramento Delta requires an assessment of existing water management infrastructure in the area that is not owned or managed by PG&E.

Power flow analyses could be combined with climate exposure and sensitivity analyses to better understand how climate change might have system impacts and connect these impacts more directly to what affects customers' service outages.

Further analysis on the risks of compound or cascading hazards or impacts could be particularly useful for better understanding the potential impacts of climate change on the energy system, resource adequacy, and customer impacts.

Analysis of potential climate change impacts to PG&E's generation portfolio may help assure adequate resource availability in the face of potential changes in generation performance.

Finally, coordinating climate vulnerability analyses among energy providers and state and regional energy agencies would be appropriate and beneficial given the highly interconnected nature of the energy system. Coordination may assist in the development of shared parameters for the use of climate projections, which is desirable to minimize complexity and enhance the ability to take shared adaptive action.

These are all considerations that might be part of the goals of the 2028 CAVA. These areas for further work in future iterations of the CAVA are not exhaustive, but progress on each of these items would benefit California's efforts to understand and address the more frequent and extreme climate impacts that we know, with a high degree of certainty, are coming.

Appendix A: Climate Change Data Methods

Table of Contents

Introduction

Appendix A describes the key methods used to identify and analyze climate data for use in the Climate Adaptation Vulnerability Assessment (CAVA). The CAVA uses the best available climate science to inform PG&E's understanding of the vulnerabilities to its infrastructure, assets, and operations and services with regard to plausible future changes in climate-related hazards.

Available climate data include spatial and temporal projections of climate variables, spatial and temporal flood and inundation projections, publicly available geohazard maps, and published literature from peer-reviewed publications and governmental agencies. In keeping with California Public Utilities Commission (CPUC) Order Instituting Rulemaking (OIR) guidance from D.19-10-054,[1] PG&E has relied, where possible, on data sources that underlie or are generated by California's Fourth Climate Assessment as its primary source.

Temperature and Precipitation Variables

The assessment uses spatially gridded Localized Constructed Analogs (LOCA) downscaled Coupled Model Intercomparison Project Phase 5 (CMIP5) projections of temperature and precipitation variables at a resolution of 1/16th degree (approximately 6 kilometers by 6 kilometers). These are the same temperature and precipitation projections that underlie California's Fourth Climate Assessment.[2]

LOCA is a statistical technique that uses historical observations to add improved fine-scale details to 32 global climate models from California's Fourth Climate Assessment.[3] Observed baseline data were derived from gridded observed meteorological data. The analysis uses a baseline period of 1976–2005 and projection time periods of 30-year averages centered on the year of interest: 2030 (2016–2045), 2050 (2036–2065), and 2080 (2066–2095). Because future climate projections incorporate natural climate variability from year to year, as well as long-term trends, averaging over a longer period provides a more accurate projection of overall future conditions.[4]

This study considered a wide range of climate variables to identify the specific metrics and thresholds of future conditions that are most relevant to informing PG&E's vulnerabilities. The

---

[1] California Public Utilities Commission. "Climate Adaptation OIR Decision 19-10-054." http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M319/K075/319075453.PDF

[2] Pierce, D.W., Cayan, D.R., and Dehann, L. 2016. "Creating Climate Projections to Support the 4th California Climate Assessment." La Jolla, CA: Division of Climate, Atmospheric Sciences, and Physical Oceanography, Scripps Institution of Oceanography. http://climate.calcommons.org/bib/creating-climate-projections-support-4th-california-climate-assessment

[3] California Energy Commission. 2021. "LOCA Downscaled Climate Projections." Cal-Adapt. https://v2.cal-adapt.org/

[4] California Energy Commission. 2021. "Guidance on Using Climate Projections." Cal-Adapt. https://v2.cal-adapt.org/

assessment focused primarily on the following variables and included analyses of eight temperature variables and three precipitation variables (see Table A-1). The study also references some expository variables, such as days above 95°F and maximum August temperatures. Analytical metrics for specific vulnerability analyses are described in each section of the CAVA.

Table A-1. Temperature and precipitation variables analyzed from LOCA data for the CAVA.

Variable	Definition
Temperature	
Annual Average Temperature	Annual average temperature in the average year,[5] calculated by the average of the daily maximum and minimum temperatures across all days.
98th Percentile Temperature	Temperature exceeded by top 2 percent of the maximum temperatures in the average year; approximately 7 days in the average year exceed this temperature threshold.
1-in-2-Year Weighted Daily Maximum Temperatures	PG&E uses weighted average temperatures to account for the heat that accumulates in equipment over the course of several hot days. This metric weights the hottest day at 70 percent, with the preceding 2 days at 20 percent and 10 percent, respectively. The 1-in-2-year daily maximum is the annual high temperature (i.e., hottest day of the year) that can be expected to occur every other year, on average (50 percent annual chance). 50 percent of the years will be hotter and 50 percent of the years will be cooler.
1-in-10-Year Weighted Daily Maximum Temperatures	See above for a description of "weighted temperature." The 1-in-10-year daily maximum is the annual high temperature (i.e., hottest day of the year) that can be expected to occur once every 10 years, on average (10 percent annual chance).
Precipitation	
1-day Annual Maximum	Maximum 1-day precipitation event per year in the average year (in millimeters).
5-day Annual Maximum	Maximum 5-day precipitation event per year in the average year (in millimeters).

[5] The term *average year*, when used to define these climate variables, indicates the average year over the course of the 30-year period used to define each future period (e.g., 2036–2065 for 2050). Within this period, some years will have higher values and some will have lower values as a result of natural variability as reflected by models.

Landslides

In addition to the precipitation projections described above, the assessment uses U.S. Geological Survey (USGS) data on landslide incidence and susceptibility.[6] The data reflect a classification of geologic units according to landslide incidence, based on past occurrence of landslides, and landslide susceptibility, based on probable degree of response of the areal rocks and soils to natural or artificial cutting or loading of slopes or to anomalously high precipitation.[7] The assessment focuses specifically on high landslide risk areas, which are defined as areas classified as having high historical landslide incidence and/or high landslide susceptibility, as defined by USGS. This dataset reflects a screening-level assessment of potential landslide risk; site-based assessment and/or more detailed local modeling would be needed to fully constrain site-specific risk.

Inland Flood Potential

The climate change vulnerability assessment uses floodplain data from the Federal Emergency Management Agency (FEMA). FEMA provides flood hazard and risk data to help guide mitigation actions in the form of National Flood Insurance Program floodplain mapping. The assessment uses data on the 1 percent annual chance (i.e., FEMA 100-year) and 0.2 percent annual chance (i.e., FEMA 500-year) flood events. FEMA floodplains are historical in nature, meaning that floodplains may not fully capture future hazard areas. However, because granular projections of climate-driven precipitation and riverine flooding are not readily available, FEMA floodplains are useful in conjunction with precipitation projections as a means of gauging inland flood potential, which, in many locations, is projected to become more widespread and intense based on precipitation change.

Sea Level Rise

The CAVA assesses flooding exacerbated by sea level rise (SLR) along the state's coastline, the San Francisco Bay Area Region, and in the Sacramento-San Joaquin Delta Region (Delta).

Coastal Flooding and Sea Level Rise

The CAVA uses both the Coastal Storm Modeling System, developed by USGS, and SLR modeling from the National Oceanic and Atmospheric Administration (NOAA) to assess coastal flooding exacerbated by SLR.

---

[6] U.S. Geological Survey. 1997. "Digital compilation of landslide overview map of the coterminous United States." https://pubs.er.usgs.gov/publication/ofr97289

[7] U.S. Geological Survey. 1982. "Landslide Overview Map of the Coterminous United States." Geological Survey Professional Paper 1183. https://pubs.usgs.gov/pp/p1183/pp1183.html

Coastal Storm Modeling System

The CAVA uses Coastal Storm Modeling System (CoSMoS) data over other modeled coastal flood data because CoSMoS dynamic flood modeling captures the largest and most complex range of physical flood drivers. In addition to modeling future SLR, CoSMoS models the effects of future climate projections on total water level, including wave run-up, storm surge, seasonal effects, tides, and SLR.

The CoSMoS dataset uses Global Climate Model projections of future storm weather and Delft3D[8] hydrodynamic models to resolve future coastal flooding. CoSMoS incorporates dynamic coastal processes, such as erosion, and uses pressure and wind projections to model current and future coastal storms. The Kopp et al. (2014) local SLR projections, which were used in the State of California Sea Level Rise Guidance[9] and served as benchmark SLR values for the PG&E Climate Change Vulnerability Assessment, account for a range of dynamic processes, including vertical coastal adjustments. Background vertical coastal adjustments are based on historical measurements and are the result of a range of natural processes, including subsidence, tectonic uplift, and other non-climatic effects. The modeling assumes that existing flood protection measures (e.g., levees) remain in effect during future storm events.[10]

---

[8] Delft3D is an advanced state-of-the-art 3D modeling suite used by countries around the world to model a range of hydrodynamic processes and relationships for fluvial, estuarine, and coastal environments.

[9] The State of California Sea Level Rise Guidance is available at https://opc.ca.gov/webmaster/ftp/pdf/agenda_items/20180314/Item3_Exhibit-A_OPC_SLR_Guidance-rd3.pdf

[10] Barnard, P.L., Erikson, L.H., Foxgrover, A.C. et al. 2019. “Dynamic flood modeling essential to assess the coastal impacts of climate change.” *Scientific Reports, 9*, Article No. 4309. https://www.nature.com/articles/s41598-019-40742-z#citeas

The CoSMoS datasets do not extend into the Delta (Figure A-1).

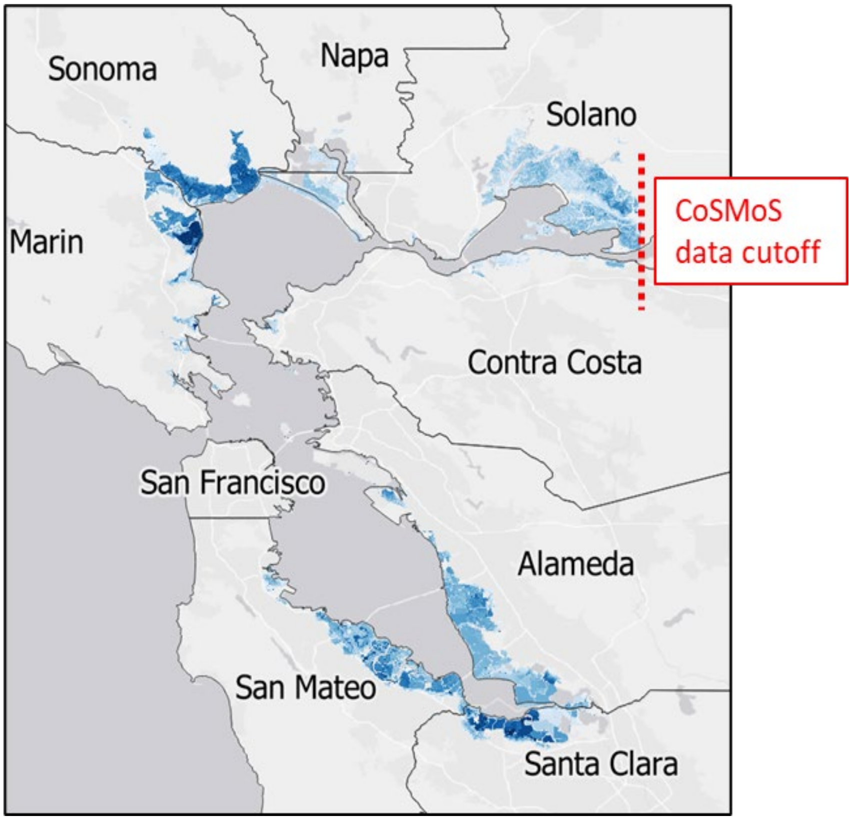


Figure A-1. Coverage extent of the CoSMoS coastal flood data in the 9 county San Francisco Bay Area.

NOAA

As the CoSMoS datasets do not extend all the way up the northern coast of California, PG&E supplemented CoSMoS data with SLR layers developed by NOAA Digital Coast[11] for the Northern California Region (i.e., PG&E's North Coast Region) (Figure A-2) using layers analogous to the CoSMoS sea levels and FEMA 100-year flood levels at a North Coast Region tide gauge as benchmarks.

[11] The NOAA Digital Coast SLR data are available at [Sea Level Rise Viewer (noaa.gov)](https://coast.noaa.gov/slr/).

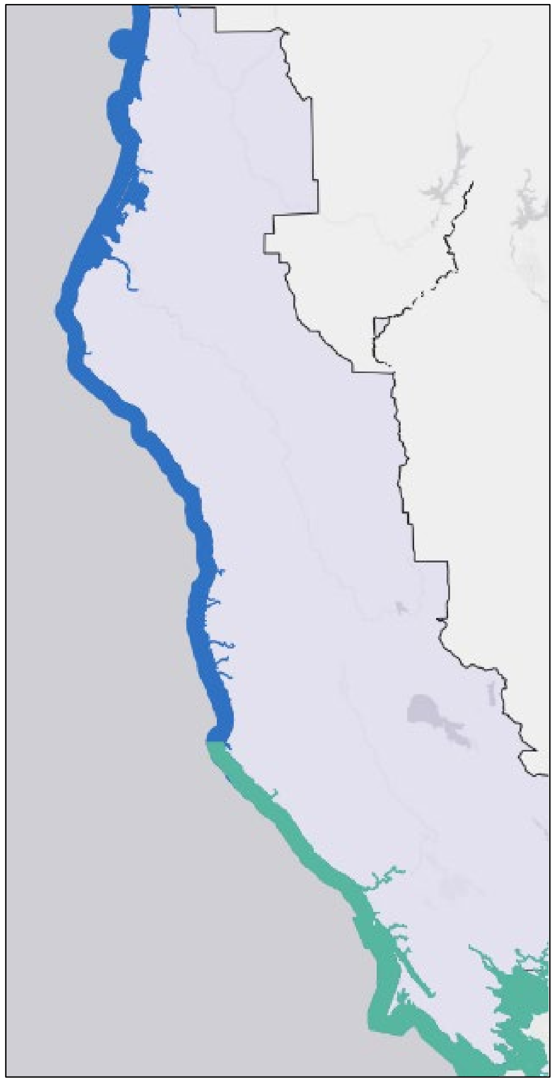


Figure A-2. CoSMoS (green) and NOAA (blue) coverage along the North Coast Region.

Delta Flooding and Sea Level Rise

To characterize Delta flooding risks, PG&E drew on Delta flood projections generated by the Delta Stewardship Council to underpin the recent vulnerability assessment, *Delta Adapts: Creating a Climate Resilient Future*.[12]

The projections represent the best and most current science for present-day and future Delta flood exposure under a range of SLR scenarios, coupled with the 100-year storm.

The Delta Stewardship Council created both deterministic and probabilistic projections. The deterministic projections outline the potential locations of flooding caused by the 100-year

[12] Delta Stewardship Council. [“Delta Adapts: Creating a Climate Resilient Future” (ca.gov)](https://www.ca.gov).

storm at five SLR scenarios (0 inches, 6 inches, 12 inches, 24 inches, and 42 inches). The probabilistic projections indicate areas of potential flooding ranked by flood likelihood (0.5 percent to 1 percent chance, 1 percent to 2 percent chance, 2 percent to 10 percent chance, and 10 percent chance). The CAVA leverages the deterministic floodplain projections as they represent the closest alignment to the CoSMoS flood projections used in the other sections.

Notably, the deterministic Delta floodplains were generated with the following key assumptions, which should be considered when interpreting flood exposure demonstrated by the projections:

- Static levees: The floodplains identify the locations of levee overtopping to project future flood exposure; they do not consider the potential for levee failure or degradation, nor do they consider future subsidence among Delta islands and their corresponding levees.
- Consistent operational goals and strategies for infrastructure management: Operations that influence nearby reservoirs or rivers may alter inflows; these are assumed to remain consistent with current management practices.

Figure A-3 shows flood extents across the three selected future scenarios (from left to right: 2030, 2050, and 2080).[13]

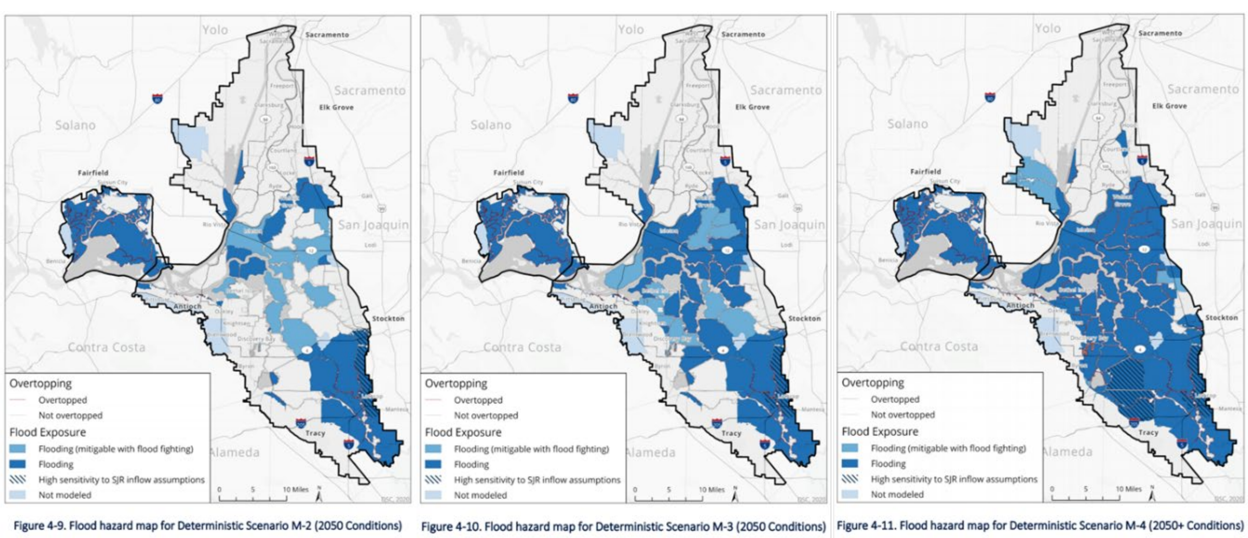


Figure A-3. Flood exposure throughout the Delta at the selected SLR scenarios for 2030, 2050, and 2080. (Source: Delta Adapts)

---

[13] Delta Stewardship Council. "Delta Adapts: Creating a Climate Resilient Future." [Delta Adapts: Creating a Climate Resilient Future (ca.gov)]

Levee failures in the Delta is a concern due to aging infrastructure, low elevation, and subsidence. Levee failures can be caused by structural failure (caused by inadequate foundations, subsidence, erosion, burrowing animals, and earthquakes) and levee overtopping (caused by floods, tidal fluctuations, and wind-driven waves) (Source: State of California Water Resources Control Board[14]). As described in Section 3.1.2c, Gas Compression and Processing, and Storage, PG&E is currently studying factors that would influence failure of the levee that protects the McDonald Island Natural Gas Storage Facility. Incorporating low-probability flood events and SLR in these assessments is a potential adaptation and resilience measure for climate change.

Sea Level Rise Data and Time Horizons

The Kopp et al. (2014) local SLR projections, which were used in the State of California Sea Level Rise Guidance,[15] served as benchmark SLR values for the CAVA. The assessment SLR projection heights are benchmarked based on the San Francisco tide gauge.

CoSMoS: The CoSMoS dataset offers the following SLR scenarios: 0 meter, 0.25 meter, 0.5 meter, 0.75 meter, 1 meter, 1.5 meters, 2 meters, 2.5 meters, 3 meters, and 5 meters. For each SLR scenario, CoSMoS offers flooding information corresponding to the 1-year storm, the 20-year storm, the 100-year storm, and average conditions, which assume astronomic spring tide and average atmospheric conditions.

After selecting study periods of 2030, 2050, and 2080, PG&E selected water level benchmarks from those made available by CoSMoS to best match a “medium-high” risk aversion level per the State of California Sea Level Rise Guidance[16] (i.e., the 99.5th percentile projection) for those periods, in addition to present-day levels (see Table A-2).

NOAA: NOAA Digital Coast offers exposure shapefiles for 1 foot, 2 feet, and so forth, up to 10 feet (e.g., 1-foot layer = Region exposed to inundation under sea levels 1 foot higher than current sea levels, under normal conditions [i.e., not a severe storm event]).

PG&E identified the data available in the North Coast Region as the Del Norte, Humboldt, Mendocino, and Trinity data download.[17] SLR layers were selected to align to the closest degree possible with the CoSMoS inundation layers, taking a conservative approach. To incorporate the heightened water levels resulting from the 100-year storm event, PG&E added 6 feet to each of these levels, which reflects the 1 percent annual chance exceedance level at the Point Reyes

---

[14] 08-07-Water-Conf-POSTER.ai (ca.gov).
[15] The State of California Sea Level Rise Guidance is available at https://opc.ca.gov/webmaster/ftp/pdf/agenda_items/20180314/Item3_Exhibit-A_OPC_SLR_Guidance-rd3.pdf
[16] *Ibid*.
[17] NOAA Digital Coast SLR data for Del Norte, Humboldt, Mendocino, and Trinity are available at Sea Level Rise Data Download (noaa.gov).

tide gauge in Marin County[18] (the only tide gauge in the North Coast Region). The final NOAA layers selected and used in the CAVA are provided in Table A-2.

Delta: The Delta Stewardship Council's Delta Adapts dataset offers the following deterministic SLR scenarios: 0 inch, 6 inches, 12 inches, 24 inches, and 42 inches. Each scenario is modeled in conjunction with the 100-year storm to identify future flood exposure among islands throughout the Delta.

After selecting study periods of 2030, 2050, and 2080, PG&E selected water level benchmarks from those made available by the Delta Adapts data in order to best match a "medium-high" risk aversion level according to the State of California Sea Level Rise Guidance[19] (i.e., the 99.5th percentile projection) for those periods, in addition to present-day levels (Table A-2).

Table A-2. CoSMoS, NOAA Digital Coast, and Delta Adapts SLR scenarios used in the CAVA and corresponding future time horizons.

Time Horizon	Corresponding Sea Level Rise Scenario (Base Sea Level Rise)		
	CoSMoS	NOAA	Delta Adapts
2010–2015	0 meter	6 feet	0 inch
2030	0.25 meter	7 feet	12 inches
2050	0.5 meter	8 feet	24 inches
2080	1.25 meter	10 feet	42 inches

Figure A-4 shows how the selected CoSMoS and Delta Adapts SLR scenarios used in the CAVA align with Kopp et al. (2014) SLR projections. Orange lines represent Delta Adapts SLR increments and dashed brown lines represent CoSMoS SLR increments. The best match SLR scenarios selected for 2030 and 2050 for the Delta Adapts data are slightly more conservative than those used for CoSMoS, and the scenario selected for 2080 for Delta Adapts is slightly less conservative.

[18] NOAA Tides and Currents. "Exceedance Probability Levels and Tidal Datums: 9415020 Point Reyes, CA." https://tidesandcurrents.noaa.gov/est/stickdiagram.shtml?stnid=9415020&name=Point%20Reyes&state=California

[19] The State of California Sea Level Rise Guidance is available at https://opc.ca.gov/webmaster/ftp/pdf/agenda_items/20180314/Item3_Exhibit-A_OPC_SLR_Guidance-rd3.pdf

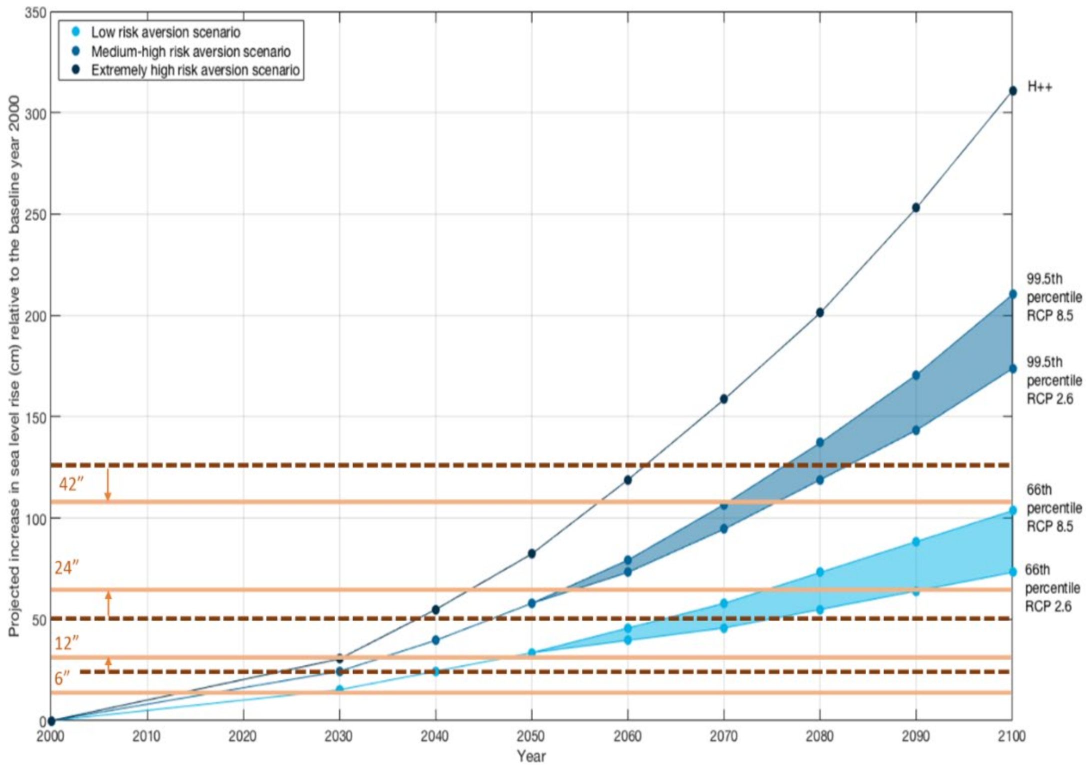


Figure A-4. SLR curves for San Francisco (blue), as provided by the State of California Sea Level Rise Guidance, overlaid with CoSMoS SLR scenarios (dashed brown lines) and Delta Adapts SLR scenarios (orange lines) for comparison. SLR projection ranges in the low and medium risk aversion scenarios represent differing emissions scenarios (RCP 2.6 and RCP 8.5), by percentile.

Wildfire

In accordance with the CPUC Climate Adaptation OIR decisions,[20] PG&E uses wildfire risk assessments from PG&E's Wildfire Mitigation Plan[21] to characterize current and future exposure to wildfire damage. Specifically, the CAVA uses PG&E's high fire risk areas (HFRAs), which are inclusive of the CPUC's high fire threat districts (Figure A-5).

High Fire Threat Districts

In January 2018, the CPUC finalized and adopted a statewide Fire Threat Map that delineates high fire threat districts (HFTDs), within which utilities are directed to apply stricter fire safety

---

[20] California Public Utilities Commission. "Climate Adaptation." https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/climate-change

[21] PG&E. 2023. "2023–2025 Wildfire Mitigation Plan R4." https://www.pge.com/assets/pge/docs/outages-and-safety/outage-preparedness-and-support/pge-wmp-r4-010824.pdf

regulations.[22] The development of the CPUC's final Fire Threat Map was a product of a nearly 3-year process involving the CPUC, the California Department of Forestry and Fire Protection, and an array of independent experts and stakeholders.

The HFTDs are the product of a complex methodology involving both quantitative modeling and stakeholder engagement. The CPUC designed a development process to identify areas with the highest overall wildfire risk based on a combination of (1) physical and environmental conditions conducive to wildfire ignition and spread, and (2) the potential for wildfire to harm people and property. Inputs to the modeling include vegetation, topography, wind, historical weather features, and other factors.

High Fire Risk Areas

In PG&E's ongoing efforts to understand and mitigate wildfire risk, PG&E developed a complementary HFRA map that provides an even more geographically granular assessment of wildfire risk to ensure that all areas of catastrophic wildfire risk are captured by PG&E's Public Safety Power Shutoff-related activities. The HFRA map was generated using incremental revisions to the CPUC's HFTD and also is updated on an annual basis (see Figure A-5). HFRA revisions are informed by detailed PG&E analysis based on modeling, aerial imagery, site visits, and other inputs.

These revisions are relatively small in geographic scope and primarily add additional covered area (there is a high degree of overlap between the HFRA and HFTD, for example, > 98 percent

---

[22] The full summary report detailing the production of the CPUC maps is available at http://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M199/K508/199508442.PDF

in the Bay Area Region), making the HFRA (which for the purposes of the CAVA, includes HFTD) a similar and more conservative assessment for wildfire risk assessment in the CAVA.[23]

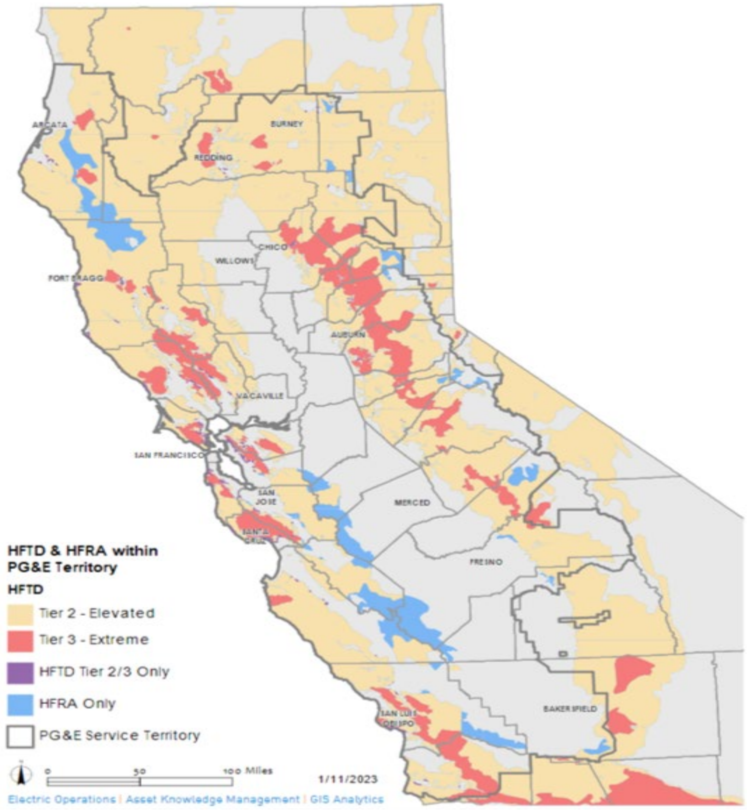


Figure A-5. HFTD Tier 2 and Tier 3 and PG&E's HFRA, November 2022. (Source: PG&E WMP)[25]

Wildfire in the Future: The Use of Forward-Looking Projections

Understanding future wildfire risk due to climate change is critical to PG&E's planning efforts. The wildfire analysis and projection results from California's Fourth Climate Change Assessment[24] are currently the best available statewide annual wildfire projections at the time of this analysis and are used for exploratory purposes in this CAVA with regard to exposure to plausible future wildfires in PG&E's service area.

PG&E's forward-looking wildfire analysis for exploratory purposes only in service area exposures (Appendix B) uses wildfire projections developed for California's Fourth Climate

---

[23] PG&E. 2021. "2021 Wildfire Mitigation Plan Errata." https://www.pge.com/content/dam/pge/docs/outages-and-safety/outage-preparedness-and-support/2021-Wildfire-Safety-Plan-Errata.pdf

[24] Westerling, A.L. 2018. "Wildfire Simulations for California's Fourth Climate Change Assessment: Projecting Changes in Extreme Wildfire Events with a Warming Climate." California's Fourth Climate Change Assessment, California Energy Commission. Publication No. CCCA4-CEC-2018-014. https://www.semanticscholar.org/paper/WILDFIRE-SIMULATIONS-FOR-CALIFORNIA'S-FOURTH-CHANGE-Westerling/a8d523cc100eb83a005485ed9d00cc5e83ea8ef0

Assessment (Westerling et al., 2018).[25] These projections show modeled annual area burned according to 6-kilometer by 6-kilometer grid cell. The annual average acreage burned incorporates year-to-year variation and is most useful for understanding landscape-scale trends over a longer period rather than any individual year's wildfire severity. These projections have less geographic granularity than the HFRA or HFTD and are less useful for near-term analysis and operational decision-making related to wildfire conditions.

The Westerling wildfire scenario projections were generated using a statistical model that leveraged historical climate, fire occurrence (based on 1984–2013), population, and ground cover data, as well as regionally downscaled LOCA climate projections of temperature and precipitation. Climate projections were derived from the four priority California climate models: HadGEM2-ES, CNRM-CM5, CanESM2, and MIROC5. The data also include three population growth scenarios (high, low, and business as usual) and two emissions scenarios (Representative Concentration Pathway [RCP] 4.5 and RCP 8.5). The CAVA uses the "business as usual" population scenario and the RCP 8.5 emissions scenario and takes a model ensemble mean to understand potential wildfire burn area across the baseline period (1976–2005) and a focus on 2050 (2035–2066).

Drought-Driven Subsidence

The CAVA incorporates information on drought-driven subsidence from recent relevant literature from the USGS and California's Fourth Climate Assessment. The USGS provides mapping, data, and publications related to land subsidence in California, including discussion of land subsidence in the San Joaquin Valley and in the Santa Clara Valley.[26] California's Fourth Climate Assessment includes discussion of subsidence hazards for each of California's regions.

In the Central Valley Region, the vulnerability assessment also relies on historical subsidence observations from the National Aeronautics and Space Administration's (NASA) Jet Propulsion Laboratory.

---

[25] Westerling, A.L. 2018. "Wildfire Simulations for California's Fourth Climate Change Assessment: Projecting Changes in Extreme Wildfire Events with a Warming Climate." California's Fourth Climate Change Assessment, California Energy Commission. Publication No. CCCA4-CEC-2018-014. https://www.semanticscholar.org/paper/WILDFIRE-SIMULATIONS-FOR-CALIFORNIA'S-FOURTH-CHANGE-Westerling/a8d523cc100eb83a005485ed9d00cc5e83ea8ef0

[26] U.S. Geological Survey. "Measuring Land Subsidence in California." https://www.usgs.gov/centers/ca-water-ls; U.S. Geological Survey. "Land Subsidence in the San Joaquin Valley." https://www.usgs.gov/centers/land-subsidence-in-california/science/land-subsidence-san-joaquin-valley; U.S. Geological Survey. "Land Subsidence in the Santa Clara Valley." https://www.usgs.gov/centers/land-subsidence-in-california/science/land-subsidence-santa-clara-valley

Appendix B: Exposure to Projected Climate Hazards in PG&E's Service Area

Table of Contents

Introduction

This section explains the scope and approach to climate change hazard exposure analyses and analytical metrics to understand vulnerabilities of PG&E infrastructure, assets, and operations and services to projected changes of environmental conditions due to climate change. Climate change hazard exposure for PG&E’s service area are provided.

For more details regarding data sources, methods for exposure analyses, and climate hazard scenarios used see Appendix A: Climate Change Methods.

Scope of Climate Change Hazards

Temperature

To assess vulnerability of assets to changing temperatures, the CAVA uses multiple metrics for characterizing changes in ambient and extreme temperatures specific to sensitivities of PG&E’s infrastructure and operations—for example, in relation to design standards and operational processes.

Flooding and Precipitation

This analysis considers pluvial and fluvial flooding in inland and coastal areas of PG&E’s service area. The CAVA is generally focused on examining future changes in precipitation patterns as well as flood risk as it relates to current Federal Emergency Management Agency (FEMA) 100-year and 500-year zones (also referred to as floodplains). FEMA flood zones are currently the best available metric to understand vulnerability to flooding, although they are backward-looking and may not be accurate in predicting the frequency and severity of future flood risks.[1]

Projected changes in expansion of coastal and tidally influenced floodplains due to sea level rise are covered in the discussion of sea level rise, below.

Landslides

Landslides and mudslides can occur during or after large rain events. However, these incidents materialize locally, and available climate change projections are not able to capture second order effect of landslides due to increased precipitation. Therefore, the risk of landslides or mudslides is an assumed potential cascading impact to PG&E assets, infrastructure, and operations and services. Further research, likely combining geosciences, hydrology, and climate change modeling, would be required to better understand changes in spatial and temporal risks of these events. The CAVA relies on a U.S. Geological Survey (USGS) risk assessment for areas that are more at risk for landslides. See Appendix A: Climate Data Methods for more details.

[1] Childress, S. and Worth, K. 2016. “How Federal Flood Maps Ignore the Risks of Climate Change.” Frontline. https://www.pbs.org/wgbh/frontline/article/how-federal-flood-maps-ignore-the-risks-of-climate-change/

Sea Level Rise

Acknowledging the overlap with coastal FEMA floodplains, the CAVA focuses on potential flooding from coastal inundation along coastal and tidally influenced areas due to sea level rise and during 100-year storm events.

Wildfire

Recent wildfire seasons in California (2018–2020) have been the most intense, destructive, and costly in the state's recorded history. Fire seasons are projected to continue to increase in length and intensity as a result of a range of environmental factors, many of which are exacerbated by climate change.[2] Wildfires of any size can be ignited by different causes, including both anthropogenic and non-anthropogenic factors, while the resulting wildfire size, dynamics, and destructiveness have multiple underlying drivers that may or may not be directly impacted by climate change.

PG&E's 2023—2025 Wildfire Mitigation Plan addresses the Company's wildfire safety programs and initiatives focused on reducing the potential for catastrophic wildfires related to electrical equipment. These initiatives include but are not limited to operational mitigations, system hardening, enhanced powerline safety settings, reducing public safety power shutoff impacts, and managing trees and vegetation near powerlines.[3]

Understanding future wildfire risk due to climate change is critical to planning efforts in California and at PG&E. The best available public and statewide projections of changes in annual wildfire activity due to climate change were provided as part of California's Fourth Climate Change Assessment.[4] For exploratory purposes only, exposure to these plausible projections is provided in the climate hazard exposure analysis provided below.

In accordance with the Climate Adaptation OIR, PG&E uses wildfire risk assessments within PG&E's Wildfire Mitigation Plan (WMP) to characterize current and future exposure to wildfire damage. Specifically, the CAVA uses PG&E's high fire risk areas (HFRAs), which are inclusive of CPUC HFTDs for exposure to wildfire conditions (see Appendix A). Additionally, internal PG&E research indicates that areas of greatest future wildfire risk levels are equivalent to areas included in the CPUC's high fire threat districts (HFTDs).

Drought-Driven Subsidence

Subsidence is the gradual or sudden sinking of the Earth's surface due to subsurface movement of earth materials. In California, subsidence has in the past been mainly a result of groundwater

---

[2] Cal Fire. 2019a. Community Wildfire Prevention and Mitigation Report in Response to Executive Order N-05-19. https://www.fire.ca.gov/media/5584/45-day-report-final.pdf.

[3] PG&E. "Our Wildfire Safety Work." https://www.pge.com/en/outages-and-safety/safety/community-wildfire-safety-program.html#tabs-d12abf1841-item-473d76dc3d-tab

[4] Dale, L., Carnall, M., Wei, M., Fitts, G., McDonald, S.L. 2018. "Assessing the Impact of Wildfires on the California Electricity Grid." A report for: California's Fourth Climate Change Assessment. energy.ca.gov/sites/default/files/2019-11/Energy_CCCA4-CEC-2018-002_ADA.pdf

pumping. Subsidence can damage buildings and infrastructure, lead to increased flood risk in low-lying areas, and cause long-term damage to groundwater aquifers.[5]

Cascading Impacts

Cascading (also known as compounding) events are those that stem from the combination of multiple climate hazards occurring simultaneously or successively to create a negative impact. Successive storms can impact distribution operations if utilities are unable to respond to infrastructural damage quickly enough. The size and geographic spread of a hazard is also important to consider due to the widespread nature of impacts that can occur within and across service areas, for example large geographic heat waves.[6]

Hazards can produce a wide range of cascading impacts on the energy system, ranging from direct physical impacts to energy shortages.[7] Cascading impacts of climate change can include events such as an extreme weather event causing another event to happen (e.g., heavy rain events leading to landslides or mudslides) and extreme weather-related events that occur simultaneously in different areas (e.g., wildfire activity and a heat wave).

Cascading impacts can also be system related; for example, some PG&E equipment may be affected indirectly by climate impacts on upstream components of the system. For instance, if a transmission substation were to be de-energized, the location and amount of load to other substations (transmission or distribution) may change.

Furthermore, resource adequacy impacts can stem from compounding hazards; for example, the combination of high day and nighttime heat can affect generation and transmission capacity, impact the asset life of equipment due to the lack of cooling periods, and influence customer demand.[8]

Cascading impacts and compound hazards are understudied and data availability and the characterization of compound hazards relevant to the power sector are important gaps for power system planning, according to the Energy Power Research Institute (EPRI) Climate READi.[9]

Because both cascading impacts and compounding hazards are difficult to quantify spatially and temporally the CAVA calls out relevant impacts or hazards such as landslides and debris flow where appropriate rather than a separate climate change risk category. The exception to this is drought-driven subsidence, described above, since this impact is more spatially constrained in PG&E's service area and is supported by research and monitoring.

[5] U.S. Geological Survey. "Land Subsidence in California." https://www.usgs.gov/centers/ca-water-ls
[6] Climate READi (epri.com)
[7] *Ibid*
[8] *Ibid*
[9] *Ibid*

The impacts of climate change on utility system dynamics such as power flow, system configuration, and transmission planning processes are areas that could be explored further in future vulnerability assessments.

Other hazards

Changes in meteorological and environmental conditions due to climate change have and will not be restricted to the hazards listed above. Below, we provide descriptions of other hazards known to be or potentially be of concern not just to critical energy infrastructure but also to other built infrastructure and to our communities. As climate projections continue to improve and climate hazard analysis matures, additional hazard variables may become available that could be incorporated into scenario analyses that support vulnerability assessments. For example, when climate change analysis on wind variables is appropriately mature, how extreme winds may change as a result of climate change can be considered as a unique hazard as well as in context of extreme storms and wildfire potential.

Atmospheric Rivers

Some of the more intense precipitation in PG&E's service area occurs under atmospheric rivers, or long streams of moisture that travel from the tropics across the Pacific Ocean and provide a large amount of precipitation to Northern California. Climate change is projected to increase the intensity of large atmospheric rivers affecting California.[10] On average, these atmospheric rivers may be about 25 percent wider and longer, increasing the frequency of heavy rain and winds by about 50 percent by the end of the 21st century.[11]

The total frequency of atmospheric rivers may slightly decrease, but the most intense atmospheric rivers are projected to nearly double by the end of the 21st century—potentially partially accounting for the projected increase in intensity in the region's largest storms, megafloods, as discussed below. Although large storm intensity is expected to increase, dry periods are also expected to increase and the likelihood of very dry years being followed by extremely wet years, or vice versa, is projected to increase.[12]

Historic Megaflood Events

Low-probability, high-impact flood events known as "megafloods" occur, on average, once every 100 to 200 years. Climate change may make these events more likely in the future.[13] The

[10] Swain, D.L., Langenbrunner, B., Neelin, J.D., Hall, A. 2018. "Increasing precipitation volatility in twenty-first-century California." Nature Clim Change 8, 427–433. https://doi.org/10.1038/s41558-018-0140-y
[11] Smith, E. 2018. "Climate change may lead to bigger atmospheric rivers." NASA's Jet Propulsion Laboratory." https://climate.nasa.gov/news/2740/climate-change-may-lead-to-bigger-atmospheric-rivers/
[12] Dettinger, Michael, et al. 2018. "Sierra Nevada Summary Report. California's Fourth Climate Change Assessment." Publication number: SUM-CCCA4-2018-004. Sierra Nevada summary report. California's Fourth Climate Change Assessment | U.S. Geological Survey (usgs.gov)
[13] Huang, X. and Swain, D. 2022. "Climate Change is Increasing the Risk of a California Megaflood." Science Advances, 8(32). https://www.science.org/doi/10.1126/sciadv.abq0995

most recent megaflood in California lasted over 3 months, from November 1861 to January 1862 during multiple, subsequent atmospheric rivers, leaving the entirety of the Sacramento-San Joaquin valley (Central Valley Region) under water, flooding up to 6,000 square miles of the state with some areas in the Central Valley under 30 feet of water.[14] The storms caused approximately $100 billion in damage (equivalent to approximately $300 billion today), and killed more than 4,000 people, approximately 1 percent of the state's population at the time.[15]

The frequency of 1862-magnitude flood events is projected to increase on the order of 300–400 percent by the end of the 21st century, suggesting it is likely that an event of similar magnitude will occur by the end of the 21st century.[16]

Extreme Winds

Future changes in extreme winds within California are often difficult to project due to the small spatial and temporal scales at which the winds occur. The climate change models used in the CAVA analyses do not provide an ability to reliably project changes in extreme wind speeds independent of other meteorological measurements such as storms. Furthermore, analysis of direct impacts from wind was out of scope for this analysis.

There are two research gaps that need further analysis to better understand how climate change will impact wind-driven impacts to the company's assets, operations, and services. These include further analysis of how high wind impacts may change wildfire risk and direct asset damage, and how climate change may affect the severity and frequency of combined high wind and high precipitation events and impact asset damage.

Drought

Drought level is not a direct variable from the global climate models. The effectiveness of using climate change projection data to determine future potential droughts will depend on many factors, including atmospheric and ocean circulation, soil moisture, topography, land surface processes, and interactions between the air, land, and ocean. Climate models have different ways of projecting these variables and interactions, and thus drought is difficult to describe with a high level of quantitative detail. Recent California droughts (such as 2012–2016) have been exacerbated by higher temperatures and reduced snowpacks.

---

[14] California Department of Water Resources. 1997. "Historic rainstorms in California: A study of 1,000-year rainfalls." https://searchworks.stanford.edu/view/4660426; Null, J., Hulbert, J. 2007. "California Washed Away: The Great Flood of 1862." Weatherwise. Doi: 10.3200/WEWI.60.1.26-30. https://www.researchgate.net/publication/254351985_California_Washed_Away_The_Great_Flood_of_1862

[15] Brewer, W., H. 1930. "Up and down California in 1860-1864; the journal of William H. Brewer." Yale University Press. https://www.loc.gov/item/30029264/; ABC News. 2020. "California's Trillion Dollar Mega Disaster No One is Talking About." https://abc7chicago.com/californias-trillion-dollar-mega-disaster-no-one-is-talking-about/8504765/

[16] Swain, D.L., Langenbrunner, B., Neelin, J.D., Hall, A. 2018. "Increasing precipitation volatility in twenty-first-century California." Nature Clim Change 8, 427–433. https://doi.org/10.1038/s41558-018-0140-y

Changes in water availability, including drought conditions, involve regional generation capacity changes over time, a topic that is out of scope for the CAVA but could be included in future analyses.

Climate Exposures for PG&E's Service Area by Region

PG&E's service area is large and geographically and environmentally varied, and includes coastal and tidally influenced areas, major cities, suburbs and rural communities, large stretches of forested and agricultural lands, and large mountain ranges. The impacts of climate change will not be uniformly experienced by PG&E's assets, systems, and, importantly, the communities that PG&E serves. Understanding the potential spatial and temporal climate hazard exposure and potential impacts to PG&E's ability to maintain safe, reliable, and affordable operations for PG&E's customers underpins all analyses presented in the CAVA.

PG&E's five regions are seen in Figure B-1 and are as follows:

- Bay Area;
- Central Valley;
- North Valley and Sierra (Sierra);
- North Coast; and
- South Bay and Central Coast (Central Coast).

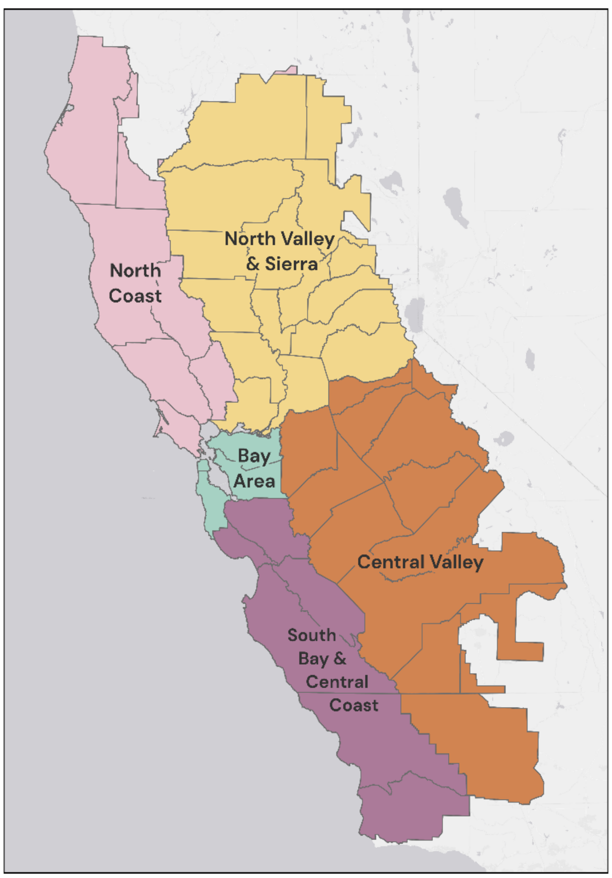


Figure B-1. PG&E Regions.

Bay Area Region

Temperature

Both average and extreme temperatures are projected to increase across the Bay Area Region. Coastal areas will continue to remain relatively cooler than inland portions of the region (Figure B-2), though temperatures in both areas are projected to rise.

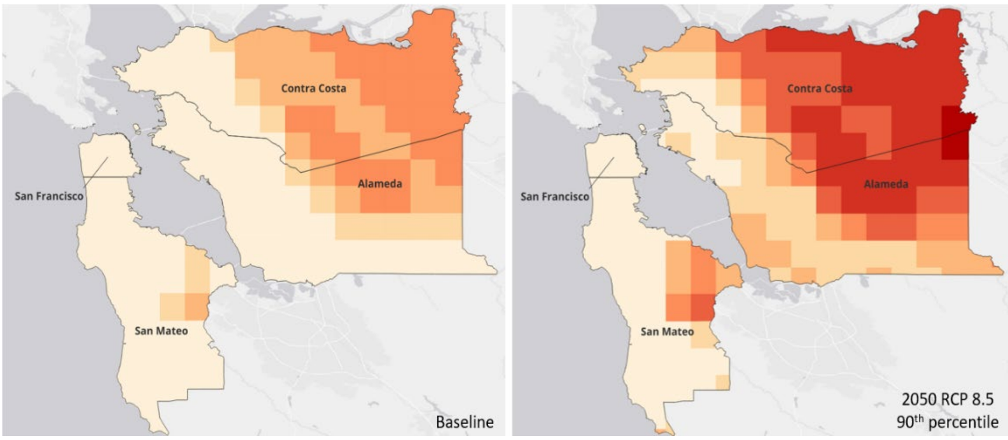


Figure B-2. 98th percentile temperatures in the Bay Area Region: historical baseline (1976 2005) and modeled 2050 projection (90th percentile of model values).

Flooding and Precipitation

FEMA 100-year and 500-year floodplains represent both coastal and inland flood risk areas within the Bay Area Region at risk of flooding during storm events (Figure B-3).

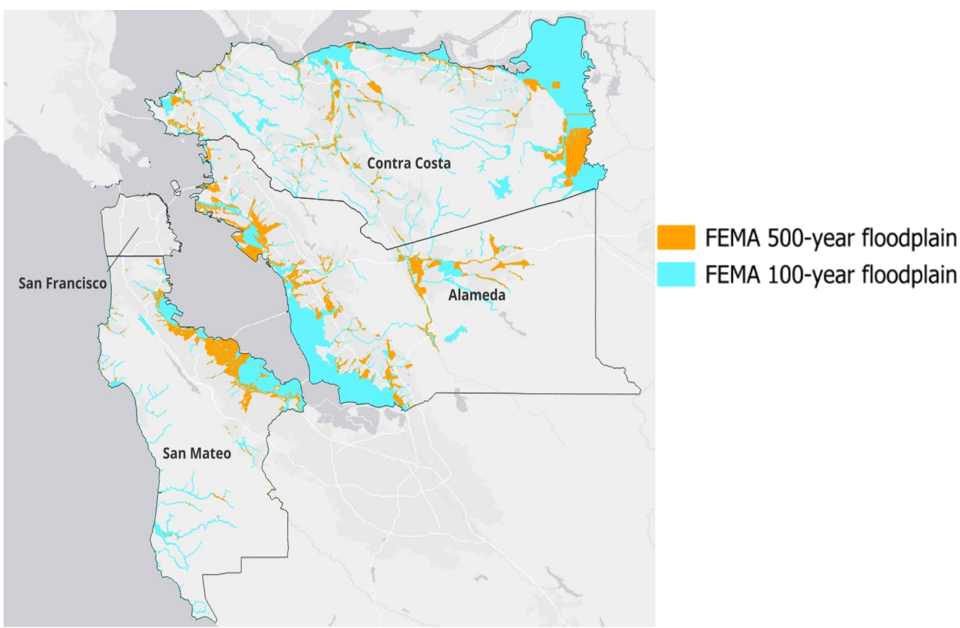


Figure B-3. 100-year and 500-year floodplains in the Bay Area Region.

By 2050, the greatest projected increase in 5-day maximum precipitation is 24 percent in Contra Costa and San Mateo Counties (Figure B-4).

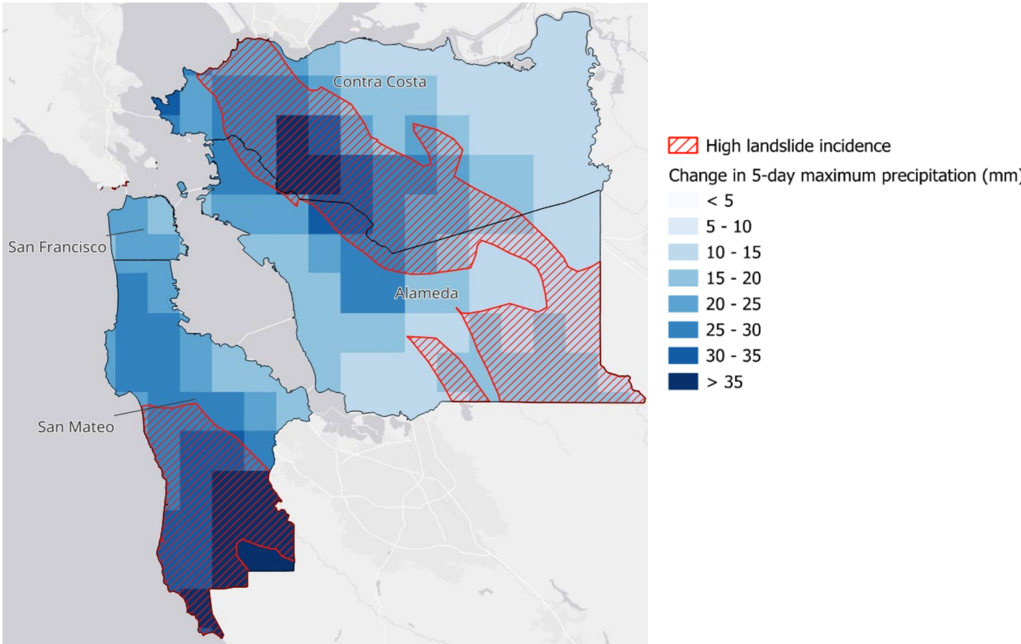


Figure B-4. Change in 5-day maximum precipitation in 2050 from baseline conditions (1976–2005).

About 41 percent of the Bay Area Region is located within high landslide risk areas (Table B-1).

Table B-1. Landslide risk areas by county in the Bay Area Region.

County	Area of County in High Landslide Risk Area (mi²)	Percent of County in High Landslide Risk Area
Contra Costa	304.30	15.29%
Alameda	296.45	14.90%
San Francisco	2.49	0.13%
San Mateo	222.95	11.20%
Total	826.19	41.52%

Sea Level Rise

Coastal flooding hazards (i.e., inundation from storm events under future sea level conditions) are a particular concern in the Bay Area Region especially along San Mateo and Alameda County coastlines. Sea levels could increase by 0.25 meters by 2030, 0.5 meters by 2050, and 1.25 meters by 2080, compared with 2000 levels (Figure B-5).

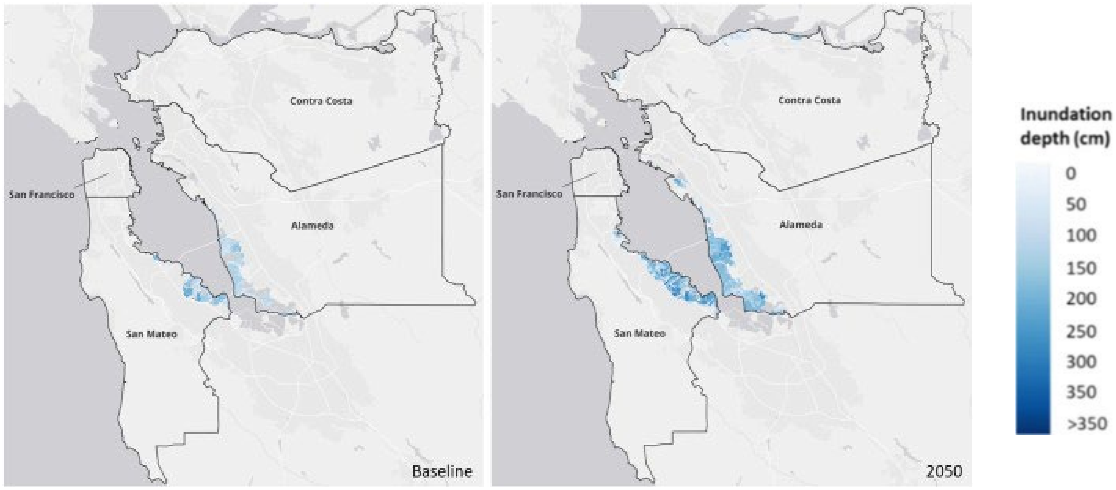


Figure B-5. 100-year inundation depths across the Bay Area Region under baseline (2010–2015) and 2050 scenarios (0.5 m of sea level rise).

Wildfire

The Bay Area Region includes a significant area (over 1 million hectares; 58 percent of the region) within PG&E's designated HFRA (Figure B-6). By 2050, average annual burn areas within the Bay Area could increase by a projected 49 percent relative to the recent historical baseline of 1976–2005 (Figure B-6).

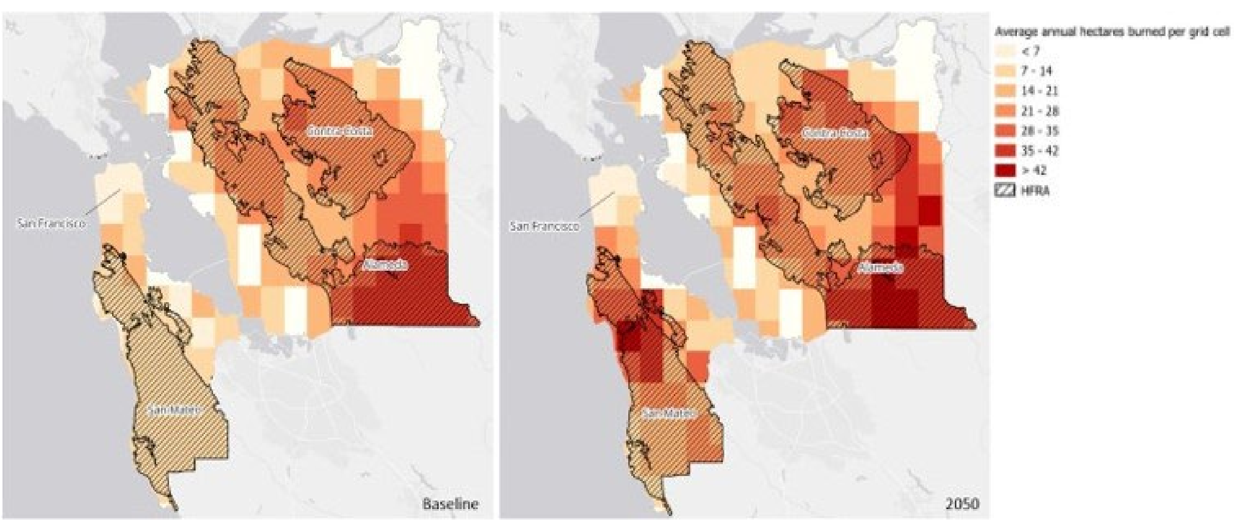


Figure B-6. Average annual hectares burned in the Bay Area Region during the baseline period (1976-2005, right) and in 2050 (2035-2066, left) per 6x6 km grid cell.

Drought-Driven Subsidence

In the early- to mid-1900s, extensive groundwater pumping in the Santa Clara Valley caused 1 meter of subsidence along the shoreline of South San Francisco Bay, exacerbating flooding concerns of low relief land adjacent to the Bay. Some of the submerged land has been recovered over the last several decades due to changing groundwater pumping practices. In the Bay Area Region, the impact of subsidence is mostly an issue of landfill compaction in places like Treasure Island and Foster City.[17]

[17] Shirzaei, M., and Bürgmann, R. 2018. "Global climate change and local land subsidence exacerbate inundation risk to the San Francisco Bay Area." Science Advances, 4(3). https://www.science.org/doi/10.1126/sciadv.aap9234

Central Valley Region

Temperature

The Central Valley contains the hottest portions of PG&E's service area, and both average and extreme high temperatures are projected to increase across the region over time. By 2050, the geographic area that is exposed to the 98th percentile temperatures in the 105–110°F and over 110°F ranges are projected to expand substantially (Figure B-7). Temperatures are projected to increase across the region, with the mountains remaining relatively cooler. Temperatures in Fresno occurring during the seven hottest days of the year are projected to increase from a baseline of 105°F to as much as 109°F in 2030 and by up to 112°F in 2050.

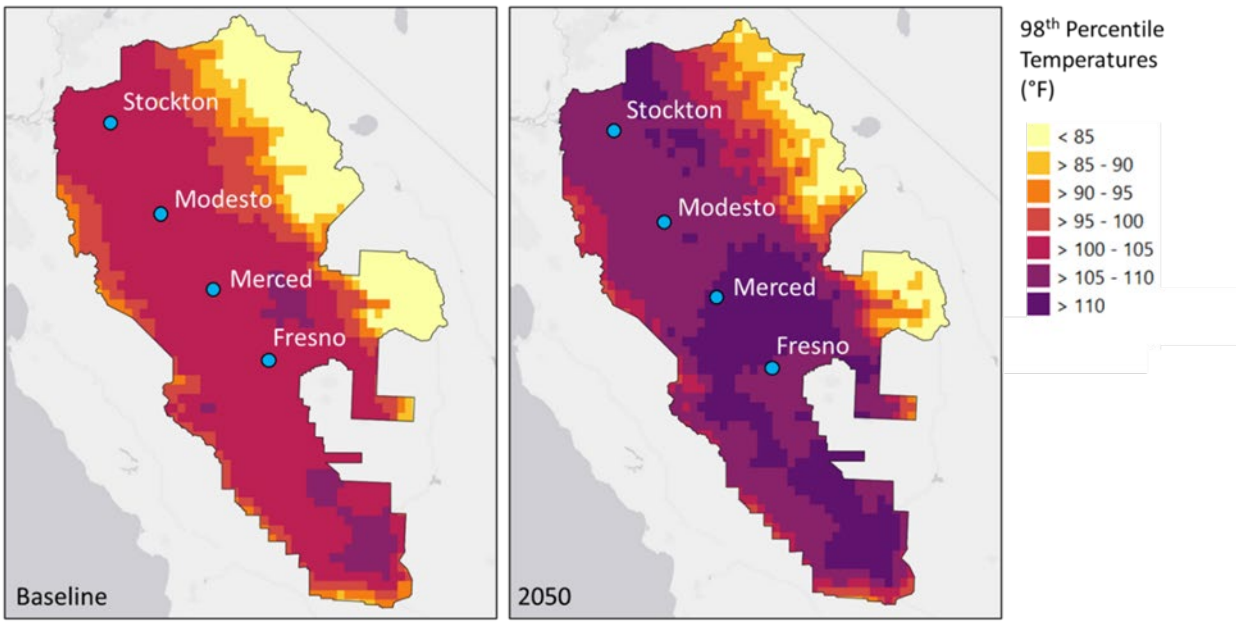


Figure B-7. 98th percentile baseline and 2050 temperatures for the Central Valley Region.

Flooding and Precipitation

Much of the Central Valley Region already exists within floodplains (Figure B-8), with several areas relying on levees for flood protection. Large portions of the Central Valley Region may be at risk of flooding under low-probability, high-impact flood events associated with extreme storms, snow melt, and runoff.

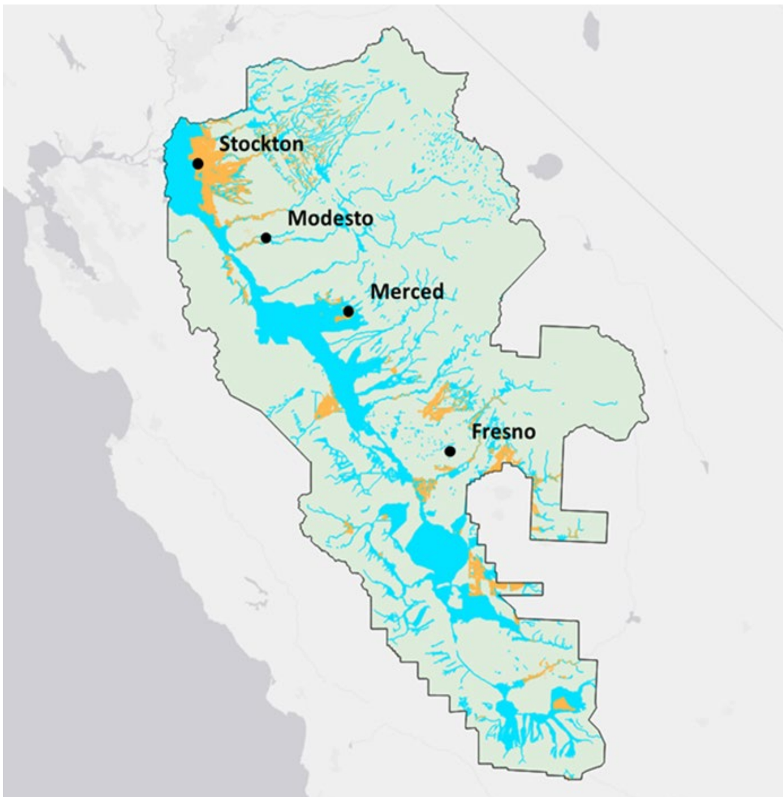


Figure B-8. FEMA floodplains in the Central Valley Region.

The Central Valley Region is home to many rivers, notably the San Joaquin River and its tributaries. Greater extreme precipitation and runoff, such as from rapid snowmelt, may increase the potential for flows exceeding watercourse capacity, leading to flooding in nearby floodplains.

The Central Valley Region is projected to see an increase in 5-day maximum precipitation events by 2050 (Figure B-9). Projected increases vary by location within the service area, with relative spatial patterns remaining largely consistent with present-day patterns. High elevation areas (primarily the Sierra Nevada Mountain Range in the northwest) have historically experienced the most intense 5-day maximum precipitation events; these events may increase in intensity.

Lower-elevation areas that have historically experienced less intense 5-day maximum precipitation events will experience slightly more intense events; however, runoff from higher elevations may also affect flood risk in the lower valley as seen in the Tulare Lake flooding in 2023.

Few areas in the Sierra Region are considered to be high landside risk and these locations are not within areas that have historically high or projected future high maximum precipitation (Figure B-9).

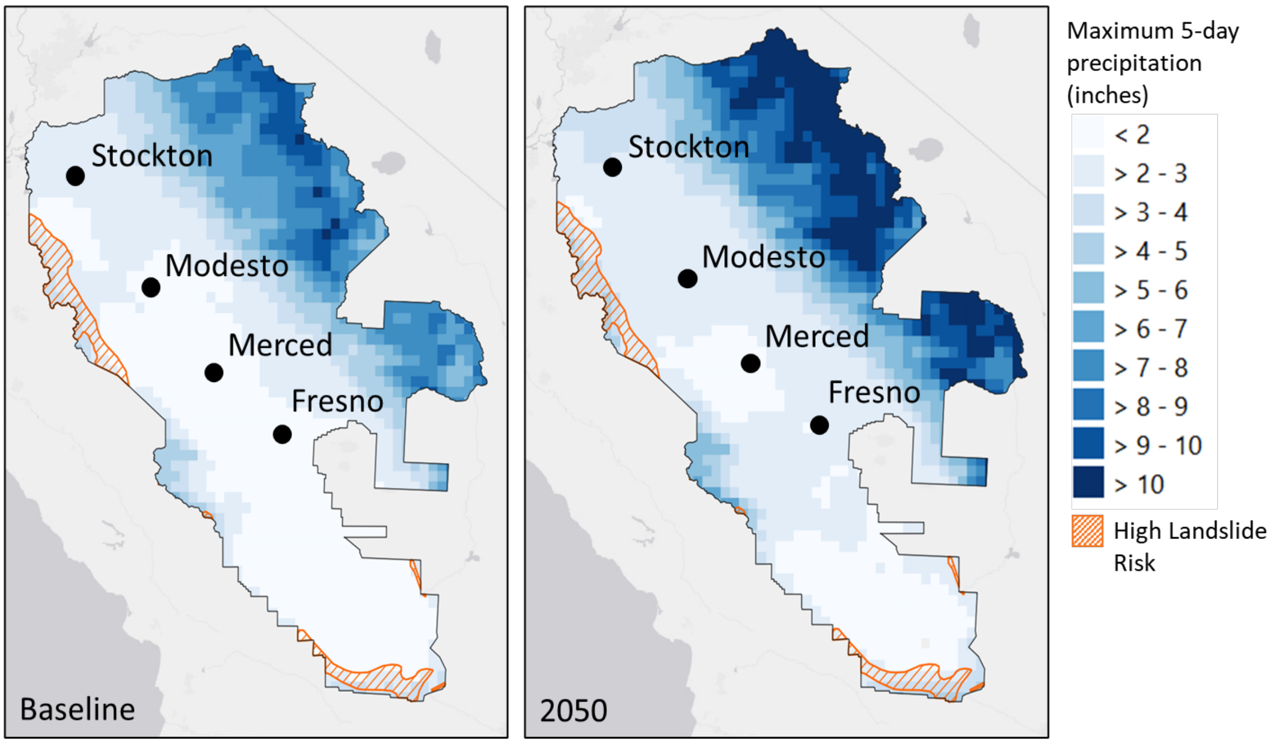


Figure B-9. Amount of rainfall (inches) in a 5-day maximum precipitation event for historical baseline and projected 2050.

Sea Level Rise

The Sacramento-San Joaquin River Delta is home to more than 1,100 miles of levees, a large portion of which were constructed in the 1930s, and some constructed even earlier in the 19th century.[18] State assessments indicate that many older flood protections face an elevated probability of failure.[19]

Recent modeling from the Delta Stewardship Council (DSC) shows increasing potential for overtopping (flood height exceeding levee height) at these levees due to increased floodwaters over time, driven by sea level rise affecting the Delta, and higher Delta inflows related to

[18] Yang, S. 2010. "Can California fix the Delta before disaster strikes?" Berkeley News. https://news.berkeley.edu/2010/04/20/delta/

[19] California Department of Water Resources. 2017. "Central Valley Flood Protection Plan." https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Flood-Management/Flood-Planning-and-Studies/Central-Valley-Flood-Protection-Plan/Files/2017-CVFPP-Update-FINAL_a_y19.pdf

changes in precipitation. Over time, a 100-year storm event in the Delta could put significantly more land area at risk of flooding from levee overtopping (Figure B-10).

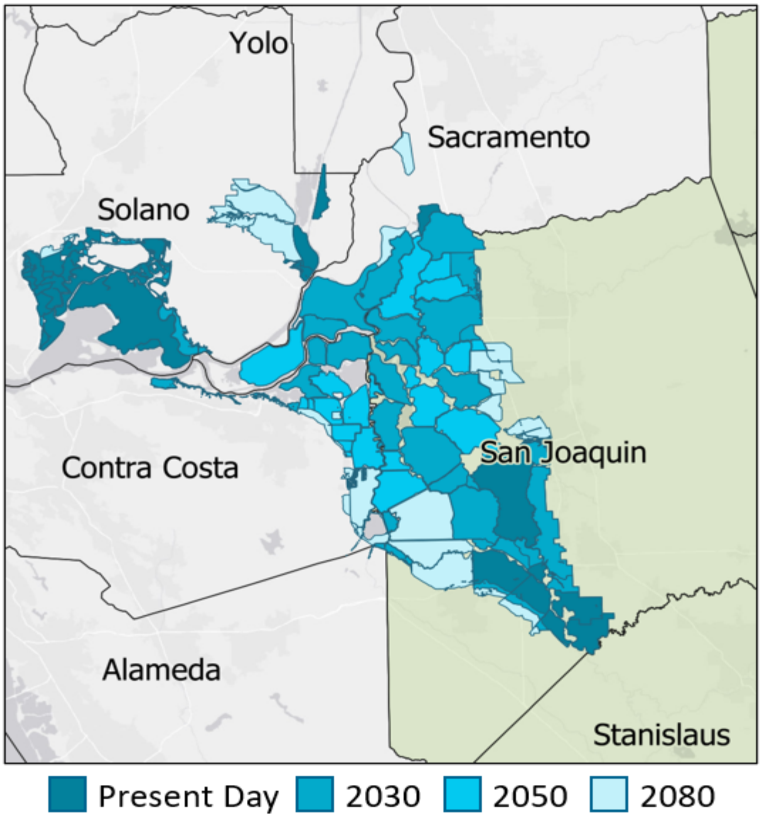


Figure B-10. Projected delta flood extents associated with levee overtopping during a 100-year flood (Source: DSC).

A potential research gap to consider in the future is how climate change will broadly impact the state's water control infrastructure and how that may impact PG&E's assets, and operations and services. The DSC's modeling considered only overtopping events and did not estimate the potential impacts of climate change on levee breach or failure due to the uncertainty and complexity of projecting these events. There is research that increased hydrostatic forces associated with climate-driven changes may increase the risk of levee breach into the future.[20]

Wildfire

Approximately one-third of the Central Valley Region lies within the HFRA, and these risk areas are concentrated along the western edge of the territory, closer to the Coastal Range, as well as the eastern edge, within the Sierra Nevada mountains (Figure B-11). Recent wildfire seasons

[20] Mount J, Twiss R. 2005. "Subsidence, sea level rise, seismicity in the Sacramento-San Joaquin Delta." San Francisco Estuary and Watershed Science. Vol. 3, Issue 1 (March 2005), Article 5. http://repositories.cdlib.org/jmie/sfews/vol3/iss1/art5

have seen a significant increase in wildfire activity in the wooded mountainous regions on either side of the Central Valley.

By 2050, average annual burn areas within the Central Valley Region could increase by a projected 32 percent relative to the recent historical baseline of 1976–2005. Most projected increases in future wildfire risk within the Central Valley Region are likely to occur within the present-day HFRAs (Figure B-11).

Projected increases in wildfire around Central Valley cities are likely due to the possibility of small grass fires with limited or no potential for expansion into a large wildfire or may be artifacts from historical wildfire patterns that feed into the modeling. These areas may have since been urbanized or agriculturized and become less vegetated.

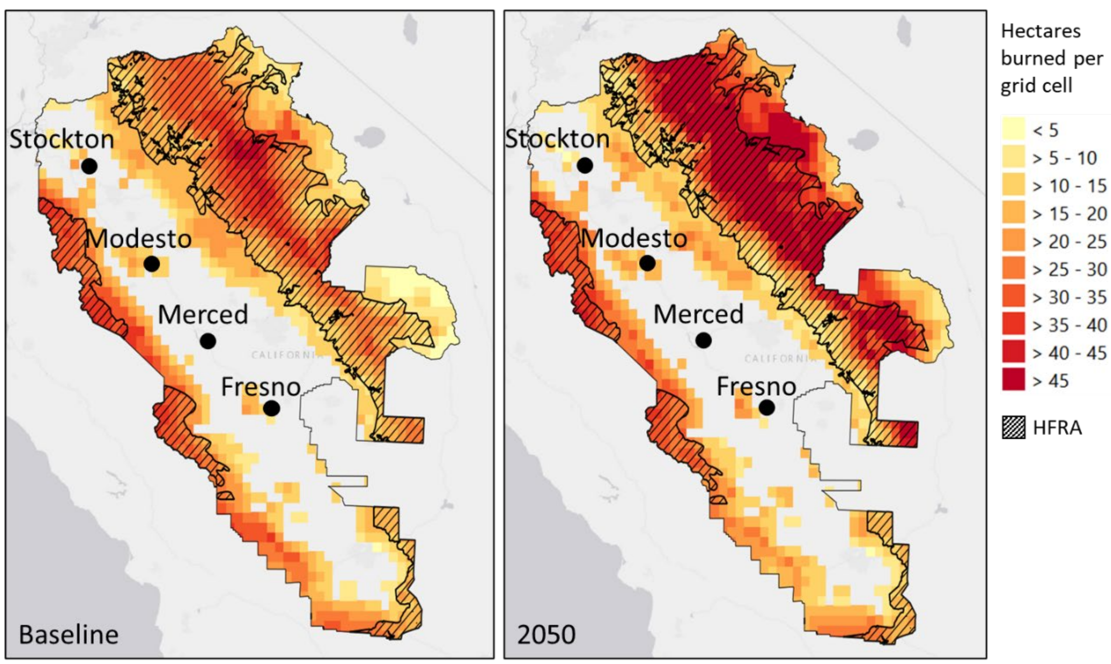


Figure B-11. Central Valley average annual area burned baseline (left) and projected 2050 (right).

Drought-Driven Subsidence

In California, subsidence is largest within the Central Valley due to the removal of water from underground aquifers, which is a main cause of this phenomenon.[21] Groundwater removal is directly related to extreme droughts, as more groundwater is pumped out of aquifers during times of extreme water stress. Figure B-12 shows the estimated total subsidence in the last half of the 20th century.

[21] Bertoldi, G.L., Johnston, R.H., and Evenson, K.D., 1991. "Ground Water in the Central Valley, California – A Summary Report." U.S. Geological Survey Professional Paper 1401-A, 44 p. Ground water in the Central Valley, California; a summary report (usgs.gov)

Due to variable rates of subsidence from variable interannual precipitation (wet/dry years) and human activity, long-term subsidence projections are not available. However, as climate change is expected to bring more severe and intense periods of droughts to California over the next century, subsidence in the Central Valley Region may be expected to increase.

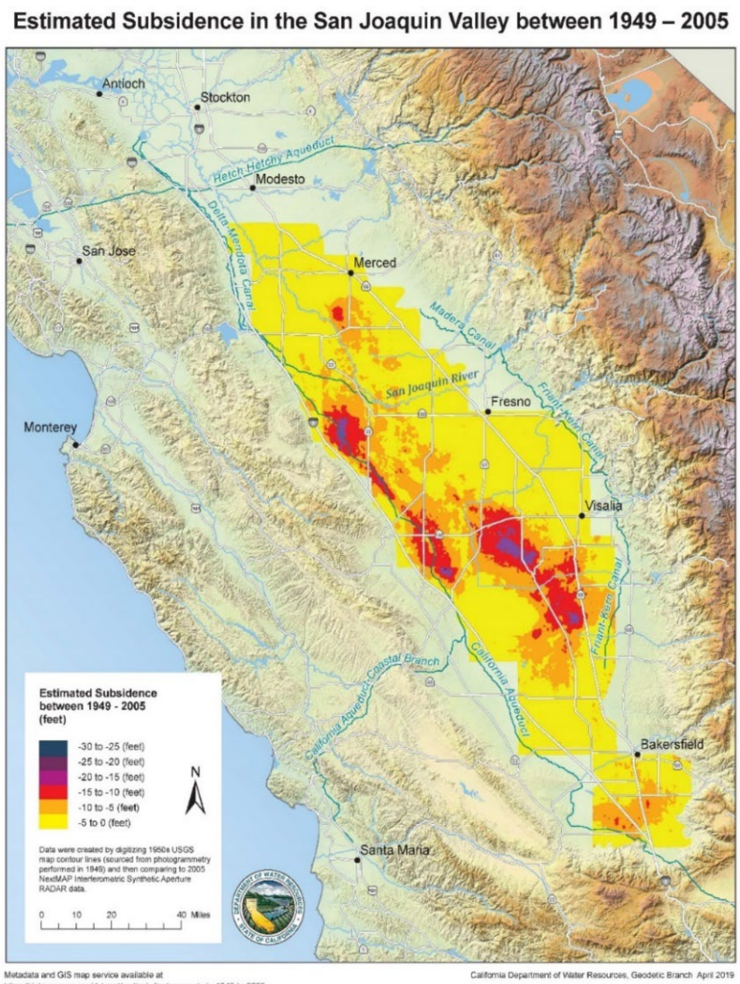


Figure B-12. Estimated subsidence in the Central Valley (1949–2005) from the California Department of Water Resources. Many areas with the highest subsidence values had various annual rates, high dependent annual moisture conditions, over the more than 5-decade period of study.

Sierra Region

Temperature

The hottest temperatures within the Sierra Region persist in lower lying areas primarily within the Sacramento Valley, such as Redding, where temperatures over 100°F are not unusual. Annual average temperatures in this region could increase by approximately 6–9°F by the end of the century.

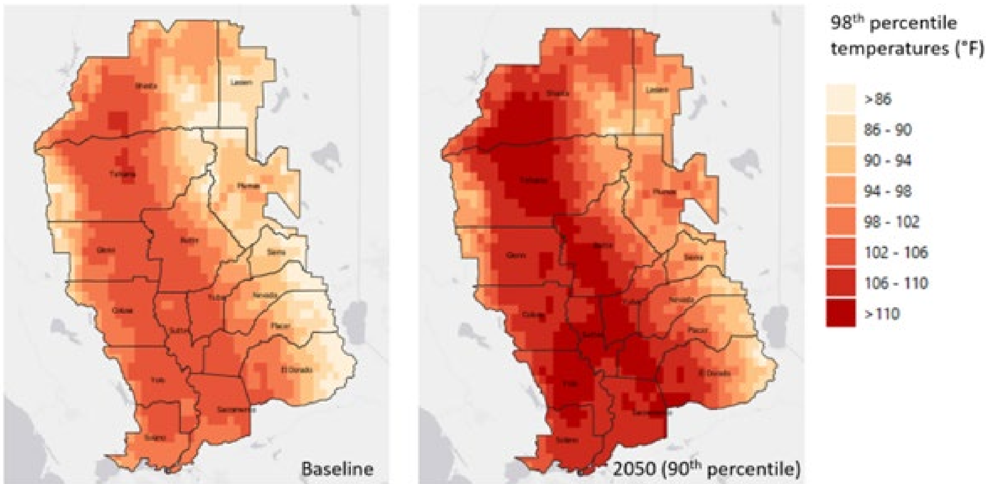


Figure B-13. 98th percentile temperatures in the Sierra Region: Historical baseline (1976-2005) and 2050.

Extreme temperatures are also projected to increase due to climate change. The low-lying areas within the Sierra Region could see 98th percentile temperatures above 112°F, particularly in central Tehama and southern Shasta Counties, near Red Bluff and Redding (Figure B-13). Temperatures occurring during the seven hottest days of the year near the city of Redding in Shasta County, one of the warmest areas of the state, are projected to increase from a historical baseline (1976–2005) of 107°F to 112.8°F in 2050.

Flooding and Precipitation

Significant portions of the Sierra Region are in a 100-year or 500-year floodplain (Figure B-14). Flood risk in the Sierra Region is projected to increase, likely due primarily to projected increases in incidence of precipitation falling as rainfall rather than snowfall during cooler seasons. Snowmelt due to warming temperatures can also lead to flooding at the end of winter and into spring.[22]

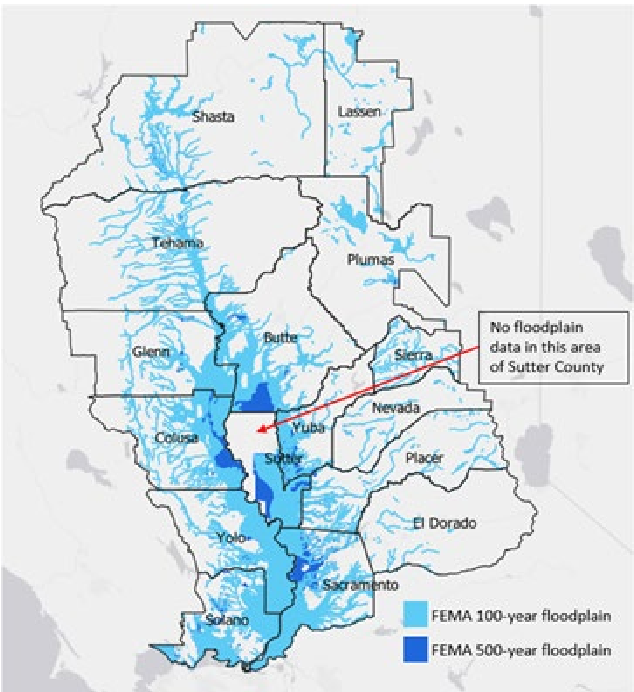


Figure B-14. FEMA 100- and 500-year floodplain in the Sierra Region.

On average, the wettest 5-day period within a year in the Sierra Region shows a projected increase in precipitation of about 7mm by 2050 (Figure B-15). Lower lying areas near and within the Sacramento Valley are expected to continue to experience more precipitation during these 5-day periods relative to the more mountainous higher elevation areas (Figure B-15). Areas of landslide risk are concentrated largely in the western portion of the Sierra Region.

[22] Lund, J. 2012. "Flood Management in California." Water, vol.4, 157-169. https://www.semanticscholar.org/paper/Flood-Management-in-California-Lund/b444fa51f4e447dddb5c92513d63700c1a3563bb

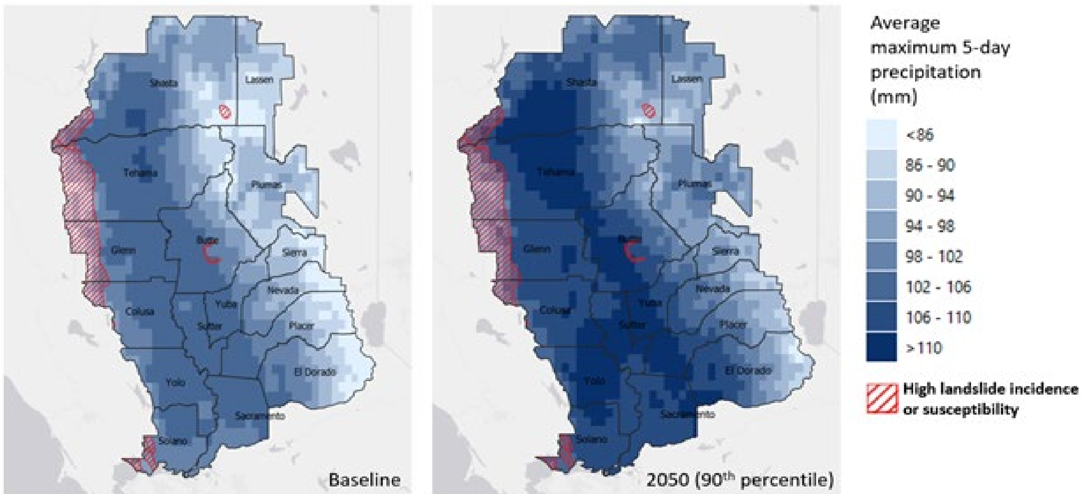


Figure B-15. Projected average annual 5-day maximum precipitation under baseline conditions (1976–2005) and in 2050.

Sea Level Rise

The southern portion of the Sierra Region may be at risk of delta flooding during extreme storm events. Recent modeling from the DSC shows potential for overtopping in southern Solano and southern Sacramento County along the Sacramento and San Joaquin Rivers (Figure B-16).

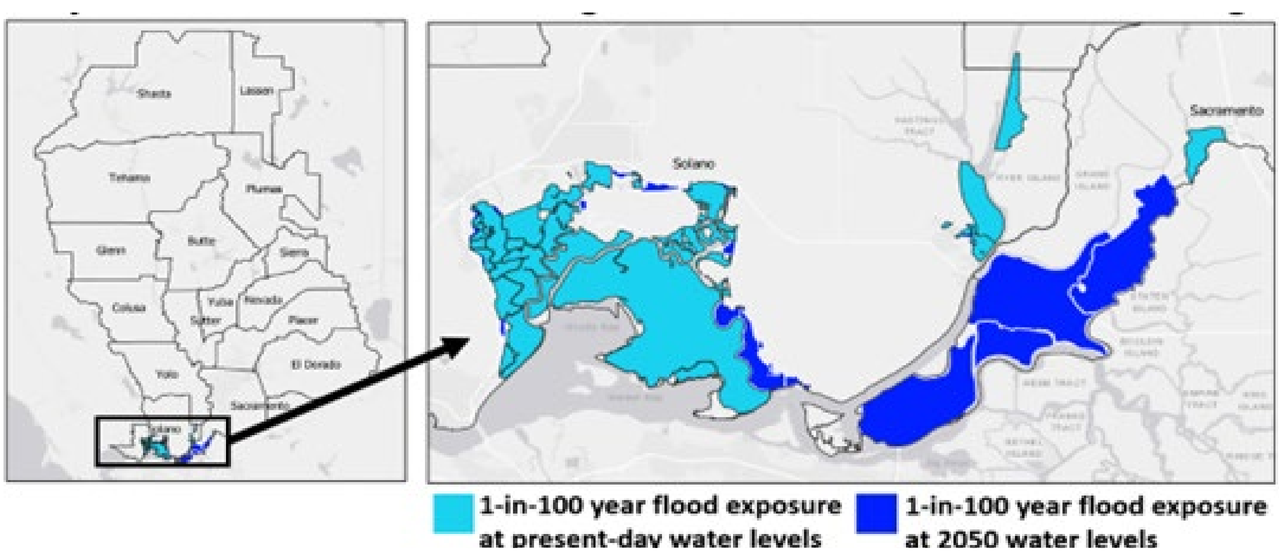


Figure B-16. Projected delta flood extents associated with levee overtopping during a 100-year flood.

Wildfire

Approximately 65 percent of the Sierra Region is within the HFRA (Figure B-17). The greatest increases in hectares burned and areas with most future hectares burned are projected to occur within higher elevation areas along the Sierra Nevada Mountain Range, while areas within the Sacramento Valley have had historically low magnitudes of hectares burned and are projected to experience limited increases in hectares burned through 2050 (Figure B-17).

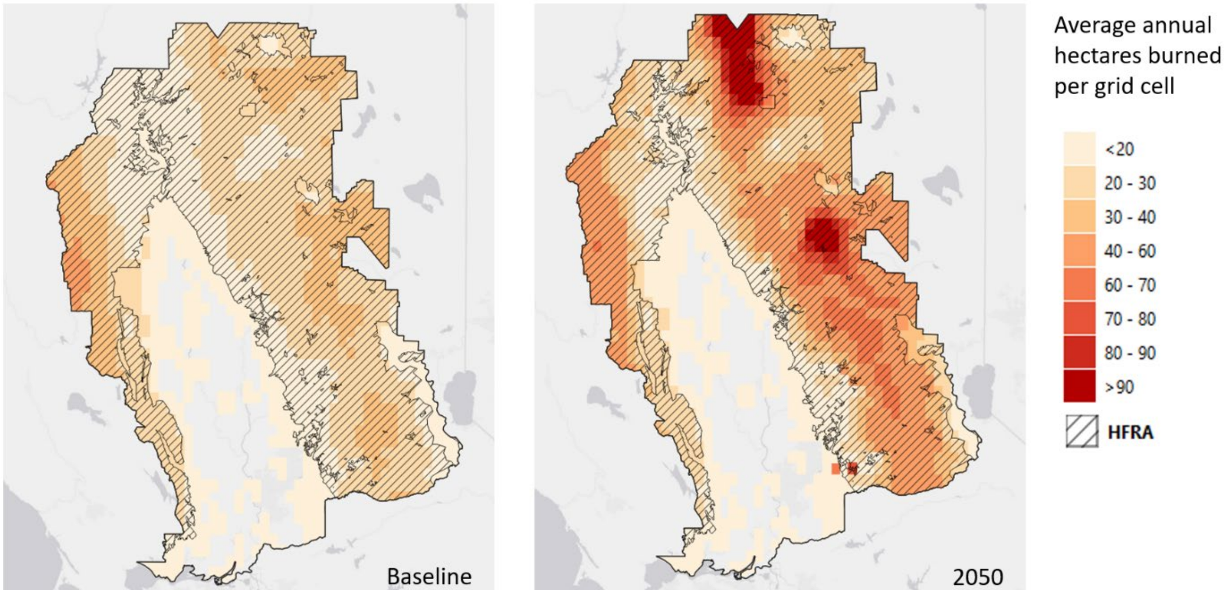


Figure B-17. Average annual hectares burned in the Sierra Region during the baseline period (1976–2005) and in 2050.

Climate Hazard: Drought-Driven Subsidence

There is no evidence to suggest that drought-driven subsidence is or will be a major concern in the Sierra Region.

North Coast Region

Temperature

Both annual average and extreme temperatures are expected to increase in the North Coast Region with the interior areas experiencing the largest degree of warming for the region. By 2050, the 98th percentile temperatures in the North Coast Region may increase by about 5–6°F (Figure B-18).

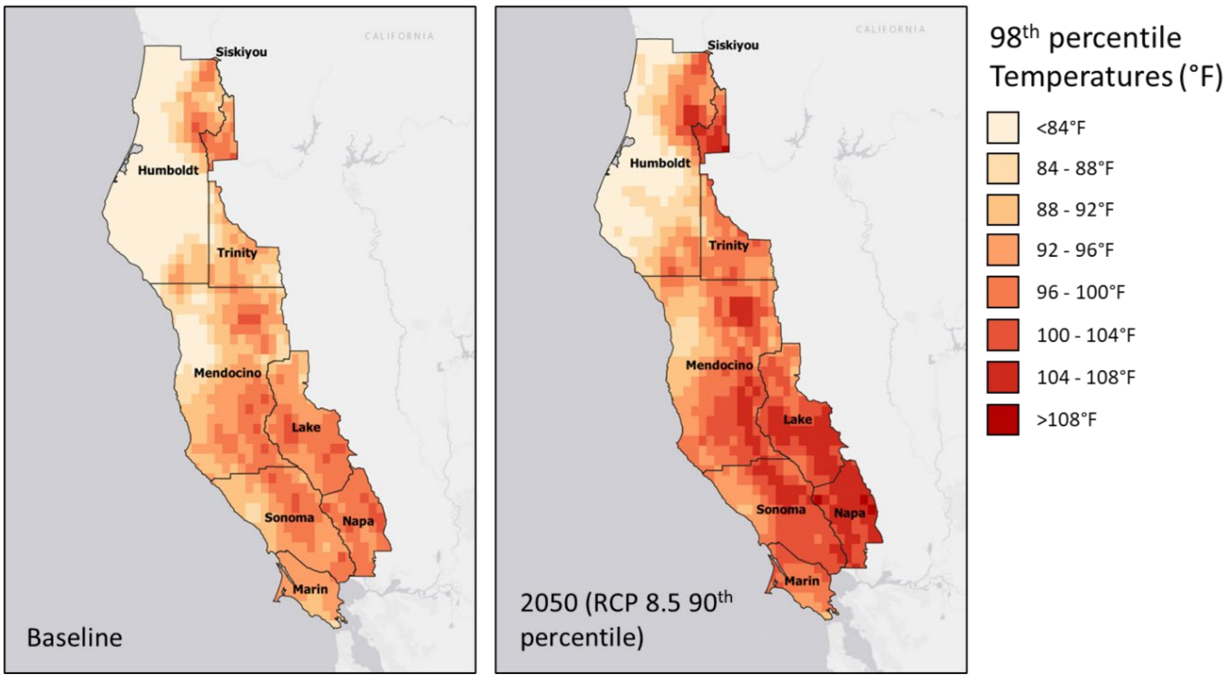


Figure B-18. 98th percentile temperatures in the North Coast Region: historical baseline (1976-2005) and modeled 2050 projection.

Flooding and Precipitation

The North Coast Region has many rivers that often have small volumetric flow during the dry seasons but increase flow during the wet season. FEMA floodplains show that some of these rivers are susceptible to flooding under intense storms (Figure B-19). Some notable areas susceptible to these flooding risks include Clear Lake and the Russian River. The Eel River Delta (just south of Humboldt Bay) and the southernmost part of the North Coast Region, including Marin County, are likely at increased flood risk due to climate change from an increase in precipitation and sea level rise.

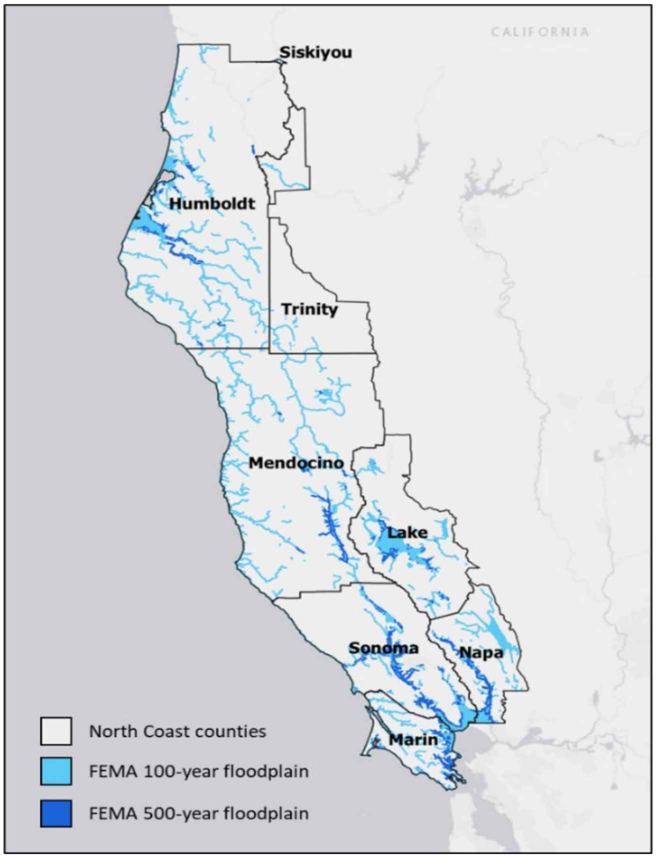


Figure B-19. FEMA 100-year and 500-year floodplains within the North Coast Region.

Average maximum 5-day precipitation totals increase in magnitude across much of the North Coast Region (Figure B-20). Through 2050, the projections for average maximum 5-day precipitation totals within the North Coast Region increase by approximately 27 percent (53 mm), and some grid cells increase by as much as 50 percent (143 mm) with some of the greatest increases occurring in areas of historical high precipitation.

The North Coast Region has many areas of high landslide risk (Figure B-20).

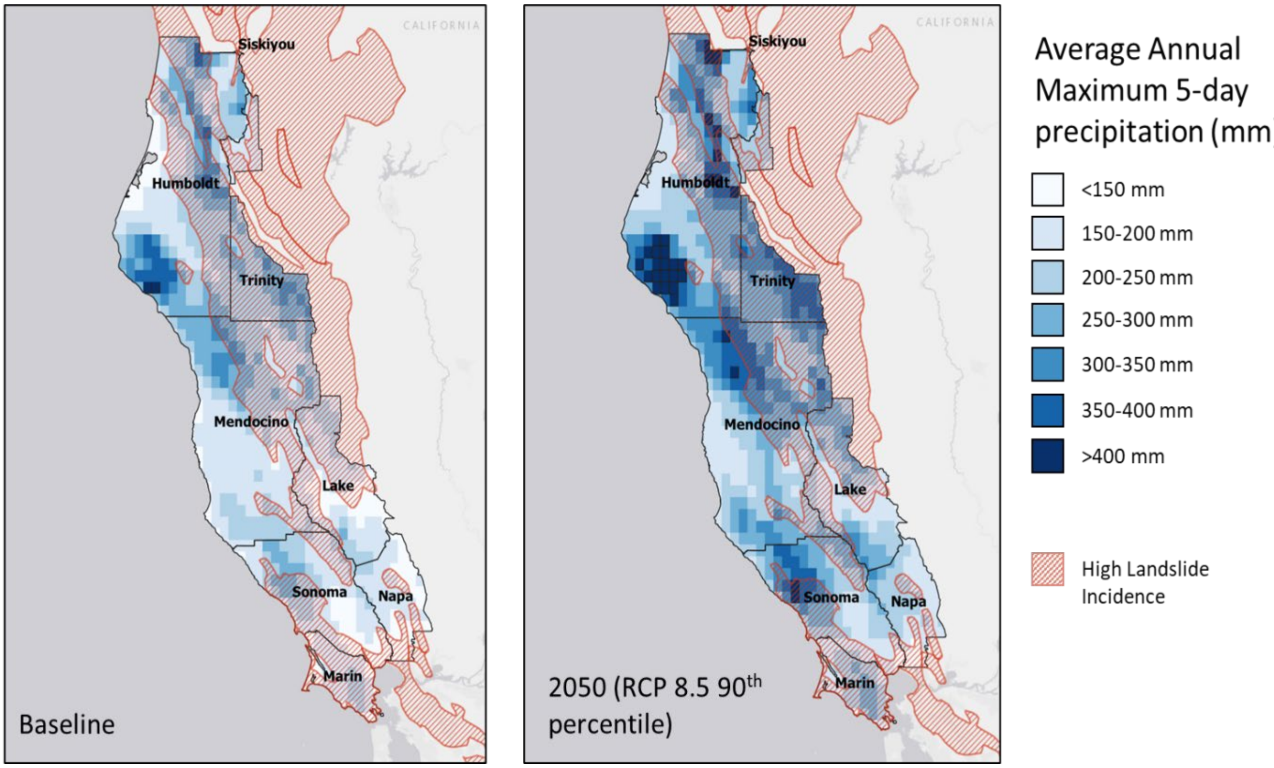


Figure B-20. Projected average annual 5-day maximum precipitation under baseline conditions (1976–2005) and in 2050 in the North Coast Region.

Sea Level Rise

The areas of the North Coast Region that are most vulnerable to sea level rise are in Humboldt Bay and the Eel River Inlet (both in Humboldt County) and the Garcia River Inlet (Mendocino County) in the north part of the Region and also along the coast of Marin, Sonoma, and Napa Counties, in the south part of the Region (Figure B-21 and Figure B-22).

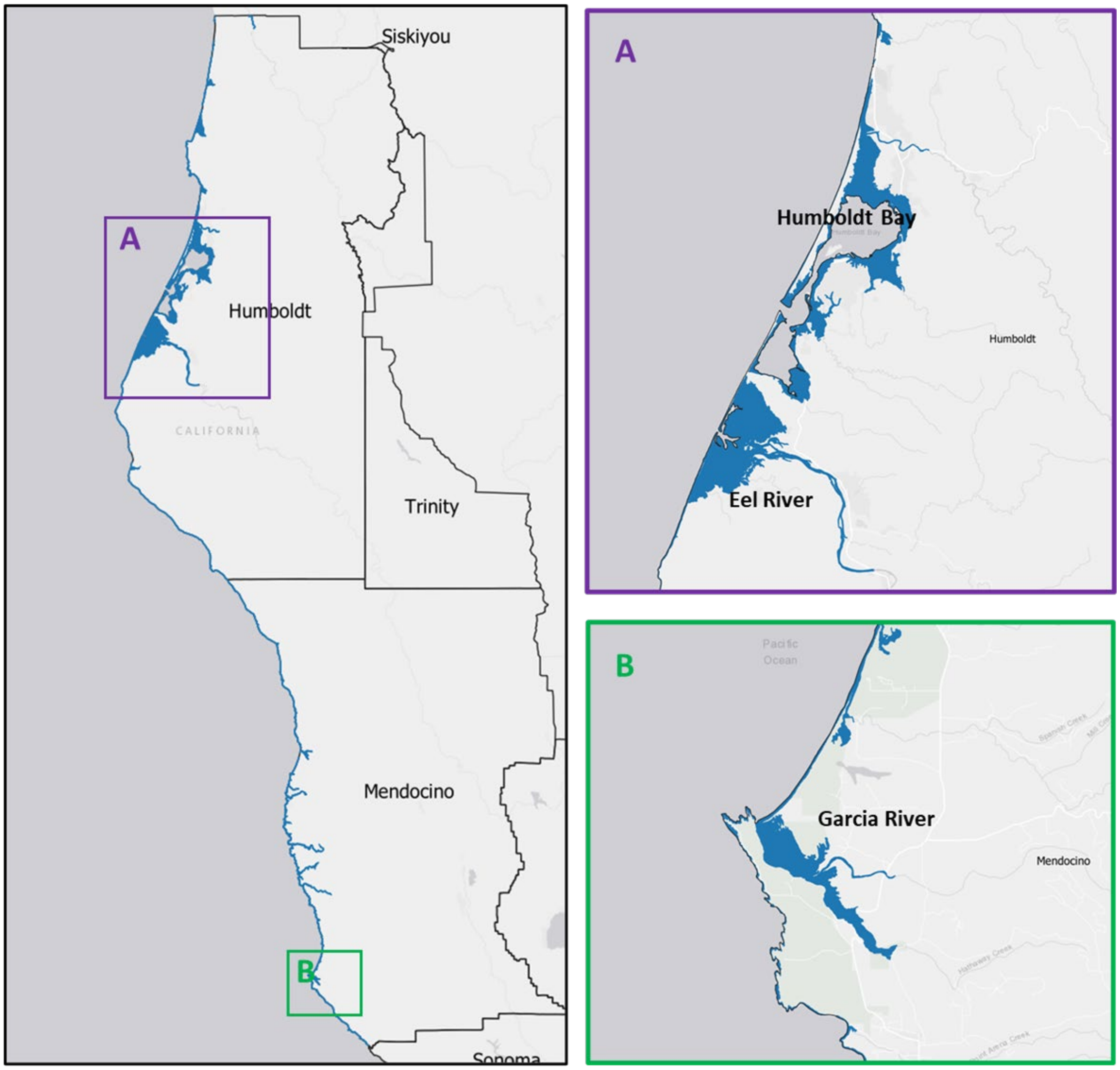


Figure B-21. 2050 Sea level rise inundation (with 100-year flood levels) along the North Coast. Two zoomed-in areas of concern are: A) Humboldt Bay and Eel River Delta in Humboldt County and B) Garcia River Inlet in Mendocino County.

Figure B-22. 2050 Sea level rise inundation (with 100-year flood levels) for 2050 in the southern part of the North Coast Region and along the coastline of Marin, Sonoma, Napa, and Solano counties.

Wildfire

Approximately 85 percent of the North Coast Region is within an HFRA, and average annual hectares burned are expected to increase through mid-century (Figure B-23). The areas of the region closest to the coast have had historically low magnitudes of hectares burned, but these areas also increase in projected fire prevalence through mid-century. More inland, as vegetation density increases near northern Lake County, eastern Mendocino County, and southeastern Trinity County, the average number of hectares burned increases up to nearly 100 percent by 2050 (Figure B-23).

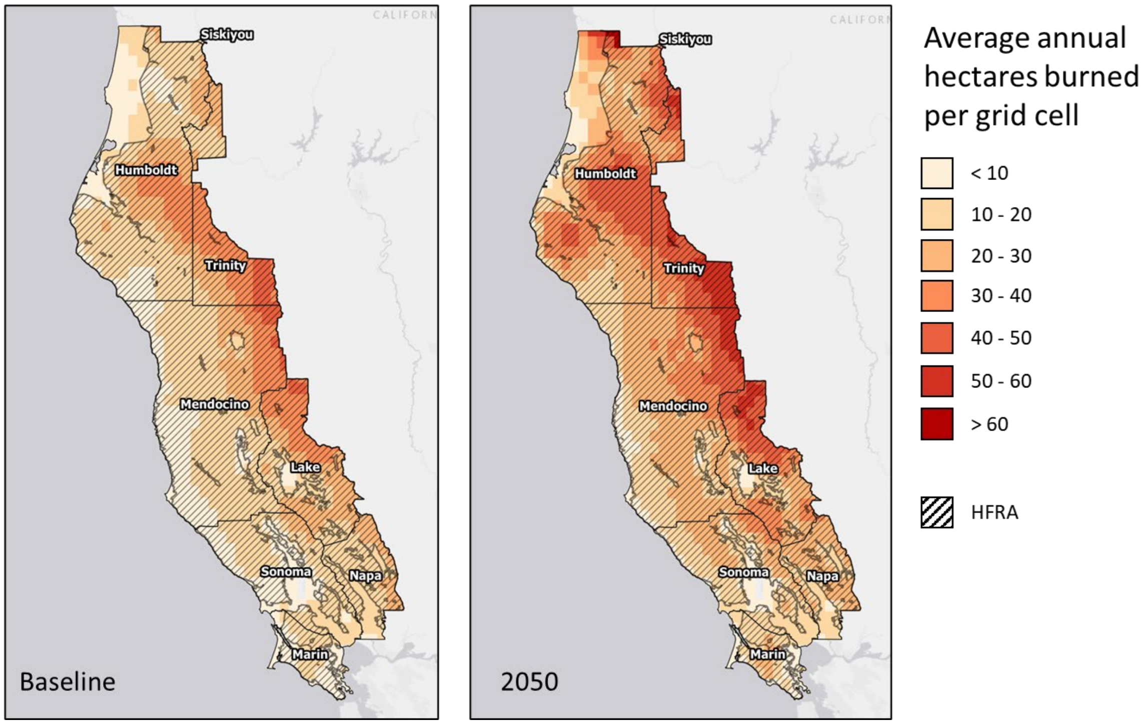


Figure B-23. Average annual hectares burned in the North Coast Region during the baseline period (1976–2005) and in 2050.

Drought-Driven Subsidence

Historically, drought-driven subsidence has not been a major concern for this region.

Central Coast Region

Temperature

Both average annual and extreme high temperatures are projected to increase across the Central Coast. Areas that have historically seen 98th percentile temperatures around 95°F to 100°F, including much of Santa Clara, San Benito, eastern Monterey, and northern and inland San Luis Obispo, are projected to see those temperatures increase to 105°F to 107°F by 2050, and cooler coastal areas in Monterey, San Luis Obispo, and Santa Barbara with historical 98th percentile temperatures in the 80°F to 90°F range are similarly projected to see approximately 5–7°F increases in hottest temperatures (Figure B-24).

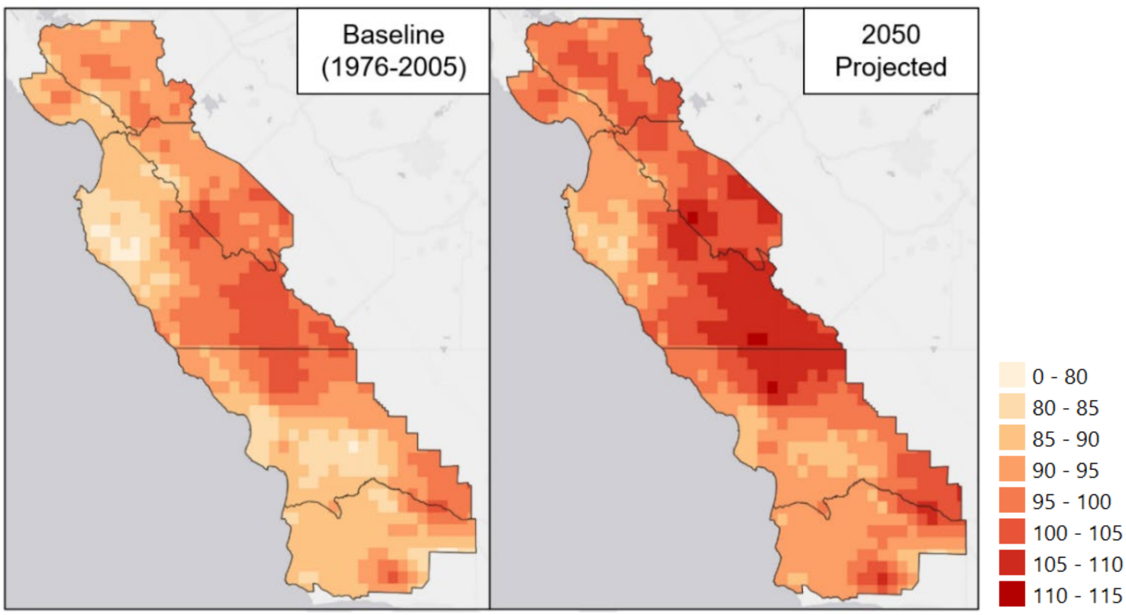


Figure B-24. 98th percentile historical and 2050 temperatures for the Central Coast Region.

Flooding and Precipitation

5 percent of the Central Coast Region falls within the FEMA 100-year floodplain, with an additional 2 percent falling within the 500-year floodplain. The majority of the 100-year floodplain extent is in Santa Clara County (11 percent of the county).

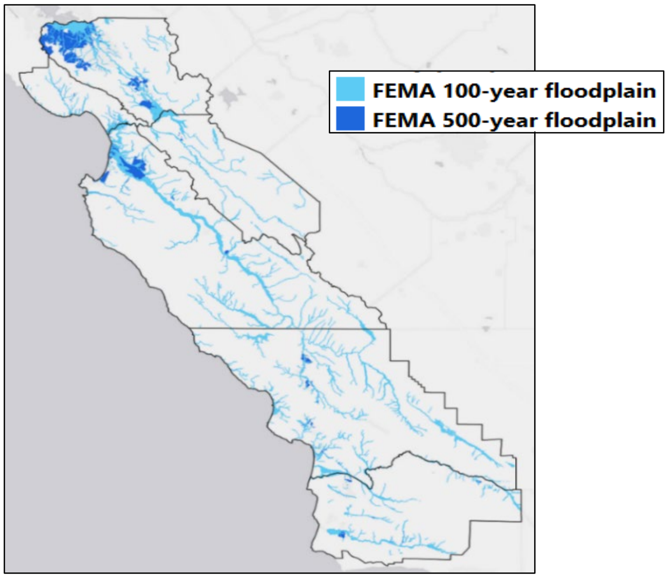


Figure B-25. Central Coast areas located in the FEMA 100-year and 500-year floodplains.

Coastal regions are projected to see more intense and frequent precipitation events (Figure B-26). Projected increase in large precipitation events vary by location with relative spatial patterns remaining largely consistent with present-day patterns. 14 percent of the Central Coast Region is located within high landslide risk areas (Figure B-26).

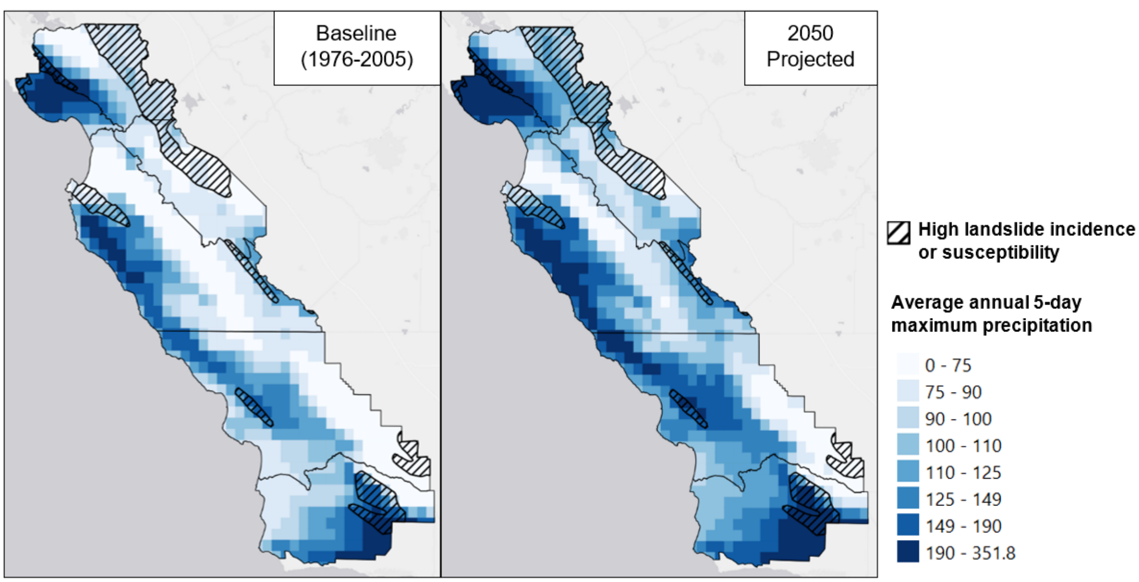


Figure B-26. Projected average annual 5-day maximum precipitation under baseline conditions (1976–2005) and in 2050.

Sea Level Rise

Coastal flooding hazards are projected to increase along much of the coastline, particularly in lower elevation coastal areas including Santa Clara along the San Francisco Bay, southwest Santa Cruz and northwest Monterey, the Morro Bay area of San Luis Obispo, and near the Santa Ynez River in Santa Barbara (Figure B-27).

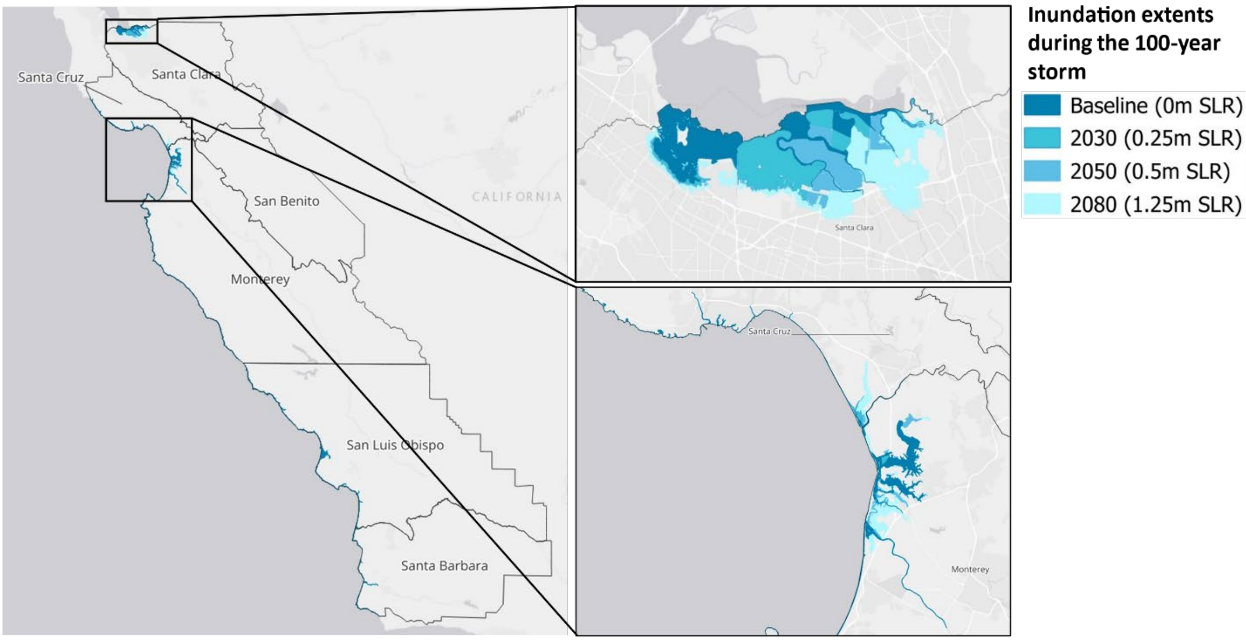


Figure B-27. Central Coast Region inundation during a 100-year storm event under baseline conditions and potential 2030, 2050, and 2080 sea level rise extents.

Wildfire

Approximately 64 percent of the Central Coast Region lies within an HFRA. These areas are concentrated along the coast of the territory as well as some regions farther inland, such as in northeastern Monterey and San Benito, and central San Luis Obispo and Santa Clara (Figure B-28).

By 2050, average annual burn areas within the Central Coast Region could increase by a projected 11 percent (Figure B-28). The regions with the current and projected future greatest hectares burned per grid cell are western parts of San Benito, Monterey, San Luis Obispo and Santa Barbara counties. Northwestern Santa Cruz and Santa Clara, along with southeastern Monterey and San Luis Obispo, currently experience relatively fewer hectares burned, a pattern that is projected to continue in the future (Figure B-28).

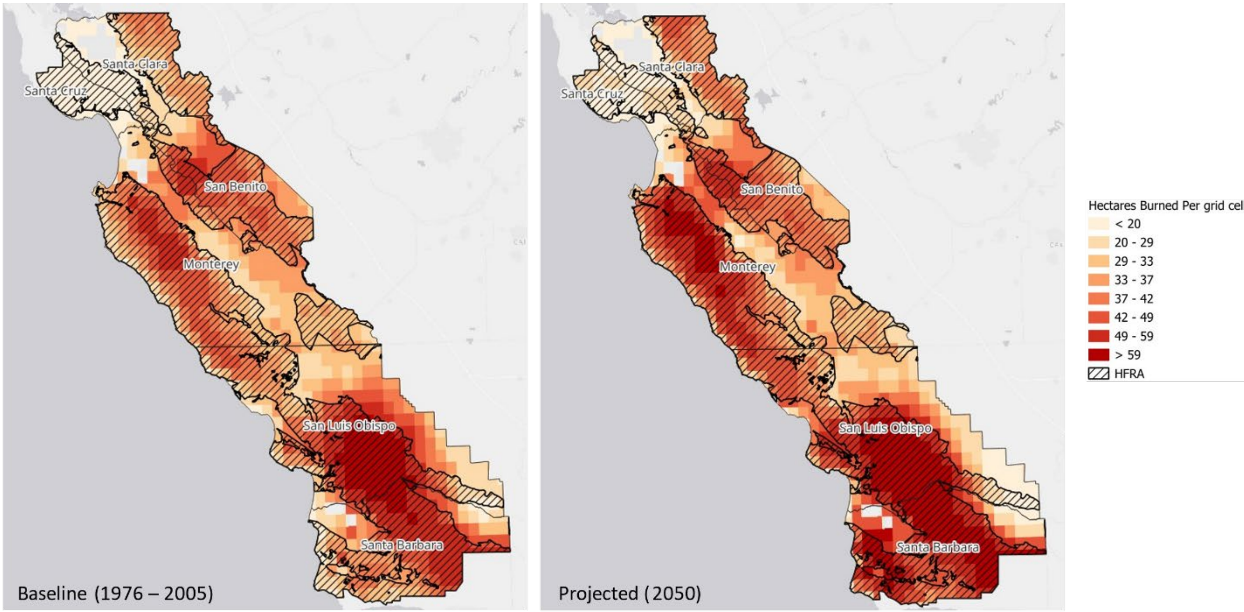
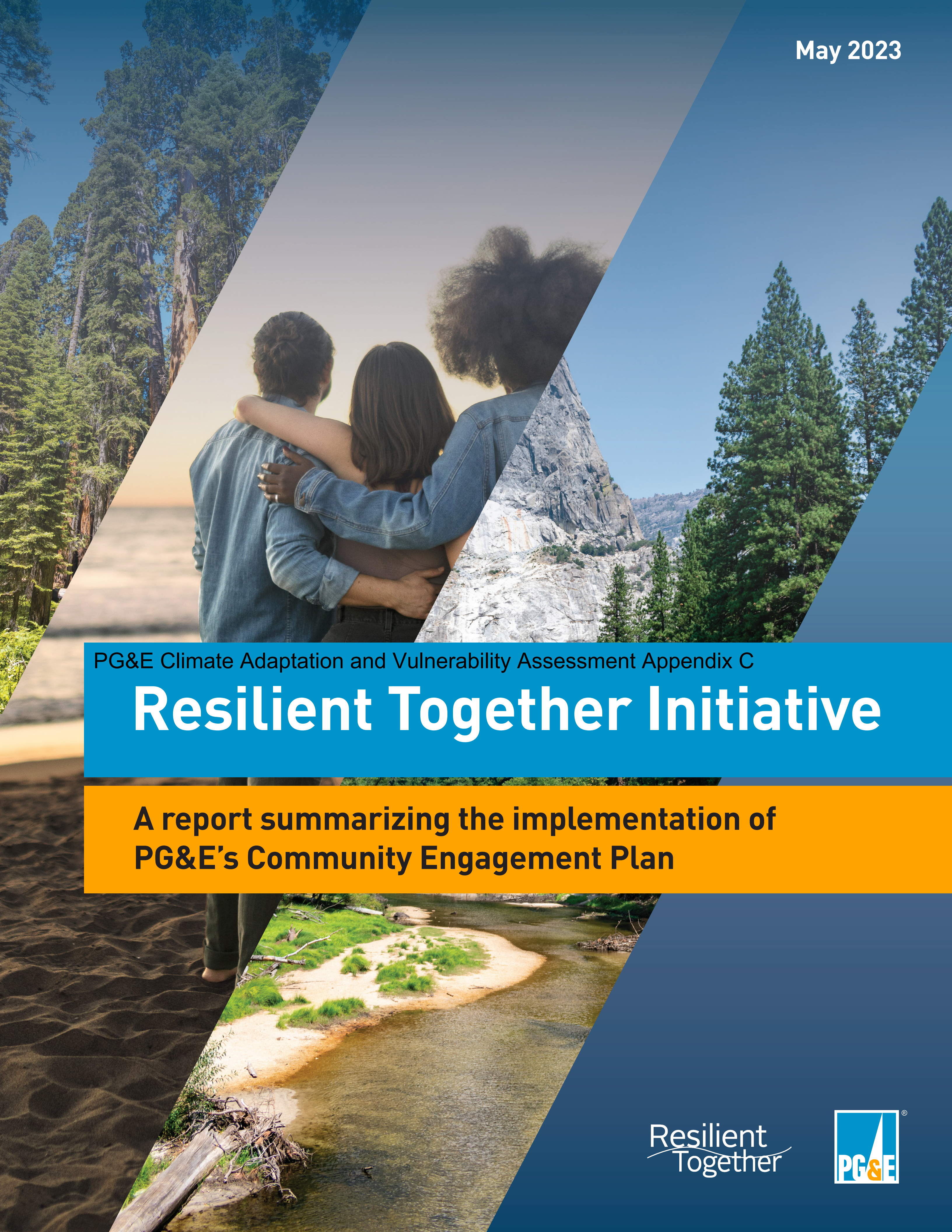


Figure B-28. Central Coast average annual area burned baseline (left) and projected 2050 (right).

Drought-Driven Subsidence

Subsidence related to groundwater pumping has been observed in the Central Coast Region in the Paso Robles area (in San Luis Obispo County) and the Cuyama Valley (which is at the border of San Luis Obispo and Santa Barbara counties);[23] however, rates are relatively low, and subsidence is not projected to be a major concern for the region.

[23] U.S. Geological Survey. "Areas of Land Subsidence in California." Subsiding Areas in California | USGS California Water Science Center



May 2023

PG&E Climate Adaptation and Vulnerability Assessment Appendix C

Resilient Together Initiative

A report summarizing the implementation of PG&E's Community Engagement Plan

Resilient Together

PG&E

REPORT CONTENT

APPENDICES

This report was created in collaboration with InterEthnica and Farallon Strategies

Executive Summary

In response to the California Public Utilities Commission's (CPUC) climate change planning mandates for each investor-owned utility, Pacific Gas and Electric (PG&E) is conducting its first Climate Vulnerability Assessment (CVA). **The purpose of the CVA is to identify vulnerabilities within PG&E infrastructure and how climate hazards and energy disruptions that occur as a result of these hazards impact communities within PG&E's service area.**

Resilient Together is an initiative by PG&E to learn how climate change impacts customers and communities throughout PG&E's service area. The community insights and recommendations documented in this report will be used to develop a dedicated section of PG&E's CVA that centers community resilience. PG&E's Resilient Together initiative, with support from InterEthnica and Farallon Strategies (Project Team), encompasses the development and implementation of PG&E's Community Engagement Plan (CEP) for each of the five regions[1] in PG&E's service area. The CEP documents how PG&E engaged with Disadvantaged and Vulnerable Communities (DVCs) to inform the development of PG&E's CVA.

The goals of the Resilient Together initiative are:

1. Learn how customers experience climate hazards and impacts, including energy disruptions.
2. Learn how PG&E can improve customer resilience through existing or new programs and investments.
3. Strengthen relationships and build equity-centered trust within PG&E's regions.

The main body of this report describes the engagement process, documents an inclusive community engagement approach, and summarizes key findings from the Resilient Together initiative across regions. The appendices detail the key findings for each PG&E service area region.

Key findings are presented in the following four sections:

A. Defining Climate Vulnerable Communities
B. Climate Hazards and Impacts
C. Adaptive Capacity
D. Resilience Strategies and Recommendations

1 The five regions include the Bay Area Region; the San Joaquin Valley Region; the North Valley, Sacramento, and Sierra Region; the North Coast Region; and the Central Coast Region

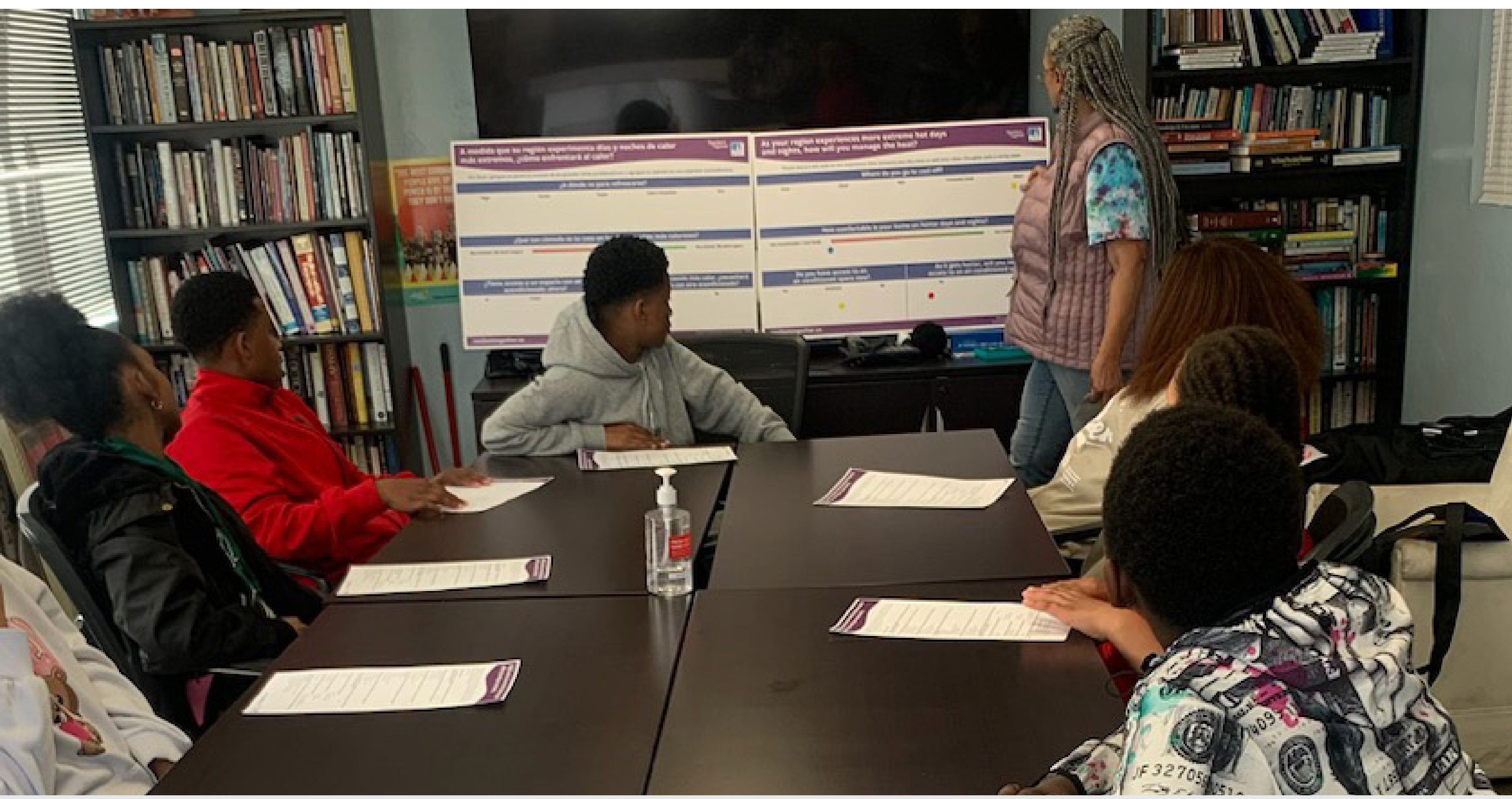
The formation of Resilient Together Advisory Groups (RTAG) was central to the implementation of the CEP. RTAG members are community-based organizations (CBOs) with trusted relationships in communities throughout PG&E's service area. RTAG members conducted community outreach and served as on-the-ground partners on behalf of PG&E.

The Resilient Together initiative highlights how DVCs already experience a range of stressors, including high energy bills, lack of affordable and safe housing, air and water pollution, and a lack of public resources and services. Climate hazards exacerbate these existing stressors and result in cascading health and financial impacts.

Across hazards and regions, the Project Team found that community members support solutions that build household and community-level adaptive capacity. Households need greater financial support to afford increasingly high energy bills, safety resources, and retrofits that protect homes during climate hazards.

Historically marginalized, low-income communities need significant investments in community resources and services, including, but not limited to: resilience centers that have backup power; housing, transportation, and broadband infrastructure; and workforce development. These community investments are needed alongside infrastructural investments in order for PG&E to deliver safe and reliable energy.

RTAG members stressed that improved emergency communication, outreach, and education to customers through partnerships with CBOs is a critical first step to protecting community members and building community resilience. The Resilient Together initiative highlighted the critical role CBOs play in distributing information, resources, and services directly to customers and across regions, and CBOs expressed the need for greater and sustained financial and capacity building support to enable them to better reach and serve their communities.



The Village Project conducting youth member focus group, Seaside

Top Recommendations

Based on the recommendations received from RTAG members and community members engaged through the Resilient Together initiative, **the Project Team developed recommendations for PG&E** to build customer and community resilience:

1. Center equity in all decision making processes, investments, and programs.
2. Expand weatherization programs to provide highly subsidized or no-cost home improvements that make homes more resilient to a variety of climate hazards.
3. Provide distribution of free safety resources that improve household resilience.
4. Provide direct reimbursements for costs associated with power outages.
5. Maximize enrollment and longevity of existing PG&E programs in DVCs.
6. Provide financial support for the development and sustained operation of community resilience centers.
7. Improve emergency notifications and community education on hazards and resources.
8. Enable the expansion of distributed energy resources (DER) to help minimize power outages in DVCs.
9. Expand urban greening and forest management programs and investments.
10. Improve emergency evacuations and improve transportation access to cooling centers.
11. Invest in and expand existing workforce development programs.

All of the strategies in this report will be most effectively implemented with long-term, trusted partnerships, which PG&E should continue to foster and maintain with the communities it serves.

Introduction

From extreme weather to rising seas, California is experiencing the significant and increasing effects of a changing climate. In recent years, most Californians have suffered from the impacts of record-high temperatures, dry, as well as historically wet winters, prolonged drought, and wildfires. As a result of these increasingly frequent and severe climate hazards, Pacific Gas and Electric (PG&E) has already taken steps to build climate resilience through investments in its physical infrastructure, adapting its operations, and prioritizing the health and well-being of its customers.

In response to the California Public Utilities Commission's (CPUC) climate change planning mandates for each investor-owned utility, PG&E is conducting a Climate Vulnerability Assessment (CVA). The purpose of the CVA is to identify vulnerabilities within PG&E infrastructure and how climate hazards and energy disruptions that occur as a result of these hazards impact communities within PG&E's service area. The Resilient Together initiative seeks to center community resilience in the CVA by assessing how the cascading impacts from climate hazards affect customers at the household and community level.

Resilient Together Goals

The primary goals of the Resilient Together initiative are for PG&E to **(1) learn how customers in Disadvantaged Vulnerable Communities (DVCs) experience the impacts of energy disruptions that result from climate hazards** and **(2) better understand how PG&E can improve customer resilience through more equitable programs**.

The Resilient Together initiative seeks to bridge the gap in understanding between infrastructure vulnerability, community priorities, and household-level impacts. By doing this, PG&E can develop a better approach to managing and mitigating the impacts of climate hazards on its customers, and make investments to create a safer, more reliable, and equitable energy system. The findings of the Resilient Together initiative will inform PG&E's CVA and decision-making regarding future investments in communities throughout the service area.

The Resilient Together initiative seeks to strengthen and develop new relationships in low-income, marginalized communities, and communities of color, while also helping to build trust. This project provides PG&E an opportunity to identify and build new relationships with community-based organizations (CBOs), as well as sustain existing ones. Partnering with CBOs who have experience conducting outreach and existing relationships within communities served by PG&E allows for culturally relevant and effective engagement. As service and resource providers, CBOs are also knowledgeable of the barriers and gaps in services that prohibit community members from preparing for and recovering from hazard events.

This project provides PG&E an opportunity to identify and build new relationships with community-based organizations.

This report documents the process and outcomes of the Resilient Together initiative for PG&E's Climate Resilience Team. Specifically, this report describes the methodology for developing and implementing the Community Engagement Plan (CEP), the key findings of the engagement, the Project Team's recommendations, and how PG&E can utilize an Equity Framework to support PG&E's goals for climate resilience plans and investments to benefit communities with the greatest need. Region-specific data and information for each component are included in the Appendix. Information presented in this report will be integrated into a focused section of the CVA that will be submitted to the California Public Utilities Commission (CPUC).

Process & Methodology

The Resilient Together initiative is informed by the CPUC's Order Instituting Rulemaking (OIR) 18-04-019 to Consider Strategies and Guidance for Climate Change Adaptation, which ordered each state's utility companies to develop a CVA.

The Commission initiated Rulemaking (R.)18-04-019, the Climate Adaptation Rulemaking, on April 26, 2018, with the purpose of "addressing how energy utilities should plan and prepare for increased operational risks due to changing climate conditions and heightened risks from wildfires, extreme heat, extreme storms, drought, subsidence and sea level rise, among other climate change phenomena."[2]

The OIR directs each of the investor-owned utilities (IOUs), including PG&E, to file a climate change vulnerability assessment every four years, one year prior to the filing of each IOU's General Rate Case submission, and on the same day as the filing of the IOU's Risk Assessment Mitigation Phase application. In addition, the OIR directed IOUs to develop a CEP documenting how IOUs engaged with DVCs to inform the development of the CVA. CEPs must be filed every four years, one year before the filing date of the CVA.

Please note: Some photos in this report are redacted to protect the privacy of our community members.

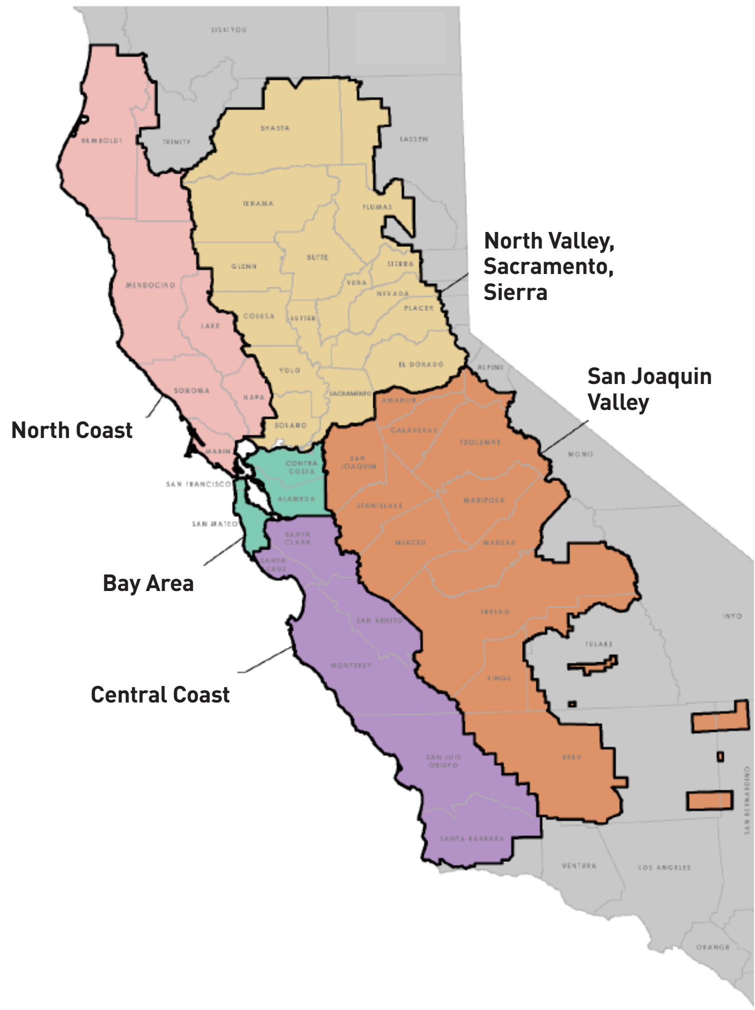
Little Manila Rising members, Stockton

2 CPUC's Order Instituting Rulemaking (OIR) 18-04-019 to Consider Strategies and Guidance for Climate Change Adaptation D.20-08-046, p. 2.

Regional Approach

Given the significant geography of PG&E's service area, the CEP for the Resilient Together initiative reflects PG&E's regional service model, which is organized by PG&E's five distinct regions:

1. **Bay Area**
2. **San Joaquin Valley**
3. **North Valley, Sacramento & Sierra**
4. **North Coast**
5. **Central Coast**



During the implementation of the Resilient Together project, the Bay Area Region included Santa Clara and Marin counties. PG&E has since updated their regions as reflected in the map above.

The Project Team's approach featured the development of regional advisory groups comprised of CBOs. CBOs can provide specific information about community vulnerabilities and adaptation needs. Resilient Together Advisory Group (RTAG)[3] members advised the Project Team on the methodology for the Resilient Together initiative. RTAG members supported the implementation of the Community Engagement Plan by conducting on-the-ground outreach in the communities they serve. Some RTAG members chose to serve an advisory role due to capacity constraints. Those who conducted community outreach are referred to as "Outreach Partners." Each Outreach Partner was expected to reach or engage at least two hundred community members as part of their outreach efforts.

Across the five regions, the Resilient Together initiative partnered with 52 CBOs to conduct over 200 outreach activities, resulting in a total of 5,754 surveys completed across 451 unique zip-codes and 49 unique counties. Table 1 provides a summary of events, hours, and reach for each region.

3 In the Bay Area Region, the advisory group was called the "Equity Advisory Group." In all other Regions the advisory group was renamed "Resilient Together Advisory Group," or RTAG. For simplicity and consistency, all advisory groups are referred to as the "Resilient Together Advisory Group" for all regions, including the Bay Area Region.

TABLE 1. Summary of RTAG Reach Across Regions

Region	# Advisory Group Meetings	# Events	# People Reached
Bay Area	6	32	~1200
San Joaquin Valley	5	35	~2660
North Valley, Sacramento & Sierra	5	35	~1060
North Coast	5	54	~1258
Central Coast	5	58	~1471
Totals	**26**	**214**	**~7649**

Recruitment of Advisory Group Members

The Project Team sought to recruit CBOs that represented low-income, racially diverse, and/or historically underrepresented or underserved populations throughout PG&E's service area.

The Bay Area Region served as a pilot region for the Resilient Together initiative. Recruitment and selection of RTAG members in the Bay Area Region included the following steps:

1. **Framework and Nominations.** The Project Team, through existing relationships and solicitation of interest via a survey, reached out to representatives from selected regional Bay Area organizations to assist in[4]:
   - Reviewing and providing feedback on the RTAG structure and role
   - Nominating candidates to serve on the RTAG
   - Creating channels of communication and building trust with CBOs in climate vulnerable communities.

2. **Application.** The Project Team sent RTAG Nominees an application to join the RTAG. The application asked for RTAG candidates' experience planning and implementing community outreach and engagement efforts, advancing racial justice or socio-economic equity, as well as their capacity to conduct outreach between June and August 2022.

3. **Selection.** The Project Team assessed RTAG applications based on applicant responses and the geographic diversity of applicants and associated organizations to ensure the RTAG represented distinct areas of the Bay Area.

4. **Onboarding.** The Project Team worked with selected RTAG members to revise outreach plans as needed to ensure each CBO would reach as many community members as possible.

4 Engagement conducted on behalf of the Resilient Together initiative was separate from PG&E's engagement with Tribal Governments but was inclusive of Indigenous communities.

Based on the lessons learned and RTAG member feedback in the Bay Area Region, the Project Team revised the recruitment approach for the remaining regions. The following describes the modified approach for recruiting, selecting, and onboarding RTAG members in all other regions.

1. **CBO Pre-identification.** The Project Team identified and reached out to PG&E's existing CBO contacts. In regions where there were fewer existing CBO contacts or gaps in diversity, the Project Team researched additional CBOs in the region. The Project Team recruited CBOs that represented diverse ethnic/racial, geographic, and service areas (e.g., food access, disability services, workforce development, LGBTQ outreach, etc.).

2. **Research Interviews.** The Project Team conducted in-depth one on one interviews with up to 12 CBOs for each region (34 in total). The research interviews included four objectives: 1) Identify vulnerable communities and language access needs, 2) Understand climate hazards and impacts of concern, 3) Understand the adaptive capacity of communities in the region, and 4) Identify the interest and capacity of CBOs to participate as RTAG members or refer other CBOs that would have the interest and capacity.

3. **RTAG Onboarding.** The Project Team conducted follow up calls and sent interested CBOs the RTAG partner Participation Expectations Form and an Outreach Plan Form (Appendix G) for CBOs to describe their approach to conducting outreach activities in their communities, and to request outreach materials in advance.

Resilient Together Advisory Group Meetings

The Project Team captured these insights over five RTAG meetings per region. During these meetings, RTAG members shared their outreach plans, roleplayed outreach scenarios, received peer mentoring, reported on key findings from the field, and built connections with other RTAG members. These meetings also provided RTAG members, as community leaders and representatives, an opportunity to share their own insights on vulnerable populations, climate impacts, and preferred solutions to supplement the findings from the community outreach.

Timeline and Budget

The Resilient Together initiative launched in October 2021 and concluded in May 2023. The deadline for PG&E's submission of the CEP is May 2023, and the CVA is May 2024. The Resilient Together initiative was conducted between May 2022–May 2023. The Outreach Period for each region (Table 2) was approximately two months.

TABLE 2. Outreach Period by Region

Region	Outreach Period
Bay Area	June 13th – August 26th 2022
San Joaquin Valley North Valley, Sacramento & Sierra	October 4th – November 30th 2022
North Coast Central Coast	January 9th – April 3rd 2023

RTAG members attending advisory group meetings received compensation for participating in each meeting. Outreach Partners received compensation for designing, leading, and implementing (including data collection and reporting) community engagement events. Additional funding was made available to Outreach Partners to cover additional costs associated with conducting community outreach, including meeting costs (i.e., venues, food and beverages, childcare, additional printed materials, etc.) for each hosted community event and prepaid gift card stipends for community survey/focus group participation. Additional funds were allocated to cover the cost of interpreters for each region. Table 3 below describes the compensation structure for each activity.

TABLE 3. Resilient Together Compensation Structure

Outreach Activity	Amount
Outreach Partner CEP Implementation	$10,000/organization[5]
Community Meeting Costs	$500/organization
Interpreters	$8,000/region
Survey Incentives	$2,000/outreach partner
RTAG Meeting Participation	$500/member/meeting

Tools of Engagement

The Project Team developed outreach tools to support the engagement effort. All materials were reviewed by the Bay Area Region RTAG (as the pilot region). Outreach collateral were ultimately translated into languages that were identified, via RTAG members and the research interviews, to be spoken by target communities throughout all regions. Materials were translated into the following 10 languages:

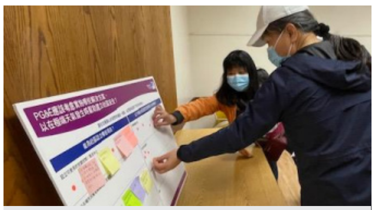
- Arabic
- Chinese
- English
- Russian
- Samoan
- Spanish
- Tagalog
- Tongan
- Tigrinya
- Vietnamese

5 Outreach Partners were compensated $9,000/organization in the Bay Area Region. This amount was increased to $10,000 in all other regions, based on Bay Area RTAG member feedback.

Chinese Newcomers Service Center, Membership Meeting, San Francisco

Survey

The Bay Area Region survey included 12 questions focused on understanding impacts, preferred strategies, and adaptive capacity. The survey was revised for the other Regions to capture optional demographic (e.g., income, race/ ethnicity) and geographic information, allowing the Project Team to provide more culturally and geographically specific analysis and recommendations. The survey was also provided digitally, along with QR codes, to allow for mobile phone access during community events.



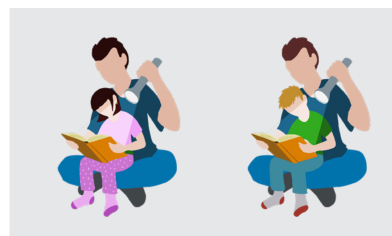
Chinese Newcomers Service Center, Membership Meeting, San Francisco

Outreach Boards

The Project Team provided interactive outreach boards to Outreach Partners who displayed them at tabling events and workshops, allowing participants to place sticky notes next to the climate impacts they experience and share their ideas for resilience strategies they support.

Social Media Toolkit

The Resilient Together Social Media Toolkit included a sample eblast and newsletter copy, and a recommended series of social media posts with culturally attuned graphics of diverse communities.



Informational Flyers

Project Overview Flyer

A Resilient Together branded one-page handout provided basic information about the project and engagement process. The flyer included a QR code to allow for mobile phone access during community events and a link to the survey.

Facilitation Guide

The Resilient Together facilitation guide included a list of talking points and sample scripts for Outreach Partners to use when conducting engagement, which supported consistent messaging to community members.

Wildfire Flyer[6]

The informational Wildfire Flyer provided by PG&E contained information about ongoing efforts to address wildfire risk and impacts across the PG&E service area.

Fausiaina o Nu'u ma Afioga ina ia mafai ona Tali Atu i Suiga o le Tau

Resilient Together Bay Area

PG&E

O le galulue fa'atasi e tali atu ai i fa'alavelave ma suiga o le tau o se fuafuaga a le PG&E e amatalia ai e fa'alapotopotoga a nu'u ma afioaga ona a'oa'oina ma malamalama i a'afiaga o le vevela maualuga, lologa, ma afi sosolo i le Bay Area. O Su'esu'ega i le Maaleale ona o Suiga i le Tau e le PG&E o lo'o iloa ai le si'itia o le leaga o le tau, a'afiaga i atina'e taumalosiaga fa'apea nu'u o lo'o latalata i le Bay Area. E ao ona malamalama i gaioiga e fa'atino e nu'u ma afioaga i taimi o se fa'alavelave fa'alenatura ma tulaga leaga o le tau, e mafai ai e le PG&E ona fuafua mamao nisi gaioiga talafeagai ina ia si'itia ai le tali atu i le lumanai.

Mafuaaga e tatau ona e auai ai?

O lo'o saili e le PG&E ni ou manatu fa'asoa mai ina ia mautu tulaga tatau ona fa'aatino ao si'itia ai le tupulaia ma le ogaoga o fesuiaiga o le tau, mo i latou o lo'o maaleale ma a'afia gofie ia malamalama i auaunaga ma vaega eseese latou te agava'a ai ina ia saogalemu ma malupuipuia tagatanu'u lautele.

O ou manatu e fesoasoani i le PG&E i fuafuaga ma fa'aiuga e fa'atatau i tali atu i suiga o le tau fa'apea atina'e, fesoasoani mo le saogalemū, ma ia si'itia tulaga o malosiaga.

Fa'atino vave se Su'esu'ega!

E fa'apefea ona e gafatia le maualuga o le tau vevela, asu ma afi sosolo ma isi suiga o le tau?

Pu'e le ata i le telefoni pe asiasi le itulau o le surveymonkey.com/r/PGESA

O nisi o auala e mafai ona e auai ai

Ina ia mautinoa o lagona manatu o lou nu'u, e valaaulia oe e le Resilient Together Bay Area ina ia e auai e fa'asoa ou manatu ma lou tomai i mataupu eseese i masina o lumanai nei.

Asiasi ane i le upega-tafai-lagi www.resilienttogether.us

A'oa'oina atili i A'afiaga Ogaoga o le Tau i le Bay Area.

Lesitala aua talafou ma nofo silafia i mea o lo'o tutupu i totonu o nu'u.

Fa'asoa lou tomai ma ou manatu.

Flyer in Samoan

CARE/FERA/Medical Baseline Applications

Per RTAG member requests, digital applications for the California Alternate Rates for Energy (CARE), Family Electric Rate Assistance (FERA), and Medical Baseline programs were provided.

6 The wildfire flyer was only available in English.

Lessons Learned

Throughout the Resilient Together initiative, and particularly in the Bay Area Region (the pilot region), **the Project Team learned many lessons on how to improve the Project Team's processes in implementing an equity centered Resilient Together initiative for future regions and community engagement initiatives.** As this process is repeated and improved in the future, the Project Team recommends a consistent, scalable, equitable, and transferable process, including:

Develop a consistent onboarding process.

Design questions to inform consistent data collection.

Develop meeting concepts and share agendas in advance.

Co-create outreach materials with community partners.

Provide information and ongoing support to community partners.

Upload data-capture from each community engagement event.

Inclusive Community Engagement Approach

The Resilient Together initiative is intended to support a variety of priorities, including a better understanding of effective equitable community engagement for use by PG&E, other IOUs, and more generally, as support for a more effective community of practice. The practices found through Resilient Together respond to the CPUC's priorities to support of DVCs.

Based on direction received from the RTAG members, the Project Team identified the following approach for equitable community engagement throughout the initiative, which are categorized as follows:

1 Support & Communication

Acknowledge that projects such as the Resilient Together initiative should move at the speed of trust.

Communicate how community input collected will be used.

Be flexible to accommodate community partners' outreach approaches.

Support collaboration among community partners in advance of outreach and engagement periods.

Provide ongoing support to community partners. Reduce administrative burdens on community partners. Extend outreach and engagement periods.

Invest more time in rural and remote areas.

Plan to invest more time in DVCs located in regions most impacted by climate hazards.

2 Outreach Materials

Use simple language, avoid dense text blocks, and add visuals that resonate.

Use culturally appropriate/translated materials.

Tailor approach in remote and communities greatly impacted by climate hazards.

3 Meeting Facilitation

Enable live transcription.

Design interactive meetings and use visualization tools.

Facilitate in clear and accessible language for community members.

4 Survey Collection

Keep surveys short.

Don't ask for personally identifying information.

Collect demographic information.

Key Findings

The Resilient Together initiative is intended to achieve three primary goals:

1. Learn how customers experience climate hazards and impacts, including energy disruptions.
2. Learn how PG&E can improve customer resilience through existing or new programs and investments.
3. Strengthen relationships and build equity-centered trust within PG&E's regions.

These goals inform the Project Team's organization of the Key Findings presented in the following four sections:

A. Defining Climate Vulnerable Communities

B. Climate Hazards and Impacts

C. Adaptive Capacity

D. Resilience Strategies and Recommendations

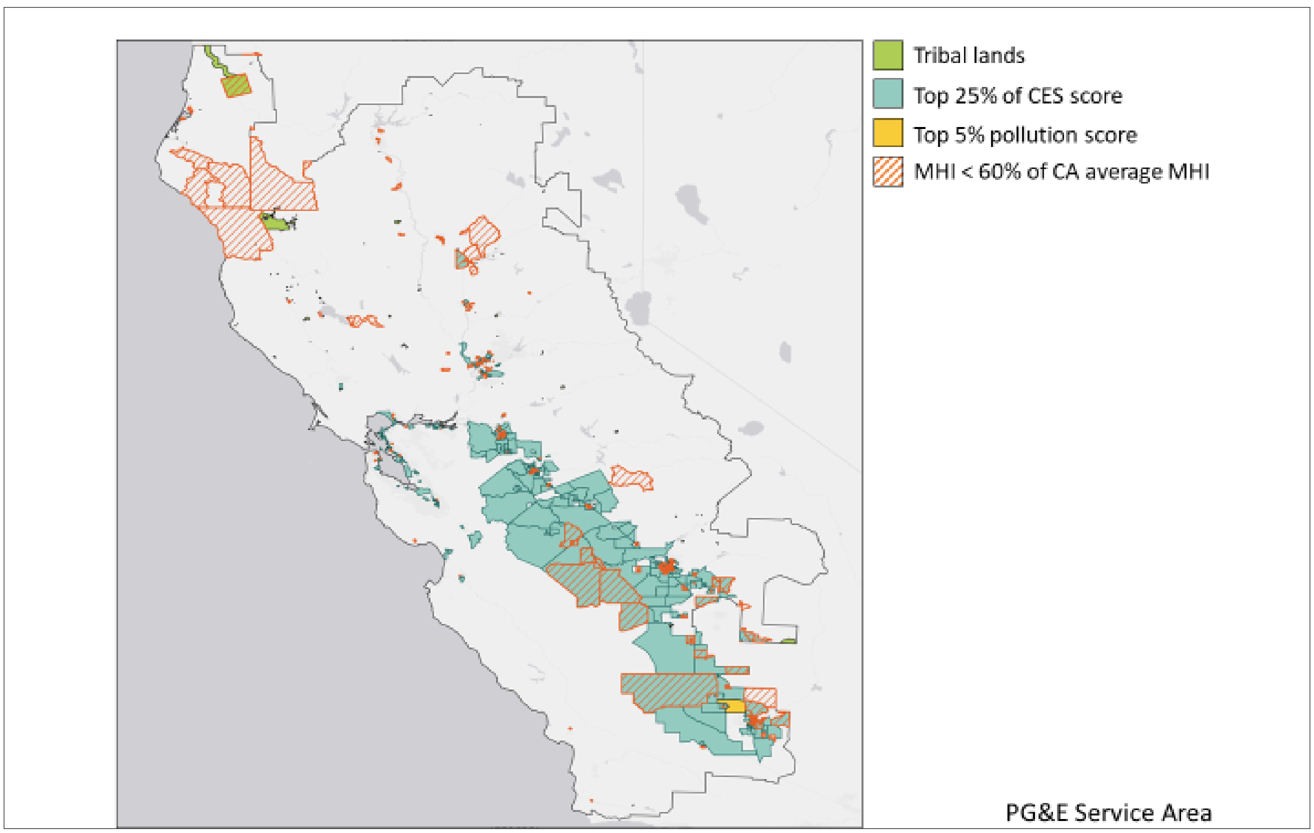
The Key Findings include all five regions in PG&E's service area. For each region, there are differences in priorities across these categories, which are described in the regional appendices.

Adaptive Capacity

The CPUC had directed the investor-owned utilities to target outreach DVCs, consistent with its Environmental and Social Justice Action Plan goals and Disadvantaged Community Advisory Group Guiding Principles. The project team consulted several tools to identify communities in PG&E's service regions that suffer most from economic, health, and environmental burdens, including the CalEnviroScreen, Census data, and the Baseline Resilience Indicators for Communities Index (BRIC)[7].

The project team utilized data sets to supplement RTAG and community input in developing a broader understanding of adaptive capacity within each region for PG&E to use to evaluate future decisions on climate resilience programs and investments, such as BRIC. Though these tools offered a good starting point for assessing communities highly impacted by climate hazards, during the RTAG workshops across all regions, members shared that those tools are not inclusive to many of their community members. For example, the CalEnviroScreen definition only measures census tracts with less than 60% of the state median income and those that are highly pollution-burdened, leaving many low-income and climate-impacted communities out.

FIGURE 1. Disadvantaged and Vulnerable Communities in PG&E Service Area



7 Baseline Resilience Indicators for Communities Index, Hazards Vulnerability & Resilience Institute, University of South Carolina https://sc.edu/study/colleges_schools/artsandsciences/centers_and_institutes/hvri/data_and_resources/bric/index.php

The project team worked closely with community-based organizations, RTAG members, and DVCs to identify gaps in tools designed to include and prioritize climate-vulnerable communities. Recognizing that all data-driven tools would only tell a fraction of the story because humans are real and complicated, and many DVCs have experienced harm from decisions made by people in powerful positions, the need to craft a strategy centered in equity that is inclusive, builds trust, and empowers community-driven decision-making became evident. Thus, an Equity Framework was developed through an effort led by the consultants at InterEthnica, in collaboration with their partners at Farallon, PG&E, and the RTAG members.

"Climate change is a major civil rights issue."
—Central Coast RTAG Member

The design of the Equity Framework (see page 31) was a community-led process that identifies the most inclusive definition of which communities to prioritize, later deemed "Climate Vulnerable Communities" (Table 4). It is designed to help government work through a series of questions to identify and prioritize DVCs and define opportunities through relationships with the community and their partner agencies resulting in more climate-resilient communities. In the context of this project, climate-vulnerable communities encompass both DVCs and additional specific community types identified by the RTAGs as vulnerable to climate change to ensure more equitable future outcomes that would uplift all highly impacted communities.

TABLE 4. Climate Vulnerable Community Types

Community Type	Bay Area	San Joaquin Valley	North Valley, Sacramento, and Sierra	North Coast	Central Coast
Low-income Communities	X	X	X	X	X
Unsheltered Communities	X		X	X	
Communities of Color	X		X		X
Limited English Proficient Communities			X		X
Indigenous Communities	X	X	X	X	X
Youth	X	X	X		X
Seniors			X	X	
Essential Workers	X				
Outdoor Workers		X			X
Immigrant Communities	X				X
People with Disabilities	X				
Small Businesses			X		
Rural Communities		X	X	X	X

Assessments of adaptive capacity are critical to understanding community climate vulnerability, as they evaluate the readiness of communities to respond to short term shocks and long-term stresses induced by climate change. The CPUC's OIR states that "IOUs' vulnerability assessments for DVCs should include an analysis of the DVC's adaptive capacity."

The Project Team used the BRIC Index to assess the adaptive capacity across regions as a complementary tool to align with RTAG feedback. BRIC is a publicly available and academically vetted index pulling from federal government data developed for U.S. counties to better understand and measure resilience across counties.

The BRIC index measures six categories of community disaster resilience: social, economic, community capital, institutional, infrastructural, and environmental. The input variables are scaled from 0 (low adaptive capacity) to 1 (high adaptive capacity), with category scores then added up to create a composite BRIC score for each county. The project team then gathered each region's counties' BRIC scores to create a composite score for each region.

By assessing the adaptive capacity using BRIC category scores within each region (Table 5), PG&E can use this tool, in addition to RTAG and community feedback, as well as the Equity Framework to improve community resilience through existing or new programs and investments.

TABLE 5. BRIC Category and Composite Scores for PG&E Regions

Region	Bay Area Region	San Joaquin Valley Region	North Valley, Sacramento & Sierra Region	North Coast Region	Central Coast Region
Social	0.683	0.611	0.641	0.618	0.654
Economic	0.515	0.460	0.459	0.427	0.477
Community Capital	0.289	0.315	0.331	0.344	0.302
Institutional	0.379	0.377	0.389	0.371	0.402
Infrastructural	0.325	0.268	0.255	0.238	0.288
Environmental	0.555	0.498	0.535	0.563	0.528
BRIC Composite Score	**0.458**	**0.422**	**0.435**	**0.427**	**0.442**

Based on BRIC scores, the Bay Area Region has the greatest adaptive capacity compared to other regions due to higher social, economic, and infrastructural resilience. While this is generally consistent with the Project Team's findings based on RTAG engagement, the RTAG shared that regional scoring frameworks often gloss over pockets of the Bay Area that are severely economically distressed and lack access to affordable housing. A high social score reflects a large and growing number of highly educated, high-income people living in the Bay Area, but does not capture high levels of income inequality and homelessness that are also prevalent in the region. In addition, the low community capital score does not reflect RTAG input that highlighted strong social networks, connection to place, and active civic organizations, particularly within communities of color.

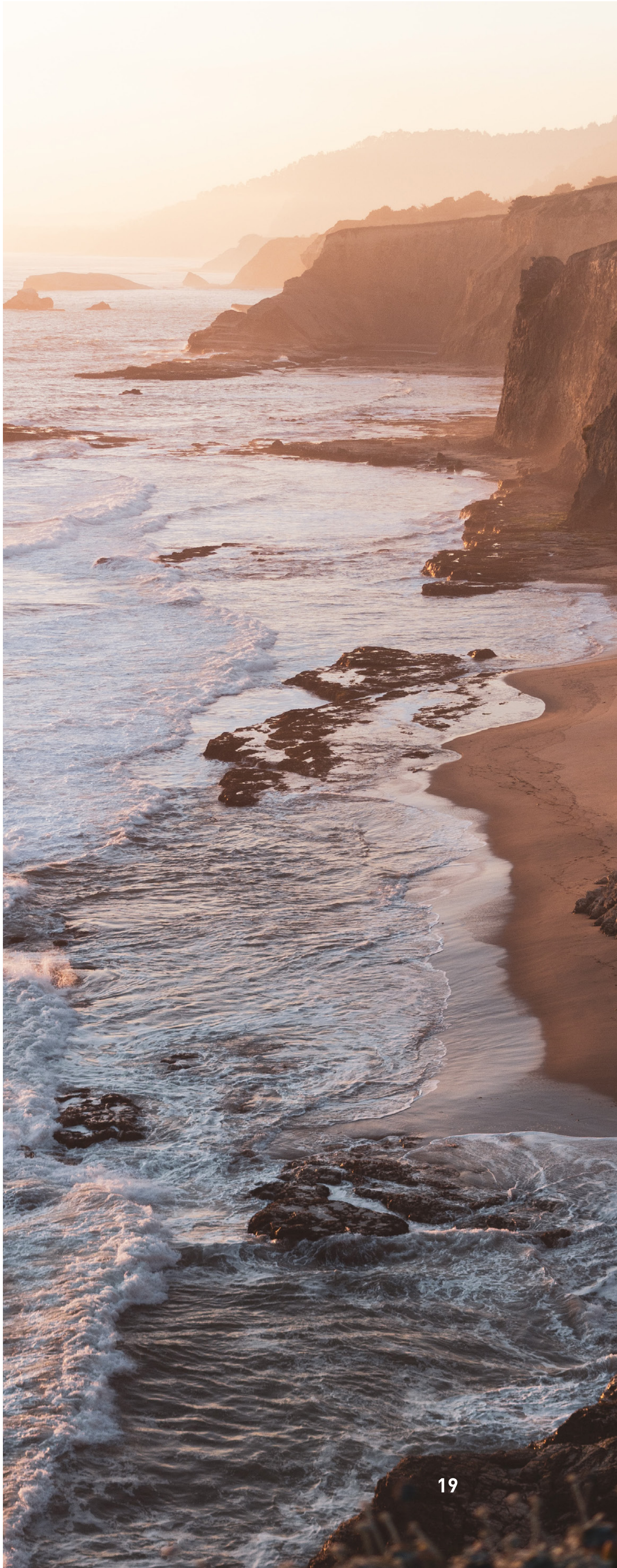
Black and Native American communities in the North Coast region are most isolated from receiving emergency communications and resources.

The San Joaquin Valley Region has the lowest adaptive capacity relative to other regions. While the San Joaquin Valley Region has high social resilience, it scores low on infrastructural and environmental resilience. These findings are consistent with RTAG feedback that voiced concerns about low quality and underdeveloped housing stock and infrastructure, as well as water stress and high energy use due to high heat.

The North Valley, Sacramento & Sierra Regions scored third, scores performing better on social and environmental resilience and the lowest on community capital and infrastructural resilience categories. Scores are consistent with RTAG input and show that the region has suffered from lack of broadband and connection to services and resources. RTAG members emphasized how access to the outdoors is a key community asset. Additionally, they reported that people continue to live in the region despite concerns about wildfires and housing affordability, due to their attachment to the region and their love of nature.

The North Coast Region is the second lowest scoring region overall, despite having the highest community capital and environmental resilience. This is due to its low economic, institutional, and infrastructural resilience. Though North Coast communities have strong social attributes of resilience, as well as strong environmental resources such as water and open space, the region is less affluent, and consistent with RTAG input; it lacks sufficient investment in housing and communication infrastructure. As a highly remote region, this region lacks access to goods and services that support adaptive capacity.

The Central Coast Region has the highest institutional resilience but scores low on community capital and infrastructural resilience. This is consistent with RTAG input that suggests governments are coordinating on climate resilience efforts, but not necessarily reaching community members with accessible information and resources, or those that are low-income in a region lacking adequate housing. The low community capital score does not reflect RTAG input that suggests strong community networks, particularly among low-income farmworker communities. RTAG members shared that these communities were isolated and are not connected to external networks.



Climate Hazards and Impacts

The Resilient Together survey asked community members about the greatest impacts they experience or are most concerned about during **extreme heat, power outages, wildfires/wildfire smoke, and sea level rise.** The following section provides a high-level summary of information collected from RTAG members on climate impacts within their respective region. Additional impacts are discussed in the regional appendices.

BAY AREA REGION

EXTREME HEAT

Transportation to cooler places is not accessible to many people. Many households lack air conditioning, and for those that do have access, many indicated they are unwilling to use it because of the high cost of electricity, resulting in increased risk of heat illness.

POWER OUTAGES

Power outages are disruptive to daily life, impacting everything from transportation, to communication, to childcare and work. Low-income communities who already struggle financially are further strained by higher energy bills and costs associated with power outages such as food spoilage. Power outages are of particular concern for elderly residents and people with disabilities who rely on medical equipment or refrigerated medicine.

WILDFIRES/WILDFIRE SMOKE

Community members reported concerns about the health impacts from wildfire smoke, particularly for low-income communities, communities of color, and outdoor workers who lack access to personal or household safety equipment such as air filters and N-95 masks.

SAN JOAQUIN VALLEY REGION

EXTREME HEAT

In urban areas, the heat island effect combined with lack of tree canopy exacerbates heat impacts. These impacts include more people going to the hospital due to dehydration and other heat illnesses, higher energy bills, and worsened air quality. Coupled with high utility bills, extreme heat creates financial strain for low-income communities and is the top concern for the region. Heat impacts may be more prominent due to the prevalence of poor housing stock that is difficult to weatherize. In remote parts of the region, many residents lack cooling centers and other resources, services, and information on how to keep themselves safe during these hazard events. In urban areas, the heat island effect combined with lack of tree canopy exacerbates heat impacts. These impacts include more people going to the hospital due to dehydration and other heat illnesses, higher energy bills, and worsened air quality.

IMPACT ON AGRICULTURAL INDUSTRY: *The agricultural industry is highly vulnerable to climate hazards and is already experiencing the impacts of climate change. The health of farmworkers, quantity of crop yields, and productivity of livestock are all negatively impacted by sustained drought and increasing frequency of extreme heat or flooded fields, resulting in unsafe working conditions and reduced work hours. Although these farmworkers experience the harshest economic impacts from climate events in the region, their immigration status prevents them from accessing unemployment benefits.*

NORTH VALLEY, SACRAMENTO AND SIERRA REGION

EXTREME HEAT

In urban areas of the region like Sacramento, extreme heat is the main hazard of concern. Increasingly, residents require air conditioning, especially those living in poorly insulated homes. However, many residents on fixed incomes indicated they cannot afford the cost of running air conditioning. Some residents indicated they had to sell their long-time homes and downsize to apartments to afford higher electric bills. Without family to help them, seniors are isolated at home due to the few transportation resources in the region, exacerbated by a lack of phone or internet access.

WILDFIRES/WILDFIRE SMOKE

In rural areas, which are most impacted by wildfires, community members expressed concern about getting stranded in wildfire zones during active fires due to limited evacuation routes and lack of communication and transportation infrastructure. Another key impact of concern with respect to wildfires is community displacement. Residents indicated they are being permanently priced out of their community due to the housing crisis, which drives housing prices up and development further into fire prone areas, in conjunction with wildfires that destroy homes and communities.

NORTH COAST REGION

POWER OUTAGES

Power outages were reported to often last long periods of time, as this region is marked by both poor transmission infrastructure and high wildfire risk. Most households are not equipped with backup power generation or batteries during power outages, resulting in residents who are 'trapped at home' in remote areas without access to food and water.

EXTREME HEAT

Power outages compound the impact of heat waves, which have become more frequent and pose a particular risk to elderly, low-income, and unhoused communities. Most households lack air conditioning due to historically moderate temperatures.

SEA LEVEL RISE/FLOODING

Evacuations and post-disaster recovery is particularly fraught in the region. Rural communities in the region have few routes in or out and are cut off from those roads when flooding occur, restricting access to food and resources.

WILDFIRES/WILDFIRE SMOKE

Many residents have been dropped by their home insurance companies, and have faced the unexpected costs related to hotel/motel rates during evacuations in a region that lacks emergency shelters and other resources/support/aid from governmental organizations or PG&E. The housing crisis and gentrification have compounded climate hazards and have led to the creation of "tent cities" and permanent displacement of community members. Those who do rebuild are concerned about having mortgages well into retirement and others have left the county or state as "climate refugees." Compounding and cascading disasters in the highly rural, heavily forested region has resulted in widespread devastation across PG&E's service areas.

CENTRAL COAST REGION

EXTREME HEAT

Lack of air conditioning and poor housing stock exacerbates extreme heat impacts for low-income communities throughout the Central Coast region. Farmworkers in the Central Coast Region experience health risks from working outside in the heat and heightened exposure to wildfire smoke. Additionally, the financial well-being of farmworker communities is impacted by changing growing conditions which affect hours and labor demand.

WILDFIRES/WILDFIRE SMOKE

Mountainous communities are more prone to fire hazards and subsequent mudslides. The key challenge for mountainous communities is that they lack reliable evacuation routes and struggle to find adequate housing post-evacuation. Wildfires are compounded by housing pressures and a lack of coordination and planning at the local government level, resulting in an overreliance on community organizations to provide emergency resources and services.

SEA LEVEL RISE/FLOODING

Low-income Black and Latinx communities in low-lying areas have experienced historical flooding, and face elevated risk from sea level rise. This flooding further contributes to dilapidated or unhealthy housing as well as water contamination and groundwater intrusion.

Climate Resilience Strategies and Considerations

Through the Resilient Together initiative, community and RTAG members had an opportunity to share preferred strategies to address the range of climate impacts identified in their communities. Based on the ideas proposed through RTAG and stakeholder engagement across PG&E's service area, the Project Team identified themes and developed strategies and consideration that synthesize and group those ideas into household and community resilience strategies.

Household Resilience Strategies

Home Improvements

Across regions, RTAG members advocated for PG&E to provide homes with solar, battery storage, backup generation, air conditioning, heat pumps, and other household safety and cooling equipment that would protect households during a hazard event. To achieve higher enrollment in home retrofit or appliance rebate programs and more equitable resilience outcomes, RTAG members stressed that home improvements should be made affordable and accessible.

RTAG members also advocated for more home retrofit/hardening programs serving renters. Many community members do not have authority to implement home improvements that would improve household safety and were concerned to ask the landlord to make improvements out of fear of rent being raised or being kicked out amidst a housing crisis.

Direct Payments

All regions were proponents of PG&E providing more direct financial relief to customers impacted by power outages and shared that the cost of paying for energy services is too high. RTAG members mentioned that cash payments for low-income households who are impacted by power outages can help residents recover from lost income due to food spoilage, loss of work, and other disruptions that occur as a result of hazard events.

Customer Programs[8]

Across regions, RTAG members provided recommendations to improve PG&E programs:

- **Increase accessibility** of PG&E programs. Revise program income eligibility requirements to take into consideration inflation and cost of living (not just income) and remove upfront capital investment requirements. Remove restrictions to program eligibility based on delinquent status.
- **Increase outreach and education** on PG&E programs. Partner with CBOs to organize and participate in community information/resource fairs. Expand geographic reach and frequency of informational meetings, particularly in rural/remote areas and highly impacted areas. Present multilingual information at existing community meetings rather than separate PG&E meetings.
- **Sustain funding** for PG&E programs. Consider long-term funding availability when developing PG&E programs (not just income-qualified programs). It is inefficient and reduces trust in PG&E for CBOs to conduct outreach to increase program enrollment in their community when it may be discontinued by PG&E due to lack of funding.

Safety Resources Distribution

RTAG members raised up ensuring the distribution of masks, air purifiers, water, battery packs, fans, and other safety resources to help households prepare for and better withstand climate hazards and related power outages. It is important that households have clear communication about where and how to access these resources. Additionally, it is important for low-income households to access these safety resources free of charge. Distribution of safety resources should be prioritized in areas with low "social" and "economic" resilience categories of the BRIC framework.

8 There are three questions on the optional demographics page of the survey for Regions 2–5 that pertain to this section, Q20, Q21, and Q22. Q20: How often do you receive information from PG&E on existing initiatives or programs? Q21: How often would you like to receive information from PG&E on existing initiatives or programs? Q22: Where do you currently receive information/ news from PG&E?

Community Resilience Strategies

Community Resilience Centers and Cooling Centers

RTAG members named the importance of more community resilience centers in their neighborhoods. RTAG members noted that both community resilience centers and cooling centers are key services to increase resilience in the face of extreme heat or wildfires. They also wanted to see more cooling centers based at community centers and accessible locations.

A well-utilized community resilience center should have the following resources and services based on the feedback from RTAG members across regions:

- Air conditioning, air purifiers, and generators
- Wheelchair access
- Public Wi-Fi
- Charging stations (e.g., technology such as phones and laptops)
- Emergency resources
- Public water access
- Refrigerators for prescription medication
- Masks, hand sanitizer, and other COVID/public health resources
- Connection to public transportation network/ systems
- Regular programming (e.g., recreational activities, childcare, etc.) that keeps community members engaged before, during and after climate hazard crises and events.
- Educational information/trainings
- Childcare & animal accommodations

Infrastructure Improvements and Grid Modernization

RTAG members across regions understood the importance of replacing aging infrastructure and improving grid reliability by better balancing energy supply and demand to reduce power outages that impact their communities.

Distributed Energy Resources

All regions advocated for increased investment in Distributed Energy Resources (DER), which includes distributed generation, energy efficiency, energy storage, electric vehicles (EVs), and demand response technologies connected at the distribution level.

Communication, Education and Outreach

RTAG members emphasized the importance of energy utilities conducting outreach to communities and the public before, during, and after a climate hazard event, and encouraged PG&E to conduct more emergency preparedness education in high-risk communities. Access to information around when power will be shut off or return, where and how to access resources, and how to prepare for emergencies is critical to ensuring communities can prepare and recover from climate shocks and stresses. RTAG members recommended PG&E educate customers utilizing traditional methods such as mailers, radio ads, and billboards, alongside more innovative methods like push notifications, text alerts, WhatsApp voice messages, Subtext, and 211 to reach non-English speaking communities. Additionally, RTAG members across regions noted that people access and absorb information in different ways, depending on their accessibility, language, and/or other needs.[9] They also conveyed that PG&E should continue to partner with CBOs to reach historically marginalized communities and underrepresented populations, and especially for communities that speak Indigenous languages and have difficulty understanding written materials.

Forest Health, Vegetation Management, and Urban Greening

In regions where extreme heat was the primary climate hazard, RTAG members recommended developing tree planting programs in low-income areas that lacked tree canopy and are shown to have significantly less canopy than more affluent areas. In fire prone areas, RTAG members elevated forest health and vegetation management strategies, and specifically advocated for increased funding for defensible space programs, wood management, and community chipping programs to process brush at residences.

9 One RTAG member gave an example that during Zoom meetings for emergency preparedness webinars, the chat messages need to be read out loud for people who are visually impaired. People with speech disabilities need verbal repeating and pauses for information processing. Another RTAG member mentioned that Indigenous communities from Mexico and Central America that speak languages like Mixteco, Zapoteco, and Triqui lack written languages and need verbal messages or videos on social media to be successfully reached.

Transportation Services

Across regions, RTAG members advocated for more accessible and affordable transportation options to support community members who need to evacuate or move to cooler places to avoid experiencing climate impacts.

Workforce Development

RTAG members across regions advocated for PG&E to continue to invest in workforce development programs that support of low-income community members getting hired into high-quality jobs, including jobs that support clean energy economy (solar installation) and community resilience activities (e.g. forest management).

Workplace Safety

RTAG members across regions noted that workforce safety standards (e.g., access to drinking water) are not enforced, and many employees, due to their immigration status, are not able or willing to report noncompliance. Moreover, many workers in these industries cannot afford to go without work despite unsafe working conditions. Workforce safety strategies can include improving education to workers, partnering with businesses to distribute safety resources (e.g., masks, cool clothing technology), or providing incentives such as utility bill reductions during climate hazards to enable employers to provide employees paid time off when it is not safe to work.

Broadband Access

RTAG members emphasized that when there is not internet, people cannot communicate because there are large areas that lack cell service. Rural areas need greater investments in regional broadband access to support emergency communications.

State Advocacy

PG&E expanding its state advocacy was another community resilience strategy area that was well supported across regions. Noting that PG&E is responsible for a portion of the climate impacts that communities are experiencing throughout California, RTAG members across regions felt that PG&E needs to take an active role in advocating for policies that mitigate climate change, either through decarbonization and electrification, greater investment in solar and wind energy, and reducing regulatory barriers to distributed energy and community micro-grids.

Slavic Center membership meeting, Sacramento

Recommendations

As a key outcome of the Resilient Together initiative, **the Project Team made the following recommendations to PG&E** to help build community resilience throughout its service area. The Project Team recommendations correspond to and are rooted in strategy areas developed based on community and RTAG member input on preferred solutions. In developing recommendations, additional considerations include RTAG member's short-term and long-term priorities, BRIC adaptive capacity scores, and PG&E's ability to act on the recommendations.

The following recommendations instead focus on how PG&E can build community resilience by investing in partnerships and programs that increase the adaptive capacity of communities throughout its service area.

Not all ideas made it into the final list of Project Team recommendations. For example, as noted earlier in discussion of the "Infrastructure Improvement and Grid Modernization" strategies, the importance of infrastructure resilience and grid modernization (e.g., undergrounding power lines) was reinforced by the RTAG members across all regions. However, the Project Team does not include a recommendation focused on energy infrastructure improvements, as this analysis is being undertaken by PG&E as part of the Climate Vulnerability Assessment.

As detailed in the Adaptive Capacity section of this report, all regions scored low on infrastructural, institutional, and community capital categories of adaptive capacity. Therefore, the Project Team Recommendations target improvements in buildings and infrastructure (e.g., roads, housing, internet); access to safety resources and services; and development of stronger social networks and connectivity among community members.

Many communities regard PG&E with distrust and skepticism. To support communities, PG&E first should lay a groundwork of trust in the communities it serves by continuing to acknowledge its past failures. PG&E should work toward a culture of sustained, clear, and regular communication with community partners and customers on how the company is working to build an energy system that will better serve customers now and in a climate-impacted future.

Strategies with an (*) indicate short term priorities. All strategies seek to contribute to long term infrastructure investments that improve the overall safety and reliability of the grid in the face of increasingly frequent and severe climate hazards. The Equity Framework provides additional direction on how PG&E could implement these recommendations to prioritize investments that build community resilience in historically underserved communities.

Fire Safe Council leading community presentation, Yuba County

Center equity in all decision making processes, investments, and programs. In order to embed equity while building climate-resilient communities, it is necessary to acknowledge that during the one-on-one interviews and RTAG workshops, equity was defined in many different ways. The project team's utilization of these diverse definitions of equity to develop an Equity Framework for PG&E is an important tool to consult that translates equity related ideas into actionable strategies. Centering equity requires working through and answering a series of tough questions to understand who to partner with, how to prioritize communities most impacted, and identify ways to mitigate negative impacts.

PG&E can utilize the Equity Framework as a roadmap in their internal efforts to integrate RTAG members' and community's input into future decision making to mitigate barriers and uplift equitable outcomes in communities most impacted by climate hazards.

Expand weatherization programs, including Low Income Home Energy Assistance Program and Energy Saving Assistance Program, to provide subsidized or no-cost home improvements that make homes more resilient to a variety of climate hazards. These programs need more funding to cover the costs of the retrofits needed to appropriately weatherize homes, without requiring high capital costs from homeowners. Program outreach should focus on helping eligible renters and/or multifamily homeowners enroll. Home weatherization improvements that community members requested financial assistance for include:

- Installing heat pumps for heating and cooling
- Hardening homes or retrofitting homes to make them more resilient to wildfires
- Creating defensible space around homes
- Providing back-up generators, with a focus on solar generators and batteries
- Installing electric appliances

***Provide distribution of free safety resources that improve household resilience.** In collaboration with local CBOs, develop a program to distribute free safety resources to low-income and climate vulnerable households, such as N-95 masks, air purifiers, water testing kits/potable water, sandbags, emergency to-go kits, fans, and portable battery packs. In addition to equipping households with these items, community resilience centers should be stocked with these supplies. These resources should be provided to CBOs and emergency shelters in advance of hazard events, particularly in rural or remote areas that have limited access to resources and limited roads, that if disrupted by a hazard, would not be able to import additional goods.

***Provide direct reimbursements for costs associated with power outages.** As a matter of policy, PG&E should discontinue shut offs that are a result of payment delinquency. PG&E should provide an extended grace period for bill payment after a power shut-off. Additionally, PG&E can improve the effectiveness of PG&E's existing Safety Net Compensation Program in alleviating financial burdens caused by power outages through the following actions:

- Increase minimum payment amount to $50 (currently $25 for 48–72-hour outage)
- Distribute payments within 7 days of power outage (currently 45–60 days after event)
- Include payments for PSPS events (not currently eligible)
- Remove the requirement for customers to be in "good standing" at the time of the outage in order for them to receive reimbursement

***Maximize uptake and longevity of existing PG&E programs in DVCs.** PG&E should dedicate additional resources and staff time to conduct outreach and provide enrollment support for multiple programs for rural/remote areas and highly impacted areas in DVCs. In addition, PG&E should continue to partner with CBOs to organize and participate in community information/resource fairs and conduct outreach on program eligibility and enrollment. Consistent with RTAG input, the Project Team recommends PG&E re-evaluate program eligibility requirements of income-qualified programs to ensure that they are not too restrictive given significant differences in the cost of living throughout its service area. PG&E should continue to leverage community advisory committees that provide input on the design of and improvements for programs. For any program to be effective, PG&E should dedicate sufficient funding for programs long-term; the Project Team heard that CBOs do not want to leverage trusted relationships and spend limited capacity and resources advertising programs in their communities for the program to be discontinued after one or two years.

Provide financial support for the development and sustained operation of community resilience centers through new and existing programs, including the Resilience Hubs Grant Program. Recognizing that services of community resilience centers and staffing needs of community resilience centers vary greatly across communities, the Resilience Hubs Program should maximize flexibility in the siting and resources provided at planned resilience hubs. Communities with the highest need for community resilience centers often have the least capacity to apply for funding; PG&E should provide funding and technical assistance for CBOs to apply for these grant programs, particularly for their main offices and program sites.

***Improve emergency notifications and community education of hazards and resources.** In consultation with CBOs, local jurisdictions, and customers, PG&E should develop a mobile application that provides multilingual push notifications on climate hazards and power outages and restoration, directs residents to resources including community/emergency centers, charging stations/generators, water access points, community-based organizations, etc. It is critical for PG&E to partner with CBOs, including providing sustained funding and collaborative infrastructure, to develop and deliver culturally appropriate, multi-lingual outreach materials and messages via effective communication channels (e.g., Reverse 211, WhatsApp, radio, billboards, etc.) and conduct educational outreach and training on available resources and programs that help residents stay safe during climate hazard events and power outages. These CBO partnerships should be maintained through PG&E's Regional Vice Presidents.

Expand and disseminate distributed energy resources (DER) in DVCs, including through investments in residential and community solar, battery storage, and microgrids, by (1) removing regulatory barriers and (2) strengthening PG&E incentive programs. PG&E has historically lobbied against proposals to help communities adopt solar and battery storage, including, but not limited to, affordable housing solar incentives, community solar, and microgrids.[10] PG&E should collaborate with other IOUs to identify best practices and share frameworks to transition their business model and enable a regulatory environment that accommodates decentralized energy systems. As the regulatory environment in California continues to evolve, and as the PG&E business model expands to integrate and operate more DER solutions to build resilience, this should include investing in the expansion of existing DER pilot programs. Such programs include the Community Microgrid Enablement Program and Vehicle To Everything Pilot Program.

Expand urban greening and forest management programs and investments. In wildland urban interface areas, PG&E should increase funding for defensible space programs, community chipping programs, and reforestation programs in previously burned areas. In addition, PG&E can support the reduction of forest fuels through investments in biomass facilities in wildfire risk areas. Camptonville Community Partnership is leading the development of a 3-megawatt biomass plant in Yuba County. The planned biomass plant would process forest biowaste from forest health projects and use it to generate clean electricity. The project would reduce the cost of regional projects, as well as bolster the local economy with new jobs and business opportunities.

10 AB 693 - Eggman, 2015; SB 843-Wolk, 2013; SB 43- Wolk, 2013; CPUC implementation; SB 1339, CPUC implementation

These programs should feature a strong workforce development component, in which PG&E trains and hires local residents to perform inspections, remove vegetation under and around power lines, haul wood off customers' property, and staff biomass facilities. Implementation and increased funding of these programs and projects should be done in partnership with Fire Safe Councils.

In urban areas, PG&E should partner with CBOs, local governments, and philanthropic foundations to expand tree planting programs in areas that lack tree canopy and are susceptible to extreme heat. As PG&E does not have a tree replacement program, it should evaluate, with input from CBO partners, whether to develop a proprietary tree replacement program like other IOUs[11] or dedicate funding to support existing programs.[12]

Improve emergency evacuations and improve transportation access to cooling centers. PG&E should partner with transit agencies to provide transportation vouchers to cooling centers, invest in electric buses to transport people to cooling centers, and provide shuttles to evacuate seniors, disabled, unhoused, and those without access to transportation during wildfire smoke and extreme heat events.

Invest in and expand existing workforce development programs. In the San Joaquin Valley Region and the Central Valley Region, PG&E should provide funding to support workforce development programs that focus on supporting farmworkers seeking career transitions due to unsafe working conditions or insufficient availability of work. In the North Valley, Sacramento, Sierra Region, PG&E should partner with workforce development organizations to develop programs that train local workers to enter the forest management industry to support brush/tree clearing near powerlines, reforestation post fires, and defensible space and chipping programs.

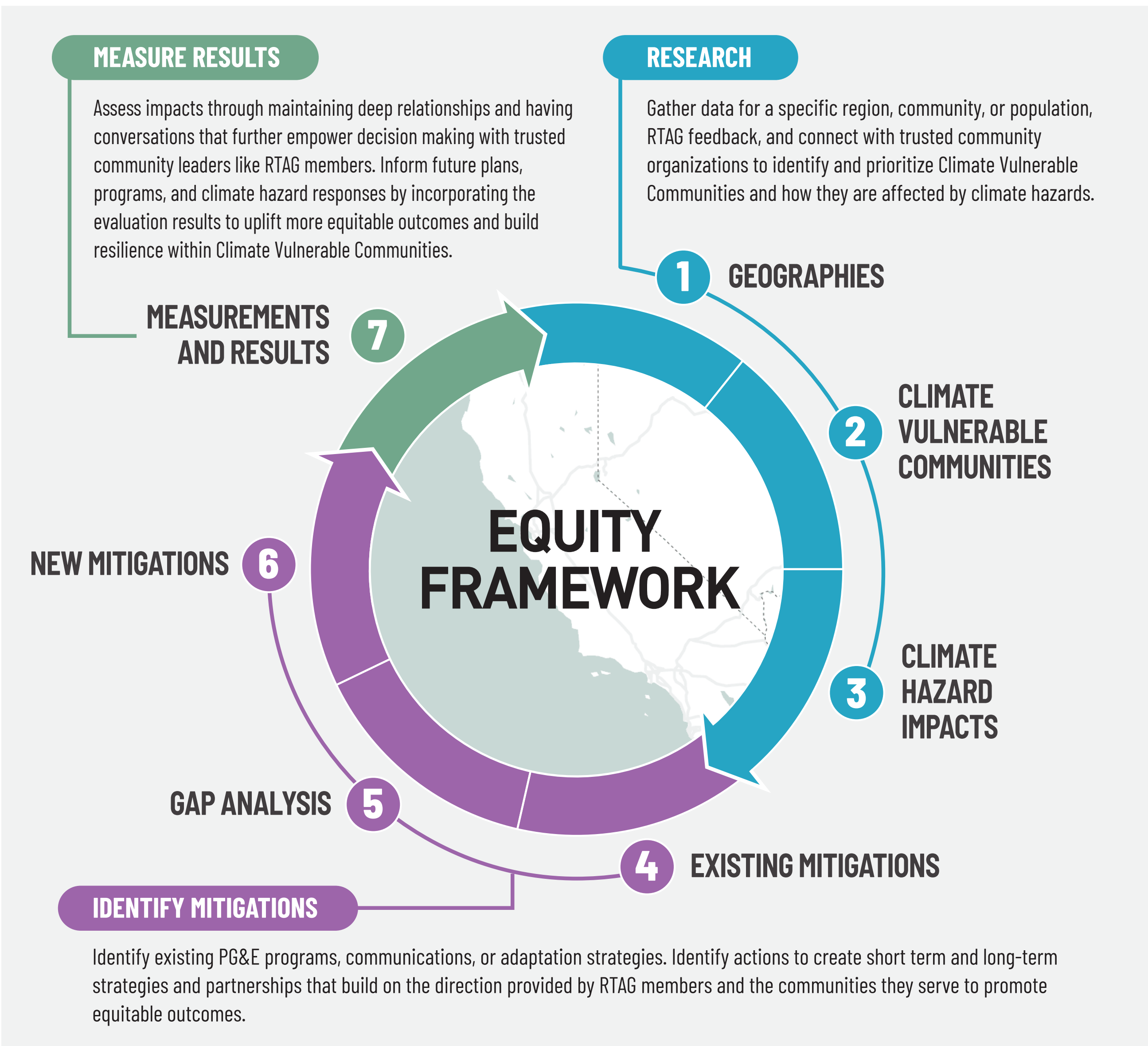
The Resilient Together initiative has laid the foundation for authentic and trusted relationships with community serving organizations. PG&E can build on this foundation with focused efforts to promote more transparent communications, provide resources, and develop/improve programs that directly address the needs of its most vulnerable customers. PG&E should continue to fund advisory committees that provide regular input on how PG&E can develop and implement programs that maximize community benefit. Specifically, PG&E should direct funding or create new grant programs to utilize and leverage the network of Resilient Together Advisory Groups to implement community resilience strategies listed in each regional appendix. Future partnerships should go beyond simply sharing information and instead be two-way conversations between PG&E and communities that allow for authentic community input. The Resilient Together initiative should be considered a model for how communities can shape future investments and program design through co-creation and implementation of programs with community partners.

11 San Diego Gas & Electric has a Community Tree Rebate Program for Residential Customers

12 For example, CalFIRE's Urban and Community Forestry Grant Program

Equity Framework

The Equity Framework is a tool to utilize and evaluate how climate hazards impact "Climate Vulnerable Communities"* and how to address negative impacts. PG&E can now identify the burdens faced by Climate Vulnerable Communities informed by RTAG members and the communities they serve. The tool will help drive PG&E's ability to create strategies, identify resources and partnerships that can be used to mitigate burdens, and take action to uplift more equitable outcomes and build resilience within Climate Vulnerable Communities.



*Climate Vulnerable Communities is a term defined by RTAG members' input and within this report.

Resilient Together Equity Framework
WORKSHEET

The questions featured in PG&E's Equity Framework were crafted by the equity consultants at InterEthnica, with input captured during conversations with the RTAG. They are designed to make the Equity Framework flexible and adaptable by various PG&E teams when addressing equity considerations for different programs, projects, and climate hazard responses. The relationships built by InterEthnica, with the support of the RTAG members, give PG&E access to community partners with critical information to help PG&E further navigate and meet the needs of their communities. When utilized to its fullest purpose, this tool will serve as PG&E's roadmap to identify opportunities to uplift equity and build more climate-resilient communities.

Step 1: Identify the Geographic Area	
In which geographic region will the project take place?	
Step 2: Identify Priority Communities	
What tools and data are available to identify priority communities in the region (i.e., Climate Vulnerability Assessment, Resilient Together Advisory Group input, CalEnviroScreen, etc.)?	
What data is needed to determine the priority communities?	
Who are the priority communities in this region? *(Check all that apply)*	☐ **Low-income Communities** ☐ **Unsheltered Communities** ☐ **Communities of Color** ☐ **Black/African-American Community** ☐ **Limited English Proficient Communities** ☐ **Indigenous Communities** ☐ **Youth** ☐ **Seniors** ☐ **Essential Workers** ☐ **Outdoor Workers** ☐ **Undocumented Communities** ☐ **People with Disabilities** ☐ **Small Businesses** ☐ **Rural Communities** ☐ ____________________ ☐ ____________________

Resilient Together Equity Framework
WORKSHEET

Prioritize the most disproportionately impacted communities in this region.	
What type of community engagement has been or is being conducted to understand these communities' needs in the event of a climate hazard?	
Who are the trusted leaders, influencers, and decision-makers within these priority communities?	
Step 3: Identify Climate Hazard Impacts	
What are the infrastructure impacts of the climate hazards?	
What are the specific impacts on people's lives? *(Check all that apply)*	☐ Loss of Work ☐ No Air Conditioning ☐ Childcare ☐ Poor Indoor Air Quality ☐ Unsafe Indoor Environments ☐ Health Concerns ☐ Unsafe Outdoor Working Conditions ☐ Evacuations ☐ Lack of Emergency Response & Planning ☐ Water Damage to Home or Business ☐ ____________ ☐ ____________ ☐ ____________ ☐ ____________

Resilient Together Equity Framework

WORKSHEET

Step 4: Identify Existing Mitigations	
What existing resources are available to mitigate the negative impacts?	
What existing strategies (i.e., projects, programs, infrastructure, tools) does PG&E already have to ensure that priority communities have access to the identified mitigations?	
What existing partnerships provide access to these mitigations? (i.e., community partners, distribution networks, etc.)	

Step 5: Conduct a Gap Analysis	
What impacts identified in Step 3 are not addressed by this project?	
What resources can PG&E allocate to address the impacts in future projects? Are there any resources missing? (i.e., language access, communications, partnerships with Office of Emergency Services, etc.)	
What makes it difficult for priority communities to access existing resources? (i.e., language, transportation, distribution network, etc.)	

Resilient Together Equity Framework

WORKSHEET

Step 6: Identify New Short Term and Long Term Mitigations

	SHORT TERM	LONG TERM
What new short term and long term mitigations could PG&E develop to help priority communities become more climate resilient?		
What is needed to implement these new short term or long term mitigations? (i.e., funding, partnerships, etc.)		
When can these mitigations be implemented?		
How will the timing of the implementation of the mitigations impact priority communities?		

Resilient Together Equity Framework
WORKSHEET

Step 7: Measurements and Results	
How quickly was the critical issue mitigated in each of the impacted communities?	
How did the mitigation build community resilience in the face of climate hazards or other disruptions?	
How long were priority communities' lives disrupted? (i.e., continuous impacts on people's lives)	
How are you measuring the impacts on priority communities? Sample questions below: How many people in priority communities received assistance? Which priority communities received assistance? What resources were distributed and in what quantity (i.e., materials, languages, hours contributed, dollar amount)? How many partners were collaborated with? (i.e., community, government, industry partners)	

Resilient Together Equity Framework

WORKSHEET

What process was used to gather feedback to understand how priority communities felt about the climate hazard response? (i.e., surveys, interviews, tabling)	

Moving Forward

Continue to utilize and build on the newly gathered data and results from this equity framework to inform strategic approaches designed to uplift equity in priority communities resulting in increased climate resilience.

Conclusion

The Resilient Together initiative provides PG&E unique insights on the ways climate change impacts climate vulnerable customers and communities throughout its service area. **Energy, transportation, and childcare disruptions results in a loss of work and expenses associated with hospitalizations and evacuations further perpetuate a cycle of poverty and destabilize low-income families.**

The Project Team found that community members expressed concern for the health of their families and community and feared for their lives as a result of these cascading hazards. Community in every region shared how climate hazards affected the mental health of those not able to go outside, are isolated, or have experienced trauma from not being unable to evacuate or access the resources needed to survive a hazard event.

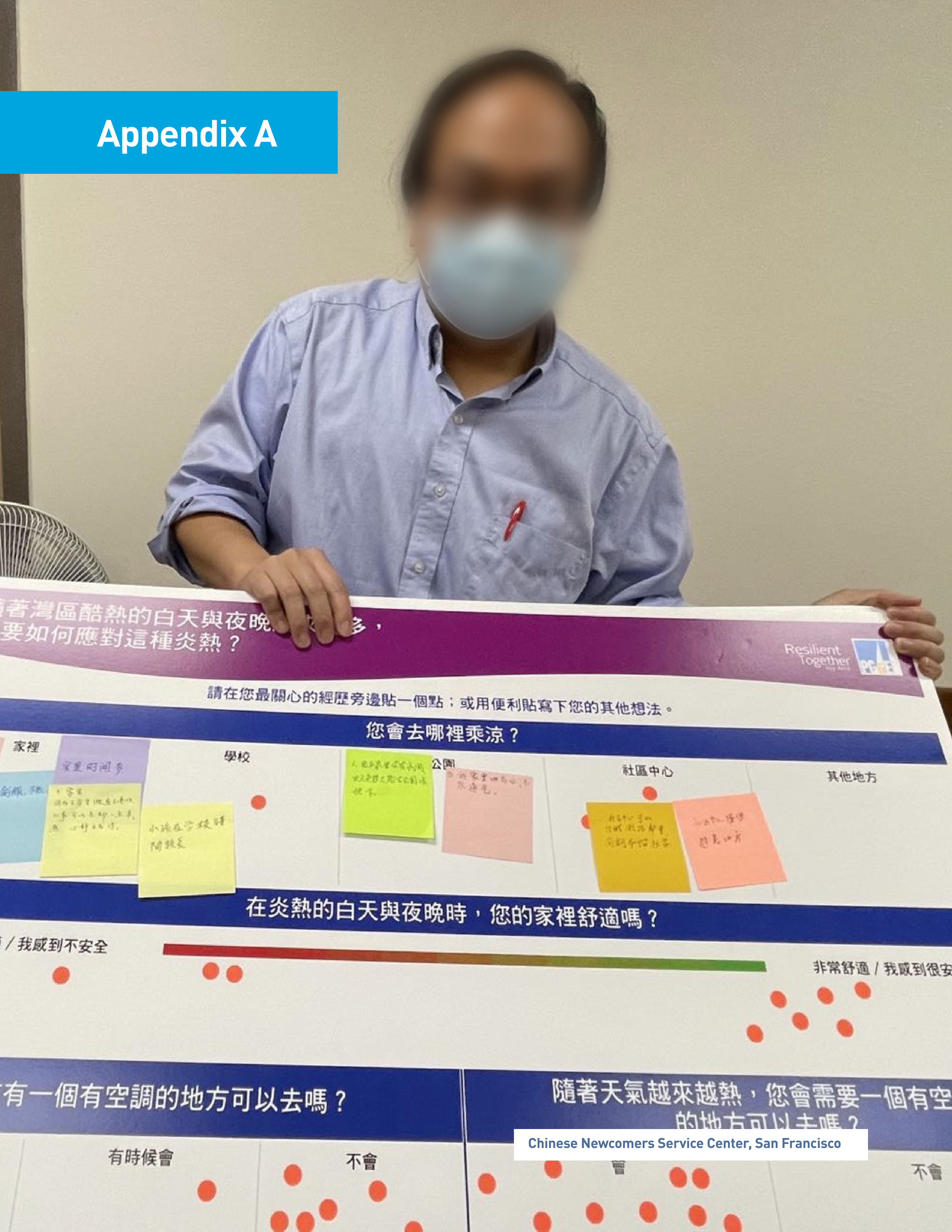
Through engaging deeply with community and CBOs, PG&E has a better understanding of the needs and challenges that customers face, and solutions sought across its service area to build community resilience. The input provided highlights of how climate hazards compound existing stressors of vulnerable communities. The data collected on the lived experiences of customers and recommendations received will inform how PG&E invests in new and existing programs that support customer safety and community resilience in the near term adapts its long-term infrastructure and operations to deliver a safe and reliable energy system in a climate-impacted future.

Improving communication, education, and access to information for DVCs are critical steps PG&E should take to create a culture of transparency and affirm PG&E's commitment to providing affordable, reliable energy and building community resilience. The Project Team recommendations provide specific strategies for improving existing programs and expanding program eligibility, providing direct financial assistance, collaborating with partners to deliver resources and services that address new customer and community resilience needs, and becoming an advocate for policies that will enable a more equitable, reliable, resilient, and affordable energy system in California.

The success of the Resilient Together initiative will be based on PG&E's ability to sustain the relationships formed during this program.

The Resilient Together initiative underscores the need and highlights the opportunities for PG&E to fund, facilitate collaboration, and build the capacity of CBOs (and local governments) to provide critical resources and services to community pre- and post-hazard events. This project built on existing relationships with CBOs and provides strong relationships with new community partners that will be integral to the implementation of the climate resilience strategies put forth in the Climate Vulnerability Assessment. PG&E stated and fulfilled a strong commitment to more robust community engagement practices within the Resilient Together initiative that go beyond the minimum requirements set by the CPUC. The success of the Resilient Together initiative will be based on PG&E's ability to sustain the relationships formed during this program. It is imperative that PG&E demonstrate to communities how PG&E is implementing strategies and recommendations through co-produced implementation plans that prioritize community partners and customers' needs, knowledge, and networks.

Appendix A



Chinese Newcomers Service Center, San Francisco

Appendix A: The Bay Area Region

This report provides a summary of the findings for the Bay Area Region, the pilot region of the Resilient Together initiative. The Bay Area Region encompasses Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, and Sonoma counties. This regional summary report provides an overview of the data collected and presents the key findings for the Bay Area Region. The key findings are organized as follows:

A Defining Climate Vulnerable Communities

B Climate Hazards and Impacts

C Adaptive Capacity

D Resilience Strategies and Recommendations

Data Collected

The Project Team collected data for the Bay Area Region from three primary sources: 1) Resilient Together Advisory Group (RTAG) meetings, 2) Outreach events conducted by RTAG members, and 3) Resilient Together surveys. This section presents a summary of the key data collected for this region. Because demographic data was not collected in the Bay Area Region, the Project Team analyzed results by county and language spoken to help Pacific Gas and Electric (PG&E) understand variation in impacts and preferred resilience strategies across different communities in the Bay Area Region.

RTAG Members

The following table of organizations participated in the Bay Area Region RTAG (Table A.1).[1] The top three populations represented by member organizations are provided in the table below, along with the mission statements for each of the organizations. Geographies represented denote the physical area each organization primarily serves. Members who conducted outreach activities (Outreach Partners) are marked with an asterisk.

Over the course of the engagement, RTAG members participated in six RTAG meetings, totaling approximately 12 hours. RTAG meetings featured a project overview and RTAG orientation, presentation of outreach materials, peer mentoring, role-playing exercises, presentation on PG&E income qualified programs, presentation of key findings from the engagement, and celebration of their partnership.

1 See Appendix F for the criteria for selecting RTAG members.

TABLE A.1 RTAG Member Profiles (* Outreach Partners)

RTAG Organization	Geographies Represented	Top Populations Represented	Mission / Profile
American Indian Cultural District*	SF/Peninsula	Indigenous Low-income communities Youth	Founded on March 31st, 2020, the American Indian Cultural District is the first established Cultural District of its size in the United States dedicated to recognizing, honoring, and celebrating the American Indian legacy, culture, people, and contributions. The Cultural District provides a recognized home base for the American Indian community to ensure that American Indian culture, history, and contributions will not be forgotten or overwritten. Their Cultural District is located in the Mission neighborhood and the American Indian Cultural District Hub is located along the water at the Fort Mason Arts & Culture Complex. AICD serves as a cultural hub and advocate for the greater San Francisco American Indian community.[2]
Center for Independent Living	East Bay	People with disabilities Low-income communities	The Center for Independent Living (CIL) provides advocacy and services that increase awareness, collaboration, and opportunity among people with disabilities and the community at large. Their programs provide people with skills, knowledge, and resources that empower them to eliminate damaging and stereotypical notions of disability so that they can strive toward realizing their full human potential. The CIL is primarily engaged in providing one or more of a wide variety of individual and family social, counseling, welfare, or referral services, including refugee, disaster, and temporary relief services. This industry includes offices of specialists providing counseling, referral, and other social services.[3]
Community Agency for Resources, Advocacy and Services*	South Bay	Low-income communities Limited English proficient communities Communities of color	Community Agency for Resources, Advocacy, and Services (CARAS) is a non-profit organization formed to serve incoming youth and families in the community through providing culturally competent and sensitive programming based on the needs and assets present in South Santa Clara County. CARAS was formed by community members concerned with the lack of services available to Latino families. The services we provide include, but are not limited to, programs for parents, women, children, adolescents, and seniors. CARAS programs focus on leadership, intervention for at risk youth, education and health and fitness as well as advocacy and immigrant's rights.[4]
Chinese Newcomers Service Center*	SF/Peninsula	Limited English proficient communities Essential workers Seniors Immigrant communities	The Chinese Newcomers Service Center (CNSC) mission is to provide underserved communities with social, economic, workforce, and business services to transform their lives. CNSC is a nonprofit organization that provides multilingual services that help Chinese Immigrants adapt to life in the United States. CNSC serves as a bridge between the two cultures, enhancing the physical, mental, social, and economic well-being of immigrants, thus facilitating their efforts to become self-sufficient, contributing members of the community.[5]

2 https://www.interfaithpower.org/
3 http://www.cilberkeley.org
4 https://www.facebook.com/CARASSouthCounty/
5 https://chinesenewcomers.org/en/front-page/

RTAG Organization	Geographies Represented	Top Populations Represented	Mission / Profile
Climate Resilient Communities*	SF/Peninsula	Low-income communities Communities of color Youth	Climate Resilient Communities (CRC) is a community-based organization dedicated to empowering underrepresented community voices to implement climate solutions that bring about unity, justice, and resilience. CRC's work stems from recognition of the fact that in the Bay Area, as throughout the world, under-resourced communities are disproportionately vulnerable to climate change impacts. Since 2016 Climate Resilient Communities has been on the ground learning the specific needs of residents in diverse, under-resourced communities in East Palo Alto and Belle Haven (Menlo Park). Their outreach cultivates environmental awareness while giving residents a voice in proactive resilience planning and adaptation. By building stronger alliances between residents, schools, local government programs and community-based organizations, this work creates resilience against climate-related stresses such as sea-level rise and economic instability.[6]
Communities for a Better Environment	East Bay	Low-income communities Communities of color Black communities	Founded in 1978, Communities for a Better Environment (CBE) is one of the preeminent environmental justice organizations in the nation. The mission of CBE is to build people's power in California's communities of color and low-income communities to achieve environmental health and justice by preventing and reducing pollution and building green, healthy, and sustainable communities and environments. CBE provides residents in heavily polluted urban communities in California with organizing skills, leadership training and legal, scientific, and technical assistance, so that they can successfully confront threats to their health and well-being.[7]
Interfaith Power & Light	East Bay	Elderly Low-income communities Communities of Color	Interfaith Power & Light inspires and mobilizes people of faith and conscience to take bold and just action on climate change. Since the year 2000, IPL has built a powerful grassroots network of people of faith, to drive smarter energy policymaking and helped thousands of congregations address global warming by modeling energy stewardship in their own facilities. They have a track record of tangible results: shrinking carbon footprints and educating millions of people of faith about the important role they have to play in this challenging issue.[8]
Isela Amarillas	SF/Peninsula	Immigrant communities Limited English proficient communities Communities of color	Latinx immigration attorney and advocate.

6 https://crcommunities.org/

7 https://www.cbecal.org/

8 https://www.interfaithpower.org/

RTAG Organization	Geographies Represented	Top Populations Represented	Mission / Profile
Maya Scott Chung	N/A	People with disabilities LGBTQ+ communities Low-income communities	Advocate for people with disabilities and representative of the Disability Justice League- Bay Area.
Multicultural Center of Marin*	North Bay	Low-income communities Communities of color Undocumented communities	The Multicultural Center of Marin provides culturally appropriate resources and opportunities in a safe environment to empower and inspire diverse communities to build an inclusive and equitable county they want to live in. The Center stands as a testament to the cultural wisdom and diversity that is inherent in the immigrant communities that make up Marin County. Through training, mentorship, collaboration, and community organizing, the Multicultural Center of Marin provides the pathways and opportunities for people of these diverse communities to come together in strength.[9]
New Voices are Rising	East Bay	Youth Low-income communities Communities of color	New Voices Are Rising seeks to increase civic participation within under-represented communities, increase young people's commitment to environmental justice, and reduce air and water pollution that severely impact both human health and the health of the San Francisco Bay. The program helps young people gain the skills and experience in civic engagement that they need to begin to tackle the problems — including environmental health problems — that disproportionately impact their communities through environmental justice advocacy and leadership development programs with Bay Area high school students.
NorCal Resilience Network	East Bay	People experiencing homelessness Communities of color Low-income communities	The NorCal Resilience Network is a grassroots coalition that activates and supports community-based, nature-inspired solutions to climate change, economic instability, and social inequity in Northern California. The Network's mission is to catalyze a just transition to an equitable and regenerative region by supporting and activating community-based and ecological solutions in Northern California. Our regional network increases capacity for grassroots projects and programs; helps to build out model sites for permaculture and resilience; and builds solidarity across divides of race, class, sector and region. We work with organizations, businesses and leaders committed to growing thriving, resilient communities.[10]

9 https://multiculturalmarin.org/

10 https://norcalresilience.org/

RTAG Organization	Geographies Represented	Top Populations Represented	Mission / Profile
Rise South City*	Peninsula	Low-income communities Limited English proficient communities Undocumented communities	Rise South City supports community members with environmental justice advocacy and technical trainings. Rise South City is committed to creating dialogues with frontline communities about climate change & social equity issues and to learn about the different intersectional systems that underpin it and help develop local solutions for transformational reform. Rise South City promotes community resilience, economic equity, and climate stability.[11]
Sonoma Valley Collaborative*	North Bay	Low-income communities Limited English proficient communities Undocumented communities	Sonoma Valley Collaborative (formerly Sustainable Sonoma) is a forum of community leaders from a wide range of sectors across Sonoma Valley, finding solutions and taking action to address the community's biggest challenges. Sonoma Valley Collaborative is a platform for the diverse interests in Sonoma Valley to come to the table for the benefit of the community. Their core partners are working together to build a common agenda, shared measurement systems, mutually reinforcing activities, continuous communication, and backbone support for our partners.[12]
Support Life Foundation*	East Bay	Limited English proficient communities People experiencing homelessness Undocumented communities	The Support Life Foundation is a CBO that is dedicated to enhancing the quality of lives of people across the globe in desperate need of opportunity; including children and women who lack basic social and economic means. Through programs carefully designed for long term impact and fundamental change across the diaspora. They want people to be able to depend on themselves, especially the most hopeless and vulnerable. Their programs provide them with the tools they need to succeed whether it be through training, education, opportunity, or just a leg up.[13]

Outreach Events

Outreach Partners conducted 32 events across 9 organizations. Outreach activities included:

- Workshops and focus groups
- Tabling at farmers' markets, restaurants, and church events
- Door knocking
- Community events, celebrations, and festivals, and
- Surveying at food distribution sites and at homeless encampments
- Participants Engaged

Over 1200 people were engaged through this effort. Outreach Partners collected 219 online and 424 paper surveys from community members. Outreach Partners engaged an additional 589 community members through the events listed above utilizing the outreach boards.

11 https://www.risesouthcity.org/about
12 https://sonomavalleycollaborative.org/
13 https://www.facebook.com/SupportLives/

Zip codes and Counties Represented

A total of at least 100 unique zip codes are represented through the data collected by the surveys and the outreach boards, across 12 counties.[14,15] Additional zip codes and counties may be represented in the data but not all survey and outreach board respondents identified their zip code, and some respondents provided their county rather than zip code. In the survey data, less than half of a percent of respondents did not provide their zip code. Table A.2 shows the counties represented through the surveys; it is not possible to identify how many people were engaged through the outreach boards per county.

TABLE A.2 Surveys per County (n=573 respondents)

County	% of Surveys
Alameda	18%
Contra Costa	2%
Marin	N/A
Napa	N/A
San Francisco	38%
San Joaquin*	0.31%
San Mateo	19%
Santa Clara	9%
Santa Cruz*	0.16%
Solano	0.31%
Sonoma	13%
Tehama*	0.16%
Yuba*	0.16%

Counties that are represented in the data that are not part of the Bay Area Region are identified with an asterisk.

Languages Represented

To reach a more diverse sampling of the Bay Area Region residents, the Project Team provided outreach materials in Arabic, Chinese, English, Samoan, Spanish, Tongan, and Vietnamese. Surveys were provided in both paper form and online. About 66 percent of survey respondents completed the survey on paper and 34 percent of respondents completed the survey online through SurveyMonkey.[16]

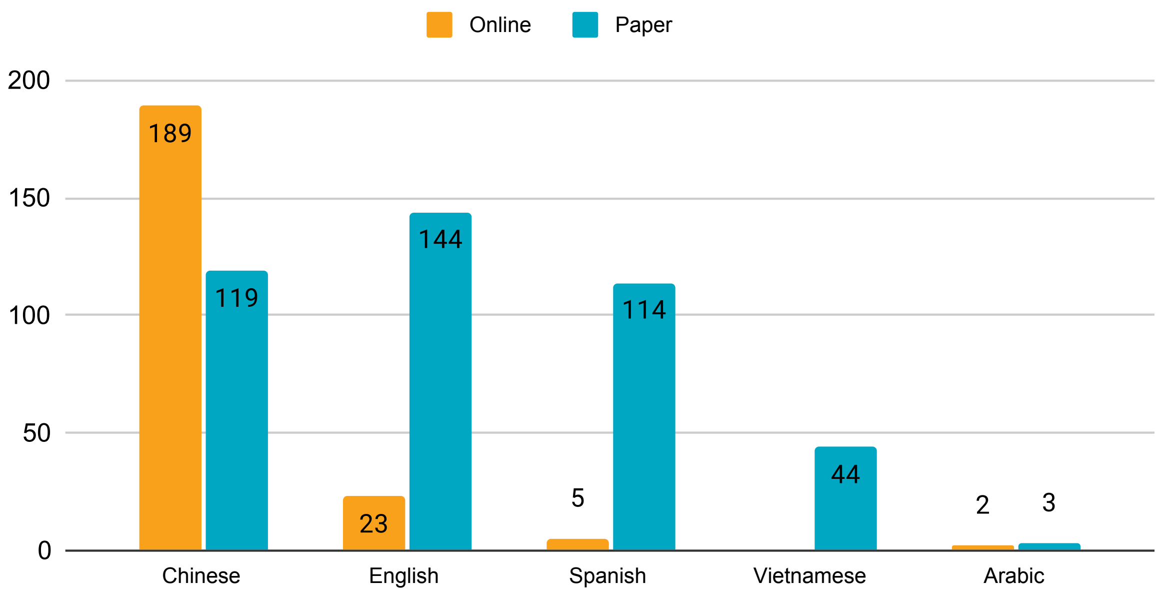
14 The data includes several counties that are not in the Bay Area Region but were collected via the Bay Area Region Outreach Partners. For example, Outreach Partners collected surveys from respondents in Tehama, San Joaquin, Santa Cruz, and Yuba counties. Though these counties are not in the Bay Area Region, the Project Team included the results of these surveys in the data analysis as the Outreach Partners are serving members from those counties. The county data from outside the Bay Area Region counties makes up less than one percent of the respondents.

15 Napa County is not reflected in the data from the surveys or the outreach boards. Marin County is not reflected in the surveys but is reflected in the outreach boards as Outreach Partners held events in Marin County. However, because the Multicultural Center of Marin reported that their events served counties outside of Marin County (in addition to Marin County), the Project Team attributed the results to "Multiple Counties" rather than Marin County following the analysis process described in the Limitations to Analysis section of this report.

16 The Project Team did not include an analysis of the number of surveys collected by paper and online for Regions 2–5. This is because it is difficult to assess how many paper surveys were collected as RTAG members input paper surveys into SurveyMonkey as part of the collection process.

Figure A.1 below illustrates the number of surveys collected by language. While the Project Team did not collect race/ethnicity data for the Bay Area Region, the Project Team can make some inferences with respect to the race/ethnicity of participants based on the language in which respondents chose to take the survey. Close to 48 percent of the survey respondents completed a Chinese language survey, followed by 26 percent who completed an English language survey. About 19 percent of respondents completed a Spanish survey and about 8 percent completed an Arabic or Vietnamese language survey. It is unclear which primary languages were spoken by community members who were engaged through in-person events (50 percent of the community members engaged), as Outreach Partners collected responses in English on the outreach boards.

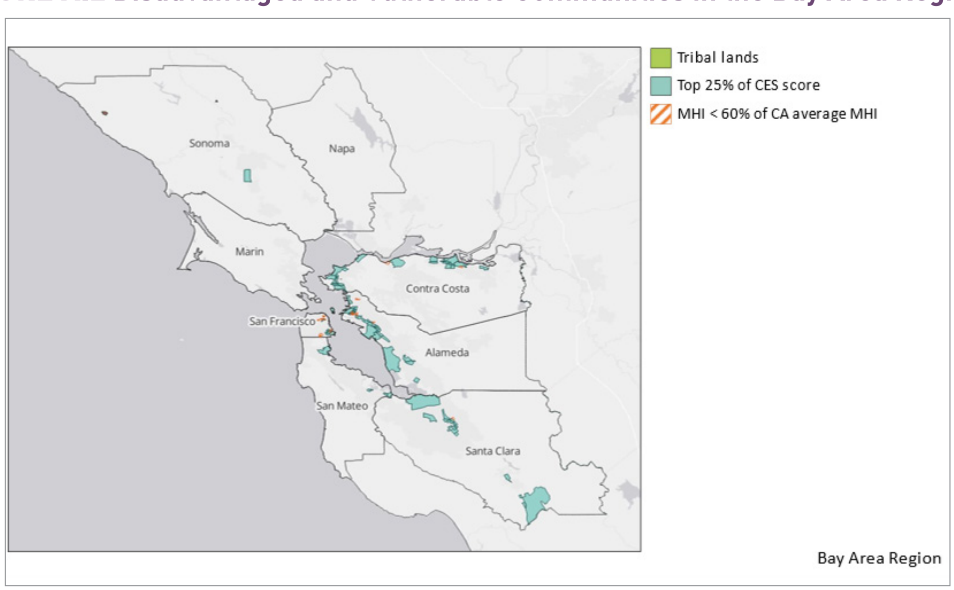
FIGURE A.1 Surveys by Language and Mode (n=643 respondents)



Climate Vulnerable Communities

Figure A.2 shows disadvantaged and vulnerable communities in the Bay Area Region based on the California Public Utility Commission's definition.

FIGURE A.2 Disadvantaged and Vulnerable Communities in the Bay Area Region



In the Bay Area Region, RTAG members identified low-income communities, people experiencing homelessness, and communities of color as populations most vulnerable to climate hazards. In addition, RTAG members highlighted the vulnerability of self-employed or small business owners to climate hazards. RTAG members also made the following qualifications to the list of vulnerable community types outlined in Table A.4 of this report.

- *Essential Workers* and *Outdoor Workers* should also encompass migrant workers and day laborers, as well as street vendors.
- *People with Disabilities* should be characterized as those with access and functional needs.
- Black/African American communities should be distinguished from *Communities of Color* as a separate vulnerable community type.

Climate Hazards and Impacts

In the Bay Area Region, community members identified power outages, extreme heat, and wildfire smoke as hazards of concern. Low-income communities, who already struggle financially, are further strained by high energy bills and costs associated with power outages like paying to replace spoiled food during power outages. Impacts related to power outages are of particular concern for elderly residents and people with disabilities who rely on medical equipment or refrigerated medicine. Power outages are disruptive to daily life, impacting everything from transportation, to communication, to childcare, and work. Moreover, many community members do not feel comfortable going outside on extremely hot days, and transportation to cooler places is not accessible to many people. Many households lack air conditioning, and for those that do have air conditioning available, many indicated they are unwilling to use it because of the high cost of electricity, resulting in increased risk of heat illness. In addition, community members were concerned about the health impacts from wildfire smoke particularly for low-income communities, communities of color, and outdoor workers who lack access to personal or household safety equipment such as air filters and N-95 masks. A summary of the key findings for the Bay Area Region on impacts is presented in Table A.3.

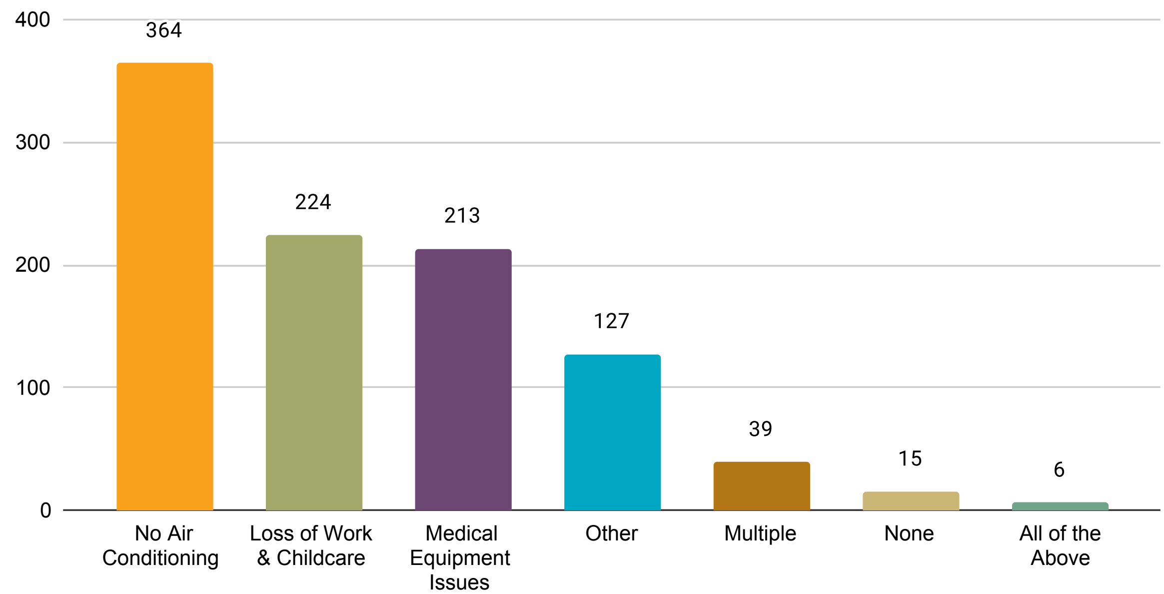
TABLE A.3 Summary of Key Impacts in the Bay Area Region

Hazard	Health Impacts	Economic Impacts	Household/ Community Impacts
Power Outage	Loss of life (e.g., medical equipment failure) Heat stress from lack of air conditioning Anxiety and other mental health impacts	Spoiled food/prescriptions Cannot work from home Loss of work/income and childcare	Transportation disruptions
Extreme Heat	Loss of life Heat stress from no air conditioning/cooling centers Heat stress from working outdoors Anxiety and other mental health impacts due to not being able to go outside	High bills from running air conditioning Loss of work due to harsh outdoor working conditions	Transportation disruptions Inability to go outside
Wildfire and Smoke	Respiratory impacts Anxiety and mental health (trauma)	Loss of work due to unsafe work conditions	Strain on community resources & resource providers Strain on natural resources Transportation disruptions Inability to go outside

Power Outages

Power outages are one of the primary hazards of concern for Bay Area residents. The Bay Area electrical grid is vulnerable to power outages during wind and wildfire events. Through survey and outreach board engagement, 985 responses were provided to the question "What impacts of power outages have you experienced or are most concerned about?" Respondents were allowed to provide more than one response. The top responses are highlighted in Figure A.3, and a summary of the health, economic, and community impacts is provided below for power outages. The qualitative data from the RTAG, survey, and the outreach boards are reflected in the following sections on Health Impacts, Economic Impacts, and Household/Community Impacts due to Power Outages.

FIGURE A.3 Impacts Experience or that Cause Concern During Power Outages
(n=985 responses)



Health Impacts Due to Power Outages

For power outages, health impacts include heat stress from lack of air conditioning, anxiety and other mental health impacts, and loss of life due to disruptions in medical equipment. Of the 985 survey responses, 38 percent of the responses indicate concern about or experience with "No Air Conditioning" as an impact. Respondents were also concerned that losing power meant they were unable to use their heater during cold winters, which can also pose health risks. Additionally, 22 percent of responses indicate concern about, or experience with, "Medical Equipment Issues." The elderly and people with disabilities are especially impacted by the loss of electricity affecting their medical equipment, including oxygen tanks, ventilators, power wheelchairs, and Continuous Positive Airway Pressure (CPAP) machines. Prescriptions that are stored in refrigerators also spoil during power outages, posing a major health risk to those relying on them.

"People who have their medicines in the refrigerator or who need daily oxygen are most impacted."

Economic Impacts Due to Power Outages

Economic impacts due to power outages include loss of income from replacing spoiled food and prescriptions in the refrigerator when the power goes out, inability to work from home or cook from home during outages, and disruptions in childcare. One in four of the survey responses indicated "Loss of Work and Childcare" as an impact respondents experienced or were concerned about.

"Power outages result in higher energy, food, and water bills in areas where the cost of living is already very high."

Household/Community Impacts Due to Power Outages

> **"You couldn't find ice in the entire county" (Marin County).**

RTAG members, survey respondents, and outreach board participants identified disruptions in transportation that affect their ability to go to work, school, community activities, and access medical services. Outages also affect pets whose care requires electricity, such as fish and reptiles. Households are unable to use the television, computer, and radio, resulting in disruptions in daily life as well as ability to access information. Other electric equipment disruptions reported include information systems being disrupted (including internet, cell services, and security cameras), the loss of appliance use, security cameras, and electric gates not working in the event of emergency evacuation. Without internet or cell service, communities have trouble receiving news, updates, and where to access essential resources (e.g., generators, food, etc.).

Power Outage Impacts by County

Survey and outreach board data of power outage impacts by county are represented in Table A.4 below. San Francisco County respondents, who represent 40 percent of all survey respondents, are shown to be most concerned about "Medical Equipment Issues." San Mateo County and Alameda County have the highest percent of respondents who are concerned with "Medical Equipment Issues." Santa Clara County has the highest percent of respondents concerned with "No Air Conditioning." Community members that attended the Multicultural Center of Marin's focus group expressed more concern for power outages affecting the ability to heat homes during the winter months than lack of air conditioning.

TABLE A.4 Power Outage Impacts by County
(n=549 responses)

County	% of Respondents	Responses: Medical Equipment Issues	Responses: Loss of Work and Childcare	Responses: No Air Conditioning
Alameda	19%	38%	12%	18%
Contra Costa	2%	9%	9%	73%
Marin	N/A	N/A	N/A	N/A
Napa	N/A	N/A	N/A	N/A
San Francisco	40%	36%	24%	11%
San Mateo	14%	37%	19%	28%
Santa Clara	2%	9%	13%	47%
Solano	N/A	N/A	N/A	N/A
Sonoma	13%	9%	15%	38%

The values in this table may not total 100% across the response categories for each county because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by county.

Power Outage Impacts by Language

Survey data of key power outage impacts by language is represented in Table A.5 below. Based on the responses to the survey, Cantonese and English-speaking respondents are most concerned with "Medical Equipment Issues" during power outages. Spanish speaking respondents (27 percent) are most concerned with "No Air Conditioning." Most community members attending a Vietnamese American Organization Community Day in Santa Clara County reported being most concerned about "No Air Conditioning." At a Marin County focus group, Vietnamese participants expressed concern about their food spoiling and not having access to ice. Spanish speaking focus group participants also voiced concern about not having access to ice or working stoves to cook.

TABLE A.5 Power Outage Key Impacts by Language
(n=607 responses)

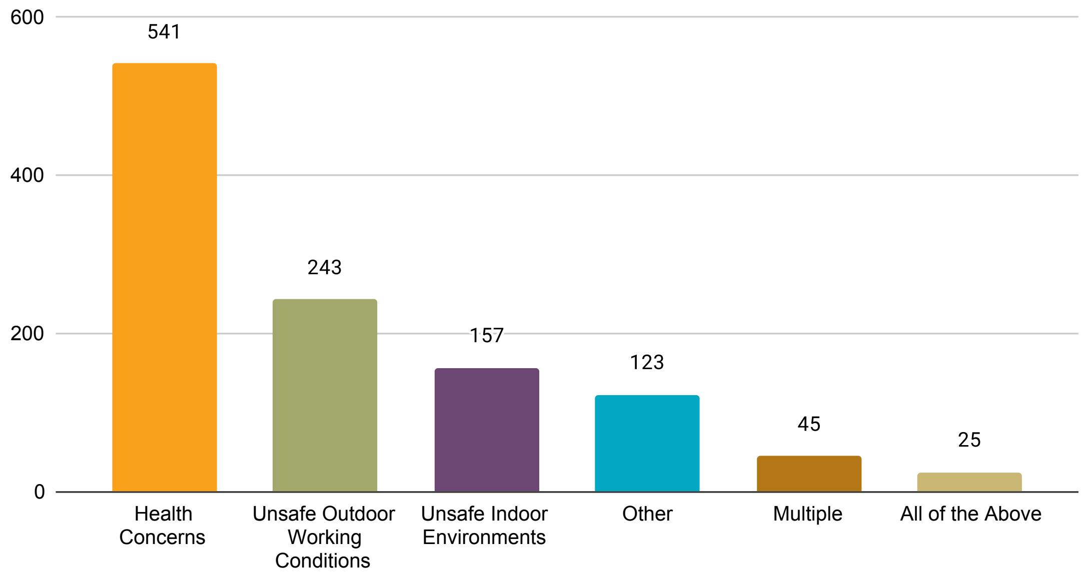
Language	% of Respondents	Responses		
		Medical Equipment Issues	Loss of Work and Childcare	No Air Conditioning
Arabic	<1%	0%	20%	60%
Chinese	48%	34%	20%	16%
English	26%	30%	14%	30%
Samoan	N/A	N/A	N/A	N/A
Spanish	19%	21%	20%	36%
Tongan	N/A	N/A	N/A	N/A
Vietnamese	7%	5%	18%	51%

The values in this table may not total 100% across the response categories for each county because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by language.

Extreme Heat

Extreme heat is another key hazard of concern in the Bay Area Region. Heat waves pose an increased risk to Bayside communities that have not historically experienced extreme heat events and lack cooling infrastructure. Through survey and outreach board engagement, 1184 responses were provided to the question "What impacts of extreme heat have you experienced or are most concerned about?" Survey respondents were allowed to provide more than one response. The top responses are highlighted in Figure A.4 summary of the health, economic, and community impacts is provided below for extreme heat.

FIGURE A.4 Impacts Experiences of that Cause Concern during Extreme Heat (n=1184 responses)



Health Impacts Due to Extreme Heat

Survey and RTAG engagement data shows "Health Concerns" is the top impact with respect to extreme heat. Survey respondents reported health impacts including loss of life, heat-induced burns, heat stress from lack of air conditioning or cooling centers and from working outdoors, and anxiety and other mental health impacts from being unable to go outside.

Economic Impacts Due to Extreme Heat

Economic impacts during extreme heat events include high bills from running the air conditioner, higher than average water use, and disruption of work due to harsh outdoor working conditions. One in four of the responses to the survey and outreach boards identified "Unsafe Outdoor Working Conditions" as an impact people have experienced/are most concerned about. Extreme heat reduces the productivity of outdoor workers, resulting in losses to the employer, and may result in lost wages for workers who suffer from heat-related illnesses.

Household/Community Impacts Due to Extreme Heat

In addition to the individual level, extreme heat events create broad community impacts. RTAG members noted that transportation disruptions due to extreme heat can result in reduced access to cooling centers, work, school, community events, and health services. In inland communities, there is insufficient transportation access for low-income communities without cars to access the coast to cool down. One RTAG member raised the issue of limited Americans with Disabilities Act (ADA) vehicle availability in the region for transportation to cooling centers.[17] Additionally, during extreme heat events, people do not go outside, impacting their ability to recreate and socialize. Those experiencing isolation and limited information channels, such as the elderly population, are

> **"[In East Palo Alto] many residents can't go outside since it's too hot. Residents go to parks since they do not have AC in their homes."**

17 One RTAG member mentioned East Bay Paratransit must be scheduled the day before it is needed. If there is a random power outage or extreme heat event, people cannot access cooling centers. Other options for transportation are available, such as Uber and Lyft but those are more expensive options and not always available.

particularly vulnerable.

Extreme Heat Impacts by County

Survey and outreach board data of extreme heat impacts by county are represented in Table A.6 below. Consistent with the region as a whole, "Health Concerns" is the top impact from extreme heat across all counties. Alameda County has the highest percent of respondents that experienced or were concerned about "Unsafe Indoor Environments." Sonoma County respondents' top impact of concern was "Unsafe Outdoor Working Conditions" (20 percent). In San Mateo County, community members engaged at tabling events expressed concern for residents living in one-bedroom apartments without air conditioning during heat waves.

TABLE A.6 Key Extreme Heat Impacts by County
(n=594 responses)

County	% of Respondents	Responses		
		Health Concerns	Unsafe Indoor Environments	Unsafe Outdoor Working Conditions
Alameda	19%	64%	19%	12%
Contra Costa	2%	19%	13%	44%
Marin	N/A	N/A	N/A	N/A
Napa	N/A	N/A	N/A	N/A
San Francisco	40%	69%	9%	19%
San Mateo	15%	60%	14%	15%
Santa Clara	2%	44%	26%	9%
Solano	0.4%	50%	0%	0%
Sonoma	14%	36%	23%	26%

The values in this table may not total 100% across the response categories for each county because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by county.

Extreme Heat Impacts by Language

Survey data of extreme heat impacts by language is represented in Table A.7 below. Across language groups, "Health Concerns" is the impact of highest concern. Community-members attending a Vietnamese American Organization Community Day in Santa Clara County reported they are most concerned about "Unsafe Indoor Environments."

TABLE A.7 Extreme Heat Impacts by Language
(n=660 responses)

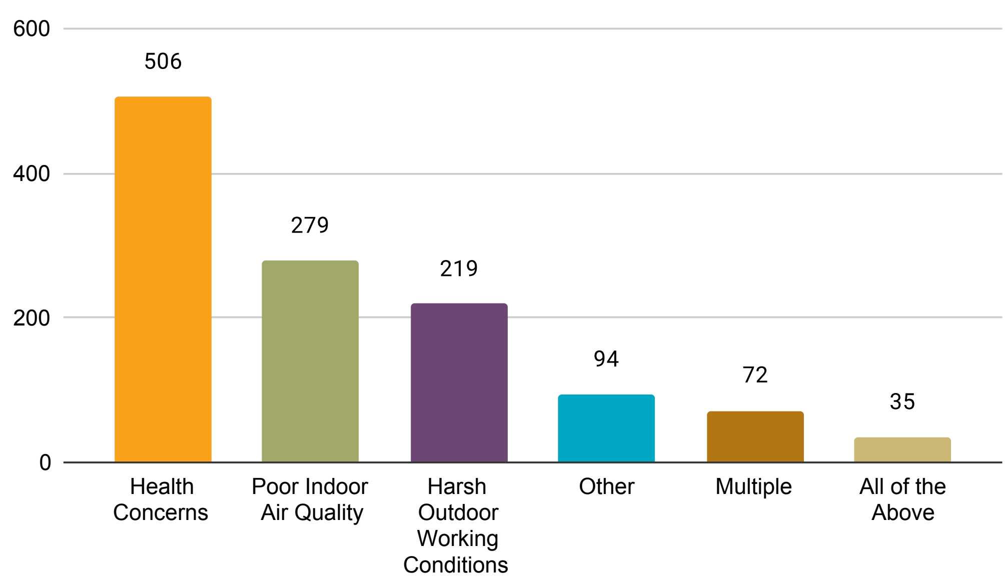
Language	% of Respondents	Responses: Health Concerns	Responses: Unsafe Indoor Environments	Responses: Unsafe Outdoor Working Conditions
Arabic	<1%	40%	60%	0%
Chinese	48%	66%	12%	18%
English	26%	47%	21%	20%
Spanish	N/A	49%	17%	21%
Samoan	19%	N/A	N/A	N/A
Tongan	N/A	N/A	N/A	N/A
Vietnamese	7%	50%	20%	3%

The values in this table may not total 100% across the response categories for each county because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by language.

Wildfires and Smoke

Wildfires and wildfire smoke are both hazards of concern in the Bay Area Region. Wildfires pose a direct risk to human life, and both urban wildfires and large wildfires to the north and east of the Bay Area undermine air quality. Through survey and outreach board engagement, 1275 responses were provided to the question "What impacts of wildfire smoke have you experienced or are most concerned about?" Respondents were allowed to provide more than one response. The top responses are highlighted in Figure A.5. A summary of the health, economic, and community impacts is provided below for wildfire smoke.

FIGURE A.5 Impacts Experienced or that Cause Concern during Wildfires and Smoke
(n=1275 responses)



Health Impacts Due to Wildfires and Smoke

> **"[In East Palo Alto] the main concern from the community is air quality since many seniors/children have asthma."**

Air pollution from wildfire smoke results in health impacts, which are elevated for children, elderly, and those suffering from respiratory illnesses. Survey data shows about 50 percent of responses indicate "Health Concerns" as an impact respondents experienced or were concerned about.[18] Survey respondents reported specific health impacts including respiratory issues, eye infections, and mental health impacts (such as anxiety) related to trauma associated with experiencing severe wildfire smoke, evacuations, or the loss of a home. When wildfire smoke is present, children, the elderly, and people with disabilities are particularly at risk, along with animals.[19] Many community members reported they are unaware of the health risks posed by wildfire smoke and poor air quality, and some community members shared they are unclear how to access healthcare related to smoke-related injuries and illness.

Economic Impacts Due to Wildfires and Smoke

Wildfires disproportionately impact renters and lower-income homeowners who generally have less ability to build or upgrade to fire-safe building codes or maintain defensible space. In a region with high housing pressures, loss of homes during wildfires can result in community displacement, especially for low-income residents. Economic impacts from wildfire smoke include loss of work and unsafe working conditionings due to the poor outdoor air quality. Transportation schedules may be altered due to wildfire smoke, and community members reported not being able to wait outside comfortably or safely for the bus without a proper mask. Respondents also mentioned that they are unable to complete errands when there is an unhealthy level of wildfire smoke outside.

Household/Community Impacts Due to Wildfires and Smoke

Other community impacts identified include the strain on community resources and natural resources. For example, it takes time to recover vegetation, garden plots, and trees and crops, leading to food scarcity for some populations. Additionally, respondents mentioned disruptions to active transportation and daily life as time spent outdoors is limited.

Several participants mentioned challenges when driving during wildfire smoke events as there is poor or no visibility on the roads. Active wildfires can jump over roads, and with limited roads in and out of some communities, people are at risk of being trapped. In addition, focus group participants were concerned about gas stations closing, and how that would impact their ability to evacuate.

18 Responses related to harsh outdoor working conditions and unsafe indoor environments are also related to health concerns.

19 An RTAG member reported that many people, especially those with disabilities, need air conditioning to survive but if there is a power outage, windows need to be shut due to the air quality posing unsafe living conditions indoors.

Wildfire Smoke Impacts by County

Survey and outreach board data of key wildfire smoke impacts by county are represented in Table A.8 below. Across all counties, "Health Concerns" are the impact of wildfire smoke that most respondents have experienced or are most concerned about, with San Francisco, San Mateo and Alameda County respondents expressing the greatest concern.

TABLE A.8 Key Wildfire Smoke Impacts by County
(n=620 responses)

County	% of Respondents	Responses: Health Concerns	Responses: Poor Indoor Air Quality	Responses: Harsh Outdoor Working Conditions
Alameda	19%	60%	21%	9%
Contra Costa	2%	33%	13%	13%
Marin	N/A	N/A	N/A	N/A
Napa	N/A	N/A	N/A	N/A
San Francisco	40%	65%	19%	13%
San Mateo	15%	60%	18%	15%
Santa Clara	2%	33%	26%	16%
Solano	0.4%	0%	0%	0%
Sonoma	14%	28%	29%	12%

The values in this table may not total 100% across the response categories for counties because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by county.

Wildfire and Smoke Impacts by Language

Survey data of key wildfire smoke impacts by survey response language is represented in Table A.9 below. Across nearly all languages, "Health Concerns" is the impact of highest concern. Across all language categories, more survey respondents reported concern with "Poor Indoor Air Quality" than "Harsh Outdoor Working Conditions." Uniquely, respondents to the Arabic language survey tended to feel that "Indoor Air Quality" was as significant of an issue as "Health Concerns."

TABLE A.9 Key Wildfire Smoke Impacts by Language
(n=680 responses)

Language	% of Respondents	Responses		
		Health Concerns	Poor Indoor Air Quality	Harsh Outdoor Working Conditions
Arabic	<1%	40%	40%	20%
Chinese	48%	64%	19%	12%
English	26%	44%	24%	15%
Spanish	N/A	45%	22%	15%
Samoan	19%	N/A	N/A	N/A
Tongan	N/A	N/A	N/A	N/A
Vietnamese	7%	35%	18%	8%

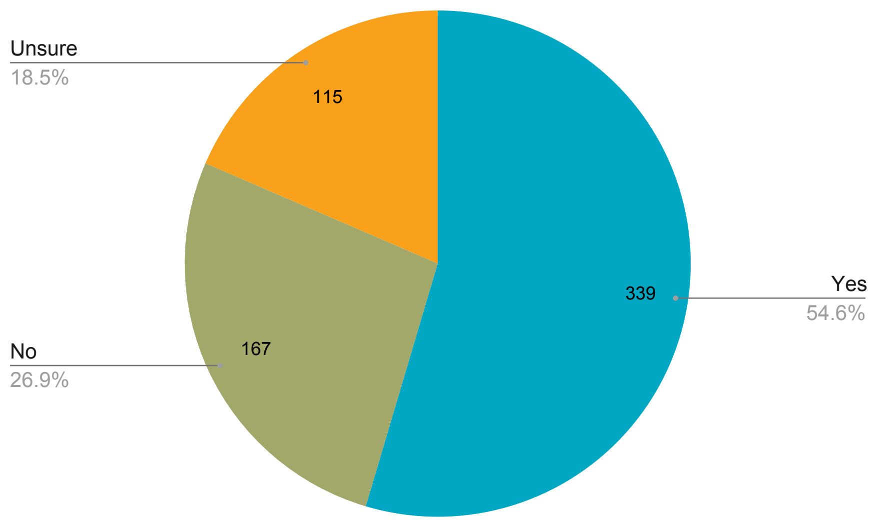
The values in this table may not total 100% across the response categories for languages because the Project Team left out survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by language.

Mental Health

"Anxiety is a factor. It is very scary on Highway 37 during fires. You feel trapped."

Mental health impacts are observed across events related to power outages, extreme heat, and wildfire smoke. Over half of respondents (n=621) report their mental health being impacted by extreme climate events, which include heat, increased rain and flooding, wildfires, drought, and landslides (Figure A.6). Respondents who completed surveys in Vietnamese, English, and Cantonese more frequently reported mental health impacts (62 percent, 56 percent, and 57 percent respectively) compared to Spanish speaking (42 percent) respondents. All respondents who completed an Arabic language survey reported impacts to their mental health due to extreme weather. Impacts include anxiety, worry, and stress due primarily to the loss of work and evacuations as a result of traumatic climate events. Respondents also mentioned that their children are tired of staying inside and that they are unable to go to community events. During extreme weather events, several respondents shared they are unable to exercise outside (due to air quality or extreme heat), which impacts their mental health.

FIGURE A.6 Mental Health Impacts due to Extreme Climate Events
(n=621 respondents)



A subset of the respondents was asked about what mental health impacts they have experienced or are most concerned about. Of the respondents asked this question,[20] 43 percent of the responses indicated they experienced mental health impacts due to "Loss of Work," followed by "Evacuations," and "Emergency Response and Planning." Table A.10 and Table A.11 illustrate survey data of mental health impacts by county and by language. Alameda County had the highest rate of mental health impacts reported (67 percent).

TABLE A.10 Mental Health Impacts due to Extreme Climate Events by County
(n=559 respondents)

County	% of Respondents	Responses		
		No	Unsure	Yes
Alameda	19%	19%	15%	67%
Contra Costa	2%	8%	33%	58%
Marin	N/A	N/A	N/A	N/A
Napa	N/A	N/A	N/A	N/A
San Francisco	40%	26%	22%	52%
San Mateo	15%	22%	12%	56%
Santa Clara	2%	35%	6%	58%
Solano	0.4%	0%	50%	50%
Sonoma	14%	38%	16%	45%

The values in this table may not total 100% across the response categories for counties because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by county.

20 Respondents were able to provide more than one response to the question. There were 1178 responses to this question on the outreach board.

TABLE A.11 Mental Health Impacts due to Extreme Climate Events by Language (n=621 respondents)

Language	% of Respondents	Responses		
		No	Unsure	Yes
Arabic	<1%	0%	0%	100%
Chinese	48%	19%	24%	57%
English	26%	31%	13%	56%
Spanish	N/A	41%	17%	42%
Samoan	19%	N/A	N/A	N/A
Tongan	N/A	N/A	N/A	N/A
Vietnamese	7%	26%	12%	62%

The values in this table may not total 100% across the response categories for languages because the Project Team left out survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by language.

Adaptive Capacity

The Project Team did not conduct research interviews in the Bay Area Region, and therefore has limited qualitative data to analyze regional adaptive capacity. Nevertheless, based on RTAG input provided during meetings, the Project Team can make the following inferences with respect to adaptive capacity in the Bay Area Region.

1. The Bay Area has extensive networks of CBOs actively working on climate resilience, environmental, social, and economic justice in underserved communities. These networks provide important communication channels between public agencies, emergency service providers, and utilities like PG&E to distribute information out to communities, as well as receive community input with respect to emergency preparedness and climate resilience strategies/opportunities.

2. Despite high average household incomes, there are many pockets of the region that are low and very low-income that lack the resources to adequately prepare for climate impacts. As discussed above, CBOs can help support resource distribution; however, they currently lack capacity and need significantly more funding to fill this needed role.

3. Community members in Bay Area Disadvantaged Vulnerable Communities (DVCs), especially in communities of color, have high levels of social/community cohesion, as reported by the Bay Area Region RTAG members, that make resilience strategies like community resilience centers attractive. High levels of social and community cohesion are important to helping people stay informed, call for help, and advocate for needed resources and services.

Regional Adaptive Capacity by County

High levels of socioeconomic inequity in the Bay Area create meaningful differences in the ability of individuals to prepare for and recover from climate hazards. Financial resources as well as improved social structures are important to enhance community resilience and reduce these disparities. The Project Team evaluated the Bay Area Region adaptive capacity by utilizing the Baseline Resilience Indicators for Communities (BRIC) Index county scores across the six categories and the BRIC Composite score for each county in the region. A description of the resilience categories is provided in the Adaptive Capacity section of the main report.

As shown in Table A.12, **San Francisco County and San Mateo County have the highest overall adaptive capacity**, while Sonoma County and Santa Clara County have the lowest. Across counties, the region performs the lowest on the "Community Capital" category, suggesting that the Bay Area communities lack social networks and connectivity among individuals and groups. This data finding is inconsistent with input from RTAG members who shared that **Bay Area communities has extensive networks actively working on climate resilience, and connection to people and place, especially in ethnic neighborhoods.**

TABLE A.12 BRIC Scores by County (High to Low)

County	Social	Economic	Community Capital	Institutional	Infrastructural	Environmental	BRIC Composite Score
San Francisco	0.675	0.520	0.266	0.368	0.412	0.655	0.483
San Mateo	0.687	0.538	0.277	0.373	0.335	0.590	0.467
Marin	0.730	0.486	0.305	0.373	0.309	0.595	0.466
Solano	0.667	0.520	0.305	0.392	0.291	0.559	0.456
Alameda	0.682	0.523	0.270	0.382	0.367	0.505	0.455
Napa	0.668	0.501	0.312	0.383	0.294	0.546	0.451
Contra Costa	0.677	0.507	0.301	0.386	0.313	0.510	0.449
Sonoma	0.676	0.495	0.314	0.376	0.283	0.541	0.447
Santa Clara	0.681	0.547	0.248	0.374	0.326	0.495	0.445

* To simplify the comparison and analysis of many variables, researchers may use a normalization technique called Min-Max normalization in social indicators research. This involves scaling all values between 0 and 1 (0 represents the minimum value and 1 represents the maximum value) through adjusting all other values by subtracting the minimum value from the maximum and dividing by the range.

Supplemental Adaptive Capacity Indicators

The Resilient Together initiative survey provides some supplemental data that is relevant to the evaluation of adaptive capacity in the Bay Area Region. Since the Resilient Together initiative sought out input specifically from DVCs, the data is not representative of the Bay Area. Therefore, supplemental adaptive capacity indicators should only be referenced with context to the survey sample and in conjunction with the BRIC index results.

"Gas stations were closing in west Marin. We were stressed about gas."

Access to Financial Resources

Access to financial resources enables households to access resources and services that improve their resilience in the face of climate hazards. For low-income households, access to financial assistance is one of the most significant ways to increase adaptive capacity. In the Bay Area Region, approximately 32 percent of survey respondents receive financial assistance on their utility bill, and another 13 percent were unsure. To qualify for financial assistance, households must meet low-income thresholds.[21] RTAG members noted that due to the higher cost of living in the Bay Area, many households struggle to pay their energy bills despite having higher incomes that make them ineligible for financial assistance programs.

21 CARE/FERA program guidelines can be accessed at the below site: https://www.pge.com/en_US/residential/save-energy-money/help-paying-your-bill/longer-term-assistance/care/program-guidelines.page#qualifying

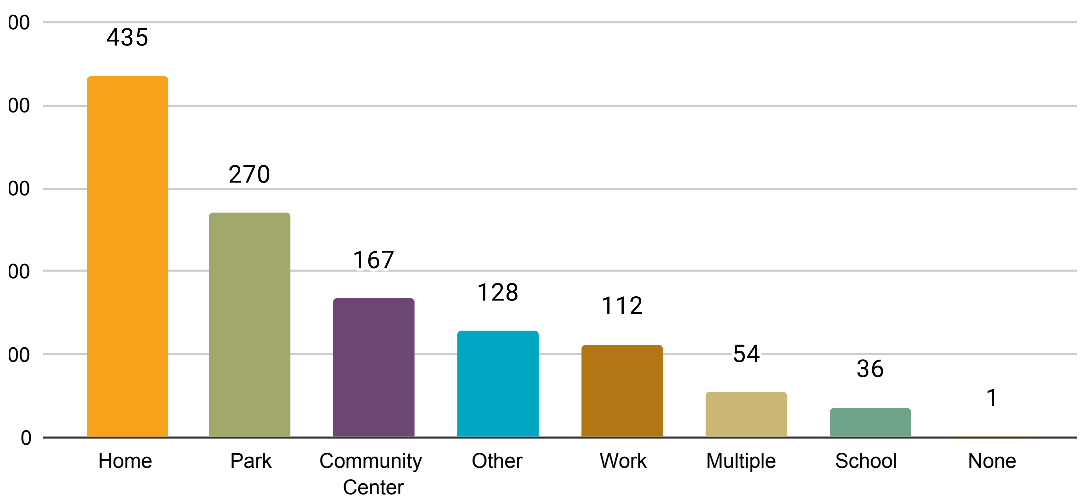
Access to Air-Conditioned Space

Access to air conditioning or air-conditioned spaces is one of the most important indicators of adaptive capacity to extreme heat events. Approximately one-quarter of respondents indicated they have access to an air-conditioned space. Lack of access to air conditioning was the primary impact of concern with respect to extreme heat. The survey also asked those respondents who do not have access to an air-conditioned space whether they need air conditioning. Of those survey respondents, about 25 percent (n=598 respondents) responded that they do not have access to an air-conditioned space, but they need air conditioning.

Nearly three quarters of survey respondents and those engaged through the outreach boards cool off in their home, park, or community center (Figure 4). Cantonese and Spanish speaking respondents were more likely to cool off outside the home compared to English language respondents.

RTAG members support resilience hubs/cooling centers as a strategy to adapt to extreme heat, but only a small percentage (~14 percent) of survey respondents reported cooling off at existing community centers. This finding suggests that resilience hubs/cooling centers are not adequately meeting community needs, despite a lack of access to air-conditioned spaces, and that resilience centers may need to provide community benefit beyond air conditioning for them to be utilized by community members. RTAG recommendations for how to improve community resilience centers to better service community members are included in the following section of this report: "Resilience Strategies & Recommendations."

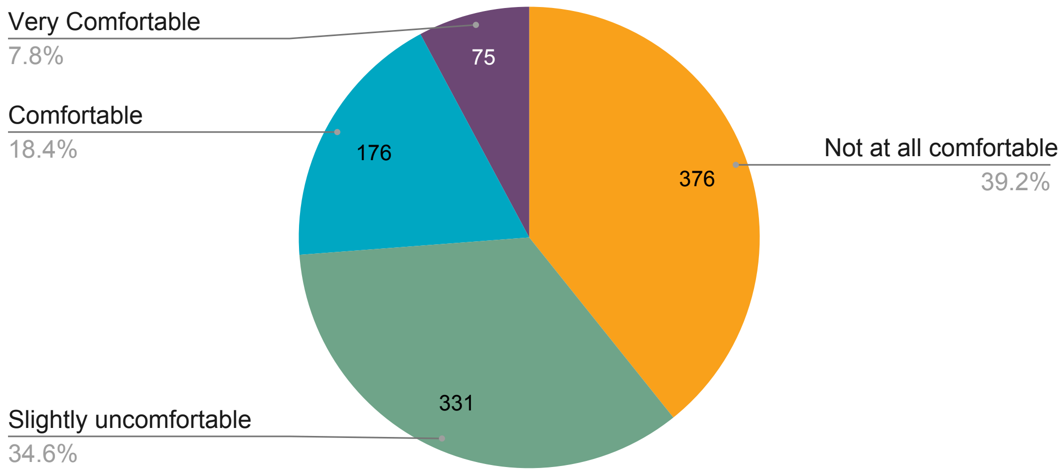
FIGURE A.7 Where the Bay Area Region Community Members Go to Cool Off on Hotter Days (n=1202 responses)



Comfort Level in Home

Most Bay Area Region respondents are not comfortable in their home on hot days. While 36 percent of the responses to this question, "How comfortable are you in your home on hot days," referenced homes as one of the places they go to cool off, approximately 74 percent of respondents are not at all comfortable or slightly uncomfortable at home on hotter days (Figure A.8).

FIGURE A.8 Comfort Levels at Home on Hotter Days Days
(n=958 respondents)



Of survey respondents who cool off at home on hotter days[22] (n=323 respondents), only about a quarter are "Comfortable" or "Very Comfortable" (Figure A.9). More notably, about 75 percent of respondents are "Not at all Comfortable" or "Slightly Uncomfortable" at home. This finding suggests that just because people "cool off" at home, does not mean they are comfortable at home doing so.

FIGURE A.9 Comfort Level at Home for Those who Cool Off at Home on Hotter Days
(n=323 responses)

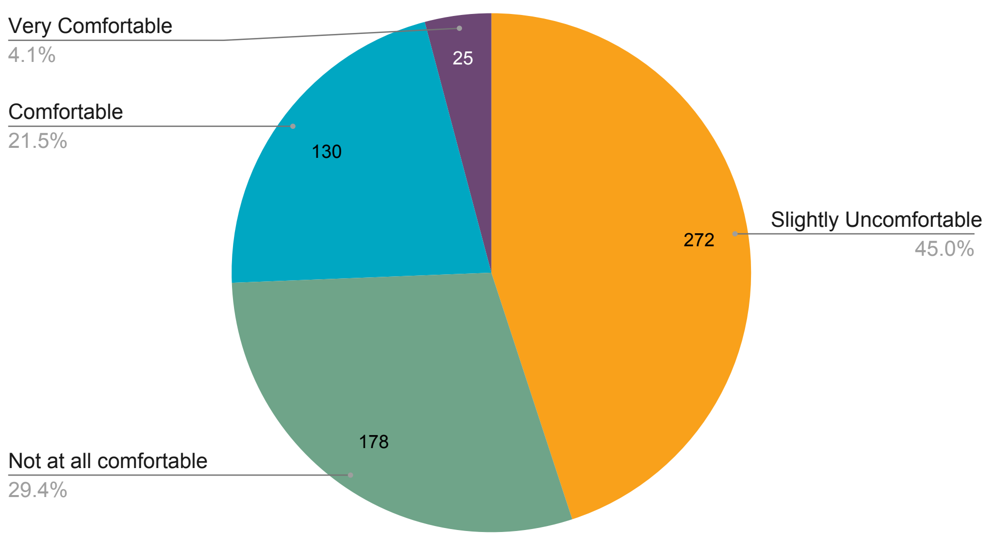


Table A.13 shows how comfortable survey respondents are at home on hotter days by county.[23] The distribution of comfort levels across counties is evenly distributed. Most respondents in each county expressed they are "Slightly Uncomfortable." As shown in Table A.14 English speaking respondents reported being "Not At All Comfortable" in their home on hotter days more than Cantonese and Spanish speaking respondents. Arabic,

22 The Project Team is only able to assess comfort levels at home for those survey respondents who said they cool off at home. This is because we are not able to connect responses to different questions to the same individual through the outreach boards.

23 Figure C.11 contains data from surveys as people engaged through outreach boards were not requested to include their zip-codes in their responses.

Spanish, and Vietnamese speaking respondents reported being "Comfortable" or "Very Comfortable" more than English or Cantonese speaking respondents. However, the data shows 44 percent of Spanish speaking respondents are "Slightly Uncomfortable." Forty percent of Vietnamese speaking respondents and forty percent of Arabic speaking respondents reported being "Comfortable" or "Very Comfortable."

TABLE A.13 Comfort Level at Home on Hotter Days by County
(n=543 respondents)

County	% of Respondents	Responses			
		Not at all Comfortable	Slightly Uncomfortable	Comfortable	Very Comfortable
Alameda	19%	44%	35%	18%	4%
Contra Costa	2%	25%	33%	33%	8%
Marin	N/A	N/A	N/A	N/A	N/A
Napa	N/A	N/A	N/A	N/A	N/A
San Francisco	40%	27%	50%	22%	1%
San Mateo	15%	27%	54%	18%	1%
Santa Clara	2%	26%	41%	24%	9%
Solano	0.4%	0%	50%	0%	50%
Sonoma	14%	21%	54%	23%	4%

The values in this table may not total 100% across the response categories for counties because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by county.

TABLE A.14 Comfort Level at Home on Hotter Days by Language
(n=605 respondents)

Language	% of Respondents	Responses			
		Very Comfortable	Comfortable	Slightly Uncomfortable	Not at All Comfortable
Arabic	<1%	0%	40%	60%	0%
Chinese	48%	1%	22%	51%	26%
English	26%	6%	16%	41%	37%
Spanish	N/A	5%	25%	44%	27%
Samoan	19%	N/A	N/A	N/A	N/A
Tongan	N/A	N/A	N/A	N/A	N/A
Vietnamese	7%	14%	26%	24%	36%

The values in this table may not total 100% across the response categories for languages because the Project Team left out survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by language.

Resilience Strategies and Recommendations

Through the Resilient Together initiative, community and RTAG members had an opportunity to share preferred strategies for how PG&E can best build community resilience to the range of climate impacts identified in communities throughout the region. These strategies, if implemented, would increase the adaptive capacity of households and communities to a range of climate impacts.

Generally, RTAG members in the Bay Area Region recommended PG&E:

- **Invest in community resilience centers in response to frequent power outages.** In addition to providing backup energy, community resilience centers increase community cohesion by providing a meeting place for communities to organize, share information and resources, and recreate/socialize before, during and after a climate hazard event.
- **Provide direct financial relief to residents who are impacted by power outages.** RTAG members recommended freezing gas and electricity rates, compensating low-income individuals or households impacted by power outages, and expanding eligibility for low-income assistance programs. In Marin County, focus group participants expressed that California Alternate Rates for Energy (CARE) eligibility requirements are too high, and only cover extremely low-income households.
- **Increase investments in infrastructure improvements and grid modernization that would reduce the frequency of power outages and wildfires** that contributed to impaired air quality. In addition, RTAG members advocated for increased investment in microgrids, access to backup generators, and solar (especially for low-income households) to help mitigate the impacts of power outages.
- **Conduct outreach to communities and the public before, during and after a climate hazard.** RTAG members recommended PG&E provide real time updates on climate hazards, and notifications on when power will be back online through text messages. Access to information around when power will be shut off or return, where and how to access resources, and how to prepare for emergencies is critical to ensuring communities can prepare for and recover from climate shocks and stresses. RTAG members also recommended PG&E host more informational meetings, conduct multi-lingual outreach, and provide educational training. They also conveyed that PG&E should continue to partner with CBOs to reach historically marginalized communities and underrepresented populations to ensure those most vulnerable have access to the resources and care they need to be safe.
- **Advocate for state funding to be directed toward building capacity of existing networks and organization of CBOs working on climate resilience**, and to direct more funding toward extreme heat mitigation, as well as state-wide workplace safety standards with respect to extreme heat.

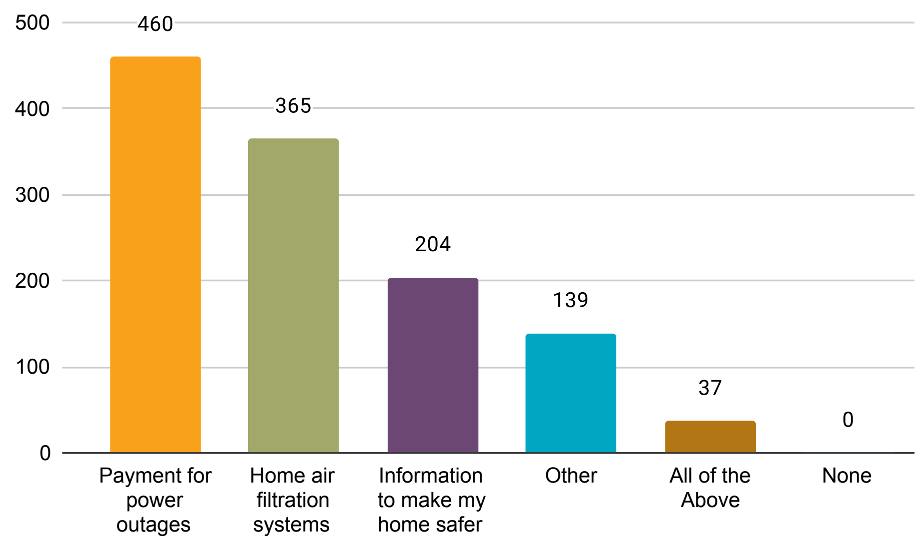
"PG&E mainly needs to improve their information communication. We need more clarity. They should come meet the community."

The following sections provide additional details for strategies and specific actions survey respondents and RTAG members recommended to improve household and community resilience.

Household Resilience Strategies

Community members were requested to provide recommendations for the kinds of strategies that PG&E could implement that would support households during extreme weather events. A summary of the strategies that were recommended by the Bay Area Region RTAG specifically are included below.

FIGURE A.10 PG&E Strategies for Households During Extreme Weather Events
(n=1279 responses)



Survey respondents and outreach board respondents at in-person events were asked to provide their top two recommended strategies for PG&E to support households during extreme weather events. Of the 1279 responses received, the top two recommended strategies are “Payment for Power Outages” (39 percent) and “Home Air Filtration Systems” (31 percent), followed by information to make homes safer.

“Payment for Power Outages” is a top priority overall, but on a county level, all but San Mateo County respondents selected “Home Air Filtration Systems” as the top household strategy (Table A.15). San Mateo County respondents selected “Payment for Power Outages” as the top choice. The survey data that provides the county breakdown represents 50 percent of the data received during the Outreach Period.

Table A.16 illustrates the breakdown of household strategies by surveys completed in different languages. “Payment for Power Outages” was the most selected strategy for surveys taken in all languages. “Home Air Filtration Systems” was close behind as the most selected strategy for surveys completed in Chinese, Spanish, and Vietnamese.

TABLE A.15 Household Strategies During Extreme Weather Events by County
(n=902 responses)

County	% of Respondents	Responses: Payment for Power Outages	Responses: Home Air Filtration Systems	Responses: Information to Make My Home Safer
Alameda	19%	25%	41%	29%
Contra Costa	2%	50%	41%	9%
Marin	N/A	N/A	N/A	N/A
Napa	N/A	N/A	N/A	N/A
San Francisco	40%	35%	37%	27%
San Mateo	15%	50%	32%	16%
Santa Clara	2%	43%	32%	22%
Solano	0.4%	33%	33%	33%
Sonoma	14%	35%	38%	26%

The values in this table may not total 100% across the response categories for counties because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by county.

TABLE A.16 Priority Household Resilience Strategies by Language
(n=641 responses)

Language	% of Respondents	Responses: Payment for Power Outages	Responses: Home Air Filtration Systems	Responses: Information to Make My Home Safer
Arabic	<1%	67%	17%	17%
Chinese	48%	45%	36%	18%
English	26%	64%	23%	9%
Samoan	N/A	N/A	N/A	N/A
Spanish	19%	48%	32%	19%
Tongan	N/A	N/A	N/A	N/A
Vietnamese	7%	40%	38%	17%

The values in this table may not total 100% across the response categories for languages because the Project Team left out survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by language.

Survey respondents also provided the following open-ended input on community resilience strategies under the "Other" responses category. All these responses were contextualized and integrated into the Bay Area Region Recommendations for Household Resilience Strategies. Table A.17 lists specific recommendations that came from RTAG input, survey respondents via open-ended survey responses, and focus group participants for PG&E to consider with respect to the following strategy areas:

1. Home Improvements
2. Direct Payments
3. Customer Programs
4. Safety Resources Distribution

Under each strategy is a list of recommended actions that the Project Team heard from community and RTAG members, categorized by: (1) within PG&E's control, (2) possible through partnerships, and (3) outside of PG&E's control.

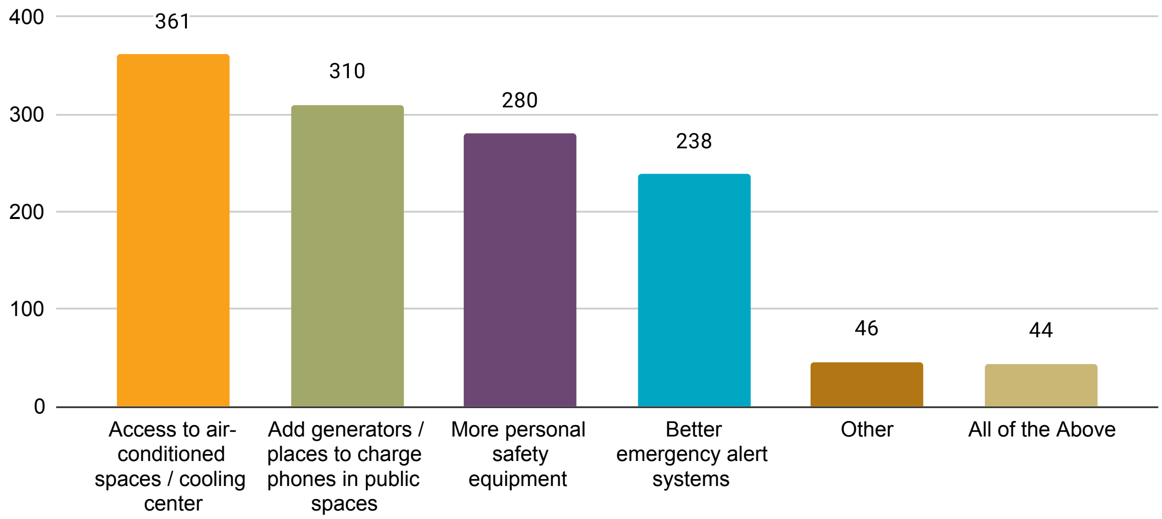
TABLE A.17 The Bay Area Region Recommendations for Household Resilience Strategies

Strategy Area	Recommended Action	Within PG&E's Control	Possible Through Partnerships	Outside of PG&E's Control
Home Improvements	Insulate homes and enhance building envelopes	X	X	
	Provide solar, batteries, and backup generation for low-income households	X	X	X
	Provide free/subsidized A/C units		X	
	Subsidize decarbonization of household, including subsidies for all-electric appliances (e.g., heat pumps)	X		
Direct Payments	Provide direct reimbursements for costs associated with power outages and wildfires (food loss, home filtration systems, prescriptions, chargers, generators)	X		
Customer Programs	Increase enrollment for eligible residents in low-income assistance programs by conducting more outreach to support enrollment and eliminating restrictions to enrollment based on outstanding balances	X		
Safety Resources Distribution	Distribute free/subsidized air purifiers	X	X	
	Distribute free N-95 masks	X	X	
	Distribute free/subsidized portable solar panel & battery packs	X	X	
	Distribute free surge protectors for appliances and computers	X	X	
	Distribute free emergency "go-kits"	X	X	

Community Resilience Strategies

Community members were requested to provide input on the kinds of strategies that PG&E could implement that would support communities during extreme weather events and energy outages. A summary of the strategies that survey respondents supported in the Bay Area Region are included below. Respondents were encouraged to pick their top two choices, although respondents chose between zero and four strategies as their responses.

FIGURE A.11 PG&E Strategies for Communities During Extreme Weather Events
(n=1411 responses)



In the Bay Area Region, "Access to Air-conditioned spaces/Cooling Centers" and "Add Generators/Places to Charge Phones in Public Spaces" were the top two strategies survey respondents identified to help communities build resilience to extreme weather events. Approximately 23 percent of the total responses selected were for "More Personal Safety Equipment" such as masks, air purifiers, and portable batteries and 20 percent for "Better Emergency Alert Systems." One suggestion for better emergency alert systems was to provide bilingual notification alerts to accommodate the community; another suggestion was to design an outreach campaign for post blackout events to reach the people affected and check-in.

On a county level, the distribution of responses across the different resilience strategies is consistent, with access to "Access to Air-conditioned Spaces/Cooling Centers" being the top response across most of the counties represented. As shown in Table A.18, "Better Emergency Alert Systems" is the top strategy followed by "Access to Air-conditioned Spaces/Cooling Centers" for San Francisco, representing 40 percent of all respondents. San Mateo County respondents' top selection is to "Add Generators/Places to Charge Phones in Public Spaces."

Table A.19 illustrates preferred household strategies by language of respondent. "Access to Air-Conditioned Spaces/Cooling Center" is the top household strategy for Cantonese and Spanish speaking respondents, while "Add Generators/Places to Charge Phones in Public Spaces" is the top strategy for Vietnamese and English speaking respondents. This finding is consistent with the English speaking respondents having greater access to air conditioning.

TABLE A.18 Priority Community Resilience Strategies by County (n=2033 responses)

County	% of Respondents	Responses: Access to Air-Conditioned Spaces/Cooling Centers	Add Generators/ Places to Charge Phones in Public Spaces	More Personal Safety Equipment	Better Emergency Alert Systems
Alameda	19%	33%	21%	28%	15%
Contra Costa	2%	31%	19%	23%	19%
Marin	N/A	N/A	N/A	N/A	N/A
Napa	N/A	N/A	N/A	N/A	N/A
San Francisco	40%	25%	24%	21%	27%
San Mateo	15%	31%	37%	23%	16%
Santa Clara	2%	36%	17%	23%	20%
Solano	0.4%	20%	20%	20%	20%
Sonoma	14%	23%	18%	11%	40%

The values in this table may not total 100% across the response categories for counties because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by county.

TABLE A.19 PG&E Strategies for Communities During Extreme Weather Events, by Language (n=1364 responses)

Language	% of Respondents	Responses: Access to Air-Conditioned Spaces/ Cooling Centers	Add Generators/ Places to Charge Phones in Public Spaces	More Personal Safety Equipment	Better Emergency Alert Systems
Arabic	<1%	25%	50%	0%	25%
Chinese	48%	24%	32%	17%	25%
English	26%	24%	43%	11%	14%
Samoan	N/A	N/A	N/A	N/A	N/A
Spanish	19%	28%	40%	6%	25%
Tongan	N/A	N/A	N/A	N/A	N/A
Vietnamese	7%	20%	39%	11%	9%

The values in this table may not total 100% across the response categories for languages because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by language.

Survey respondents also provided open-ended input on community resilience strategies under "Other" strategies. Responses were contextualized and integrated into the Bay Area Region Recommendations for Community Resilience Strategies (Table A.25). Table A.20 lists specific recommendations that came from RTAG input, survey respondents via open-ended survey responses, and focus group participants for PG&E to consider with respect to the following strategy areas:

1. Community Resilience Centers and Cooling Centers
2. Infrastructure Improvements and Grid Modernization
3. Distributed Energy Resources
4. Communication, Education & Outreach
5. Transportation Services
6. State Advocacy

Under each strategy area is a list of recommended actions that the Project Team heard from community and RTAG members, categorized by: (1) within PG&E's control, (2) possible through partnerships, and (3) outside of PG&E's control.

TABLE A.20 Recommended Actions for the Bay Area Region by Community Resilience Strategy Area

Strategy Area	Recommended Action	Within PG&E's Control	Possible Through Partnerships	Outside of PG&E's Control
Community Resilience Center	Provide financial support for the development and sustained operation of community resilience centers at places of worship, schools, and nonprofits through new and existing grant programs, including incentives for existing community centers.	X	X	
	Develop and share maps of community spaces, generators, refrigeration, and public charging stations	X	X	
Infrastructure Improvements and Grid Modernization	Transmission and distribution system hardening (e.g., insulation) and enhanced power safety settings (e.g., reclosers)	X		
	Underground power lines	X		
	Target PSPS events to areas susceptible to fire risk	X		
Distributed Energy Resources	Invest in and provide access to micro-grids	X		
	Increase investment in solar and wind energy	X	X	
	Invest in vehicle-to-grid integration (use of electric vehicles as distributed energy resources)	X		
Transportation Services	Provide transportation access to the coast to cool down		X	
	Provide transportation access to cooling centers/ resilience hubs		X	
	Support electrification of transit	X		
	Improve and expand existing transit infrastructure/ services			X
	Convert old paratransit vehicles to on demand vehicles during climate events			X
Forest Health, Vegetation Management & Urban Greening	Increase urban tree canopy		X	
	Improve maintenance around power lines (e.g., tree pruning)	X	X	

Strategy Area	Recommended Action	Within PG&E's Control	Possible Through Partnerships	Outside of PG&E's Control
Communication Education & Outreach	Provide real time updates on climate hazards/risk and when power will be back online through text messages	X		
	Develop app providing information and direction to services and resources	X		
	Host more informational meetings on PG&E programs with bilingual outreach	X		
	Develop and distribute multi-lingual materials to inform public on how to stay safe/make home safer during extreme weather events	X		
	Provide educational trainings on topics including: • DIY/cheap air filters • Plant education for heat mitigation • Native American traditional ecological knowledge related to fire suppression • Energy conservation	X	X	
	Conduct culturally appropriate door-to-door check ins		X	
	Provide informational materials on infrastructure maintenance and improvements	X		
State Advocacy	Advocate for funding and grant programs that build capacity for existing networks and organizations	X	X	
	Advocate for funding to go toward extreme heat mitigation	X	X	
	Advocate for state-wide workplace safety standards with respect to extreme heat (especially for farmworkers)	X	X	

Appendix B

Little Manila Rising conducting focus group at membership meeting, Stockton

Appendix B: San Joaquin Valley Region

This report provides a summary of the findings for the San Joaquin Valley Region, which encompasses Alpine, Amador, Calaveras, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin, Stanislaus, Tulare, and Tuolumne counties. This regional summary report provides an overview of the data collected and presents the key findings for the San Joaquin Valley Region. The key findings are organized as follows:

- A: Defining Climate Vulnerable Communities
- B: Climate Hazards and Impacts
- C: Adaptive Capacity
- D: Resilience Strategies and Recommendations

Data Collected

The Project Team collected data for the San Joaquin Valley Region from four primary sources: 1) Research interviews conducted with Resilient Together Advisory Group (RTAG) candidates, 2) RTAG meetings, 3) Outreach events conducted by RTAG members, and 4) Resilient Together surveys. This section presents a summary of the key data collected for this region.

RTAG Members

The following table (Table B.1) lists the organizations that participated in the San Joaquin Valley Region RTAG, the top three populations represented by each RTAG member, and the mission statements for each of the organizations. An asterisk indicates RTAG members who conducted outreach activities (Outreach Partners).

Over the course of the engagement, RTAG members participated in five RTAG meetings, totaling approximately 10 hours. RTAG meetings featured a project overview and RTAG orientation, presentation of outreach materials, peer mentoring, role-playing exercises, presentation on Pacific Gas and Electric (PG&E) income qualified programs, presentation of key findings from engagement, and celebration of their partnership.

TABLE B.1 RTAG Member Profiles

RTAG Organization	Geographies Represented	Top Populations Represented	Mission/Profile
African American Network of Kern County*	Kern County	Low-income communities Essential workers Communities of color	The African American Network of Kern County is a non-profit organization formed in 1990. It was the intent of the founders to create a network that would aid minority businesses and promote professionals within the community while also providing services to the community at large. Through unity, African American Network of Kern County promotes responsible and meaningful programs that are designed to educate, create economic parity, create job opportunities, produce positive role models and enhance the culture of the African American community.[24]
California Farmworker Foundation*	Kern County	Low-income communities Communities of color Undocumented communities	California Farmworker Foundation is a non-profit organization designed to help Farmworkers become leaders, empowering individuals to become advocates for themselves and their communities. The California Farmworker Foundation mission is to serve and support California Farmworkers by providing programs and services to better their quality of life. The California Farmworker Foundation has five pillars of focus: education, workforce development, health and wellness, immigration services, and community engagement. They trains trusted local Ambassadors who link farmworkers and California Farmworker Foundation by conducting focus groups and reporting Farmworker needs so that the California Farmworker Foundation can invest in the programs and services of interest to Farmworkers and their families.[25]
Friends of Calwa*	Fresno County	Low-income communities Farmworkers Renters	In 2009, a group of neighbors came together and formed Friends of Calwa, Inc. with the vision that all people, regardless of income level, cultural background or political persuasion, will live in neighborhoods that nurture their development. Friends of Calwa, Inc. brings resources and people together to foster healthy neighborhoods - where all people have access to quality education, good jobs, healthy food, transportation, housing, recreation, retail, recreation and parks, meaningful civic engagement, and the opportunity to enjoy artistic, spiritual and cultural amenities. Friends of Calwa, Inc. is an independent non-profit 501(c)3 organization.[26]
Leadership Counsel for Justice and Accountability	San Joaquin County	Low-income communities Undocumented communities Rural communities	Based in the San Joaquin and Eastern Coachella Valleys, Leadership Counsel for Justice and Accountability works alongside the most impacted communities to advocate for sound policy and eradicate injustice to secure equal access to opportunity regardless of wealth, race, income, and place. Through community organizing, research, legal representation, and policy advocacy, Leadership Counsel for Justice and Accountability impacts land use and transportation planning, shifts public investment priorities, guides environmental policy, and promotes the provision of basic infrastructure and services.[27]

24 http://aankc.org/
25 https://californiafarmworkers.org/
26 https://www.friendsofcalwa.org/
27 https://leadershipcounsel.org/about-us/

RTAG Organization	Geographies Represented	Top Populations Represented	Mission/Profile
Little Manila Rising*	San Joaquin County	People with disabilities Low-income communities Communities of color	Little Manila Rising serves the South Stockton community, developing equitable solutions to the effects of historical marginalization, institutionalized racism, and harmful public policy. Little Manila Rising offers a wide spectrum of programs that address education, environment, redevelopment, and public health. Little Manila Rising values all people's unique and diverse experiences and wishes to see the residents of South Stockton enjoy healthy, prosperous lives.[28]
Public Health Advocates	San Joaquin County	Low-income communities Youth Black/ African American communities	The California Center for Public Health Advocacy was established in 1999 and for over 20 years Public Health Advocates has challenged the social, political, and economic systems that perpetuate racial, economic and health disparities. Public Health Advocates have worked to ban soda and junk food from schools and promote physical education along with education on proper nutrition.[29]
San Joaquin Valley Clean Energy Organization*	Kings County	Rural communities Low-income communities Limited English proficient communities	The San Joaquin Valley Clean Energy Organization's (SJVCEO) mission is to make life better for rural California energy customers because all Californians deserve access to more efficient, more reliable, and more affordable energy. Their plan involves increasing access to utility programs, ratepayer funds, and securing outside grant and foundation funding to build competitive communities.[30]
Fresno Economic Opportunities Commission*	Fresno County	Low-income communities Communities of color Seniors & Youth	Established in 1965, Fresno Economic Opportunities Commission is a non-profit Community Action Agency that provides opportunities, strengthens self-sufficiency, and offers support for all people. Fresno Economic Opportunities Commission is continuing the war on poverty with over 35 programs dedicated to getting people the help they need to achieve their goals. Fresno EOC envisions a strong Fresno County where people have resources to shape their future free from poverty. They value working together to accelerate change, centering work around equity and inclusion, trustworthiness and transparency, the community's voice and direction, and empathy, compassion, and human connection.[31]

28 https://littlemanila.org/
29 https://phadvocates.org/our-work/
30 https://www.sjvcleanenergy.org/
31 https://fresnoeoc.org/about/

RTAG Organization	Geographies Represented	Top Populations Represented	Mission/Profile
Stone Soup Fresno*	Fresno County	Low-income communities Communities of color Essential workers	Stone Soup Fresno envisions a world in which every person is respected, and families have the resources they need to cultivate growth and positive change. Stone Soup Fresno is determined to inspire children and nurture families to realize their full potential in America. Since 1996, Stone Soup Fresno has supported thousands of Fresno County residents, most of which have been Southeast Asian refugee children and families, to find their voices in America. Today, they continue to operate at the notable location of the El Dorado Park neighborhood to provide services not only for the children of the refugee generation and their families, but all communities in Fresno County.[32]

Outreach Events

The eight Outreach Partners conducted 35+ events, totaling 124+ hours of community outreach. Outreach activities included:

- Resident/community meetings
- COVID testing/vaccination sites
- Workforce development trainings
- Community resource fairs and celebrations/events
- Leadership councils
- Church events
- Door knocking
- Focus groups
- Community public safety events

Participants Engaged

Outreach Partners engaged 2635 people over the course of the Outreach Period. A total of 1565 surveys were completed. An additional estimated 1070 community members were engaged in the events listed above. The data collected at outreach events were included in the outreach boards. Following the completion of the Bay Area Region engagement, select demographic questions (e.g., race, income, household characteristics) were added to the Resilient Together survey for Regions 2–5 to better understand the participants that were engaged through this effort. The following section describes the geographic areas, incomes, race, and household characteristics of the participants engaged.

Zip Codes and Counties Represented

The data collected represents a total of at least 109 unique zip codes gathered by the surveys and the outreach boards, across 14 counties. Additional zip codes and counties may be represented in the data but not all survey and outreach board respondents identified the zip code of their personal residence, and some respondents provided their county rather than zip-code. Less than half a percent of survey respondents did not provide their zip code. Table B.2 shows the counties represented through surveys and in the outreach boards.

32 https://sites.google.com/stonesoupfresno.org/stonesoup/home

TABLE B.2 Responses per County
(n=2634 respondents)

County	% of Surveys
Alpine	N/A
Amador	N/A
Calaveras	N/A
Contra Costa*	0.04%
Fresno	42%
Kern	36%
Kings	4%
Los Angeles*	0.08%
Madera	2%
Mariposa	N/A
Merced	0.04%
Sacramento*	0.2%
San Joaquin	10%
Santa Barbara*	4%
San Bernardino*	0.04%
Santa Clara*	0.04%
San Mateo*	0.04%
Stanislaus	N/A
Tulare	0.7%
Tuolumne	N/A

Counties that are represented in the data that are not part of the San Joaquin Valley Region are identified with an asterisk.

Languages Represented

To reach many of the diverse communities within the San Joaquin Valley Region, materials were provided in Arabic, Chinese, English, Russian, Spanish, Tagalog, and Vietnamese. Slightly more than 84 percent of the survey respondents completed an English language survey, and 16 percent completed a Spanish language survey. It is unclear which primary languages were spoken by community members who were engaged through the in-person outreach events (41 percent of the community members engaged), as the responses were captured in English on the outreach boards by Outreach Partners.

Racial Backgrounds Represented

Although demographic questions were optional, 94 percent of the San Joaquin Valley Region survey respondents answered the question on racial identification. The other six percent of respondents either chose "prefer not to respond" or left the question blank. Of those who answered the question, 93 percent identified with groups comprised of people of color, more than two races, or other races. Some participants (four participants) specified that they are "mixed with many races" but did not specify which races. Other participants specified their racial background as multiple races. Participants who indicated "Other" identify as Middle Eastern (two participants), Chicana (one participant), and Indigenous American (two participants).

Table B.3 and Table B.4 identify the number of survey respondents by racial background and racial background of survey respondents by Outreach Partner, respectively.

TABLE B.3 San Joaquin Valley Region Racial Background of Survey Respondents
(n=1431 responses)

Racial Background	% of Respondents
Asian	15%
Black or African American	14%
Latinx or Hispanic	48%
Native American, American Indian, or Alaska Native	2%
Native Hawaiian and Pacific Islander	2%
Other	1%
Two or more races	11%
White	7%

Values may not add up to 100% because some survey respondents marked the "prefer not to answer" option for this question. Those values are not shown in this table.

TABLE B.4 Racial Background of Survey Respondents by Outreach Partner

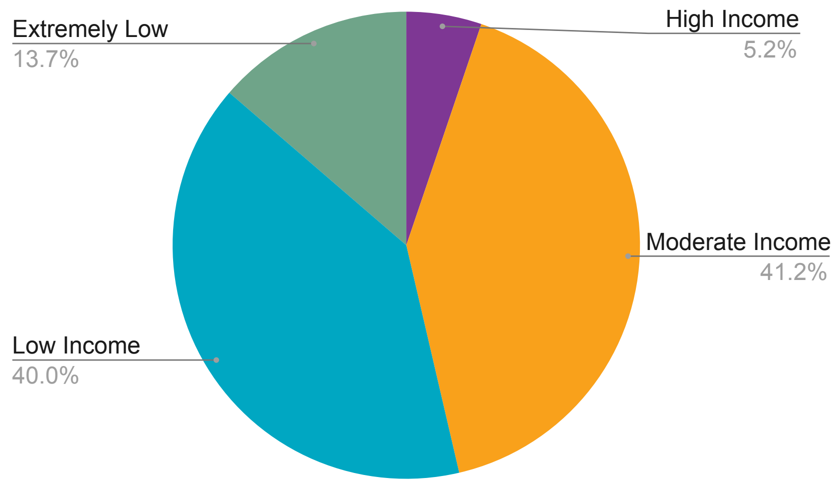
Racial Background	African American Network of Kern County	California Farmworker Foundation	Fresno Economic Opportunities Commission	Friends of Calwa	Little Manila Rising	Center for Public Health Advocates	San Joaquin Valley Clean Energy Organization	Stone Soup Fresno
Asian	4%	1%	9%	2%	22%	14%	4%	63%
Black or African American	36%	0%	17%	13%	9%	13%	2%	1%
Latinx or Hispanic	35%	69%	50%	65%	48%	53%	73%	24%
Native American, American Indian, or Alaska Native	3%	0%	3%	0%	0%	2%	1%	0%
Native Hawaiian and Pacific Islander	2%	0%	1%	0%	0%	2%	3%	0%
Other	0%	0%	1%	0%	0%	1%	0%	1%
Two or more races	15%	30%	7%	13%	13%	8%	6%	5%
White	6%	1%	13%	7%	9%	8%	10%	5%

Values may not add up to 100% because some survey respondents marked the "prefer not to answer" option for this question. Those values are not shown in this table.

Income Levels Represented

Survey respondents were asked: "How would you describe your income level?" Breakdowns of income level categories were not described as part of the survey. Of the 1499 responses, only five percent identify themselves as high-income and 41 percent identify as moderate-income. Additionally, 54 percent of respondents identified as extremely low or low-income, indicating that the outreach conducted in the San Joaquin Valley Region was effective in reaching low-income and extremely low-income households, as shown in Figure B.1.

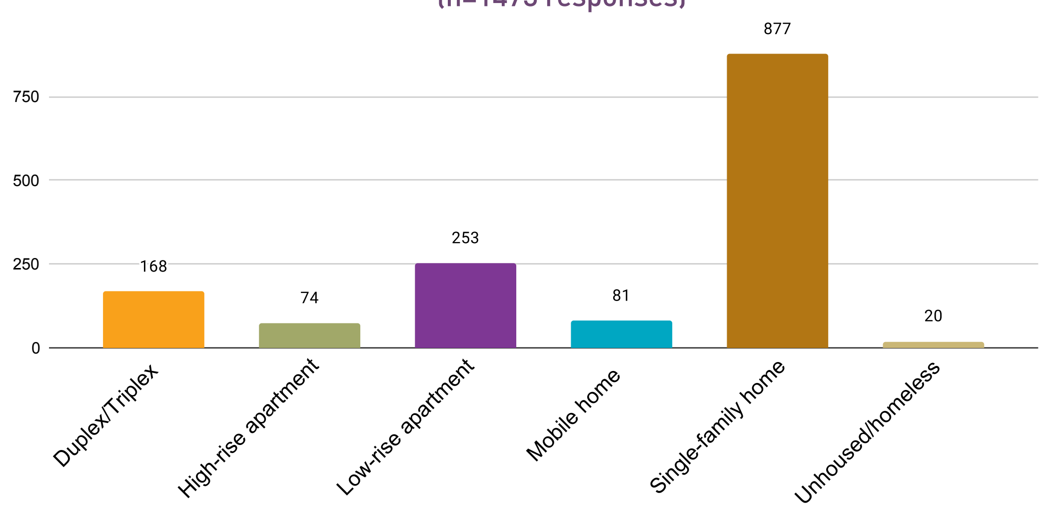
FIGURE B.1 Survey Respondents by Income Level (n=1499 responses)



Household Characteristics Represented

The optional demographic question section of the survey also asked about housing. One of the questions asked: "What type of home do you live in?" As shown in Figure B.2, most survey respondents lived in single-family homes (60 percent), followed by respondents who live in low-rise apartments or condo buildings[33] (17 percent). In a separate survey question, respondents were asked: "Do you own your home?" In response, 65 percent of survey respondents said "No," indicating that they are renters (n=1445 respondents).

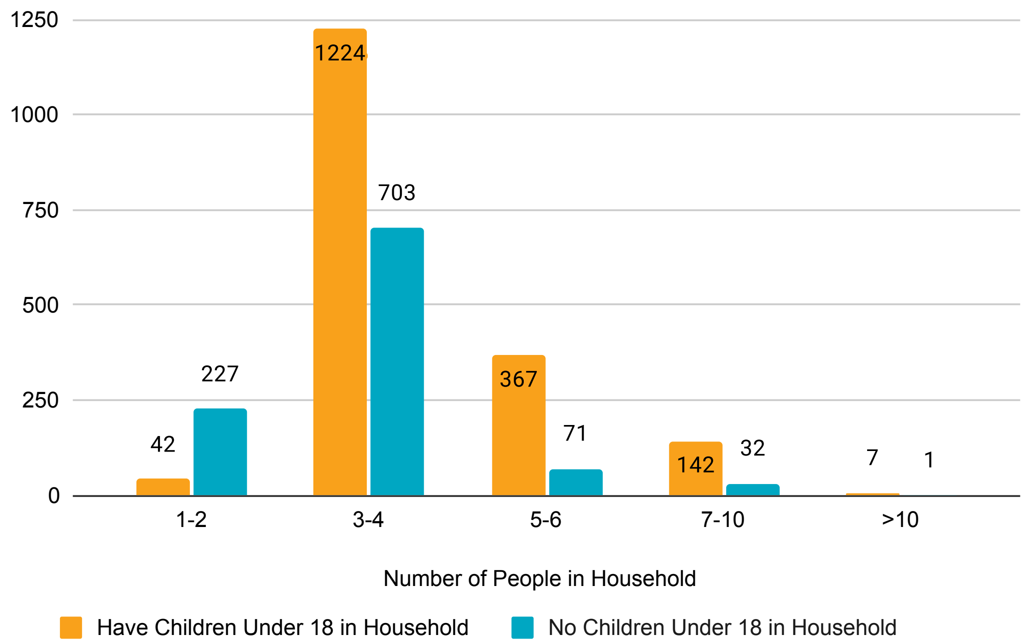
FIGURE B.2 Survey Respondents by Housing Type (n=1473 responses)



33 Low-rise apartments or condo buildings are represented by three stories or fewer. High-rise apartment or condo buildings are represented by four stories or more.

Survey respondents shared how many people are in their household, and if there were any other children under 18. The average number of people in the households for the San Joaquin Valley Region was four people, and 63 percent of survey respondents said that they did have children under 18 in the household. These two questions are grouped together in Figure B.3 below.

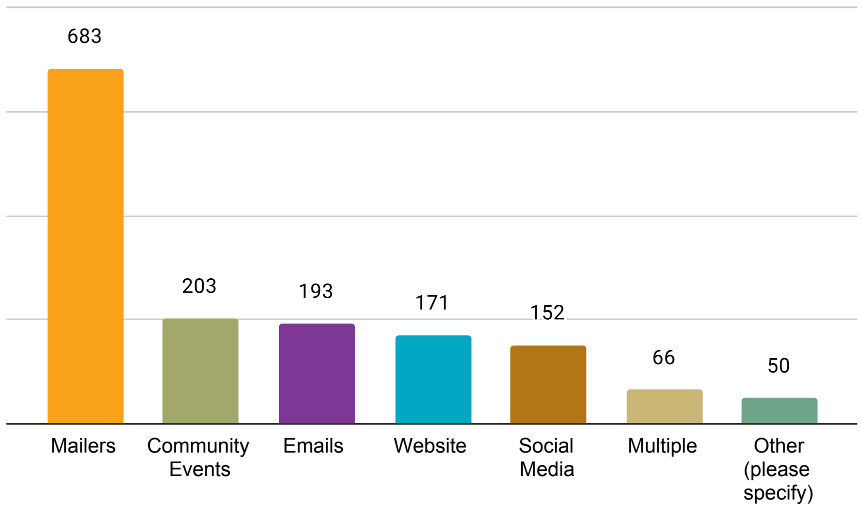
FIGURE B.3 How Many People are in the Household and Whether there are Other Children Under 18 in the Household (n=1407 respondents)



PG&E Communications

Survey respondents were asked how and when they receive information and news from PG&E. Figure B.4 reflects how participants currently receive information and news from PG&E. The leading source of information is mailers (45 percent), followed by community events and emails (both approximately 13 percent). Other methods of communication participants identified included by phone (texting or calls), television and online news, door-to-door representatives, work, word of mouth, the Low-Income Home Energy Assistance Program (LIHEAP), and community emails. Several participants also said they do not receive any information.

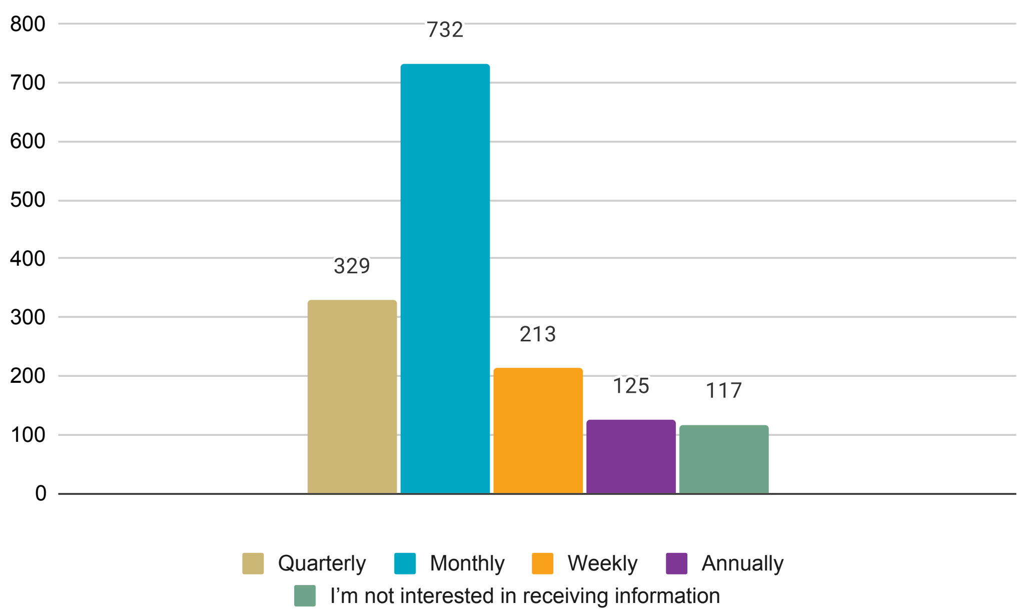
FIGURE B.4 **Where Participants Currently Receive Information and News from PG&E**
(n=1518 respondents)



Survey respondents were asked "How often do you receive information from PG&E on existing initiatives and programs?" Of the 1504 survey respondents, 69 percent responded, "Not Enough" and 31 percent responded, "Too Often." Of the 31 percent of survey respondents that responded, "Too Often," most were interested in receiving future information on a monthly basis, followed by quarterly. Of the 69 percent of survey respondents that responded, "Not Enough," most indicated they were also interested in receiving future information on a monthly basis, followed by quarterly.

Respondents were then asked, "How often they would like to receive information in the future from PG&E on existing initiatives and programs". Of the 1516 survey respondents for this question, 70 percent responded "Monthly" or "Quarterly." The remaining 70 percent responded "Weekly" (14 percent), "Once a Year" (8 percent), or "I'm not interested in receiving information" (8 percent).

FIGURE B.5 **How Often Survey Respondents Would Like to Receive Information from PG&E on Existing Initiatives or Programs**
(n=1516 respondents)



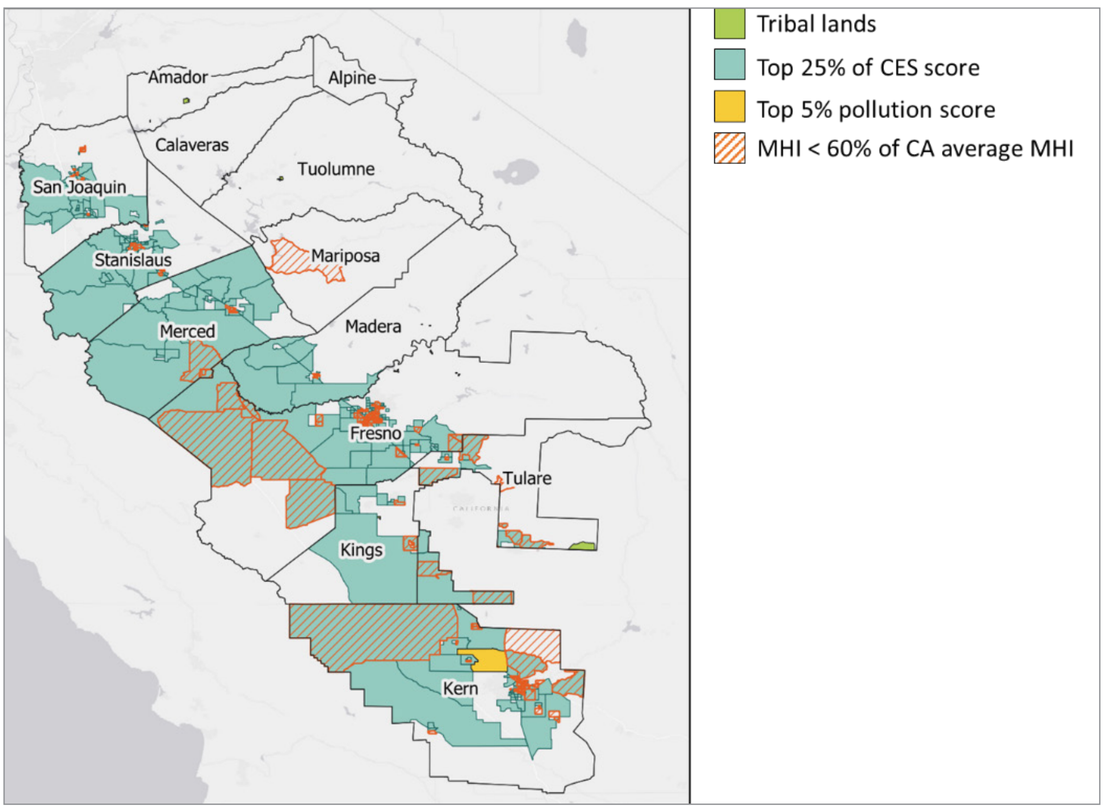
Research Interviews

The Project Team conducted a series of interviews with RTAG candidates in the San Joaquin Valley Region to better understand (1) community demographics and language needs, (2) climate hazards/impacts, adaptive capacity, and preferred resilience strategies, (3) their capacity and interest in participating on the RTAG, and (4) existing reports/data that could inform the Climate Vulnerability Assessment (CVA). The summary report of these interviews can be found in Appendix J. Findings from these interviews that address objective two (climate hazards/impacts, adaptive capacity, and preferred resilience strategies) are interwoven throughout the following sections of this regional summary report.

Climate Vulnerable Communities

Figure B.6 shows disadvantaged and vulnerable communities in the San Joaquin Valley Region based on the California Public Utility Commission's definition.

FIGURE B.6 San Joaquin Valley Region Disadvantaged and Vulnerable Communities



In the San Joaquin Valley Region, RTAG members emphasized that nearly all community members living in the San Joaquin Valley suffer from the worst air quality in the State, food insecurity, water contamination, inadequate housing, poor education, and lack of healthcare access. While all populations face these burdens, RTAG members consistently identified farmworkers as one of the most vulnerable groups due to heightened exposure to poor air quality (exacerbated by wildfire smoke) and extreme heat due to working outdoors. Farmworkers struggle to wear protective masks while conducting physical labor all day; and worker rights to breaks and water are often not followed or enforced. Even when granted breaks, it was reported that farmworkers may forego breaks because they cannot afford to work less hours and lose wages.

RTAG members also highlighted immigrants as particularly vulnerable. Immigrants who do not speak English may not be able to access information and resources that would mitigate health impacts and may not know how to seek help. The San Joaquin Valley is home to many Indigenous Latin Americans and Spanish speaking communities, as well as Chinese, Filipino, Vietnamese, Cambodian, Hmong, and Laotian immigrants, the latter four groups having come as refugees decades ago.

RTAG members also identified rural communities, and low-income seniors as particularly vulnerable. Limited communication and transportation infrastructure in rural areas create problems for emergency response systems. In addition, rural populations have limited access to health care facilities.

In the San Joaquin Valley Region RTAG made the following additions/qualifications to the list of vulnerable community types outlined in Table B.4 of this report.

Qualifications

- *People experiencing homelessness* should be referred to as "unsheltered populations"
- *Low-income communities* should be further delineated by "urban poor" and "rural poor"
- *Essential workers* should encompass "working poor"

Additions

- Linguistically isolated
- Agriculture workers and truck drivers
- Rural communities
- Mobile home residents
- Previously incarcerated citizens, or "returning citizens"

The following table (Table B.5) provides information on vulnerable communities, community demographics, and languages spoken based on data collected from research interviews with RTAG candidates. Because RTAG candidates represent specific areas of the San Joaquin Valley Region, not all counties are included.

TABLE B.5 Climate Vulnerable Communities in Select Counties of the San Joaquin Valley Region

County	Climate Vulnerable Communities	Community Demographics	Languages Spoken
Kern County	City of Bakersfield, including East Bakersfield, the Cities of Arvine, Lamont, Shafter, McFarland, and Delano, and the unincorporated neighborhoods of Frazier Park, La Colonia Mexicana, Fuller Acres, and Lost Hills, as well as areas adjacent to the Tehachapi Mountains	African American, White, Latinx communities, including Mexican, Central American, Indigenous communities.	Spanish, Mixteco, Triqui, Zapoteco, as well as community members across ethnicities who communicate in American Sign Language
Fresno County	City of Fresno's neighborhoods of the former "Asian Village," East, Southeast and Southwest Fresno, the Cities of Parlier, Reedley, Firebaugh, Kerman, Sanger, Mendota, Coalinga, and Huron, as well as the unincorporated neighborhoods of Biola, El Porvenir, Lanare, Riverdale, Caruthers, 5 points, Tombstone, and Cantua Creek	Southeast Asian (Filipino, Vietnamese, Laotian, Cambodian, and Hmong), South Asian (Sikhs), African American, White, Latinx including Mexican, Central American, Indigenous, second/third generation Chicanx communities	Hmong, Lao, Tagalog, Vietnamese, Cantonese, Mandarin, Khmer, Punjabi, Spanish, Arabic, Mixteco, Triqui, Zapoteco
San Joaquin County	City of Stockton's neighborhoods of Little Manila, South Stockton, Central Stockton, Seaport, and the area around Stribley Park	Southeast Asian (Filipino, Vietnamese, Laotian, Cambodian, and Hmong), South Asian (Sikhs, Punjabi Indians), African American, White, Latinx	Hmong, Lao, Tagalog, Vietnamese, Cantonese, Mandarin, Khmer, Spanish
Madera County	City of Madera and the unincorporated neighborhood of La Vina	Latinx, White	Spanish, Mixteco, Triqui, Zapoteco
Butte County	Cities of Oroville and Gridley, the unincorporated neighborhoods of Feather Falls, Berry Creek, Feather River Canyon	Indigenous, White, Latinx	Spanish, Mixteco, Triqui, Zapoteco
Tulare County	Cities of Woodlake and Lindsay and the unincorporated neighborhoods of Cutler, Strathmore, Poplar-Cotton Center, Earlymart, Tipton, East Porterville, Orosi, and Seville	Latinx, White	Spanish, Mixteco, Triqui, Zapoteco
Kings County	N/A	Latinx, White, Black, Asian, Middle Eastern (Iranian)	Spanish, Farsi

Climate Hazards and Impacts

Research interviews and RTAG meetings provide insights into the climate hazards and impacts of greatest concern in the San Joaquin Valley Region. The San Joaquin Valley experiences some of the worst air quality in the country. Wildfires and extreme heat further deteriorate air quality and disproportionately impact human health among vulnerable groups like farmworkers and rural poor communities. Power outages are not experienced as frequently as in other regions in this report. In urban areas like Fresno, the heat island effect combined with lack of tree canopy exacerbate heat impacts. Increased impacts from heat include increased hospitalizations due to dehydration and other heat illnesses, higher energy bills, and worsened air quality. These impacts are more prominently felt due to the prevalence of poor housing stock that is difficult to weatherize. In remote parts of the region, many residents lack cooling centers and other resources, services (including access to health care facilities), and information on how to keep themselves safe during these hazard events. Low-income communities in both rural and urban areas of the region are financially strained by high energy bills that increase when the region experiences extreme heat.

The agricultural industry is particularly vulnerable to climate hazards and is already experiencing the impacts of climate change. The health of farmworkers, quantity of crop yields, and productivity of livestock are all negatively impacted by sustained drought and increasing frequency of extreme heat. The economic impacts are heavily felt by farmworkers whose hours are reduced due to unsafe working conditions from heat or when fields flood. Many farmworkers are undocumented immigrants and cannot access unemployment benefits when they experience loss of work. The loss of income for these workers can severely impact the well-being of farmworker families throughout the region who often live paycheck to paycheck.

Throughout the Outreach Period for the San Joaquin Valley Region, the Project Team asked community members and RTAG members about the impacts they have experienced or are most concerned about during power outages, extreme heat events, and when wildfire smoke is present. A summary of the key findings on impacts for the San Joaquin Valley Region is presented in Table B.6.

TABLE B.6 Summary of Key Impacts in the San Joaquin Valley Region

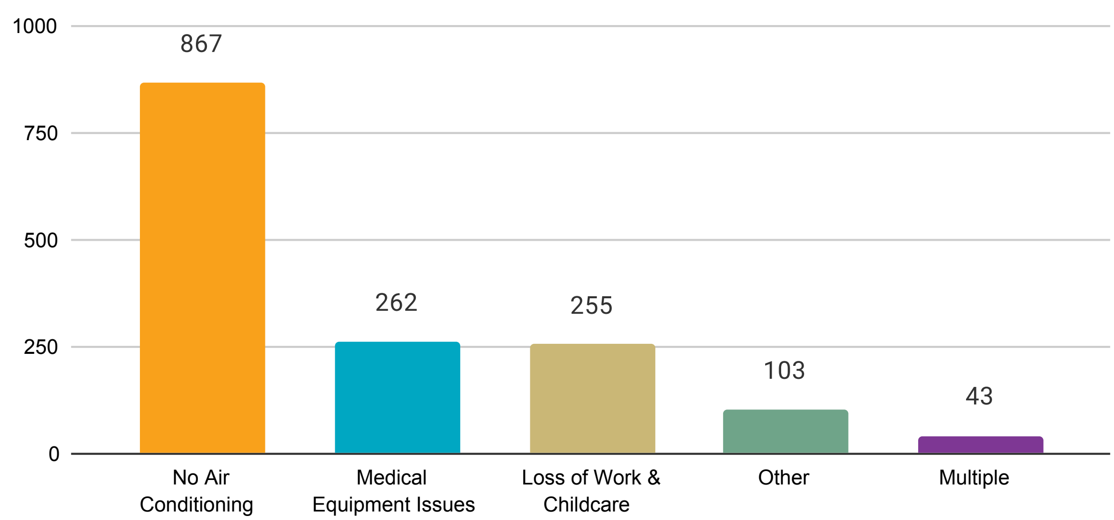
Hazard	Health Impacts	Economic Impacts	Household/Community Impacts
Power Outage	Heat stress from air conditioning not working Declining mental health outcomes including increased anxiety and stress Increased use of generators that worsen air pollution Risk of death from monoxide poisoning Disruption of air purifiers and medical equipment use Loss of refrigerated medication	Household economic impacts from food and medicine loss Lost revenue for small businesses Loss of work and childcare	Unable to charge electric vehicles Disruption of childcare Breakdown of family structure/ routine Learning loss from school closure Loss of communication due to internet outage Revenue loss for small businesses
Extreme Heat	Heat related illness/death Hospitalizations from heat exhaustion and dehydration Declining mental health outcomes including increased anxiety and stress Poor indoor air quality Harsh outdoor working conditions	High electricity bills from running air conditioning Loss of hours/wages for farmworkers Appliance breakdown, especially in mobile/older homes Livestock and pet loss Diminished crop yields Loss of workforce Loss of small farms	Increase in violence/domestic abuse Nowhere to go/cannot be outdoors Childhood education impacted (schools without air conditioning) Community organizations cancel services Risk of infrastructure (e.g., bridges) failure Next generation leaving/loss of community
Wildfire and Smoke	Respiratory impacts, due to poor indoor air quality and harsh outdoor working conditions Smoke infiltrates low-income homes (poor housing stock) Pulmonary disease, pneumonia, heart disease Declining mental health outcomes including increased anxiety and stress Increase in asthma	Wage loss for agricultural workers Impact to transportation schedules Inability to complete errands	Increase in violence/domestic abuse Disruption in transportation and communication Community organizations stop services Intergenerational loss of trust
Flooding	Polluted drinking water systems Respiratory health impacts from mold in buildings after flood events	Damage to homes, buildings, and roads Crop loss on farms	Overtopped levees Disruption in transportation

Power Outages

Survey results and RTAG engagement responses show that power outages are not considered a hazard of primary concern in the San Joaquin Valley Region, compared to other hazards. Nevertheless, the Project Team collected information on what impacts community members are most concerned about in the event of a power outage to ensure consistency with questions being asked across other PG&E regions. Through survey and outreach board engagement, 2856 responses were provided to the question "What impacts of power outages have you experienced or are most concerned about?" The response options differed between the survey and the outreach boards, and survey respondents and outreach board participants were allowed to provide more than one response. The survey asked about three specific impacts for power outages, plus an option for "Other." In contrast, the outreach board provided ten options for climate related impacts that participants have experienced. These ten impact options were provided for power outages, extreme heat, and wildfire smoke on the same board.

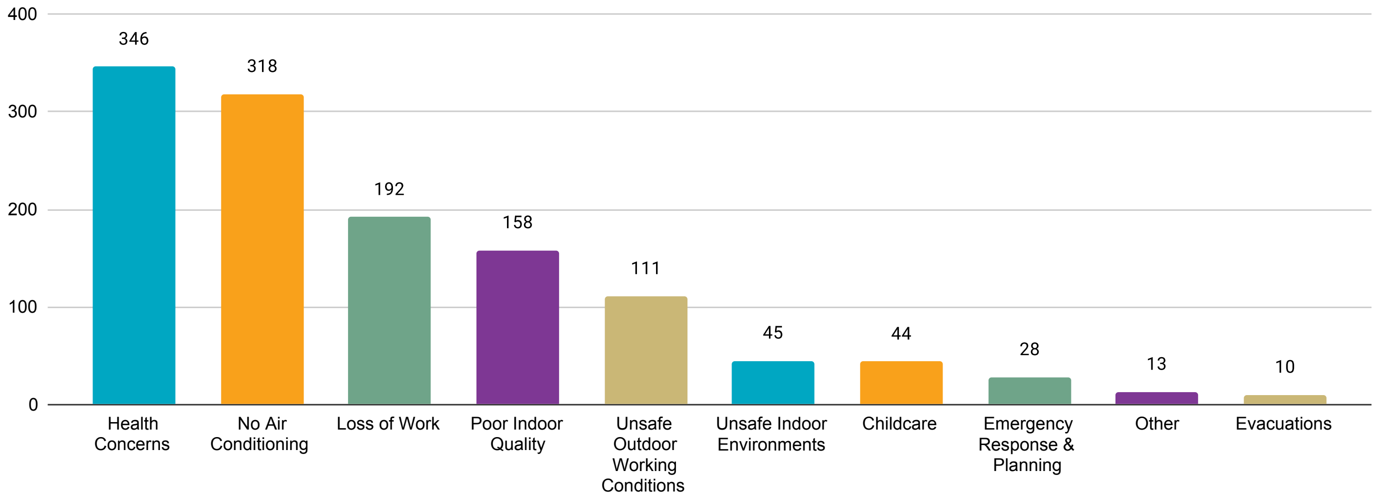
The top responses for the survey and outreach board are highlighted in Figure B.7 and Figure B.8, respectively. 57 percent of responses note "No Air Conditioning" as the impact of most concern, followed by "Medical Equipment Issues" and "Loss of Work & Childcare," representing 17 percent of responses. In contrast, "Health Concerns" is the impact that outreach board participants reported being most concerned about, accounting for 27 percent of responses, followed by "No Air Conditioning" (25 percent) and "Loss of Work"[34] (15 percent). The qualitative data from the RTAG, survey, and the outreach boards are reflected in the following sections on Health Impacts, Economic Impacts, and Household/Community Impacts due to Power Outages.

FIGURE B.7 Impacts Experienced or that Cause Concern During Power Outages (Survey Respondents) (n=1530 responses)



34 Outreach boards separated the responses into "Loss of Work" and "Childcare." The survey combined responses to "Loss of Work & Childcare."

FIGURE B.8 Impacts Experienced or that Cause Concern During Power Outages (Outreach Board Participants) (n=1265 responses)



Health Impacts Due to Power Outages

Input gathered through the survey and RTAG engagement indicate the leading health impacts of power outages include heat stress from lack of air conditioning, declining mental health outcomes including increased anxiety, worsened air quality and increased risk of carbon monoxide poisoning due to the use of diesel generators and portable gas stoves, and increased risk of death or acute illness from the disruption of air purifiers and medical equipment.

Of the 1530 responses to this question from the survey, 57 percent of the responses indicate an inability to use air conditioning due to power outages. The San Joaquin Valley is one of the hottest regions in PG&E's service area, and access to air conditioning is necessary for many people to survive. Survey respondents also reported concern that losing power meant they were unable to use their heaters during cold winters, which can also pose health risks.

Additionally, 17 percent of survey responses indicate concern about, or experience with, medical equipment disruptions. As part of the survey, participants were asked if anyone in the household relies on medical equipment. Of the 1505 survey responses to this question, 28 percent indicate that someone in their household relies on medical equipment. RTAG members noted that elderly and people with disabilities are especially impacted by the loss of electricity affecting their medical equipment (e.g., oxygen tanks, ventilators, continuous positive airway pressure machines, etc.).

Economic Impacts Due to Power Outages

Survey data shows respondents, who primarily identify as low or very low-income, and RTAG members reported economic impacts due to power outages including loss of income from spoiled food, lost revenue for small businesses, and loss of childcare. Nineteen percent of survey and outreach board responses are related to childcare and loss of work. In addition, survey respondents noted that as remote work becomes increasingly common, loss of Wi-Fi/internet access also results in disruption or loss of work/income. Survey respondents reported high energy costs, even during power outages.

Household/Community Impacts Due to Power Outages

During power outages, the San Joaquin Valley residents experience household and community-wide impacts in addition to health and economic impacts (which are also affected on a community-wide level). RTAG members, survey respondents, and outreach board participants identified disruptions in childcare, inability to charge electric vehicles, breakdown of family structure/routine, school closure/learning loss, loss of internet/communication, and loss of revenue for small businesses as the community impacts that are most felt.

Due to power outages, households are unable to use their television and radios, computers, and gaming devices. The result is a disruption in daily life and entertainment and information access, including where to go and where to access needed services and resources (e.g., energy, food, etc.). Survey respondents also noted inability to use kitchen appliances during outages, limiting their ability to prepare food for their household. Loss of internet is the most noted impact after loss of food in written survey responses. Internet disruptions result in loss of education (e.g., participation in class and inability to do homework etc.) and a loss of the ability to work and collect income for remote workers.

Power Outage Impacts by County

Survey and outreach board data of key power outage impacts by county are shown in Table B.7 below. "No Air Conditioning" is the top impact of power outages across all counties and is of particular concern in Fresno and San Joaquin counties.[35] For most counties, the second and third top responses are "Health Concerns"/ "Medical Equipment Issues" and "Loss of Work"/ "Childcare."

TABLE B.7 Power Outages Impacts by County (Survey Respondents and Outreach Board Participants) (n=1452 responses)

County	% of Respondents	Responses		
		No Air Conditioning	Health Concerns/ Medical Equipment Issues	Loss of Work/Childcare
Alpine	N/A	N/A	N/A	N/A
Amador	N/A	N/A	N/A	N/A
Calaveras	N/A	N/A	N/A	N/A
Fresno	42%	41%	13%	20%
Kern	36%	33%	30%	24%
Kings	4%	69%	5%	22%
Madera	2%	69%	19%	12%
Mariposa	N/A	N/A	N/A	N/A
Merced	N/A	N/A	N/A	N/A
San Joaquin	10%	47%	14%	13%
Stanislaus	N/A	N/A	N/A	N/A
Tulare	1%	82%	12%	6%
Tuolumne	N/A	N/A	N/A	N/A

The values in this table may not total 100% across the response categories for counties because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by county.

Power Outage Impacts by Racial Background

The survey data of key power outage impacts felt by survey respondents by racial background is represented as percentages in Table B.8 below. "No Air Conditioning" is the top impact from power outages across respondents of all racial backgrounds. For most racial groups "Health Concerns"/ "Medical Equipment Issues" and "Loss of

35 "No Air Conditioning" also represented over 50 percent of responses in Kings, Madera, and Tulare counties, but each of these counties represent less than 8 percent of respondents.

Work and Childcare" are closely the second and third most selected impacts. Notably, for Native Hawaiian and Pacific Islanders, "Loss of Work and Childcare" is only eight percent below the impact of "No Air Conditioning."

TABLE B.8 Power Outage Impacts by Racial Background (Survey Respondents) (n=1403 responses)

Racial Background	% of Respondents	Responses: No Air Conditioning	Responses: Health Concerns/ Medical Equipment Issues	Responses: Loss of Work/ Childcare
Asian	15%	65%	10%	12%
Black or African American	14%	52%	14%	22%
Latinx or Hispanic	48%	55%	19%	18%
Native American, American Indian, or Alaska Native	2%	50%	18%	23%
Native Hawaiian and Pacific Islander	2%	43%	13%	35%
Other race	1%	50%	20%	10%
Two or more races	11%	57%	21%	15%
White	7%	52%	18%	16%

The values in this table may not total 100% across the response categories for racial backgrounds because the Project Team left out survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by race.

Power Outages Impacts by Income Level

Survey data of key power outage impacts by income level is represented by percentages in Table B.9 below. "No Air Conditioning" is the top impact across all income levels. "Loss of Work and Childcare" is reported more than "Health Concerns"/ "Medical Equipment Issues" for high-income respondents. Comparatively, survey data for extremely low-income respondents shows the opposite, with "Health Concerns"/ "Medical Equipment Issues" being selected more frequently than "Loss of Work and Childcare." Survey data shows both impacts are about equal for low and moderate-income respondents.

TABLE B.9 Power Outage Impacts by Income Level (Survey Respondents) (n=1471 responses)

Income Level	% of Respondents	Responses: No Air Conditioning	Responses: Health Concerns/ Medical Equipment Issues	Responses: Loss of Work/ Childcare
Extremely low-income	14%	54%	22%	16%
Low-income	40%	56%	16%	17%
Moderate-income	41%	60%	16%	15%
High-income	5%	40%	19%	32%

The values in this table may not total 100% across the response categories for income levels because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by income level.

Extreme Heat

Extreme heat is one of the top hazards of concern in the San Joaquin Valley Region. Through survey and outreach board engagement, 2913 responses were collected for the question, "What impacts of extreme heat have you experienced or are most concerned about?" The response options differed between the survey and the outreach board, and participants were allowed to provide more than one response. The survey asked about three specific impacts for Extreme Heat, plus an option for "Other." In contrast, the outreach board provided ten options for climate related impacts that participants have experienced, which were provided for power outages, extreme heat, and wildfire smoke on the same board. These ten impact options were provided for power outages, extreme heat, and wildfire smoke on the same board.

The top responses for the survey and outreach board are highlighted in Figure B.9 and Figure B.10, respectively. "Health Concerns" is the impact that survey respondents are most concerned about, accounting for 38 percent of survey responses, followed by "Poor Indoor Air Quality" (32 percent) and "Harsh Outdoor Working Conditions" (24 percent). In contrast, "Unsafe Outdoor Working Conditions" is the impact that outreach board participants are most concerned about, accounting for 25 percent of responses, followed by "Health Concerns" (21 percent) and "Loss of Work" (20 percent). The qualitative data from the RTAG, survey, and the outreach boards are reflected in the following sections on Health Impacts, Economic Impacts, and Household/Community Impacts due to Extreme Heat.

FIGURE B.9 Impacts Experienced or that Cause Concern During Extreme Heat (Survey Respondents) (n=1594 responses)

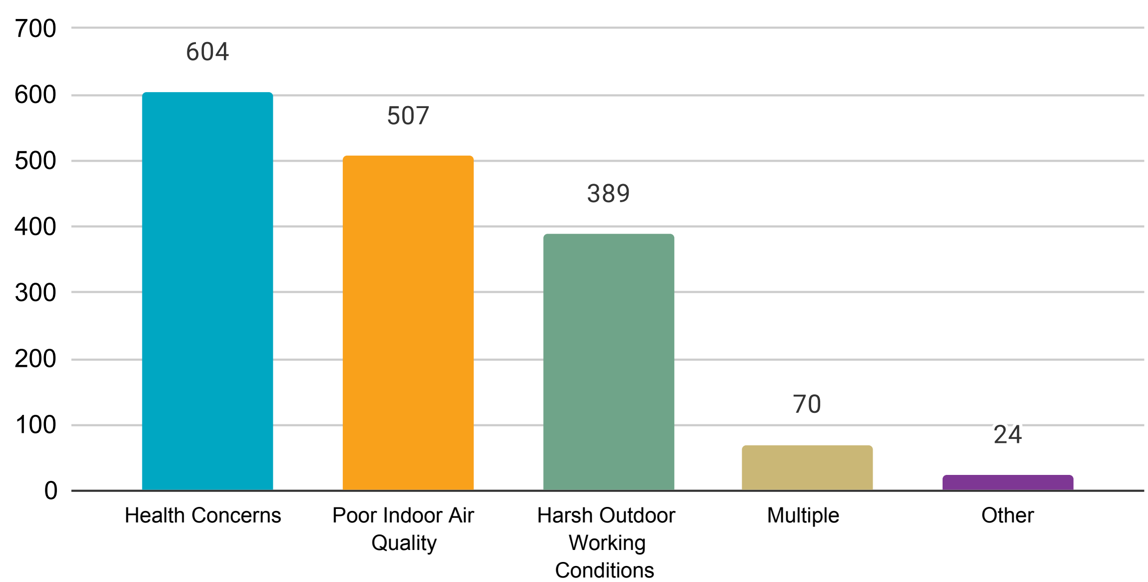
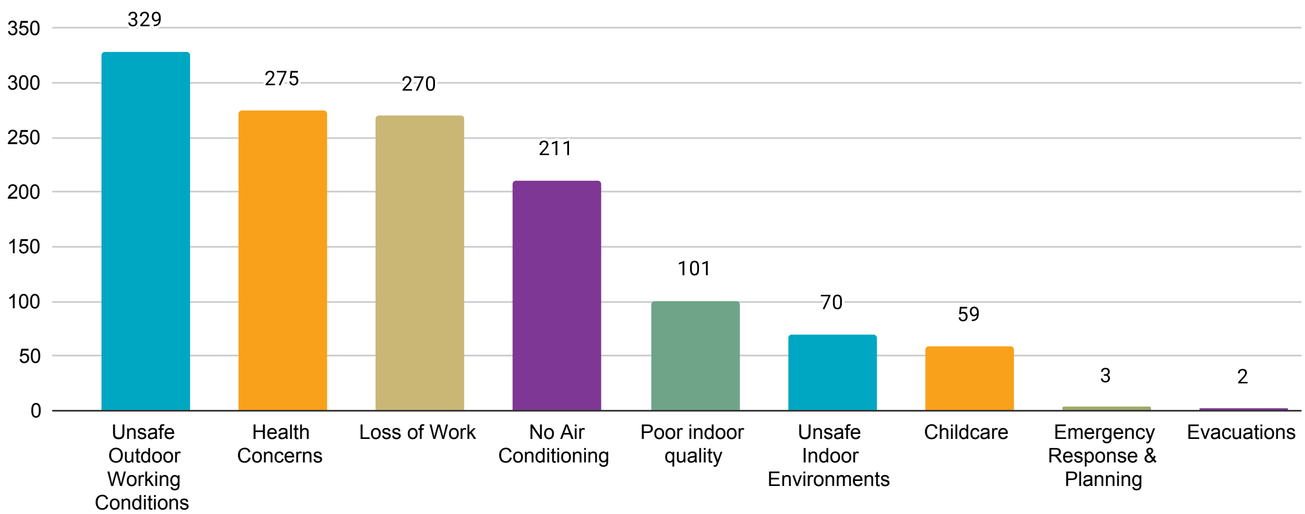


FIGURE B.10 Impacts Experienced or that Cause Concern During Extreme Heat (Outreach Board Participants) (n=1320 responses)



Health Impacts Due to Extreme Heat

With respect to extreme heat, "Health Concerns" is the top impact in the San Joaquin Valley Region. Survey respondents and RTAG members reported health impacts including loss of life or heat related illness, sunburn, skin cancer, inability to exercise outside, difficulty breathing, heat stress for the unsheltered, and declining mental health outcomes including increased anxiety and stress from being unable to go outside. RTAG members expressed concerns about higher temperatures resulting in heat strokes, valley fever, asthma, heat exhaustion, and heart conditions, leading to more emergency room visits and heat-related deaths, particularly amongst outdoor workers and other vulnerable populations like the elderly. Survey respondents expressed that the unhoused were most impacted because they do not have access to shelter to escape the heat/sun. Inadequate access to health services in rural, underserved areas exacerbates the vulnerability of frontline communities.

Economic Impacts Due to Extreme Heat

Primary economic impacts during extreme heat events include high bills from running the air conditioner and loss of hours/wages for farmworkers who cannot work in the heat. Due to their immigration status, many farmworkers cannot access unemployment benefits. Lacking an economic safety net, some farmworkers end up working in unsafe conditions because they cannot afford to lose income. One in four of the responses to the survey and outreach boards identified "Harsh Outdoor Working Conditions" as an impact people have experienced/are most concerned about.

Survey respondents also shared that they experienced economic impacts due to breakdown of household appliances and noted that appliance breakdown is a concern especially for those in older homes or mobile homes. RTAG members shared that the health of livestock and crop yields are all negatively impacted by increasing frequency of extreme heat (and drought). Small farmers, including disadvantaged and minority farmers, are among the most impacted by extreme heat because they have limited resources to adapt agricultural practices. As a result, small farms are being lost to larger corporations, threatening the economic resilience of the region.

Household/Community Impacts Due to Extreme Heat

San Joaquin Valley Region community members indicated that along with health and economic impacts, a wide range of community impacts are also felt during extreme heat events. These community impacts include an increase in violence, including child abuse and other domestic abuse. Survey respondents also experience distress from having nowhere to go/not being able to be outside. Older homes and mobile homes are difficult or impossible to weatherize, leaving occupants highly exposed to high heat and poor air quality. Education is also disrupted when schools close, or do not have air conditioning, impacting students' ability to learn. RTAG members also noted that community organizations sometimes cancel events during heat waves, impacting households' ability to access community resources and services. Survey respondents also noted their concern for extreme heat contributing to wildfire events, which severely impact communities. Those experiencing isolation, including elderly individuals and those that live in remote areas, and lack access to traditional information channels (e.g., Wi-Fi) are particularly vulnerable, as they are not able to access extreme heat warnings or access assistance if they are experiencing heat stress.

"South Stockton is not built to withstand the heat. The building stock, built during the turn of the century, is poorly insulated and deteriorating."

Extreme Heat Impacts by County

Survey and outreach board data of key extreme heat impacts by county is represented by percentages in Table B.10 below. "Health Concerns"/ "Medical Equipment Issues" and "Poor Indoor Air Quality" are the top impacts for the counties. Notably, in Kings County "Health Concerns"/ "Medical Equipment Issues" and "Poor Indoor Air Quality" are ranked equally as the highest concern.

TABLE B.10 Extreme Heat Impacts by County
(Survey Respondents & Outreach Board Participants) (n=2681 responses)

County	% of Respondents	Responses		
		Health Concerns/ Medical Equipment Issues	Harsh Outdoor Working Conditions/ Unsafe Outdoor Working Conditions	Poor Indoor Air Quality
Alpine	N/A	N/A	N/A	N/A
Amador	N/A	N/A	N/A	N/A
Calaveras	N/A	N/A	N/A	N/A
Fresno	42%	25%	23%	19%
Kern	36%	36%	29%	17%
Kings	4%	37%	25%	37%
Madera	2%	36%	14%	51%
Mariposa	N/A	N/A	N/A	N/A
Merced	N/A	N/A	N/A	N/A
San Joaquin	10%	37%	26%	25%
Stanislaus	N/A	N/A	N/A	N/A
Tulare	1%	33%	6%	56%
Tuolumne	N/A	N/A	N/A	N/A

The values in this table may not total 100% across the response categories for counties because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by county.

Extreme Heat by Racial Background

Survey data of the key extreme heat impacts by racial background is represented by percentages in Table B. 11 below. While "Health Concerns" is the most selected impact from extreme heat across almost all respondents of all racial backgrounds, no impact has more than 50 percent of responses. Notably, for Native Hawaiian and Pacific Islanders, "Poor Indoor Air Quality" is the highest concern. Generally, "Poor Indoor Air Quality" is the second highest impact across all ethnic groups. "Harsh Outdoor Working Conditions" is the lowest reported impact across all racial backgrounds.

TABLE B.11 Extreme Heat Impacts by Racial Background (Survey Respondents) (n=1468 responses)

			Responses	
Racial Background	% of Respondents	Health Concerns	Harsh Outdoor Working Conditions	Poor Indoor Air Quality
Asian	15%	43%	23%	25%
Black or African American	14%	41%	22%	31%
Latinx or Hispanic	48%	36%	27%	32%
Native American, American Indian, or Alaska Native	2%	41%	27%	27%
Native Hawaiian and Pacific Islander	2%	19%	19%	54%
Other race	1%	40%	30%	30%
Two or more races	11%	38%	23%	33%
White	7%	33%	25%	32%

The values in this table may not total 100% across the response categories for racial backgrounds because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by race.

Extreme Heat Impacts by Income Level

Survey data of key extreme heat impacts by income level is represented by percentages in Table B. 12 below. "Health Concerns" is the top impact from extreme heat across all income levels, as well as being the majority impact for all races. "Poor Indoor Air Quality" is the second highest impact for extremely low, low, and moderate-income categories. This does not indicate that low and extremely low-income communities do not feel the impacts of "Harsh Outdoor Working Conditions" as strongly as high-income respondents, but rather "Poor Indoor Air Quality" impacts are more prominent.

TABLE B.12 Extreme Heat Impacts by Income Level (Survey Respondents) (n=1536 responses)

Income Level	% of Respondents	Responses: Health Concerns	Harsh Outdoor Working Conditions	Poor Indoor Air Quality
Extremely low-income	14%	49%	15%	34%
Low-income	40%	39%	23%	32%
Moderate-income	41%	34%	27%	32%
High-income	5%	37%	33%	21%

The values in this table may not total 100% across the response categories for income levels because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by income level.

Wildfires and Smoke

Though wildfires and wildfire smoke are not a top hazard of concern in the San Joaquin Valley Region, wildfire smoke is exacerbating already extremely poor air quality. Through survey and outreach board engagement, 2496 responses were provided to the question "What impacts of wildfire smoke have you experienced or are most concerned about?" The response options differed between the survey and the outreach boards, and survey respondents and outreach board participants could provide more than one response. The survey asked about three specific impacts for wildfire smoke, plus an option for "Other." In contrast, the outreach board provided ten options for climate related impacts that participants have experienced. These ten impact options were provided for power outages, extreme heat, and wildfire smoke on the same board.

The top responses for the survey and outreach board are highlighted in Figure B.11 and Figure B.12, respectively. "Health Concerns" is the top impact among survey respondents, accounting for 40 percent of survey responses, followed by "Poor Indoor Air Quality" (35 percent) and "Harsh Outdoor Working Conditions (19 percent). Similarly, "Health Concerns" is the top impact that outreach board participants were most concerned about, reported, accounting for 28 percent of responses, followed by "Unsafe Outdoor Working Conditions" (25 percent) and "Loss of Work" (20 percent). The qualitative data from the RTAG, survey, and the outreach boards are reflected in the following sections on Health Impacts, Economic Impacts, and Household/Community Impacts due to Wildfire and Smoke.

FIGURE B.11 Impacts Experienced or that Cause Concern During Wildfire Smoke (Survey Respondents) (n=1632 responses)

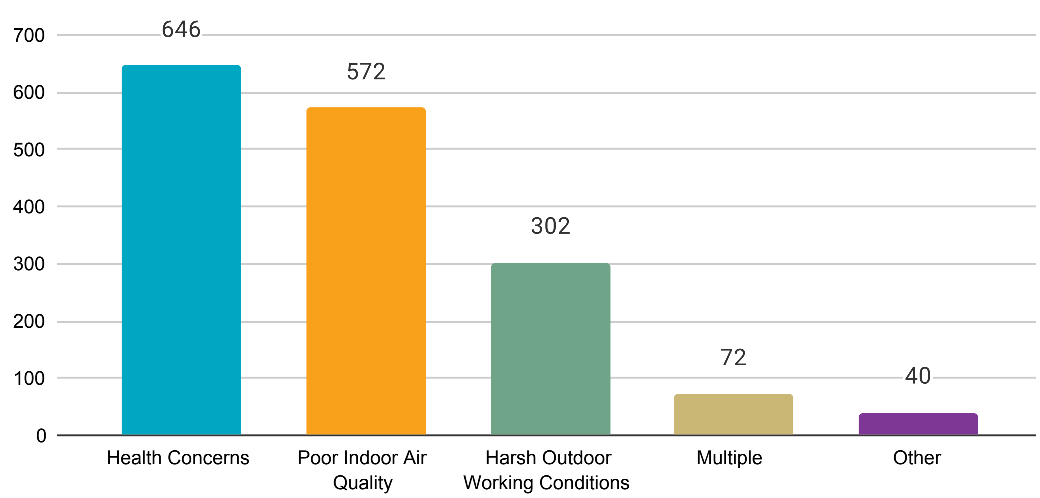
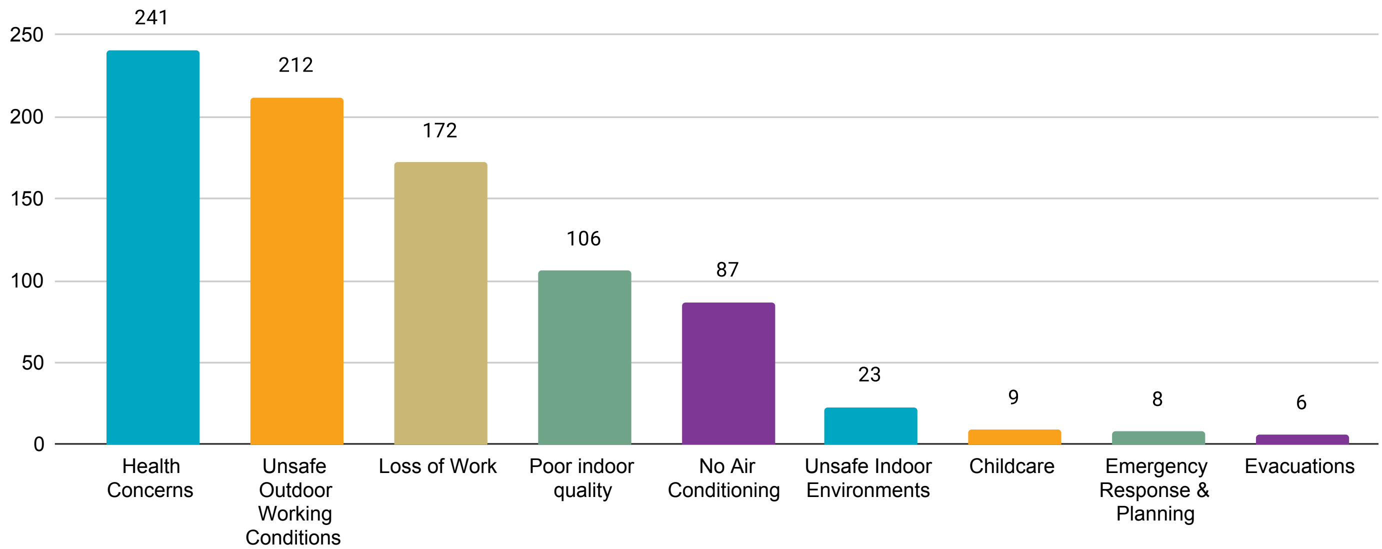


FIGURE B.12 Impacts Experienced or that Cause Concern during Wildfire Smoke (Outreach Board Participants) (n=864 responses)



Health Impacts Due to Wildfires and Smoke

About 40 percent of survey responses received are related to health concerns, the primary impact of extreme heat. Survey respondents noted that respiratory impacts are especially a risk for outdoor workers and farmworkers due to poor outdoor air quality, but that indoor air quality is also impacted, and can affect indoor workers, particularly in warehouses (e.g., meat packing plants). RTAG members shared that during wildfires, though employers are required to give out N95 masks when the air quality drops below a certain threshold, it is too hot for workers to comfortably work with them on, so they are exposed to the smoke and poor air quality. Furthermore, rules that require employers to offer workers breaks or to swap work locations are rarely enforced. Poor housing stock, which is often found in low-income areas, allows for smoke infiltration, making lower income communities especially vulnerable to the impacts of wildfire smoke. Survey respondents also noted that wildfire smoke impedes community members ability to exercise outdoors, further exacerbating mental health impacts.

Economic Impacts Due to Wildfires and Smoke

Survey respondents felt that wage loss for agricultural workers was the most acutely felt economic impact of wildfire smoke. Wildfire smoke exacerbates already poor outdoor air quality, making it unsafe to work outdoors, which can result in workers losing income if they choose not to work when it is unsafe to do so. However, RTAG members noted that many agricultural workers will work despite unsafe conditions. Poor outdoor and indoor air quality from wildfire smoke also impacts the productivity of farmworkers and warehouse workers, negatively impacting the region's agricultural industry.

Household/Community Impacts Due to Wildfires and Smoke

RTAG members and survey respondents also identified household and community impacts from wildfire smoke. Transportation schedules may be altered due to wildfire smoke, and community members are not able to wait outside comfortably or safely for the bus without a proper mask. Survey respondents indicated they may not be able to complete errands when there is a dangerous level of wildfire smoke outside. One survey respondent noted that wildfire smoke ruins their pool equipment.

Other community impacts identified by RTAG members include an increase in violence and domestic abuse because people cannot go outside or access community resources (community organizations may discontinue services). Notably, RTAG members stated that wildfires have also resulted in loss of trust in institutions/

government, especially among the youth. Specifically, they highlighted a loss of trust in the San Joaquin Air Pollution Control District, which community members believe use wildfires as an excuse for poor air quality, and do not take responsibility for approving new pollution sources in the region.

Wildfire Smoke Impacts by County

Survey and outreach board data of key wildfire smoke impacts by county are represented by percentages in Table B.13 below. "Health Concerns"/ "Medical Equipment Issues" are the top impact from wildfire smoke across all counties. In Kings County "Health Concerns"/ "Medical Equipment Issues" and "Poor Indoor Air Quality" are all shown to be equally felt impacts. "Harsh Outdoor Working Conditions"/ "Unsafe Outdoor Working Conditions" are impacts of less concern relative to other impact options across all counties.

"The area around Kern River has limited routes out during wildfires due to the deep canyons."

TABLE B.13 Wildfire Smoke Impacts by County (Survey Respondents and Outreach Board Participants) (n=1554 responses)

		Responses		
County	% of Respondents	Health Concerns/ Medical Equipment Issues	Poor Indoor Air Quality	Harsh Outdoor Working Conditions/Unsafe Outdoor Working Conditions
Alpine	N/A	N/A	N/A	N/A
Amador	N/A	N/A	N/A	N/A
Calaveras	N/A	N/A	N/A	N/A
Fresno	42%	29%	24%	20%
Kern	36%	39%	25%	24%
Kings	4%	40%	40%	19%
Madera	2%	54%	34%	12%
Mariposa	N/A	N/A	N/A	N/A
Merced	N/A	N/A	N/A	N/A
San Joaquin	10%	44%	29%	14%
Stanislaus	N/A	N/A	N/A	N/A
Tulare	1%	40%	35%	20%
Tuolumne	N/A	N/A	N/A	N/A

The values in this table may not total 100% across the response categories for counties because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by county.

Wildfire Smoke Impacts by Racial Background

Survey data of key wildfire smoke impacts selected by survey respondents by racial background is represented by percentages in Table B.14 below. "Health Concerns" and "Poor Indoor Air Quality" are the top impacts across respondents of all racial backgrounds. "Health Concerns" is the top impact for Black or African American and Latinx or Hispanic respondents whereas "Poor Indoor Air Quality" is the top impact for Native American, American Indian, or Alaska Native and Native Hawaiian and Pacific Islander respondents. Asian survey respondents selected the two impacts equally as a primary concern. "Harsh Outdoor Working Conditions" is the second most selected impact for Native Hawaiian and Pacific Islander respondents.

TABLE B.14 Wildfires and Smoke Impacts by Racial Background (Survey Respondents) (n=1502 responses)

Racial Background	% of Respondents	Responses: Health Concerns	Responses: Poor Indoor Air Quality	Responses: Harsh Outdoor Working Conditions
Asian	15%	37%	37%	16%
Black or African American	14%	40%	28%	23%
Latinx or Hispanic	48%	40%	36%	18%
Native American, American Indian, or Alaska Native	2%	36%	45%	9%
Native Hawaiian and Pacific Islander	2%	23%	38%	31%
Other race	2%	33%	29%	17%
Two or more races	10%	44%	31%	21%
White	7%	42%	34%	16%

The values in this table may not total 100% across the response categories for racial backgrounds because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by race.

Wildfire Smoke Impacts by Income Level

Survey data of key wildfire smoke impacts by income level is represented by percentages in Table B.15 below. "Health Concerns" is the top impact from wildfire smoke across incomes, except for moderate-income communities where "Poor Indoor Air Quality" is a slightly higher concern. "Harsh Outdoor Working Conditions" was selected more frequently by high-income respondents than low-income respondents. This does not indicate that low and extremely low-income communities do not feel the impacts of "Harsh Outdoor Working Conditions" as strongly as high-income respondents, but rather "Health Concerns" are more prominent.

TABLE B.15 Wildfires and Smoke Impacts by Income Level (Survey Respondents) (n=1574 responses)

Income Level	% of Respondents	Responses: Health Concerns	Responses: Poor Indoor Air Quality	Responses: Harsh Outdoor Working Conditions
Extremely low-income	14%	45%	37%	16%
Low-income	40%	44%	33%	18%
Moderate-income	41%	34%	38%	18%
High-income	5%	43%	25%	26%

The values in this table may not total 100% across the response categories for income levels because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by income level.

Flooding

The outreach materials used in the San Joaquin Valley Region only asked community members about their experience with the impacts from power outages, extreme heat, and wildfire smoke. Therefore, there is no quantitative data to report on flood impacts. However, RTAG members identified flooding as a hazard of concern, particularly in Kern County (Lake Isabella and the Kern River) and Stockton County.

"If Lake Isabella dam were to break, it would flood downtown Bakersfield within thirty minutes."

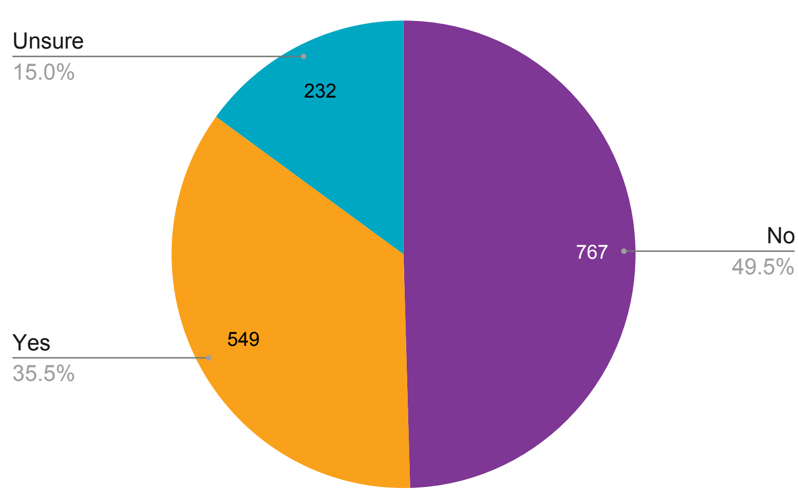
RTAG members expressed concern about the impacts of flooding on housing in the region. Flooding could damage housing, and many community members lack flood insurance or are under-insured. Flooded houses may develop mold, which can result in adverse health/respiratory impacts. One RTAG member believed that new housing has better levee protections than lower cost housing and expressed their opinion that the Army Corps of Engineers had perpetuated flood risk disparities in the region. For example, RTAG members expressed concern that Conway Homes, a public housing community in Stockton, was at higher risk of levee failure than surrounding properties if a superstorm event were to occur.

RTAG members were also concerned about agricultural runoff from flooding, which can cause harmful algae blooms and contaminate drinking water. RTAG members stated that there should be greater investment in smart stormwater runoff/water pumping systems during flooding, as well as green infrastructure in parks to absorb floodwaters. Lastly, one RTAG member noted that South Stockton had old transmission lines affected during flooding events that should be replaced or undergrounded to improve public safety.

Mental Health

The survey asked about mental health impacts while the outreach boards did not include questions on mental health impacts. Participants engaged through the outreach boards did however touch on mental health impacts that are a result of other hazards and are included in the relevant sections of this report. Approximately 35 percent of survey respondents (n=1548 respondents) respondend "Yes" to the question asking if mental health has been impacted by extreme climate events, which include heat, increased rain and flooding, wildfires, drought, and landslides (50 percent of responses are "No" and 15 percent are "Unsure"). Survey respondents noted that their kids are tired of staying inside and that during extreme weather events people are unable to exercise, which can contribute to poor mental health.

FIGURE B.13 Whether Mental Health has Been Impacted by Extreme Climate Events (Survey Respondents) (n=1548 respondents)



Mental Health Impacts by County

The Project Team also analyzed the information collected through the surveys by county. The results by county are consistent with the results of the survey overall, where about 50 percent of participants within each county responded "No" to the question asking if their mental health has been impacted by extreme climate events followed by "Yes" and "Unsure." Madera and San Joaquin counties had the highest percentage of survey respondents who said "Yes." These two counties also had the lowest percentage of "Unsure" responses, which may indicate a better understanding of the role the hazards play in affecting mental health.

TABLE B.16 Mental Health Impacts due to Extreme Climate Events, by County (n=1469 responses)

			Responses	
County	% of Respondents	No	Unsure	Yes
Alpine	15%	49%	10%	42%
Amador	14%	46%	15%	39%
Calaveras	48%	54%	14%	31%
Fresno	2%	45%	14%	41%
Kern	2%	42%	21%	38%
Kings	1%	40%	20%	40%
Madera	11%	43%	20%	37%
Mariposa	7%	40%	19%	41%
Merced	N/A	N/A	N/A	N/A
San Joaquin	10%	50%	9%	41%
Stanislaus	N/A	N/A	N/A	N/A
Tulare	1%	44%	17%	39%
Tuolumne	N/A	N/A	N/A	N/A

The values in this table may not total 100% across the response categories for counties because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by county.

Mental Health Impacts by Racial Background

Most survey respondents across racial backgrounds, except for White respondents, reported "No" to the question asking if their mental health has been impacted by extreme climate events more than "Yes" and "Unsure." Asian and White respondents more frequently reported mental health impacts, while Latinx or Hispanic respondents reported significantly lower mental health impacts (Table B.17).

TABLE B.17 Mental Health Impacts due to Extreme Climate Events by Racial Background (n=1547 respondents)

Racial Background	% of Respondents	Responses		
		No	Unsure	Yes
Asian	15%	49%	10%	42%
Black or African American	14%	46%	15%	39%
Latinx or Hispanic	48%	54%	14%	31%
Native American, American Indian, or Alaska Native	2%	45%	14%	41%
Native Hawaiian and Pacific Islander	2%	42%	21%	38%
Other race	1%	40%	20%	40%
Two or more races	11%	43%	20%	37%
White	7%	40%	19%	41%

The values in this table may not total 100% across the response categories for racial backgrounds because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by race.

Mental Health Impacts by Income Level

Extremely low-income and low-income survey respondents were more likely to report mental health impacts (53 percent) compared to those who identified as moderate-income (28 percent) or high-income (27 percent).

TABLE B.18 Mental Health Impacts due to Extreme Climate Events by Income Level (n=1492 responses)

Income level	% of Respondents	Responses		
		No	Unsure	Yes
Extremely low-income	14%	36%	11%	53%
Low-income	40%	46%	16%	38%
Moderate-income	41%	58%	14%	28%
High-income	5%	53%	21%	27%

The values in this table may not total 100% across the response categories for income levels because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by income level.

Adaptive Capacity

Based on RTAG input collected during research interviews, the San Joaquin Valley Region has low adaptive capacity. RTAG members noted a lack of historic investment in basic infrastructure such as quality housing that shelters residents from climate hazards. Furthermore, the agricultural economy and workforce are both highly vulnerable to drought and extreme heat, and farming communities lack resources to adapt farming practices and working conditions in response to these stressors. Nevertheless, strong ethnic and cultural ties have created community cohesion and grassroots networks in the absence of institutional safety nets to support community needs, particularly during climate hazard events.

Regional Adaptive Capacity by County

Utilizing the Building Resilience Indicators for Communities (BRIC) Index county scores across the six categories and the BRIC Composite score for each county in the region, the Project Team evaluated the adaptive capacity of the San Joaquin Valley Region (Table B.19). A description of the BRIC adaptive capacity framework and its resilience categories is provided in the Adaptive Capacity section of the main report.

As shown in Table B.19, **San Joaquin and Tulare counties have the highest overall adaptive capacity**, while Kings, Madera, Merced, and Kern counties have the lowest. Across counties, the region **performs the lowest on the "Infrastructural" resilience category**, which is consistent with RTAG input that the San Joaquin Valley has suffered from lack of investment in basic infrastructure, resulting in low quality housing and transportation infrastructure. The category with **the second lowest score is "Community Capital,"** suggesting that communities in the **San Joaquin Valley lack strong social networks and connectivity among individuals and groups.** This data is consistent with RTAG member input that the region is geographically remote and rural communities lack connection to services and resources; however, RTAG members also noted that strong social networks exist among ethnic communities.

TABLE B.19 BRIC Scores by County (High to Low)

County	Social	Economic	Community Capital	Institutional	Infrastructural	Environmental	BRIC Composite Score
San Joaquin	0.612	0.492	0.302	0.408	0.306	0.521	0.440
Tulare	0.629	0.451	0.375	0.364	0.232	0.539	0.432
Alpine	0.623	0.422	0.320	0.365	0.319	0.527	0.429
Calaveras	0.632	0.444	0.375	0.367	0.225	0.533	0.429
Tuolumne	0.623	0.422	0.320	0.365	0.319	0.527	0.429
Stanislaus	0.612	0.487	0.310	0.398	0.280	0.488	0.429
Amador	0.642	0.445	0.356	0.372	0.237	0.517	0.428
Fresno	0.598	0.469	0.304	0.376	0.278	0.477	0.417
Mariposa	0.621	0.434	0.349	0.354	0.220	0.519	0.416
Kings	0.603	0.461	0.268	0.374	0.273	0.478	0.409
Madera	0.592	0.451	0.286	0.368	0.257	0.494	0.408
Merced	0.574	0.456	0.273	0.394	0.274	0.479	0.408
Kern	0.593	0.462	0.288	0.356	0.269	0.466	0.406

* To simplify the comparison and analysis of many variables, researchers may use a normalization technique called Min-Max normalization in social indicators research. This involves scaling all values between 0 and 1 (0 represents the minimum value and 1 represents the maximum value) through adjusting all other values by subtracting the minimum value from the maximum and dividing by the range.

Supplemental Adaptive Capacity Indicators

The Resilient Together initiative survey provides supplemental data that is relevant to the evaluation of adaptive capacity for the San Joaquin Valley Region. The following section describes respondents' access to financial resources, a cool space (at home or outside of home), a comfortable home, and air conditioning by select demographic characteristics. However, the data is not representative of the region as a whole and should only be referenced with context to the survey sample and in conjunction with the BRIC index results, which provide a region-wide analysis.

Access to Financial Resources

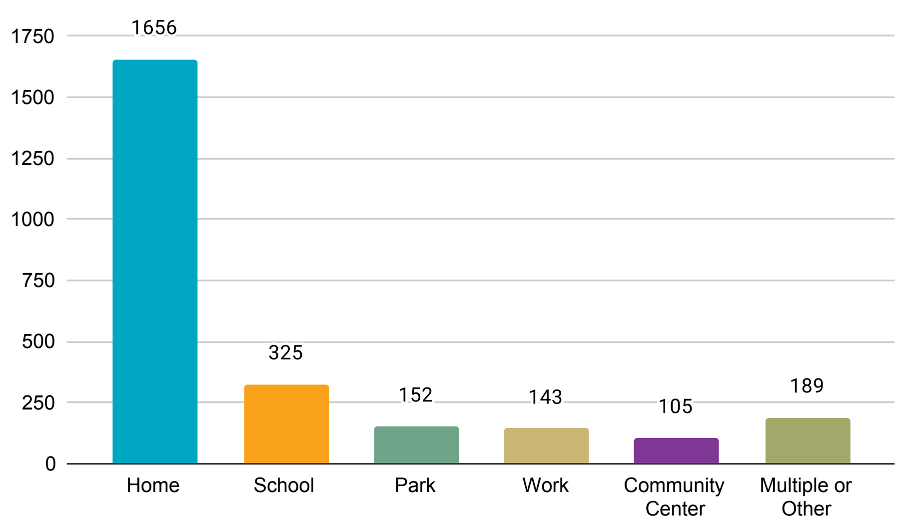
Access to financial resources enables households to access resources and services that improve their resilience in the face of climate hazards. For low-income households, increasing access to financial assistance is one of the most significant ways to increase adaptive capacity. In the San Joaquin Valley Region, approximately 24 percent of survey respondents reported they receive financial assistance on their utility bill, and another 21 percent were unsure. To qualify for financial assistance, households must meet low-income thresholds set by PG&E.[36]

Access to Cool Space

As shown in Figure B.14, approximately 30 percent of survey respondents and outreach board participants cool off at a school, park, work, or community center, while about 64 percent cool off in their home. Seven percent of the survey respondents to this question selected multiple options or provided other places to cool off on hot days. One survey respondent indicated that they were not aware that community centers were an option for people to go to cool off. Additional places people go to cool off as reported through the survey and RTAG outreach events include homes of friends and family, coffee shops, shopping malls and stores, pools, and beach, out of town (e.g., to the Bay Area or the mountains), movie theater, church, and the library.

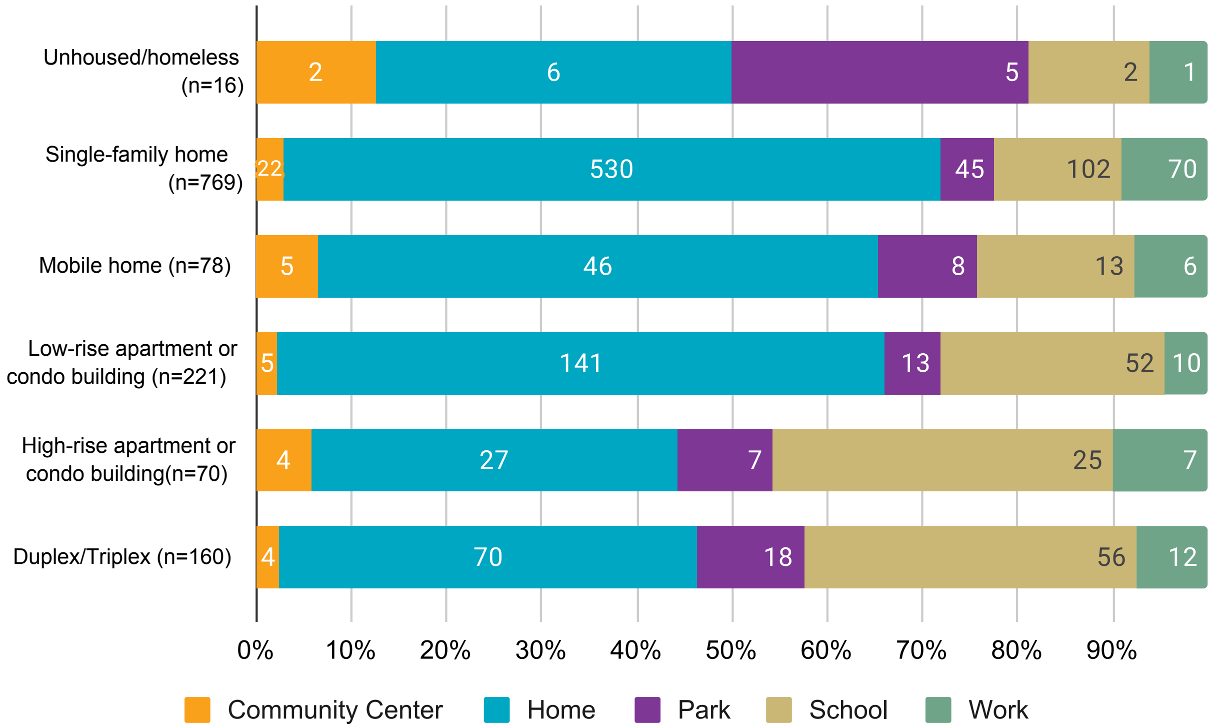
Figure B.15 illustrates where people go to cool off based on what type of home they live in. Unhoused/homeless survey respondents (1 percent of the survey responses) were the most likely, at 13 percent, to use community centers, followed by survey respondents who live in mobile homes (6 percent). Survey respondents living in duplexes, high rise or low-rise apartment or condo buildings were the most likely to utilize schools as places to cool off compared to survey respondents with other housing types, presumably due to the higher number of children residing in these housing types.

FIGURE B.14 Where People Go to Cool Off on Hotter Days (Survey Respondents & Outreach Board Participants) (n=2570 responses)



36 CARE / FERA program guidelines can be accessed at the below site: https://www.pge.com/en_US/residential/save-energy-money/help-paying-your-bill/longer-term-assistance/care/program-guidelines.page#qualifying

FIGURE B.15 Where People Cool Off by Housing Type (Survey Respondents) (n=1314 responses)



Access to Comfortable Home

Half of all survey and outreach board responses (51 percent) indicated that community members are comfortable or very comfortable in their home on hotter days. RTAG members support resilience hubs/cooling centers as a strategy to adapt to extreme heat, but only a small percentage (~3 percent) of survey respondents reported cooling off at existing community centers, reflecting the large number of respondents who are comfortable staying in their homes on hotter days.

For those who reported they cool off at home on hotter days (n=869 respondents), approximately half indicated they are "Comfortable" or "Very Comfortable." If people are comfortable at home, they will stay at home. But for nearly half of survey respondents who are "Not at All Comfortable" or "Slightly Uncomfortable," they will go somewhere other than home to cool off.

Table B.20 shows how comfortable respondents are at home on hotter days by county, for counties in the San Joaquin Valley Region for which there is data available. Across counties, over half of respondents are "Comfortable" or "Very Comfortable" in their homes on hotter days. The counties with the highest percentage of respondents indicating they were "Comfortable" or "Very Comfortable" in their homes on hotter days are Fresno, Kern, Kings, and San Joaquin. The counties with the highest percentage of respondents indicating they were "Slightly Uncomfortable" or "Not at All Comfortable" in their homes on hotter days are Madera and Tulare.

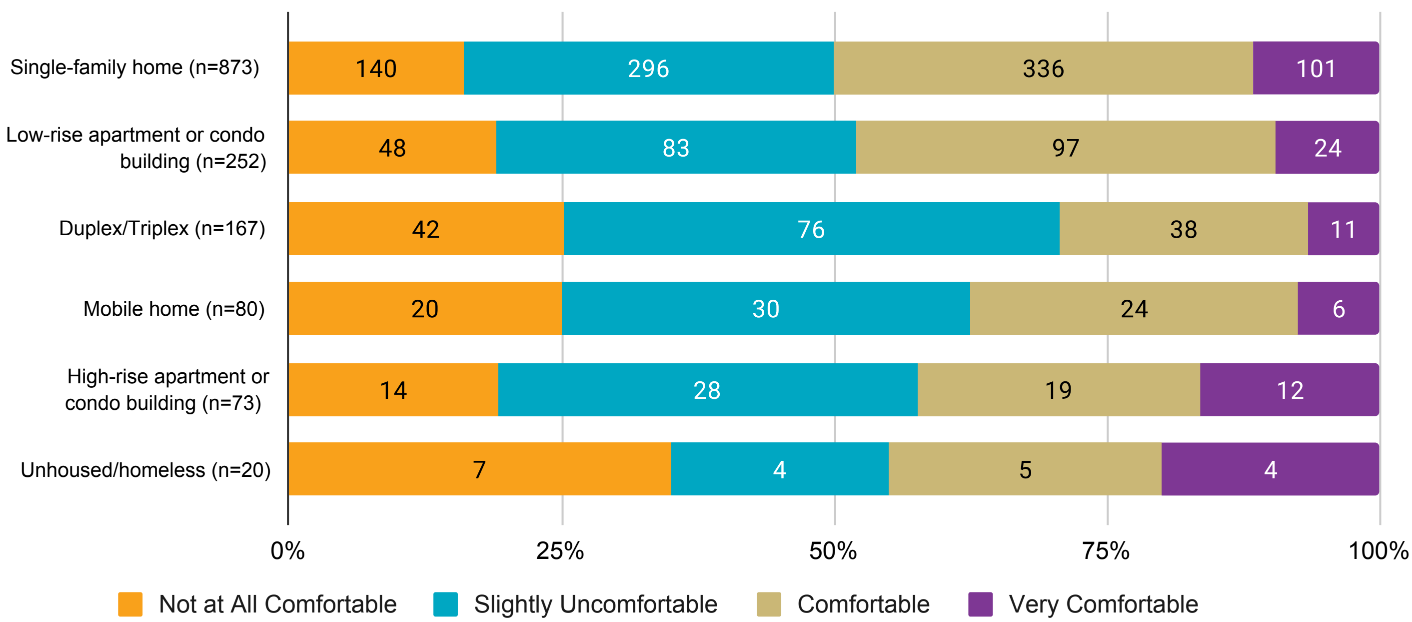
The survey findings (Figure B.16) demonstrate that survey respondents living in single-family homes are the most comfortable on hotter days (50 percent of low to moderate-income respondents live in single-family homes); and those living in a duplex/triplex are least comfortable (even compared to respondents who identified as unhoused or homeless).

TABLE B.20 Comfort Level at Home on Hotter Days, by County
(n=1891 respondents)

County	% of Respondents	Responses: Not at All Comfortable	Slightly Uncomfortable	Comfortable	Very Comfortable
Alpine	N/A	N/A	N/A	N/A	N/A
Amador	N/A	N/A	N/A	N/A	N/A
Calaveras	N/A	N/A	N/A	N/A	N/A
Fresno	42%	12%	39%	40%	9%
Kern	36%	7%	16%	48%	30%
Kings	4%	11%	32%	47%	11%
Madera	2%	16%	42%	42%	0%
Mariposa	N/A	N/A	N/A	N/A	N/A
Merced	N/A	N/A	N/A	N/A	N/A
San Joaquin	10%	13%	33%	41%	13%
Stanislaus	N/A	N/A	N/A	N/A	N/A
Tulare	1%	0%	67%	33%	0%
Tuolumne	N/A	N/A	N/A	N/A	N/A

The values in this table may not total 100% across the response categories for counties because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by county.

FIGURE B.16 Comfort Level in Home on Hotter Days by Housing Type
(Survey Respondents) (n=1465 respondents)



Access to Air conditioning

Approximately 71 percent of survey respondents and outreach board participants (n=2456 total responses to this question) have access to an air-conditioned space. The survey also asked those respondents who do not have access to an air-conditioned space now if they need air-conditioning or not. Of those survey respondents, about 78 percent (n=170 respondents) need air-conditioning. The outreach boards asked if people will need access to an air-conditioned space as it gets hotter, and 66 percent (n=966 participants) indicated "Yes."

Resilience Strategies and Recommendations

Through the Resilient Together initiative, community and RTAG members had an opportunity to share preferred strategies for how PG&E can best build community resilience to the range of climate impacts identified in communities throughout the region. These strategies, if implemented, would increase the adaptive capacity of households and communities to a range of climate impacts.

"Cooling centers should be built. There aren't even enough community centers to begin with. Cooling centers should provide recreational activities/resources."

Generally, RTAG members in the Bay Area Region recommended PG&E:

- **Fund cooling centers that serve rural areas of the region, as well as provide transportation vouchers to cooling centers.** RTAG members in the San Joaquin Valley Region stated that community/cooling centers need to be more accessible to seniors and rural community members, either by providing mobile cooling centers or improving more accessible transit options. RTAG members expressed that community/cooling center administrators need to build relationships with trusted community members, not just CBOs. In general, RTAG members felt there needs to be more money to build community spaces and fund new and existing programs at these community centers.

- **Fund programs that improved home insulation, energy efficiency, and indoor air quality of homes.** RTAG members also stressed the importance of designing programs that are relevant to the needs of the community it seeks to service. For example, electric vehicle programs are not of interest to residents that are very low-income and cannot afford electric vehicles even with rebates, or for communities that lack electric vehicle infrastructure. Similarly, electric appliance rebate programs are not helpful to residents, since many homes do not have an electrical panel that can accommodate electric appliances. Instead, RTAG members recommended developing a program that focused on home improvements and weatherization, especially for renters. Specific improvements include electrical panel service and replacement, insulation improvements, and heat pump installation.

- **Conduct outreach to communities before, during and after climate hazard events.** RTAG members also recommended PG&E host more informational meetings, work with community leaders to conduct multi-lingual outreach and provide educational emergency preparedness training.

- **Provide direct financial relief to customers impacted by power outages** and encouraged PG&E to increase enrollment in low-income assistance programs for those who are eligible by conducting more multilingual outreach. As in other regions, RTAG members also supported the distribution of free safety resources, such as N-95 masks, to protect community members from impaired air quality.

- **Invest in workforce development as a critical community resilience strategy area to support farmers and warehouse workers to transition to safer careers.** In response to increased exposure to extreme heat and poor air quality among people living in inadequate housing, RTAG members in the San Joaquin Valley Region called for PG&E to engage in state advocacy to increase investments in quality housing in the region and to improve enforcement of workplace safety standards to protect indoor/outdoor workers, particularly agricultural workers, that are vulnerable to extreme heat and wildfire smoke.

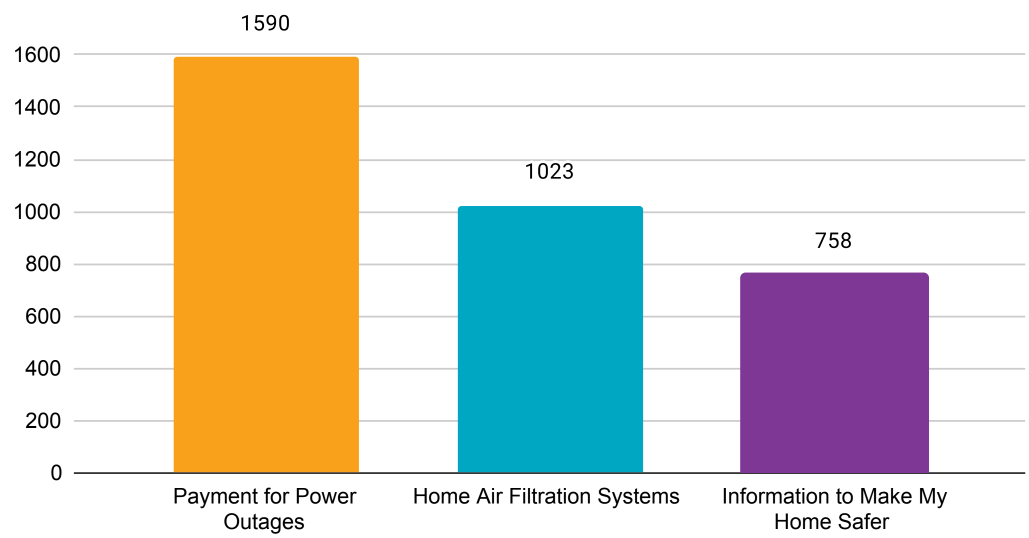
- **Advocate for and deliver resources to support electrification** (of buildings and cars) in vulnerable communities in the region.

The following section details survey respondents and RTAG member-recommended actions to improve community and household resilience.

Household Resilience Strategies

Community members were requested to provide recommendations for the kinds of strategies that PG&E could implement that would support households during extreme weather events. A summary of the strategies recommended by community members in the San Joaquin Valley Region specifically are included below.

FIGURE B.17 PG&E Strategies for Households during Extreme Weather Events (n=3371 responses)



Survey respondents and outreach board participants at in-person events provided their top two recommended strategies for PG&E to consider to support households during extreme weather events. Of the 3371 responses received, the top two recommended strategies out of the three choices provided are "Payment for Power Outages" (47 percent) and "Home Air Filtration Systems" (30 percent), followed by "Information to Make My Home Safer" (22 percent).

Survey respondents also provided the following open-ended input on community resilience strategies under the "Other" response category. All these responses were contextualized and integrated into the San Joaquin Valley Region Recommendations for Household Resilience Strategies (Table B.21).

Key Household Resilience Strategies by County

"Payment for Power Outages" is a top priority overall, which is consistent across all counties except for Tulare, where "Home Air Filtration Systems" is ranked as the top solution that PG&E could provide households during extreme weather events. The survey data that provides the county breakdown represents 50 percent of the data received during the Outreach Period.

TABLE B.21 Priority Household Resilience Strategies by County (n=3257 responses)

County	% of Respondents	Responses		
		Payment for Power Outages	Home Air Filtration Systems	Information to Make My Home Safer
Alpine	N/A	N/A	N/A	N/A
Amador	N/A	N/A	N/A	N/A
Calaveras	N/A	N/A	N/A	N/A
Fresno	42%	45%	31%	24%
Kern	36%	58%	24%	19%
Kings	4%	41%	28%	32%
Madera	2%	48%	35%	17%
Mariposa	N/A	N/A	N/A	N/A
Merced	N/A	N/A	N/A	N/A
San Joaquin	10%	39%	37%	24%
Stanislaus	N/A	N/A	N/A	N/A
Tulare	1%	38%	57%	5%
Tuolumne	N/A	N/A	N/A	N/A

The values in this table may not total 100% across the response categories for counties because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by county.

Key Household Resilience Strategies by Racial Background

The household resilience strategies can also be reviewed based on how participants identified their racial background, as illustrated in Table B. 22 below. "Payment for Power Outages" is the top solution for respondents who identified their racial backgrounds as Asian (48 percent), Black or African American (44 percent), Latinx or Hispanic (39 percent), Two or more races (41 percent), and White (42 percent). "Home Air Filtration Systems" is the top response for Native American, American Indian, or Alaska Native participants (50 percent) and Native Hawaiian and Pacific Islander participants (38 percent).

TABLE B.22 Priority Household Resilience Strategies by Racial Background (n=1836 responses)

Racial Background	% of Respondents	Responses: Payment for Power Outages	Responses: Home Air Filtration Systems	Responses: Information to Make my Home Safer
Asian	15%	48%	31%	21%
Black or African American	14%	44%	38%	18%
Latinx or Hispanic	48%	39%	37%	24%
Native American, American Indian, or Alaska Native	2%	42%	50%	8%
Native Hawaiian and Pacific Islander	2%	27%	38%	35%
Other race	1%	34%	28%	38%
Two or more races	11%	41%	38%	21%
White	7%	42%	35%	23%

The values in this table may not total 100% across the response categories for racial backgrounds because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by race.

Key Household Resilience Strategies by Income Level

Income is another lens by which to evaluate the top strategies identified by survey respondents. For extremely low-income participants, "Payment for Power Outages'' is the top response (41 percent). "Payment for Power Outages" is the top response for moderate-income and high-income participants as well. "Home Air Filtration Systems" is the top response for low-income participants.

TABLE B.23 Priority Household Resilience Strategies by Income Level (n=1909 responses)

Income Level	% of Respondents	Responses: Payment for Power Outages	Responses: Home Air Filtration Systems	Responses: Information to Make My Home Safer
Extremely low-income	14%	41%	39%	20%
Low-income	40%	32%	43%	26%
Moderate-income	41%	43%	37%	20%
High-income	5%	41%	35%	24%

The values in this table may not total 100% across the response categories for each income levels the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by income level.

Household Resilience Recommendations

Table B. 24 below lists specific recommendations that came from RTAG input, survey respondents via open-ended survey responses, and focus group participants for PG&E to consider with respect to the following strategy areas:

1. Home improvements
2. Utility Bill Support/ Direct Payments
3. Safety Resources Distribution

Under each strategy is a list of recommended actions that community and RTAG members shared with the Project Team categorized by: (1) within PG&E's control, (2) possible through partnerships, and (3) outside of PG&E's control.

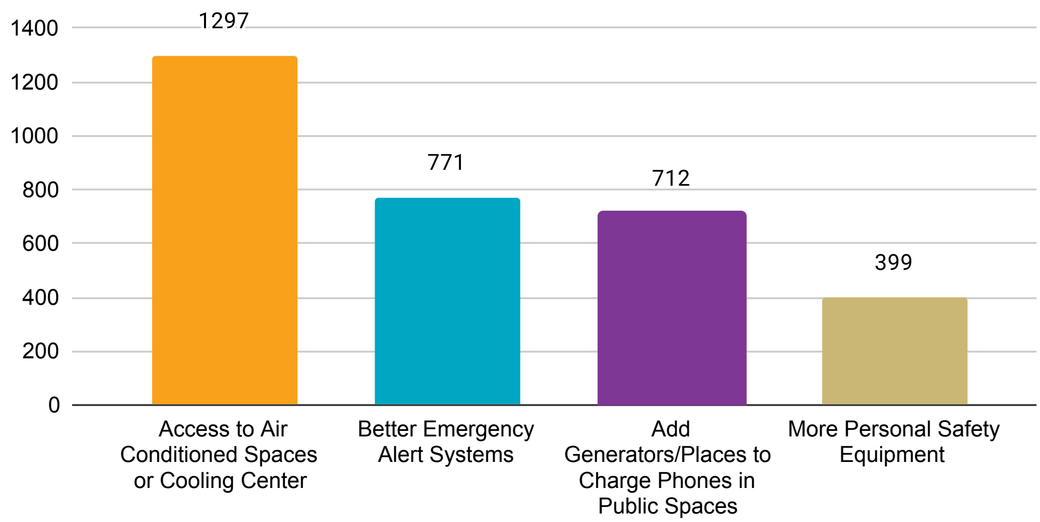
TABLE B.24 San Joaquin Valley Region Recommendations for Household Resilience Strategies

Strategy Area	Recommended Action	Within PG&E's Control	Possible Through Partnerships	Outside of PG&E's Control
Home Improvements	Increase funding for weatherization programs for existing housing stock, especially low-income and mobile homes	X		
	Partner with regional energy networks to expand weatherization programs		X	
	Expand weatherization programs to include swamp coolers	X		
	Fund affordable housing trust funds or land trusts that allow low-income customers to transition into adequate housing stock	X		
	Support the development of homes that are heat resistant and energy efficient by improving access to higher quality building materials			X
	Develop more home improvement/appliance programs for renters	X		
Utility Bill Support/ Direct Payments	Provide cost reduction/rebates for air purifiers	X		
	Provide financial support for customers who have higher utility bills due to increase in use of air conditioning on hot days	X		
	Increase CARE/FERA subsidies and expand income eligibility	X		
	Partner with CBOs that have relationship with residents to increase enrollment in CARE/FERA		X	
	Create emergency funds for customers impacted by power outages	X		
	Provide free replacement of water heaters for homeowners every ten years			
Safety Resources Distribution	Identify mask distribution partners and distribute free N-95 masks to employers and workers	X	X	
	Distribute free/subsidized battery packs	X	X	

Community Resilience Strategies

The Project Team requested that community members provide input on the kinds of strategies that PG&E could implement to support communities during extreme weather events. The following information is a summary of the strategies that survey respondents from the San Joaquin Valley Region supported. Respondents were encouraged to pick their top two choices, although respondents chose between zero and four strategies as their responses.

FIGURE B.18 PG&E Strategies for Communities During Extreme Weather Events (n=3179 responses)



In the San Joaquin Valley Region, "Access to Air-conditioned Spaces/Cooling Centers" (41 percent of responses) and "Better Emergency Alert Systems" (24 percent of responses) were the top two strategies survey respondents selected out of the four choices provided to help communities build resilience to extreme weather events. Approximately 22 percent of the total responses selected were to "Add Generators/Places to Charge Phones in Public Spaces" and approximately 13 percent of total responses related to "More Personal Safety Equipment (such as masks, batteries, etc.)."

Survey respondents also provided open-ended input on community resilience strategies under "Other" strategies. All these responses were contextualized and integrated into the San Joaquin Valley Region Recommendations for Community Resilience Strategies (Table B.28).

Key Community Resilience Strategies by County

On a county level, the top response is primarily "Access to Air-conditioned Spaces/Cooling Centers." Respondents of Kings County reported "Add Generators/Places to Charge Phones in Public Spaces" as the top response and Madera County selected "Better Emergency Alert Systems" as the top response. Table B.25 highlights 7 of the 13 San Joaquin Valley Region represented counties in the survey and the outreach boards.

TABLE B.25 PG&E Strategies for Communities During Extreme Weather Events (by County) (n=3034 responses)

County	% of Respondents	Responses: Access to Air-conditioned Spaces/ Cooling Centers	Better Emergency Alert Systems	Add Generators/ Places to Charge Phones in Public Spaces	More Personal Safety Equipment (masks, batteries, etc.)
Alpine	N/A	N/A	N/A	N/A	N/A
Amador	N/A	N/A	N/A	N/A	N/A
Calaveras	N/A	N/A	N/A	N/A	N/A
Fresno	42%	42%	22%	22%	13%
Kern	36%	45%	25%	21%	8%
Kings	4%	28%	29%	30%	14%
Madera	2%	34%	48%	16%	2%
Mariposa	N/A	N/A	N/A	N/A	N/A
Merced	N/A	N/A	N/A	N/A	N/A
San Joaquin	10%	34%	21%	25%	20%
Stanislaus	N/A	N/A	N/A	N/A	N/A
Tulare	1%	37%	32%	26%	5%
Tuolumne	N/A	N/A	N/A	N/A	N/A

The values in this table may not total 100% across the response categories for counties because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by county.

Key Community Resilience Strategies by Racial Background

The community resilience strategies can also be reviewed based on how participants identified their racial background, as illustrated in Table B. 26 below. Ninety percent of participants provided a response on racial background. "Access to Air-Conditioned Spaces/Cooling Centers" was the top solution for participants who identified as Asian (34 percent), Latinx or Hispanic (32 percent), Native Hawaiian and Pacific Islander (41 percent), and White (39 percent). "Add Generators/Places to Charge Phones in Public Spaces" was the top solution for Black or African American (38 percent), and Native American, American Indian, and Alaska Native participants (33 percent). For the participants that identify as two or more races, "Better Emergency Alert Systems" was the top response (33 percent).

TABLE B.26 PG&E Strategies for Communities During Extreme Weather Events (by Racial Background) (n=1924 responses)

Racial Background	% of Respondents	Responses: Access to Air-conditioned Spaces/Cooling Centers	Better Emergency Alert Systems	Add Generators/ Places to Charge Phones in Public Spaces	More Personal Safety Equipment (masks, batteries, etc.)
Asian	15%	34%	25%	23%	18%
Black or African American	14%	30%	20%	38%	11%
Latinx or Hispanic	48%	32%	27%	26%	15%
Native American, American Indian, or Alaska Native	2%	30%	26%	33%	11%
Native Hawaiian and Pacific Islander	2%	41%	22%	19%	19%
Other race	1%	42%	15%	24%	18%
Two or more races	11%	29%	33%	30%	7%
White	7%	39%	23%	26%	13%

The values in this table may not total 100% across the response categories for racial backgrounds because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by race.

Key Community Resilience Strategies by Income Level

The Project Team evaluated top strategies identified by survey respondents based on the income of respondents. For extremely low-income participants, "Better Emergency Alert Systems" and "Add Generators/Places to Charge Phones in Public Spaces" were tied for the top response. "Access to Air-Conditioned Spaces/Cooling Centers" is the top strategy for participants in the low-income and moderate-income groups, followed by "Add Generators/Places to Charge Phones in Public Spaces." "More Personal Safety Equipment" was the least selected solution by number of responses across all income levels (Table B.27).

TABLE B.27 PG&E Strategies for Communities During Extreme Weather Events (by Income Level) (n=1992 responses)

Income Level	% of Respondents	Responses: Access to Air-conditioned Spaces/Cooling Centers	Better Emergency Alert Systems	Add Generators/ Places to Charge Phones in Public Spaces	More Personal Safety Equipment (masks, batteries, etc.)
Extremely low-income	14%	27%	30%	30%	13%
Low-income	40%	34%	27%	27%	11%
Moderate-income	41%	32%	25%	27%	16%
High-income	5%	29%	28%	30%	13%

The values in this table may not total 100% across the response categories for income levels because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by income level.

Community Resilience Recommendations

Table B.28 lists specific recommendations that came from RTAG input, survey respondents via open-ended survey responses, and focus group participants for PG&E to consider with respect to the following strategy areas:

1. Community Resilience and Cooling Centers
2. Infrastructure Improvements and Grid Modernization
3. Distributed Energy Resources
4. Communication, Education, and Outreach
5. Forest Health, Vegetation Management, and Urban Greening
6. Transportation Services
7. Workforce Development
8. Broadband Access
9. State Advocacy

Under each strategy is a list of recommended actions that community and RTAG members shared with the Project Team categorized by: (1) within PG&E's control, (2) possible through partnerships, and (3) outside of PG&E's control.

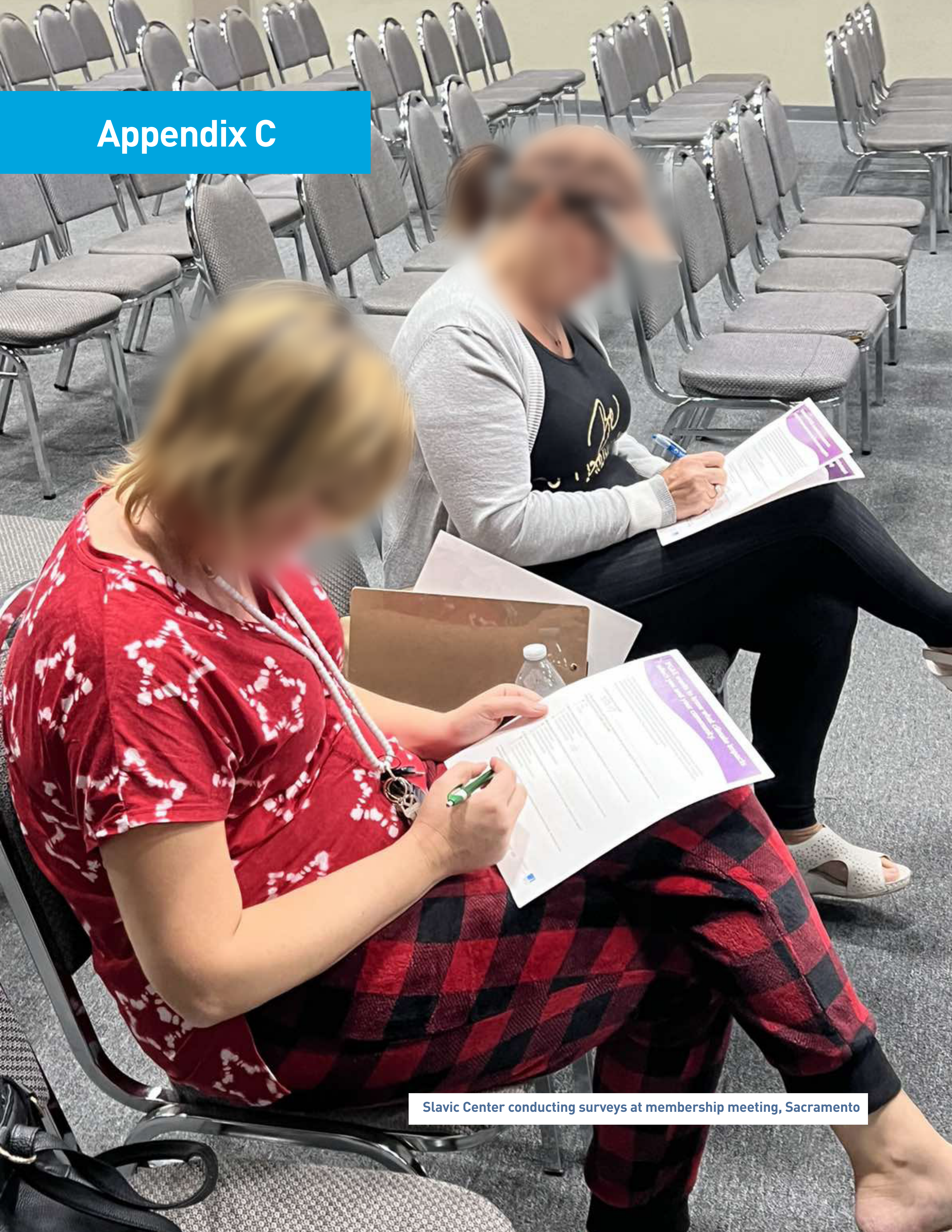
TABLE B.28 San Joaquin Valley Recommendations for Community Resilience Strategies

Strategy Area	Recommended Action	Within PG&E's Control	Possible Through Partnerships	Outside of PG&E's Control
Community Resilience and Cooling Centers	Provide financial support for the development and sustained operation of community resilience centers at places of worship, schools, and nonprofits through new and existing grant programs, including incentives for existing community centers	X	X	
	Provide access to shaded pools		X	
	Provide generators in public spaces			
	Develop new cooling centers in rural communities	X	X	
	Waive cost of electricity/gas for cooling centers during hazard events	X		
Infrastructure Improvements and Grid Modernization	Improve maintenance around power lines	X		
	Underground power lines	X		
	Narrow PSPS areas so that fewer disadvantaged communities are impacted	X		
Distributed Energy Resources	Invest in and provide access to micro-grids	X		
	Develop renter-focused community solar programs			
	Develop program focused on electrical panel service/replacement	X		
	Increase access to backup energy and generators	X		
	Create a program for installation of solar/batteries (not just equipment rebates)	X		

Strategy Area	Recommended Action	Within PG&E's Control	Possible Through Partnerships	Outside of PG&E's Control
Forest Management & Urban Greening	Conduct more prescribed burns to prevent wildfires		X	
	Develop programs that increase tree canopies in areas that experience urban heat island effect	X	X	X
	Create a program that constructs green roofs for multi-dwelling units that cannot install solar		X	
	Invest in green infrastructure at parks to reduce flood risk		X	
Communication Education & Outreach	Build collaborations with CBOs (e.g., expand Energy Partners Program to utilize CBO networks that were active in COVID response)	X		
	Host more informational meetings on PG&E programs with bilingual outreach	X		
	Partner with school districts to develop trainings with students to teach parents about emergency preparedness plannings	X	X	
	Improve communication to customers about peak grid demand to avoid power outages	X		
	Develop and distribute multi-lingual materials to inform public on how to stay safe/make home safer during extreme weather events, as well as where people should go during an emergency event (if home is not safe)	X		
	Purchase billboard space to inform communities about emergency preparedness	X		
Transportation Services	Provide transportation vouchers to cooling centers		X	
	Expand programs for electric vehicle charging infrastructure and electric vehicle subsidies or rideshares	X	X	
	Remove local match requirements for electric vehicle grant programs to ensure resources reach vulnerable communities	X		
Workforce Development	Provide access to workforce development training including electrification/EV workforce development as well as career transition to allow farmworkers to transition into new industries		X	
	Fund trainings and technical assistance for farmworkers seeking to open small organic farms (e.g., trainings on permits/land acquisition)			X
	Provide financial support to farms transitioning to indoor growing			X
	Fund pilot program to invest in farms that install lighting to enable farmworkers to work in the evenings			
Broadband Infrastructure	Expand internet service in rural communities to ensure customers get emergency alerts		X	X

Strategy Area	Recommended Action	Within PG&E's Control	Possible Through Partnerships	Outside of PG&E's Control
State Advocacy	Advocate for policies that allow for electricity to be shared across neighboring parcels	X		
	Advocate for state agencies to provide unrestricted capacity building grants to CBOs in DVCs	X	X	
	Advocate for greater enforcement of workplace safety standards	X	X	
	Advocate for building/transportation electrification dollars to be directed to vulnerable communities in the region.	X	X	
Other	Charge larger agricultural customers higher rates	X		
	Require profits from biomass facilities in DVCs to be reinvested in the communities (establish Community Benefit Agreements)			X
	Fund local affordable housing trust funds or land trusts			X
	Upgrade aging infrastructure that hinders mobility (e.g., wheelchairs are unable to navigate cracked and broken sidewalks)			X

Appendix C



Slavic Center conducting surveys at membership meeting, Sacramento

TABLE C.1 RTAG Member Profiles[39]

RTAG Organization	Geographies Represented	Top Populations Represented	Mission/Profile
Camptonville Community Partnership*	Yuba County	Low-income communities Essential workers Youth	Incorporated in 2001, Camptonville Community Partnership 501(c)3, serves Camptonville (and region) as rural people working together for a safe, sustainable, and healthy community. Among others, Camptonville Community Partnership runs an Early Childhood Program, a Rural Health Advocacy program, a Family Resource Center, a Forest Biomass Business Center, and a Courier Newspaper.[40]
California Urban Partnership	Sacramento County	Tribal/Indigenous communities and sovereign nations Black/African American communities Small businesses	The mission of the California Urban Partnership is to promote equity and economic security by lifting up Black Business, Culture, and Community. Their work is focused through a Community Investment Initiative, a Corporate Partnership Council, and the Institute for MORE (Marijuana Opportunity, Reinvestment and Equity).[41]
Habitat for Humanity Yuba/Sutter*	Yuba County	People experiencing homelessness Low-income communities Housing burdened	The mission of Habitat for Humanity Yuba/Sutter is to end homelessness by providing sustainable housing in Yuba and Sutter counties. They are committed to serving the local community through housing, education, and service with the ultimate goal of ending homelessness and substandard housing in a fiscally and socially responsible manner. In partnership with Hands of Hope, Habitat for Humanity runs a Coordinated Entry Program which assesses each client for vulnerability and places those with mental illness, chronic health conditions, and chronic homelessness at the top of the priority list for assistance to housing.[42]
Hands of Hope: Resources for Homeless Families	Sutter County	Low-income communities People experiencing homelessness People with disabilities	Hands of Hope is a community facility providing resources for those experiencing homelessness in the Yuba-Sutter area. They work to provide core support services to the homeless, reintegrate the homeless within our community, and engage the community to respond to the challenge of homelessness. Hands of Hope has established a day service center offering core services including showers, laundry facilities, a clothes closet, and referrals to other agencies. In partnership with Habitat for Humanity, Hands of Hope runs a Coordinated Entry Program which assesses each client for vulnerability and places those with mental illness, chronic health conditions, and chronic homelessness at the top of the priority list for assistance to housing.[43]
Northern Rural Training and Employment Consortium	Butte County	Low- income communities People with disabilities Youth	Northern Rural Training and Employment Consortium is a consortium of eleven Northern California counties established to address the needs of job seekers and businesses in our region. They believe that a healthy business community creates economic vitality and are dedicated to strengthening and supporting area businesses to create jobs and encourage economic prosperity.[44]

39 RTAG Member organization missions/profiles are taken from the listed organizations' website. Links to each site for more information are provided in footnotes.

40 https://ccp.camptonville.net/p/welcome.html

41 http://www.californiaup.org/#/

42 https://yubasutterhabitat.org/

43 https://www.ychandsofhope.org/

44 http://www.ncen.org/

RTAG Organization	Geographies Represented	Top Populations Represented	Mission/Profile
Sacramento Environmental Justice Coalition*	Sacramento County	Low-income communities Essential Workers Communities of color	Sacramento Environmental Justice Coalition is a grassroots coalition of Black, Indigenous, and People of Color (BIPOC), Residents, Neighborhood Associations, and Faith Based Communities who are dedicated to advocate for environmentally just policies in low-income and historically excluded communities.[45]
Sacramento Area Congregations Together*	Sacramento County	Limited English proficiency communities Renters Black/African American communities	Sacramento Area Congregations Together is a multi-faith grass roots organizing network serving the region for over 30 years. Sacramento Area Congregation Together's congregation-base organizing model allows us to reach people of color, immigrants, youth, residents experiencing homelessness, the formerly incarcerated and low-income families. Their members include over 30 congregations located throughout the Sacramento region.[46]
Sierra Climate Adaptation and Mitigation Partnership and Sierra Business Council	Alpine, Amador, Butte, Calaveras, El Dorado, Lassen, Mariposa, Nevada, Placer, Plumas, Sierra, Sutter, Tuolumne, and Yuba counties	Remote/rural communities Small businesses Community-based organizations	Sierra Climate Adaptation and Mitigation Partnership (CAMP) is a cross-sector partnership that promotes and facilitates regional climate adaptation and mitigation strategies, serves as a climate action capacity-building hub for Sierra/Cascade communities, and fosters urban-rural connections to build statewide investment in the region's communities and natural resources. The Sierra Climate Adaptation and Mitigation Partnership priorities are to educate on and engage in climate solutions, provide climate policy analysis and education, convene region-wide collaborators to maximize funding opportunities, support & facilitate projects where appropriate, and build stakeholder capacity to address climate change.[47]
Slavic Community Center*	Sacramento County, Yolo County	Limited English proficiency communities Youth Community-based organizations People experiencing homelessness	The Slavic Community Center is the first non-profit Slavic Ethnic organization in Greater Sacramento providing refugee populations with critical services to assist them in becoming integrated members of American society. The Slavic Community Center provides an array of social, immigration, crime prevention, drug awareness and education services to the Russian, Ukrainian, Kazakh, Moldavian, Belarus (etc.) immigrants in Northern California.[48]

45 https://www.facebook.com/sacejc

46 https://www.sacact.org/

47 https://www.sierrabusiness.org/archives/sierra-camp/

48 https://www.slavicsacramento.org/#/

RTAG Organization	Geographies Represented	Top Populations Represented	Mission/Profile
United Way of Northern California*	Shasta County, Tehama County	Low-income communities People experiencing homelessness Remote/rural communities	The United Way of Northern California was started in 1953 by a group of volunteers who wanted to make a difference in their community. Their mission is to fight for the health, education, and financial stability of every person in the community and to be there for the community and its residents during times of crisis. Today, they are a leading nonprofit that works to help Northern California residents build better lives. They run and support programs focused on the building blocks of a good life – health, education, housing, and financial stability. The United Way team is here for individuals and the community during public emergencies, disasters, or other crises. They believe in running toward the difficult problems facing our communities, rather than running away from them. They serve a nine-county region that includes: Butte, Glenn, Lassen, Modoc, Plumas, Shasta, Siskiyou, Tehama, and Trinity.[49]
Yuba Fire Safe Council*	Yuba County	Remote/rural communities Low-income communities Elderly/Senior	The Yuba Watershed Protection and Fire Safe Council is a nonprofit 501(c)(3) community-based group consisting of concerned citizens, local, state and federal fire professionals, law enforcement, professional foresters, local timber companies and resource conservation groups along with county government. They are working together to prevent wildfire where possible, minimize the effects of wildfire, maintain Yuba County forest health, and protect property and lives.[50]

49 https://www.norcalunitedway.org/about-us

50 https://yubafiresafe.org/

Outreach Events

The six Outreach Partners conducted 13+ events totaling 47 hours. Outreach activities included:

- Community workshops
- Working groups and council meetings
- Community festivals and gatherings
- Community resource fairs
- Interviews with community leaders
- Seasonal events at public facilities (Halloween Night at the Public Library)
- Habitat for Humanity ReStore Checkout
- Resident meetings
- Newsletters
- Social media
- End of year parties
- Collaborating with other community organizations
- Worship events and workshops
- Library events

Participants Engaged

Outreach Partners engaged 1058 people over the course of the Outreach Period. A total of 709 surveys were completed. An additional estimated 349 community members engaged in events listed above. The data collected at outreach events were included in the outreach boards. Following completion of the Bay Area Region engagement, select demographic questions (e.g., race, income, household characteristics) were added to the Resilient Together survey for Regions 2–5 in order to better understand the participants that were engaged through this effort. The following section describes the geographic areas, incomes, race, and household characteristics of the participants engaged.

Zip codes and Counties Represented

A total of at least 134 unique zip codes are represented through the data collected by the surveys and the outreach boards, across 25 counties.[51] Additional zip codes and counties may be represented in the data but not all survey and outreach board respondents identified their zip code, and some respondents provided their county rather than zip code. Less than 1 percent of survey respondents did not provide their zip-code. Table C.2 shows the counties represented through the surveys and in the outreach boards.

51 The data includes several counties that are not in the North Valley, Sacramento & Sierra Region but were collected via the North Valley, Sacramento & Sierra Region Outreach Partners. Surveys were collected by outreach partners from Butte, El Dorado, Lassen, Nevada, Placer, Plumas, Sacramento, Shasta, Sierra, Sutter, Tehama, Yolo, and Yuba counties. The North Valley, Sacramento & Sierra Region counties not reflected in the data collected: Colusa and Glenn. The county data from outside the North Valley, Sacramento & Sierra Region makes up approximately 2.7 percent of the respondents.

TABLE C.2 Surveys per County (n=702 respondents)

County	% of Surveys
Amador*	0.2%
Butte	2%
Calaveras	0.5%
Colusa	0%
Contra Costa	0.2%
El Dorado	1%
Fresno*	0.1%
Glenn	0%
Humboldt*	0.1%
Lassen	0.2%
Merced*	0.1%
Nevada	1%
Placer	3%
Plumas	0.3%
Riverside*	0.2%
Sacramento	61%
San Joaquin*	1%
San Mateo*	0.1%
Shasta	13%
Sierra	0.3%
Siskiyou*	0.1%
Solano*	0.1%
Sutter	0.4%
Tehama	5%
Tuolumne*	0.2%
Yolo	2%
Yuba	9%

Counties that are represented in the data that are not part of Region 3 are identified with an asterisk.

Languages Represented

To reach a more diverse sampling of the North Valley, Sacramento & Sierra Region, materials were provided in Arabic, Chinese, English, Russian, and Spanish. RTAG members translated some of the surveys taken in other languages into English when inputting them into SurveyMonkey. For example, all of the Slavic Center's paper surveys were completed in Russian and input to SurveyMonkey online using the English form. Additionally, RTAG members indicated they engaged participants in English, Hmong, Russian, and Spanish at outreach events (33 percent of the community members engaged).[52,53]

52 Several RTAG members did attempt to record how many English, Spanish, and Hmong speakers were engaged at each event. Based on the input received, 332 English speaking people were engaged, and 449 Spanish speaking people were engaged. This leaves 326 people unaccounted for when reporting on language of people engaged at in-person events.

53 We do not have translated materials for Hmong, as several Southeast Asian organizers told us during the interview process that written translation would not be very helpful given low literacy rates. However, we recommended that if organizations have Hmong speaking staff, volunteers, or translators for events to use the Facilitation Guide in the Drive as talking points they could translate verbally.

Racial Backgrounds Represented

Although demographic questions were optional, 93 percent of the North Valley, Sacramento & Sierra Region survey respondents answered the question on racial identification. The other seven percent of respondents either chose "prefer not to respond" or left the question blank. Of those who answered the question, 40 percent identified as groups comprised of people of color, more than two races, or other races. And, 60 percent identified as White, given the smaller ethnic diversity of this region. Participants who indicated "Other" identify as Irish, Central American, "Global Majority," Native American and Mexican, Middle Eastern, Euro-American, and Chicano.

Table C.3 and Table C.4 identify the number of survey respondents by racial background and racial background of survey respondents by Outreach Partner, respectively.

TABLE C.3 Racial Background of Survey Respondents North Valley, Sacramento & Sierra Region (n=658 respondents)

Racial Background	% of Respondents
Asian	2%
Black or African American	10%
Latinx or Hispanic	15%
Native American, American Indian, or Alaska Native	3%
Native Hawaiian and Pacific Islander	1%
Other	2%
Two or more races	6%
White	60%

Values may not add up to 100% because some survey respondents marked the "prefer not to answer" option for this question. Those values are not shown in this table.

TABLE C.4 Racial Background of Survey Respondents by Outreach Partner (n=658 respondents)

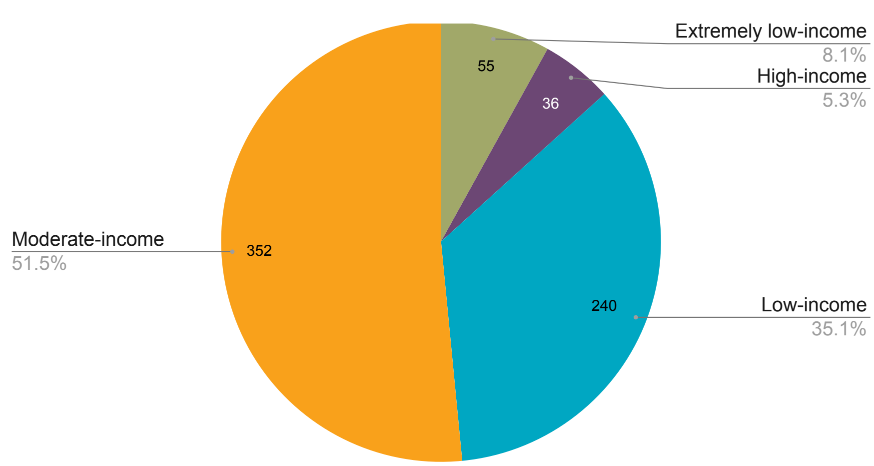
Racial Background	Camptonville Community Partnership	Habitat for Humanity Yuba/Sutter Inc.	Sacramento Area Congregation Together	Sierra Climate Adaptation and Mitigation Partnership	Slavic Community Center	United Way of Northern California	Yuba Fire Safe Council
Asian	NA	NA	2%	NA	1%	3%	3%
Black or African American	50%	17%	29%	NA	NA	4%	3%
Latinx or Hispanic	NA	17%	21%	NA	1%	14%	13%
Native American, American Indian, or Alaska Native	NA	NA	2%	NA	NA	6%	7%
Native Hawaiian and Pacific Islander	NA	33%	1%	6%	NA	2%	NA
Other	NA	NA	1%	6%	NA	2%	NA
Two or more races	NA	NA	12%	13%	NA	5%	10%
White	50%	33%	33%	75%	98%	63%	63%

Values may not add up to 100% because some survey respondents marked the "prefer not to answer" option for this question. Those values are not shown in this table.

Income Levels Represented

Survey respondents were asked: "How would you describe your income level?" Breakdowns of income level categories were not described as part of the survey. Of the 683 respondents, only five percent identify themselves as high-income, while 43 percent of respondents identify as extremely low or low-income, indicating that the outreach conducted in the North Valley, Sacramento & Sierra Region was extremely effective in reaching low-income and extremely low-income households, as shown in Figure C.1.

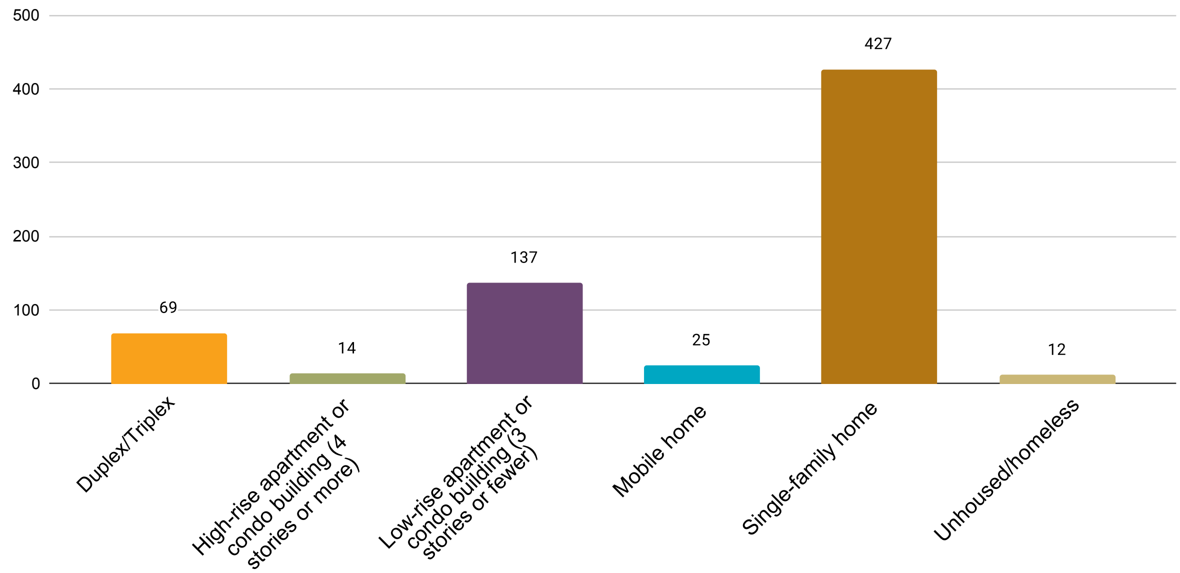
FIGURE C.1 Survey Respondents by Income Level (n=649 respondents)



Household Characteristics Represented

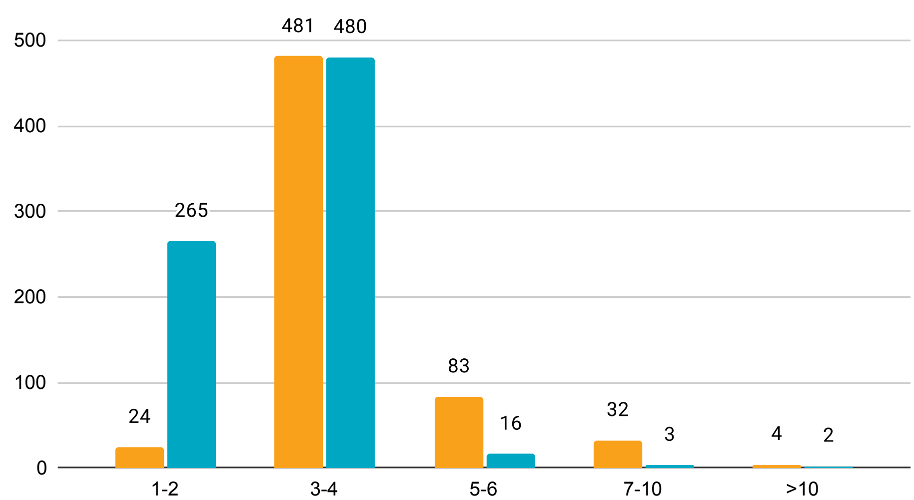
The optional demographic question section of the survey also asked about housing. One of the questions asked: "What type of home do you live in?" As shown in Figure C.2, most survey respondents live in single-family homes (62 percent), followed by respondents who live in low-rise apartments or condo buildings (20 percent). In a separate survey question, respondents were asked: "Do you own your home?" In response, nearly 55 percent of survey respondents answered "No," indicating they are renters (n=679 respondents).

FIGURE C.2 Survey Respondents by Housing Type (n=651 respondents)



Survey participants were also asked how many people are in their household, and if there are any other children under 18.[54] The average number of people in households for the North Valley, Sacramento & Sierra Region is three people, and 55 percent of survey respondents said that they do have other children under 18 in the household. These two questions are grouped together in Figure C.3 below.

FIGURE C.3 How Many People are in the Household and Whether There are Other Children Under 18 in the Household (n=684 respondents)

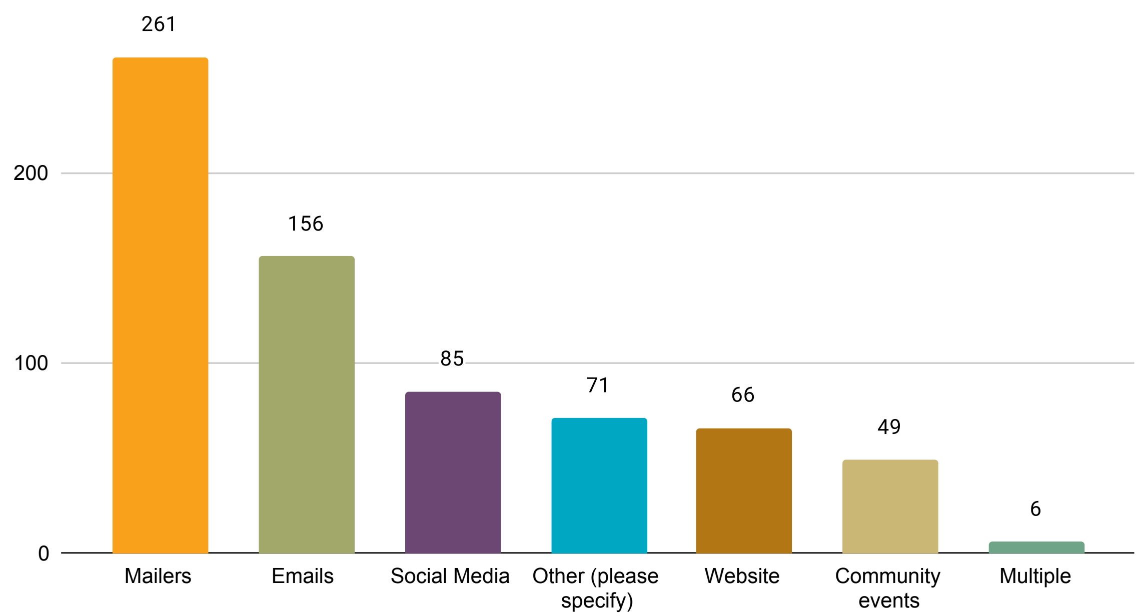


54 The second question is framed in a way to anticipate that children 18 and younger may be survey respondents.

PG&E Communications

Survey respondents were asked how and when they receive information and news from PG&E. Figure C.4 reflects how participants currently receive information and news from PG&E. The primary source of information is mailers (38 percent), followed by emails (23 percent). Participants also receive information and news from the news, nonprofits, and community-based organizations (CBOs), phone and text messages, word of mouth, and PG&E bills. A few people answered the question indicating that they do not currently receive any information.

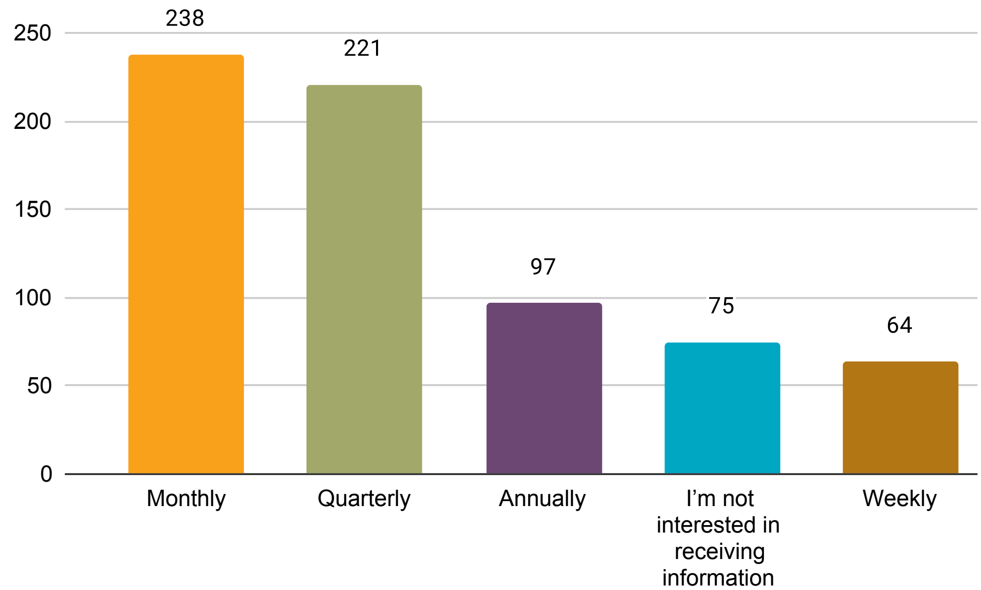
FIGURE C.4 Where Survey Respondents Receive PG&E Information and News
(n=1401 respondents)



In response to the question "How often survey respondents receive information from PG&E on existing initiatives and programs," of the 660 respondents, 75 percent responded, "Not Enough" and 25 percent responded, "Too Often." Of the 25 percent of survey respondents that responded, "Too Often," most were interested in receiving future information on a quarterly basis. Of the 74 percent of survey respondents that responded, "Not Enough," most indicated they were interested in receiving future information monthly.

The survey then asked respondents about how often they would like to receive information in the future from PG&E on existing initiatives and programs. Of the 695 survey respondents for this question, 66 percent responded "Monthly" or "Quarterly." The remaining 34 percent responded "Weekly" (9 percent), "Once a Year" (14 percent), or "I'm not interested in receiving information" (11 percent).

FIGURE C.5 How Often Survey Respondents Would Like to Receive Information from PG&E on Existing Initiative or Programs
(n=695 respondents)



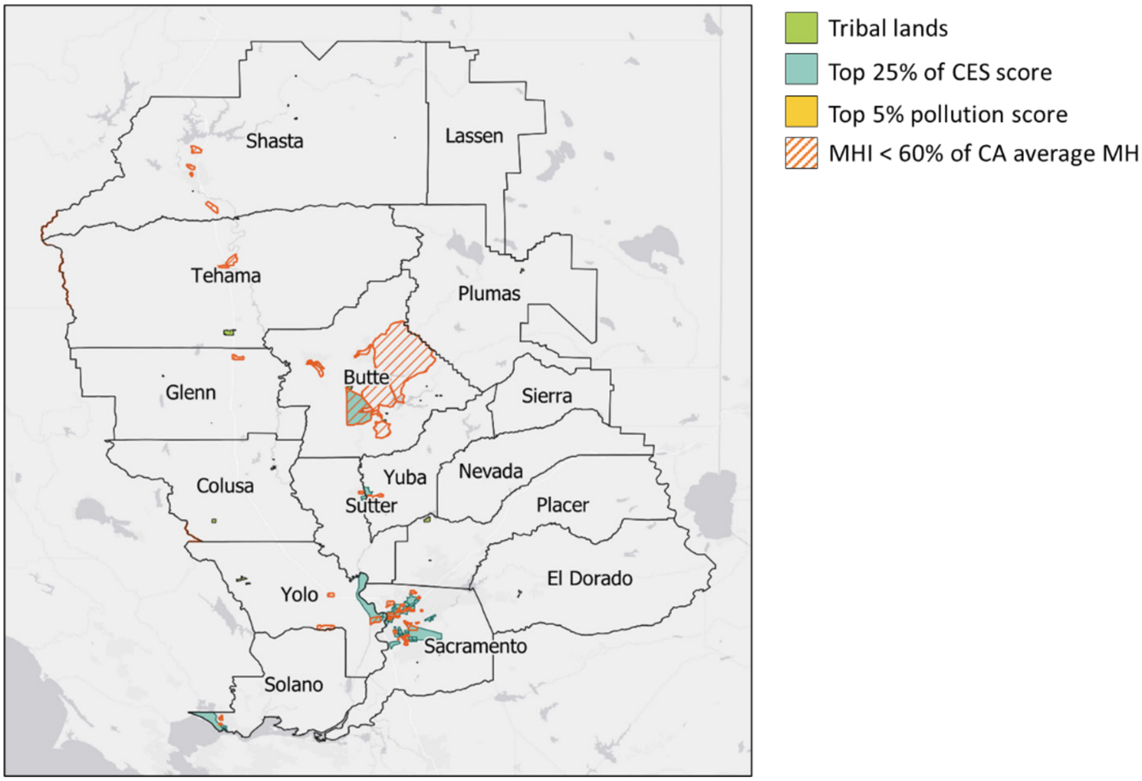
Research Interviews

The Project Team conducted a series of interviews with RTAG candidates in the North Valley, Sacramento & Sierra Region. Research interviews were conducted with RTAG candidates to help the Project Team better understand (1) community demographics and language needs, (2) climate hazards/impacts, adaptive capacity, and preferred resilience strategies, (3) their capacity and interest in participating on the RTAG, and (4) existing reports/data that could inform the Climate Vulnerability Assessment. The summary report of these interviews can be found in Appendix J. Findings from these interviews that address objective (2) are interwoven throughout the following sections of this regional summary report.

Climate Vulnerable Communities

Figure C.6 shows disadvantaged and vulnerable communities in the North Valley, Sacramento & Sierra Region based on the California Public Utility Commission's definition.

FIGURE C.6 North Valley, Sacramento & Sierra Region Disadvantaged and Vulnerable Communities



In the North Valley, Sacramento & Sierra Region, community leaders interviewed by Outreach Partners and RTAG members identified low-income people as the most vulnerable populations. Low-income people cannot afford to mitigate climate impacts by upgrading their home, installing air conditioning, or purchasing a generator when the power goes out.

Community leaders also identified the elderly and disabled, and others with compromised health conditions, as particularly vulnerable in the region. Many elderly residents live in remote areas that are not easily accessible. This makes it challenging for them to receive resources and information to help them prepare for climate hazards and to evacuate (many areas lack more than one access road). Community leaders noted that elderly might also lack community connections and may have difficulty understanding what is happening regarding climate hazards or what they can do to protect themselves. They are also more physiologically sensitive to changes in their environment (e.g., smoke, heat, etc.).

Community leaders also highlighted that people living in older housing or trailer parks, and renters are generally at a disadvantage when it comes to staying safe. Renters have little control over decisions related to home hardening or other risk-reducing home improvements. Property owners are the ones that can make decisions about what modifications to make on-site.

The North Valley, Sacramento & Sierra Region RTAG made the following qualifications/additions to the list of vulnerable community types outlined in Table C.4 of this report.

Qualifications

- People of different abilities/with disabilities should be referred to simply as "people with disabilities"
- Essential workers should include construction workers and agricultural worker

Additions

- Households without a car
- Youth experiencing homelessness
- Households without air conditioning
- Small businesses
- Housing burdened/housing insecure households
- Remote/rural communities
- People who rely on electrically powered medical equipment
- Agricultural workers

The following table (Table C.5) provides information on climate vulnerable communities, community demographics, and languages spoken based on data collected from research interviews with RTAG candidates. Because RTAG candidates represent specific areas of the North Valley, Sacramento & Sierra Region, not all counties are included.

TABLE C.5 Climate Vulnerable Communities in Select Counties of the North Valley, Sacramento & Sierra Region

County	Climate Vulnerable Communities	Community Demographics	Languages Spoken
Butte	Paradise	White	English
Nevada, Placer, El Dorado	Service and hospitality workers serving tourist towns (such as Lake Tahoe), including those that work at resorts, hotels, restaurants and small businesses	White, Latinx	English, Spanish
Placer	City of Roseville	Native American, Asian (Filipino and Korean), Latinx, White	Spanish, Tagalog,Korean
Plumas	Renters who cannot make decisions about on-site risk reduction efforts/ investments, Feather River Canyon, Quincy/American Valley (insufficient fuel breaks)	White	English
Sacramento	City of Sacramento's neighborhoods of Yolo/West, Little Saigon, and South Sacramento, the Cities of Elk Grove, Folsom, and Rancho Cordova and the unincorporated neighbor-hood of Antelope	Asian (Chinese, Filipino, Vietnam-ese, Thai, and Hmong), South Asian (Indians), Pacific Islander (Guamanian and Tahitian), African American, White, Slavic (Russian/ Ukrainian), Latinx	Arabic, Hmong, Tagalog, Vietnamese, Cantonese, Mandarin, Hindi, Punjabi, Russian,Spanish
Shasta	City of Redding, Mount Shasta, Lassen, Bali Hills, neighborhoods by the Sacramento River	White, Latinx, Asian (Chinese, Hmong, Laotian)	English, Spanish, Hmong, Lao, Mandarin, Cantonese
Sutter	Yuba City's neighborhoods by the Feather River and South Yuba City	South Asian (Indian), Latinx, White	Spanish, Punjabi
Yuba	Yuba Foothills, unincorporated neighborhoods of Camptonville, Linda, Oliverhurst, Plumas Lake	White, Native American (Nisenan people)	English, Spanish

Climate Hazards and Impacts

In the North Valley, Sacramento & Sierra Region, power outages, wildfires/wildfire smoke and extreme heat are all key hazards of concern. In rural areas, which are most impacted by wildfires, community members expressed concern that limited evacuation routes and lack of communication and transportation infrastructure may lead to being stranded in wildfire zones during active fires. Another key impact of concern with respect to wildfires is community displacement. Residents are being permanently priced out of their community due to the housing crisis, which drives housing prices up and development further out in high-risk areas, in conjunction with wildfires that destroy homes and communities.

In urban areas of the region like Sacramento, extreme heat is the main hazard of concern. Increasingly, residents require air conditioning, especially those living in poorly insulated homes. However, many residents on fixed incomes cannot afford the cost of running air conditioning. Some residents do not use air conditioning even when they have it due to the cost and have had to sell their long-time homes and downsize to apartments to afford higher electric bills. Seniors without family to help them do errands remain trapped and isolated at home, with few transportation resources. Their isolation is exacerbated by a lack of phones or internet access.

Throughout the Outreach Period, community members and RTAG members were asked about the impacts they have experienced or are most concerned about during power outages, extreme heat events, and when wildfire smoke is present. Additionally, community members were asked about the impacts of climate hazards on their mental health. A summary of the key findings on impacts for the North Valley, Sacramento & Sierra Region is presented in Table C.6.

TABLE C.6 Summary of Key Impacts in the North Valley, Sacramento & Sierra Region

Hazard	Health Impacts	Economic Impacts	Household/Community Impacts
Power Outage	Air purifiers and air conditioning failures, resulting in respiratory and heat stress Declining mental health outcomes including increased anxiety and stress Loss of prescription medication that requires refrigeration Medical devices disrupted, including medical equipment not deemed "necessary" (e.g. CPAP machine) Loss of access to drinking water for those on wells/tanks	Household economic impacts from food loss Lost revenue for small businesses Loss of work and childcare	Unreliable communication/ emergency notifications Increased reliance on food banks Loss of internet/communications Closure of community services (e.g., park closures)

Hazard	Health Impacts	Economic Impacts	Household/Community Impacts
Extreme Heat	Loss of life, with the unhoused being particularly at risk Heat stress from a lack of air conditioning or cooling centers Declining mental health outcomes including increased anxiety and stress Inability to exercise/recreate outdoors Poor indoor air quality	High bills from running air conditioning Loss of productivity at work Drought impacts the regional economy Harsh outdoor working conditions Loss of tourism Agricultural loss	Nowhere to go/cannot be outdoors Lack of transportation, particularly for seniors Negative impacts on natural environment (e.g. tree loss or inability to maintain a garden)
Wildfire and Smoke	Declining mental health outcomes including increased anxiety, stress and trauma Inability to spend time/recreate outdoors Harsh outdoor working conditions Respiratory impacts due to poor indoor and outdoor air quality Inability to access well-water or test air quality to ensure drinking safety	Loss of homes, businesses, and vehicles Loss of work, especially for low wage workers Lost revenue for small businesses Loss of tax revenue from displacement/ relocation Loss of revenue from tourism Loss of fire insurance or increasing premiums	Loss of homes Displacement of community members Loss of human and social capital Lack of public transit/people stranded without vehicles Inability to go on vacation or travel (may need to be home to evacuate)

Power Outages

While power outages are of concern across the North Valley, Sacramento & Sierra Region, communities are impacted differently between the urban areas in Sacramento and the rural areas in the North Valley and Sierra regions. Residents in urban areas that also experience heat island effect, especially in low-income areas, are very concerned about the health and economic implications of power outages, whereas rural communities in the foothills have more experience being "off-grid". Through survey and outreach board engagement, 987 responses were provided to the question "What impacts of power outages have you experienced or are most concerned about?" The response options differed between the survey and the outreach boards, and survey respondents and outreach board participants were allowed to provide more than one response. The survey asked about three specific impacts for Power Outages, plus an option for "Other." In contrast, the outreach board provided ten options for climate related impacts that participants have experienced. These ten impact options were provided for power outages, extreme heat, and wildfire smoke on the same board.

The top responses for the survey and outreach board are highlighted in Figure C.7 and Figure C.8, respectively. "No Air Conditioning" is the impact that survey respondents are most concerned about, accounting for 51 percent of survey responses, followed by "Loss of Childcare" (14 percent) and "Medical Equipment Issues" (13 percent).

Notably, 20 percent of survey responses indicated "Other" impacts. Similarly, "No Air Conditioning" is the impact that outreach board participants reported being most concerned about, accounting for 42 percent of responses, followed by "Unsafe Indoor Environments"/ "Poor Indoor Air Quality" (25 percent) and "Evacuations" (13 percent). The qualitative data from the RTAG, survey, and the outreach boards are reflected in the following sections on Health Impacts, Economic Impacts, and Household/Community Impacts due to Power Outages.

FIGURE C.7 Impacts Experienced or that Cause Concern during Power Outages (Survey) (n=705 responses)

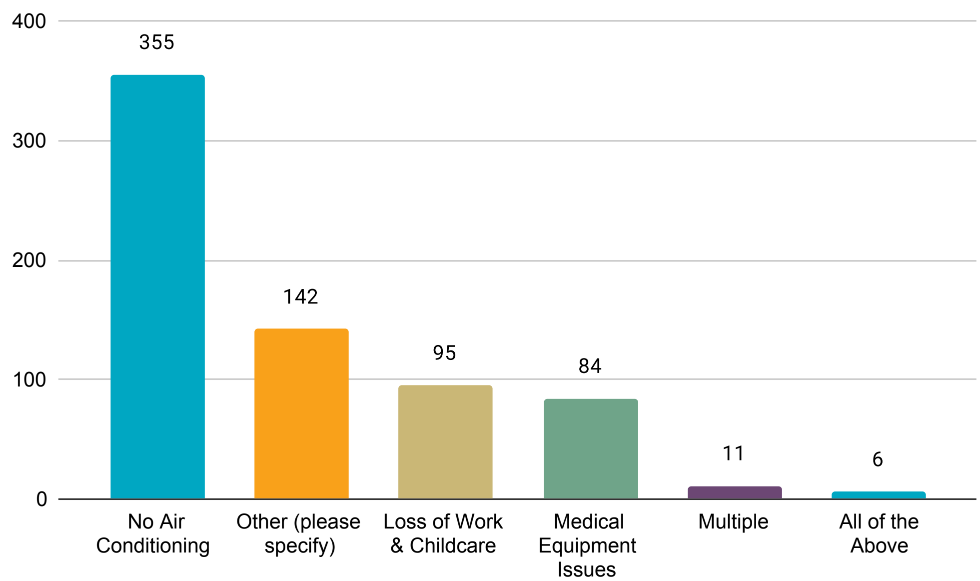
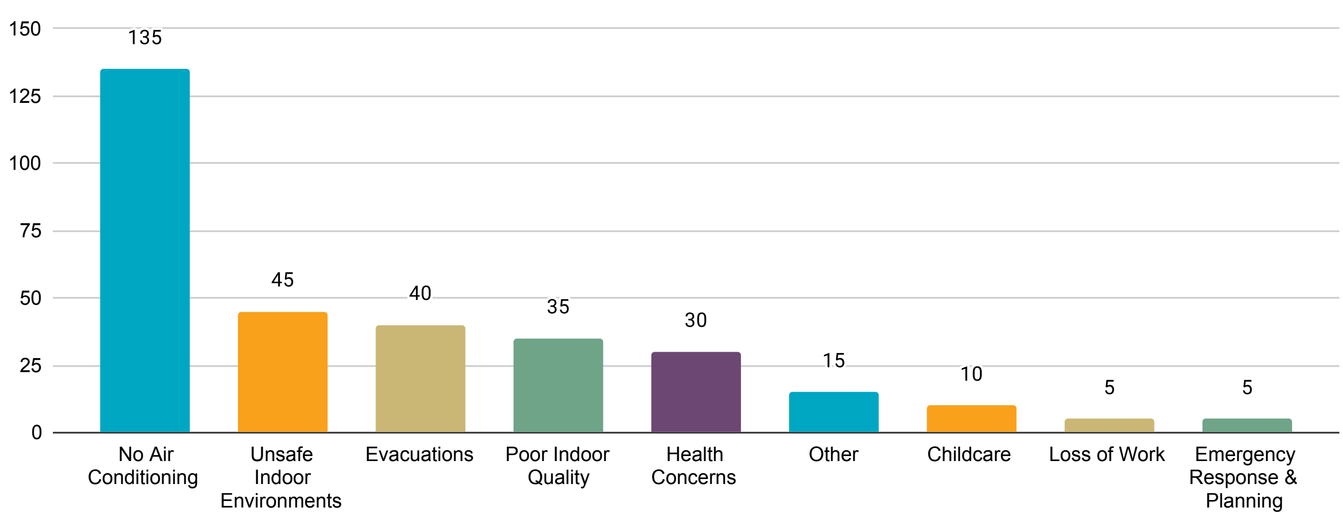


FIGURE C.8 Impacts Experienced or that Cause Concern during Power Outages (Outreach Board) (n=320 responses)



Health Impacts Due to Power Outages

There are several health impacts due to power outages that survey respondents and RTAG members highlighted. One key impact is losing access to refrigerated medicine (e.g., insulin) and medical equipment. The survey asked participants if anyone in the household relies on medical equipment. Survey data shows 16 percent of respondents (n=700) indicated that they rely on medical equipment. RTAG members noted that some medical equipment, like continuous positive airway pressure machines and air purifiers, are not considered "necessary" even though they impact people's health. Approximately 13 percent of survey responses indicated concern about, or experience with, medical equipment disruptions or health concerns more broadly.[55]

Inability to regulate body temperature is another critical health impact of power outages identified by survey respondents. Survey respondents expressed concern for young children and elderly folks overheating. Approximately 50 percent of the responses (n=1025) indicated an inability to use air conditioning due to power outages. Compared to other regions, more survey respondents were concerned that they were unable to use their heater during power outages. As a result, survey respondents were also concerned about indoor air pollution due to increased use of gas generators to regulate indoor temperatures. RTAG members also noted that there are instances of firewood shortages when the power goes out, as more people rely on fires to heat their home. Reliance on fires to heat homes can also have negative impacts on indoor air quality.

Lastly, RTAG members noted that power outages affect the reliability of getting evacuation notifications, which can mean the difference between life and death in some instances, particularly in fire-prone areas.

Economic Impacts Due to Power Outages

In terms of economic impacts due to power outages, losses that result from food spoilage as a result of losing power to refrigerators is the top concern for the North Valley, Sacramento, and Sierra Region. RTAG members highlighted that many households cannot afford to resupply lost food and rely on food banks (which also lose food during outages). Community members in the foothills in the Sierra Nevada area who are accustomed to living "off-grid" or anticipate power outages also noted the economic costs associated with preparation for power outages, such as purchasing a generator or batteries. RTAG members also noted loss of income due to internet disruptions that impact remote work, and loss of revenue for businesses. Approximately 14 percent of responses are related to loss of work and childcare.[56] When some businesses, such as food processing plants, lose power, the effects ripple across industries and throughout the community.

Household/Community Impacts Due to Power Outages

During power outages, the region experiences additional community-wide impacts in addition to health and economic impacts (which are also affected on a community-wide level). RTAG members, survey respondents, and outreach board participants identified loss of internet and inability to pump water (for those on well systems) as the most critical household/community impacts. Loss of internet results in disruptions in communication and emergency notifications. Survey respondents expressed concern for loss of hot water, inoperative kitchen/household appliances, and damage to pipes when water freezes. Respondents also noted a loss of community resources, including park districts not operating.

"People are becoming more experienced with being uncomfortable."

55 The outreach boards asked about health concerns more broadly, while the survey asked about medical equipment issues.

56 This includes survey responses "Loss of Work and Childcare" and outreach board responses "Loss of Work" and "Childcare."

Power Outage Impacts by County

Survey and outreach board data of key power outage impacts by county[57] is shown in Table C.7 below. "No Air Conditioning" is the top impact from power outages across counties. "No Air Conditioning" and "Health Concerns"/ "Medical Equipment Issues" are tied as the top impacts for Lassen County and El Dorado County. The highest felt impact is unanimously "Loss of Work and Childcare" for Plumas County.

TABLE C.7 Power Outage Impacts by County
(Survey Responses & Outreach Board Participants) (n=994 responses)

County	% of Respondents	Responses		
		No Air Conditioning	Health Concerns/ Medical Equipment Issues	Loss of Work/ Childcare[58]
Butte	2%	38%	19%	14%
Colusa	N/A	N/A	N/A	N/A
El Dorado	1%	20%	20%	0%
Glenn	N/A	N/A	N/A	N/A
Lassen	0.2%	50%	50%	0%
Nevada	1%	8%	0%	25%
Placer	3%	74%	12%	6%
Plumas	0.3%	0%	0%	75%
Sacramento	61%	53%	9%	11%
Shasta	13%	50%	15%	18%
Sierra	0.3%	50%	0%	0%
Sutter	0.4%	33%	33%	33%
Tehama	5%	44%	15%	13%
Yolo	2%	71%	10%	5%
Yuba	1%	30%	17%	2%

The values in this table may not total 100% across the response categories for counties because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by county.

Power Outage Impacts by Racial Background

Survey data of key power outage impacts by racial background is represented as percentages in Table C.8 below. "No Air Conditioning" is the most frequently selected impact from power outages across most categories of racial background. Notably, for Native Hawaiian and Pacific Islanders, "Loss of Work and Childcare" is only eight percent below the impact of "No Air Conditioning" and represents a common impact/concern. "Health Concerns"/ "Medical Equipment Issues" is the top impact for Native American, American Indian, or Alaska Native peoples.

57 The counties presented in Table C.7 are Region 3 North Valley, Sacramento, and Sierra counties. The other 2.7 percent of respondents are from counties outside of this region.

58 This includes "Loss of Work & Childcare" responses from the survey, which combined these responses in addition to "Loss of Work" and "Childcare" responses from the outreach boards.

TABLE C.8 Power Outage Impacts by Racial Background
(Survey Responses) (n=651 responses)

Racial Background	% of Respondents	Responses: No Air Conditioning	Health Concerns/ Medical Equipment Issues	Loss of Work/ Childcare
Asian	2%	62%	15%	23%
Black or African American	10%	61%	7%	15%
Latinx or Hispanic	15%	34%	15%	24%
Native American, American Indian, or Alaska Native	3%	18%	35%	29%
Native Hawaiian and Pacific Islander	1%	63%	13%	13%
Other	2%	20%	0%	20%
Two or more races	6%	49%	15%	5%
White	60%	58%	12%	10%

The values in this table may not total 100% across the response categories for racial backgrounds because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by race.

Power Outages Impacts by Income Level

Survey data of key power outage impacts by income level is represented by percentages in Table C.9 below. "No Air Conditioning" is the top impact from power outages across survey respondents of all incomes. For each income level, the percentage difference between "Loss of Work and Childcare" and "Health Concerns"/ "Medical Equipment Issues" is small, suggesting survey respondents have about the same level of concern for these impacts.

TABLE C.9 Power Outage Impacts by Income Level
(Survey Responses) (n=642 responses)

Income Level	% of Respondents	Responses: No Air Conditioning	Health Concerns/ Medical Equipment Issues	Loss of Work/ Childcare
Extremely low-income	8%	42%	20%	18%
Low-income	35%	58%	11%	17%
Moderate-income	52%	53%	13%	11%
High-income	5%	38%	8%	8%

The values in this table may not total 100% across the response categories for income levels because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by income level.

Extreme Heat

Through survey and outreach board engagement, 1077 responses were provided to the question "What impacts of extreme heat have you experienced or are most concerned about?" The survey asked about three specific impacts for Extreme Heat, plus an option for "Other." In contrast, the outreach board provided ten options for climate related impacts that participants have experienced, which were provided for power outages, extreme heat, and wildfire smoke on the same board. The top responses for the survey and outreach board are highlighted in Figure C.9 and Figure C.10, respectively. "Health Concerns" is the top impact for survey respondents, accounting for 38 percent of survey responses, equally followed by "Harsh Outdoor Working Conditions and "Poor Indoor Air Quality" (27 percent each). "No Air Conditioning" is the top impact that outreach board participants are most concerned about, accounting for 31 percent of responses, followed by "Health Concerns" (19 percent). "Poor Indoor Air Quality" and "Unsafe Indoor Environments" (which is related to not having air conditioning) together account for 30 percent of all responses. The qualitative data from the RTAG, survey, and the outreach boards are reflected in the following sections on Health Impacts, Economic Impacts, and Household/Community Impacts due to Extreme Heat.

FIGURE C.9 Impacts Experienced or that Cause Concern during Extreme Heat (Survey Respondents) (n=773 responses)

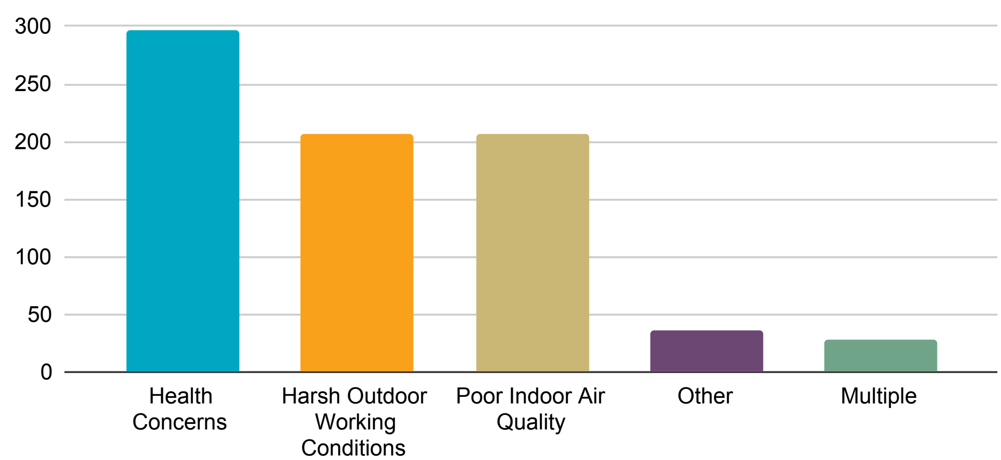
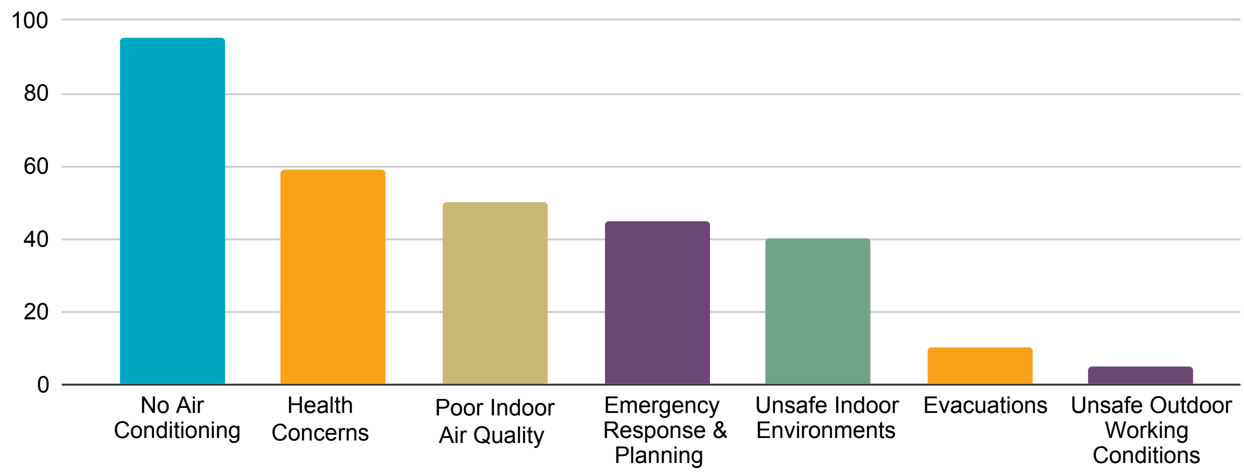


FIGURE C.10 Impacts Experienced or that Cause Concern during Extreme heat (Outreach Board Participants) (n=304 responses)



Health Impacts Due to Extreme Heat

With respect to extreme heat, survey respondents identified "Health Concerns" as the top impact. Survey respondents reported health impacts including loss of life or heat related illness, including heat stroke, inability to exercise, difficulty breathing, and anxiety. Survey respondents expressed concerns for the health of outdoor workers, community members who do not have air conditioning, and their unhoused neighbors. Respondents did not believe there were sufficient resources for unhoused individuals to escape the heat.

"My son overheats. He has autism and is very sensitive to his environment."

Economic Impacts Due to Extreme Heat

Survey respondents identified high electricity bills, particularly from running air conditioners, as the primary economic impact of extreme heat affecting residents. One in five of survey/outreach board responses identified "Harsh Outdoor Working Conditions" as an impact people have experienced or are most concerned about. Survey respondents were also concerned about the loss of tourism to communities, as well as the impact on the agricultural industry regionally. The health of livestock, farmworkers, and crop yields are all negatively impacted by increasing frequency of extreme heat (and drought).

Household/Community Impacts Due to Extreme Heat

Many survey respondents were concerned about how heat impacts children's ability to go outside and participate in outdoor sports. Others expressed concern for the natural environment, including loss of trees and not being able to maintain a garden.

Extreme Heat Impacts by County

Survey and outreach board data of key extreme heat impacts by county[59] is represented by percentages in Table C.10 below. "Health Concerns" is the top impact of extreme heat across respondents from most counties, while "Harsh Outdoor Working Conditions" is the top impact for two counties. "Poor Indoor Air Quality" is the impact of greatest concern for Placer County. Plumas County equally reported "Health Concerns" and "Harsh Outdoor Working Conditions" as the top and only impacts.

59 The counties presented in Table C.10 are North Valley, Sacramento & Sierra Region counties. The other 2.7 percent of respondents are from counties outside of this region.

TABLE C.10 Extreme Heat Impacts by County
(Survey Respondents and Outreach Board Participants) (n=1041 responses)

County	% of Respondents	Responses		
		Health Concerns/ Medical Equipment Issues	Harsh Outdoor Working Conditions	Poor Indoor Air Quality
Butte	2%	35%	30%	20%
Colusa	N/A	N/A	N/A	N/A
El Dorado	1%	40%	40%	20%
Glenn	N/A	N/A	N/A	N/A
Lassen	0.2%	50%	25%	25%
Nevada	1%	36%	29%	14%
Placer	3%	24%	29%	44%
Plumas	0.3%	50%	50%	0%
Sacramento	61%	29%	17%	25%
Shasta	13%	42%	25%	27%
Sierra	0.3%	0%	100%	0%
Sutter	0.4%	60%	20%	20%
Tehama	5%	38%	35%	25%
Yolo	2%	13%	5%	10%
Yuba	9%	72%	18%	5%

The values in this table may not total 100% across the response categories for counties because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by county.

Extreme Heat by Racial Background

Survey data of key extreme heat impacts by racial background is represented by percentages in Table C.11 below. "Health Concerns" is the top impact of extreme heat across all categories of racial background, except for Asian respondents, who more commonly selected "Harsh Outdoor Working Conditions" as the impact they had experienced or were most concerned about.

TABLE C.11 Extreme Heat Impacts by Racial Background (n=715 responses)

Racial Background	% of Respondents	Responses: Health Concerns	Responses: Harsh Outdoor Working Conditions	Responses: Poor Indoor Air Quality
Asian	2%	31%	38%	31%
Black or African American	10%	39%	21%	32%
Latinx or Hispanic	15%	34%	31%	28%
Native American, American Indian, or Alaska Native	3%	55%	20%	20%
Native Hawaiian and Pacific Islander	1%	38%	25%	13%
Other	2%	40%	10%	10%
Two or more races	6%	32%	29%	17%
White	60%	40%	27%	27%

The values in this table may not total 100% across the response categories for racial backgrounds because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by race.

Extreme Heat Impacts by Income Level

Survey data of key extreme heat impacts by income level is represented by percentages in Table C.12 below. As is the case across racial backgrounds, "Health Concerns" is the top impact from extreme heat across all income levels. "Harsh Outdoor Working Conditions" is the second most frequently selected impact for low and moderate-income respondents, while "Poor Indoor Air Quality" is the second most frequently selected impact for extremely low-income respondents. This does not indicate that low and extremely low-income communities do not feel the impacts of "Harsh Outdoor Working Conditions" as strongly, but rather "Poor Indoor Air Quality" impacts are more prominent.

TABLE C.12 Extreme Heat Impacts by Income Level (Survey Respondents) (n=704 responses)

Income Level	% of Respondents	Responses: Health Concerns	Responses: Harsh Outdoor Working Conditions	Responses: Poor Indoor Air Quality
Extremely low-income	8%	43%	33%	11%
Low-income	35%	38%	29%	28%
Moderate-income	52%	39%	29%	29%
High-income	5%	31%	26%	29%

The values in this table may not total 100% across the response categories for income levels because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by income level.

Wildfires and Smoke

Through survey and outreach board engagement, 1143 responses were provided to the question "What impacts of wildfire smoke have you experienced or are most concerned about?" The response options differed between the survey and the outreach boards, and survey respondents and outreach board participants were allowed to provide more than one response. The survey asked about three specific impacts for wildfire smoke, plus an option for "Other." In contrast, the outreach board provided ten options for climate related impacts that participants have experienced. These ten impact options were provided for power outages, extreme heat, and wildfire smoke on the same board.

The top responses for the survey and outreach board are highlighted in Figure C.11 and Figure C.12, respectively. "Health Concerns" is the impact that survey respondents are most concerned about, accounting for 43 percent of survey responses, followed by "Poor Indoor Air Quality" (33 percent) and "Harsh Outdoor Working Conditions" (16 percent). "Unsafe Indoor Environments" and "Unsafe Outdoor Working Conditions" are the impacts that outreach board participants are most concerned about, each accounting for 35 percent of responses, followed by "Emergency Response and Planning" (9 percent) and "Poor Indoor Air Quality" (7 percent). The qualitative data from the RTAG, survey, and the outreach boards are reflected in the following sections on Health Impacts, Economic Impacts, and Household/Community Impacts due to Wildfire and Smoke.

FIGURE C.11 Impacts Experienced or that Cause Concern during Wildfire Smoke (Survey Respondents) (n=801)

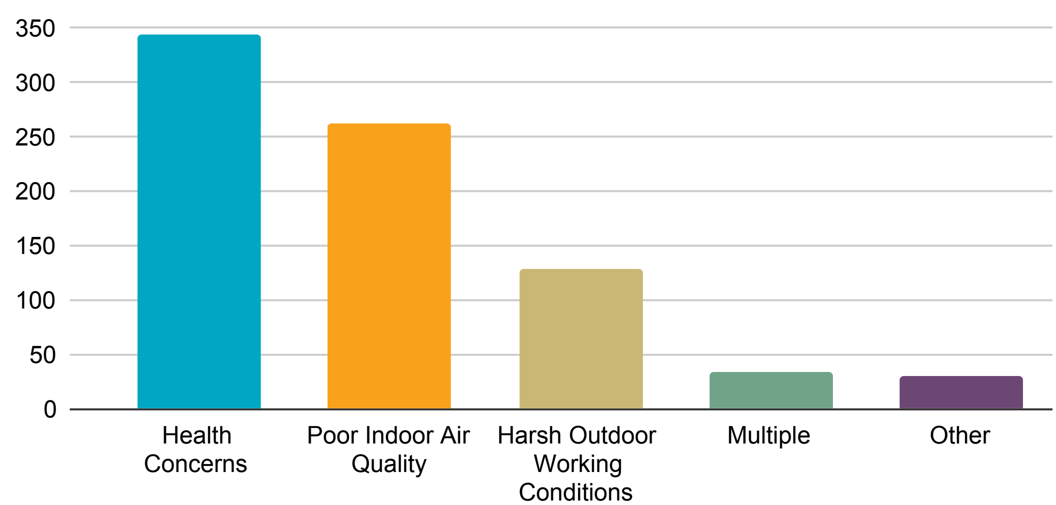
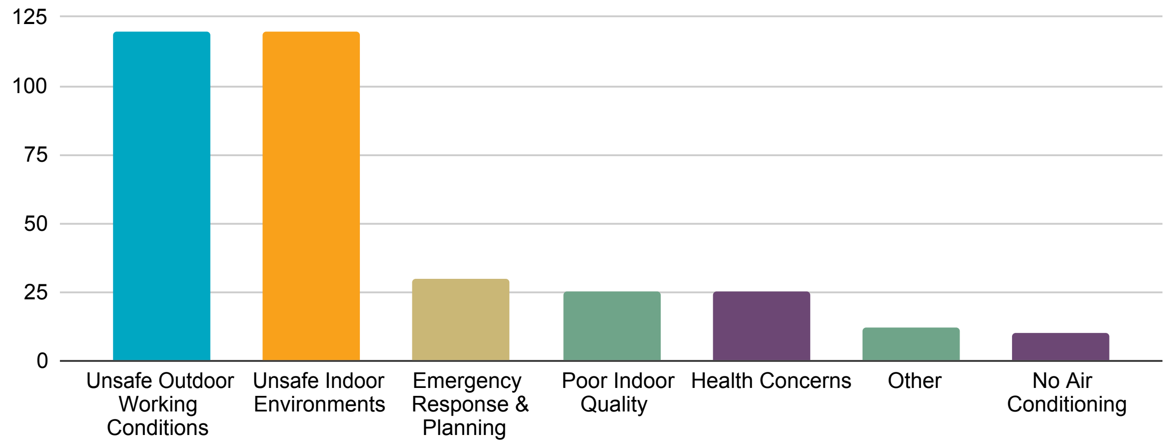


FIGURE C.12 Impacts Experience or that Cause Concern during Wildfire Smoke (Outreach Board Participants) (n=342 responses)



Health Impacts Due to Wildfires and Smoke

Approximately 38 percent of survey and outreach board responses received were related to health concerns, which is also the primary impact of extreme heat.[60] Survey respondents were primarily concerned with wildfire smoke worsening their ability to breathe, especially for those who already have asthma. They noted that wildfire smoke made it difficult to recreate outdoors and were experiencing poor air quality while hiking or walking, or had to stay indoors, reducing their ability to exercise and maintain a healthy lifestyle. Survey respondents also expressed concern about indoor air quality, noting poor ventilation. In rural areas where many residents drink from wells, people may not be able to access the well after a fire and may need to test their water quality to ensure it is safe to drink.

> **"I am disabled and am afraid I would not be able to evacuate in time."**

Economic Impacts Due to Wildfires and Smoke

Wildfires in the summer, coupled with droughts that impact winter snowpack, have a significant economic impact in the North Valley and Sierra where local economies rely heavily on tourism. RTAG members noted that grant making foundations have had to increase grantmaking to hunger relief organizations to help stabilize community economic impacts. Survey respondents also noted that wildfire smoke damaged their crops, resulting in loss of income. Interview participants also noted that work is disrupted, and people lose income during evacuations, which sometimes last several days if not weeks. Some of the most significant economic impacts at the household level, however, are from wildfires directly destroying buildings (including homes and businesses) and cars. For those who can keep their homes or rebuild, RTAG members noted that many insurance companies are no longer covering their properties or significantly raising their premiums, leaving them even more vulnerable should future fires affect their homes. Residents

> **"There's a financial impact that people don't budget for to prepare for wildfires – it's part of living in the foothills."**

> **"Regardless of the wildfire's scale, if it destroys your home, it upends your livelihood."**

60 Responses related to unsafe outdoor working conditions and unsafe indoor environments are also related to health concerns.

shared concerns about higher premiums as their homes have higher equity values now relative to the lower insurance rates available when they first bought their properties. Additional concerns include that many of the insurance options now available would not cover the full cost to rebuild their homes.

Household/Community Impacts Due to Wildfires and Smoke

RTAG members shared that the most critical community impact of wildfires is displacement. In the short-term, people are displaced during evacuations. Community-members struggle to access transportation and lodging to accommodate evacuations due to wildfires or escape wildfire smoke. Transportation is of particular concern, as many rural areas that have the greatest wildfire risk also lack public transit, and oftentimes, only have one access road available for evacuations.

"Wildfires impact the community's connection to the place."

Over the long-term, RTAG members expressed concern that residents are being permanently priced out of the area due to the housing crisis in conjunction with climate hazards. Of those that lost their homes in a fire, RTAG members expressed particular concern for renters without insurance who have no safety net and are at risk of becoming homeless. While many folks would like to stay in their community, many who lose their home cannot afford to rebuild or buy a home. RTAG members also shared anecdotes of seniors selling their properties after fires and moving out of state, as they are unable to do the physical labor of protecting their homes from future fires. Interview participants also noted the environmental impact of wildfires on watersheds & ecological processes. They expressed concern that there has not been much post fire restoration work (in the Yuba Foothills) because it is not clear who is responsible or has the capacity to do the work, especially for small acreage burns. Small landowners often do not have resources to know where to start, or how to finance landscape restoration, and lack locally specific resources to help get the work done.

Wildfire Smoke Impacts by County

Survey and outreach board data of key wildfire smoke impacts by county[61] is represented by percentages in Table C.13 below. "Health Concerns"/ "Medical Equipment Issues" is the top impact from wildfire smoke for most of the counties, while "Poor indoor Air Quality" is the top impact by survey respondents and outreach board participants in El Dorado, Placer, and Sierra County. Sutter County equally reported all three impacts as the top concern to wildfire smoke.

61 The counties presented in Table C.13 are North Valley, Sacramento, and Sierra Region counties. The other 2.7 percent of respondents are from counties outside of this region.

TABLE C.13 Wildfire Smoke Impacts by County
(Survey Respondents & Outreach Board Participants) (n=1061 responses)

County	% of Respondents	Responses		
		Health Concerns and Medical Equipment Issues	Poor Indoor Air Quality	Harsh Outdoor Working Conditions/Unsafe Outdoor Working Conditions
Butte	2%	52%	24%	12%
Colusa	N/A	N/A	N/A	N/A
El Dorado	1%	40%	60%	0%
Glenn	N/A	N/A	N/A	N/A
Lassen	0.2%	50%	25%	25%
Nevada	1%	43%	36%	14%
Placer	3%	22%	44%	28%
Plumas	0.3%	75%	25%	0%
Sacramento	61%	33%	25%	26%
Shasta	13%	46%	34%	16%
Sierra	0.3%	50%	50%	0%
Sutter	0.4%	33%	33%	0%
Tehama	5%	43%	41%	16%
Yolo	2%	50%	27%	15%
Yuba	9%	11%	6%	20%

The values in this table may not total 100% across the response categories for counties because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by county.

Wildfire Smoke Impacts by Racial Background

Survey data of key wildfire smoke impacts by racial background is represented by percentages in Table C.14 below. "Health Concerns" is the top impact of wildfire smoke across respondents of all racial backgrounds. Asian respondents also identified "Harsh Outdoor Working Conditions" as the top impact. "Poor Indoor Air Quality" is the second most selected impact across races.

TABLE C.14 Wildfire Smoke Impacts by Racial Background (Survey Respondents) (n=741 responses)

Racial Background	% of Respondents	Responses		
		Health Concerns	Poor Indoor Air Quality	Harsh Outdoor Working Conditions
Asian	2%	47%	13%	33%
Black or African American	10%	45%	32%	4%
Latinx or Hispanic	15%	43%	33%	17%
Native American, American Indian, or Alaska Native	3%	47%	24%	12%
Native Hawaiian and Pacific Islander	1%	50%	25%	25%
Other (please specify)	2%	42%	33%	8%
Two or more races	6%	40%	30%	19%
White	60%	43%	34%	17%

The values in this table may not total 100% across the response categories for racial backgrounds because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by race.

Wildfire Smoke Impacts by Income Level

Survey data of key wildfire smoke impacts by income level is represented by percentages in Table C.15 below. The wildfire smoke impacts of highest concern are consistent regardless of differences in income. "Health Concerns" is the top impact from wildfire smoke, and "Poor Indoor Air Quality" is the second most selected impact across all income levels.

TABLE C.15 Wildfire Smoke Impacts by Income Level (Survey Respondents) (n=729 responses)

Income Level	% of Respondents	Responses		
		Health Concerns	Poor Indoor Air Quality	Harsh Outdoor Working Conditions
Extremely low-income	8%	41%	32%	17%
High-income	35%	45%	27%	11%
Low-income	52%	45%	34%	15%
Moderate-income	5%	41%	32%	17%

The values in this table may not total 100% across the response categories for income levels because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by income level.

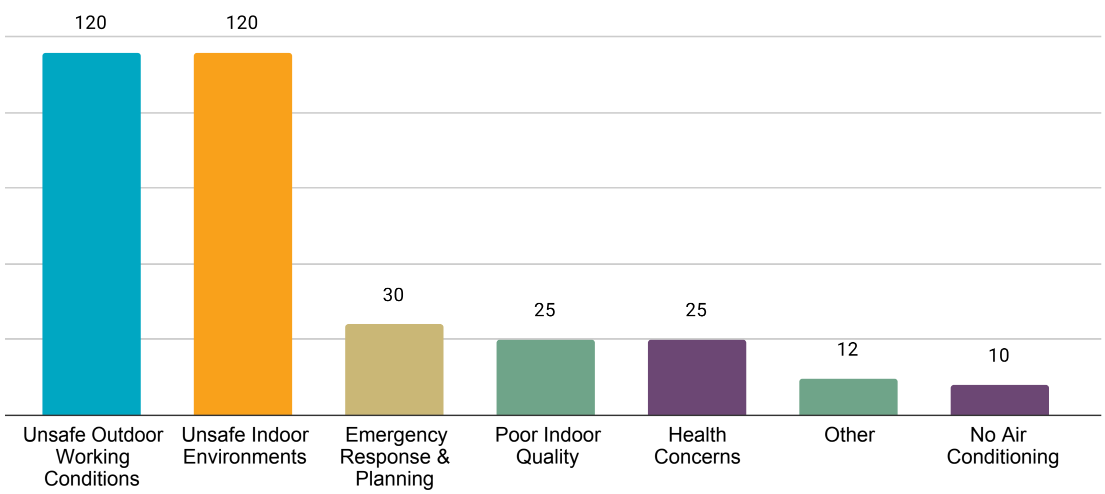
Mental Health

The survey asked about mental health impacts while the outreach boards did not include questions on mental health impacts. Participants engaged through the outreach boards did however touch on mental health impacts that are a result of other hazards and are included in the relevant sections of this report. Approximately 41 percent of respondents (n=744 respondents) said "Yes," to the question asking if their mental health has been impacted by extreme climate events, which include heat, increased rain and flooding, wildfires, drought, and landslides (47 percent of respondents said "No" and 12 percent were "Unsure").

Power outages result in community members feeling anxious, because they cannot communicate directly with friends and family, and because they are unable to get news or access the internet to learn what is going on; and therefore, are unable to coordinate an emergency response or plan. In rural areas, which are also most impacted by wildfires, RTAG members stated that community members grapple with severe mental health impacts and are constantly in fear of the next wildfire event.

Participants shared that those who have been displaced from wildfires are still dealing with mental distress and lack support to deal with trauma associated with evacuations or losing their home. Some people evacuate multiple times a summer. One interview participant noted that some folks stay home all summer, and do not feel like they can take a vacation, out of fear that if a wildfire broke out, they would not find out about the fire in a timely manner and may not be able to evacuate their home.

FIGURE C.13 Whether Mental Health has Been Impacted by Extreme Climate Events (Survey Respondents) (n=744 respondents)



Mental Health Impacts by County

The Project Team also analyzed the information collected through the surveys by county. Butte County, which suffered the most destruction from the 2018 Camp Fire,[62] by far had the highest number of survey respondents say "Yes" to the question asking if their mental health has been impacted by extreme climate events, followed by Nevada and Sutter counties.

62 According to CalFire, the 2018 Camp Fire destroyed 18,804 structures and resulted in 85 fatalities.

TABLE C.16 Mental Health Impacts due to Extreme Climate Events, by County (n=710 respondents)

County	% of Respondents	Responses: No	Unsure	Yes
Butte	2%	10%	5%	86%
Colusa	N/A	N/A	N/A	N/A
El Dorado	1%	20%	20%	60%
Glenn	N/A	N/A	N/A	N/A
Lassen	0.2%	50%	0%	50%
Nevada	1%	25%	8%	67%
Placer	3%	72%	3%	25%
Plumas	0.3%	0%	25%	75%
Sacramento	61%	53%	12%	35%
Shasta	13%	42%	11%	46%
Sierra	0.3%	50%	0%	50%
Sutter	0.4%	0%	33%	67%
Tehama	5%	40%	10%	50%
Yolo	2%	50%	14%	36%
Yuba	9%	25%	33%	42%

The values in this table may not total 100% across the response categories for counties because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by county.

Mental Health Impacts by Racial Background

Native American, American Indian, or Alaskan Native and Latinx or Hispanic respondents responded "Yes" more often to the question asking if their mental health has been impacted by extreme climate events compared to Black or African American, White, and Native Hawaiian or Pacific Islander respondents.

TABLE C.17 Mental Health Impacts due to Extreme Climate Events by Racial Background (Survey Respondents) (n=689 respondents)

Racial Background	% of Respondents	Responses: No	Unsure	Yes
Asian	2%	27%	33%	40%
Black or African American	10%	49%	10%	41%
Latinx or Hispanic	15%	39%	13%	48%
Native American, American Indian, or Alaska Native	3%	28%	17%	56%
Native Hawaiian and Pacific Islander	1%	50%	13%	38%
Other (please specify)	2%	67%	0%	33%
Two or more races	6%	26%	21%	54%
White	60%	55%	10%	35%

The values in this table may not total 100% across the response categories for racial backgrounds because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by race.

Mental Health Impacts by Income Level

Extremely low-income and low-income respondents reported more mental health impacts (88 percent) compared to those who identified as moderate-income (37 percent said yes) or high-income (47 percent).

TABLE C.18 Mental Health Impacts due to Extreme Climate Events by Income Level (Survey Respondents) (n=681 responses)

		Responses		
Income Level	% of Respondents	No	Unsure	Yes
Extremely low-income	8%	29%	16%	55%
Low-income	35%	51%	13%	37%
Moderate-income	52%	53%	9%	38%
High-income	5%	38%	16%	55%

The values in this table may not total 100% across the response categories for income levels because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by income level.

Adaptive Capacity

Based on RTAG input collected during research interviews, the North Valley Sacramento & Sierra Region has lower adaptive capacity due to physical and technological access barriers that are associated with the rural geography of the region. Research interview participants believe service providers have trouble physically reaching communities, and the lack of broadband infrastructure and cellular service makes it difficult to disseminate information. On the other hand, participants felt that many community members were more resilient and equipped to deal with hazard events because they are accustomed to the risks associated with living in more rural, isolated areas.

Regional Adaptive Capacity by County

The Project Team also evaluated the North Valley, Sacramento & Sierra Region adaptive capacity by utilizing the Building Resilience Indicators for Communities (BRIC) Index county scores across the 6 categories and the BRIC Composite score for each county in the region (Table C.19). A description of the resilience categories is provided in the Adaptive Capacity section of the main report.

"Some progress has been made, but we have a lot further to go in building adaptive capacity and getting people to understand the need for it."

As shown in Table C.19, **Placer and Tehama counties have the highest overall adaptive capacity**, while Colusa, Sutter and Shasta counties have the lowest. Across counties, **the region performs the lowest on the "Infrastructural" resilience category**, which is consistent with RTAG input that the region has suffered from lack of broadband and transportation infrastructure. The category with the second lowest score is "Community Capital," suggesting that communities in the region lack strong social networks and connectivity among individuals and groups. This data is consistent with RTAG member input that **the region is geographically remote and rural communities lack connection to services and resources**; however, RTAG members also noted that these same **communities are more accustomed to living without services and being self-sufficient**, which may increase their ability to prepare for and recover from climate impacts.

TABLE C.19 BRIC Scores by County (High to Low)

County	Social	Economic	Community Capital	Institutional	Infrastructural	Environmental	BRIC Composite Score
Placer	0.705	0.515	0.354	0.383	0.284	0.509	0.458
Tehama	0.672	0.495	0.296	0.400	0.290	0.523	0.446
El Dorado	0.682	0.478	0.350	0.382	0.252	0.521	0.444
Nevada	0.694	0.468	0.363	0.370	0.237	0.534	0.444
Butte	0.654	0.463	0.348	0.382	0.261	0.539	0.441
Plumas	0.663	0.434	0.363	0.404	0.239	0.546	0.441
Yuba	0.654	0.463	0.348	0.382	0.261	0.539	0.441
Lassen	0.641	0.445	0.324	0.416	0.235	0.548	0.435
Sierra	0.623	0.461	0.307	0.422	0.272	0.526	0.435
Yolo	0.613	0.484	0.316	0.401	0.272	0.525	0.435
Sacramento	0.643	0.461	0.350	0.370	0.245	0.532	0.434
Shasta	0.627	0.389	0.323	0.377	0.280	0.540	0.423
Sutter	0.605	0.456	0.341	0.363	0.219	0.551	0.422
Colusa	0.574	0.444	0.291	0.398	0.257	0.546	0.418
Glenn	0.583	0.429	0.303	0.385	0.232	0.555	0.414

* To simplify the comparison and analysis of many variables, researchers may use a normalization technique called Min-Max normalization in social indicators research. This involves scaling all values between 0 and 1 (0 represents the minimum value and 1 represents the maximum value) through adjusting all other values by subtracting the minimum value from the maximum and dividing by the range.

Supplemental Adaptive Capacity Indicators

The Resilient Together initiative survey provides supplemental data that is relevant to the evaluation of adaptive capacity for the North Valley, Sacramento & Sierra Region. The following section describes respondents' access to financial resources, a cool space (at home or outside of home), a comfortable home, and air conditioning by select demographic characteristics. However, the data is not representative of the region as a whole and should only be referenced with context to the survey sample and in conjunction with the BRIC index results, which provide a region-wide analysis.

Access to Financial Resources

Access to financial resources enables households to access resources and services that improve their resilience in the face of climate hazards. For low-income households, increasing access to financial assistance is one of the most significant ways to increase adaptive capacity. In the North Valley, Sacramento & Sierra Region, approximately 20 percent of survey respondents currently receive financial assistance on their utility bill, and another 5 percent were unsure.[63] To qualify for financial assistance, households must meet low-income thresholds set by PG&E.[64]

63 This question received responses from 99 percent of survey respondents, with n=1545 responses.

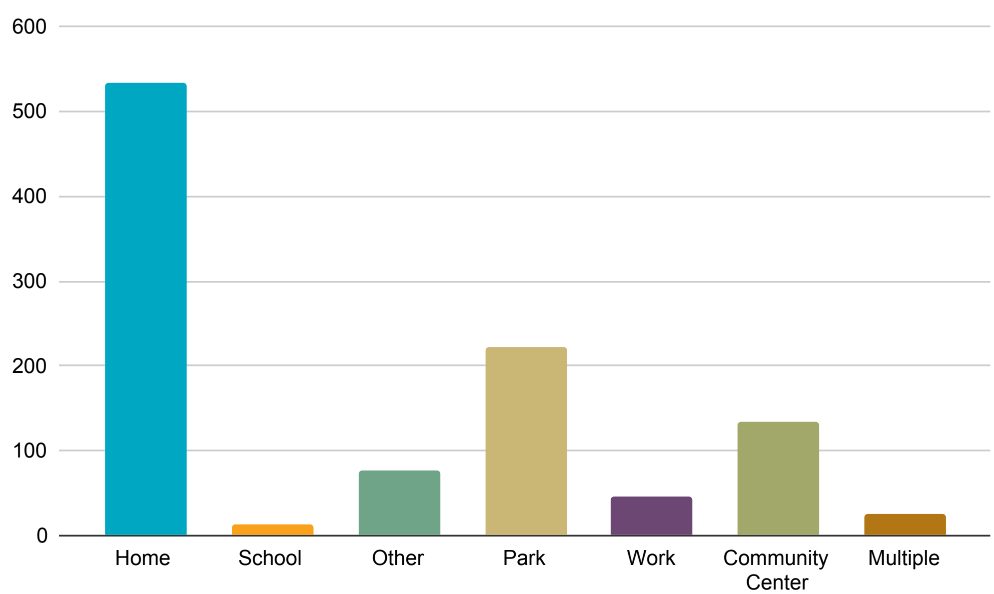
64 CARE / FERA program guidelines can be accessed at the below site: https://www.pge.com/en_US/residential/save-energy-money/help-paying-your-bill/longer-term-assistance/care/program-guidelines.page#qualifying

Access to Cool Space

As shown in Figure C.14, approximately 39 percent of survey respondents and outreach board participants cool off in the park, school, work,[65] or community center, while 51 percent cool off in their home. One respondent that selected "Home" specified "If air is working," and another respondent specified "In my back yard with sprinklers." The remaining nine percent cool off at multiple places or other places. Other places listed by many participants included: other water sources (pool,[66] river, ocean, lake[67]), church, stores (e.g., department stores, grocery centers,[68] malls, shopping centers), movie theater, gyms, library, cars, coffee shops, and out of town (e.g., Fort Bragg and the mountains[69]).

Figure C.15 illustrates where people go to cool off based on their type of home. Unhoused/homeless survey respondents are more likely to use community centers than other groups (8 percent of survey responses for this group) as well as work (17 percent). Survey respondents living in duplexes/triplexes and mobile homes were the most likely to utilize schools as places to cool off compared to respondents with other housing types, presumably due to the higher number of children residing in these housing types. However, only 1.5 percent of all survey respondents chose schools. People with all housing types, including unhoused/homeless survey respondents, chose home over anywhere else for where to go to cool off on hotter days.

FIGURE C.14 Where People Go to Cool Off on Hotter Days (Survey and Outreach Boards) (n=1052 responses)



65 Work was removed from the outreach boards as an option for Regions 2–5, and was included in the online and paper surveys. Work is reflected as a response in "Other" through outreach board engagement but may be represented at a lower response level than the Bay Area Region where Work was included as an option on the outreach boards.

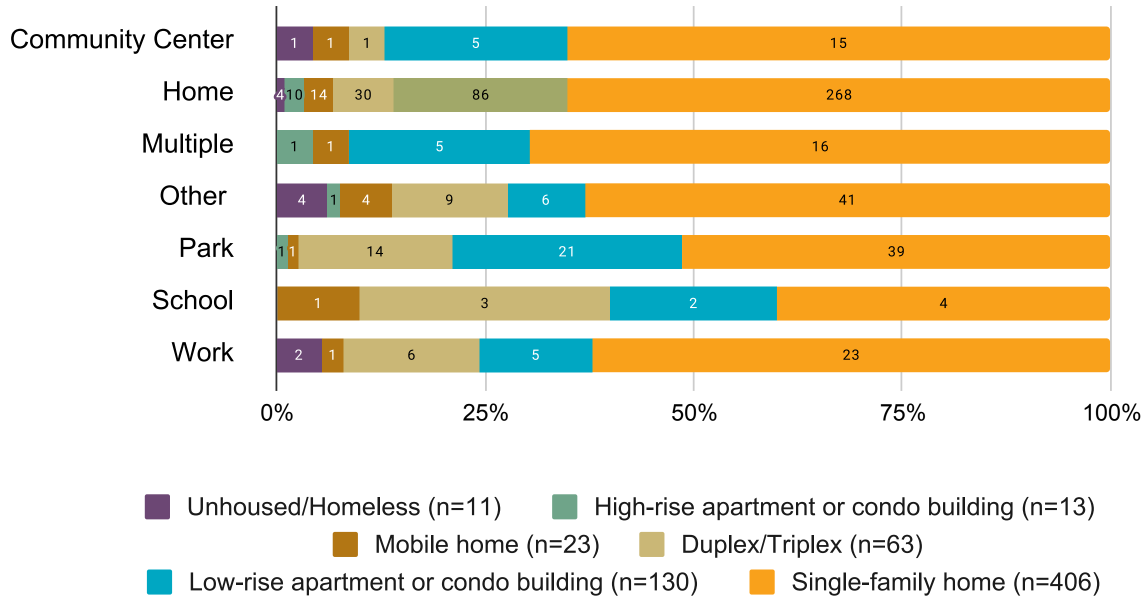
66 16 participants mentioned the pool. One participant reported going to the pool at the Sacramento Aquatic Center. Another participant said, "swimming at lakes and pools when not overcrowded; need community pool."

67 22 participants mentioned going to the lake. The following lakes were called out by participants: Donner Lake, Lake Whiskeytown, and Lake Natoma.

68 One participant specified the meat section at Sprouts grocery store.

69 One participant indicated they go to mountains and provided additional detail: "At high altitude, we don't have air conditioning and rely on being able to open windows at night to cool the houses then shutting things up mid-morning. Wildfire smoke prevents this."

FIGURE C.15 Where People Cool Off by Housing Type (Survey Respondents) (n=646 responses)



Access to Comfortable Home

Nearly half of all survey and outreach board responses (45 percent) indicate that community members are "Comfortable" or "Very Comfortable" in their home on hotter days. RTAG members support resilience hubs/cooling centers as a strategy to adapt to extreme heat, but only a small percentage (~13 percent) of survey respondents and outreach board participants indicate they cool off at existing community centers, reflecting the large number of respondents who are comfortable staying in their homes on hotter days.

For those who cool off at home on hotter days[70] (n=470 respondents), a little over half of (54 percent) indicate they are "Comfortable" or "Very Comfortable." If people are "Comfortable" or "Very Comfortable" they will stay at home. But the nearly 50 percent of survey respondents who are "Not at All Comfortable" or "Slightly Uncomfortable" will go somewhere other than home to cool off.

Table C.20 shows how comfortable respondents are at home on hotter days by county, for counties in the North Valley, Sacramento & Sierra Region for which there is data available. Across counties, nearly half of all survey and outreach board responses (46 percent) are "Comfortable" or "Very Comfortable" in their homes on hotter days. The counties with the highest percentage of responses (>60 percent) indicating they are "Comfortable" or "Very Comfortable" in their homes on hotter days are Placer, Butte, El Dorado, and Yuba. The counties with the highest percentage of responses (>60 percent) indicating they are "Slightly Uncomfortable" or "Not at All Comfortable" in their homes on hotter days are Lassen, Nevada, Plumas, Sutter, and Yolo.

70 The level of specificity was not asked as part of this question on the outreach boards due to simplicity.

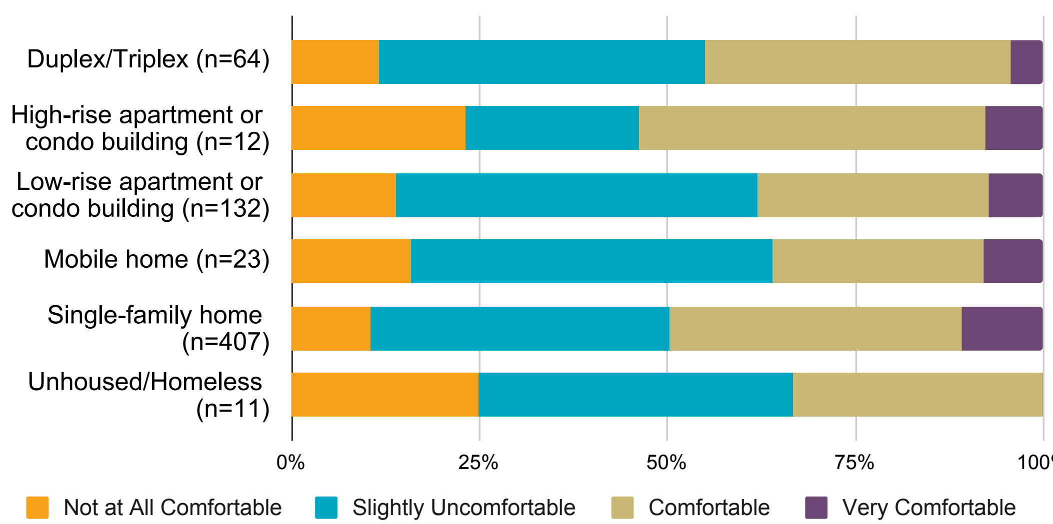
TABLE C.20 Comfort Level at Home on Hotter Days, by County
(Survey Respondents and Outreach Board Participants) (n=945 responses)

County	% of Respondents	Responses			
		Not at All Comfortable	Slightly Uncomfortable	Comfortable	Very Comfortable
Butte	2%	5%	33%	52%	10%
Colusa	N/A	N/A	N/A	N/A	N/A
El Dorado	1%	20%	20%	60%	0%
Glenn	N/A	N/A	N/A	N/A	N/A
Lassen	0.2%	50%	50%	0%	0%
Nevada	1%	8%	58%	25%	8%
Placer	3%	6%	26%	57%	11%
Plumas	0.3%	0%	75%	0%	25%
Sacramento	61%	27%	38%	27%	8%
Shasta	13%	9%	38%	38%	15%
Sierra	0.3%	50%	50%	0%	0%
Sutter	0.4%	0%	67%	33%	0%
Tehama	5%	8%	42%	38%	12%
Yolo	2%	14%	50%	36%	0%
Yuba	9%	3%	9%	84%	4%

The values in this table may not total 100% across the response categories for counties because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by county.

Figure C.16 shows how comfortable survey respondents are at home on hotter days by housing type. The survey findings demonstrate that survey respondents living in single-family homes are the most comfortable on hotter days (on average 40 percent of extremely low and low-income respondents live in single-family homes); and those living in a mobile home, those unhoused or homeless, and low-rise apartments or condo buildings are least comfortable.

FIGURE C.16 Comfort Level in Home on Hotter Days by Housing Type
(Survey Respondents) (n=649 respondents)



Access to Air conditioning

Approximately 82 percent of survey respondents and outreach board respondents (n=953 total respondents to this question) indicate they have access to an air-conditioned space. The survey also asked those respondents who do not have access to an air-conditioned space now if they need air conditioning or not. Of the 738 survey respondents who were asked this question, six percent said they do not have access to air conditioning. Of those survey respondents, only about 4 percent (n=32 respondents) responded that they do not have access to an air-conditioned space, but they need air conditioning. This finding is inconsistent with data collected via the outreach boards; outreach boards asked if people would need access to an air-conditioned space as it gets hotter, and 93 percent of outreach board participants said "Yes."

Resilience Strategies and Recommendations

Through the Resilient Together initiative, community and RTAG members had an opportunity to share preferred strategies for how PG&E can best build community resilience to the range of climate impacts identified in communities throughout the region. These strategies, if implemented, would increase the adaptive capacity of households and communities to a range of climate impacts.

Generally, RTAG members in the Bay Area Region recommended PG&E:

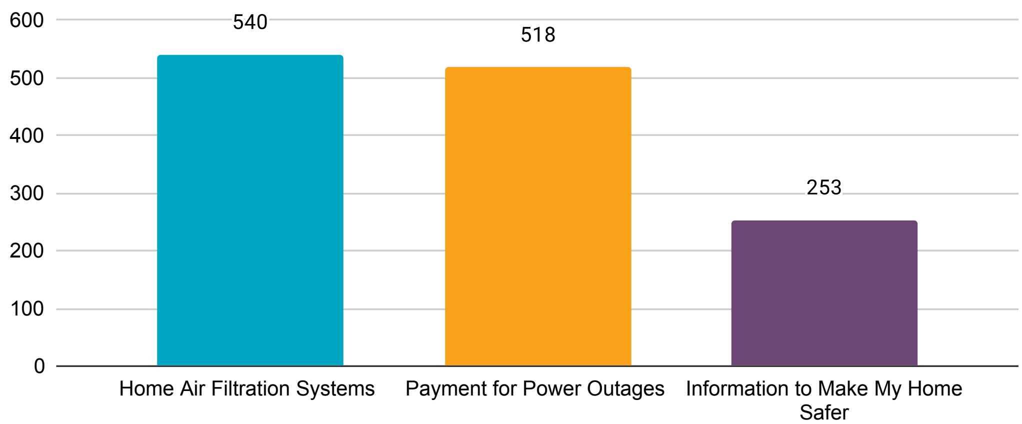
- Invest in home hardening and defensible space programs that improve household resilience. This was particularly important for renters, who do not have as much control over decisions pertaining to their home's safety.
- Provide direct financial relief to customers financially impacted by power outages and extreme heat, as well as provide free air purifiers, batteries, water testing kits, and masks to help improve household resilience.
- Invest in infrastructure improvements such as transmission line undergrounding
- Develop forest health and vegetation management strategies that reduced the risk of catastrophic wildfires.
- Improve communication, education, and outreach to remote communities that are highly vulnerable to wildfires have access to information and resources they need to prepare for increasingly frequent and severe wildfire events.
- Improve transportation services and broadband access to support evacuations and emergency communications, particularly in remote areas of the region with greater numbers of isolated individuals, elderly, and disabled people.

The following section details survey respondents and RTAG members recommended actions to improve community and household resilience.

Household Resilience Strategies

Community members were requested to provide recommendations for the kinds of strategies that PG&E could implement that would support households during extreme weather events. A summary of the strategies that were recommended by the North Valley, Sacramento & Sierra Region specifically are included below.

FIGURE C.17 PG&E Strategies for Households during Extreme Weather Events (n=1311 responses)



Survey respondents and those whose responses are reflected through the outreach boards in-person were asked to provide their top two recommended strategies for PG&E to consider supporting households during extreme weather events. Of the 1311 responses received, the top two recommended strategies are “Home Air Filtration Systems” (41 percent) and “Payment for Power Outages” (40 percent). “Information to Make My Home Safer” is the third top solution (19 percent).

Survey respondents also provided open-ended input on community resilience strategies under the “Other” response category. All these responses were contextualized and integrated into the North Valley, Sacramento & Sierra Region Recommendations for Household Resilience Strategies (Table C.24).

Key Household Resilience Strategies by County

While “Home Air Filtration Systems” is a top priority overall, the top household resilience strategy differed by county. “Home Air Filtration Systems” is the top solution selected by Sacramento, Placer, Yolo, and Nevada County respondents. “Payment for Power Outages” is the top solution for Shasta, Tehama, Yuba, Butte, Plumas, Lassen, and Sierra county respondents. In El Dorado County, responses are split evenly across all three solution categories, and in Sutter County the top two strategies split evenly are for “Payments for Power Outages” and “Home Air Filtration Systems.” Table C.22 highlights 8 of the 13 Region 3 North Valley, Sacramento & Sierra represented counties in the survey and the outreach boards.

TABLE C.21 Priority Household Resilience Strategies by County (n=996 responses)

County	% of Respondents	Responses		
		Payment for Power Outages	Home Air Filtration Systems	Information to Make My Home Safer
Butte	2%	56%	36%	8%
Colusa	N/A	N/A	N/A	N/A
El Dorado	1%	33%	33%	33%
Glenn	N/A	N/A	N/A	N/A
Lassen	0.2%	40%	40%	20%
Nevada	1%	38%	62%	0%
Placer	3%	32%	50%	18%
Plumas	0.3%	67%	33%	0%
Sacramento	61%	49%	61%	29%
Shasta	13%	51%	34%	14%
Sierra	0.3%	67%	33%	0%
Sutter	0.4%	60%	20%	20%
Tehama	5%	58%	30%	12%
Yolo	2%	22%	42%	36%
Yuba	9%	50%	35%	15%

The values in this table may not total 100% across the response categories for counties because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by county.

Key Household Resilience Strategies by Racial Background

The household resilience strategies can also be reviewed based on how participants identified their racial background, as illustrated in Table C.22 below. "Payment for Power Outages" is the top recommended type of solution for respondents who identified their racial backgrounds as Asian (50 percent), Native American, American Indian, or Alaska Native (47 percent), and Latinx or Hispanic (39 percent). "Payment for Power Outages" and "Home Air Filtration Systems" are the top two strategies (both at 40 percent) for participants who identified as Black or African American. "Home Air Filtration Systems" is the top response for White participants (40 percent).

TABLE C.22 Priority Household Resilience Strategies by Racial Background (n=969 responses)

Racial Background	% of Respondents	Responses: Payment for Power Outages	Home Air Filtration Systems	Information to Make My Home Safer
Asian	2%	50%	45%	5%
Black or African American	10%	40%	40%	19%
Latinx or Hispanic	15%	39%	35%	26%
Native American, American Indian, or Alaska Native	3%	47%	30%	23%
Native Hawaiian and Pacific Islander	1%	38%	31%	31%
Other race	2%	38%	25%	38%
Two or more races	6%	42%	35%	24%
White	60%	37%	40%	23%

The values in this table may not total 100% across the response categories for racial backgrounds because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by race.

Key Household Resilience Strategies by Income Level

Income is another lens by which to evaluate the top strategies identified by survey respondents. For extremely low-income participants, "Payment for Power Outages" is the top response (48 percent), followed by "Home Air Filtration Systems" (35 percent). "Home Air Filtration Systems" is the top response for low-income participants. Moderate-income and high-income participants identified "Payment for Power Outages" and "Home Air Filtration Systems" as tied for the top two strategies (about 40 percent for each respectively).

TABLE C.23 Priority Household Resilience Strategies by Income Level (n=959 responses)

Income Level	% of Respondents	Responses: Payment for Power Outages	Home Air Filtration Systems	Information to Make My Home Safer
Extremely low-income	8%	48%	35%	17%
Low-income	35%	37%	40%	23%
Moderate-income	52%	38%	38%	24%
High-income	5%	39%	39%	22%

The values in this table may not total 100% across the response categories for income levels because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by income level.

Household Resilience Recommendations

Other responses included the following strategies for PG&E to provide to households during extreme weather, which are incorporated into the specific recommendations for PG&E below.

Table C.25 lists specific recommendations that came from RTAG input, survey respondents via open-ended survey responses, and focus group participants for PG&E to consider with respect to the following strategy areas:

1. Home improvements
2. Direct Payments
3. Safety Resource Distribution

"Being able to survive a fire while staying put is the top priority. It would be great to improve communication and evacuation routes. However, if those still failed, it would still come down to having a survivable home location."

Under each strategy is a list of recommended actions that the Project Team heard from community and RTAG members, categorized by: (1) within PG&E's control, (2) possible through partnerships, and (3) outside of PG&E's control.

TABLE C.24 North Valley, Sacramento & Sierra Region Recommendations for Household Resilience Strategies

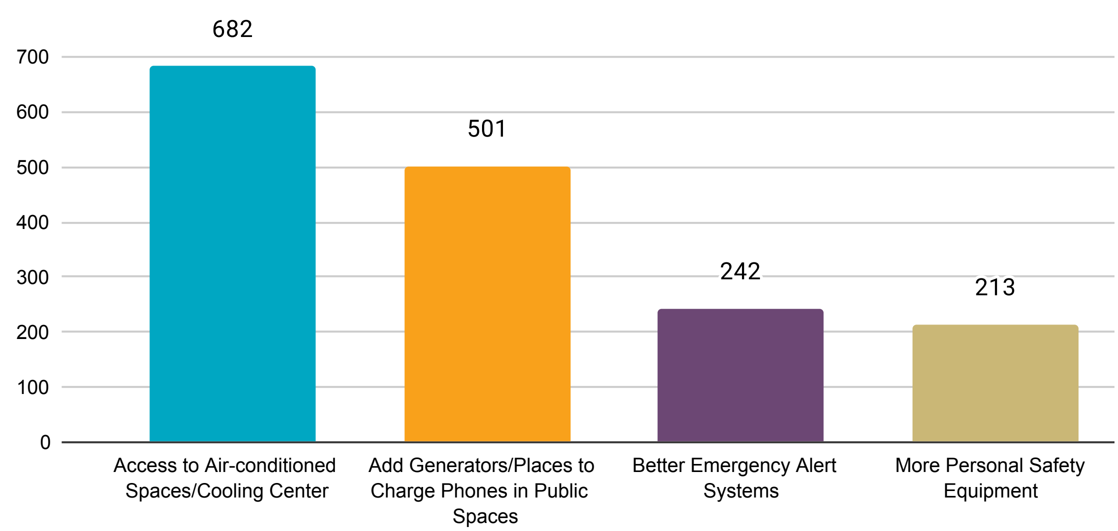
Strategy Area	Recommended Action	Within PG&E's Control	Possible Through Partnerships	Outside of PG&E's Control
Home Improvements	Increase funding for and enrollment in weatherization and other home upgrade programs to improve home insulation, efficiency, hardening, and air filtration.	X		
	Increase investments in solar for low-income households	X		
	Improve access/affordability of Powerwalls & batteries for low-income households	X		
	Support and encourage residents to electrify home appliances	X		
	Develop and fund programs that provide home consultations, home retrofits and maintenance around people's yard to improve wildfire resilience (e.g., Wildfire Mitigation Review Program)			
	Ensure all counties have equal access to home hardening/ defensible space programs	X		
	Provide financial assistance/rebate programs for heat pumps and air conditioning units	X		
Direct Payments	Provide direct compensation for households impacted during power outages	X		
Customer Programs	Provide tiered PG&E rates for low-income customers	X		
	Provide financial support for customers who have higher utility bills due to increase in use of air conditioning on hot days	X		

Strategy Area	Recommended Action	Within PG&E's Control	Possible Through Partnerships	Outside of PG&E's Control
Safety Resources Distribution	Distribute air purifiers before wildfire season, including to schools, businesses, and low-income households			
	Distribute N-95 masks	X	X	
	Provide water distribution and water testing kits for those on wells that lose access to water	X	X	
	Distribute portable cooling devices (e.g., mini fans)			
	Distribute large portable batteries/solar generators to residents	X	X	

Community Resilience Strategies

Community members were requested to provide input on the kinds of strategies that PG&E could implement that would support communities during extreme weather events. A summary of the strategies that survey respondents supported in the North Valley, Sacramento & Sierra Region are included below. Respondents were encouraged to pick their top two choices, although respondents chose between zero and four strategies as their responses.

FIGURE C.18 PG&E Strategies for Communities During Extreme Weather Events (n=1638 responses)



In the North Valley, Sacramento & Sierra Region, "Access to Air-conditioned Spaces and Cooling Centers" and "Adding Generators and Places to Charge Phones in Public Spaces" were the top two strategies survey respondents identified to help communities build resilience to extreme weather events. Approximately 13 percent of the total responses selected were for "More Personal Safety Equipment" such as masks, air purifiers, and portable batteries and 15 percent of total responses related to "Better Emergency Alert Systems."

Survey respondents also provided open-ended input on community resilience strategies under "Other" strategies. Responses were contextualized and integrated into the North Valley, Sacramento & Sierra Region Recommendations for Community Resilience Strategies (Table C.28).

Key Community Resilience Strategies by County

"Access to Air-conditioned Spaces and Cooling Centers" is the top response across most of the counties represented. Tehama and Nevada County respondents selected "Adding Generators and Places to Charge Phones in Public Spaces" as their top community resilience strategy, and El Dorado and Plumas County respondents selected "Better Emergency Alert Systems" as their top strategy.

"Spending time and money on other community programs is nice, but PG&E needs to focus on getting their infrastructure issues dealt with first and foremost."

Table C.26 highlights 8 of the 13 North Valley, Sacramento & Sierra Region represented counties in the survey and the outreach boards.

TABLE C.25 PG&E Strategies for Communities during Extreme Weather Events (by County) (n=1095 responses)

County	% of Respondents	Responses			
		Access to Air-conditioned Spaces/Cooling Centers	Better Emergency Alert Systems	Add Generators/ Places to Charge Phones in Public Spaces	More Personal Safety Equipment (masks, batteries, etc.)
Butte	2%	45%	14%	28%	14%
Colusa	N/A	N/A	N/A	N/A	N/A
El Dorado	1%	17%	67%	17%	0%
Glenn	N/A	N/A	N/A	N/A	N/A
Lassen	0.2%	67%	0%	33%	0%
Nevada	1%	31%	8%	46%	15%
Placer	3%	46%	7%	21%	25%
Plumas	0.3%	33%	67%	0%	0%
Sacramento	61%	46%	12%	32%	11%
Shasta	13%	33%	22%	30%	16%
Sierra	0.3%	67%	0%	33%	0%
Sutter	0.4%	50%	17%	17%	17%
Tehama	5%	28%	24%	33%	16%
Yolo	2%	41%	25%	25%	9%
Yuba	9%	40%	17%	33%	10%

The values in this table may not total 100% across the response categories for counties because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by county.

Key Community Resilience Strategies by Racial Background

The community resilience strategies can also be reviewed based on how participants identified their racial background. The information collected is represented in Table C.26 below. As a reminder, 93 percent of participants provided a response on racial background. "Access to Air-conditioned Spaces and Cooling Centers" is the top solution for participants who identified as White (45 percent), Black or African American (32 percent, tied with "Adding Generators and Places to Charge Phones in Public Spaces"), Native American, American Indian, or Alaska Native participants (32 percent), Asian (37 percent), two or more races (38 percent), and as other (44 percent). "Adding Generators and Places to Charge Phones in Public Spaces" is the tied top solution for Black or African American respondents (32 percent). "Better Emergency Alert Systems" is the top solution for Latinx or Hispanic participants (28 percent) followed closely by "Access to Air-conditioned Spaces and Cooling Centers." The top solution for Native Hawaiian and Pacific Islander participants is "More Personal Safety Equipment."

TABLE C.26 PG&E Strategies for Communities during Extreme Weather Events (by Racial Background) (n=1076 responses)

		Responses			
Racial Background	% of Respondents	Access to Air-conditioned Spaces/Cooling Centers	Better Emergency Alert Systems	Add Generators/ Places to Charge Phones in Public Spaces	More Personal Safety Equipment
Asian	2%	37%	11%	26%	26%
Black or African American	10%	32%	16%	32%	20%
Latinx or Hispanic	15%	27%	28%	25%	19%
Native American, American Indian, or Alaska Native	3%	32%	21%	24%	24%
Native Hawaiian and Pacific Islander	1%	9%	36%	9%	45%
Other race	2%	44%	22%	11%	22%
Two or more races	6%	38%	23%	25%	14%
White	60%	45%	18%	21%	16%

The values in this table may not total 100% across the response categories for racial backgrounds because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by county.

Key Community Resilience Strategies by Income Level

The Project Team also evaluated top strategies identified by survey respondents based on the income of respondents. "Access to Air-conditioned Spaces and Cooling Centers" is the top solution across all income levels. The second top solution for all income levels except for low-income participants is "Adding Generators and Places to Charge Phones in Public Spaces." The second top solution for low-income participants is "Better Emergency Alert Systems," which is the lowest identified solution by number of responses for extremely low-income participants. "More Personal Safety Equipment" is the lowest identified solution by number of responses for low-income and high-income categories (Table C.27).

TABLE C.27 PG&E Strategies for Communities during Extreme Weather Events (by Income Level) (n=1009 responses)

		Responses			
Income Level	% of Respondents	Access to Air-conditioned Spaces/Cooling Centers	Better Emergency Alert Systems	Add Generators/ Places to Charge Phones in Public Spaces	More Personal Safety Equipment (masks, batteries, etc.)
Extremely low-income	8%	37%	11%	29%	23%
Low-income	35%	40%	22%	19%	19%
Moderate-income	52%	40%	19%	24%	17%
High-income	5%	44%	22%	25%	9%

The values in this table may not total 100% across the response categories for income levels because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by income level.

Community Resilience Recommendations

Table C.28 lists specific recommendations that came from RTAG input, survey respondents via open-ended survey responses, and focus group participants for PG&E to consider with respect to the following strategy areas:

1. Community Resilience and Cooling Centers
2. Infrastructure Improvements and Grid Modernization
3. Distributed Energy Resources
4. Forest Health, Vegetation Management, and Urban Greening
5. Communication, Education, and Outreach
6. State Advocacy

Under each strategy area is a list of recommended actions that the Project Team heard from community and RTAG members, categorized by: (1) within PG&E's control, (2) possible through partnerships, and (3) outside of PG&E's control.

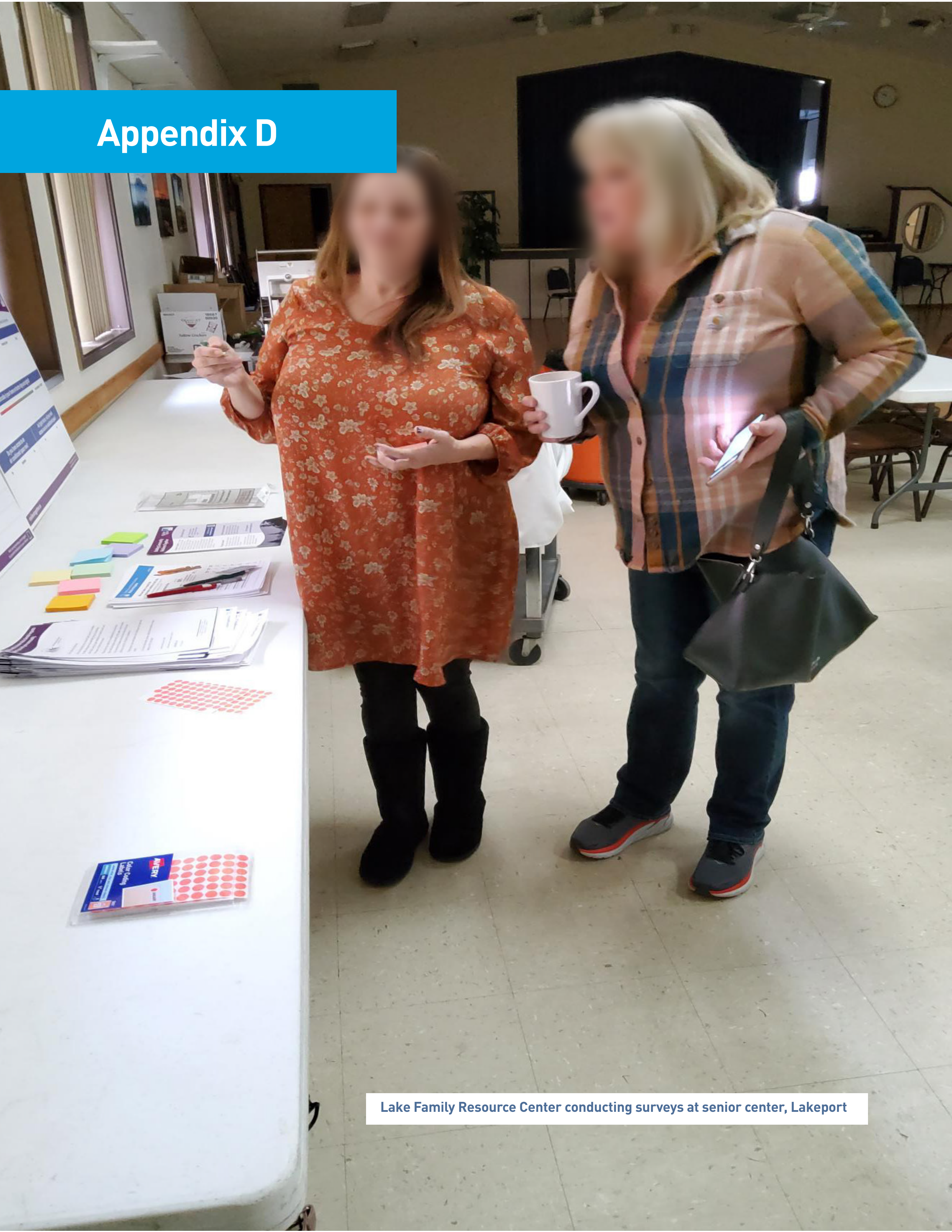
TABLE C.28 North Valley, Sacramento & Sierra Recommendations for Community Resilience Strategies

Strategy Area	Recommended Action	Within PG&E's Control	Possible Through Partnerships	Outside of PG&E's Control
Community Resilience and Cooling Centers	Provide financial support for the development and sustained operation of community resilience centers at places of worship, schools, and nonprofits through new and existing grant programs, including incentives for existing community centers	X	X	
	Fund CBOs that have capacity to operate cooling centers		X	
	Build misting centers in parks		X	
	Develop rural or mobile cooling centers that can serve rural residents		X	

Strategy Area	Recommended Action	Within PG&E's Control	Possible Through Partnerships	Outside of PG&E's Control
Infrastructure Improvements and Grid Modernization	Underground power lines, and prioritize powerline undergrounding in green watersheds	X		
	Increase oversight and forced implementation on problematic transmission lines in high fire risk areas	X		
	Invest in and improve long distance detection and prevention of rapid spread	X		
Distributed Energy Resources	Invest in and provide access to micro-grids	X		
	Increase access to backup energy and generators	X		
	Invest in "vehicle to grid" solutions (cars as backup battery)	X		
	Invest in residential solar, especially for low-income households	X		
Forest Management and Urban Greening	Construct more shaded fuel breaks	X		
	Prioritize wildfire resilience efforts where land has cultural importance	X		
	Outsource tree trimming/removal efforts to speed up protection in rural areas	X		
	Create forest stewardship maps that indicate land ownership and use of agroforestry practices		X	
	Establish liaison between PG&E and cities/counties to coordinate outreach on fuel removal	X		
	Increase tree canopy in urban centers that lack shade		X	
	Establish tree removal programs in previously burned areas	X		
	Improve maintenance around power lines (e.g., tree pruning)	X		
	Clean up debris/wood left from vegetation management subcontractors who cut trees and leave them on residents' properties		X	
	Continue to fund/increase funding for defensible space programs (e.g. Special Needs Defensible Space Program), wood management, and community chipping programs	X		
	Invest in community scale biomass and make biomass part of PG&E business model	X		
Transportation Services	Fund local transit agencies to provide more evacuation buses during emergency events, especially for the unhoused	X		
	Provide transportation for seniors, disabled, and those without cars seeking to escape wildfire smoke/heat		X	
	Create "red teams" for community responsiveness to emergencies to assist in community evacuations	X	X	
	Invest in electric buses to transport people to cooling centers		X	
	Ensure residential areas have access to more than one evacuation road/route			X

Strategy Area	Recommended Action	Within PG&E's Control	Possible Through Partnerships	Outside of PG&E's Control
Communication Education & Outreach	Build collaborations with community-based organizations to conduct education and outreach	X		
	Host more informational meetings on PG&E programs with bilingual outreach	X		
	Fund law enforcement/EMT to conduct emergency preparation presentations	X		
	Provide planning grants for CBOs to educate and empower resident/community leaders	X		
	Support the establishment of Community Organizations Activated in Disaster teams	X	X	
	Provide wildfire mitigation trainings year-round	X		
	Provide stipends to community members, including the unhoused, to attend emergency preparedness trainings	X		
	Research and invest in technologies that allow for communication systems to be available during power outages and wildfires		X	
	Use push notifications to cell phones for emergency prevention, not just emergency notification		X	
	Identify and fund CBOs that can provide childcare during climate hazards		X	
	Provide information to homeowners about fuel removal via mailers and trainings	X		
	Keep customers informed about the development of CVA and adaptation strategies.	X		
Workforce Development	Hire local workers to assist in tree trimming, debris clearing and forest restoration efforts		X	
Broadband Infrastructure	Provide faster, more reliable internet in rural communities			X
State Advocacy	Advocate for policies to support a carbon neutral future (e.g., advocate for transition away from propane in rural areas)	X	X	
	Advocate for policies that remove regulatory barriers to distributed energy and community micro-grids	X		
	Advocate for policies that discourage housing development in wildfire risk areas	X		
	Advocate for policies that require logging industry to improve cleanup to reduce flammable debris	X		
	Advocate for investments in regional broadband services	X		
Other	Invest in local housing to support tribal workforce			X

Appendix D



Lake Family Resource Center conducting surveys at senior center, Lakeport

Appendix D: The North Coast Region

This report provides a summary of the findings for the North Coast Region of the Resilient Together initiative. The North Coast Region encompasses Humboldt, Lake, Mendocino, Siskiyou, and Trinity counties. Sonoma County was also included due to less representation in the Bay Area Region, as well organic community ties to the broader North Coast region by CBOs in the county. This regional summary provides an overview of the data collected and presents the key findings for the North Coast Region. The key findings are organized as follows:

- A Defining Climate Vulnerable Communities
- B Climate Hazards and Impacts
- C Adaptive Capacity
- D Resilience Strategies and Recommendations

Data Collected

The Project Team collected data for the North Coast Region from four primary sources: 1) Research interviews conducted with Resilient Together Advisory Group (RTAG) candidates, 2) RTAG meetings, 3) Outreach events conducted by RTAG members, and 4) Resilient Together surveys. This section presents a summary of the key data collected for this region.

RTAG Members

The following table (Table D.1) lists the organizations that participated in the North Coast Region RTAG, the top three populations represented by each RTAG member, and the mission statements for each of the organizations. An asterisk indicates RTAG members who conducted outreach activities (Outreach Partners).

Over the course of the engagement, RTAG members participated in five RTAG meetings, totaling approximately 10 hours. RTAG meetings featured a project overview and RTAG orientation, presentation of outreach materials, peer mentoring, role-playing exercises, a presentation on PG&E income qualified programs, presentation of key findings from engagement, and celebration of their partnership.

TABLE D.1 RTAG Member Profiles

RTAG Organization	Geographies Represented	Top Populations Represented	Mission/Profile
Arcata House Partnership*	Greater Humboldt County	Unsheltered communities Low-income communities People with disabilities	Arcata House Partnership was founded in 1991 and provides critical services to people who are homeless in Arcata and Humboldt County. Their mission is to provide advocacy for and services to the homeless and food insecure with compassion, dignity and empowerment.[71]
Fort Bragg Food Bank/ Mendocino Food & Nutrition Program, Inc*	Mendocino County	Low-income communities Limited English proficient communities Seniors Unhoused	Founded in 1979, the Mendocino Food & Nutrition Program (the Fort Bragg Food Bank) is a nonprofit 501(c)(3) corporation. Their objective is to distribute food to those who need it most. They work to provide nutritious food to those in need for a healthy and better life.[72]
Graton Day Labor Center*	Sonoma County (Graton, Santa Rosa, Windsor, Rohnert Park, Petaluma)	Low-income communities Limited English proficient communities Undocumented communities	Graton Day Labor Center is a place to gather day laborers and improve their working conditions and hiring terms. Centro Laboral de Graton's focus on leadership development and organizing creates benefits beyond vital job-related opportunities. Their worker-led center offers everyone an opportunity to participate in leadership, rights advocacy, civic participation, networking, and community service.[73]
Lake Family Resource Center*	Lake County	Low-income communities Rural communities Seniors	Lake Family Resource Center (Lake FRC) serves Lake County to achieve safe, sustainable, and healthy families and communities. Lake Family Resource Center offers services including an early start program, teen services, domestic violence services, a rape crisis center, housing services, and an anti-human trafficking program.[74]
Mendocino Coast Children's Fund*	Mendocino Coast (from Westport to Gualala)	Low-income communities Limited English proficient communities Undocumented communities	Mendocino Coast Children's Fund's mission is to make sure all coastal children can be healthy and thrive. Mendocino Coast Children's Fund provides children with essentials and necessities, hopes and dreams, opportunities, and activities. Mendocino Coast Children's Fund projects range from medical mileage, homelessness prevention, and pandemic support to sports, recreation, and supplying essentials.[75]

71 https://www.arcatahouse.org/about

72 https://www.fortbraggfoodbank.org/

73 https://www.gratondaylabor.org/history

74 https://www.lakefrc.org/

75 https://www.mccf.info/

RTAG Organization	Geographies Represented	Top Populations Represented	Mission/Profile
National Association for the Advancement of Colored People- Santa Rosa Sonoma County Branch*	Sonoma County, Marin County, Mendocino County	Black/African American communities Renters Seniors	The vision of National Association for the Advancement of Colored People- Santa Rosa Sonoma County Branch is to ensure a society in which all individuals have equal rights and there is no racial hatred or racial discrimination. Their mission is to ensure the political, educational, social, and economic equality of rights of all persons and to eliminate racial hatred and racial discrimination. Slogan: Lifting as we climb. Growing as we build.[76]
North Coast Opportunities, Inc.*	Mendocino County, Lake County	Low-income communities Limited English proficient communities Rural communities	The vision of National Association for the Advancement of Colored People- Santa Rosa Sonoma County Branch is to ensure a society in which all individuals have equal rights and there is no racial hatred or racial discrimination. Their mission is to ensure the political, educational, social, and economic equality of rights of all persons and to eliminate racial hatred and racial discrimination. Slogan: Lifting as we climb. Growing as we build.[77]
Trinity County Food Bank*	Trinity County	Low-income communities Community-based organizations Rural communities	The Trinity County Food Bank distributes food commodities to low-income families in the area in which they live, on a first come, first served basis. They are a nonprofit organization focused on helping make the world around us a better, happier place.[78]
United Way of the Wine Country	Sonoma County, Mendocino County	Low-income communities Limited English proficient communities Community-based organizations	United Way of the Wine Country specializes in dispersing designated donations and targeted grants to trusted, highly effective community partners serving those most in need of vital services. They serve Del Norte, Humboldt, Lake, Mendocino, and Sonoma Counties.[79]

Outreach Events

The nine Outreach Partners conducted 14 events totaling 48 hours.[80] Outreach activities included:

- Community workshops
- Focus groups
- Tabling at community events (farmers markets, food banks)
- Tabling at day labor assembly meetings
- Tabling at college campuses
- Community resource fairs
- Interviews with community leaders
- Seasonal events at public facilities (Valentine's Day Event)
- Resident meetings
- Social media campaigns

76 https://naacpsantarosasonomaco.org/

77 https://www.ncoinc.org/about-us/mission-vision/

78 https://trinitycountyfoodbank.org/

79 https://www.unitedwaywinecountry.org/?gclid=Cj0KCQiA_P6dBhD1ARIsAAGI7HD1je-f1OOoYaQtkXIGDfutho5WXt2gr7qcHLatMOLbyn_XWKH2Md8aAkO8EALw_wcB

80 This represents anticipated events from RTAG Outreach Plans. The Project Team did not track how many events occurred for RTAG members in Regions 4 and 5.

Participants Engaged

Outreach Partners engaged 1632 people over the course of the Outreach Period. A total of 1151 online paper surveys were completed. An additional estimated 481 community members engaged in events listed above. The data collected at outreach events were included in the outreach boards. Following completion of the Bay Area Region engagement, select demographic questions (e.g., race, income, household characteristics) were added to the Resilient Together survey for Regions 2–5 to better understand the participants that were engaged through this effort. The following section describes the geographic areas, incomes, race, and household characteristics of the participants engaged.

Zip codes and Counties Represented

A total of at least 74 unique zip codes are represented through the data collected by the surveys and the outreach boards, across 16 counties. Additional zip codes and counties may be represented in the data but not all survey and outreach board respondents identified their zip code, and some respondents provided their county rather than zip code. Less than one percent of survey respondents did not provide their zip-code. Table D.2 shows the counties represented through the surveys and in the outreach boards.

TABLE D.2 Surveys per County (n=1147 respondents)

County	% of Surveys
Alameda*	0.1%
El Dorado*	0.2%
Humboldt	19%
Lake	19%
Los Angeles*	0.1%
Marin*	0.2%
Mendocino	76%
Monterey*	0.3%
Napa*	0.1%
Petaluma*	0.3%
San Benito*	0.1%
San Diego*	0.1%
Santa Cruz*	0.4%
Sonoma*	9%
Siskiyou	0%
Trinity	17%
Yolo*	0.1%

Counties that are represented in the data that are not part of the North Coast Region are identified with an asterisk.

Languages Represented

To reach a more diverse sampling of the North Coast Region, materials were provided in Chinese, English, Spanish, Tigrinya, and Vietnamese . RTAG members translated some of the surveys taken in other languages into English when inputting them into Survey Monkey. The survey included a question for RTAG members regarding what language the paper survey was originally taken in to accurately track languages represented.[81] Additionally, RTAG members indicated they engaged participants in English and Spanish at outreach events (29 percent of the community members engaged).[82]

Racial Backgrounds Represented

Although demographic questions were optional, 26 percent of the North Coast Region survey respondents answered the question on racial identification. The other 74 percent of respondents either chose "prefer not to respond" or left the question blank. Of those who answered the question, 41 percent identified as groups comprised of people of color, more than two races, or other races. The remaining 59 percent of respondents identified as White. Participants who indicated "Other" identify as Latina, Mexican, Jewish, Indigenous Mexican, Armenian, European, Northern European, Samoan, Pomo, Concow, Nomelaki, and Middle Eastern.

Table D.3 and Table D.4 identify the number of survey respondents by racial background and racial background of survey respondents by Outreach Partner, respectively.

TABLE D.3 North Coast Region Racial Background of Survey Respondents (n=853 respondents)

Racial Background	% of Respondents
Asian	1%
Black or African American	1%
Latinx or Hispanic	23%
Native American, American Indian, or Alaska Native	6%
Native Hawaiian and Pacific Islander	0%
Other	2%
Two or more races	7%
White	59%

Values may not add up to 100% because some survey respondents marked the "prefer not to answer" option for this question. Those values are not shown in this table.

81 This question was included in the online survey for Regions 4 and 5.

82 The Project Team tracked the information from the events using an online reporting tool, similar to the tool that was used in Regions 1-3. Rather than have RTAG members input the data from their outreach events into the tool, the Project Team completed this task. Information about events was only collected for events that used outreach boards. Several RTAG members did attempt to record how many English and Spanish speakers were engaged at each event. Based on the input received, 276 English speaking people were engaged, and 205 Spanish speaking people were engaged, totaling the 481 people engaged through outreach events.

TABLE D.4 Racial Background of Survey Respondents by Outreach Partner (n=1048 respondents)

Racial Background	Arcata House	Fort Bragg Food Bank/Mendocino Food & Nutrition Program, Inc	Graton Day Labor Center	Lake Family Resource Center	Mendocino Coast Children's Fund	National Association for the Advancement of Colored People Santa Rosa Sonoma County Branch	North Coast Opportunities	Trinity County Food Bank
Asian	0%	1%	0%	1%	0%	0%	2%	1%
Black or African American	0%	0%	4%	5%	0%	8%	1%	0%
Latinx or Hispanic	67%	18%	94%	10%	21%	8%	42%	5%
Native American, American Indian, or Alaska Native	0%	2%	0%	13%	2%	0%	1%	12%
Native Hawaiian and Pacific Islander	0%	0%	0%	1%	0%	0%	1%	0%
Other	0%	2%	2%	1%	1%	0%	6%	1%
Two or more races	0%	12%	0%	8%	7%	0%	6%	8%
White	33%	64%	0%	61%	69%	83%	42%	74%

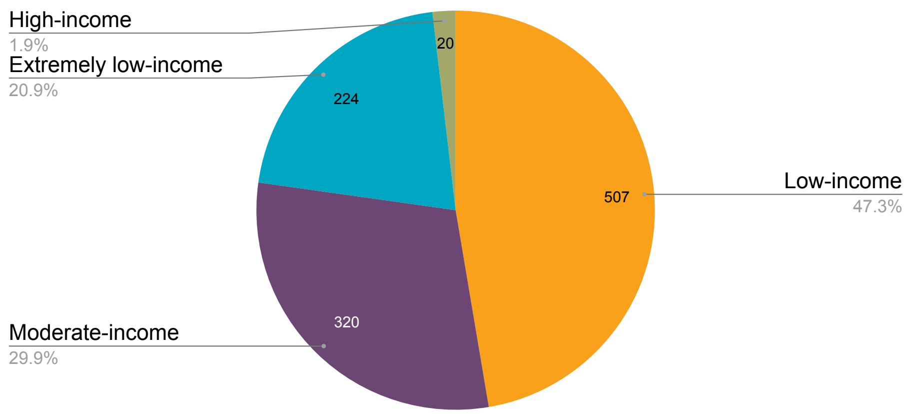
Values may not add up to 100% because some survey respondents marked the "prefer not to answer" option for this question. Those values are not shown in this table.

Income Levels Represented

Survey respondents were asked: "How would you describe your income level?" Breakdowns of income level categories were not described as part of the survey. Of the 1071 respondents,[83] only about two percent identify themselves as high-income, while 68 percent of respondents identify as extremely low or low-income, indicating that the outreach conducted in the North Coast Region was extremely effective in reaching low-income and extremely low-income households, as shown in Figure D.1

83 This does not include the 23 participants that chose the response "Prefer not to answer."

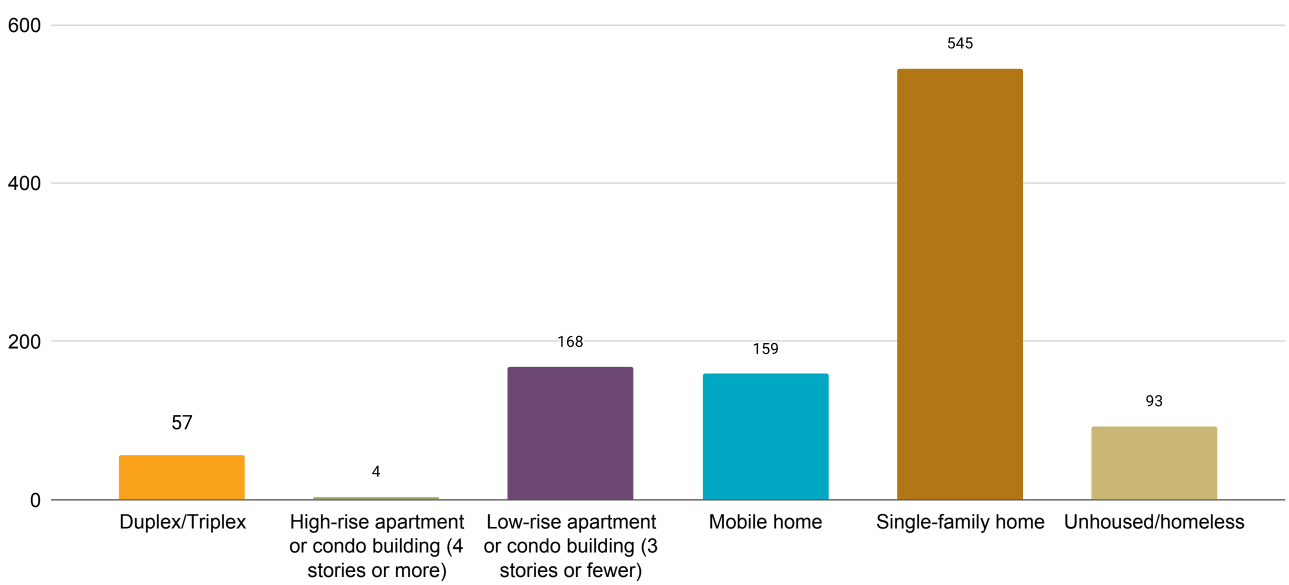
FIGURE D.1 Survey Respondents by Income Level
(n=1071 respondents)



Household Characteristics Represented

The optional demographic question section of the survey also asked about housing. One of the questions asked: "What type of home do you live in?" As shown in Figure D.2, most survey respondents live in single-family homes (53 percent), followed by respondents who live in low-rise apartments or condo buildings[84] (16 percent). In a separate survey question, respondents were asked: "Do you own your home?" In response, nearly 66 percent of survey respondents said "No," indicating they are renters (n=1050 respondents).

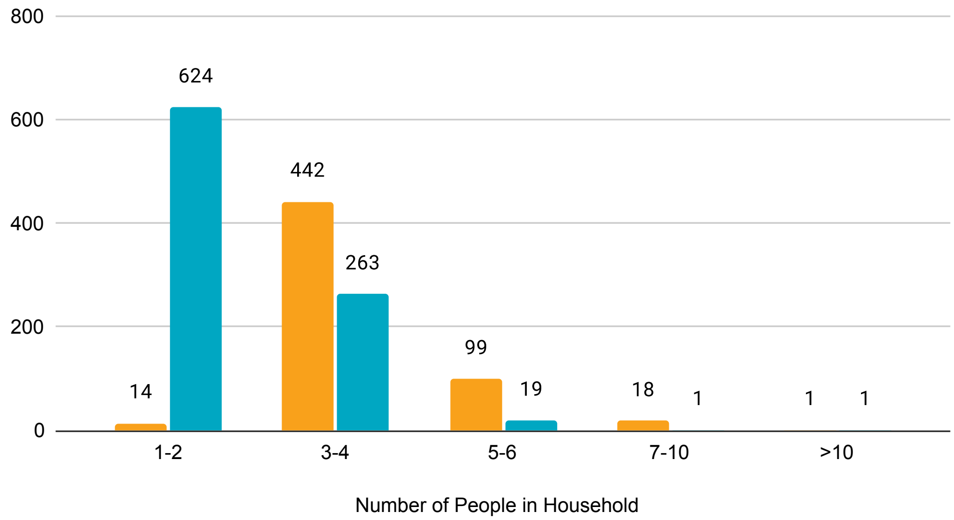
FIGURE D.2 Survey Respondents by Housing Type
(n=1050 respondents)



84 Low-rise apartments or condo buildings are represented by three stories or fewer. High-rise apartment or condo buildings are represented by four stories or more.

Survey participants were also asked how many people are in their household, and if there are any other children under 18.[85] The average number of people in the households for the North Coast Region was 2.5 people, and 30 percent of survey respondents said that they do have other children under 18 in the household.[86] These two questions are grouped together in Figure D.3 below.

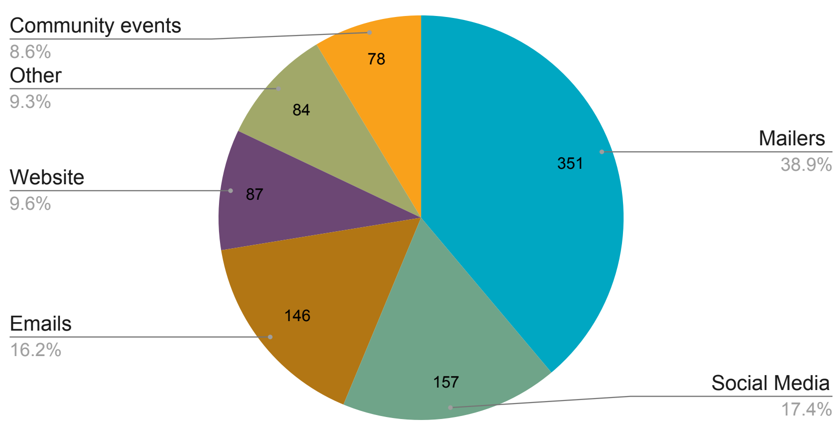
FIGURE D.3 How Many People are in the Household and Whether There are Other Children Under 18 in the Household (n=1039 respondents)



PG&E Communications

Survey respondents were asked how and when they receive information and news from PG&E. Figure D.4 reflects how participants currently receive information and news from PG&E. The primary source of information is mailers (39 percent), followed by emails (16 percent). Participants also receive information and news from the news, phone and text messages, word of mouth (such as from friends and family), nonprofits, and PG&E bills. About 11 people responded that they do not currently receive any information.

FIGURE D.4 Where Participants Currently Receive Information and News from PG&E (n=903 respondents)



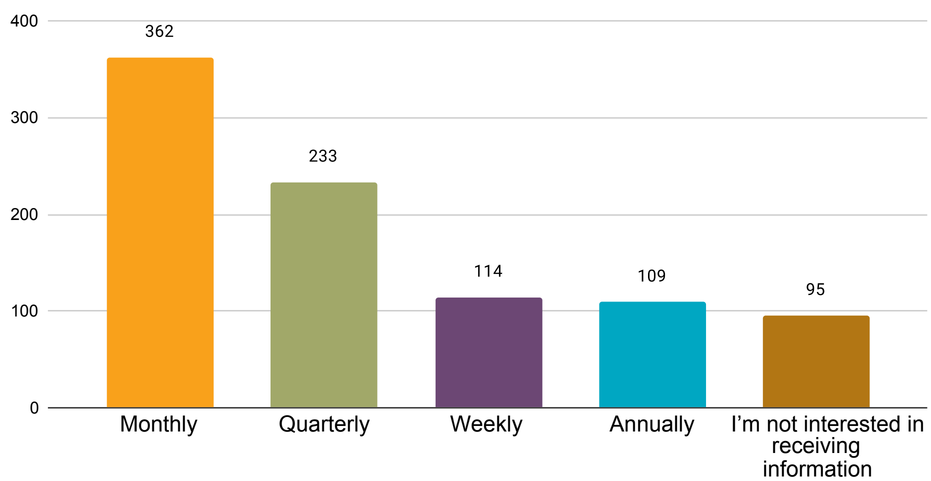
85 The second question is framed in a way to anticipate that children 18 and younger may be survey respondents.

86 One survey respondent from Sonoma County provided the following comment through the survey: "I think the info yielded by this excellent and very important survey would benefit greatly from including options from BOTH Affordable housing and HUD Voucher housing in the above question. It is SO important to identify this piece when considering the impacts of extreme weather."

In response to the question "How often survey respondents receive information from PG&E on existing initiatives and programs," of the 841 respondents, 85 percent responded, "Not Enough" and 15 percent responded, "Too Often." Of the 15 percent of survey respondents that responded, "Too Often," most were interested in receiving future information on a quarterly or monthly basis. Of the 85 percent of survey respondents that responded, "Not Enough," most indicated they were interested in receiving future information monthly.

The survey then asked respondents about how often they would like to receive information in the future from PG&E on existing initiatives and programs. Of the 913 total survey respondents, 66 percent responded "Monthly" or "Quarterly." The remaining 34 percent responded "Weekly" (12 percent), "Once a Year" (12 percent), or "I'm not interested in receiving information" (10 percent).

FIGURE D.5 How Often Survey Respondents Would Like to Receive Information from PG&E on Existing Initiatives or Programs
(n=913 respondents)



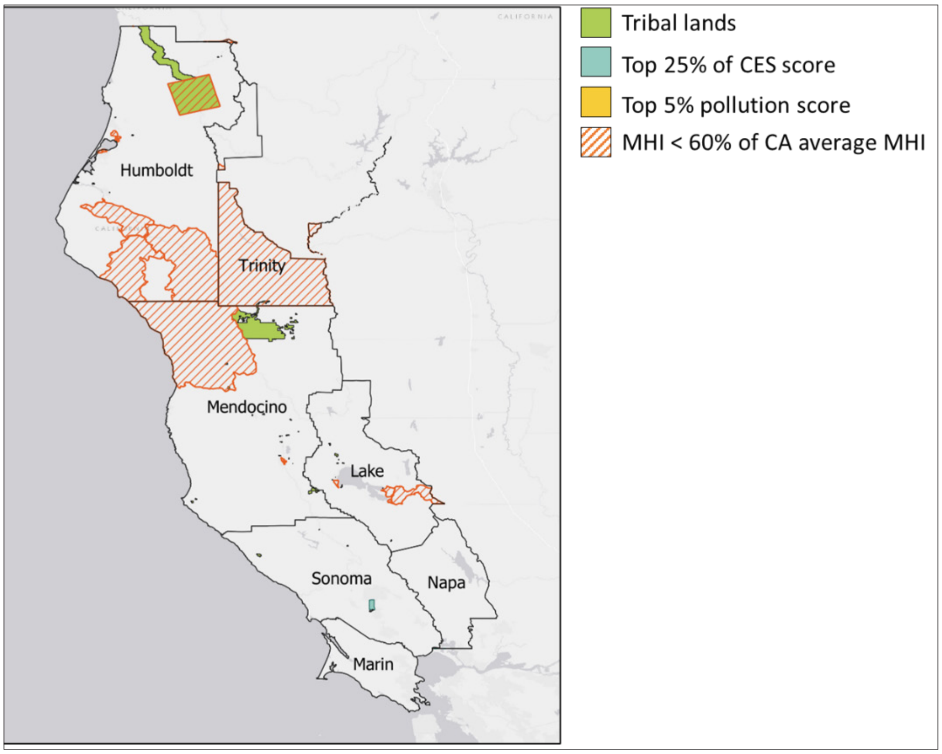
Research Interviews

The Project Team conducted a series of interviews with RTAG candidates in the North Coast Region. Research interviews were conducted with RTAG candidates to help the Project Team better understand (1) community demographics and language needs, (2) climate hazards/impacts, adaptive capacity, and preferred resilience strategies, (3) their capacity and interest in participating on the RTAG, and (4) existing reports/data that could inform the Climate Vulnerability Assessment. The summary report of these interviews can be found in Appendix J. Findings from these interviews that address objective (2) are interwoven throughout the following sections of this regional summary report.

Climate Vulnerable Communities

Figure D.6 shows disadvantaged and vulnerable communities in the North Coast Region based on the California Public Utility Commission's definition.

FIGURE D.6 North Coast Region Disadvantaged and Vulnerable Communities



In the North Coast Region, community leaders interviewed by Outreach Partners and RTAG members identified low-income people as the most vulnerable populations. Low-income people cannot afford to mitigate climate impacts by upgrading their home, installing air conditioning, or purchasing a generator when the power goes out.

RTAG members also identified the elderly and disabled, and others with compromised health conditions, as particularly vulnerable in the region. Many elderly residents live alone in remote areas that are not easily accessible (particularly in Lake County). This makes it challenging for them to receive resources and information to help them prepare for climate hazards and to evacuate.[87] Community leaders noted that the elderly might also lack community connections and may have difficulty understanding what is happening regarding climate hazards or actions they can take to protect themselves. They are also more physiologically sensitive to changes in their environment (e.g., smoke, heat, etc.).

Renters and people living in older housing or trailer parks are generally at a disadvantage when it comes to staying safe, based on feedback from community leaders. Renters have little control over decisions related to home hardening or other risk-reducing home improvements. Property owners are the ones that can make decisions about what modifications to make on-site. RTAG members shared that in a tight housing market, renters are concerned to request household safety improvements out of fear the landlord will raise the rent.

The North Coast Region RTAG made the following qualifications or additions to the list of vulnerable community types outlined in Table D.4 of this report.

87 Many areas lack more than one access road.

Qualifications

- Essential workers refer to those that are essential to the health and well-being of the community, including health care workers, social workers, day laborers, agricultural workers, law enforcement, and firefighters
- Day laborers are different than essential workers

Additions

- People with medical problems or difficulty breathing
- Rural communities
- Domestic workers

Table D.5 provides information on climate vulnerable communities, community demographics, and languages spoken based on data collected from research interviews with RTAG candidates. Because RTAG candidates represent specific areas of the North Coast Region, not all counties are included.

TABLE D.5 Climate Vulnerable Communities in Select North Coast Region Counties

County	Climate Vulnerable Communities	Community Demographics	Languages Spoken
Humboldt	Cities of Arcata (specifically the neighborhoods of Downtown, Valley West, by the university, and by the Mad River) and Eureka. The unincorporated neighborhoods of Humboldt Bay, Field's Landing, King's Salmon, and Samoa	Native American, Asian (Hmong), White, Latinx communities, including Mexican, Central American, Indigenous Latin Americans, unhoused residents, many with disabilities	Spanish, Hmong, Latin American Indigenous dialects like Mixteco, Triqui, and Zapoteco
Lake	Cities of Clearlake, Lakeport, Cobb, and Kelseyville. The unincorporated neighborhoods of Lucerne and near Cobb Mountain	Native American, White, Latinx	Spanish
Mendocino	Cities of Ukiah, Willits, and Fort Bragg. The unincorporated neighborhoods of Talmadge, Little Lake Valley, and Anderson Valley, as well as mountainous areas like Sherwood Road, Brooktrails, and Pine Mountain	Native American, Asian (Chinese, Japanese, Filipino, and Hmong), White, Russian, Latinx communities, high senior population	Spanish, Mandarin, Hmong, Russian
Siskiyou	The unincorporated neighborhood of Happy Camp and communities along the Klamath River	Native American, White, Asian (Hmong and Chinese), Latinx	Spanish, Hmong, Mandarin, Cantonese, Khmer
Trinity	Note: None of the interviewees were focused on Trinity County and didn't disclose specific affected communities.	Native American, White, Asian (Hmong), Latinx	Spanish, Hmong

Climate Hazards and Impacts

In the North Coast Region, compounding and cascading disasters in the highly rural, heavily forested region have resulted in widespread devastation unrivaled across PG&E's service areas. Power outages, extreme heat (and cold), flooding, sea level rise, and wildfires (in addition to mudslides as a secondary hazard) were all identified as hazards of concern. Power outages were reported to often last long periods of time, as this region is marked by both poor transmission infrastructure and high wildfire risk. Most households are not equipped with backup power generation or batteries during power outages, resulting in residents who are 'trapped at home' in remote areas without access to food and water. Power outages impact households' ability to heat their home, which results in reliance on wood and increases the risk of people falling ill from a cold.

Power outages compound the impact of heat waves, which have become more frequent and pose a particular risk to elderly, low-income, and unhoused communities. Most households lack air conditioning due to historically moderate temperatures, and inland county residents are increasingly uncomfortable in their homes during extreme heat days.

In addition, evacuations and post-disaster recovery are particularly fraught in the region. Rural communities in the region have few routes in or out and are cut off from those roads when fires or flooding occur, restricting access to food and resources. Many residents have been dropped by their home insurance companies, and have faced exorbitant motel rates during evacuations in a region that lacks emergency shelters and other resources, support, and aid from governmental organizations or PG&E. The housing crisis and gentrification have compounded climate hazards and have led to the creation of "tent cities" and permanent displacement of community members. Those who do rebuild are concerned about having mortgages well into retirement and others have left the county or state as "climate refugees."

Throughout the Outreach Period, community members and RTAG members were asked about the impacts they have experienced or are most concerned about during power outages, extreme heat events, and when wildfire smoke is present. Additionally, community members were asked about the impacts of climate hazards on their mental health. A summary of the key findings on impacts for the North Coast Region is presented in Table D. C. B. 6.

TABLE D.6 Summary of Key Impacts in the North Coast Region

Hazard	Health Impacts	Economic Impacts	Household/Community Impacts
Power Outage	Medical devices are interrupted Loss of medication Elderly physically unable to start generators Sickness due to lack of heat	Day laborers can't work because no electricity on site Sickness results in loss of work/ income Cannot afford generator/fuel to run generator Loss of food from refrigerators not working	Residents rely on food banks/ community groups to deliver food Gas stations shut down, can't fuel generators Can't use water pumps/ loss of water access Can't charge phones or watch TV Loss of internet and communication Cannot cook Appliance damage from power surges

Hazard	Health Impacts	Economic Impacts	Household/Community Impacts
Extreme Heat	Higher asthma rates Heat exhaustion, illness (heat stroke, dehydration), and mortality Mental health Discomfort Seizures	Cannot afford to use air conditioning Agricultural and construction workers lose hours/income Higher energy bills	School closures affect childhood education Loss of childcare
Wildfires and Smoke	Unsafe working conditions Greater asthma rates Lack of reliable evacuation routes Difficulty accessing food & resources Health impacts on animals/pets	Agricultural and construction workers lose hours/income Local businesses close Loss of tourism Household financial instability Loss of savings High motel rates during evacuations Higher rents and insurance Property damage to homes and businesses	Housing shortages and gentrification School closures/ loss of education Loss of childcare Community relocation/ displacement Roads cut off limit access to goods and services Residents cannot retire Loss of home insurance Semi-permanent tent cities Children can't play outside/ outdoor sports canceled

Power Outages

Power outages are key climate hazards in Trinity, Mendocino, and Humboldt counties. Power outages occur frequently, resulting in reduced hours at work, life-threatening medical emergencies, and a loss of food and refrigerated medicines. Outages sometimes last for weeks, particularly in rural areas, requiring residents to rely on food banks,[88] community groups, and neighbors. Community members in Leggett, Mendocino County, noted that they were without power for three weeks during a winter storm. Through survey and outreach board engagement, 1477 responses were provided to the question "What impacts of power outages have you experienced or are most concerned about?" The response options differed between the survey and the outreach boards, and survey respondents and outreach board participants were allowed to provide more than one response. The survey asked about three specific impacts for power outages, plus an option for "Other." In contrast, the outreach board provided ten options for climate related impacts that participants have experienced. These ten impact options were provided for power outages, extreme heat, wildfire smoke, and flooding and sea level rise on the same board.

88 Food banks were also named as a place where people get their news from PG&E.

The top responses for the survey and outreach board are highlighted in Figure D.7 and Figure D.8, respectively. The survey data shows the top impact for power outages is "Other"(29 percent), followed by "Loss of Work & Childcare» and "No Air Conditioning" (26 percent) and "Medical Equipment Issues" (19 percent). The top impact for power outages through the outreach boards is "No Air Conditioning" (21 percent), followed by "Childcare" (15 percent) and "Poor Indoor Air Quality" (15 percent). The qualitative data from the RTAG, survey, and the outreach boards are reflected in the following sections on Health Impacts, Economic Impacts, and Household/ Community Impacts due to Power Outages.

FIGURE D.7 Impacts Experienced or that Cause Concern during Power Outages (Survey) (n=1219 responses)

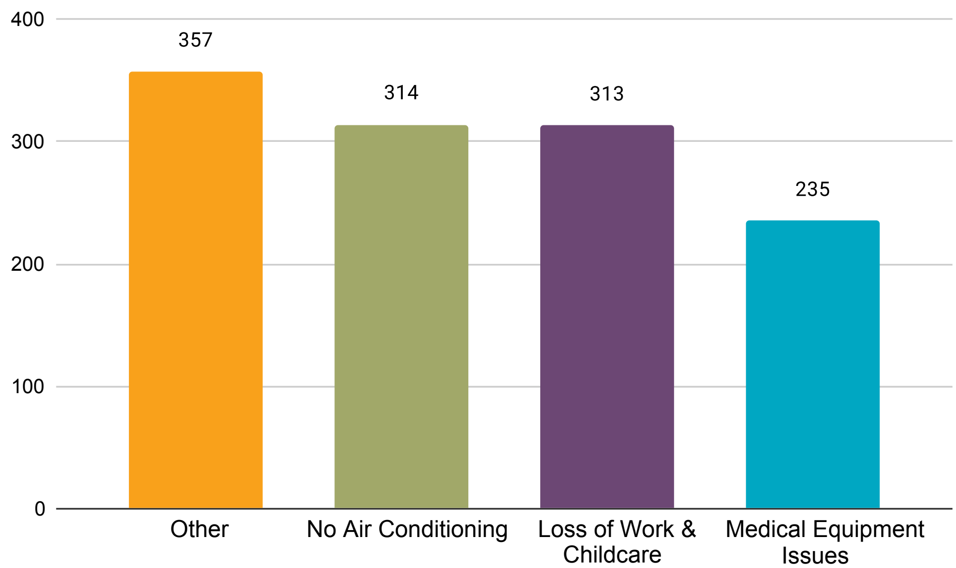
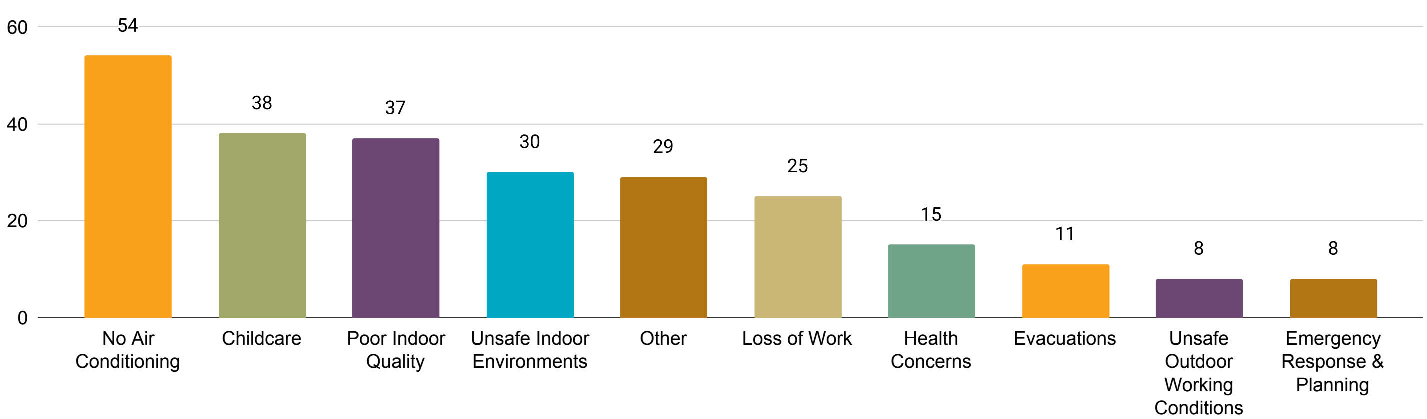


FIGURE D.8 Impacts Experienced or that Cause Concern during Power Outages (Outreach Boards) (n=255 responses)



Health Impacts Due to Power Outages

> **"An elderly woman lost power for two weeks. We had to plug in her oxygen machine to her car to keep breathing."**

There are several health impacts due to power outages that survey respondents and RTAG members highlighted. For example, those who rely on oxygen tanks or other electric medical devices are at risk. Additionally, elderly populations on fixed incomes cannot afford to run generators or replace spoiled food as a result of power outages and are more likely to experience health impacts as a result. Interview participants also noted that some community members, particularly the elderly, are physically unable to start generators. RTAG members and survey respondents also noted concern for community members getting sick because they cannot heat their homes when they experience loss of power.[89] The top two survey responses and outreach board selections indicate an inability to use air conditioning due to power outages.

The survey asked participants if anyone in the household relies on medical equipment. Of the 1093 survey respondents that answered this question, 17 percent do rely on medical equipment. As mentioned earlier, approximately 19 percent of survey responses indicate concern about, or experience with, medical equipment issues. Additionally, survey respondents expressed concern that they are not able to run their air purifiers on days when the air quality is poor.

Economic Impacts Due to Power Outages

In terms of the economic impacts of power outages, survey respondents are most concerned with the loss of work and childcare. Survey respondents were also concerned about the financial impact of running generators in lieu of having power. RTAG members highlighted that spoiled food from refrigerators not working during power outages impacts low-income households that cannot afford to replace lost food. Food loss also came up often from survey respondents and outreach board participants.[90]

Research participants noted that day laborers are impacted financially by power outages because employers cancel, as there is no electricity on site, or they become sick due to the lack of heat and therefore cannot go to work. This results in cascading financial impacts, including an inability to pay medical bills.

Many community members cannot afford a generator, and even for those who do have a generator, many cannot afford the expense of fuel to run the generator over significant periods of time. Survey respondents reported that power outages are costly, and energy bills are still high despite gaps in service.

Household/Community Impacts Due to Power Outages

> **"My children cannot go to school and almost everything in our area shuts down."**

During power outages, the region experiences additional community-wide impacts in addition to health and economic impacts (which are also affected on a community-wide level). Outages have sometimes lasted for weeks, particularly in rural areas, requiring residents to rely on food banks and neighbors to access food and ice. RTAG members noted that it is not sufficient just to have one source of backup energy. Even those who have generators (many do not) may have difficulty accessing gas to fuel the generator because gas stations shut down or face noise complaints due to the loud nature of the generators. Community members also noted that running generators for community centers during peak hours is costly. Low-income seniors may have trouble accessing food if their families cannot drop off groceries during outages, and many rely on community groups to provide this service. An unsheltered survey respondent shared that power outages affect their ability to access services.

89 Survey respondents identified loss of heat as an impact approximately 65 times.

90 Survey respondents identified food loss as an impact about 100 times.

Power outages cause damage to and/or disable water pumps that community members rely on for drinking water, while also limiting access to toilets and showers. Survey respondents also expressed concern for disruptions of the internet, which impacts their ability to communicate since there is no or limited cell service. Internet disruptions also limit the ability of students to complete online classes. Community members expressed that some areas lose all communication access due to cell phone dead zones during PSPS events. Respondents also noted they are unable to cook at home during power outages and reported broken appliances due to power surges. Community members noted that in rural areas there is often only one route in and out of town and expressed concern for a lack of emergency routes for PG&E to use to access damaged lines or power infrastructure.

Power Outage Impacts by County

Survey and outreach board data of key power outage impacts by county[91] is shown in Table D.7 below. Interview participants shared that power outages are of particular concern in Humboldt, Mendocino, and Trinity counties. Of the three impacts provided as options, the top impact differed between the three North Coast Region counties. For Humboldt County survey respondents and outreach board participants, while "Other" is the top answer, the highest single reported impact is "Loss of Work / Childcare." Lake and Mendocino County respondents reported "No Air Conditioning" as the top single impact. Trinity County respondents and participants identified "Health Concerns/Medical Equipment Issues" as the top impact.

TABLE D.7. Power Outage Impacts by County
(Survey Responses & Outreach Board Participants) (n=1247 responses)

County	% of Respondents	Responses		
		No Air Conditioning	Health Concerns/ Medical Equipment Issues	Loss of Work/ Childcare[92]
Humboldt	19%	8%	12%	19%
Lake	19%	32%	12%	20%
Mendocino	76%	16%	16%	32%
Siskiyou	0%	0%	0%	0%
Trinity	17%	27%	24%	12%

The values in this table may not total 100% across the response categories for counties because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by county

Power Outage Impacts by Racial Background

Survey data of key power outage impacts by racial background is represented as percentages in Table D.8 below. "No Air Conditioning" and "Loss of Work & Childcare" are the top impacts from power outages across most of the racial background categories. While White survey respondents (the largest representation of respondents) and Two or More Race respondents reported other impacts, "No Air Conditioning" and "Loss of Work" are the top impacts, respectively. Native Hawaiian and Pacific Islander respondents reported a relatively even split across the key impacts.

91 The counties presented in D.7 are the North Coast Region counties. The other 10 percent of respondents are from counties outside of this region.

92 This includes "Loss of Work & Childcare" responses from the survey, which combined these responses in addition to "Loss of Work" and "Childcare" responses from the outreach boards.

TABLE D.8 Power Outage Impacts by Racial Background (Survey Responses) (n=838 responses)

Racial Background	% of Respondents	Responses: No Air Conditioning	Responses: Medical Equipment Issues	Responses: Loss of Work & Childcare
Asian	1%	29%	14%	43%
Black or African American	1%	36%	0%	64%
Latinx or Hispanic	23%	27%	17%	33%
Native American, American Indian, or Alaska Native	6%	32%	14%	18%
Native Hawaiian and Pacific Islander	0%	33%	33%	33%
Other	2%	26%	5%	16%
Two or more races	7%	21%	17%	23%
White	59%	20%	19%	18%

The values in this table may not total 100% across the response categories for racial backgrounds because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by race.

Power Outages Impacts by Income Level

Survey data of key power outage impacts by income level is represented by percentages in Table D.9 below. Although other impacts were reported for each group, "No Air Conditioning" is the top single impact from power outages across survey respondents that indicated their income level as high-income and "Loss of Work & Childcare" is the top impact for low-income respondents. Survey respondents that indicated their income level as extremely low-income equally reported "Loss of Work & Childcare" and "No Air Conditioning," as their top impacts, although "Other" was the top response. Respondents of moderate-income reported "Loss of Work & Childcare" as the top concern form power outages.

TABLE D.9 Power Outage Impacts by Income Level (Survey Responses) (n=1079 responses)

Income Level	% of Respondents	Responses: No Air Conditioning	Responses: Medical Equipment Issues	Responses: Loss of Work & Childcare
Extremely low-income	21%	20%	21%	20%
Low-income	47%	19%	16%	20%
Moderate-income	30%	18%	15%	27%
High-income	2%	28%	11%	17%

The values in this table may not total 100% across the response categories for income levels because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by income level.

Extreme Heat

In the North Coast Region, extreme heat is not one of the primary hazards of concern, given many counties are located along the coast which tend to have lower average temperatures. Thirty survey respondents reported no impacts of extreme heat. However, RTAG members noted that Sonoma County is already experiencing impacts from extreme heat, particularly in inland communities. Survey respondents also expressed concern that heat exacerbates other hazards including wildfires and drought. Many RTAG members, especially in Humboldt and Mendocino counties, noted that residents are more concerned about cold weather, particularly when there is no power to heat homes.

Through survey and outreach board engagement, 1,575 responses were provided to the question "What impacts of extreme heat have you experienced or are most concerned about?" The survey asked about three specific impacts for Extreme Heat, plus an option for "Other." In contrast, the outreach board provided ten options for climate related impacts that participants have experienced, which were provided for power outages, extreme heat, and wildfire smoke on the same board. These ten impact options were provided for power outages, extreme heat, wildfire smoke, and flooding and sea level rise, on the same board.

The top responses for the survey and outreach board are highlighted in Figure D.9 and Figure D.10, respectively. The survey data shows the top impact for extreme heat is "Health Concerns," accounting for 40 percent of survey responses, followed by "Harsh Outdoor Working Conditions" at 32 percent. The outreach board data shows the top impact for extreme heat is also "Health Concerns," representing 16 percent, while "Emergency Response and Planning" was the lowest impact at one percent. The qualitative data from the RTAG, survey, and the outreach boards are reflected in the following sections on Health Impacts, Economic Impacts, and Household/ Community Impacts due to Extreme Heat.

FIGURE D.9 Impacts Experiences or that Cause Concern during Exteme Heat (Survey Respondents) (n=1365 responses)

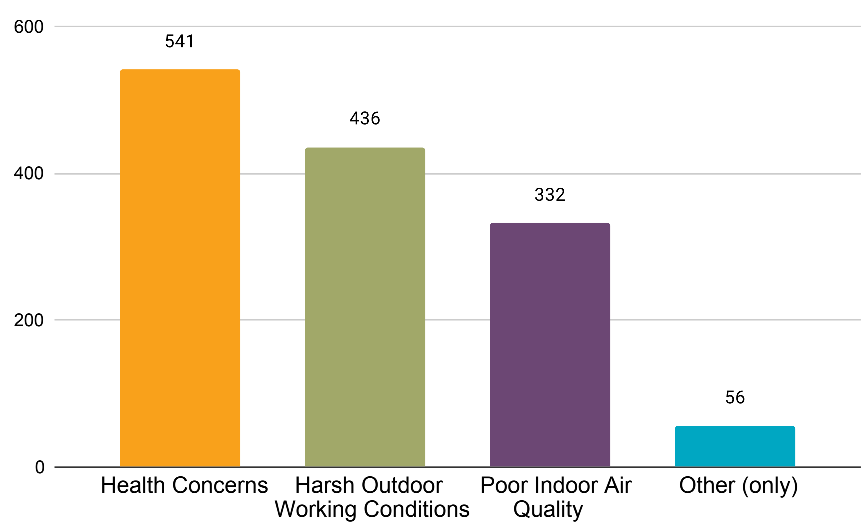
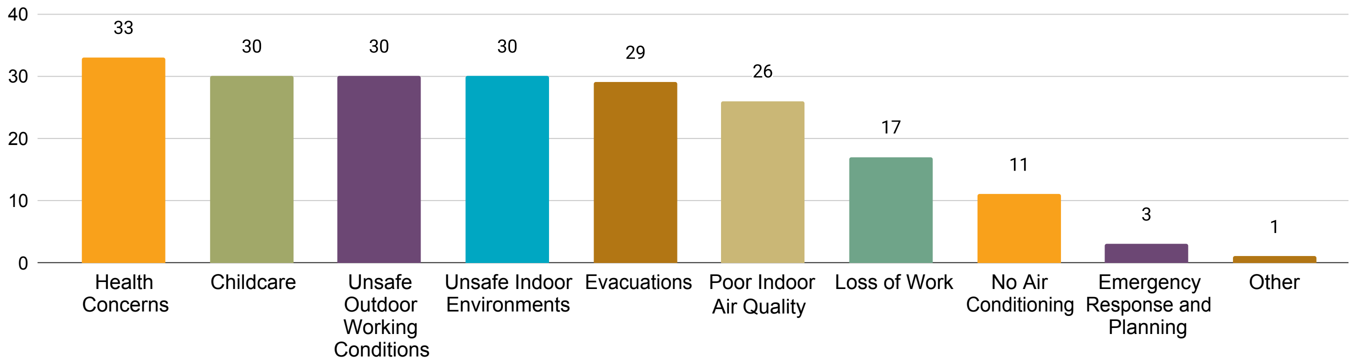


FIGURE D.10 Impacts Experienced or that Cause Concern during Extreme Heat (Outreach Board Participants) (n=210 responses)



Health Impacts Due to Extreme Heat

With respect to extreme heat, survey respondents and outreach board participants identified "Health Concerns" as the top impact. Research participants shared that the unhoused are particularly vulnerable to extreme heat and some were seen lying unconscious or "laid out in the street" from heat exhaustion in Sonoma County. One survey respondent shared they had four heat strokes last year, and another shared they had a seizure disorder that was triggered by the heat. RTAG members emphasized that the unhoused also experience the greatest mental health impacts and are the most uncomfortable during extreme heat events because they have nowhere to go to cool off from the heat. Survey respondents noted that most warming and cooling centers are not open on Sundays. RTAG members reported heat stroke and dehydration as health impacts of concern from extreme heat. Survey respondents also expressed concern for the health of their animals during extreme heat.

> **"I have witnessed the extreme suffering and early death caused by heat stroke among the people I serve in the mental health and homeless communities, devastating. There is often no water for these neighbors and no cool respite either."**

Economic Impacts Due to Extreme Heat

Research participants shared that agricultural and construction workers experience reduction in hours along with their income during heatwaves. RTAG members also reported that community members experience higher power bills during extreme heat and cold events. Survey respondents also reported that homeless people who live in their car cannot afford the gas to run their air conditioning, and the car overheats.

> **"Because we cannot afford to run our already poor running air conditioner during high heat months, we have been trying to leave it off in order to survive the financial hardships."**

Around 32 percent of survey responses were related to "Harsh Outdoor Working Conditions" as an impact people have experienced or are most concerned about during extreme heat events. About 14% of outreach board responses were related to "Unsafe Outdoor Working Conditions."

Household/Community Impacts Due to Extreme Heat

Research participants noted that there are many schools without air conditioning in Sonoma County, resulting in children being sent home early. School closures affect childhood education and put a strain on childcare for many parents. "Childcare" was the second top impact and "Evacuations" was another top response among outreach board participants. Survey respondents were also concerned about extreme heat resulting in algal blooms that make rivers toxic to drink and swim in, especially for livestock, pets, and wildlife.

Extreme Heat Impacts by County

Survey and outreach board data of key extreme heat impacts by county[93] is represented by percentages in Table D.10 below. Across all counties, the top single impact of extreme heat is "Medical Equipment Issues/Health Concerns," although Humboldt County respondents reported "Other" as the top response. This is followed by "Harsh Outdoor Working Conditions" and then "Poor Indoor Air Quality" as the third highest concern for extreme heat.

TABLE D.10 Extreme Heat Impacts by County (Survey Respondents and Outreach Board Participants) (n=1141 responses)

County	% of Respondents	Responses		
		Medical Equipment Issues/Health Concerns	Harsh Outdoor Working Conditions	Poor Indoor Air Quality
Humboldt	19%	34%	11%	22%
Lake	19%	30%	24%	20%
Mendocino	76%	31%	27%	18%
Siskiyou	0%	0%	100%	0%
Trinity	17%	31%	23.83%	22%

The values in this table may not total 100% across the response categories for counties because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by county.

Extreme Heat by Racial Background

Survey data of key extreme heat impacts by racial background is represented by percentages in Table D.11 below. The survey data shows the top impact for extreme heat for Native Americans, American Indians, or Alaska Natives, those who marked "Other," and White respondents is "Health Concerns." The single top impact for respondents of Black or African American, two or more, and Asian racial backgrounds is "Harsh Outdoor Working Conditions," although Black or African American respondents reported multiple impacts for their response. Latinx or Hispanic respondents equally reported "Health Concerns" and "Harsh Outdoor Working Conditions" as their top impact. While Native Hawaiian and Pacific Islander respondents equally reported "Harsh Outdoor Working Conditions" and "Poor Indoor Air Quality" as their top and only impacts. They also equally reported multiple impacts for their response to experiences or concerns about extreme heat.

93 The counties presented in D.10 are the North Coast Region counties. The other 8 percent of respondents are from counties outside of this region.

TABLE D.11 Extreme Heat Impacts by Racial Background (n=977 responses)

		Responses		
Racial Background	**% of Respondents**	**Health Concerns**	**Harsh Outdoor Working Conditions**	**Poor Indoor Air Quality**
Asian	1%	25%	42%	33%
Black or African American	1%	42%	33%	18%
Latinx or Hispanic	23%	27%	27%	18%
Native American, American Indian, or Alaska Native	6%	33%	26%	19%
Native Hawaiian and Pacific Islander	0%	0%	33%	33%
Other	2%	34%	21%	24%
Two or more races	7%	26%	27%	25%
White	59%	25%	26%	19%

The values in this table may not total 100% across the response categories for racial backgrounds because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by race.

Extreme Heat Impacts by Income Level

Survey data of key extreme heat impacts by income level is represented by percentages in Table D.12 below. As is the case across racial backgrounds, the top impact for extreme heat is "Health Concerns." "Harsh Outdoor Working Conditions" is the second most reported impact. The third highest impact across income levels for extreme heat is "Poor Indoor Air Quality."

TABLE D.12 Extreme Heat Impacts by Income Level (Survey Respondents) (n=1034 responses)

		Responses		
Income Level	**% of Respondents**	**Health Concerns**	**Harsh Outdoor Working Conditions**	**Poor Indoor Air Quality**
Extremely low-income	21%	32%	26%	14%
Low-income	47%	30%	25%	19%
Moderate-income	30%	29%	25%	21%
High-income	2%	36%	32%	23%

The values in this table may not total 100% across the response categories for income levels because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by income level.

Wildfires and Smoke

Through survey and outreach board engagement, 1943 responses were provided to the question "What impacts of wildfire smoke have you experienced or are most concerned about?" The response options differed between the survey and the outreach boards, and survey respondents and outreach board participants were allowed to provide more than one response. The survey asked about three specific impacts for wildfire smoke, plus an option for "Other." In contrast, the outreach board provided ten options for climate related impacts that participants have experienced. These ten impact options were provided for power outages, extreme heat, wildfire smoke, and flooding and sea level rise on the same board.

The top responses for the survey and outreach board are highlighted in Figure D.11 and Figure D.12, respectively. The survey data shows the top impact for wildfire smoke is "Health Concerns," accounting for 45 percent of survey responses, followed by "Poor Indoor Air Quality" at 30 percent, then "Harsh Outdoor Working Conditions" at 22 percent. The outreach board data shows the top impact for wildfire smoke is "Poor Indoor Air Quality," followed by "Childcare." The qualitative data from the RTAG, survey, and the outreach boards are reflected in the following sections on Health Impacts, Economic Impacts, and Household/Community Impacts due to Wildfire and Smoke.

FIGURE D.11 Impacts Experienced or that Cause Concern during Wildfire Smoke (Survey Respondents) (n=1644 responses)

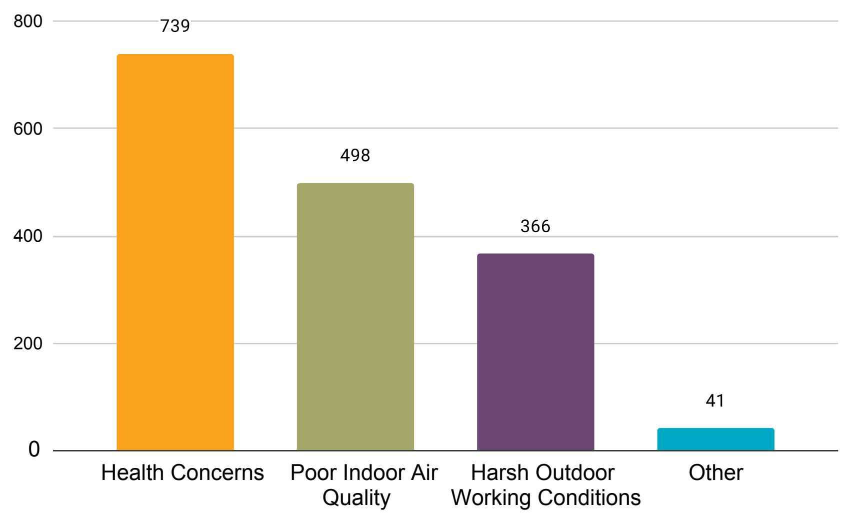
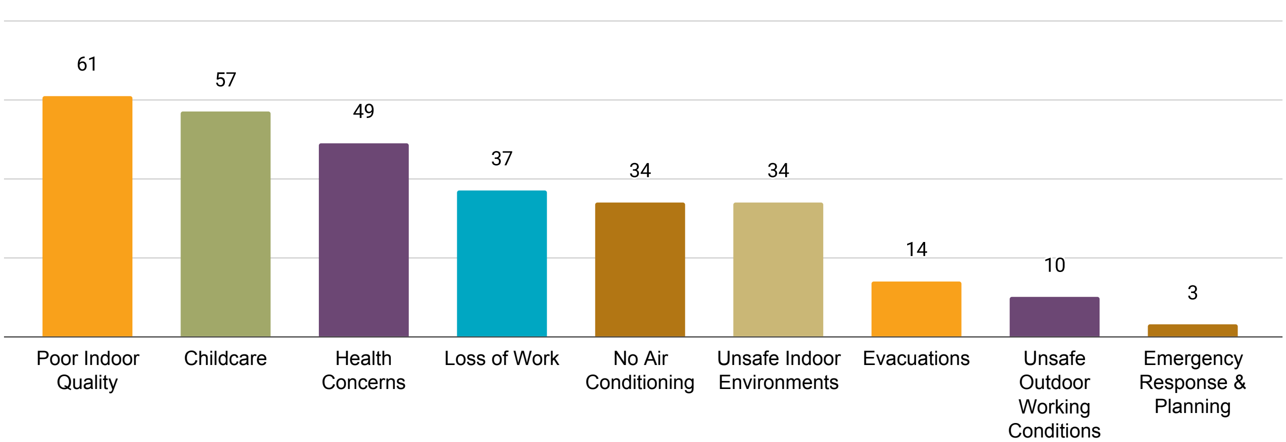


FIGURE D.12 Impacts Experienced or that Cause Concern during Wildfire Smoke (Outreach Board Participants) (n=299 responses)



Health Impacts Due to Wildfires and Smoke

> **"Since the fires in 2017, we've been fighting for farmworkers protections because the challenge was the wine industry folks were using their political pushes to kill legislation. People were being forced to work."**

Survey respondents and RTAG members expressed concern for outdoor air quality resulting in respiratory impacts. Survey respondents were particularly concerned with the health of children. Though "Unsafe Outdoor Working Conditions" is not a top response among outreach board participants, RTAG members specifically noted a lack of workforce protections for farmworkers during wildfire events. Many undocumented, Latinx, immigrant, low-wage workers don't qualify for government aid, including FEMA aid or unemployment, resulting in them working despite unsafe outdoor working conditions. Latinx immigrant, low-wage workers are also hired to do wildfire clean-up remediation work at extremely low wages with unscrupulous working conditions. These workers are exposed to smoke and toxic substances while doing the work, exacerbating economic and health disparities within the Latinx community. Because of the rural nature of the region, many residents lack reliable evacuation routes during disasters and have difficulty accessing food and resources pre- and post-disaster.

Wildfire smoke has resulted in greater asthma rates in the region and poses a health risk to those who already suffer from asthma. Responses related to health concerns were the top responses for wildfires and smoke through the surveys and outreach boards, which were also the primary impacts of extreme heat.[94] Survey respondents were primarily concerned with poor air quality affecting the health of people and animals, including not being able to go outside and exercise.

Economic Impacts Due to Wildfires and Smoke

Wildfires have a significant economic impact on the region. Agricultural and construction workers experience reduction in hours along with their income during wildfires. RTAG members also noted that farms experience crop losses and smaller yields as a result of wildfires and wildfire smoke, which results in lost income. Many local businesses have closed after wildfires, and tourism suffers, both of which hurt the local economy and workforce.

In addition, wildfire smoke can result in property damage to homes and businesses. RTAG members noted that people have to shampoo their carpets that collect ash from smoke, and homes continue to smell like a fire even after the fire has stopped. Survey respondents also noted smoke damage to household furniture and goods.

Wildfires result in household financial instability, as many families who could not afford renters' insurance had to expend all their savings to get motels or find housing. Survey respondents noted how evacuations result in lost income because people are not able to go to work. "Loss of Work" was one of the top four impacts based on outreach board responses. At the same time, residents face exorbitant motel rates during evacuations. RTAG members and survey respondents also shared that community members experience higher rents and insurance premiums after wildfires.

Household/Community Impacts Due to Wildfires and Smoke

Interview participants shared that the most critical community impact of wildfires is community displacement and gentrification. Many Black family renters have left the area to find cheaper housing. In addition, many of the tenants in rental properties in Santa Rosa were displaced because their landlords' owner-occupied properties had burned down, and the landlords then moved into their investment properties (that were previously rented). Interview participants shared that wildfire events impacted the affordability of housing and displaced many residents, particularly in Lake County. For some who have had to rebuild homes, residents expressed concern that their new mortgages have extended well into retirement.

94 Responses related to unsafe outdoor working conditions and unsafe indoor environments are also related to health concerns.

For residents that lost their home during a wildfire, those without savings were at risk of becoming homeless because they didn't receive FEMA assistance. RTAG members also shared there is a lack of emergency shelters, particularly those that accommodate the larger families common in Native communities. High costs of hotels during hazard events results in semi-permanent "tent cities." Many residents who are not able to afford to rebuild their home are forced to relocate outside the county or out of state. Participants shared that many residents have been dropped by their home insurance companies due to high fire risk.

In both Mendocino and Humboldt counties, limited and circuitous roads used to deliver food from other parts of the state, like the Central Valley, were also cut off during faraway fires, landslides, and floods. This was reported to result in empty store shelves in many towns that already have limited stores available for residents.

Lastly, RTAG members noted that kids are not able to play outside, and schools are closed because of poor air quality. Outreach board participants selected "Childcare" most often as an impact of concern, after "Poor Indoor Air Quality."

Wildfire Smoke Impacts by County

Survey and outreach board data of key wildfire smoke impacts by county[95] is represented by percentages in Table D.13 below. "Medical Equipment Issues/Health Concerns" is the top impact from wildfire smoke across all counties. This is followed by "Poor Indoor Air Quality" and then "Harsh Outdoor Working Conditions."

TABLE D.13 Wildfire Smoke Impacts by County (Survey Respondents & Outreach Board Participants) (n=1457 responses)

County	% of Respondents	Responses		
		Medical Equipment Issues/Health Concerns	Poor Indoor Air Quality	Harsh Outdoor Working Conditions/Unsafe Outdoor Working Conditions
Humboldt	19%	79%	1%	3%
Lake	19%	34%	25%	20%
Mendocino	76%	34%	27%	18%
Siskiyou	0%	0%	0%	0%
Trinity	17%	33%	24%	22%

The values in this table may not total 100% across the response categories for counties because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by county.

Wildfire Smoke Impacts by Racial Background

Survey data of key wildfire smoke impacts by racial background is represented by percentages in Table D.14 below. The survey data shows the top impact for wildfire smoke is "Health Concerns," for most counties. However, Black or African American and Asian respondents selected multiple impacts for their response. Native American, American Indian, or Alaska Native respondents, equally reported "Poor Indoor Air Quality" and "Health Concerns" as their top impact. While Asian respondents reported multiple impacts, their top single reported impact is "Harsh Outdoor Working Conditions."

95 The counties presented in D.13 are the North Coast Region counties. The other 8 percent of respondents are from counties outside of this region.

TABLE D.14 Wildfire Smoke Impacts by Racial Background (Survey Respondents) (n=1135 responses)

Racial Background	% of Respondents	Responses		
		Health Concerns	Poor Indoor Air Quality	Harsh Outdoor Working Conditions
Asian	1%	0%	14%	29%
Black or African American	1%	23%	8%	23%
Latinx or Hispanic	23%	28%	27%	23%
Native American, American Indian, or Alaska Native	6%	30%	30%	17%
Native Hawaiian and Pacific Islander	0%	67%	0%	0%
Other	2%	31%	27%	23%
Two or more races	7%	32%	26%	27%
White	59%	36%	23%	20%

The values in this table may not total 100% across the response categories for racial backgrounds because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by race.

Wildfire Smoke Impacts by Income Level

Survey data of key wildfire smoke impacts by income level is represented by percentages in Table D.15 below. The wildfire smoke impacts of highest concern are consistent across income levels. The survey data shows "Health Concerns" is the top impact from wildfire smoke across all income levels. "Poor Indoor Air Quality" is ranked as the second highest impact and "Harsh Outdoor Working Conditions" is the third highest impact across all incomes.

TABLE D.15 Wildfire Smoke Impacts by Income Level (Survey Respondents) (n=1278 responses)

Income Level	% of Respondents	Responses		
		Health Concerns	Poor Indoor Air Quality	Harsh Outdoor Working Conditions
Extremely low-income	21%	40%	19%	18%
High-income	47%	40%	21%	19%
Low-income	30%	35%	23%	19%
Moderate-income	2%	42%	25%	21%

The values in this table may not total 100% across the response categories for income levels because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by income level.

Flooding and Sea Level Rise

The top responses for the survey and outreach board are highlighted in Figure D.13 and Figure D.14, respectively. The survey data shows the top impact for flooding and sea level rise is "Evacuation," accounting for 25 percent of survey responses, followed by "Water Damage to the Home"[96] and "Emergency Response and Planning", at 23 percent and 20 percent, respectively. These impacts are then followed by "Health Concerns" at 16 percent and "Loss of Work" at 15 percent. The outreach boards show "Loss of Work" as the top response (50 percent),

96 "Water Damage to the Home" was included as an option on the survey for Flooding and Sea Level Rise but not as part of the outreach boards.

followed by "No Air Conditioning" (43 percent) and "Poor Indoor Air Quality" (7 percent). There were no responses for the other categories on the outreach boards for flooding and sea level rise. The qualitative data from the RTAG, survey, and the outreach boards are reflected in the following sections on Health Impacts, Economic Impacts, and Household/Community Impacts due to Flooding and Sea Level Rise.

FIGURE D.13 Impacts Experienced or that Cause Concern during Flooding and Sea Level Rise (Survey Respondents) (n=1349 responses)

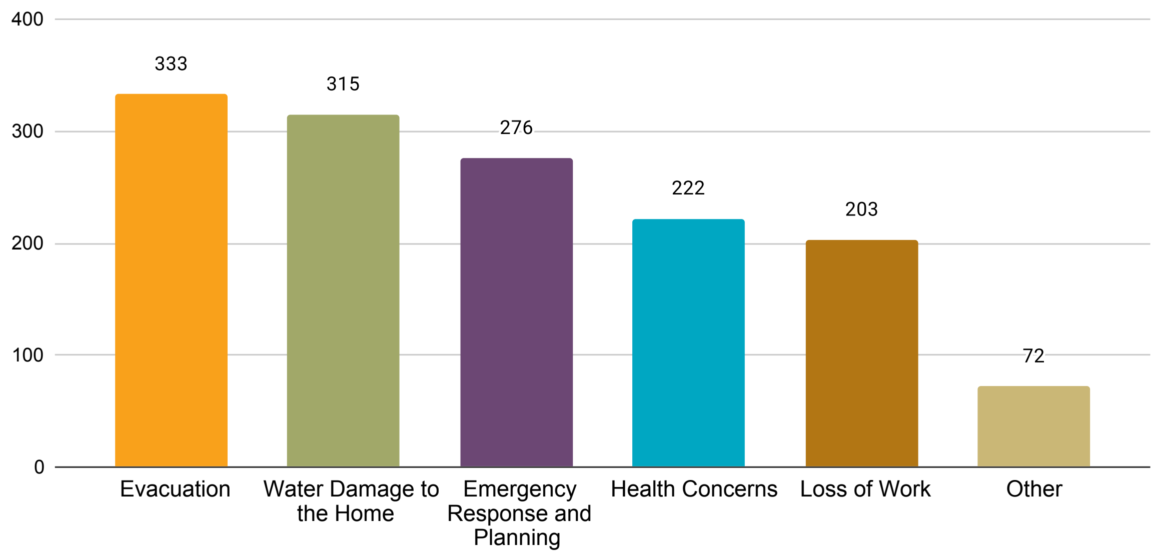
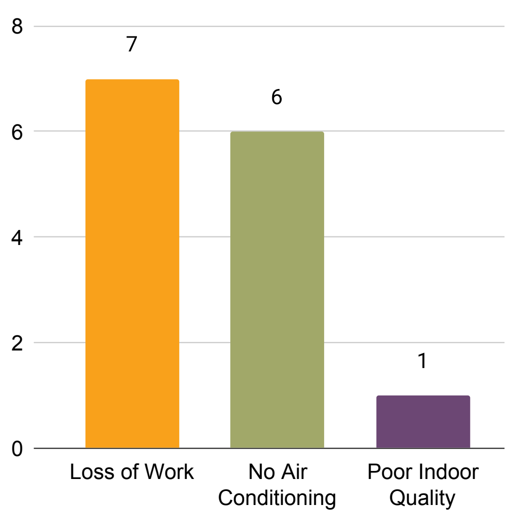


FIGURE D.14 Impacts Experienced or that Cause Concern during Flooding and Sea Level Rise (Outreach Board Participants) (n=14 responses)



Health Impacts

Survey respondents noted the physical danger of fast-moving waters as well as trees being uprooted or falling on their property as health impacts of concern with respect to flooding and sea level rise. In addition, survey respondents noted that mold is a huge issue for some households after a flood event and can impact the health of families. Survey respondents also expressed concern for flooded homeless encampments. RTAG members also noted how difficult it was to get approval to open emergency shelters due to political barriers.

Economic Impacts

RTAG members and survey respondents shared that one of the primary economic impacts of flooding is loss of work and wages, especially for outdoor workers. "Loss of Work" is the top impact among outreach board participants, and the fifth highest impact for survey respondents. Interview participants shared that flooding has resulted in household financial instability, as many families who could not afford renters' insurance had to expend all their savings to get motels or find housing. In addition, survey respondents noted that flooding results in property damage that is costly to repair.

"Storms created a lot of damage to homes. Trees came down and destroyed roofs."

Community/Household Impacts

Because of the rural nature of the region, many residents lack reliable evacuation routes during disasters and have difficulty accessing food and resources pre- and post-disaster. Survey respondents also noted travel delays and hazardous traveling conditions. In both Mendocino and Humboldt counties, limited and circuitous roads used to deliver food from other parts of the state, like the Central Valley, were also cut off during faraway fires, landslides, and floods. This was reported to result in empty store shelves in many towns that already have limited stores available for residents. Survey respondents also noted impacts on the environment, including loss of trees during storms. RTAG members also noted that they were forced to close their offices during flood events, resulting in being unable to provide community resources and services.

"We are red tagged out of one of our offices because its deemed dangerous from storm damage, so we lost our services."

Flooding and Sea Level Rise Impacts by County

Survey and outreach board data of key flooding and sea level rise impacts by county[97] is represented by percentages in Table D.16 below. For Lake and Mendocino County, respondents selected multiple impacts, but the top impacts are "Water Damage to the Home" and "Emergency Response," respectively. While "Other" is by far the top answer for Humboldt County, "Evacuation" is the top single reported impact. Trinity County respondents selected multiple impacts, but the top concern is "Water Damage to the Home" for flooding and sea level rise impacts.

TABLE D.16 Flooding and Sea Level Rise Impacts by County
(Survey Respondents & Outreach Board Participants) (n=924 responses)

County	% of Respondents	Responses				
		Evacuation	Emergency Response and Planning	Health Concerns	Loss of Work	Water Damage to Home
Humboldt	19%	6%	3%	3%	1%	3%
Lake	19%	10%	10%	9%	11%	15%
Mendocino	76%	14%	15%	10%	11%	13%
Siskiyou	0%	0%	0%	0%	0%	0%
Trinity	17%	14%	11%	12%	5%	17%

The values in this table may not total 100% across the response categories for counties because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by county.

97 The counties presented in D.16 are the North Coast Region counties. The other 8 percent of respondents are from counties outside of this region.

Flooding Impacts by Racial Background

Survey data of key flooding and sea level rise impacts by racial background is represented by percentages in Table D.17 below. For Asian respondents, "Emergency Response and Planning" is the top impact of wildfire smoke. Black or African American respondents reported "Emergency Response and Planning," as the top impact, although respondents selected multiple impacts for their response. Latinx or Hispanic respondents equally reported "Evacuation" and "Loss of Work" as the top impact, although respondents selected multiple impacts in their response. Native American, American Indian, or Alaska Native respondents equally reported "Loss of Work" and "Water Damage to the Home" as their top concerns, although multiple impacts were selected. Native Hawaiian and Pacific Islander respondents reported multiple and other responses. Other respondents reported "Loss of Work" as the top single impact although multiple impacts were selected. Two or more and White respondents reported "Emergency Response and Planning" as their top impact although both groups selected multiple impacts in their response.

TABLE D.17 Flooding and Sea Level Rise Impacts by Racial Background (Survey Respondents) (n=804 responses)

Racial Background	% of Respondents	Responses				
		Evacuation	Emergency Response and Planning	Health Concerns	Loss of Work	Water Damage to Home
Asian	1%	9%	36%	9%	9%	9%
Black or African American	1%	9%	27%	0%	9%	9%
Latinx or Hispanic	23%	15%	8%	13%	15%	14%
Native American, American Indian, or Alaska Native	6%	13%	11%	4%	15%	15%
Native Hawaiian and Pacific Islander	0%	0%	0%	0%	0%	0%
Other	2%	8%	16%	8%	24%	16%
Two or more races	7%	8%	14%	8%	5%	15%
White	59%	13%	15%	11%	8%	16%

The values in this table may not total 100% across the response categories for racial backgrounds because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by race.

Flooding and Sea Level Rise Impacts by Income Level

Survey data of key flooding and sea level rise impacts by income level is represented by percentages in Table D.18 below. The Flooding and Sea Level Rise impacts of highest concern slightly vary between income. "Evacuation" and "Water Damage to the Home" are equally reported as the top impact from flooding and sea level rise for high-income respondents. While respondents of extremely low-, low- and moderate-income reported more than one response as the top impact, "Water Damage to the Home," "Evacuation" and "Emergency Response" are the top impacts, respectively.

TABLE D.18 Flooding and Sea Level Rise Impacts by Income Level (Survey Respondents) (n=864 responses)

Income Level	% of Respondents	Responses: Evacuation	Emergency Response and Planning	Health Concerns	Loss of Work	Water Damage to Home
Extremely low-income	21%	11%	9%	12%	7%	16%
Low-income	47%	13%	12%	9%	12%	12%
Moderate-income	30%	11%	15%	10%	9%	14%
High-income	2%	26%	16%	0%	11%	26%

The values in this table may not total 100% across the response categories for income levels because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by income level.

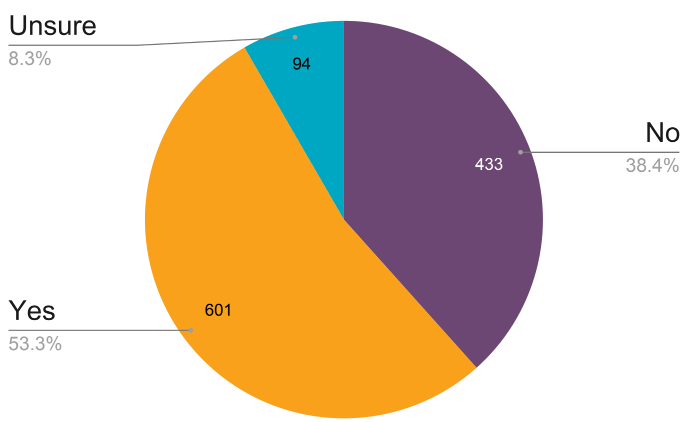
Mental Health

The survey asked about mental health impacts while the outreach boards did not include questions on mental health impacts. Participants engaged through the outreach boards did however touch on mental health impacts that are a result of other hazards and are included in the relevant sections of this report. Approximately 53 percent of respondents (n=1128) said "Yes," to the question asking if their mental health has been impacted by extreme climate events, which include heat, increased rain and flooding, wildfires, drought, and landslides (38 percent of respondents said "No" and eight percent were "Unsure").

"I live with severe PTSD and ask PG&E consider the impacts to people living with mental health challenges the same way they consider the survival and health needs of people living with medical challenges."

Power outages result in community members feeling anxious, because they cannot communicate directly with friends and family, they are unable to get news or access the internet to learn what is going on and are unable to coordinate an emergency response or plan. During extreme heat events, one survey respondent shared their experience having panic attacks. Flood and fire related evacuations can be extremely stressful for families, especially if they are not able to find/afford temporary shelter. Dealing with the aftermath of flooded or damaged homes, including the administrative burden of accessing government aid, also takes a toll on the mental health of families. Isolated communities also deal with the stress of not being able to access food and water when roads are damaged and restrict the flow of goods.

FIGURE D.15 Whether Mental Health has Been Impacted by Extreme Climate Events (Survey Respondents) (n=1128 respondents)



Mental Health Impacts by County

The Project Team also analyzed the information collected through the surveys by county.[98] Three-fourths in Lake County and half of responses in Mendocino County indicate mental health has been impacted as a result of extreme climate events.

TABLE D.19 Mental Health Impacts due to Extreme Climate Events, by County (n=986 respondents)

		Responses		
County	% of Respondents	No	Unsure	Yes
Humboldt	19%	3%	0%	10%
Lake	19%	5%	1%	25%
Mendocino	76%	21%	6%	55%
Siskiyou	0%	0%	0%	0%
Trinity	17%	3%	1%	8%

The values in this table may not total 100% across the response categories for counties because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by county.

Mental Health Impacts by Racial Background

Respondents across racial backgrounds responded "Yes" to the question asking if their mental health has been impacted by extreme climate events more than "No." Except for Native Hawaiian and Pacific Islander and Other respondents that equally reported "Yes" and "No."

TABLE D.20 Mental Health Impacts due to Extreme Climate Events by Racial Background (Survey Respondents) (n=844 respondents)

		Responses		
Racial Background	% of Respondents	No	Unsure	Yes
Asian	1%	0%	0.1%	0%
Black or African American	1%	0%	0%	1%
Latinx or Hispanic	23%	7%	4%	11%
Native American, American Indian, or Alaska Native	6%	2%	1%	3%
Native Hawaiian and Pacific Islander	0%	0.1%	0.1%	0.1%
Other	2%	1%	0%	1%
Two or more races	7%	2%	1%	5%
White	59%	23%	5%	31%

The values in this table may not total 100% across the response categories for racial backgrounds because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by race.

98 The counties presented in D.19 are Central Coast Region counties. The other 8 percent of respondents are from counties outside of this region.

Mental Health Impacts by Income Level

Across most income levels, the highest response to the question asking if their mental health has been impacted by extreme climate events is "Yes." High-income respondents equally reported "Yes" and "No."

TABLE D.21 Mental Health Impacts due to Extreme Climate Events by Income Level (Survey Respondents) (n=912 responses)

		Responses		
Income Level	% of Respondents	No	Unsure	Yes
Extremely low-income	21%	8%	1%	12%
Low-income	47%	18%	4%	23%
Moderate-income	30%	11%	3%	19%
High-income	2%	1%	0%	1%

The values in this table may not total 100% across the response categories for income levels because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by income level.

Adaptive Capacity

Based on RTAG input collected during research interviews, the North Coast Region has lower adaptive capacity compared to other regions due to geographical and technological access barriers that are associated with the rural geography of the region. Research interview participants believe service providers have trouble physically reaching communities, and the lack of broadband infrastructure and cellular service makes it difficult to disseminate information.

Regional Adaptive Capacity by County

The Project Team also evaluated the North Coast Region adaptive capacity by utilizing the Building Resilience Indicators for Communities (BRIC) Index county scores across the 6 categories and the BRIC Composite score for each county in the region (Table D.22). A description of the resilience categories is provided in the Adaptive Capacity section of the main report.

Humboldt County has the highest overall adaptive capacity, while Lake County has the lowest. Across counties, **the region performs the lowest on the "Infrastructural" resilience category**, which is consistent with RTAG input that North Coast has suffered from lack of broadband and transportation infrastructure. The category with the second lowest score is "Community Capital," suggesting that communities in the North Coast lack strong social networks and connectivity among individuals and groups. This data is consistent with RTAG member input that **the region is geographically remote and rural communities lack connection to services and resources**. The North Coast Region also has the lowest "Institutional" score compared to other regions, which is reinforced by RTAG members noting the existence of jurisdictional fragmentation.

TABLE D.22 BRIC Scores by County (High to Low)

County	Social	Economic	Community Capital	Institutional	Infrastructural	Environmental	BRIC Composite Score
Humboldt	0.642	0.453	0.356	0.326	0.281	0.572	0.438
Lake	0.604	0.427	0.333	0.382	0.210	0.554	0.418
Mendocino	0.630	0.439	0.330	0.356	0.249	0.566	0.428
Siskiyou	0.627	0.421	0.355	0.359	0.250	0.546	0.426
Trinity	0.589	0.395	0.344	0.435	0.198	0.579	0.423

* To simplify the comparison and analysis of many variables, researchers may use a normalization technique called Min-Max normalization in social indicators research. This involves scaling all values between 0 and 1 (0 represents the minimum value and 1 represents the maximum value) through adjusting all other values by subtracting the minimum value from the maximum and dividing by the range.

Supplemental Adaptive Capacity Indicators

The Resilient Together initiative survey provides supplemental data that is relevant to the evaluation of adaptive capacity for the North Coast Region. The following section describes respondents' access to financial resources, a cool space (at home or outside of home), a comfortable home, and air conditioning by select demographic characteristics. However, the data is not representative of the region as a whole and should only be referenced with context to the survey sample and in conjunction with the BRIC index results, which provide a region-wide analysis.

Access to Financial Resources

Access to financial resources enables households to access resources and services that improve their resilience in the face of climate hazards. For low-income households, increasing access to financial assistance is one of the most significant ways to increase adaptive capacity. In the North Coast Region, approximately 27 percent of survey respondents currently receive financial assistance on their utility bill, and another ten percent were unsure.[99] To qualify for financial assistance, households must meet low-income thresholds set by PG&E.[100]

Access to Cool Space

As shown in Figure D.16, approximately 32 percent of survey respondents and outreach board participants cool off in the park, school, work,[101] or community center, while 46 percent cool off in their home. The remaining 22 percent cool off at multiple places or other places. Other places listed by many participants include: other water

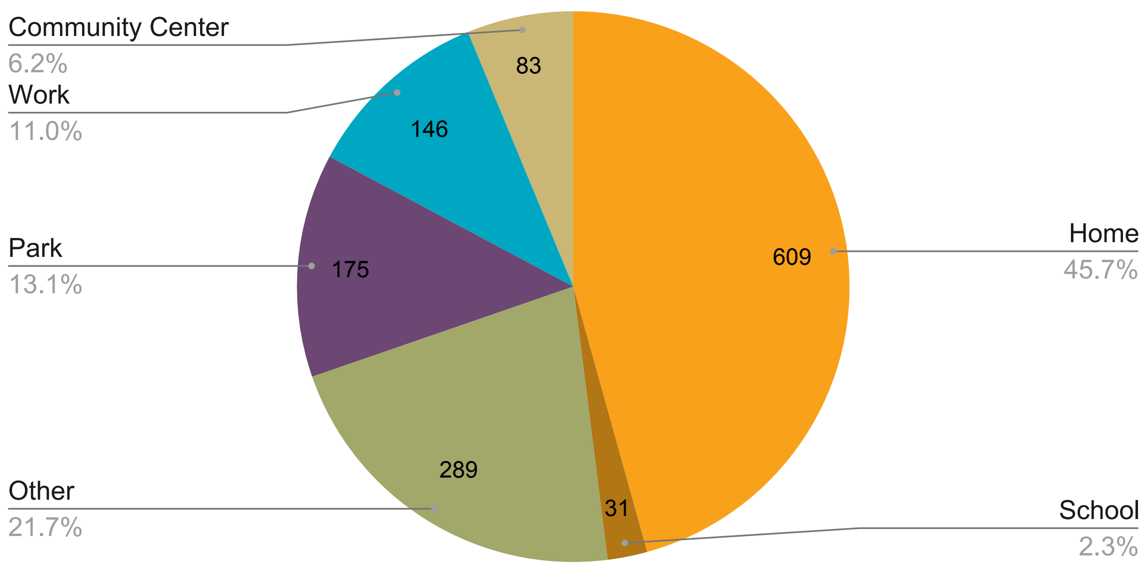
99 This question received responses from 94 percent of survey respondents, with n=1078 responses.

100 CARE / FERA program guidelines can be accessed at the below site: https://www.pge.com/en_US/residential/save-energy-money/help-paying-your-bill/longer-term-assistance/care/program-guidelines.page#qualifying

101 Work was removed from the outreach boards as an option for Regions 2–5 and was included in the online and paper surveys. Work is reflected as a response in "Other" through outreach board engagement but may be represented at a lower response level than the Bay Area Region where Work was included as an option on the outreach boards.

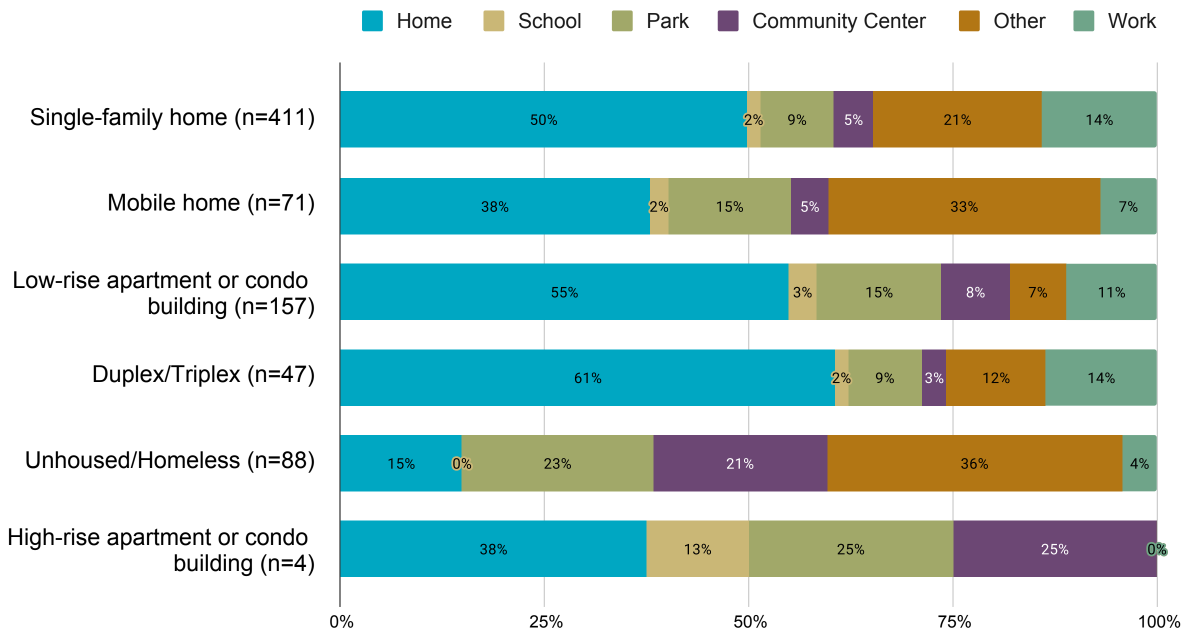
sources (pool,[102] river, ocean, lake[103]), their car or camper[104], shelter [105], senior center [106], library [107], and stores[108]. Figure D.17 illustrates where people go to cool off based on their type of home. Unhoused/homeless survey respondents and those living in high-rise apartments or condo buildings are more likely to use community centers than other groups (21 percent and 25 percent of survey responses for this group). These two groups also go to the park more than other places. Survey respondents living in high-rise apartments or condo buildings were the most likely to utilize schools as places to cool off compared to respondents with other housing types, presumably due to the higher number of children residing in these housing types.

FIGURE D.16 Where People Go to Cool Off on Hotter Days (Survey and Outreach Boards) (n=1333 responses)



102 Nine participants mentioned the pool.
103 Approximately 90 participants mentioned the lake, river, ocean, beach, or another open water source.
104 23 participants mentioned camper or car.
105 22 participants mentioned shelter.
106 Nine participants mentioned senior center.
107 Six participants mentioned library.
108 13 participants mentioned stores

FIGURE D.17 Where People Cool Off by Housing Type (Survey Respondents) (n=1138 responses)



Access to Comfortable Home

Nearly half of all survey and outreach board responses (47 percent) indicate that community members are "Comfortable" or "Very Comfortable" in their home on hotter days. RTAG members support resilience hubs/cooling centers as a strategy to adapt to extreme heat, but only a small percentage (6 percent) of survey respondents and outreach board participants indicated they cool off at existing community centers, reflecting the large number of respondents who are comfortable staying in their homes on hotter days.

For those who said they cool off at home on hotter days through the survey[109] (n=609 respondents), a little less than half of survey respondents (49 percent) indicated they are "Comfortable" or "Very Comfortable." If people are "Very Comfortable," or " Comfortable" at home, they will stay at home. But for the over 50 percent of survey respondents who are "Not at All Comfortable" or "Slightly Uncomfortable" they will go somewhere other than home to cool off.

Table D.23 shows how comfortable respondents are at home on hotter days by county, for counties in the North Coast Region for which there is data available. For Humboldt and Mendocino counties, greater than half of all survey and outreach board responses (50 percent) are "Comfortable" or "Very Comfortable" in their homes on hotter days. The county with the highest percentage of responses (> 90 percent) indicating respondents are "Comfortable" or "Very Comfortable" in their homes on hotter days is Humboldt County. The counties with the highest percentage of responses (> 50 percent) indicating they are "Slightly Uncomfortable" or "Not at All Comfortable" in their homes on hotter days are Lake and Trinity counties.

109 The level of specificity was not asked as part of this question on the outreach boards due to simplicity.

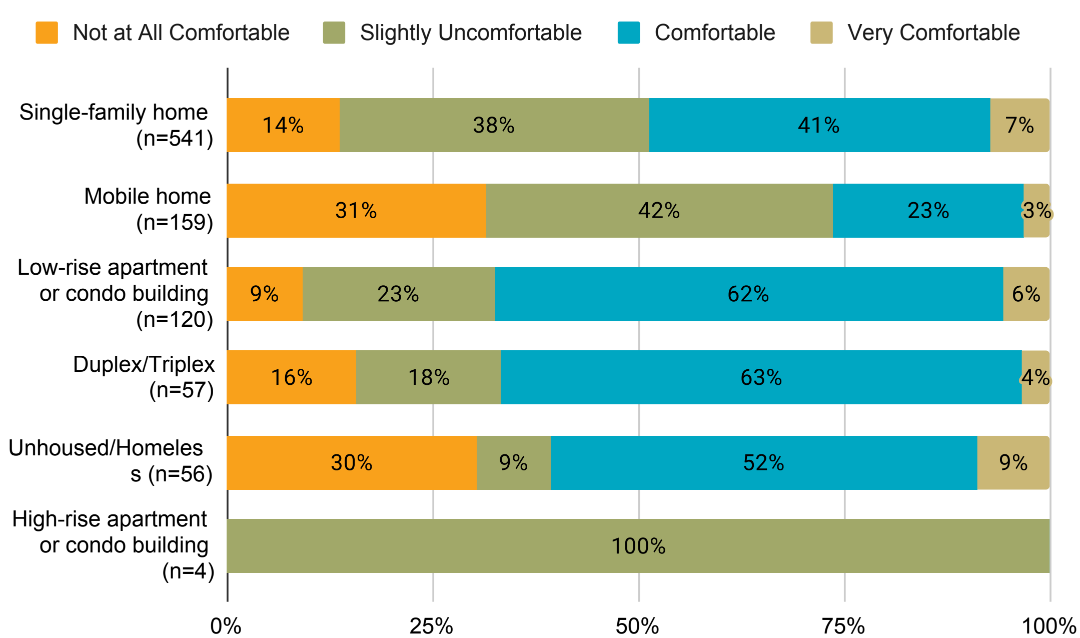
TABLE D.23 Comfort Level at Home on Hotter Days, by County (Survey Respondents and Outreach Board Participants) (n=1076 responses)

County	% of Respondents	Responses			
		Not at All Comfortable	Slightly Uncomfortable	Comfortable	Very Comfortable
Humboldt	19%	0%	7%	93%	0%
Lake	19%	31%	41%	25%	3%
Mendocino	76%	16%	31%	42%	11%
Siskiyou	0%	0%	0%	0%	0%
Trinity	17%	19%	46%	31%	4%

The values in this table may not total 100% across the response categories for counties because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by county.

Figure D.18 shows how comfortable survey respondents are at home on hotter days by housing type. The survey findings demonstrate that survey respondents living in duplex/triplex and single-family homes are the most comfortable on hotter days (on average 26 percent of extremely low and low-income respondents live in single-family homes). Those living in a mobile home, those unhoused or homeless, and low-rise apartments or condo buildings are least comfortable.

FIGURE D.18 Comfort Level in Home on Hotter Days by Housing Type (Survey Respondents) (n=937 respondents)



Access to Air conditioning

Approximately 41 percent of survey respondents and outreach board respondents (n=1062 total respondents to this question) indicate they have access to an air-conditioned space. The survey also asked those respondents who do not have access to an air-conditioned space now if they need air conditioning or not. Of the 1029 survey respondents who were asked this question, 43 percent said they do not have access to air-conditioning. Of those survey respondents, only about 19 percent (n=192 respondents) responded that they do not have access to an air-conditioned space, but they need air-conditioning. This finding is inconsistent with data collected via the outreach boards; outreach boards asked if people would need access to an air-conditioned space as it gets hotter, and 54 percent of outreach board participants said "Yes."

Resilience Strategies and Recommendations

Through the Resilient Together initiative, community and RTAG members had an opportunity to share preferred strategies for how PG&E can best build community resilience to the range of climate impacts identified in communities throughout the region. These strategies, if implemented, would increase the adaptive capacity of households and communities to a range of climate impacts.

Generally, RTAG members in the Bay Area Region recommended PG&E:

"PGE has opportunity to work with community organizations within their service area. They don't need to reinvent the wheel, why not put their effort and resources toward supporting those organizations that are doing the work already."

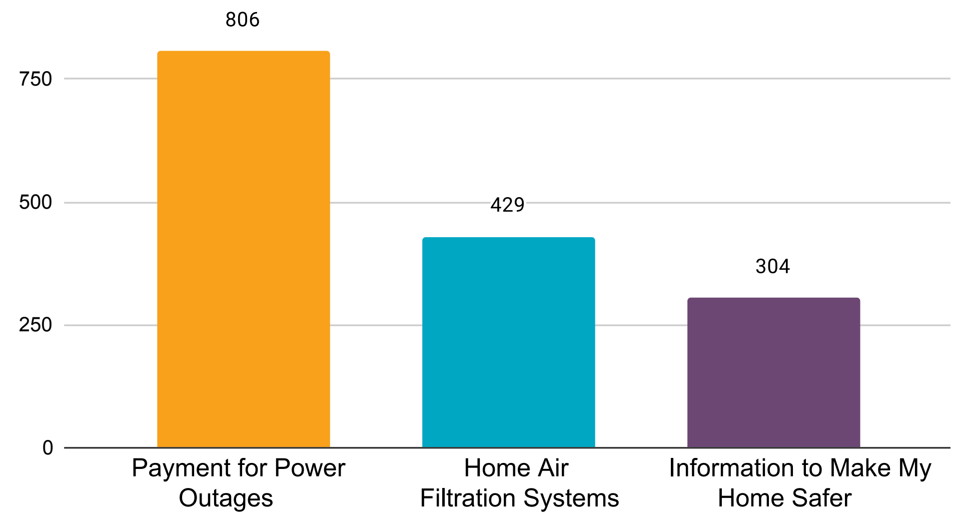
- **Provide household and personal safety equipment** including air filtration machines, generators, batteries, sandbags, cooling clothes for outdoor workers, and high-quality masks.
- **Improve access to, and greater financial support for community resilience centers or emergency shelters** that have backup power and are a central hub for distributing resources and services to community members affected by hazard events. Importantly, these shelters/community centers need to be resourced in advance of a hazard event, since hazards often damage roads and disrupt flow of goods and services to the many isolated or remote communities. RTAG members stressed the importance of providing sufficient resources to CBOs to coordinate the distribution of these resources.
- **Improve communication, education and coordination between PG&E and customers**, including continuing to partner with trusted community partners to distribute information, hosting more emergency workshops, improving language access, and increasing awareness and enrollment in PG&E programs through outreach, material distribution, and improving website usability.

The following section details survey respondents and RTAG members recommended actions to improve community and household resilience.

Household Resilience Strategies

Community members were requested to provide recommendations for the kinds of strategies that PG&E could implement that would support households during extreme weather events. A summary of the strategies that were recommended by the North Coast Region specifically are included below.

FIGURE D.19 PG&E Strategies for Households during Extreme Weather Events
(n=1539 responses)



Survey respondents and those whose responses are reflected through the outreach boards in-person were asked to provide their top two recommended strategies for PG&E to consider supporting households during extreme weather events. Of the 1539 responses received, the top two recommended strategies are "Payment for Power Outages" and "Home Air Filtration Systems."

Survey respondents also provided open-ended input on community resilience strategies under the "Other" response category. All these responses were contextualized and integrated into the Region 4 North Coast Recommendations for Household Resilience Strategies (Table D.27).

Key Household Resilience Strategies by County

"Payment for Power Outages" is the top priority across counties. "Home Air Filtration Systems" is the second highest solution. Humboldt County equally reported "Home Air Filtration Systems" and "Information to Make my Home Safer" as the second highest impact. "Information to Make My Home Safer" is the third highest impact. Table D.24 highlights the North Coast Region represented counties in the survey and the outreach boards.

TABLE D.24 Priority Household Resilience Strategies by County
(n=1462 responses)

County	% of Respondents	Responses		
		Payment for Power Outages	Home Air Filtration Systems	Information to Make My Home Safer
Humboldt	19%	75%	13%	13%
Lake	19%	52%	31%	17%
Mendocino	76%	54%	26%	20%
Siskiyou	0%	0%	0%	0%
Trinity	17%	57%	27%	16%

The values in this table may not total 100% across the response categories for counties because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by county.

Key Household Resilience Strategies by Racial Background

The household resilience strategies can also be reviewed based on how participants identified their racial background, as illustrated in Table D.25 below. “Payment for Power Outages” is the top impact across racial background categories, followed by “Home Air Filtration Systems.” Most survey responses were represented by White respondents and Latinx or Hispanic respondents. Both White and Latinx or Hispanic respondents identified “Payment for Power Outages” as the top response.

TABLE D.25 Priority Household Resilience Strategies by Racial Background (n=1253 responses)

Racial Background	% of Respondents	Responses		
		Payment for Power Outages	Home Air Filtration Systems	Information to Make My Home Safer
Asian	1%	58%	33%	8%
Black or African American	1%	50%	28%	22%
Latinx or Hispanic	23%	49%	26%	25%
Native American, American Indian, or Alaska Native	6%	54%	28%	17%
Native Hawaiian and Pacific Islander	0%	29%	43%	29%
Other race	2%	46%	35%	19%
Two or more races	7%	54%	26%	20%
White	59%	56%	27%	17%

The values in this table may not total 100% across the response categories for racial backgrounds because the Project Team removed the survey respondents who marked “other” or “multiple” as their response for the purpose of reporting impacts by race.

Key Household Resilience Strategies by Income Level

Income is another lens by which to evaluate the top strategies identified by survey respondents. For all respondents, “Payment for Power Outages” is the top response, followed by “Home Air Filtration Systems,” then “Information to Make My Home Safer.” High-income respondents equally reported “Home Air Filtration Systems” and “Information to Make My Home Safer” for the second highest impact.

TABLE D.26 Priority Household Resilience Strategies by Income Level (n=1265 responses)

Income Level	% of Respondents	Responses		
		Payment for Power Outages	Home Air Filtration Systems	Information to Make My Home Safer
Extremely low-income	21%	53%	29%	18%
Low-income	47%	53%	27%	20%
Moderate-income	30%	54%	28%	18%
High-income	2%	58%	21%	21%

The values in this table may not total 100% across the response categories for income levels because the Project Team removed the survey respondents who marked “other” or “multiple” as their response for the purpose of reporting impacts by income level.

Household Resilience Recommendations

Other responses included the following strategies for PG&E to provide to households during extreme weather, which are incorporated into the specific recommendations for PG&E below.

Table D.27 lists specific recommendations that came from research interviews, RTAG meetings, and survey respondents via open-ended survey responses for PG&E to consider with respect to the following strategy areas:

1. Home improvements
2. Direct Payments
3. Customer Programs
4. Safety Resources Distribution

Under each strategy is a list of recommended actions that the Project Team heard from community and RTAG members, categorized by: (1) within PG&E's control, (2) possible through partnerships, and (3) outside of PG&E's control.

TABLE D.27 North Coast Region Recommendations for Household Resilience Strategies

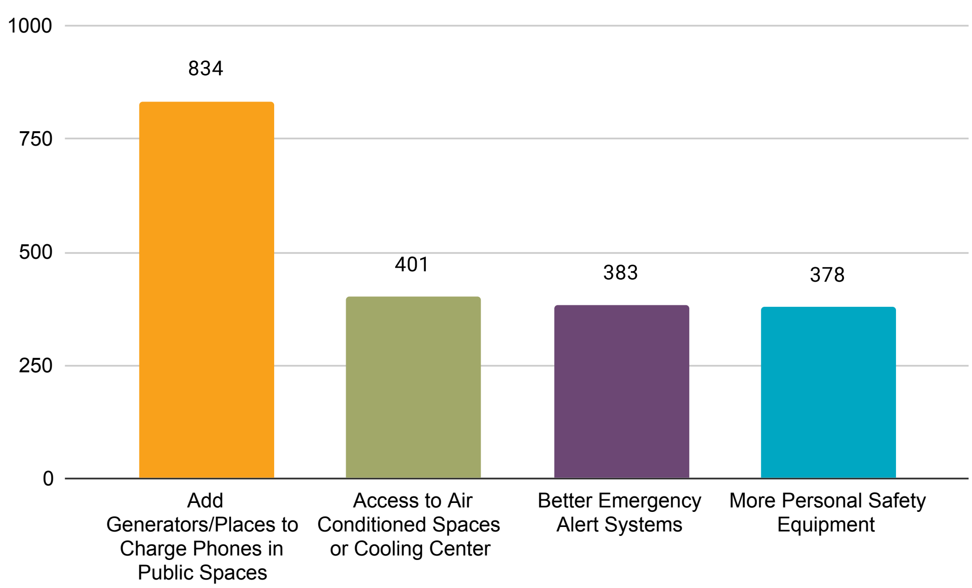
Strategy Area	Recommended Action	Within PG&E's Control	Possible Through Partnerships	Outside of PG&E's Control
Home Improvements	Fund programs to get older homes up to code to support solar panel installation	X		
	Improve access and affordability of batteries for low-income households	X		
	Provide homeowners with subsidies/direct installs (instead of reimbursements or rebates) for energy efficiency retrofits	X		
	Develop and fund programs that provide home consultations, home retrofits and maintenance around people's yard to improve wildfire resilience (e.g., Wildfire Mitigation Review Program)	X		
	Incentivize property owners to upgrade multifamily buildings with upfront subsidies and free energy audits.	X		
	Provide financial assistance/rebate programs for heat pumps and air conditioning units	X		
	Provide subsidies for low-income homeowners to conduct fireproofing work on/around their homes	X		
Direct Payments	Provide direct compensation for households impacted during power outages	X		
	Fund a wage replacement program for farmworkers and other outdoor workers that lose work due to wildfires and extreme heat	X	X	
	Provide financial assistance to low-income households for cost of gas to fuel generators and purchase wood/pellets			

Strategy Area	Recommended Action	Within PG&E's Control	Possible Through Partnerships	Outside of PG&E's Control
Customer Programs	Adjust the Disaster Resilience Fund to include climate hazard resources	X		
	Provide greater financial support through CARE/FERA programs to take into account increased use of air conditioning during heat waves	X		
	Provide more outreach to support CARE/FERA enrollment in areas at risk of power shutoffs	X		
	Decrease complexity and expand eligibility criteria for customer program applications. Default to automatic enrollment when possible.	X		
Safety Resources Distribution	Distribute air purification machines and air filters	X	X	
	Distribute N-95 masks	X	X	
	Proactively identify areas that may be blocked off and provide water and meals ready to eat (MRE) in hazard prone areas	X	X	
	Distribute personal protective clothing with cooling technology to agricultural workers	X	X	
	Distribute large portable batteries/ generators to community members who rely on refrigerated medicine or electrically powered medical equipment	X	X	
	Distribute free sandbags	X	X	

Community Resilience Strategies

Community members were requested to provide input on the kinds of strategies that PG&E could implement that would support communities during extreme weather events. A summary of the strategies that survey respondents supported in the North Coast Region are included below. Respondents were encouraged to pick their top two choices, although respondents chose between zero and four strategies as their responses.

FIGURE D.20 PG&E Strategies for Communities During Extreme Weather Events (n=1996 responses)



In the North Coast Region, the top two strategies are "Add Generators/Places to Charge Phones in Public Spaces" and "Access to Air-Conditioned Spaces/Cooling Centers." Survey respondents also provided open-ended input on community resilience strategies under "Other" strategies. Responses were contextualized and integrated into the North Coast Region Community Resilience Strategies (Table D.31).

Key Community Resilience Strategies by County

"Adding Generators and Places to Charge Phones in Public Spaces" is the top response across counties. Table D.28 highlights the North Coast Region represented counties in the survey and the outreach boards.

TABLE D.28 PG&E Strategies for Communities during Extreme Weather Events (by County) (n=1864 responses)

County	% of Respondents	Responses			
		Access to Air-conditioned Spaces/Cooling Centers	Better Emergency Alert Systems	Add Generators/ Places to Charge Phones in Public Spaces	More Personal Safety Equipment (masks, batteries, etc.)
Humboldt	19%	1%	0%	96%	2%
Lake	19%	28%	17%	32%	23%
Mendocino	76%	18%	20%	42%	20%
Siskiyou	0%	0%	0%	0%	0%
Trinity	17%	23%	21%	35%	21%

The values in this table may not total 100% across the response categories for counties because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by county.

Key Community Resilience Strategies by Racial Background

The community resilience strategies can also be reviewed based on how participants identified their racial background. The information collected is represented in Table D.29 below. Across most racial backgrounds, the top impact is "Add Generators and Places to Charge Phones in Public Spaces," except for Native Hawaiian and Pacific Islander respondents who equally reported "Better Emergency Alert Systems" and "is "Add Generators and Places to Charge Phones in Public Spaces."

TABLE D.29 PG&E Strategies for Communities during Extreme Weather Events (by Racial Background) (n=1446 responses)

Racial Background	% of Respondents	Responses: Access to Air-conditioned Spaces/Cooling Centers	Better Emergency Alert Systems	Add Generators/ Places to Charge Phones in Public Spaces	More Personal Safety Equipment
Asian	1%	31%	31%	23%	15%
Black or African American	1%	22%	6%	33%	39%
Latinx or Hispanic	23%	22%	27%	29%	22%
Native American, American Indian, or Alaska Native	6%	23%	15%	34%	28%
Native Hawaiian and Pacific Islander	0%	29%	29%	29%	14%
Other race	2%	18%	24%	38%	21%
Two or more races	7%	22%	17%	35%	26%
White	59%	21%	20%	39%	20%

The values in this table may not total 100% across the response categories for racial backgrounds because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by county.

Key Community Resilience Strategies by Income Level

The Project Team also evaluated top strategies identified by survey respondents based on the income of respondents (Table D.30). "Adding Generators and Places to Charge Phones in Public Spaces" is the top solution across all income levels. The second top solution for extremely low-income, moderate-income and high-income respondents is "More Personal Safety Equipment." The second top solution for low-income participants is "Better Emergency Alert Systems."

TABLE D.30 PG&E Strategies for Communities during Extreme Weather Events (by Income Level) (n=1671 responses)

Income Level	% of Respondents	Responses: Access to Air-conditioned Spaces/ Cooling Centers	Better Emergency Alert Systems	Add Generators/ Places to Charge Phones in Public Spaces	More Personal Safety Equipment (masks, batteries, etc.)
Extremely low-income	21%	17%	15%	47%	21%
Low-income	47%	18%	19%	45%	18%
Moderate-income	30%	22%	21%	37%	20%
High-income	2%	8%	17%	50%	25%

The values in this table may not total 100% across the response categories for income levels because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by income level.

Community Resilience Recommendations

Table D.31 lists specific recommendations that came from research interviews, RTAG input, and survey respondents via open-ended survey responses for PG&E to consider with respect to the following strategy areas:

1. Community Resilience and Cooling Centers
2. Infrastructure Improvements and Grid Modernization
3. Distributed Energy Resources
4. Forest Health, Vegetation Management, and Urban Greening
5. Transportation Services
6. Communication, Education and Outreach
7. Workforce Development and Workplace Safety
8. Broadband Access
9. State Advocacy

Under each strategy area is a list of recommended actions that the Project Team heard from community and RTAG members, categorized by: (1) within PG&E's control, (2) possible through partnerships, and (3) outside of PG&E's control.

TABLE D.31 North Coast Region Recommendations for Community Resilience Strategies

Strategy Area	Recommended Action	Within PG&E's Control	Possible Through Partnerships	Outside of PG&E's Control
Community Resilience and Cooling Centers	Provide financial support for the development and sustained operation of community centers/shelters that have backup power and provide community members a location to charge phones	X	X	
	Support the development of mobile cooling centers that can serve rural residents		X	
	Provide shelter for vulnerable or unhoused populations that don't have anywhere to go/do not have access to safety resources			X
	Coordinate with local governments to open shelters where they are needed in areas that have a NIMBY attitude.		X	
Infrastructure Improvements and Grid Modernization	Underground power lines in forested areas	X		
	Expedite phasing out generation facilities, especially natural gas plants, at risk of sea level rise	X		
Distributed Energy Resources	Invest in micro-grids	X		
	Increase access to backup energy and generators (at community shelters)	X		
	Invest in residential and community-owned solar, especially for low-income households/ communities	X		
Forest Health, Vegetation Management, and Urban Greening	Maintain trees along main roads on the coast to protect transmission lines	X		
	Fund and expedite tree planting in burned areas	X	X	

Strategy Area	Recommended Action	Within PG&E's Control	Possible Through Partnerships	Outside of PG&E's Control
Transportation Services	Provide public shuttles or dial a ride for seniors and people with disabilities to access cooling centers		X	
	Provide funding to support infrastructure projects that stabilize main roads affected by fires/mudslides to prevent disruption in resource distribution following hazard events	X		
Communication Education & Outreach	Deploy more staff or fund CBOs to enroll people into PG&E programs by meeting community members where they are (e.g. at a location they frequent or existing community meeting)	X		
	Fund CBOs to engage with community members and distribute safety resources at trainings/outreach events	X		
	Fund inter-tribal emergency prep, management, and coordination	X		
	Streamline processes for CBOs to secure funding and resources	X		
	Fund CBOs leading CERT trainings	X	X	
	Partner with CBOs who support Black, Indigenous, Asian and other communities of color to organize events in their communities to promote energy efficiency and electrification programs	X		
	Provide trainings and outreach to promote renters and homeowners' insurance for low-income and communities of color	X		
	Coordinate with local Offices of Emergency Management to lead more proactive, inclusive engagement that is responsive to community needs		X	
	Use push notifications, text alerts, radio/tv advertisements, and billboards to inform residents where to evacuate during fires, and where to get real-time updates on hazards	X		
	Connect climate change to familiar values, concepts, or climate-hazard experiences in rural communities and communities of color	X		
	Conduct proactive multilingual outreach to agricultural guest workers who live onsite at their employers' ranches and farms about safety during fires.	X		
	Partner with trusted institutions, such as schools and faith-based organizations, to send information on hazard preparedness to parents/families by text/app	X		
	Strengthen partnerships with local governments to increase proactive communications about resources during planned outages or other hazards		X	
	Host in person safety information community workshops in various languages	X		
	Engage with disaster relief teams	X		

Strategy Area	Recommended Action	Within PG&E's Control	Possible Through Partnerships	Outside of PG&E's Control
Workforce Development/ Safety	Partner with California Division of Occupational Safety and Health and CBOs to educate employers and farmworkers about mandatory N95 mask provisions on extreme heat days		X	
Broadband Infrastructure	Provide faster, more reliable internet in rural communities			X
State Advocacy	Lobby state legislature to increase funding for hazard mitigation plans for local governments and tribes	X		
	Advocate for federal funding to be directed toward climate resilience planning for tribes		X	
	Lobby state legislature to fund and expand 211 phone service to ramp up disaster prep and emergency resource distribution	X		
	Advocate for investments in regional broadband services to improve emergency notifications	X		
Other	Work with local government and private companies to utilize ships to temporarily deliver food and critical supplies to North Coast ports immediately after wildfires/landslides		X	

Appendix E

Barrios Unidos tabling at community fair, Santa Cruz

Appendix E: The Central Coast Region

This report provides a summary of the findings for the Central Coast Region of the Resilient Together initiative. The Central Coast Region encompasses Monterey, San Benito, San Luis Obispo, Santa Barbara, and Santa Cruz counties. This regional summary provides an overview of the data collected and presents the key findings for the Central Coast Region. The key findings are organized as follows:

A — Defining Climate Vulnerable Communities

B — Climate Hazards and Impacts

C — Adaptive Capacity

D — Resilience Strategies and Recommendations

Data Collected

The Project Team collected data for the Central Coast Region from four primary sources: 1) Research interviews conducted with Resilient Together Advisory Group (RTAG) candidates, 2) RTAG meetings, 3) Outreach events conducted by RTAG members, and 4) Resilient Together surveys. This section presents a summary of the key data collected for this region.

RTAG Members

The following table (Table E.1) of organizations participated in the Central Coast Region. The top three populations represented by RTAG members are provided in the table below, along with the mission statements for each of the organizations. RTAG members who conducted outreach activities ("Outreach Partners") are marked with an asterisk.

Over the course of the engagement, RTAG members participated in five RTAG meetings, totaling approximately 10 hours. RTAG meetings featured a project overview and RTAG orientation, presentation of outreach materials, peer mentoring, role-playing exercises, presentation on Pacific Gas and Electric (PG&E) income qualified programs, presentation of key findings from engagement, and celebration of their partnership.

TABLE E.1 RTAG Member Profiles

RTAG Organization	Geographies Represented	Top Populations Represented	Mission/Profile
Barrios Unidos*	Santa Cruz County	Low-income communities Communities of Color Youth	To promote multicultural social justice, nonviolence, and economic equity through cultural healing, civic leadership, and community development. In all of Barrios Unidos' endeavors, they seek to provide a curative space in the face of oppression. They seek the end of mass incarceration. Barrios Unidos seeks meaningful pathways for youth, whether it be political and economic or interpersonal and spiritual.[1]
Central Coast Alliance United for a Sustainable Economy	Santa Barbara County	Low-income communities Limited English proficient communities Farmworkers	Central Coast Alliance United for a Sustainable Economy (CAUSE) is a base-building organization committed to social, economic, and environmental justice for working-class and immigrant communities in California's Central Coast. They build grassroots power through community organizing, leadership development, coalition building, civic engagement, policy research, and advocacy.[2]
Community Action Board*	Santa Cruz County	Low-income communities Limited English proficient communities Communities of Color	Community Action Board's mission is to partner with the community to eliminate poverty and create social change through advocacy and essential services.[3]
Community Action Partnership of San Luis Obispo*	San Luis Obispo County, Monterey County, Northern Santa Barbara County	Low-income communities Limited English proficient communities Seniors	Through a variety of programs and in collaboration with other community service agencies, Community Action Partnership helps individuals and families achieve self-sufficiency and economic stability through programs that focus on: high-quality early education and child care, accessible, affordable dependent care, addressing barriers to safe, affordable housing and basic needs, health services and education, and resource connection and navigation.[4]
Community Bridges*	Santa Cruz County (City of Santa Cruz, City of Scotts Valley, City of Watsonville, unincorporated areas in Santa Cruz County)	Low-income communities Limited English proficient communities Seniors	Community Bridge's mission is to deliver essential services, provide equitable access to resources, and advocate for health and dignity across every stage of life.[5]
Community Food Bank of San Benito County*	Hollister, San Juan Bautista, Aromas, Tres Pinos, Paicines, Bittwewater	Low-income communities CBOs Farmworkers	The Community Food Bank of San Benito County's growing mission: Building dignity. Sharing abundance. Nourishing lives. The statement guides a shared desire to provide empowerment and opportunity through food and education.[6]

1 https://barriosunidos.net/
2 https://causenow.org/
3 https://cabinc.org/
4 https://capslo.org/
5 https://communitybridges.org/
6 https://www.communityfoodbankofsbc.org/

RTAG Organization	Geographies Represented	Top Populations Represented	Mission/Profile
The Epicenter*	Monterey County (Salinas)	Youth Low-income communities Communities of color	The Epicenter exists to empower at-risk and system involved and LGBT youth ages 16–24 to flourish by connecting them to community resources that provide opportunities for equity and hope in order to improve youth outcomes in Monterey County.[7]
Mixteco Indigena Community Organizing Project	Santa Barbara County (Santa Maria, Guadalupe)	Tribal/ Indigenous communities and sovereign nations Farmworkers Undocumented Communities	Mixteco Indigena Community Organizing Project's (MICOP) mission is to support, organize and empower the Indigenous migrant communities in California's Central Coast. MICOP envisions a strong Indigenous immigrant community actively engaged to achieve just working and living conditions, equality, and full human rights in the broader community.[8]
Mujeres En Acción*	Monterey County (Salinas, Castroville, Soledad, Greenfield, King City, Seaside)	Communities of Color Farmworkers Indigenous Communities	Mujeres en Acción (Mujeres), a bilingual/bicultural agency, empowers Latinas by providing services which reflect their values, culture and being and advocate on the issues that make a difference in their lives. Mujeres have a comprehensive array of social services and advocacy initiatives that promote non-violence, reproductive health and leadership development.[9]
The Village Project*	Monterey County (Marina and Seaside)	Black/African American communities People with disabilities Communities of Color Low-income communities Youth/children	The Village Project provides vulnerable adults, children, and families from historically underserved communities in Monterey County with culturally appropriate mental health services, educational support, and social advocacy so that they can become self-sufficient, self-directed, and self-determining members of the community.[10]

7 https://epicentermonterey.org/
8 https://mixteco.org/
9 https://mujeresenaccion831.org/
10 https://www.villageprojectinc.org/

Outreach Events

Eight Outreach Partners conducted 58 events totaling 47+ hours.[11] Outreach activities included:

- Community workshops and focus groups
- Community festivals and gatherings
- Community resource fairs
- Tabling at churches, senior centers, mobile home parks, dining/food distribution centers
- Resident meetings
- Social media outreach
- Collaborating with other community organizations

Participants Engaged

Outreach Partners engaged 1700 people over the course of the Outreach Period. A total of 1667 online paper surveys were completed. An additional estimated 52 community members were engaged in events listed above. The data collected at outreach events were included in the outreach boards. Following completion of the Bay Area Region engagement, select demographic questions (e.g., race, income, household characteristics) were added to the Resilient Together survey for Regions 2–5 in order to better understand the participants that were engaged through this effort. The following section describes the geographic areas, incomes, race, and household characteristics of the participants engaged.

Zip codes and Counties Represented

A total of at least 82 unique zip codes are represented through the data collected by the surveys and the outreach boards, across 10 counties.[12] Additional zip codes and counties may be represented in the data but not all survey and outreach board respondents identified their zip code, and some respondents provided their county rather than zip code. Less than one percent of survey respondents did not provide their zip-code. Table E.2 shows the counties represented through the surveys and in the outreach boards.

11 This represents anticipated events from RTAG Outreach Plans. The Project Team did not track how many events occurred for RTAG members in Regions 4 and 5.

12 The data includes several counties that are not in the Central Coast Region but were collected via the Central Coast Region Outreach Partners. For example, Outreach Partners collected surveys from respondents in Fresno, Mendocino, Merced, Orange, Sacramento, San Joaquin, San Mateo, Santa Clara and Solano counties. Though these counties are not in the Central Coast Region, the Project Team included the results of these surveys in the data analysis as the Outreach Partners are serving members from those counties. The county data from outside Central Coast Region counties makes up about 3 percent of the respondents.

TABLE E.2 Surveys per County
(n=1638 respondents)

County	% of Surveys
Fresno*	0.1%
Mendocino*	0.4%
Merced*	0.1%
Monterey	38%
Orange*	0.5%
Sacramento*	0.1%
San Benito	12%
San Joaquin*	0.1%
San Luis Obispo	11%
San Mateo*	0.2%
Santa Barbara	2%
Santa Clara*	0.3%
Santa Cruz	35%
Solano*	3%

Counties that are represented in the data that are not part of Region 5 are identified with an asterisk.

Languages Represented

To reach a more diverse sampling of the Central Coast Region, materials were provided in English, Spanish, and Chinese. RTAG members translated some of the surveys taken in other languages into English when inputting them into SurveyMonkey. The survey included a question for RTAG members regarding what language the paper survey was originally taken in to accurately track languages represented.[13] Additionally, RTAG members indicated they engaged participants in English at outreach events (33 percent of the community members engaged).[14]

Racial Backgrounds Represented

Although demographic questions were optional, 89 percent of the Central Coast Region survey respondents answered the question on racial identification. Three percent of respondents either chose "prefer not to respond" or left the question blank. Of those who answered the question, 81 percent identified as groups comprised of people of color, more than two races, or other races and 16 percent identify as White. Disadvantaged Communities where respondents indicated "Other" identify as Filipino, Italian, Dutch, Jewish, Hispanic, Spaniard, Ukrainian, European, Mexican, Panameño, Latino, African, Puerto Rican, Creole, Chicano, and French.

13 This question was included in the online survey for Regions 4 and 5.

14 Several RTAG members did attempt to record how many English and Spanish speakers were engaged at each event. Based on the input received, 52 people were engaged in English and no one was engaged in Spanish. The Project Team tracked the information from the events using an online reporting tool, similar to the tool that was used in Regions 1-3. Rather than have RTAG members input the data from their outreach events into the tool, the Project Team completed this task. Information about events was only collected for events that used outreach boards.

Table E.3 and Table E.4 identify the number of survey respondents by racial background and racial background of survey respondents by Outreach Partner, respectively.

TABLE E.3 Central Coast Region Racial Background of Survey Respondents (n=1429 respondents)

Racial Background	% of Respondents
Asian	3%
Black or African American	8%
Latinx or Hispanic	63%
Native American, American Indian, or Alaska Native	1%
Native Hawaiian and Pacific Islander	2%
Other	1%
Two or more races	6%
White	16%

Values may not add up to 100% because some survey respondents marked the "prefer not to answer" option for this question. Those values are not shown in this table.

TABLE E.4 Racial Background of Survey Respondents by Outreach Partner (n=1468 respondents)

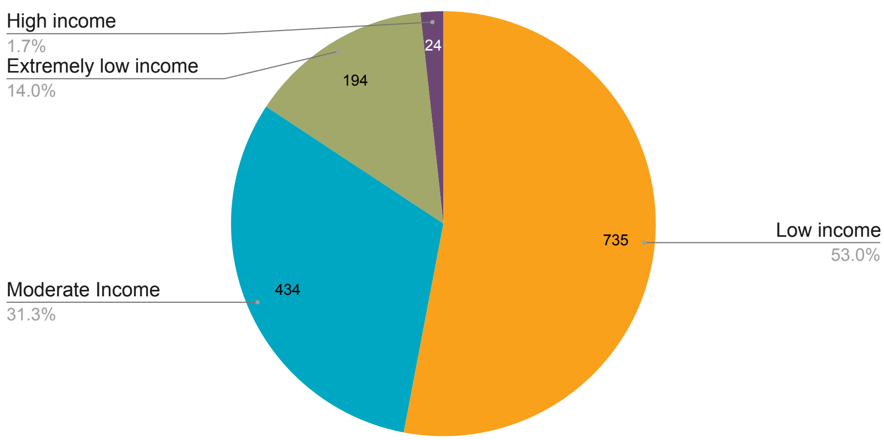
Racial Background	The Village Project	The Epicenter	Community Action Partnership of San Luis Obispo	Mujeres En Acción	Community Food Bank of San Benito County	Community Action Board	Community Bridges	Barrios Unidos
Asian	2%	1%	1%	1%	4%	0%	2%	16%
Black or African American	45%	3%	4%	1%	1%	0%	1%	7%
Latinx or Hispanic	37%	85%	55%	96%	65%	93%	56%	23%
Native American, American Indian, or Alaska Native	0%	0%	0%	0%	1%	3%	1%	2%
Native Hawaiian and Pacific Islander	0%	0%	4%	1%	1%	0%	0%	6%
Other	3%	2%	0%	1%	1%	0%	4%	1%
Two or more races	9%	6%	9%	2%	6%	1%	5%	6%
White	4%	4%	27%	1%	20%	4%	36%	40%

Values may not add up to 100% because some survey respondents marked the "prefer not to answer" option for this question. Those values are not shown in this table.

Income Levels Represented

Survey respondents were asked: “How would you describe your income level?” Breakdowns of income level categories were not described as part of the survey. Of the 1387 respondents, only two percent identify themselves as high-income, while 67 percent of respondents identify as extremely low or low-income, indicating that the outreach conducted in the Central Coast Region was extremely effective in reaching low-income and extremely low-income households, as shown in Figure E.1.

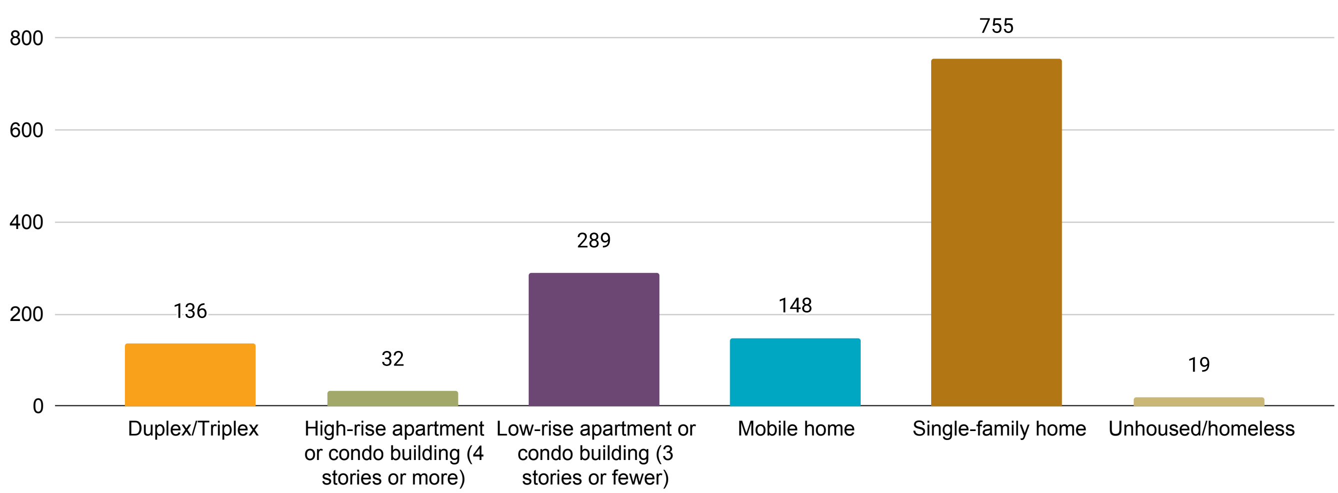
FIGURE E.1 Survey Respondents by Income Level (n=1387 respondents)



Household Characteristics Represented

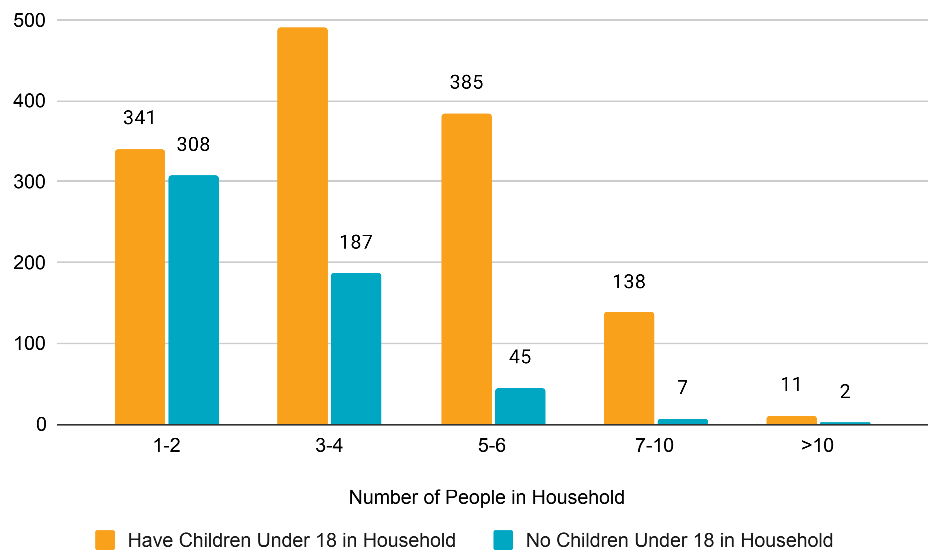
The optional demographic question section of the survey also asked about housing. One of the questions asked: “What type of home do you live in?” As shown in Figure E.3, most survey respondents live in single-family homes (55 percent), followed by respondents who live in low-rise apartments or condo buildings (21 percent). In a separate survey question, respondents were asked: “Do you own your home?” In response, nearly 76 percent of survey respondents responded “No,” indicating they are renters (n=1355 respondents).

FIGURE E.2 Survey Respondents by Housing Type (n=1355 respondents)



Survey participants were also asked how many people are in their household, and if there are any other children under 18.[15] The average number of people per household for the Central Coast Region is 4 people, and 59 percent of survey respondents reported that they do have other children under 18 in the household. These two questions are grouped together in Figure E.3 below.

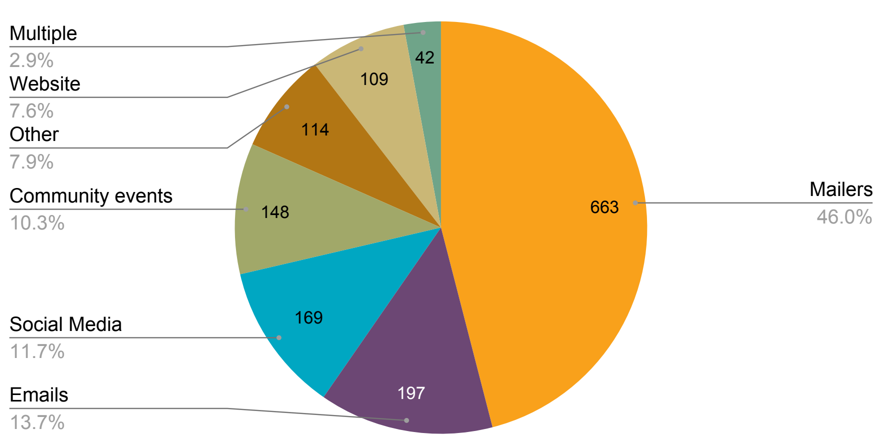
FIGURE E.3 How Many People are in the Household and Whether There are Other Children Under 18 in the Household
(n=1366 respondents)



PG&E Communications

Survey respondents were asked how and when they receive information and news from PG&E. Figure E.4 reflects how participants currently receive information and news from PG&E. The primary source of information is mailers (46 percent), followed by emails (14 percent). Participants also receive information and news from the news, nonprofits, and community-based organizations (CBOs), phone and text messages, word of mouth, and PG&E bills. A few people answered the question indicating that they do not currently receive any information.

FIGURE E.4 Where Participants Currently Receive Information and News from PG&E
(n=1442 respondents)

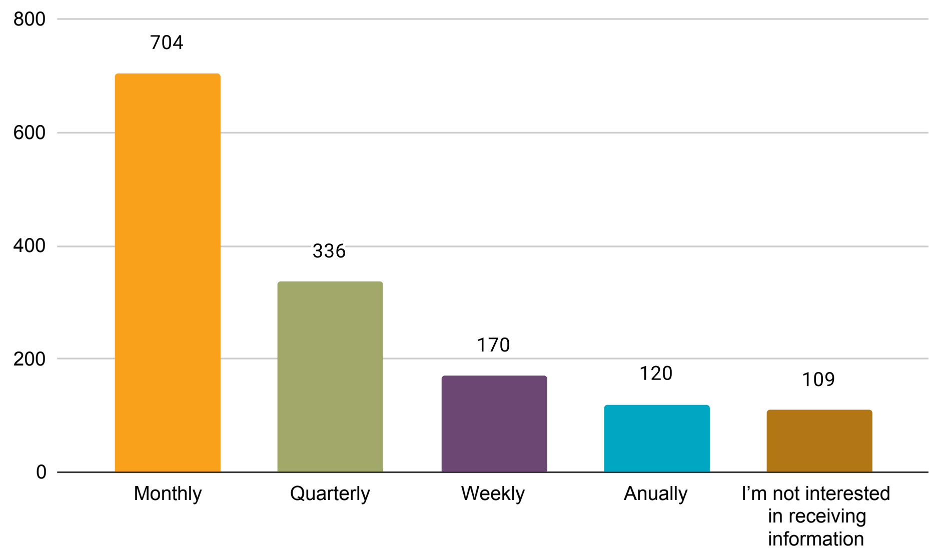


15 The second question is framed in a way to anticipate that children 18 and younger may be survey respondents.

In response to the question "How often survey respondents receive information from PG&E on existing initiatives and programs," of the 1425 respondents, 83 percent responded, "Not Enough" and 17 percent responded, "Too Often." Of the 17 percent of survey respondents that responded, "Too Often," most were interested in receiving future information on a monthly basis. Of the 83 percent of survey respondents that responded, "Not Enough," most indicated they were also interested in receiving future information monthly.

The survey then asked respondents about how often they would like to receive information in the future from PG&E on existing initiatives and programs. Of the 1439 survey respondents for this question, 72 percent responded "Monthly" or "Quarterly." The remaining 28 percent responded "Weekly" (12 percent), "Once a Year" (8 percent), or "I'm not interested in receiving information" (8 percent).

FIGURE E.5 How Often Survey Respondents Would Like to Receive Information from PG&E on Existing Initiatives or Programs (n=1439 respondents)



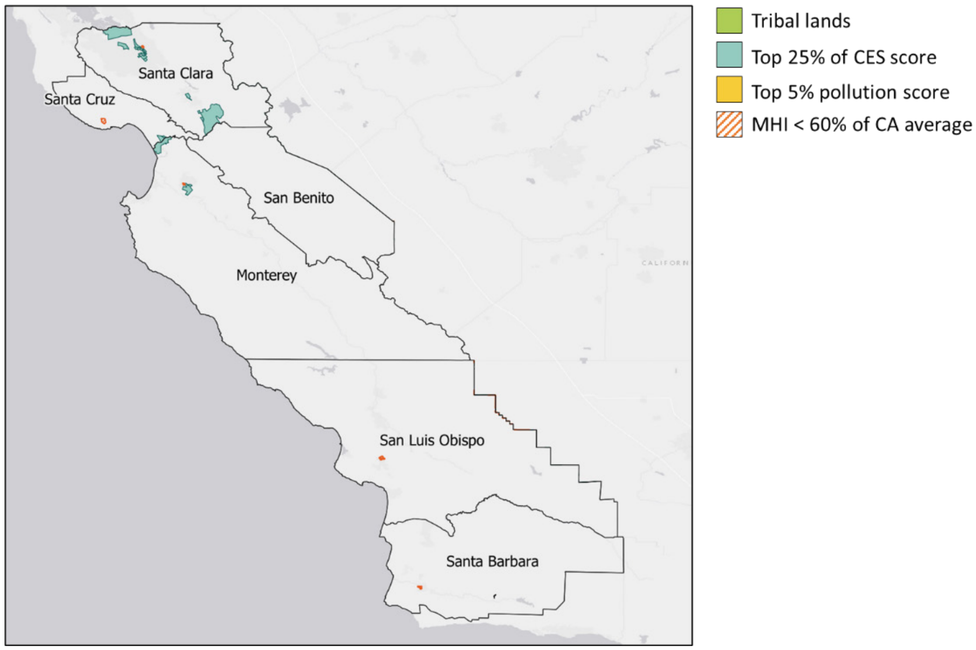
Research Interviews

The Project Team conducted a series of interviews with RTAG candidates in the Central Coast Region. Research interviews were conducted with RTAG candidates to help the Project Team better understand (1) community demographics and language needs, (2) climate hazards/impacts, adaptive capacity, and preferred resilience strategies, (3) their capacity and interest in participating on the RTAG, and (4) existing reports/data that could inform the Climate Vulnerability Assessment. The summary report of these interviews can be found in Appendix J. Findings from these interviews that address objective (2) are interwoven throughout the following sections of this regional summary report.

Climate Vulnerable Communities

Figure E.6 shows disadvantaged and vulnerable communities in the Central Coast Region based on the California Public Utility Commission's definition.

FIGURE E.6 Central Coast Region Disadvantaged and Vulnerable Communities



The Central Coast Region is a heavily rural, dispersed region with large populations of low-income Indigenous and Latinx farmworkers and small historically Black communities who are most affected by climate hazards. In Santa Cruz County, lower-income farmworker communities face financial pressures from lost income and reduced hours due to extreme heat days above 100 degrees. In Monterey County, Black and Latinx communities in areas like Marina, Seaside, and King City are highly affected by outages, heat, wildfire smoke, and sea level rise. They also face environmental hazards from the waste of Fort Ord and increasing gentrification as an economic pressure. Much of San Luis Obispo County's low-wage, undocumented farmworker population can only afford to live in substandard mobile homes that are either unfixable or suffer from mold.

The Central Coast Region RTAG made the following qualifications/additions to the list of vulnerable community types outlined in Table E.4 of this report.

Qualifications

- Refer to "people experiencing homelessness" as "unhoused population"
- "Students" is too broad of an age group; separate "Youth" from "Students"

Additions

- LGBTQ+
- Incarcerated and previously incarcerated people
- Black veterans and military family descendants who have been displaced from areas like Seaside and Marina
- Multi-family households
- Day laborers

The following table (Table E.5) provides information on climate vulnerable communities, community demographics, and languages spoken based on data collected from research interviews with RTAG candidates. Because RTAG candidates represent specific areas of the Central Coast Region, not all counties are included.

TABLE E.5 Climate Vulnerable Communities in Select Central Coast Region Counties

County	Climate Vulnerable Communities	Community Demographics	Languages Spoken
Monterey	Cities of Seaside, Marina, Kings City, Soledad, Gonzales, Salinas, Tulare, Greenfield, and Watsonville. The unincorporated areas of Las Lomas, Aromas, Castroville, Salinas Valley, and San Lucas	African American, Asian (Filipinos and Vietnamese), White, Latinx, including Mexican and Indigenous Latin Americans	Spanish, Latin American Indigenous dialects like Mixteco, Triqui, and Zapoteco, Tagalog
Santa Barbara	Cities of Santa Maria and Guadalupe. The unincorporated area of Santa Maria Valley	White, Latinx, including Mexican, Central American, and Indigenous Latin Americans	Spanish, Latin American Indigenous dialects like Mixteco, Triqui, Zapoteco
San Benito	Cities of Hollister (specifically the neighborhoods of Buena Vista/ Talaveres, by Lover's Lane, and the mountainous areas of Gavilan) and San Juan Bautista. The unincorporated neighborhood of Aromas	White, Latinx, including Mexican and Indigenous Latin Americans	Spanish, Latin American Indigenous dialects like Mixteco, Triqui, Zapoteco
Santa Cruz	Cities of Watsonville (specifically the neighborhoods of downtown, by Cary St., by the airport, near the levee, Martinelli, and College Lake), Capitola. The unincorporated neighborhoods of Freedom, Pajaro (by the Pajaro River), Corralitos, Davenport (including nearby ranches), Aptos, Live Oak, Bonny Doon, and Last Chance,	Native American, White, Slavic (Russians), Latinx, including Mexican and Indigenous Latin Americans, Middle Eastern (Syrian, Jordanian, Central Asians)	Spanish, Latin American Indigenous dialects like Mixteco, Triqui, Zapoteco, Arabic, Russian
San Luis Obispo	The cities of Arroyo Grande, Pismo Beach, Paso Robles (northern neighborhood), Grover Beach, and the South County Five Cities. The unincorporated neighborhoods of Nipomo, Oceano, Los Osos, and Santa Margarita, areas along the San Luis Obispo Creek, and the Santa Maria Valley	White, Black, Asian (Filipinos), Latinx, including Mexican and Indigenous Latin Americans	Spanish, Latin American Indigenous dialects like Mixteco, Triqui, Zapoteco

Climate Hazards and Impacts

The Central Coast Region has been historically temperate but has increasingly faced rising temperatures, power outages, wildfires, and sea level rise. It is a heavily rural, dispersed region with large populations of low-income Indigenous and Latinx farmworkers and small historically Black communities who are most affected by climate hazards. Farmworkers in the region experience health risks from working outside in the heat and heightened exposure to wildfire smoke. Additionally, the financial well-being of farmworker communities is impacted by changing growing conditions which affect hours and labor demand.

Lack of air conditioning and poor housing stock exacerbates extreme heat impacts for low-income communities throughout the region. Low-income Black and Latinx communities in low-lying areas have experienced historical flooding and face elevated risk from sea level rise. This flooding further contributes to dilapidated or unhealthy housing as well as water contamination and groundwater intrusion. Mountainous communities are more prone to fire hazards and subsequent mudslides. Key challenges for mountainous communities include a lack of reliable evacuation routes and difficulty finding adequate housing post-evacuation.

Climate hazards in this region are magnified by a lack of coordination and planning at the local government level and an overreliance on community organizations to provide emergency resources. Nonprofits are left to close the resource gap and provide basic protections like masks. Local nonprofits are even left to lead the efforts to create cooling center resource hubs. At the same time, gentrification is another economic pressure communities face, which climate hazards threaten to worsen.

Throughout the Outreach Period, community members and RTAG members were asked about the impacts they have experienced or are most concerned about during power outages, extreme heat events, and when wildfire smoke is present. Additionally, community members were asked about the impacts of climate hazards on their mental health. A summary of the key findings on impacts for the Central Coast Region is presented in Table E.6.

TABLE E.6 Summary of Key Impacts in the Central Coast Region

Hazard	Health Impacts	Economic Impacts	Household/Community Impacts
Power Outage	Medical equipment disrupted Diabetics lose insulin from loss of refrigeration Difficult to replace medicine Seniors and children suffer from mental health impacts	Loss of food Loss of hours/income Day laborers cannot access unemployment Loss of childcare High energy bills	Loss of communication with loved ones Road closures impact propane availability
Extreme Heat	No air-conditioning in homes/ discomfort in homes Harsh indoor/outdoor working conditions Heat stroke Respiratory illnesses exacerbated Day laborers have limited access to water Lack of places to cool down/lack access to cooling centers	High energy bills/cannot afford air-conditioning	Agricultural losses - impacts on crops and livestock Exacerbate wildfire risk Unhoused have nowhere to go to escape heat

Hazard	Health Impacts	Economic Impacts	Household/Community Impacts
Wildfires and Smoke	Poor outdoor air quality (day laborers suffer) Lack of access to safety resources (low quality masks) Exacerbated health impacts for those with asthma Mental health/well-being impacted	Loss of homes/property damage Loss of food Loss of jobs/income for farmworkers and day laborers	Animals need to be evacuated Disruption of community health/ wellness programs Lack of safe spaces for evacuees

Power Outages

Power outages were identified as a top hazard of concern in the Central Valley Region, especially following severe flooding or in combination with another hazard. Through survey and outreach board engagement, 1724 responses were provided to the question "What impacts of power outages have you experienced or are most concerned about?" The response options differed between the survey and the outreach boards, and survey respondents and outreach board participants were allowed to provide more than one response. The survey asked about three specific impacts for power outages, plus an option for "Other." In contrast, the outreach board provided ten options for climate related impacts that participants have experienced. These ten impact options were provided for power outages, extreme heat, wildfire smoke, and flooding and sea level rise on the same board.

The top responses for the survey and outreach board are highlighted in Figure E.7 and Figure E.8 respectively. The survey data shows the top impact for power outages is "No Air Conditioning," accounting for 34 percent of survey responses, closely followed by "Loss of Work & Childcare" at 32 percent, then "Medical Equipment Issues" at 25 percent. The qualitative data from the RTAG, survey, and the outreach boards are reflected in the following sections on Health Impacts, Economic Impacts, and Household/Community Impacts due to Power Outages.

FIGURE E.7 Impacts Experienced or that Cause Concern during Power Outages (Survey) (n=1662 responses)

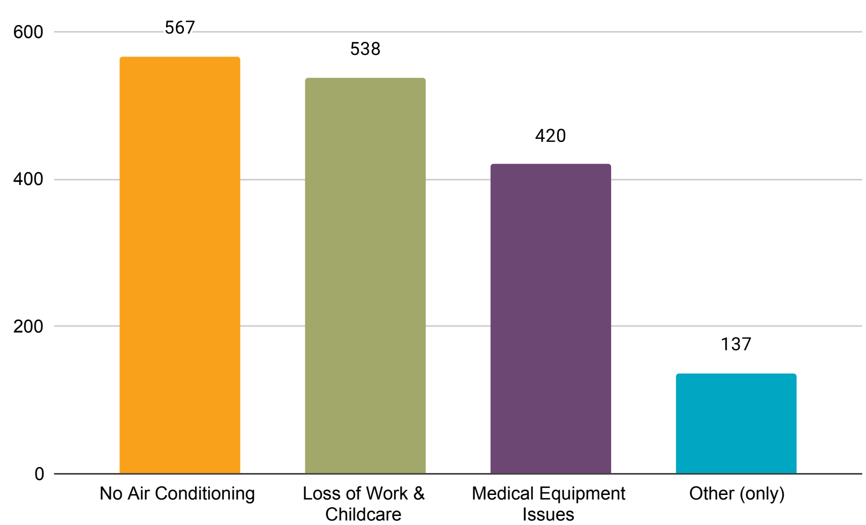
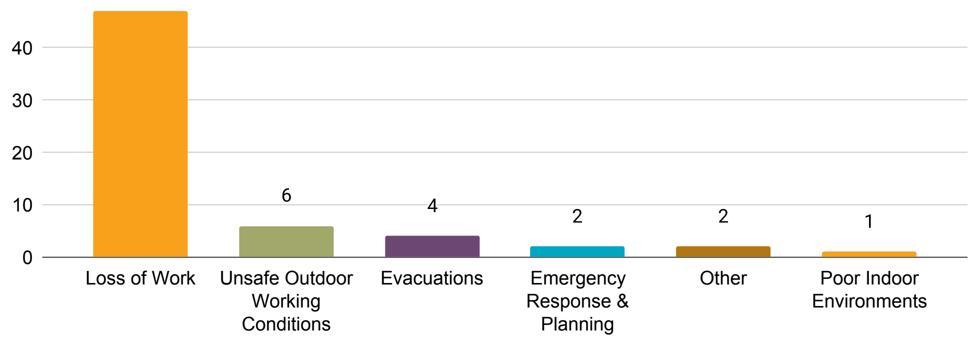


FIGURE E.8 Impacts Experienced or that Cause Concern during Power Outages (Outreach Boards) (n=62 responses)



Health Impacts Due to Power Outages

"There is fear of not having a generator for medical equipment. It is rare to have generators in the communities we are serving."

There are several health impacts due to power outages that research participants, survey respondents, and RTAG members highlighted. RTAG members reported that medical equipment is disrupted during outages, and most households do not have access to a generator. The survey asked participants if anyone in the household relies on medical equipment. Of the 1439 survey respondents that answered this question, 23 percent indicated that they did rely on medical equipment. Many low-income, multi-family households and those living in mobile homes or accessory dwelling units do not have room to store a generator. During outages, diabetics are also harmed as they do not have refrigeration for their insulin. LGBTQ+ members also lose access to medicine when refrigeration is lost. RTAG members noted that it can be difficult for low-income community members to replace their medicine when it goes bad, as they have to go through government programs. Approximately 25 percent of survey responses indicated concern about, or experience with, medical equipment disruptions or health concerns more broadly. [16] Survey respondents also expressed concern about the health implications of losing access to heat in the winters.

Economic Impacts Due to Power Outages

"It is critical to represent the loss of communication that happens when the power goes out. Many people rely on Wi-Fi calls, so they are completely in the dark during PSPS events or other loss of power events."

Interview participants shared that planned outages and blackouts have spoiled food many times and low-income families often cannot afford to replace this food.[17] Power outages hurt low-wage workers and small business owners' bottom lines. Power outages also result in people not being able to go to work; particularly day laborers, many of whom are not able to enroll in unemployment and may not be comfortable accessing other government relief because of their immigration status. In addition, survey respondents noted that they were not able to work from home due to power outages. Approximately 32 percent of the survey responses are related to loss of work and childcare.[18]

Household/Community Impacts Due to Power Outages

RTAG members reported that many community members are uncomfortable when their house gets too cold during outages. Impacted communities experience a shortage in batteries available for purchase because demand is so high. Survey respondents shared that internet disruptions result in loss of connectivity and the ability of students to complete online assignments. They also expressed concern that they cannot cook or do laundry during outages, which disrupts daily routines.

16 The outreach boards asked about health concerns more broadly, while the survey asked about medical equipment issues.

17 Survey respondents identified loss of food as an impact 63 times.

18 This includes survey responses "Loss of Work and Childcare" and outreach board responses "Loss of Work" and "Childcare."

Power Outage Impacts by County

Survey and outreach board data of key power outage impacts by county[19] is shown in Table E.7 below. "No Air Conditioning" is the top impact from power outages across most counties, except for Monterey County where "Loss of Work" is the top impact. For San Luis Obispo and Santa Barbara County, respondents selected multiple impacts in their responses but "No Air Conditioning" is the top single impact. "Loss of Work" is generally the second highest impact, followed by "Medical Equipment Issues" for most counties. However, in Santa Barbara County "Medical Equipment Issues" are the second highest impact and "Loss of Work" is the third highest impact from power outages.

TABLE E.7 Power Outage Impacts by County
(Survey Responses & Outreach Board Participants) (n=1624 responses)

County	% of Respondents	Responses		
		No Air Conditioning	Health Concerns/ Medical Equipment Issues	Loss of Work/ Childcare[20]
Monterey	38%	24%	20%	32%
San Benito	12%	34%	20%	22%
San Luis Obispo	11%	24%	9%	20%
Santa Barbara	2%	24%	16%	12%
Santa Cruz	35%	27%	21%	23%

The values in this table may not total 100% across the response categories for counties because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by county.

Power Outage Impacts by Racial Background

Survey data of key power outage impacts by racial background is represented as percentages in Table E.8 below. "Loss of Work" or "No Air Conditioning" is the most frequently selected impact from power outages across most categories of racial background. Native Hawaiian and Pacific Islander and White respondents selected multiple impacts in their response, but "No Air Conditioning" is the top single impact. Two or More Race respondents selected multiple impacts in their response, but "Loss of Work" is the top single impact.

19 The counties presented in Table E.7 are Central Coast Region counties. The other 2.9 percent of respondents are from counties outside of this region.

20 This includes "Loss of Work & Childcare" responses from the survey, which combined these responses in addition to "Loss of Work" and "Childcare" responses from the outreach boards.

TABLE E.8 Power Outage Impacts by Racial Background (Survey Responses) (n=1400 responses)

Racial Background	% of Respondents	Responses: No Air Conditioning	Medical Equipment Issues	Loss of Work & Childcare
Asian	3%	33%	24%	11%
Black or African American	8%	17%	31%	25%
Latinx or Hispanic	63%	26%	18%	28%
Native American, American Indian, or Alaska Native	1%	40%	0%	30%
Native Hawaiian and Pacific Islander	2%	32%	9%	14%
Other	1%	25%	19%	31%
Two or more races	6%	21%	17%	23%
White	16%	26%	14%	22%

The values in this table may not total 100% across the response categories for racial backgrounds because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by race.

Power Outages Impacts by Income Level

Survey data of key power outage impacts by income-level is represented by percentages in Table E.9 below. The top impact from power outages is "No Air Conditioning" across most income-levels except for the low-income category for which "Loss of Work" is the top impact. "No Air Conditioning" and "Loss of Work" are the top impacts for those of moderate-income. "Medical Equipment Issues" is the third highest concern across all income levels.

TABLE E.9 Power Outage Impacts by Income Level (Survey Responses) (n=1358 responses)

Income Level	% of Respondents	Responses: No Air Conditioning	Medical Equipment Issues	Loss of Work & Childcare
Extremely low-income	14%	26%	18%	25%
Low-income	53%	24%	19%	26%
Moderate-income	31%	26%	19%	26%
High-income	2%	36%	18%	27%

The values in this table may not total 100% across the response categories for income levels because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by income level.

Extreme Heat

The Central Coast Region has historically experienced a temperate climate along the coast. As a result, very few communities in the Central Coast Region reported having air conditioning, despite increasing temperatures. Lower-income communities like Watsonville are disproportionately hotter than nearby Santa Cruz partly due to a lack of green space and tree canopy. Moreover, low-income households have dilapidated, older building stock that is not energy efficient and does not have air-conditioning. In more inland communities like King City, higher temperatures affect Latinx farmworkers and immigrant communities. Within Santa Barbara County, rural communities like Santa Maria and Guadalupe, which lie several hours away from urban hubs and resources, are more affected by extreme heat. RTAG members noted that there is a lack of places to go to cool down/cooling centers throughout the region.

"There are zero cooling centers in our area. There is nowhere to cool down other than the grocery store."

Through survey and outreach board engagement, 2006 responses were provided to the question "What impacts of extreme heat have you experienced or are most concerned about?" The survey asked about three specific impacts for extreme heat, plus an option for "Other." In contrast, the outreach board provided ten options for climate related impacts that participants have experienced, which were provided for power outages, extreme heat, wildfire smoke, flooding and sea level rise on the same board. These ten impact options were provided for power outages, extreme heat, and wildfire smoke on the same board.

The top responses for the survey and outreach board are highlighted in Figure E.9 and Figure E.10, respectively. The survey data shows the top impact for extreme heat is "Health Concerns," accounting for 40 percent of survey responses, followed by "Poor Indoor Air Quality" at 31 percent," then "Harsh Outdoor Working Conditions" at 28 percent. The qualitative data from the RTAG, survey, and the outreach boards are reflected in the following sections on Health Impacts, Economic Impacts, and Household/Community Impacts due to Extreme Heat.

FIGURE E.9 Impacts Experienced or that Cause Concern during Extreme Heat (Survey Respondents) (n=1978 responses)

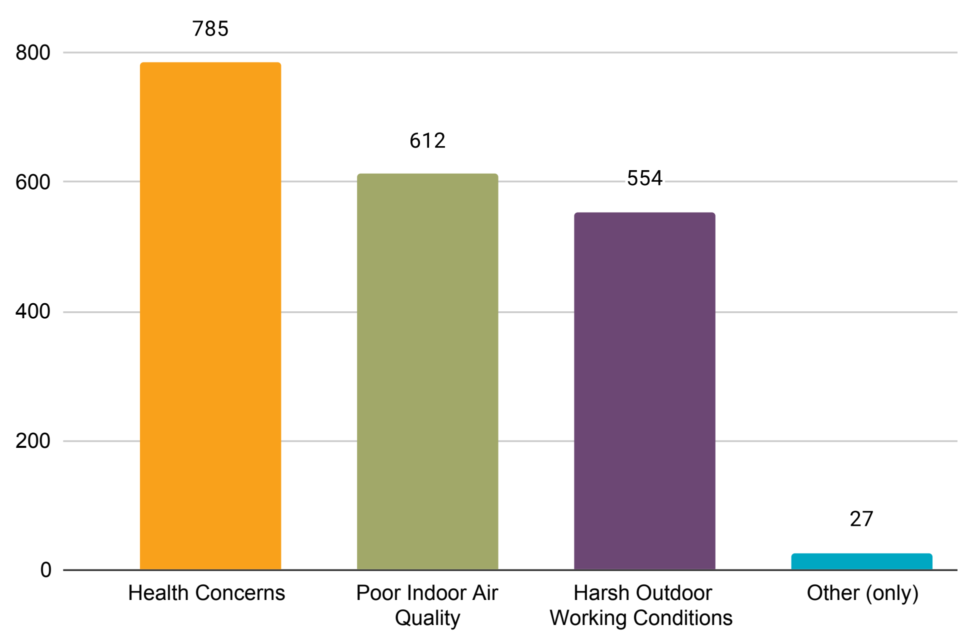
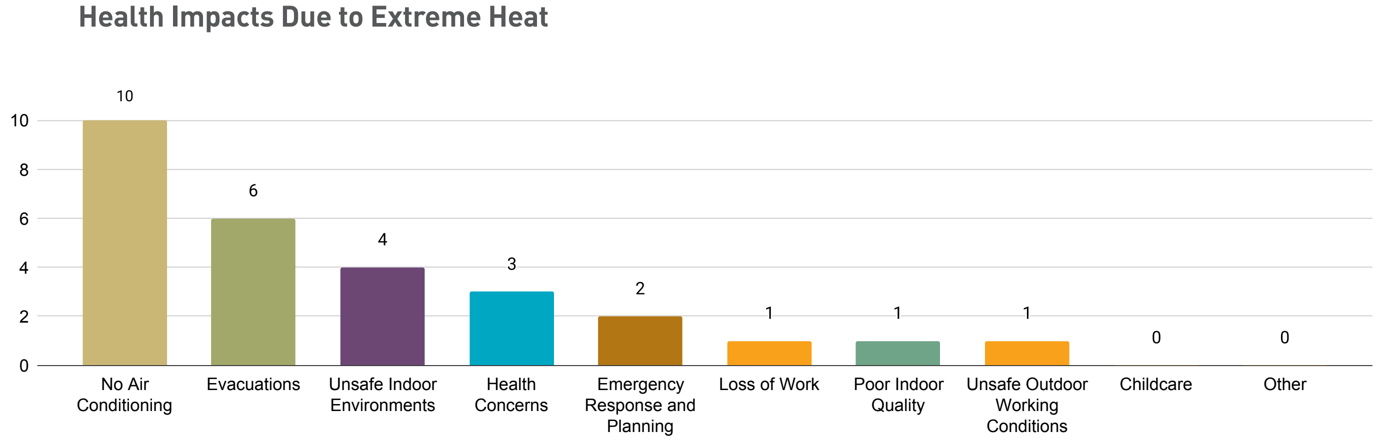


FIGURE E.10 Impacts Experienced or that Cause Concern during Extreme Heat (Outreach Board Participants) (n=28 responses)



Many interview participants shared that they do not have air conditioning, and cooling centers are inaccessible to most community members. RTAG members noted that landlords are not required to provide air conditioning. In addition, cooling centers have been politically unsupported and previously blocked by local elected officials. Even in communities that have cooling centers or spaces available to the public during extreme heat days, most community members do not know about them. As a result, many community members experience discomfort during extreme heat days, and are at risk of experiencing heat-related illnesses.

> **"We hear a lot from families that conditions in prisons are inhumane."**

Interview participants noted that increasing temperatures have posed a major health issue, especially for seniors and the unhoused population. Seniors and people with disabilities have adverse health outcomes without air conditioning and require the help of community groups to bring them portable air conditioning units. During extreme heat days, the unhoused population has nowhere to go, which has reportedly led to increased deaths and emergency room visits from dehydration and heat-related illnesses. RTAG members also noted that people in prisons are highly vulnerable to extreme heat, as many prisons in the desert do not have air conditioning, and there are many reports of incarcerated people getting sick or dying while institutionalized.

Farmworkers also suffer from negative health impacts due to extreme heat. Many farmworkers in this region harvest berries, which require being grown in plastic tarp greenhouses that concentrate heat and increase worksite temperatures by 10–15%. Farmworkers are routinely exposed to pesticides, and wearing personal protective equipment can increase the risk of heat stress. Participants shared that some farmworkers continue to work through unsafe working conditions and despite physical health challenges, even forgoing breaks in this extreme heat, because they are paid based on the pounds of crops harvested. RTAG members noted that outdoor laborers are often denied workplace protections by their employers and are not able to take necessary water breaks.

Many schools are also without air conditioning, which has resulted in some classrooms' indoor temperatures measuring 100 degrees. This high-level temperature exposure creates a public health concern for children and teachers.

Economic Impacts Due to Extreme Heat

According to interview participants and RTAG members, farmworkers are the most financially impacted by extreme heat because they cannot work in such extreme temperatures, and there are not sufficient workplace protections to allow for compensated breaks. In Santa Cruz County, low-income farmworker communities face financial pressures from lost income and reduced hours due to extreme heat days above 100 degrees. Short-term financial impacts have led to more farmworker families seeking financial assistance from community organizations. Farmworker families need significant electrical bill financial assistance as their bills are higher during heatwaves, but they have mostly relied on getting aid from non-profits (rather than utility companies or the government). The high cost of housing in Santa Cruz County raises concern that farmworkers will be evicted during heatwave-driven work shortages.

In the long-term, community members are concerned about the viability of operating farms, growing certain crops, and the number of farmworker jobs available. Farmworker jobs may be dramatically reduced if farmers have to let more land fallow due to extreme heat or grow crops that require less water and human labor. Like other heavily agricultural counties, extreme heat in San Benito County has ruined crops and hurt the local economy.

Household/Community Impacts Due to Extreme Heat

Survey respondents expressed concerns that increasing extreme heat days would dry out bushes, which increases the likelihood of wildfires. However, the most common response from survey respondents was "no impact" or "none."

Extreme Heat Impacts by County

Survey data of key extreme heat impacts by county[21] is represented by percentages in Table E.10. below. "Health Concerns" is the top impact for most counties. Although San Luis Obispo and Santa Barbara County respondents selected multiple impacts in their response, "Health Concerns" is the top single reported impact. "Harsh Outdoor Working Conditions" is the impact of highest concern for Monterey County. Notably, "Health Concerns" is the top and only reported impact for Santa Barbara County. "Poor Indoor Air Quality" is the third highest concern for most counties.

TABLE E.10 Extreme Heat Impacts by County
(Survey Respondents and Outreach Board Participants) (n=749 responses)

County	% of Respondents	Responses		
		Health Concerns/ Medical Equipment Issues	Harsh Outdoor Working Conditions	Poor Indoor Air Quality
Monterey	38%	23%	30%	19%
San Benito	12%	33%	21%	25%
San Luis Obispo	11%	24%	10%	15%
Santa Barbara	2%	10%	0%	0%
Santa Cruz	35%	40%	16%	25%

The values in this table may not total 100% across the response categories for counties because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by county.

21 The counties presented in Table E.10 are Central Coast Region counties. The other 2.9 percent of respondents are from counties outside of this region.

Extreme Heat by Racial Background

Survey data of key extreme heat impacts by racial background is represented by percentages in Table E.11 below. Asian and White respondents reported "Health Concerns" as the top impact. Although Black or African American, Latinx or Hispanic, and Two or More Races respondents selected multiple impacts in their response, "Health Concerns" is the top single reported impact. "Poor Indoor Air Quality" is the top impact for Native Hawaiian or Pacific Islander and Other respondents and "Harsh Outdoor Air Quality" is the top impact of concern for Native American, American Indian, or Alaska Native respondents.

TABLE E.11 Extreme Heat Impacts by Racial Background (n=631 responses)

Racial Background	% of Respondents	Responses		
		Health Concerns	Harsh Outdoor Working Conditions	Poor Indoor Air Quality
Asian	3%	75%	0%	0%
Black or African American	8%	36%	9%	9%
Latinx or Hispanic	63%	25%	24%	21%
Native American, American Indian, or Alaska Native	1%	0%	67%	33%
Native Hawaiian and Pacific Islander	2%	0%	25%	50%
Other	1%	22%	11%	33%
Two or more races	6%	29%	21%	16%
White	16%	35%	14%	18%

The values in this table may not total 100% across the response categories for racial backgrounds because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by race.

Extreme Heat Impacts by Income Level

Survey data of key extreme heat impacts by income level is represented by percentages in Table E.12 below. "Health Concerns" is the top impact from extreme heat across almost all income levels, followed by "Harsh Outdoor Working Conditions," then "Poor Indoor Air Quality." While high- and low-income respondents selected multiple impacts in their response, "Health Concerns" is the top single impact due to extreme heat.

TABLE E.12 Extreme Heat Impacts by Income Level (Survey Respondents) (n=612 responses)

Income Level	% of Respondents	Responses		
		Health Concerns	Harsh Outdoor Working Conditions	Poor Indoor Air Quality
Extremely low-income	14%	29%	23%	21%
Low-income	53%	28%	17%	22%
Moderate-income	31%	27%	26%	20%
High-income	2%	43%	14%	0%

The values in this table may not total 100% across the response categories for income levels because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by income level.

Wildfires and Smoke

The Central Coast Region is primarily affected by wildfire smoke that pools in the valley when fires occur in the nearby mountains. Long-term post-disaster recovery is a challenge, as it is in other regions heavily impacted by wildfires. Stringent development regulations, high costs associated with rebuilding, and gaps in insurance coverage all contribute to the region's housing affordability crisis, which is further exacerbated by increasingly frequent wildfires. Wildfires and subsequent evacuations have affected parts of Monterey County, including Big Sur and the inland "valley cities" where low-wage workers live. The mountainous areas of Gavilan Hills and the Tenoch Valley area are prone to fires and subsequent mudslides due to an abundance of eucalyptus groves.

Through survey and outreach board engagement, 2042 responses were provided to the question "What impacts of wildfire smoke have you experienced or are most concerned about?" The response options differed between the survey and the outreach boards, and survey respondents and outreach board participants were allowed to provide more than one response. The survey asked about three specific impacts for wildfire smoke, plus an option for "Other." In contrast, the outreach board provided ten options for climate related impacts that participants have experienced. These ten impact options were provided for power outages, extreme heat, and wildfire smoke on the same board.

The top responses for the survey and outreach board are highlighted in Figure E.11 and Figure E.12, respectively. The survey data shows the top impact for wildfire smoke is "Health Concerns," accounting for 44 percent of survey responses, followed by "Poor Indoor Air Quality," at 33 percent, then "Harsh Outdoor Working Conditions" at 22 percent. The qualitative data from the RTAG, survey, and the outreach boards are reflected in the following sections on Health Impacts, Economic Impacts, and Household/Community Impacts due to Wildfire and Smoke.

FIGURE E.11 Impacts Experienced or that Cause Concern during Wildfire Smoke (Survey Respondents) (n=1996 responses)

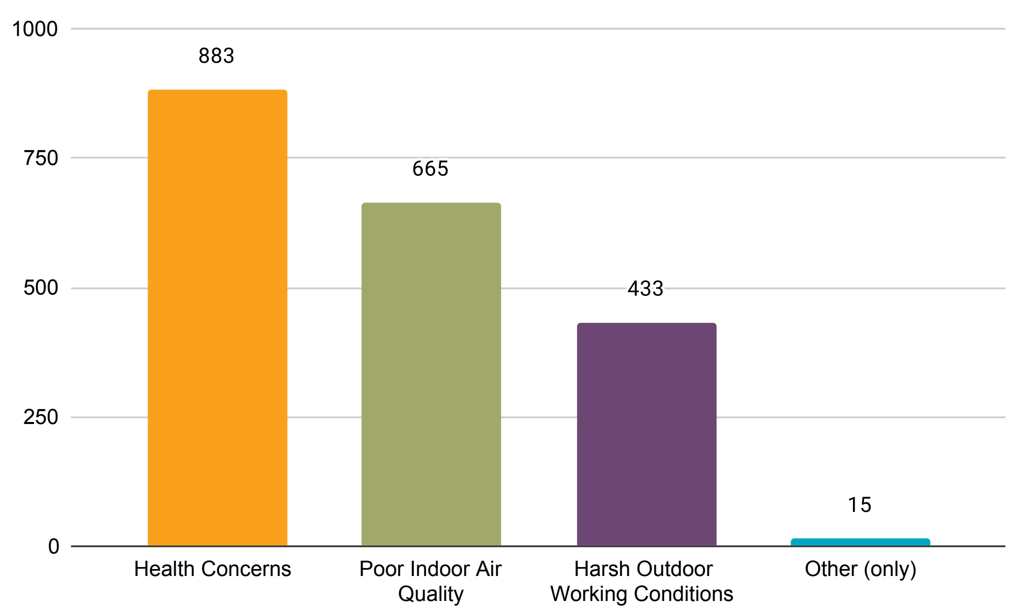
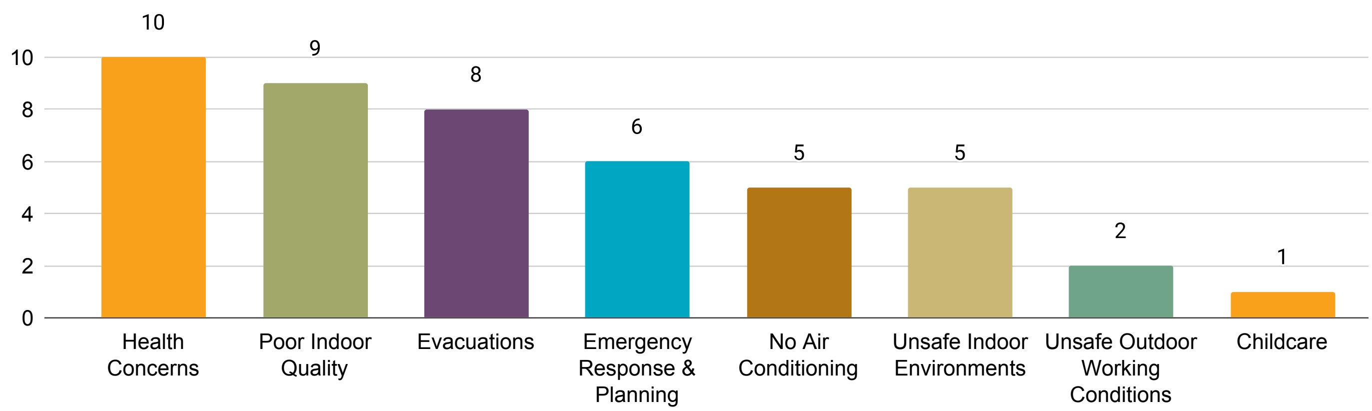


FIGURE E.12 Impacts Experienced or that Cause Concern during Wildfire Smoke (Outreach Board Participants) (n=46 responses)



Health Impacts Due to Wildfires and Smoke

Interview participants shared that wildfire smoke has made air quality so poor that asthmatics must evacuate even for prescribed burns, which has proven difficult even with advance notice. One RTAG member noted that her vision was impaired as a result of wildfire smoke, and she required special glasses to keep particles in the air from causing eye irritation. In addition, RTAG members noted that another community impact of concern is disruption in community health and wellness programs, which result in community members not receiving needed services, including mental health services. Survey respondents reported outdoor air quality resulting in harsh outdoor working conditions. They also noted the health of animals/pets was a concern. However, many survey respondents reported no impacts.

Economic Impacts Due to Wildfires and Smoke

Wildfires in the mountainous region of the Central Coast Region result in direct economic impacts including the loss of homes and property damage. Wildfires have burned down low-income homes, including mobile home parks, and spread across very dry oak woodlands in San Luis Obispo County. However, most of the Central Coast Region is impacted by wildfire smoke. Wildfires result in loss of income for day laborers and farmworkers when jobs are canceled, or hours are shortened due to severe wildfire smoke. One survey respondent was concerned about the impact of wildfire smoke on the economy.

Household/Community Impacts Due to Wildfires and Smoke

RTAG members shared that the most critical community impact of wildfires is increasing housing prices, with many community members expressing difficulty finding affordable housing after a wildfire event. Evacuations during fires in remote or rural areas are challenging, as there are few roads to escape, which are often obstructed during hazards. Wildfires have resulted in community members evacuating their animals/livestock. Transportation disruptions also pose a challenge to rural communities like Santa Maria and Guadalupe, which lie several hours away from urban hubs and resources and have difficulty accessing needed resources during and after a wildfire event.

Wildfire Smoke Impacts by County

Survey and outreach board data of key wildfire smoke impacts by county[22] is represented by percentages in Table E.13 below. "Health Concerns" is the top impact from wildfire smoke for most of the counties. While San Luis Obispo and Santa Barbara counties respondents selected multiple impacts in their response, "Health Concerns"

22 The counties presented in Table E.13 are Central Coast Region counties. The other 2.9 percent of respondents are from counties outside of this region.

is the top single reported impact. "Poor Indoor Air Quality" and "Harsh Outdoor Working Conditions" are the second and third highest reported impacts of wildfire smoke.

TABLE E.13 Wildfire Smoke Impacts by County (Survey Respondents and Outreach Board Participants) (n=769 responses)

County	% of Respondents	Responses: Health Concerns and Medical Equipment Issues	Responses: Poor Indoor Air Quality	Responses: Harsh Outdoor Working Conditions/ Unsafe Outdoor Working Conditions
Monterey	38%	30%	23%	24%
San Benito	12%	38%	27%	15%
San Luis Obispo	11%	34%	5%	5%
Santa Barbara	2%	20%	10%	0%
Santa Cruz	35%	14%	30%	14%

The values in this table may not total 100% across the response categories for counties because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by county.

Wildfire Smoke Impacts by Racial Background

Survey data of key wildfire smoke impacts by racial background is represented by percentages in Table E.14 below. "Health Concerns" is the top impact of wildfire smoke across almost all racial backgrounds, except for Native American, American Indian, or Alaska Native respondents who reported "Poor Indoor Air Quality" as the top impact. Notably, Native Hawaiian and Pacific Islander respondents selected multiple impacts in their response but equally reported "Health Concerns" and "Harsh Outdoor Working Conditions" as the top single concern due to wildfire smoke.

TABLE E.14 Wildfire Smoke Impacts by Racial Background (Survey Respondents) (n=1226 responses)

Racial Background	% of Respondents	Responses: Health Concerns	Responses: Poor Indoor Air Quality	Responses: Harsh Outdoor Working Conditions
Asian	3%	83%	0%	0%
Black or African American	8%	45%	9%	9%
Latinx or Hispanic	63%	32%	22%	20%
Native American, American Indian, or Alaska Native	1%	25%	75%	0%
Native Hawaiian and Pacific Islander	2%	25%	0%	25%
Other	1%	40%	30%	10%
Two or more races	6%	45%	21%	10%
White	16%	35%	22%	18%

The values in this table may not total 100% across the response categories for racial backgrounds because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by race.

Wildfire Smoke Impacts by Income Level

The key wildfire smoke impacts by income level are represented by percentages in Table E.15 below. The top impact across all income levels is "Health Concerns." While high-income respondents selected multiple impacts in their response, "Health Concerns" is the top single reported impact to wildfire smoke. "Poor Indoor Air Quality" is the second highest impact followed by "Harsh Outdoor Working Conditions."

TABLE E.15 Wildfire Smoke Impacts by Income Level (Survey Respondents) (n=628 responses)

		Responses		
Income Level	% of Respondents	Health Concerns	Poor Indoor Air Quality	Harsh Outdoor Working Conditions
Extremely low-income	14%	38%	20%	20%
Low-income	53%	37%	21%	15%
Moderate-income	31%	29%	24%	19%
High-income	2%	38%	0%	25%

The values in this table may not total 100% across the response categories for income levels because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by income level.

Flooding and Sea Level Rise

Flooding and sea level rise are primary hazards of concern in the Central Coast Region. The most frequent flooding in the Central Coast Region is flash flooding caused by sudden local or nearby heavy rainfall. Santa Cruz County was hit particularly hard during the most recent March 2023 atmospheric river. The Pajaro and San Lorenzo Rivers and creeks have historically inundated Latinx neighborhoods and resulted in heavy damage, with the construction of a repaired levee repair at the Pajaro River only just commenced. Communities like Downtown Watsonville are at risk of flooding and inundation from sea level rise, threatening their water treatment plant on the coast. Santa Barbara County is also at high risk of flooding, as well as fire/flood cycles that result in severe debris flows such as those observed after the Thomas Fire in 2017. Sea level rise is accelerating, and coastal wave events in combination with rising seas will continue to drive coastal flooding inland, increasing the region's vulnerability. The most vulnerable areas for future flooding across the region include Carpinteria, Santa Barbara, Harbor East Beach neighborhood, Goleta Slough/Santa Barbara Airport, Devereux Slough, and Gaviota State Park.[23] Sea level rise is also responsible for saltwater intrusion and groundwater depletion in Santa Cruz County.

"The overwhelming issue is flooding because we all got so hit with the rain over the last three months. We would not have seen as much engagement if those events didn't happen. Flooding leaped into the forefront of everyone's minds."

The top responses for the survey and outreach board are highlighted in Figure E.13 and Figure E.14, respectively. The survey data shows the top impacts for flooding are "Evacuation" at 25 percent, equally followed by "Water Damage to the Home"[24] and "Loss of Work" each accounting for 22 percent of survey responses. This is followed by "Health Concerns" at 17 percent, then "Emergency Response and Planning" at 14 percent. The qualitative data from the RTAG, survey, and the outreach boards are reflected in the following sections on Health Impacts, Economic Impacts, and Household/Community Impacts due to Flooding.

23 California's Fourth Climate Change Assessment. Central Coast Region Report. California Natural Resources Agency. 2019. https://www.energy.ca.gov/sites/default/files/2019-11/Reg_Report-SUM-CCCA4-2018-006_CentralCoast_ADA.pdf

24 "Water Damage to the Home" was included as an option on the survey for Flooding and Sea Level Rise

FIGURE E.13 Impacts Experienced or that Cause Concern During Flooding (Survey Board Participants) (n=2437 responses)

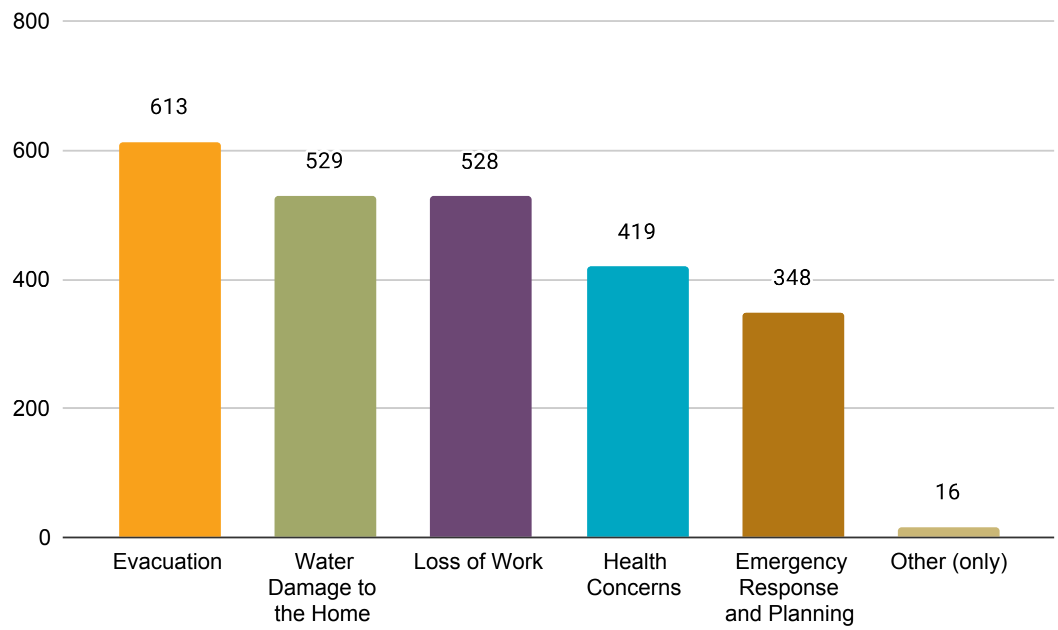
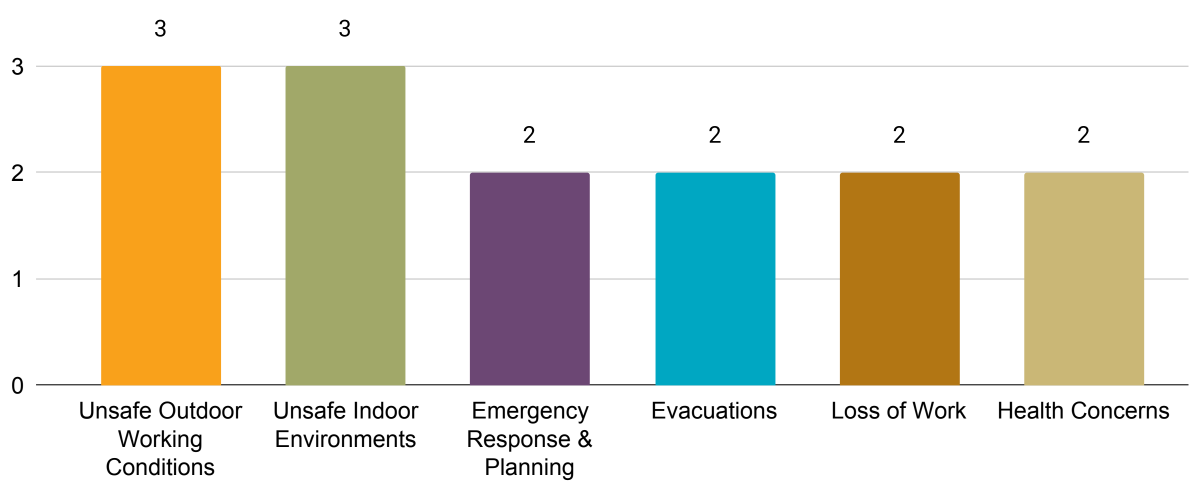


FIGURE E.14 Impacts Experienced or that Cause Concern during Flooding (Outreach Board Participants) (n=14 responses)



but not as part of the outreach boards.

Health Impacts of Flooding and Sea Level Rise

Flooding can result in injury and risk to life from drowning. After flood events, many households experience mold exposure which can negatively impact health. Health risks are also associated with evacuations, loss of access to health services, and loss of health infrastructure including essential drugs and supplies.

Some RTAG members expressed concern that flooding would exacerbate water contamination and toxic substance exposure, particularly at the former Fort Ord army base. The Fort Ord army base left behind toxic waste and drinking water contamination that has resulted in higher rates of premature death, cancer, severe allergies, and asthma in nearby neighborhoods.

Economic Impacts of Flooding and Sea Level Rise

One of the primary economic impacts of flooding is loss of or damage to property. Interview participants expressed concerns that sandbags are the only tool the community has to protect their homes. Older housing stock in low-lying areas is not sturdy enough to withstand water and sandbags are a limited response measure. Many low-income apartment complexes are at high risk of being inundated by coastal flooding. Retaining walls have been built on the beach, but many community members think they are insufficient to protect against future sea level rise.

"With the rain, day laborers haven't had a job since December."

RTAG members emphasized the financial impacts of flooding on low-income, farming communities like Pajaro. Families are evacuated or displaced and cannot work. In the meantime, if they are renters, they have to keep paying rent and utility bills despite not being able to be in their home or use power. These financial impacts are compounded over time.

The agricultural industry is also highly impacted by severe flood events. Day laborers and farmworkers lose work and often cannot apply for unemployment due to their immigration status. Flooding of farmland can result in extensive economic losses due to loss of crops.

"They need to continue to pay for utility bills but do not have access to what they are paying for."

Community/Household Impacts of Flooding and Sea Level Rise

In addition to health and economic impacts, flood events result in evacuations and disruptions in public infrastructure and utility services. People don't have a place to go after their home is flooded, with many communities experiencing permanent displacement. In Monterey County, more than 8,500 people were under evacuation orders in the most recent atmospheric river event in March 2023 (during the Outreach Period), including 1,700 residents - many of them Latino farmworkers - from the unincorporated community of Pajaro. RTAG members shared that low-income, Indigenous communities cannot access resources and services post-flood because of language barriers and their immigration status affects their ability/willingness to ask for the resources they need. RTAG members also noted disruptions in transportation throughout the region, noting that roads don't get repaired as quickly in low-income areas. RTAG members also shared that power outages often occur during severe flood events, and customers are charged for utilities despite not being able to access power or water (from ruptured septic tanks).

"We have a lot of displaced families living at fairgrounds or in their cars. That is a huge crisis."

"Impacts in north county, where people have money and jobs in tech, the roads were fixed immediately. But in Pajaro, people are still dislocated."

Flooding and Sea Level Rise Impacts by County

Survey and outreach board data of key flooding and sea level rise impacts by county[25] is represented by percentages in Table E.16 below. While respondents of all counties selected multiple impacts in their response," Evacuation" is the top single impact for Monterey and Santa Cruz counties and "Water Damage" is the top single impact for San Benito and San Luis Obispo counties. Notably, Santa Barbara County equally reported "Evacuation" and "Water Damage to the Home" as the top single impact for flooding.

TABLE E.16 Flooding and Sea Level Rise Impacts by County (Survey Respondents & Outreach Board Participants) (n=794 responses)

County	% of Respondents	Responses				
		Evacuation	Emergency Response and Planning	Health Concerns	Loss of Work	Water Damage to Home
Monterey	38%	16%	9%	11%	13%	13%
San Benito	12%	16%	9%	16%	13%	17%
San Luis Obispo	11%	5%	8%	2%	8%	9%
Santa Barbara	2%	10%	0%	0%	0%	10%
Santa Cruz	35%	21%	12%	14%	11%	12%

The values in this table may not total 100% across the response categories for counties because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by county.

Flooding Impacts by Racial Background

Survey data of key flooding and sea level rise impacts by racial background is represented by percentages in Table E.17 below. While most respondents selected multiple impacts in their responses, White, Two or more races and Latinx or Hispanic respondents reported "Evacuation" as the top single impact. Respondents of Other races reported "Evacuation" as the top impact. Black or African American respondents equally reported "Evacuation," "Health Concerns" and "Water Damage to the Home" as the top single impact. Asian respondents equally reported "Evacuation," "Health Concerns" and "Loss of Work" as the top single impact to flooding.

TABLE E.17 Flooding and Sea Level Rise Impacts by Racial Background (Survey Respondents) (n=667 responses)

County	% of Respondents	Responses				
		Evacuation	Emergency Response and Planning	Health Concerns	Loss of Work	Water Damage to Home
Asian	3%	25%	0%	25%	25%	0%
Black or African American	8%	13%	7%	13%	13%	13%
Latinx or Hispanic	63%	15%	11%	11%	13%	13%
Native American, American Indian, or Alaska Native	1%	0%	0%	25%	25%	50%

25 The counties presented in Table 129 are Central Coast Region counties. The other 2.9 percent of respondents are from counties outside of this region.

County	% of Respondents	Responses: Evacuation	Emergency Response and Planning	Health Concerns	Loss of Work	Water Damage to Home
Native Hawaiian and Pacific Islander	2%	0%	0%	25%	25%	0%
Other	1%	36%	0%	9%	9%	27%
Two or more races	6%	19%	11%	5%	5%	11%
White	16%	21%	7%	6%	4%	15%

The values in this table may not total 100% across the response categories for racial backgrounds because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by race.

Flooding and Sea Level Rise Impacts by Income Level

Survey data of key flooding and sea level rise impacts by income level is represented by percentages in Table E.18 below. The flooding and sea level rise impacts of highest concern are consistent across all income levels, with "Evacuation" as the top impact. "Water Damage to the Home" is the second highest impact across all income levels. "Emergency Response and Planning" and "Health Concerns" are the third and fourth reported concerns for flooding across income levels.

TABLE E.18 Flooding and Sea Level Rise Impacts by Income Level (Survey Respondents) (n=637 responses)

County	% of Respondents	Responses: Evacuation	Emergency Response and Planning	Health Concerns	Loss of Work	Water Damage to Home
Extremely low-income	14%	19%	14%	15%	13%	15%
Low-income	53%	14%	9%	10%	9%	10%
Moderate-income	31%	18%	12%	9%	13%	15%
High-income	2%	29%	0%	14%	14%	14%

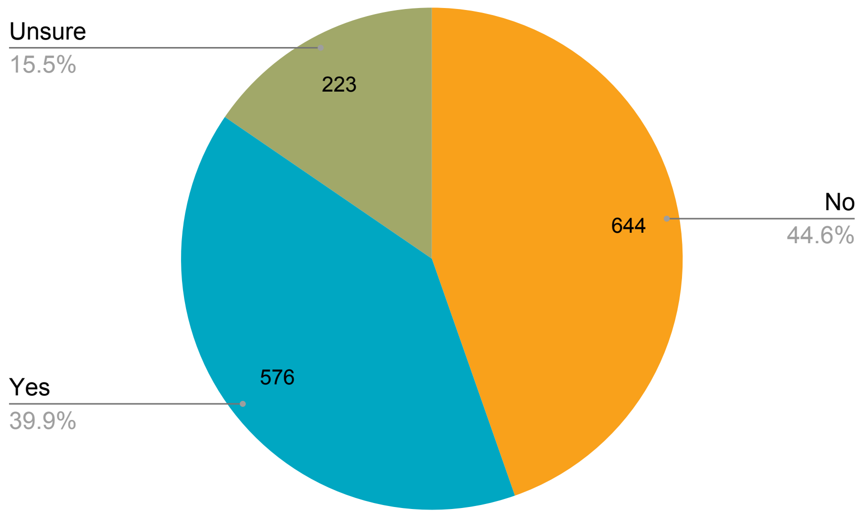
The values in this table may not total 100% across the response categories for income levels because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by income level.

Mental Health

The survey asked about mental health impacts while the outreach boards did not include questions on mental health impacts. Participants engaged through the outreach boards did however touch on mental health impacts that are a result of other hazards and are included in the relevant sections of this report. Approximately 40 percent of survey respondents (n=1443) said "Yes," to the question asking if their mental health has been impacted by extreme climate events, which include heat, increased rain and flooding, wildfires, drought, and landslides (45 percent of respondents said "No" and 15 percent were "Unsure").

Power outages result in community members feeling anxious, because they cannot communicate directly with friends and family, and because they are unable to get news or access the internet to learn what is going on; and therefore, are unable to coordinate an emergency response or plan. RTAG members reported power outages impacting the mental health of seniors, who may be left alone without electricity, and children, who fear the dark. In rural areas, which are also most impacted by wildfires, RTAG members stated that community members grapple with severe mental health impacts and are in fear of the next wildfire event.

FIGURE E.15 Whether Mental Health has been Impacted by Extreme Climate Events (Survey Respondents) (n=1443 respondents)



Mental Health Impacts by County

The Project Team also analyzed the information collected through the surveys by county.[26] Santa Cruz County by far had the highest number of survey respondents say "Yes" to the question asking if their mental health has been impacted by extreme climate events, followed by San Luis Obispo County. Approximately half of respondents from Monterey and San Benito County said "No" to the question on mental health impacts.

TABLE E.19 Mental Health Impacts due to Extreme Climate Events, by County (n=1615 respondents)

		Responses		
County	% of Respondents	No	Unsure	Yes
Monterey	38%	53%	13%	34%
San Benito	12%	51%	14%	35%
San Luis Obispo	11%	28%	33%	39%
Santa Barbara	2%	12%	52%	36%
Santa Cruz	35%	32%	25%	43%

The values in this table may not total 100% across the response categories for counties because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by county.

26 The counties presented in Table E.19 are Central Coast Region counties. The other 2.9 percent of respondents are from counties outside of this region.

Mental Health Impacts by Racial Background

Black or African American, Latinx or Hispanic, Native American, American Indian, or Alaska Native and Other respondents were more likely to respond "No" to the question asking if their mental health has been impacted by extreme climate events compared to White and Native Hawaiian and Pacific Islander respondents who were more likely to answer "Yes" or "Unsure."

TABLE E.20 Mental Health Impacts by Racial Background (Survey Respondents) (n=1408 responses)

		Responses		
Racial Background	% of Respondents	No	Unsure	Yes
Asian	3%	32%	32%	36%
Black or African American	8%	44%	18%	38%
Latinx or Hispanic	63%	44%	16%	40%
Native American, American Indian, or Alaska Native	1%	42%	33%	25%
Native Hawaiian and Pacific Islander	2%	18%	55%	27%
Other	1%	60%	15%	25%
Two or more races	6%	33%	34%	34%
White	16%	29%	33%	38%

The values in this table may not total 100% across the response categories for racial backgrounds because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by race.

Mental Health Impacts by Income Level

Extremely low and low-income respondents reported more mental health impacts (31 percent and 20 percent, respectively) compared to those who identified as high-income (21 percent said yes).

TABLE E.21 Mental Health Impacts due to Extreme Climate Events by Income Level (Survey Respondents) (n=1367 responses)

		Responses		
Income Level	% of Respondents	No	Unsure	Yes
Extremely low-income	14%	31%	38%	31%
Low-income	53%	38%	42%	20%
Moderate-income	31%	45%	37%	18%
High-income	2%	58%	21%	21%

The values in this table may not total 100% across the response categories for income levels because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by income level.

Adaptive Capacity

> **"Some families don't have space for generators because they share a garage or rent."**

Based on RTAG input collected during research interviews, the Central Coast Region has lower adaptive capacity than other regions because historically, the region has experienced a mild climate, and there is no air conditioning. Sandbags are the only treatment for sea level rise. Low-income homes are not sturdy enough to withstand flooding or cliff erosion. RTAG members noted that government agencies are beginning to address climate adaptation. The City of Santa Cruz and City of Watsonville have climate action plans and climate adaptation plans. Some counties have Offices of Emergency Services that notify people to evacuate via reverse 911 calls in English and Spanish. However, others shared that government agencies struggle to communicate with each other and lack resources; leaving communities unsure of who is leading efforts to address climate impacts. In these areas, there is a disproportionate reliance on CBOs like the Red Cross to step in. In general, RTAG members felt that people were not equipped or prepared for climate impacts, and do not know what they can do or how to advocate for needed resources.

Regional Adaptive Capacity by County

The Project Team also evaluated the Central Coast Region adaptive capacity by utilizing the Building Resilience Indicators for Communities (BRIC) Index county scores across the 6 categories and the BRIC Composite score for each county in the region (Table E.22). A description of the resilience categories is provided in the Adaptive Capacity section of the main report.

San Luis Obispo has the highest overall adaptive capacity, while Monterey County has the lowest. Across counties, **the region performs the lowest on the "Infrastructural" resilience category**. The category with the second lowest score is "Community Capital," suggesting that communities in the Central Coast lack strong social networks and connectivity among individuals and groups. This data is consistent with RTAG member input that **many immigrant farmworker communities, while connected amongst themselves, are disconnected from community resources and language barriers, as well as immigration status, can be a barrier to community involvement.** In addition, the remote nature of many communities likely contributes to a low community capital score.

TABLE E.22 BRIC Scores by County (High to Low)

County	Social	Economic	Community Capital	Institutional	Infrastructural	Environmental	BRIC Composite Score
Monterey	0.604	0.459	0.240	0.373	0.295	0.542	0.419
San Benito	0.632	0.491	0.327	0.436	0.273	0.521	0.447
San Luis Obispo	0.691	0.479	0.352	0.459	0.273	0.536	0.465
Santa Barbara	0.651	0.476	0.281	0.372	0.303	0.508	0.432
Santa Cruz	0.691	0.479	0.312	0.371	0.295	0.533	0.447

* To simplify the comparison and analysis of many variables, researchers may use a normalization technique called Min-Max normalization in social indicators research. This involves scaling all values between 0 and 1 (0 represents the minimum value and 1 represents the maximum value) through adjusting all other values by subtracting the minimum value from the maximum and dividing by the range.

Supplemental Adaptive Capacity Indicators

The Resilient Together initiative survey provides supplemental data that is relevant to the evaluation of adaptive capacity for the Central Coast Region. The following section describes respondents' access to financial resources, a cool space (at home or outside of home), a comfortable home, and air conditioning by select demographic characteristics. However, the data is not representative of the region as a whole and should only be referenced with context to the survey sample and in conjunction with the BRIC index results, which provide a region-wide analysis.

Access to Financial Resources

Access to financial resources enables households to access resources and services that improve their resilience in the face of climate hazards. For low-income households, increasing access to financial assistance is one of the most significant ways to increase adaptive capacity. In the Central Coast Region, approximately 23 percent of survey respondents currently receive financial assistance on their utility bill, and another 19 percent were unsure.[27] To qualify for financial assistance, households must meet low-income thresholds set by PG&E.[28]

Access to Cool Space

As shown in Figure E.16, approximately 45 percent of survey respondents and outreach board participants cool off in the park, school, work,[29] or community center, while 50 percent cool off in their home. Other places listed by many respondents include: other water sources (pool,[30] river, ocean, lake[31]), stores,[32] and the library.[33] Less than five survey respondents shared they cool off in a hotel, movie theater, or gym. Figure E.17 illustrates where people go to cool off based on their type of home. Unhoused/homeless survey respondents are more likely to use parks than other groups (57 percent of survey responses for this group). Survey respondents living in duplexes/triplexes and high-rise apartments were the most likely to utilize schools as places to cool off compared to respondents with other housing types, presumably due to the higher number of children residing in these housing types. However, only six percent of all survey respondents chose schools. People with all housing types, including unhoused/homeless survey respondents, chose the park as a cool space approximately a quarter of the time.

27 This question received responses from nearly 100 percent of survey respondents, with n=1647 responses.

28 CARE / FERA program guidelines can be accessed at the below site: https://www.pge.com/en_US/residential/save-energy-money/help-paying-your-bill/longer-term-assistance/care/program-guidelines.page#qualifying

29 Work was removed from the outreach boards as an option for Regions 2–5, and was included in the online and paper surveys. Work is reflected as a response in "Other" through outreach board engagement but may be represented at a lower response level than the Bay Area Region where Work was included as an option on the outreach boards.

30 14 respondents mentioned the pool.

31 56 respondents mentioned the lake, river, ocean, creek or beach.

32 25 respondents mentioned store.

33 7 respondents mentioned library.

FIGURE E.16 Where People Go to Cool Off on Hotter Days (Survey and Outreach Boards) (n=1900 responses)

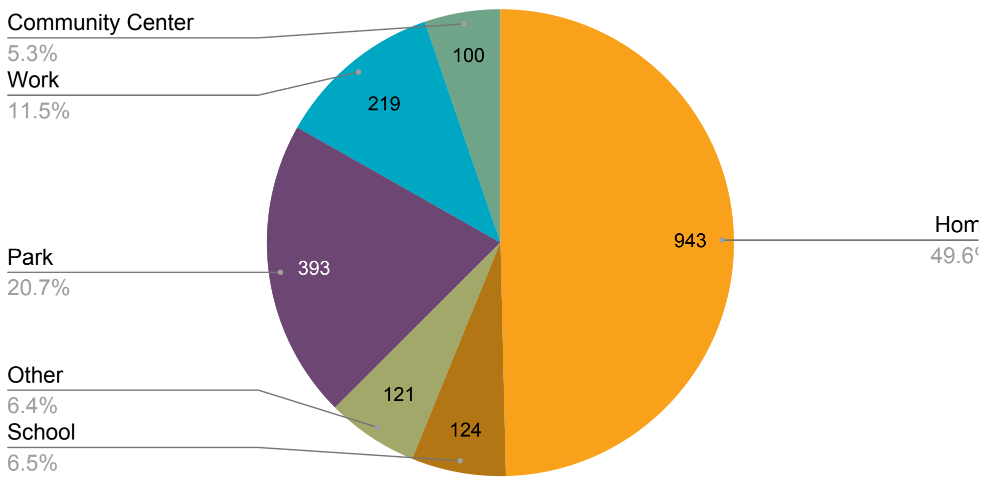
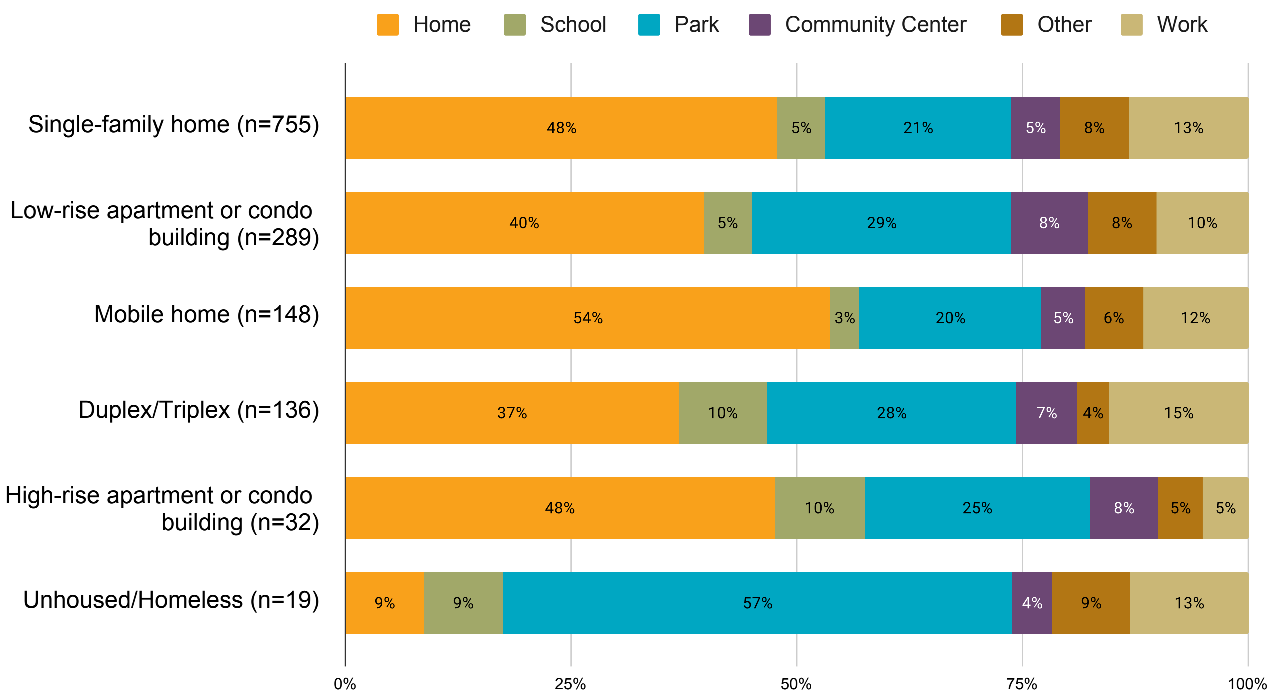


FIGURE E.17 Where People Cool Off by Housing Type (Survey Respondents) (n=1865 responses)



Access to Comfortable Home

Nearly half of all survey and outreach board responses (33 percent) indicated that community members are "Comfortable" or "Very Comfortable" in their home on hotter days. RTAG members support resilience hubs/ cooling centers as a strategy to adapt to extreme heat, but only a small percentage (5 percent) of survey respondents and outreach board participants indicated they cool off at existing community centers, reflecting the large number of respondents who are comfortable staying in their homes on hotter days.

For those who said they cool off at home on hotter days through the survey[34] (n=943 respondents), a little over a third of survey respondents (38 percent) indicated they were "Comfortable" or "Very Comfortable." If people are "Comfortable," "Very Comfortable" at home, they will stay at home. But for the nearly 63 percent of survey respondents who are "Not at All Comfortable" or "Slightly Uncomfortable" they will go somewhere other than home to cool off.

Table E.23 shows how comfortable respondents are at home on hotter days by county, for counties in the Central Coast Region for which there is data available. Across counties, nearly a fifth of all survey and outreach board respondents (16 percent) are "Comfortable" or "Very Comfortable" in their homes on hotter days. The counties with the highest percentage of responses (> 5 percent) indicating respondents are "Comfortable" or "Very Comfortable" in their homes on hotter days are Monterey, Santa Barbara and Santa Cruz counties. The counties with the highest percentage of responses (>50 percent) indicating respondents are "Slightly Uncomfortable" are Monterey, San Luis Obispo and Santa Cruz counties. Monterey County includes both dense coastal population and many farmworkers and others who live inland, explaining the diversity of comfort felt at home by respondents across the county. The counties with the highest percentage of responses (>40 percent) indicating respondents are "Not at All Comfortable" in their homes on hotter days are San Luis Obispo and Santa Barbara County.

TABLE E.23 Comfort Level at Home on Hotter Days, by County (Survey Respondents and Outreach Board Participants) (n=1311 responses)

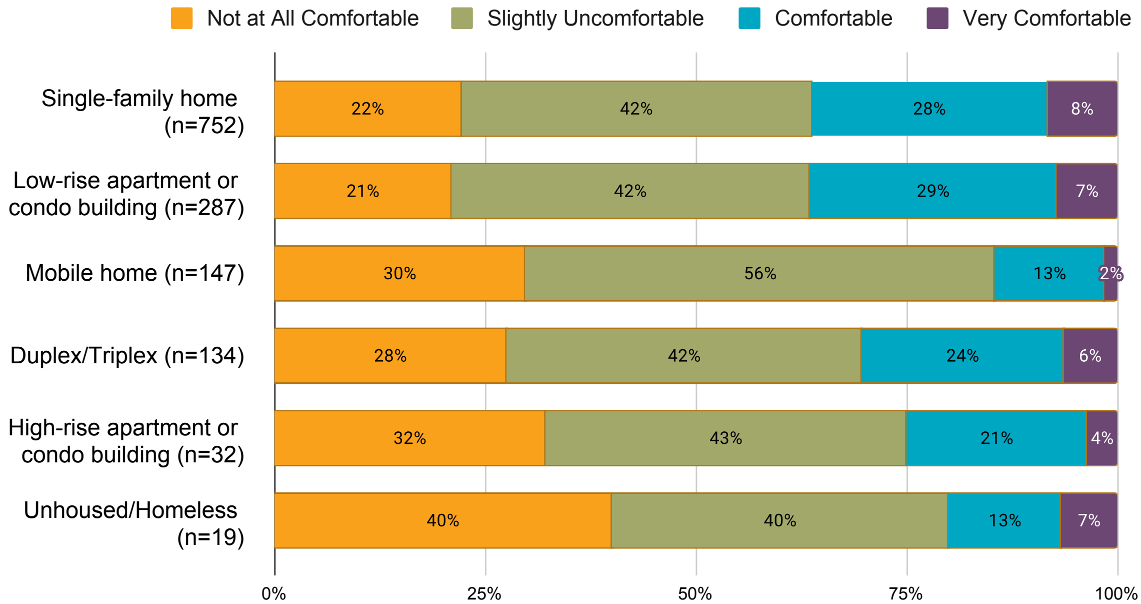
County	% of Respondents	Responses			
		Not at All Comfortable	Slightly Uncomfortable	Comfortable	Very Comfortable
Monterey	38%	21%	58%	11%	11%
San Benito	12%	36%	49%	8%	8%
San Luis Obispo	11%	45%	55%	0%	0%
Santa Barbara	2%	56%	44%	0%	0%
Santa Cruz	35%	33%	51%	8%	8%

The values in this table may not total 100% across the response categories for counties because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by county.

Figure E.18 shows how comfortable survey respondents are at home on hotter days by housing type. The survey findings demonstrate that survey respondents living in low-rise apartment or condo buildings and single-family homes are the most comfortable on hotter days (on average 77 percent of extremely low and low-income respondents live in low-rise apartment or condo buildings and 58 percent in single-family homes); and those living in a mobile home and those unhoused or homeless are least comfortable.

34 The level of specificity was not asked as part of this question on the outreach boards due to simplicity.

FIGURE E.18 Comfort Level in Home on Hotter Days by Housing Type (Survey Respondents) (n=1371 respondents)



Access to Air conditioning

Approximately 25 percent of survey respondents and outreach board respondents (n=1668 total respondents to this question) indicated they have access to an air-conditioned space. The survey also asked those respondents who do not have access to an air-conditioned space now if they need air-conditioning or not. Of the 1654 survey respondents who were asked this question, 53 percent said they do not have access to air-conditioning. Of those survey respondents, only about 40 percent (n=660 respondents) responded that they do not have access to an air-conditioned space, but they need air-conditioning. This finding is inconsistent with data collected via the outreach boards; outreach boards asked if people would need access to an air-conditioned space as it gets hotter, and 64 percent of outreach board participants said "Yes."

> **"There are a lot of resources that support those affected by flooding, but it's a struggle to share with communities that don't speak Spanish (speak Mixteco). We're missing a lot of families."**

Resilience Strategies and Recommendations

Through the Resilient Together initiative, community and RTAG members had an opportunity to share preferred strategies for how PG&E can best build community resilience to the range of climate impacts identified in communities throughout the region. These strategies, if implemented, would increase the adaptive capacity of households and communities to a range of climate impacts.

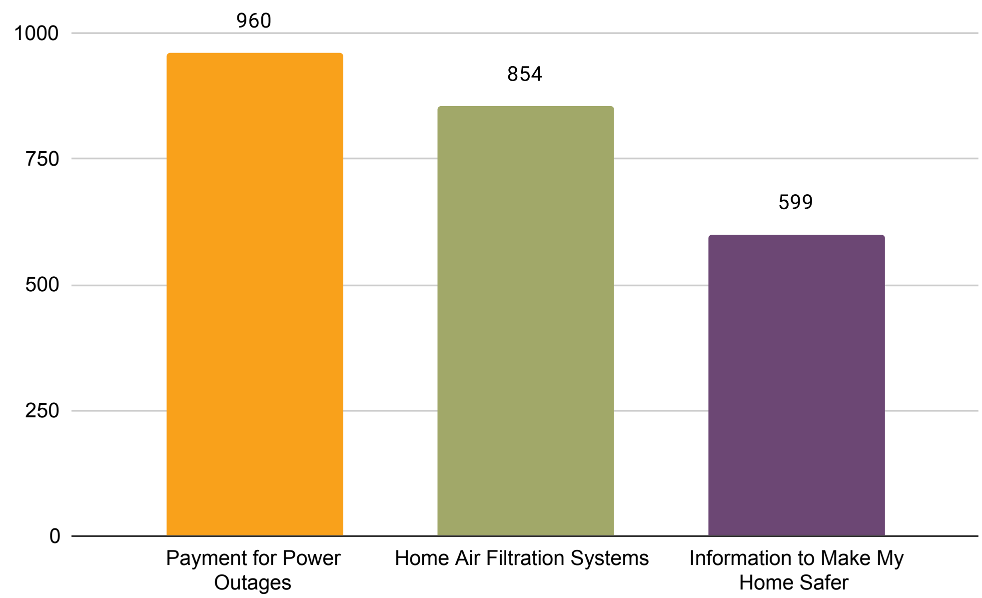
Generally, RTAG members in the Bay Area Region recommended PG&E:

- **Provide direct financial assistance** to low-income households and farmworkers.
- **Distribute resources** including food, water, masks, sandbags, and battery packs.
- **Invest in infrastructure upgrades** that would reduce planned power outages as well as ensure communities have access to backup energy.
- **Improve community outreach and education**, including funding and building the capacity of CBOs to conduct multi-lingual outreach to support customer enrollment in PG&E programs and distribution of safety resources. They also suggested that PG&E make the process of engaging with them easier, since CBOs are not aware of what PG&E programs exist to support community members.
- **Help build the operational capacity of CBOs**, since they are the ones that communities turn to in crisis.

Household Resilience Strategies

Community members were requested to provide recommendations for the kinds of strategies that PG&E could implement that would support households during extreme weather events. A summary of the strategies that were recommended by the Central Coast Region specifically are included below.

FIGURE E.19 PG&E Strategies for Households during Extreme Weather Events (n=2413 responses)



Survey respondents and those whose responses are reflected through the outreach boards in-person were asked to provide their top two recommended strategies for PG&E to consider supporting households during extreme weather events. Of the 2413 responses received, the top two recommended strategies are "Payment for Power Outages" and "Home Air Filtration Systems." Survey respondents also provided open-ended input on community resilience strategies under the "Other" response category. All these responses were contextualized and integrated into the Central Coast Region Recommendations for Community Resilience Strategies (Table E.24).

Key Household Resilience Strategies by County

Prioritization of resilience strategies varied by county. For Monterey and San Benito counties, the top strategy is "Payment for "Home Air Filtration Systems." "Payment for Power Outages" is the top strategy for Santa Barbara County and "Home Air Filtration Systems" for Santa Cruz County. Notably, "Home Air Filtration Systems" is the top and only strategy for San Luis Obispo County. "Information to Make My Home Safer" is the third highest strategy. Table E.24 highlights the Central Coast Region represented counties in the survey and the outreach boards.

TABLE E.24 Priority Household Resilience Strategies by County
(n=2391 responses)

County	% of Respondents	Responses: Payment for Power Outages	Responses: Home Air Filtration Systems	Responses: Information to Make My Home Safer
Monterey	38%	39%	34%	27%
San Benito	12%	34%	25%	27%
San Luis Obispo	11%	0%	100%	0%
Santa Barbara	2%	60%	40%	0%
Santa Cruz	35%	30%	40%	30%

The values in this table may not total 100% across the response categories for counties because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by county.

Key Household Resilience Strategies by Racial Background

The household resilience strategies can also be reviewed based on how participants identified their racial background, as illustrated in Table E.25 below. "Payment for Power Outages" is the top strategy across most racial backgrounds except for Asian and Native Hawaiian and Pacific Islander respondents who reported "Home Air Filtration System" as the top strategy. Notably, Latinx or Hispanic respondents equally reported "Payment for Power Outages" and "Home Air Filtration Systems" as the top strategy.

TABLE E.25 Priority Household Resilience Strategies by Racial Background
(n=2021 responses)

Racial Background	% of Respondents	Responses: Payment for Power Outages	Responses: Home Air Filtration Systems	Responses: Information to Make My Home Safer
Asian	3%	32%	39%	29%
Black or African American	8%	51%	26%	23%
Latinx or Hispanic	63%	37%	37%	26%
Native American, American Indian, or Alaska Native	1%	47%	27%	27%
Native Hawaiian and Pacific Islander	2%	32%	37%	32%
Other race	1%	44%	28%	28%
Two or more races	6%	58%	21%	21%
White	16%	42%	38%	20%

The values in this table may not total 100% across the response categories for racial backgrounds because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by race.

Key Household Resilience Strategies by Income Level

Income is another lens through which to evaluate the top strategies identified by survey respondents. Across all income levels, "Payment for Power Outages" is the top response. "Home Air Filtration Systems" is the second highest response, followed by "Information to Make My Home Safer."

TABLE E.26 Priority Household Resilience Strategies by Income Level (n=2010 responses)

Income Level	% of Respondents	Responses		
		Payment for Power Outages	Home Air Filtration Systems	Information to Make My Home Safer
Extremely low-income	14%	43%	34%	24%
Low-income	53%	38%	36%	26%
Moderate-income	31%	40%	35%	25%
High-income	2%	42%	39%	19%

The values in this table may not total 100% across the response categories for income levels because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by income level.

Household Resilience Recommendations

Other responses included the following strategies for PG&E to provide to households during extreme weather, which are incorporated into the specific recommendations for PG&E below.

Table E.27 lists specific recommendations that came from RTAG input, survey respondents via open-ended survey responses, and focus group participants for PG&E to consider with respect to the following strategy areas:

1. Home improvements
2. Direct Payments
3. Customer Programs
4. Safety Resources Distribution

Under each strategy is a list of recommended actions that the Project Team heard from community and RTAG members, categorized by: (1) within PG&E's control, (2) possible through partnerships, and (3) outside of PG&E's control.

TABLE E.27 Central Coast Region Recommendations for Household Resilience Strategies

Strategy Area	Recommended Action	Within PG&E's Control	Possible Through Partnerships	Outside of PG&E's Control
Home Improvements	Improve access/affordability of small batteries for low-income households to charge phones as well as larger batteries for medical baseline customers	X		
	Develop and fund programs that provide home consultations, home retrofits and maintenance around people's yard to improve wildfire resilience (e.g., Wildfire Mitigation Review Program)	X		
	Provide financial assistance/rebate programs for heat pumps and air conditioning units	X		
Direct Payments	Provide direct compensation for households who lose power based on need rather than length of the power outage. Increase payments to account for inflation.	X		
	Provide funding for shelters or hotel vouchers for residents evacuating from wildfires in high-risk counties			
	Fund a wage replacement program for farmworkers and other outdoor workers that lose work due to wildfires and extreme heat	X		

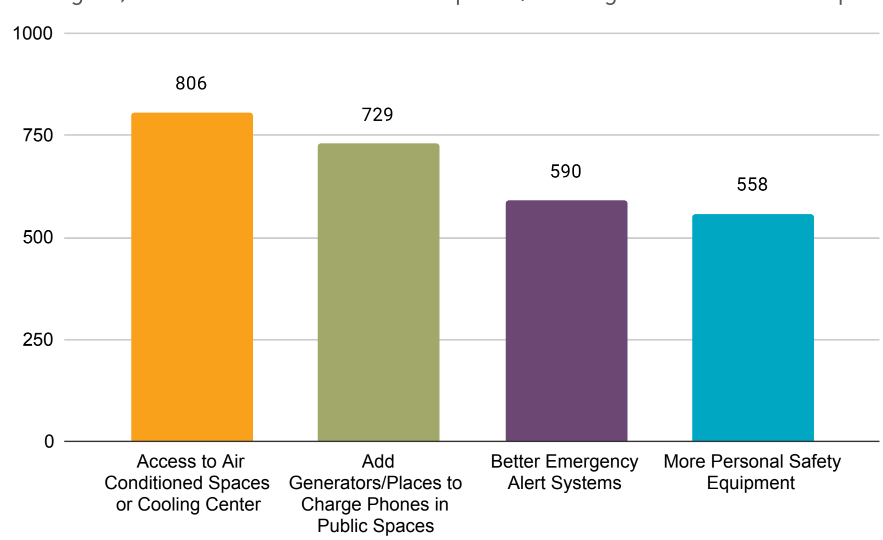
Strategy Area	Recommended Action	Within PG&E's Control	Possible Through Partnerships	Outside of PG&E's Control
Customer Programs	Reallocate some LIHEAP funding for home electrification	X		
	Proactively notify and help customers get set up with payment plans to prevent power shutoffs	X		
	Provide greater financial support through EAP/LIHEAP to upgrade older homes owned by low-income families	X		
	Offer additional discount on PG&E bills for medical baseline customers	X		
	Provide more outreach to support CARE/FERA enrollment in areas at risk of power shutoffs	X		
	Create renter focused programs and expand existing programs to be more inclusive of renters	X		
Safety Resources Distribution	Lead the coordination between local government and CBO coalitions distributing emergency resources during climate hazards	X	X	
	Distribute emergency preparedness kids/backpacks	X	X	
	Help communities at risk of extreme heat purchase water trucks	X	X	
	Ensure food banks are well-stocked, have generators, and vehicle to deliver food during high wildfire risk seasons		X	
	Distribute portable cooling devices (e.g., fans/portable air conditioning units)	X	X	
	Distribute N-95 masks (especially to farmworkers)	X	X	

Community Resilience Strategies

Community members were requested to provide input on the kinds of strategies that PG&E could implement that would support communities during extreme weather events. A summary of the strategies that survey respondents support in the Central Coast Region are included below. Respondents were encouraged to pick their top two choices, although respondents chose between zero and four strategies for their responses.

FIGURE E.20 PG&E Strategies for Communities During Extreme Weather Events (n=2683 responses)

In the Central Coast Region, "Access to Air Conditioned Spaces/Cooling Center" was the top strategy. Survey



respondents also provided open-ended input on community resilience strategies under "Other" strategies. Responses were contextualized and integrated into the Central Coast Region (Table E.28).

Key Community Resilience Strategies by County

"Access to Air-conditioned Spaces and Cooling Centers" is the top response across all counties. This is followed by "Adding Generators and Places to Charge Phones in Public Spaces," then "Better Emergency Alert Systems," and lastly, "More Personal Safety Equipment." Respondents of San Luis Obispo and Santa Barbara County prioritized "Better Emergency Alert Systems" very little and ranked it after "More Personal Safety Equipment." Table E.28 highlights the Central Coast Region represented counties in the survey and the outreach boards.

TABLE E.28 PG&E Strategies for Communities during Extreme Weather Events (by County) (n=3050 responses)

		Responses			
County	% of Respondents	Access to Air-conditioned Spaces/Cooling Centers	Better Emergency Alert Systems	Add Generators/ Places to Charge Phones in Public Spaces	More Personal Safety Equipment (masks, batteries, etc.)
Monterey	38%	29%	24%	26%	21%
San Benito	12%	32%	26%	25%	16%
San Luis Obispo	11%	46%	2%	28%	25%
Santa Barbara	2%	46%	0%	20%	34%
Santa Cruz	35%	25%	27%	28%	19%

The values in this table may not total 100% across the response categories for counties because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by county.

Key Community Resilience Strategies by Racial Background

The community resilience strategies can also be reviewed based on how participants identified their racial background. The information collected is represented in Table E.29 below. As a reminder, 97 percent of participants provided a response on racial background. "Access to Air-conditioned Spaces and Cooling Centers" is the top response for Latinx or Hispanic, Native Hawaiian and Pacific Islander, Two or more, and White respondents. For Black or African American, Native American, American Indian, or Alaska Native, and Other races respondents "Adding Generators and Places to Charge Phones in Public Spaces" is the top response. Notably, Asian respondents reported "Better Emergency Alert Systems" as the top response to community resilience strategies.

TABLE E.29 PG&E Strategies for Communities during Extreme Weather Events (by Racial Background (n=2264 responses)

Racial Background	% of Respondents	Responses: Access to Air-conditioned Spaces/Cooling Centers	Better Emergency Alert Systems	Add Generators/ Places to Charge Phones in Public Spaces	More Personal Safety Equipment
Asian	3%	29%	33%	19%	19%
Black or African American	8%	24%	19%	33%	24%
Latinx or Hispanic	63%	30%	23%	26%	20%
Native American, American Indian, or Alaska Native	1%	19%	25%	31%	25%
Native Hawaiian and Pacific Islander	2%	45%	14%	18%	23%
Other race	1%	25%	21%	29%	25%
Two or more races	6%	33%	14%	30%	23%
White	16%	34%	13%	28%	24%

The values in this table may not total 100% across the response categories for racial backgrounds because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by race.

Key Community Resilience Strategies by Income Level

The Project Team also evaluated top strategies identified by survey respondents based on the income of respondents. "Access to Air-conditioned Spaces and Cooling Centers" is the top solution for low and moderate-income respondents. "Adding Generators and Places to Charge Phones in Public Spaces" is the top response for extremely low and high-income respondents. "More Personal Safety Equipment" is generally the lowest identified solution by number of responses for low-income and high-income (Table E.30).

TABLE E.30 PG&E Strategies for Communities during Extreme Weather Events (by Income Level) (n=2204 responses)

Income Level	% of Respondents	Responses: Access to Air-conditioned Spaces/Cooling Centers	Better Emergency Alert Systems	Add Generators/ Places to Charge Phones in Public Spaces	More Personal Safety Equipment (masks, batteries, etc.)
Extremely low-income	14%	29%	21%	31%	20%
Low-income	53%	30%	22%	26%	23%
Moderate-income	31%	31%	21%	28%	21%
High-income	2%	29%	29%	34%	9%

The values in this table may not total 100% across the response categories for income levels because the Project Team removed the survey respondents who marked "other" or "multiple" as their response for the purpose of reporting impacts by income level.

Community Resilience Recommendations

Table E.31 lists specific recommendations that came from RTAG input, survey respondents via open-ended survey responses, and focus group participants for PG&E to consider with respect to the following strategy areas:

1. Community Resilience and Cooling Centers
2. Infrastructure Improvements and Grid Modernization
3. Distributed Energy Resources
4. Transportation Services
5. Communication, Education and Outreach
6. Workforce Development and Workplace Safety
7. Broadband Access
8. State Advocacy

Under each strategy area is a list of recommended actions that the Project Team heard from community and RTAG members, categorized by: (1) within PG&E's control, (2) possible through partnerships, and (3) outside of PG&E's control.

TABLE E.31 North Coast Region Recommendations for Community Resilience Strategies

Strategy Area	Recommended Action	Within PG&E's Control	Possible Through Partnerships	Outside of PG&E's Control
Community Resilience and Cooling Centers	Provide financial support for the development and sustained operation of community resilience centers	X	X	
	Fund more cooling centers to be multi-purpose evacuation sites during floods, fires and heat waves		X	
	Promote cooling centers in low-income communities	X		
	Staff cooling centers (do not rely on CBOs to staff cooling centers)		X	
	Support the development of mobile cooling centers/stations that can serve rural residents and farmworkers		X	
Infrastructure Improvements and Grid Modernization	Underground power lines in mountainous areas	X		
	Reduce planned outages through strategic transmission upgrades	X		
	Replace expired or aging infrastructure	X		
Distributed Energy Resources	Build microgrids at key community hubs like cooling centers, clinics, hospitals, food banks and other community gathering places	X		
	Install community solar and storage in DVCs	X		
Transportation Services	Fund transportation shuttles or rideshare vouches for rural residents to get to cooling centers		X	

Strategy Area	Recommended Action	Within PG&E's Control	Possible Through Partnerships	Outside of PG&E's Control
Communication Education & Outreach	Fund and build the capacity of CBOs to conduct multi-lingual, culturally congruent outreach, enroll customers into PG&E programs, and distribute safety resources by meeting community members where they are (e.g., at a location they frequent or existing community meeting)	X		
	Fund and co-lead hazard mitigation trainings for CBOs and government agencies	X		
	Streamline communication between customers and PG&E through appointment of PG&E community liaisons	X		
	Streamline processes for CBOs to secure funding and resources from PG&E and municipalities	X		
	Develop farmworker specific outreach materials and go onsite to discuss emergency preparedness with farmworkers	X	X	
	Hire Mixteco, Zapotec, and Triqui speaking staffers or contractors for ongoing outreach efforts	X		
	Use WhatsApp voice messages, Subtext, radio ads, 211, reverse 911 calls and social media to promote multilingual alerts	X		
	Create a multilingual app to issue alerts and information	X		
	Reduce PG&E's repetitious climate plan processes to focus on implementation to reduce engagement fatigue	X		
	Connect climate change to familiar values, concepts, or climate-hazard experiences	X		
	Lead and convene local governments and CBOs to streamline and consolidate information (public bulletin) on how to access resources and services	X		
Workforce Development and Workplace Safety	Partner with CBOs serving BIPOC communities to promote PG&E job opportunities to low-income Black communities and communities of color, especially those who have suffered displacement		X	
Broadband Infrastructure	Invest in and expand telecommunication and broadband infrastructure so residents can receive alerts			X
State Advocacy	Advocate for policies to support a carbon neutral future (e.g., advocate for transition away from propane in rural areas)	X	X	
	Lobby state legislature to require landlords to offer air conditioning, especially in hotter areas	X		
	Advocate and coordinate with state agencies to provide prisons with air conditioning and heating	X	X	
Other	Divest from fossil fuels and accelerate the transition to 100% renewable energy	X	X	
	Fund the development of county climate plans	X		

Appendix F:

Interviews: Summary of Findings

For the San Joaquin Valley (Region 2) and the North Valley, Sacramento & Sierra Regions (Region 3)

Resilient Together Regions 2 and 3 Individual Interview Summary of Findings Report

Introduction and Methodology

InterEthnica and Farallon Strategies (Consultant Team) conducted a series of interviews with community-based organizations (CBOs) across Disadvantaged and Vulnerable Communities (DVCs) in Pacific Gas and Electric (PG&E) Service Regions 2 and 3 (San Joaquin Valley; North Valley, Sacramento & Sierra) to learn about the following objectives: (1) community demographics and language needs, (2) climate hazards/impacts, and preferred resilience solutions, (3) CBOs' capacity and interest in participating on the Resilient Together Advisory Group (RTAG), and (4) existing reports/data that could inform Climate Vulnerability Assessment. PG&E provided the Project Team a list of CBOs with whom they have worked with previously. PG&E staff initiated email introductions to CBOs that they had an existing relationship with and the Consultant Team followed up and scheduled interviews with interested CBO staff. The Consultant Team conducted supplemental research to identify additional CBOs that would address any gaps in PG&E's provided list to ensure diverse ethnic/cultural organizational representation of the RTAG.

An interview guide was developed to align conversations with PG&E's objectives. The interviews were an hour long and recorded. To facilitate a safe space for honest dialogue, PG&E staff wasn't present at any of the interviews. The recruitment and interview process took approximately one month. The Consultant Team conducted a total of 17 interviews with current and former staff from the following organizations:

Region 2 - San Joaquin Valley

- San Joaquin Valley Clean Energy Organization
- Leadership Council for Justice and Accountability
- Little Manila Rising
- Public Health Advocates
- Rising Sun Center of Opportunity
- Independent Living Center of Kern
- Fresno Center
- Central California Environmental Justice Network
- Valley CAN
- Stone Soup Fresno

Region 3 - North Valley, Sacramento & Sierra

- The Slavic Center of Sacramento
- Hands of Hope
- Habitat for Humanity Yuba/Sutter
- Camptonville Community Partnership
- Tahoe Truckee Community Foundation
- Northern Rural Communities Development, Inc.
- Organization of Chinese Americans - Sacramento
- Shasta Family YMCA

Findings

Community Understanding

The objective of this section was to identify "communities of opportunity," including key geographies/ languages spoken. To gain a more nuanced perspective of communities within Regions 2 and 3, interview discussions elicited insights about community composition, including discerning communities of opportunity and identifiable geographic factors that may make an area more at risk to climate hazards. Community demographic insights are delineated in the tables below by region and county. After developing an understanding of communities in each region, interviewers focused the discussion on barriers to participation for those populations.

Region 2 - San Joaquin Valley

The San Joaquin Valley region contains 12 counties: Alpine, Amador, Calaveras, Fresno, Kings, Madera, Mariposa, Merced, San Joaquin, Stanislaus, Tulare, and Tuolumne.

Communities of Concern/Opportunity

Participants provided insights on the types and locations of communities of opportunity and the primary languages spoken in 8 of the 12 counties.

County	Communities of Opportunity	Community Demographics	Languages Spoken
Kern County	City of Bakersfield, including East Bakersfield, the Cities of Arvine, Lamont, Shafter, McFarland, and Delano, and the unincorporated neighborhoods of Frazier Park, La Colonia Mexicana, Fuller Acres, and Lost Hills, as well as areas adjacent to the Tehachapi Mountains	African American, White, Latinx, including Mexican, Central American, Indigenous	Spanish and Latin American Indigenous dialects like Mixteco, Triqui, and Zapoteco, as well as community members across ethnicities who communicate in American Sign Language
Fresno County	City of Fresno's neighborhoods of the former "Asian Village," East, Southeast and Southwest Fresno, the Cities of Parlier, Reedley, Firebaugh, Kerman, Sanger, Mendota, Coalinga, and Huron, as well as the unincorporated neighborhoods of Biola, El Porvenir, Lanare, Riverdale, Caruthers, 5 points, Tombstone, and Cantua Creek	Southeast Asian (Filipino, Vietnamese, Laotian, Cambodian, and Hmong), South Asian (Sikhs), African American, White, Latinx, including Mexican, Central American, Indigenous, and second/third generation Chicanx	Hmong, Lao, Tagalog, Vietnamese, Cantonese, Mandarin, Khmer, Punjabi, Spanish, Arabic, Mixteco, Triqui, Zapoteco
San Joaquin County	City of Stockton's neighborhoods of Little Manila, South Stockton, Central Stockton, Seaport, and the area around Stribley Park	Southeast Asian (Filipino, Vietnamese, Laotian, Cambodian, and Hmong), South Asian (Sikhs, Punjabi Indians), African American, White, Latinx communities	Hmong, Lao, Tagalog, Vietnamese, Cantonese, Mandarin, Khmer, Spanish
Madera County	City of Madera and the unincorporated neighborhood of La Vina	White, Latinx	Spanish, Mixteco, Triqui, Zapoteco
Butte County	Cities of Oroville and Gridley, the unincorporated neighborhoods of Feather Falls, Berry Creek, Feather River Canyon	White, Native American, Latinx	Spanish, Mixteco, Triqui, Zapoteco
Tulare County	Cities of Woodlake and Lindsay and the unincorporated neighborhoods of Cutler, Strathmore, Poplar-Cotton Center, Earlymart, Tipton, East Porterville, Orosi, and Seville	White, Latinx	Spanish, Mixteco, Triqui, Zapoteco
Kings County	N/A	White, Latinx, Black, Asian, Middle Eastern communities (Iranian)	Spanish, Farsi

Barriers to Engagement

Participants shared that geographic isolation has created barriers to engagement in the following ways:

- As the Valley is rural and diverse, organizations face geographic and linguistic barriers in reaching community members to provide needed services.
- Rural areas lack community centers or central meeting places close to them to receive information and resources.
- PG&E and other local agencies rely too much on virtual dissemination of information, which creates a challenge for rural residents because:
  - Few people in rural areas have broadband access to receive virtual information

  - Some rural residents lack phones or reliable cell service due to lack of investment into infrastructure

  - Rural residents without access to virtual platforms can only be reached via door knocking by CBOs.

Technical information and language translation challenges also present a barrier to participants in this region. Participants shared the following comments about the dissemination of information:

- Text heavy materials aren't written in terms that are easily digestible and are not comprehensible to the average person, even in English. Technical climate change concepts are not communicated as relatable issues for the community.

  - Information is not translated into languages for limited-English proficient community members. Participants shared that some materials are translated into Spanish, if at all, but often exclude other key languages.

- Often, CBOs are contracted to do written translation, which isn't optimal for large amounts of information that need to be understood by and reach the community.

- In addition, written translated materials alone aren't sufficient and need to be paired with paid ambassadors from local CBOs who can conduct in person multilingual outreach.

- Some requested languages do not have a written language. For example, several Indigenous Latinx dialects are only understood through verbal communication.

- Some communities have low rates of literacy in their native languages, making written translation ineffective. Written materials in Hmong/Lao are not necessarily helpful due to low community literacy rates, burdening American raised Hmong/Laotian American CBO staff to interpret (verbally) English materials with little assistance from agencies.

Participants expressed a general lack of trust and frustration with ineffectually designed programs. They shared the following concerns:

- PG&E's existing pilot programs often do not match the needs of the customer base they want to reach. Three examples stood out:

  1. Customers are not interested in PG&E's Electric Vehicle (EV) program in these regions. Participants shared residents often can't afford EVs even with the program's rebates/incentives. Additionally, their communities lack the infrastructure/education to adopt the technology.

  2. The Energy Partners program's eligibility requirements are too restrictive.

  3. Other weatherization programs haven't succeeded in areas of Fresno County with many mobile homes that lack building stock that can be upgraded or retrofitted.

- The participants stated that they feel that their communities have been historically neglected with a lack of investment by PG&E. This has resulted in unsafe living conditions, and therefore, community members and leaders do not trust PG&E.

- There is a general lack of bandwidth and capacity to participate in community initiatives as participants shared that many community members are just trying to pay their bills and stay afloat.

Region 3 - North Valley, Sacramento & Sierra

The North Valley, Sacramento & Sierra Region contains the 15 counties including Butte, Colusa, El Dorado, Glenn, Lassen, Nevada, Placer, Plumas, Sacramento, Shasta, Sierra, Tehama, Yolo, and Yuba.

Communities of Opportunity

Participants provided insights on the types and locations of communities of opportunity and the primary languages spoken in 7 of the 12 counties.

County	Communities of Opportunity	Community Demographics	Languages Spoken
Sacramento	City of Sacramento's neighborhoods of Yolo/West, Little Saigon, and South Sacramento, the Cities of Elk Grove, Folsom, and Rancho Cordova and the unincorporated neighborhood of Antelope	Asian (Chinese, Filipino, Vietnamese, Thai, and Hmong), South Asian (Indians), Pacific Islander (Guamanian and Tahitian), African American, White, Slavic (Russian and Ukrainian), Latinx	Arabic, Hmong, Tagalog, Vietnamese, Cantonese, Mandarin, Hindi, Punjabi, Russian, Ukranian, Spanish
Placer	City of Roseville	Native American, Asian (Filipino and Korean), Latinx, White	Spanish, Tagalog, Korean
Sutter	Yuba City's neighborhoods by the Feather River and South Yuba City	South Asian (Indian), Latinx, White	Spanish,Punjabi
Yuba	Yuba Foothills, unincorporated neighborhoods of Camptonville, Linda, Oliverhurst, Plumas Lake	White, Native American (Nisenan people)	English, Spanish
Butte	Paradise	White	English
Nevada, Placer, El Dorado	Service and hospitality workers serving tourist towns (such as Lake Tahoe), including those that work at resorts, hotels, restaurants and small businesses	White, Latinx	English, Spanish
Shasta	City of Redding, Mount Shasta, Lassen, Bali Hills, neighborhoods by the Sacramento River	White, Latinx, Asian (Chinese, Hmong, Laotian)	English, Spanish, Hmong, Lao, Mandarin, Cantonese

Barriers to Engagement

In Region 3, participants shared that complicated bureaucratic challenges present a barrier to engagement, such as the large number of public agencies (special districts) with jurisdiction over the area, which makes regional collaboration, strategy alignment, and opportunities for meaningful engagement difficult.

Another barrier that surfaced in discussions included geographic isolation, as many of the rural areas in the North Valley/Sierra are spread over a large geographic footprint with many isolated farmworker communities.

Similar to Region 2, participants from Region 3 expressed the following language translation and outreach material challenges:

- Lack of prioritization by PG&E and local agencies to translate all key materials
- When there are translated materials, they tend to only be in Spanish and not other common languages, including Russian and Asian languages (Hmong, Lao, Khmer, Vietnamese, and Tagalog).
    - Many seniors in this area do not speak English and can't read important information or materials
- Government agencies rely heavily on CBOs to fill the translation gaps instead of hiring professional translators.
- Some cultures are uncomfortable seeking government assistance and do not receive resources that they should be getting.
- There are no preventative outreach, education, or materials before a climate event, particularly to limited-English proficient communities
- Communities are best serviced by verbal conversations with community service providers than through written materials
- There aren't enough marketing strategies/research to identify which radio and media community members use, and what types of events they go to

Finally, a barrier to engagement in Region 3 is a general lack of trust with government assistance and a lack of trusted community partners/members to help communicate information.

2. Climate Hazards, Impacts

The objective of this section was to understand climate hazards and impacts of concern.

Interview questions in this section were designed to elicit nuanced insights about climate hazards and impacts of concern. Across both regions, extreme heat and power outages were top concerns, though wildfires in rural, mountainous areas of both regions were a priority concern. More insights on concerns are broken down by region below.

Region 2 - San Joaquin Valley

In areas of San Joaquin County, like in Stockton, participants noted a slew of hazards that ranged from extreme heat due to a lack of tree canopy and urban heat island effect, to wildfire smoke, to flooding, which would further exacerbate algal methane pollution in marina and port adjacent neighborhoods. Hazard impacts include more people going to the hospital due to dehydration and other adverse health conditions. Climate hazards lead to high bills from extreme heat, food waste from outages, low air quality and asthma from wildfire smoke, and the inability to improve home energy efficiency due to crumbling or inefficient housing stock or mobile homes that cannot be weatherized.

In Kern County, wildfires were the primary hazard of concern particularly in the rural and isolated areas by the Tehachapi Mountains. Other hazards of concern include extreme heat, power outages, and flooding from Lake Isabella and the Kern River. Participants noted that related impacts included community members getting stranded in wildfire zones during active fires due to limited evacuation routes and fire prone terrain, loss of power, endangering seniors and people with disabilities who need electrically powered medical equipment and medication with limited transportation, and smoke-induced health impacts.

In Fresno County, the hazards shared by participants included extreme heat, drought, and smoke from wildfires. Impacts noted include heat concentration and increased indoor air pollution for residents and workers (who work on farms and in warehouses) due to poor housing stock that can't accommodate central air conditioning or be weatherized. Examples provided included aging mobile homes in areas with a lack of tree canopy, and lack of cooling centers in rural areas. Participants expressed concerns about the heat exacerbating valley fever, asthma, and heart conditions, leading to more emergency room visits, more heat exhaustion, and heat-related deaths amongst the elderly. The economic impacts range from reduced hours for farmworkers with no unemployment access to residents' expensive electricity bills. It was noted that when there is loss of agricultural production in Region 3, this eliminates transportation and access to goods and services. Participants also shared that during wildfires, though employers are required to give N95 masks when the air quality gets to a certain level, it's too hot for workers to comfortably work with them on so they are exposed to the smoke and existing poor air quality.

Across the San Joaquin Valley, the agriculture industry is feeling the impacts of extreme heat and drought, according to participants. They shared that the health of livestock, farmworkers, and crop yields are all negatively impacted by sustained drought and increasing frequency of extreme heat. As a result, small farms are being lost to larger corporations, resulting in a loss of transportation and workforce, threatening the economic viability of the region and the ability of children to stay in the communities where they grew up. Due to the rural nature of the region, power outages are not felt as acutely, but extreme heat, coupled with high utility bills, puts enormous financial strain on agricultural and residential communities.

Region 3 - North Valley, Sacramento & Sierra

Participants explained that communities in the North Valley/Sierra are highly impacted by drought and changes in precipitation. When there is no snow, grant making foundations have had to increase grantmaking to hunger relief organizations to help stabilize community economic impacts. These rural areas, which are also most impacted by wildfires, experience both physical and mental health impacts, fearing for the next wildfire event. Participants shared those who have been displaced from wildfires are still dealing with mental distress and lack supports to deal with climate trauma. Some chose not to leave their properties, despite being isolated in rural areas and at high risk during fires, since they wouldn't be able to emotionally or socially adapt to living in a new place or home.

Participants also shared that a key impact of climate change was community displacement during evacuations. They voiced concerns that residents are being permanently priced out of the area they have called home due to the housing crisis in conjunction with climate hazards. Of those that lost their homes in a fire, participants expressed concern for renters without insurance who have no safety net and are at risk of becoming homeless. While many folks would like to stay in their community, many who lose their home cannot afford to rebuild or buy a home. Seniors have often sold their properties after fires and moved out of state, as they are unable to do the physical labor of protecting their homes from future fires.

In addition, for those who are able to keep their homes or rebuild, many have had to contend with insurance companies no longer covering their properties or significantly raising their premiums, leaving them even more vulnerable should future fires affect their homes. Residents are worried about higher premiums as their homes have higher equity values now, as lower insurance rates tied to when they first bought their properties at affordable rates don't cover the current cost of rebuilding their homes.

It was noted that rural areas in the North Valley, Sacramento & Sierra often do not have air conditioning in their older homes or schools, and thus lack adaptive capacity to respond to extreme heat events. While tourists and some residents can (and do) leave these communities when there is risk of fire or poor air quality from smoke, service workers, who comprise the majority of the economy and public servants cannot leave. Additionally, as regions like Redding and other places' economies rely on recreational tourism, burned down and extinguished forests and recreational areas makes the Sierra a very vulnerable area, with little adaptive capacity. Burn sites are at risk of igniting in multiple fires, presenting ongoing risk if not cleared quickly.

In Placer and Sutter counties, participants' top hazards of concern were extreme heat and smoke from wildfires and flooding. Unique to these counties were concerns shared about hazards' impact on the unhoused population, including flooding by the Feather River for the unhoused living amongst its banks and nearby senior residences, health impacts for the unhoused that are exacerbated by an insufficient amount of cooling centers, resulting in more emergency room visits, mental health stressors and incidents, and law enforcement altercations/arrests.

Within Sacramento County, extreme heat was the main hazard shared by participants. Impacts include residents requiring air conditioning at high rates that they can't afford on fixed incomes with poorly insulated homes. They also said that some residents don't use air conditioning even when they have it due to the cost and have had to sell their long-time homes to downsize to apartments to afford higher electric bills. Seniors without family to help them do errands remain trapped and isolated at home, with little transportation resources, exacerbated by the lack of phones or internet access.

3. Community Preparedness, Adaptive Capacity, and Resilience Strategies

The objective of this section was to understand communities' adaptive capacity, specifically with respect to vulnerability, resources, preparedness, and support.

Adaptive Capacity

The San Joaquin Valley has very low adaptive capacity, based on participant responses. Reasons provided include a lack of historic investment in basic infrastructure that would support adaptive responses, such as electrification. Furthermore, the agricultural economy and workforce are both highly vulnerable to drought and extreme heat, and farming communities lack resources to adapt farming practices and working conditions in response to these stressors. Strong ethnic and cultural ties have created community cohesion and grassroots networks in the absence of institutional safety nets to support community needs, particularly during climate hazards. These grassroots networks can be leveraged to support resource distribution, if trusted partners are properly funded.

The North Valley, Sacramento & Sierra Region has low adaptive capacity due to its rural nature, which results in physical and technological access barriers. Participants believe service providers have trouble physically reaching communities, and the lack of broadband infrastructure and cellular service makes it difficult to disseminate information. However, because of its rural nature, participants felt that many community members were more resilient and equipped, as they are accustomed to the risks that isolation imposes on them and their families.

Resilience Strategies

Improving resilience starts with better emergency preparedness engagement. While few communities are well prepared for climate events, low-income, monolingual, and communities of color have almost no access to resources in their languages. Better preparedness engagement should include more face to face, multilingual approaches, printed materials and phone alerts and partnerships with trusted CBOs. The CBOs knocking on doors are oftentimes the only information channel in rural communities and felt that they should be paid by PG&E to conduct the service. They noted that additional funding should be put aside for written translation either by professional firms or the CBOs (if they desire). While some rural communities lack phone access, multilingual text alerts are more effective with those who do have phones, above websites, email, or mailers. Written collateral should use clear, simplified language, be translated into the regions' key languages, and include creative bill inserts, door hangers, flyers at community hubs/centers, and targeted social media ads.

Participants recommended detailed resilience strategies that PG&E can directly implement or fund in partnership with other entities to make a greater impact. The top 4 resilience solution themes included 1) Improving emergency preparedness communication channels to better reach monolingual, disabled, and rural communities who often don't receive any alerts, 2) Expanding and increasing funding for more targeted, streamlined residential customer programs aimed at low-income customers that give greater financial relief or install infrastructure (such as batteries) without requiring capital upfront, 3) Increasing funding for CBOs to be ongoing partners on the ground to communicate and lead mitigating climate change impacts across a breadth of programs and investments, and 4) Funding external partnerships to both address housing stock and workforce impacts marginalized communities disproportionately face that are related to climate change and their future survival. For more detailed strategies, there is a reference table in the appendix (which is not in a particular order).

4. Existing Data

The objective of this section was to identify existing reports/data that could inform PG&E's Climate Vulnerability Assessment. The California Utilities Public Commission (CPUC) requested that PG&E research and crowdsource community data that could better inform equitable climate resiliency efforts. Interviewees were asked for data in the form of reports, quantitative and qualitative research or projects, community testimonials, and any other sources of key data.

Interviewees suggested reviewing and possibly including the following reports and data sources:

- A Transformative Climate Communities (TCC) grant created the "Sustainable Neighborhood Program" to identify community priorities around climate, which called for lower electric bills.
- TCC is also doing a displacement survey right now–Public Health Advocates can connect PG&E with this effort later when the results are gathered.
- Restore the Delta is currently conducting a survey around algal blooms in Stockton/health impacts on communities nearby.
- The Center for Independent Living and Kern County Network for Children both have helpful reports
- The CA Farmworker Foundation has health outcomes data
- The Tahoe Truckee Community Foundation
    - 2022 Community Engagement and Behavioral Health Survey Report
    - 2019 Demographics, Economics, Housing
    - 2019 Community Issue Brief
    - Community Collaborative Partner List

5. Conclusion

As a result of the 16 interviews conducted, the Consultant Team learned about the unique needs, challenges, and targeted solutions required across Regions 2 and 3. This summary provides PG&E with granular and useful data on the community types and languages spoken, key climate hazards and impacts of concern, and the adaptive capacity on the ground of the San Joaquin and North Valley/Sierra regions. It also is building on existing or new relationships with key CBOs who will be integral to the implementation of the ultimate Climate Vulnerability Assessment.

Participants spoke in nuanced ways about the primary and secondary impacts of climate hazards. This ranged from immediate physical danger and health problems to the longer term impacts of financial hardship and the ability to survive in their homes and workplaces across these regions as climate hazards increase.

In both regions, participants highlighted the lack of adaptive capacity, due to limited economies heavily impacted by climate change, infrastructure investments, and geographic isolation. They also noted that the impact of higher energy bills hits communities harder who are already economically disenfranchised. However, participants from both regions also flagged immediate and longer term resilience strategies, ranging from improved, culturally and linguistically attuned emergency alert communications, access to back-up batteries, convenient and appealing cooling centers, and better forest management practices, to more basic and immediate needs, including greater direct financial assistance for energy bills and basic infrastructure (e.g. electric panel) improvements.

The information collected will also support the development and implementation of PG&E's Community Engagement Plan and Resilient Together Advisory Group meetings. As a result of these interviews, 9 out of the 15 total CBOs committed to participating as Resilient Together Advisory Group (RTAG) members were recruited. It is a testament to the participants' commitment to their communities and openness to working with PG&E to come to the table and participate in the interviews and RTAG to advance resilience solutions, despite historic mistrust and challenging experiences.

Research Interviews Resilience Strategies Detailed Table[1]

Region	Improvement Category	Participant Recommendation
San Joaquin Valley Region 2	Reduce bills, energy costs, and outages	• Increase amount of CARE/FERA subsidies and expand income eligibility • Reduce bill costs/offer credits during extreme weather • Don't charge cooling centers for power during hazards • Narrow PSPS alert areas to only most essential areas to reduce outage impacts on vulnerable customers • Expand "No Blackout" list to include more DVC homes
San Joaquin Valley Region 2	Develop New Funded Programs	• Create a program for installation of solar/batteries (not just equipment rebates), especially for elderly. • Target batteries to diabetics who need insulin refrigerated, electrical nebulizer users for asthmatics, and immobile people in electrically powered hospital beds at home and electric wheelchairs • Create programs for green roofs, prioritizing multi-dwelling units that cannot access solar • Create renter-focused programs such as community solar • Create a program to provide indoor air filtration • Create a program focused on electrical panel service/replacement
San Joaquin Valley Region 2	Restructure/expand existing programs	• Provide programs that match the needs of communities. Decarbonization and electrification are not relevant in areas that do not have infrastructure to support electrification • Expand programs that replace A/C units • Expand programs for EV charging infrastructure and EV subsidies or rideshare in DVCs • Expand weatherization programs to include swamp coolers for those without A/C • Restructure PG&E's Energy Partners program's income threshold to make it more accessible to renters • Get rid of grant requirements for local CBOs to find matching dollars to prioritize resources for vulnerable communities • Enable microgrid power sharing to allow communities to share energy

1 The Project Team incorporated the recommendations provided during the research interviews into the regional tables of recommendations.

Region	Improvement Category	Participant Recommendation
San Joaquin Valley Region 2	Fund and Establish Partnerships with External Mitigation Efforts and Programs	• Fund farmworker unemployment monies with climate mitigation funding • Partner with and support regional energy networks, and their weatherization programs • Fund training for farmworkers to open small organic farms and get TA on permits/land acquisition Fund local future land trust to do the land acquisition. • Partner w/ community colleges and workforce development organizations to allow farmworkers to transition into new industries, such as entrepreneurship or solar/electrification • Partner/fund Central Valley Community Foundation (F3 Initiative) to invest in more farms transitioning to indoor growing and worker training to manage automation or have bill incentives to do this transition • Fund pilot program to invest in farms that can install lighting and have farmworkers work in evenings • Fund local affordable housing trust funds or land trusts that allow low-income customers to transition into proper housing stock from mobile homes that have A/C and internet • Lobby the state legislature and local governments to be required to develop Climate Action Plans

<table>
<tr><th>Region</th><th>Improvement Category</th><th>Participant Recommendation</th></tr>
<tr><td>San Joaquin Valley Region 2</td><td>Expand community investments and infrastructure</td><td>

Build new and expand existing cooling centers:

Bring back utility funded cooling centers that local governments cannot afford to fund in DVCs
Build new centers in rural communities as they are almost exclusively in urban areas
Build new urban centers where the community already naturally congregates, like CBOs, faith based organizations, schools, etc.
For new centers that need infrastructure improvements to come online, like transformer or transmission upgrades, waive PG&E fees or amortize them
Develop rural focused mobile cooling centers with internet and air conditioning
Develop and fund multilingual cooling center programming to allow people to get resources, enroll in programs, and be attractive destinations to encourage people to stay there/utilize the centers
Fund accessible transportation that can be arranged offline as well to the cooling centers in partnership with transit agencies or non-profits
Fund expansions of existing centers to build more space/capacity that also allows for existing programming to continue
Send text alerts to encourage the community to come and have, more visible cooling center signage outside
Advertise about cooling centers in multiple languages and on ethnic media/social media
Hold well advertised emergency preparation trainings for the public at community centers

Invest in programs that increase tree canopies in targeted areas that also include vegetation canopies to help deal with the heat island effect while trees mature
Fix or underground older transmission lines in flood prone areas or mountainous fire zones to improve safety
Larger agricultural customers should get charged higher rates if they over consume electricity/over export foodRequire profits from biomass facilities in DVCs to be reinvested in the communities and establish Community Benefits Agreements
PG&E and CPUC could partner to expand internet or phones with internet service to get alerts to customers without connection
Sync transformer and electrical connections to new affordable homes / upgrades at existing low-income homes

</td></tr>
</table>

Region	Improvement Category	Participant Recommendation
San Joaquin Valley Region 2	Expanded, funded multilingual marketing, education, and outreach	• Increase unrestricted capacity building grants to CBOs in DVCs (ex: a grant to support general operating expenses for an environmental justice organization not tied to a project) • If PG&E already owns billboard spaces, use them for alerts/ emergency prep info • Survey communities to determine what people want/know about climate • More trainings with students to teach parents about how to create emergency prep plans and heat/flood trainings at school districts • Deeper engagement with communities on the ground, not just CBOs • More emergency preparedness education in high risk communities
North Valley, Sacramento & Sierra Region 3	Reduce bills, energy costs, and outages	• Fund solar for community members with high bills
North Valley, Sacramento & Sierra Region 3	Expand community investments and infrastructure	• Build cooling centers in Sacramento, south of Yuba, Marysville, and Yuba City in convenient locations • Fund CBOs who have capacity to operate cooling centers on-site • Create cooling centers with more indoor recreational space and activities to attract more people • Create rural cooling centers or mobile cooling centers that can be set up in rural areas • Build/fund misting centers in parks that ensure access to both the unhoused community and the general public • Invest in childcare facilities • Invest in electric buses • Step up tree removal programs, especially in previously burned areas
North Valley, Sacramento & Sierra Region 3	Restructure existing programs	• Fund programs to help replace old air conditioners, especially for renters, incentive air conditioning upgrades with an incentive for landlords • Fund more air purifier programs in wildfire prone areas • Improve transit or rideshare systems to help seniors get to cooling centers • Fund air purifier programs before wildfire season • Expand residential energy efficiency programs • Minimize customer and CBO enrollment paperwork and barriers during climate hazards to get relief funds

Region	Improvement Category	Participant Recommendation
North Valley, Sacramento & Sierra Region 3	Fund and Establish Partnerships with External Mitigation Effort and Programs	• Fund local transit agencies to provide more evacuation buses during hazards, especially for unhoused people • Fund law enforcement/EMT to do emergency prep presentations with stipends for unhoused people to attend • Outsource tree trimming/removal efforts to speed up protection in rural areas, partnering with the state • Establish partners with neighbors outside service of PG&E's service area that manage land, and therefore have an impact on land/forest stewardship • Create forest stewardship maps that indicate land ownership and use of agroforestry practices • Fund/support the establishment of a Community Organizations Activated in Disaster
North Valley, Sacramento & Sierra Region 3	Expanded, funded multilingual marketing, education, and outreach	• Educate homeowners about fuel removal with mailers/ trainings • Establish a new central liaison between PG&E and cities/counties to coordinate outreach on fuel removal • Fund CBOs/entities that can provide childcare during climate hazards

Appendix F:

Interviews: Summary of Findings

For the North Coast (Region 4) and
Central Coast Regions (Region 5)

RESILIENT TOGETHER REGIONS 4 AND 5 INDIVIDUAL INTERVIEW

SUMMARY OF FINDINGS REPORT

DECEMBER 19, 2022

Submitted by:
InterEthnica, Inc.
52 Washburn Street
San Francisco, CA 94103

TABLE OF CONTENTS

1.

INTRODUCTION AND METHODOLOGY

Climate Vulnerability Assessment Study

An interview guide was developed to align conversations with PG&E's objectives.

The recruitment and interview process took approximately one month.

17 interviews

9 organizations in Region 4

8 organizations in Region 5

Interview Objectives

1. Demographics and language needs.
2. Identify climate hazards, impacts and preferred resilience solutions.
3. CBOs' capacity/interest in participating in the RTAG.
4. Identifying existing reports/data to inform the Climate Vulnerability Assessment.

1:1 Interviews

Interviews lasted 90 minutes and included time to discuss RTAG participation.

PG&E staff was not present to ensure interviewees feeling safe to express themselves freely.

PG&E's Climate Vulnerability Assessment explores how climate change, and the resulting increase in extreme weather, impacts energy infrastructure and the communities across PG&E's service area. The Resilient Together Project is an initiative by PG&E to convene community-based organizations (CBOs) and learn about how communities across California are impacted by extreme heat, flooding, and wildfires. By understanding communities' response to and needs during today's extreme weather events, PG&E can plan for a more climate-resilient future. The CBO convenings are called Resilient Together Advisory Groups (RTAGs).

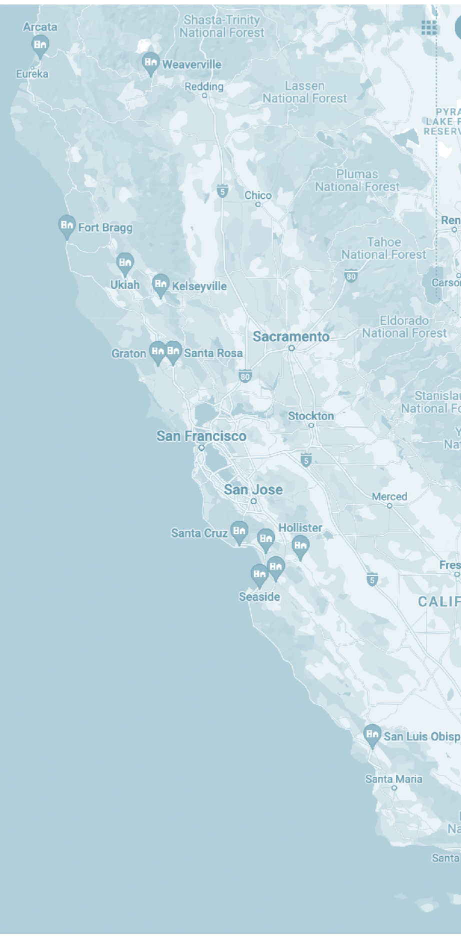
To supplement the RTAGs, InterEthnica conducted a series of in-depth interviews with CBOs across Disadvantaged and Vulnerable Communities (DVCs) in PG&E Service **Regions 4 (North Coast)** and **5 (Central Coast)**. PG&E provided InterEthnica with a list of CBOs with whom they have worked previously and initiated email introductions. InterEthnica followed up and scheduled interviews with CBO staff and conducted supplemental research to identify additional CBOs that would address any gaps in the list provided by PG&E. The supplemental research aimed to ensure the interview insights and potential RTAG membership includes organizations that represent a diversity of Region 4 and 5's geographic, ethnic, and cultural perspectives. The recruitment and interview process took approximately one month. InterEthnica conducted a total of 17 interviews with staff from the following organizations:

Region 4: North Coast

- Arcata House Partnership
- Fort Bragg Food Bank/Mendocino Food & Nutrition Program, Inc.
- Graton Day Labor Center
- Humboldt Area Foundation
- National Association for the Advancement of Colored People—Santa Rosa/Sonoma County Branch
- North Coast Opportunities, Inc.
- Northern California Indian Development Council
- Seven Generations Fund
- United Way of the Wine Country

Region 5: Central Coast

- Community Action Board of Santa Cruz County
- Community Action Partnership of San Luis Obispo
- Community Bridges
- Community Food Bank of San Benito County
- Mixteco Indigena Community Organizing Project
- Mujeres En Acción
- Regeneración Pajaro Valley
- The Village Project



This report summarizes the findings from the interviews and provides more in-depth analysis for both the CVA and PG&E's interrelated community relations, marketing, and other efforts. It is intended to be a supplement to RTAG discussions and community outreach input.

2.

FINDINGS/RESULTS

2.1. Community Understanding

To gain a more nuanced perspective of communities within Regions 4 and 5, interview discussions elicited insights about community composition, including discerning "communities of opportunity" and identifiable geographic factors that may make an area more at risk to climate hazards. Community demographic insights are delineated in the tables below by region and county. The table denotes community demographics, languages spoken, and whom interviewees see as "communities of opportunity"; these are communities that are low-income, underserved, and often communities of color. After developing an understanding of communities in each region, interviewers focused the discussion on barriers to participation.

2.1.1. Region 4: North Coast

PG&E's North Coast region contains five counties: **Humboldt**, **Lake**, **Mendocino**, **Siskiyou**, and **Trinity**. The Resilient Together project convened an Equity Advisory Group in Region 1 (the Bay Area), which included Sonoma County. Our learnings made it evident that the program would benefit from including Sonoma County in Region 4 because the organizations serving the other counties in Region 4 extend into Sonoma County. Given these factors, PG&E and InterEthnica decided to include Sonoma County in Region 4 efforts, including in these interviews and RTAG representation.

2.1.1.1. Communities of Concern/Opportunity

Participants provided insights on the types and locations of communities of opportunity and the primary languages spoken in each of the five counties.

County	Communities of Opportunity	Community Demographics	Languages Spoken
Humboldt	Cities of Arcata (specifically the neighborhoods of Downtown, Valley West, by the university, and by the Mad River) and Eureka. The unincorporated neighborhoods of Humboldt Bay, Field's Landing, King's Salmon, and Samoa	Native American, Asian (Hmong), white, and Latino/a/x communities, including Mexican, Central American, and indigenous Latin Americans, unhoused residents, many with disabilities	Spanish, Hmong, and Latin American indigenous dialects like Mixteco, Triqui, and Zapoteco
Lake	Cities of Clearlake, Lakeport, Cobb, and Kelseyville. The unincorporated neighborhoods of Lucerne and near Cobb Mountain	Native American, white, and Latino/a/x communities	Spanish
Mendocino	Cities of Ukiah, Willits, and Fort Bragg. The unincorporated neighborhoods of Talmadge, Little Lake Valley, and Anderson Valley, as well as mountainous areas like Sherwood Road, Brooktrails, and Pine Mountain	Native American, Asian (Chinese, Japanese, Filipino, and Hmong), white, Russian, and Latino/a/x communities, high senior population	Spanish, Mandarin, Hmong, and Russian

County	Communities of Opportunity	Community Demographics	Languages Spoken
Sonoma	Cities of Rohnert Park, Cloverdale, Graton, Santa Rosa (including the Oakmont, South Park, Coffee Park, and Fullman River Rd. adjacent neighborhoods), Sebastopol, and Petaluma (including the Southeast neighborhood). The unincorporated neighborhoods of Moorland, Forestville, Windsor, Guerneville, and rural ranches	African Americans, Africans (Eritrean), Native Americans, Asians (Filipinos and Vietnamese), Pacific Islanders (Fijian and Samoan), white, and Latino/a/x communities, including Mexicans, and indigenous Latin Americans, and Haitians	Spanish, Eritrean, Arabic, Mandarin, Vietnamese, Khmer, and Latin American indigenous dialects like Mixteco, Triqui, Zapoteco, and Mapuche
Siskiyou	The unincorporated neighborhood of Happy Camp and communities along the Klamath River	Native American, white, Asian (Hmong and Chinese) and Latino/a/x communities	Spanish, Hmong, Mandarin, Cantonese, Khmer
Trinity	Note: None of the interviewees were focused on Trinity County and didn't disclose specific affected communities.	Native American, white, Asian (Hmong) and Latino/a/x communities	Spanish, Hmong

2.1.1.2. Barriers to Engagement

Participants shared that geographic isolation has created barriers to engagement and provided the following rationales.

Geographic isolation has created barriers to engagement.

- As much of the region is rural, organizations face geographic barriers in reaching community members to provide needed services.
- Rural areas lack community centers or central meeting places close to them to receive information and resources.
- Broadband and cell phone infrastructure/access are limited in rural areas, especially in mountainous areas where Native American reservations and offsite homesteads are located.

Technical, untranslated information and non-resonant messaging also present barriers to communities in this region. Participants shared the following:

- "Climate change" framing turns off many rural, white communities, even those affected by climate hazards, from receiving critical information and assistance.
- Written materials alone are not sufficient and need to be paired with funded CBOs who can conduct verbal outreach, including in multiple languages.
- Many Spanish speakers only have a grade school education and/or lower levels of tech literacy, so text-heavy and online-based materials aren't helpful to them.
- When multilingual materials have existed, they have been primarily in Spanish, excluding African, indigenous Latin American, and Pacific Islander languages.

A lack of outreach and post-hazard resources creates short and long-term barriers to engagement and the adoption of an ingrained safety culture in all North Coast communities. Participants noted that:

- There are varying degrees of access to information and resources, depending on the political inclination of the county, and within communities of color. Participants shared that specifically, Black and Native American communities in the region are most isolated from receiving emergency communications and resources.
- Many post-wildfire rebuilding organizations and funding were perceived to be primarily directed towards white communities, such as Community Organizations Active in Disaster (COAD) and After the Fire.
- While many communities already burdened by wildfires had access to go-bags and basic preparedness tips (primarily through intermittent non-profit efforts), they rarely got information from agencies or PG&E during an active hazard.
- In addition, the communication channels most recommended by participants to use during active hazards (radio, texts, and social media short videos) with communities of color and rural communities often did not align with the types of emergency communications agencies and PG&E actually conducted.

Black and Native American communities in the region are most isolated from receiving emergency communications and resources.

2.1.2. Region 5: Central Coast

The Central Coast region contains five counties, including **Monterey**, **San Benito**, **San Luis Obispo**, **Santa Barbara**, and **Santa Cruz**.

2.1.2.1. Communities of Opportunity

Participants provided insights on the types and locations of communities of opportunity and the primary languages spoken in the five counties.

County	Communities of Opportunity	Community Demographics	Languages Spoken
Monterey	Cities of Seaside, Marina, Kings City, Soledad, Gonzales, Salinas, Tulare, Greenfield, and Watsonville. The unincorporated areas of Las Lomas, Aromas, Castroville, Salinas Valley, and San Lucas	African American, Asian (Filipinos and Vietnamese), white, and Latino/a/x communities, including Mexican and indigenous Latin Americans	Spanish, Latin American indigenous dialects like Mixteco, Triqui, and Zapoteco, Tagalog
Santa Barbara	Cities of Santa Maria and Guadalupe. The unincorporated area of Santa Maria Valley	white, and Latino/a/x communities, including Mexican, Central American, and indigenous Latin Americans	Spanish, Latin American indigenous dialects like Mixteco, Triqui, and Zapoteco
San Benito	Cities of Hollister (specifically the neighborhoods of Buena Vista/Talaveres, by Lover's Lane, and the mountainous areas of Gavilan) and San Juan Bautista. The unincorporated neighborhood of Aromas	white and Latino/a/x communities, including Mexican and indigenous Latin Americans	Spanish, Latin American indigenous dialects like Mixteco, Triqui, and Zapoteco
Santa Cruz	Cities of Watsonville (specifically the neighborhoods of downtown, by Cary St., by the airport, near the levee, Martinelli, and College Lake), Capitola. The unincorporated neighborhoods of Freedom, Pajaro (by the Pajaro River), Corralitos, Davenport (including nearby ranches), Aptos, Live Oak, Bonny Doon, and Last Chance	Native American, white, Slavic (Russians), and Latino/a/x communities, including Mexican and indigenous Latin Americans, Middle Eastern (Syrian, Jordanian, and Central Asians)	Spanish, Latin American indigenous dialects like Mixteco, Triqui, and Zapoteco, Arabic, and Russian
San Luis Obispo	The cities of Arroyo Grande, Pismo Beach, Paso Robles (northern neighborhood), Grover Beach, and the South County Five Cities. The unincorporated neighborhoods of Nipomo, Oceano, Los Osos, and Santa Margarita, areas along the San Luis Obispo Creek, and the Santa Maria Valley	white, Black, Asian (Filipinos), and Latino/a/x communities, including Mexican and indigenous Latin Americans	Spanish, Latin American indigenous dialects like Mixteco, Triqui, and Zapoteco

2.1.2.2. Barriers to Engagement

Participants shared that geographic and linguistic isolation, particularly for farmworker communities, have created the following barriers to engagement:

Geographic and linguistic isolation, particularly for farmworker communities have created barriers to engagement.

- Rural areas lack community centers or central meeting places close to them to receive information and resources.
- Farmworkers face geographic barriers in receiving needed information and services, particularly because many of them live on employers' isolated ranches.
- In every Central Coast county, there are communities from Southern Mexico and Central America who speak Mixteco, Triqui, and Zapoteco, which lack a written form. Most agencies lack bilingual staff and rarely offer or fund interpretation in these languages, which burdens poorly paid/unpaid CBO staff to interpret.

Technical information, a lack of trust, language, and messaging disconnects also present barriers to participants in this region. Participants shared the following comments about the dissemination of information:

- Text-heavy materials are written using terminology that isn't digestible.
- Technical climate change concepts are not communicated as relatable issues for the community, nor are they provided in accessible visual and auditory formats.
- This has resulted in materials that are often not comprehensible, even in English, that do not engage their intended audiences, with engagement materials like surveys often not being completed.
- Messaging focused on concepts like "saving or rescuing the earth" feels discordant to indigenous Latinx and Native communities who already use less resources and do not feel severed from their connection to their ancestral lands.
- In addition, written and online-based materials alone are not sufficient, particularly to reach heavily rural communities.
- Immigration and Customs Enforcement (ICE)'s presence in public spaces has intimidated immigrant communities and prevented them from receiving the services and information they are eligible for. This hasn't been mitigated consistently, and only happens when agencies or organizations adopt strict policies to limit ICE from coming onto their premises.

A lack of access to timely information on climate hazards and emergency preparedness stood out as another key barrier. Participants shared that:

- There is a great deal of infrequency and inconsistency in which communities receive climate change and wildfire preparedness information, based on either local political leaders' leanings or underdeveloped local governments' emergency communications infrastructure. Some communities do receive regular communication, while others are out of the loop.
- When PG&E has sent emergency alerts out, they are not perceived to be very helpful due to the lack of follow-up alerts that could connect community members to post-hazard resources.
- Though there have been some past preparedness efforts, they often are one-off efforts and reliant on CBOs leading that work; CBOs report that their communities are wholly unprepared for hazards when conducting that outreach.
- Wildfires appear to be the only hazard featured in emergency information and resources, despite heatwaves and sea level rise being increasingly reported issues.

2.2. Climate Hazards and Impacts

The objective of this section was to gather more nuanced insights about climate hazards and impacts of concern. More insights on concerns are broken down by region below.

Region 4: North Coast

Participants expressed deep concern about the combination of extreme heat, flooding, and repeat wildfires (and related mudslides) in this highly rural, heavily forested region. They shared that the combined disasters and their extremity have led to a level of devastation almost unrivaled across PG&E's service areas. They pinpointed the most disproportionate impacts borne by Native American communities in the North Coast who cannot "simply relocate" as they live on reservations or homesteads or tribal trust properties on tribal land (inherited generations ago from their families). As a result, they may lack official building permits or legal documents, which are typically required to reap the full benefits of resources and programs.

Many residents suffer from extreme poverty and isolation, with few physical resources to easily evacuate during climate hazards. There was a common sentiment among participants that both climate hazard risks and electric bills are increasing without immediate protections being implemented, and there is a perception among participants that rate hikes are in place (in part) to pay for climate hazard legal settlements. Their comments show that community trauma is felt across Region 4 from repeated hazards and loss, with inadequate mental health services, especially in **Humboldt and Lake Counties**.

During the interviews, we learned that rural communities in the region have few routes in or out and are cut off from those roads when fires or flooding occur. This results in an inability to access food and resources that must be transported into the community from elsewhere. Because of the topography of their region, they reported suffering from frequent Public Safety Power Shutoffs (PSPS) alerts and outages but typically cannot afford generators nor have backup batteries. The insights derived here highlight the life-threatening secondary consequences experienced during outages when residents are 'trapped at home' in remote areas without access to food and water.

"PG&E sends these PSPS alerts-we're shutting you off due to high winds. My assistant in Butte County has 7 children, no power, that means the well {won't turn on}, that means no water, no going to the bathroom. That's a deal breaker."

—North Coast Participant

Participants shared that power outages also cause permanent damage to the electrically-powered water pumps they rely on for drinking water, while also depriving them of showers and toilet access. Interviewees noted that there is no replacement fund for customers to replace their individual damaged water pumps after these hazards. In addition, outages were reported to often last long periods of time due to these areas being at high risk with poor transmission infrastructure. For example, participants shared that communities near the Klamath River went without power for three weeks.

Outages were reported to often last long periods of time...{sometimes} 3 weeks without power.

Rural communities, especially Native communities, in this region have been forced to cope with extreme heat and outages through primarily non-governmental resources and strategies. This includes relying on CBOs to get emergency services, getting ice, or driving to local creeks/rivers, as cooling centers were too far away (some were reported to be an hour away), and gas was too expensive to drive further. Participants shared that many residents have been dropped by their home insurance companies. At the same time, they have faced exorbitant motel rates during evacuations in a region that lacks access to emergency shelters, particularly those that accommodate the larger families common in Native communities. These factors have led to many Native families fleeing fires and setting up tent cities, leaving some permanently displaced when their homes burned down, who then face the grim realities of very few resources and support from their municipalities or PG&E.

In **Lake County**, participants shared that the area has historically been an affordable community to buy a home, but repeated fires have destroyed the overall housing stock and displaced many residents. Participants shared examples of white seniors or people with disabilities who have had to rebuild homes that are isolated from resources and evacuation centers and were worried that the new homes come with new mortgages unexpectedly extending well into retirement. They shared that others have relocated to other counties or out of state as "climate refugees" as a result. Participants also shared that repeated opportunities to rebuild their communities smarter, with more resilience, after numerous fires were missed. In addition, many local businesses have gone under after the fires and cannot reopen, which has hurt the local economy for workers who do remain post-fire. We learned that many of the remaining jobs pay too low wages for community members to financially support their families. Extreme heat and wildfire smoke were also expressed concerns resulting in greater asthma and heat exhaustion for the residents of Lake County.

Within **Trinity and Humboldt Counties**, outages and sea level rise were reported to be key climate hazards. Climate refugees from elsewhere have settled in these counties due to their temperate coastal climates. Participants noted that this could eventually put pressure on local housing markets, which already have a sparser housing inventory and, therefore, would be likely to exacerbate the high number of unhoused people already in Trinity and Humboldt Counties. One participant guesstimated it would lead to an increase of 15% more unhoused people in the area. This growing rate of unhoused people also places strain on CBOs' resources that serve the unhoused community.

Shrinking housing inventory due to "climate refugees".

Participants also shared that outages happened somewhat frequently, resulting in reduced hours at work, life-threatening medical emergencies, and a loss of food and refrigerated medicines. Coastal communities in Humboldt County, like Arcata, were less affected by extreme heat and wildfires, thanks to what participants call the "Redwood Curtain", insulating from those hazards by the redwoods ringing the town and upgraded transmission lines in this area. However, they were still secondarily affected by smoke and lower air quality from fires that took place in the inland parts of California.

Sea level rise is an issue in **Humboldt County** as a coastal community located along active tectonic plates, which could be worsened by tsunamis triggered by earthquakes. Participants shared that communities along the coast will not see safety improvements to coastal roads prone to flooding for at least a decade from the current construction underway. Participants report that sea level rise and flooding after heavy rains tend to impact lower-income communities more, such as in the Samoa Peninsula. While sea level rise may not directly affect residents' homes, participants brought up the risks to coastal infrastructures, like PG&E's decommissioned Humboldt Bay natural gas power plant and nuclear waste facility. We learned climate change (and resulting hazards) also affect the county's fishing economy due to warming temperatures reducing salmon and mussel populations and, in turn, fisherman jobs held largely by Native Americans.

Within **Mendocino County**, more inland, low-income communities, such as Ukiah or Willits, we heard have been impacted most by wildfires, extreme heat, and outages. During fires, many residents faced a shortage of hotels and homelessness if they lacked savings or didn't receive FEMA assistance and participants' sentiments drew concern about this. Rising temperatures in coastal areas, while still fairly temperate, are an issue as air conditioning is rare for many in Mendocino County. In both Mendocino and Humboldt Counties, limited and circuitous roads used to deliver food from other parts of the state, like the Central Valley, were also cut off during faraway fires, landslides, and floods. This was reported to result in empty store shelves in many towns that already have limited stores available for residents. Outages have sometimes lasted for weeks, particularly in rural areas, requiring residents to rely on food banks, neighbors, ice, and generators. Sea level rise is less of an issue in the coastal part of the county, as housing is either set back from the coast or higher up on cliffs and not close to the water.

In **Sonoma County**, low-income Black and Latino/a/x residents (especially farmworkers) are primarily renters and are the groups most affected by fires, outages, flooding, and extreme heat in Santa Rosa and Graton. As noted by participants, this county has experienced extreme gentrification and a housing crisis, making climate hazard-driven, racialized housing loss that much more devastating in these communities.

> ***"So many developers bought up the land from those who chose not to return and built these beautiful new homes that they now want to rent. There's a lot of rent gouging now, so maybe someone would have rented a 2 bedroom home in prior years for, at max, $2200/month, now, they're looking at $3800/month. So now you have a lot of {low-income Black renter} families having to move around quite a bit."*** —North Coast Participant

Many Black families who rent have to move outside of the area to find cheaper rent and can not afford to be homeowners. In addition, many of the tenants in rental properties in Santa Rosa were displaced because their landlords' owner-occupied properties had burned down, and the landlords then moved into their investment properties (that were previously rented).

In addition, participants shared stories about how fires and flooding have caused extended financial instability, as many families had to expend all of their savings to get motels or find additional housing. Few could afford to have renters' insurance. In Graton, many Latinx immigrants permanently lost their apartments when the Russian River flooded their neighborhood. Participants noted that the full economic effects of fires and flooding continued well after the actual hazard events, with residents who fall behind a month or two on rent often taking a full year to be able to catch up financially.

Outages worsened during heatwaves, and participants shared the outages have affected Black and elderly communities more so than others, particularly those dependent on oxygen tanks. We heard that many schools have sent children (of families with low incomes) home early during heat waves, putting stress on their parents who work during those early closures. Similar to other coastal communities in Region 4, few residents have air conditioning because of the historically cool weather, but heat waves of over 100 degrees have disrupted that equilibrium. For those who do have air conditioning, they cannot afford to use it as much as they need. Seniors with low incomes have been isolated from food access if their families cannot drop off groceries during outages and have had to rely on community groups to survive those periods of time. Black unhoused people were heavily affected during heat waves, as they make up a disproportionately large portion of the unhoused population relative to their overall population in Sonoma County. Apathy from local governments stalled a quick rollout of cooling centers for unhoused persons to congregate within, and as a result, participants noted that many unhoused people fell unconscious or "laid out in the street" from heat exhaustion during 100+ degree weather.

"{This happened} because our elected officials and the people who support them view providing any means of services to the unsheltered community as a burden and not as a necessity or human right." —North Coast Participant

As many undocumented Latino/a/x immigrant low-wage immigrant workers don't qualify for government aid during climate hazards, including FEMA aid or unemployment, they have faced financial hardship. Participants shared that this also applied to many households with "mixed status", meaning that the parents may have been undocumented, but their children may have been U.S. citizens, yet this status prevented entire families from receiving help.

"We found out during the Tubbs Fire in 2017 that…only people who were U.S. citizens were eligible to receive FEMA aid. FEMA is run out of the Department of Homeland Security and no one really knows the relationship it has with ICE {Immigration Customs and Enforcement} and sharing of {sensitive} data, so there is a lot of fear." —North Coast Participant

The only recourse we heard about was to rely on community organizations with limited funding who do not limit food boxes or other aid to those with citizenship. Similar to the Central Valley (Region 2), those who did agricultural or construction work had their hours reduced along with their income during fires and extreme heat. Interviewees pointed out that this economic burden put some workers in danger as they took a big risk and worked in extreme temperatures to afford their bills. Some were hired to do wildfire clean-up remediation work at extremely low wages with unscrupulous working conditions. They were also exposed to smoke and toxic substances while doing the work, exacerbating economic and health disparities within the Latino/a/x community.

Region 5: Central Coast

Region 5 (**Monterey**, **San Benito**, **San Luis Obispo**, **Santa Barbara**, and **Santa Cruz** counties) has been historically temperate but has increasingly faced rising temperatures, power outages, wildfires, and sea level rise. It is a heavily rural, dispersed region with large populations of low-income indigenous and Latino/a/x farmworkers and small historical Black communities who are most affected by climate hazards. Interviews recognized that while there is political momentum towards climate change planning, communities of color are very marginalized and not engaged in those processes or lack access to post-hazard resources. Very few communities in this region were reported to have air conditioning, despite increasing temperatures.

> ***"Climate change is a major civil rights issue."*** —Central Coast participant

In **Santa Cruz County**, lower-income farmworker communities face the same financial pressures as the North Coast (Region 4) and San Joaquin Valley (Region 2) of lost income and reduced hours due to extreme heat days above 100 degrees. This has presented physical problems, and participants gave many examples of those health challenges, including fainting, since their bodies are not accustomed to such high temperatures. Many farmworkers in this region harvest berries, which require being grown in plastic tarp greenhouses that concentrate heat and increase worksite temperatures by 10–15%; pesticide health risks that the workers are routinely exposed to worsen in higher temperatures. Participants shared that some workers continue, despite the challenges, even forgoing breaks in this extreme weather, as they are paid "by the piece" (paid based on the pounds of crops harvested), exacerbating health risks.

From participants' comments, we can see the short-term financial impacts have led to more farmworker families than ever seeking financial assistance from community organizations to fight evictions from community organizations, as they may not be able to receive government aid due to legal barriers. The high cost of housing in Santa Cruz County means that they may not be able to find affordable housing to move into if they are evicted during heatwave-driven work shortages. In the longer term, we learned that the viability of operating farms, growing certain crops, and the number of farmworker jobs may be dramatically reduced if farmers have to let more land fallow due to extreme heat or grow crops that require less water and human labor. Participants raised concerns about housing affordability worsening as climate refugees from inland regions were likely to relocate to Santa Cruz County's more livable temperatures.

> **Some classrooms' indoor temperatures measuring 100 degrees, which created a public health emergency for children and teachers.**

Due to a lack of green space and tree canopy in lower-income communities like Watsonville are disproportionately hotter than nearby Santa Cruz. Participants shared that farmworker families who live in Watsonville tend to live in dilapidated, older building stock that isn't energy efficient nor has air conditioning. We also learned that their community's schools do not have air conditioning, which has resulted in some classrooms' indoor temperatures measuring 100 degrees, creating a public health emergency for children and teachers.

While fires tend to happen in the more affluent mountainous areas and not the lower-income, urbanized communities like Watsonville, the latter community is still affected by wildfire smoke, which pools in the valley they live in. The exception shared is that fires have affected farmworkers living onsite at their workplaces, who hadn't heard about previous evacuations at all nor had the savings to pay for a motel (even if they were made aware of the hazard in time). We heard that farmworkers were only able to leave safely because non-profit staff led complicated relocations and gathered workers from their isolated worksites to bring them to a shelter, while navigating challenging, narrow exit routes. In addition, much like in the North Coast, there is a lot of immediate material support for homeowners who lost their homes in the fires but not in the long term after the properties are cleaned up and need to be rebuilt. The difficulty of meeting regulations, not being able to afford to rebuild, and insurance challenges are worsening the region's housing affordability crisis.

Flooding and sea level rise (including its impacts on clean water access) are other concerns raised by participants that affect Santa Cruz County. The water table has been sinking due to groundwater depletion, and saltwater has infiltrated drinking wells because of the county's proximity to the ocean. The Pajaro and San Lorenzo Rivers and creeks have historically inundated Latino/a/x neighborhoods and resulted in heavy damage, with the construction of a repaired levee repair at the Pajaro River only just commenced. Participants shared that communities like Downtown Watsonville and farms are at risk of flooding and sea level rise, highlighting that their water treatment plant on the coast is at risk of being damaged. Currently, participants expressed concerns that sandbags are the only tool the community has to protect their homes, but their older housing stock in low-lying areas isn't sturdy enough to withstand water.

Outages are less of an issue in the communities in the southern part of Santa Cruz County, as participants reported that PG&E has made many infrastructure improvements in these areas in the past few years. They tend to occur mostly during heatwaves in the more remote areas of the North Coast ranches and in Davenport. Farmworker families need significant electrical bill financial assistance as their bills are higher during heatwaves, but they have mostly relied on getting aid from non-profits.

In **Monterey County**, Black and Latino/a/x communities in areas like Marina, Seaside, and King City are highly affected by outages, heat, wildfire smoke, and sea level rise. A participant described that the former Fort Ord army base left behind toxic waste and drinking water contaminated with lead that have led to higher rates of premature death, cancer, severe allergies, and asthma in these areas. At the same time, there are economic pressures facing communities due to gentrification that climate hazards threaten to worsen. In these towns, the ocean is only about a mile away from all housing, especially many apartment complexes with low-income families, which are at high risk of being damaged by sea level rise. There are unhoused community members living very close to the ocean who could face life-threatening harm from sea level rise. Many homes have mold as a result of being so close to rising water. Retaining walls were

In Monterey County, Black and Latino/a/x communities in areas like Marina, Seaside, and King City are highly affected by outages, heat, wildfire smoke, and sea level rise.

built on the beach, but participants did not think they would be enough to protect against future sea level rise.

Wildfires have affected parts of Monterey County, like Big Sur and the inland “valley cities” where low-wage workers live, and have resulted in evacuations. In addition, wildfire smoke has worsened air quality for asthmatics and even prescribed burns requiring them to evacuate, which is difficult even with advance notice. Planned outages and blackouts have caused low-income families (including unemployed farmworkers’) food to go to waste many times that they can’t afford to replace, especially living in food deserts. Outages hurt low-wage workers and small business owners’ bottom lines alike; many live in the community, yet there is no compensation for lost income. We learned that diabetics are also harmed during outages by not having refrigeration for their insulin. In more inland communities like King City, higher temperatures affect Latino/a/x farmworkers and immigrant communities.

> ***“One of our Latina members in King City said she felt terrible for several days and tested herself for COVID {and was negative but it was due to heatstroke symptoms}...for someone who has the money, it’s not a big deal, you can just buy an A/C unit but if you don’t have the means, you have to suffer.”*** —Central Coast Participant

Much of the building stock in these areas is poorly insulated, affecting people’s health. Like in many other counties, farmworkers are hard-hit financially because they can not work at such hot temperatures and do not have a policy that protects them or paid time off for extreme weather.

San Benito County has experienced the hazards of flooding, heat/drought, and wildfires. The mountainous areas of Gavilan Hills and the Tenoch Valley area are prone to fires and subsequent mudslides due to an abundance of eucalyptus groves. Participants shared that evacuations during fires in these areas are challenging, as there are only three narrow roads to escape that are often obstructed during hazards. One participant estimates that 65% of people commute to the Bay Area for work from San Benito County; many are isolated far from home and have to get hotels when hazards occur. During extreme heat days, the unhoused population has nowhere to go, which has reportedly led to more deaths and emergency room visits from dehydration and heat-related illnesses. Like other heavily agricultural counties, extreme heat in the past five years has ruined crops and hurt the local economy, while also exposing farmworkers to 100+ degree heat. Participants said this is magnified by a lack of coordination and planning at the local government level and an overreliance on community organizations to provide emergency resources. Unincorporated areas of the county experienced flooding during the winter, while a local aqueduct failed and destroyed some homes.

In **San Luis Obispo County**, the primary hazards reported are wildfires and heat, particularly in the northern part of the county, which is inland, hotter, and more rural. This is especially the case in areas like Santa Margarita, Atascadero, and Paso Robles. Many fires have burned down low-income homes, including mobile home parks, and spread across very dry oak woodlands.

In addition, we heard that much of San Luis Obispo County's large, low-wage, undocumented farmworker population can only afford to live in substandard mobile homes that are either unfixable or suffer from mold. Finding affordable replacement housing after the fires is difficult and affects the farmworkers' basic survival. While outages were not reported to be as severe in this county, increasing temperatures have been a major health issue, especially for seniors and the unhoused population. Participants shared that few have air conditioning, and there are not any cooling centers in the northern part of the county. Unhoused people have had to be transported primarily by community organizations to cooling centers in the City of San Luis Obispo to survive. Seniors and people with disabilities have adverse health outcomes without air conditioning and require the help of community groups to bring them portable air conditioning units.

Within **Santa Barbara County**, rural communities like Santa Maria and Guadalupe are affected by extreme heat and wildfire smoke. We learned they are isolated several hours away from urban areas like Santa Barbara, where most resources are concentrated, so farmworker communities do not have accessible support during extreme weather. Though wildfires and outages affect these areas less, smoke from nearby fires in Santa Barbara and Ventura has affected communities. If employers are out of compliance, participants noted that nonprofits are forced to close the gap and provide basic protections like masks or even lead the charge to advance efforts to create cooling center resource hubs, which have been politically unsupported and blocked by local elected officials. As in Santa Cruz County, extreme heat and pesticides combined are more dangerous to farmworker health.

Extreme heat and pesticides combined are more dangerous to farmworker health.

3.

COMMUNITY PREPAREDNESS, ADAPTIVE CAPACITY, AND RESILIENCE STRATEGIES

The insights derived in this section seek to help the reader understand communities' adaptive capacity, specifically with respect to vulnerability, resources, preparedness, and support. This project has followed the California Public Utilities Commission (CPUC) definition of adaptive capacity: a "broad range responses and adjustments to daily and extreme climate change-related events available to communities. This includes communities' ability and resources to moderate potential damages, take advantage of opportunities, and cope with consequences."

Adaptive Capacity

The current adaptive capacity of the North Coast (Region 4) is very low, particularly with the lack of coordinated local emergency and climate planning efforts. Given the instability of the grid and heavily rural, fire-prone terrain, participants focused on investments in infrastructure to ensure survival and reduce death and displacement. Participants were concerned about whether clean energy or electrification efforts would worsen the risk of devastating fires in their region before the grid stabilizes and can handle the higher load. Resilience could be improved with an emphasis on reducing high-risk infrastructure, investing in targeted infrastructure (microgrids, batteries, and generators), and funding and coordinating local climate planning efforts.

Though the Central Coast (Region 5) faces adaptive capacity challenges due to its increasing heat and dispersed agricultural and rural nature, the generally temperate climate still allows time for more impactful interventions to take place. Though residents are linguistically and/or geographically isolated and have poor broadband access, fortifying local networks of agencies and CBOs and targeted infrastructure (microgrids/batteries) can go a long way to make this region more resilient and prepared long term.

Resilience Strategies

Improving resilience will happen if communities are connected with more resources and communications before, during, and after active climate hazards. While few communities are well prepared for climate events, rural, low-income, monolingual, and communities of color have almost no access to resources in their areas and/or languages. Better preparedness and response engagement should include more face-to-face, multilingual, verbal approaches, phone alerts, and partnerships with trusted CBOs. Both regions are very isolated and rural, with few cooling and evacuation centers, emergency resources (food or shelter) during hazards, and inconsistent efforts and planning by local agencies, with a high distrust in government. The CBOs knocking on doors are oftentimes the only emergency response, evacuation team, and information channel in rural communities, and they felt that they should be paid by PG&E to conduct the service.

Participants recommended detailed resilience strategies that PG&E can directly implement or fund in partnership with other entities to make a greater impact.

The top resilience solutions that were derived in these interviews included:

1	Improving emergency response resources and coordination, in tandem with coalitions of tribes, local governments, and CBOs to better reach Native, monolingual, farmworker, communities of color, and rural communities who often don't receive any alerts or resources.
2	Rapid installation or relocation of infrastructure and maintenance (such as power plants, upgraded transmission lines, tree trimming, brush clearance, generators, and batteries) without requiring individual capital upfront.
3	More nimble resilience hubs that are easily set up in rural areas for the variety of disasters (fires, heat, and flooding) experienced in these regions.
4	Enact a policy campaign at the state level to require climate change planning to override local resistance exacerbating dangers.

A detailed list of improvement categories and recommendations can be found in **Appendix A: Resilience Strategies: Detailed Recommendations Table**.

4.

EXISTING DATA

Interviewers set aside discussion time to identify existing reports/data that could inform PG&E's Climate Vulnerability Assessment. The California Utilities Public Commission (CPUC) requested that PG&E research and crowdsource community data that could better inform equitable climate resiliency efforts. Interviewees were asked to share data that may be useful in this effort in the form of reports, quantitative and qualitative research or projects, community testimonials, and any other sources of key data.

Interviewees suggested reviewing and possibly including the following reports and data sources:

- "**California's Indigenous Farmworkers**" is a 2010 report by California Rural Legal Assistance and Richard Mines, Sandra Nichols, and David Runsten all about indigenous farmworker report in the Central Coast
- California Policy Lab's report, "**High Utilizers of Multiple Systems in Sonoma County**" talks about unhoused Black folks and the impacts they experience
- Community Action Board does a **Community Action Plan** report every 2 years recommending ways to reduce poverty and barriers in Santa Cruz
- **DataShare Santa Cruz** is a central hub of information for Santa Cruz County with the data, dashboards, reports and over 475 community wellbeing indicators. Data is submitted by CBOs regularly to this site
- The Homeless Management Information System run by Humboldt County (HMIS)-Data on Humboldt County unhoused populations
- Measure of America of the Social Science Research Council, **"A Portrait of California 2021–2022: Human Development and Housing Justice"** provides useful Census data
- Michael Mendez of the University of Irvine, in partnership with the Mixteco Indigena Community Organizing Project (MICOP) and Central Coast Alliance United for a Sustainable Economy (CAUSE) developed a **report**, "Addressing Disparities In Sonoma County's Agriculture Pass Program" on how farmworkers were impacted and marginalized during Sonoma County wildfires.
- Research by Dr. Hugh Stalwart on disparities in healthcare for Black folks (from 2007) refers to environmental justice/health impacts due to lead poisoning and pollution.
- Santa Cruz County's Environmental Resiliency office has a **Climate Action Strategy**
- The California Office of Health Equity has a **"California Building Resilience Against Climate Effects (Calbrace) Project: Preparing For Climate Change In California - A Public Health Approach"** framework and collection of reports, as well as a "**Healthy Communities Data and Indicators Project"**
- The City of Watsonville did a **Climate Action and Adaptation Plan in 2021**
- The National Day Laborer Organizing Network and Nik Theodore of the University of Illinois, Chicago developed **a report,** "Recovering From Climate Disasters: Immigrant Day Laborers As "Second Responders" about day laborers doing second responder work and the rise of predatory labor practices post-Hurricane Sandy that is applicable to post hazard clean up risks in California.
- UC Berkeley's Othering and Belonging Institute has an open-source repository of policy ideas to address structural racism via **The Structural Racism Remedies Project**
- United Way of Wine Country did an **interactive data report** on Sonoma County's 211 services (data is broken by race, gender, city, type of need, etc.)

5.

CONCLUSION

As a result of the interviews/calls conducted, InterEthnica learned about the unique needs, challenges, and targeted solutions required across Regions 4, 5, and parts of Sonoma County. This summary provides PG&E with granular and useful data on the community types and languages spoken, key climate hazards and impacts of concern, and the adaptive capacity on the ground of the North Coast and Central Coast regions. It also builds on existing relationships with CBOs, and new relationships were developed in earnest throughout this process. These relationships will be integral to the implementation of the ultimate Climate Vulnerability Assessment.

13 out of 18 CBOs recruited came from these interviews.

The information collected will also support the development and implementation of PG&E's Community Engagement Plan and Resilient Together Advisory Group meetings. As a result of these interviews, 13 out of the 18 total CBOs committed to participating as RTAG members were recruited. Amid the slew of concerns raised in their interviews, the RTAG commitment of 13 interviewees is a testament to the participants' commitment to their communities and openness to working with PG&E to come to the table and participate in the interviews and RTAG to advance resilience solutions, despite historic mistrust and challenging experiences.

6.

APPENDIX: RESILIENCE STRATEGIES: DETAILED RECOMMENDATIONS TABLE

The recommendations provided in the table below are not presented in any particular order.

Region 4

Improvement Category	Participant & Insight-driven Recommendations
Reduce bills, energy costs, and outages	• Offer more backup generators (loaned or with rebates for purchasing) for Medical Baseline customers • More back up generators (loaned or with rebates for purchasing) for customers in mountainous areas • Offer more backup generators (loaned or with rebates for purchasing) for Medical Baseline customers • More back up generators (loaned or with rebates for purchasing) for customers in mountainous areas • Increase the types and quantity of bill payment programs/funding for those in arrears • Restructure CARE/FERA programs to take into account greater use of A/C during heatwaves • Increase PG&E outreach to proactively enroll people in the programs/payment plans, with an emphasis on reducing their administrative burden • Deploy more staff or fund CBOs to enroll people into programs by meeting them where they are in the community (i.e. at an location they frequent or existing community meeting with tablets for enrollment) • Decrease process steps and expand eligibility criteria for customer program applications, default to automatic enrollment when possible
Develop New Funded Programs	• Deploy contractors or provide subsidies for low-income/elderly homeowners to complete fully subsidized fireproofing work around their homes • Offer A/C subsidies and programs targeted towards coastal areas that haven't historically had A/C but need it due to climate change • Fund programs to help get older homes up to code to support solar panels
Fund/expand emergency response efforts	• Fund CBOs leading CERT trainings and provide them with go-bags to distribute at the trainings • Play a leadership role or fund more intertribal emergency prep/management coordination and staff • Fund/staff up inland response teams to make coordination around fires and hazards quicker/efficient • Work with and fund tribes/CBOs to establish in-person emergency response outreach teams to knock on doors and provide real time information on hazards/resources
Restructure/ expand existing programs	• Increase funding and provide homeowners with upfront subsidies/direct installs (instead of reimbursements or rebates) for energy efficiency programs • Explore solar and backup batteries potential to help reduce impacts/costs in inland or fire prone areas like Lake County • Streamline processes for CBOs to secure funding and resources • Adjust the Disaster Resilience Fund to include climate hazard resources • Invest in targeted weatherization and electrical upgrades in older homes along the coast • Increase funding for CBOs to do engagement and disseminate supplies • Partner with CBOs who support Black, Indigenous, Asian, and other communities of color to produce events in their communities to promote efficiency/electrification programs and appliances targeting older homes/condos • Incentivize landlords to upgrade multifamily buildings with upfront subsidies, free energy audits, and demonstrate common area savings • Offer meaningful rebates for electric vehicle charger installation for low-income single family homes and multi-family buildings

Improvement Category	Participant & Insight-driven Recommendations
Fund and Establish Partnerships with External Mitigation Efforts and Programs	• Co-fund or lobby the state to fund 211 phone service (especially in Sonoma County, which is currently run by United Way and Interface Children and Family Services) to ramp up disaster prep and emergency resources • Evaluate existing case studies (like the FEMA funded Lake County Riviera neighborhood project to harden 500 homes and fund resident preparedness trainings) to see if they can be a replicable model PG&E can help fund • Co-invest in efforts to expand broadband infrastructure so more residents can get internet alerts • Co-invest in stabilizing main roads affected by fires/ mudslides to prevent food blockages during hazards • Work with local government and private companies to utilize ships to temporarily deliver food and critical supplies to North Coast ports immediately after wildfire caused landslides • Partner with CalOSHA and CBOs to enforce and educate employers and farmworkers about mandatory N95 mask provisions rule on extreme heat days • Co-fund a wage replacement program for farmworkers and other workers who work outdoors that lose work due to wildfires and extreme heat • Co-fund and lobby the state to fund hazard mitigation plans and include tribes in that funding stream • Lobby for restarting federal funding for tribes to be included climate resilience work in hazard planning • Co-fund public shuttles or dial a ride for seniors and people with disabilities to go to cooling centers • Co-fund and promote renters' and homeowners' insurance for low-income and communities of color • Coordinate with and lobby local Offices of Emergency Management to lead more proactive, inclusive engagement that is responsive to community feedback
Expand community investments and infrastructure	• Focus on community solar and target solar installations or subsidies in critically impacted neighborhoods • Fund/expedite planting trees in burned areas • Fund and coordinate more rigorous forest management • Fund mobile cooling centers and deploy them in rural areas and ranches • Fund cooling centers that can serve different communities, one for the unhoused, one for seniors in urban areas to make cooling centers more comfortable • Provide services and other attractions at cooling centers to incentivize participation, such as food trucks • Evaluate and fund projects like the Redwood Region Climate Resilience Core Hub, the first rural carbon sequestering region to see if they are replicable models • Move more transmission lines underground more expeditiously in heavily forested areas • Invest in and upgrade transmission lines to allow microgrids and more renewable energy sources • Expedite phasing out generation facilities, especially natural gas plants, at risk of sea level rise • Maintain trees along main roads on the coast to protect transmission lines • Fund resilience hubs and community centers in communities that lack natural gathering places, particularly for Sonoma County's Black community • Build more grid capacity in areas that currently lack solar but are appropriate areas for it

Improvement Category	Participant & Insight-driven Recommendations
Expanded, funded multilingual marketing/ messaging, education, and outreach	• Connect climate change to familiar values, concepts, or climate-hazard experiences in rural communities and communities of color. Ex: Latino/a/x immigrants have spoken informally about deforestation in rural Mexico, and leveraging this would help messaging resonate better. • Expand communications during fires that clearly establish where people can evacuate to and use billboards/text alerts • More marketing of CARE/FERA programs, particularly to those at risk of shut-offs from being in arrears • More real-time PSAs and announcements during fires explaining where to get information and who to call to get status updates on fires • Radio and television ads and public relations efforts to inform the community about preparedness efforts • Proactive multilingual outreach planning efforts to reach agricultural guest workers who live onsite at their employers' ranches and farms about safety during fires. Work with local agricultural commissioner's office to identify agricultural workers and their employers • Partner with trusted institutions to be messengers during hazards, such as schools sending updates to parents by text/app or using faith-based leaders to inform people about hazard preparedness • Focus on proactive outbound communication and not on driving people to find information online • Strengthen partnerships with local governments to increase proactive communications about resources during planned outages or other hazards, including cooling center information • Promote customers following the "Watch Duty" program to raise the number of people receiving updates on fires • Partner with CBOs to host or join existing community festivals or events to promote emergency preparedness

Region 5

Improvement Category	Participant & Insight-driven Recommendations
Reduce bills, energy costs, and outages	• Increase subsidies for larger households having higher electric bills • More bill assistance promotion and ramped up enrollment efforts • Proactively notify and help customers get set up with payment plans to prevent shut offs much earlier
Develop New Funded Programs	• Offer more A/C assistance programs (targeting smaller apartment landlords) or programs to give away free fans • Offer programs that offer mobile cooling tools to farmworkers to keep their water cold in the fields • Create a program to help homeowners keep up with brush clearance, especially larger properties, that includes an enforcement mechanism and adequate water onsite if they choose not to evacuate during fires • Increase targeted information, outreach, and brush clearing programs and go-bags to most at risk areas • Create a program to allow CBOs to disseminate emergency portable A/C units in hotter areas • Reallocate some LIHEAP funding for home electrification • Create new renter focused programs/expand relevant existing programs to be more inclusive of renters
Reduce bills, energy costs, and outages	• Increase subsidies for larger households having higher electric bills • More bill assistance promotion and ramped up enrollment efforts • Proactively notify and help customers get set up with payment plans to prevent shut offs much earlier
Develop New Funded Programs	• Offer more A/C assistance programs (targeting smaller apartment landlords) or programs to give away free fans • Offer programs that offer mobile cooling tools to farmworkers to keep their water cold in the fields • Create a program to help homeowners keep up with brush clearance, especially larger properties, that includes an enforcement mechanism and adequate water onsite if they choose not to evacuate during fires • Increase targeted information, outreach, and brush clearing programs and go-bags to most at risk areas • Create a program to allow CBOs to disseminate emergency portable A/C units in hotter areas • Reallocate some LIHEAP funding for home electrification • Create new renter focused programs/expand relevant existing programs to be more inclusive of renters
Restructure/ expand existing programs	• Promote and target outreach about PG&E job opportunities to low-income Black communities and communities of color, especially those who have suffered displacement or are part of the re-entry population • Increase EAP/LIHEAP/energy efficiency programs to upgrade older homes owned by low-income families • Pair and create more programs for solar with programs that will allow people to add and afford A/C

Improvement Category	Participant & Insight-driven Recommendations
Expand community investments and infrastructure	• Reduce planned outages through strategic transmission upgrades and install community solar+storage in DVCs • Underground more transmission in mountainous areas • Build more microgrids and back up storage at key community hubs like cooling centers, clinics/ hospitals, food banks, and other natural gathering places • Fund more cooling center sites at schools and government buildings, and map how to do so equitably in high density areas, and rely less on CBOs to run them • Expand coastal cooling centers to be multi-purpose evacuation sites during floods, fires, and heat • Fund mini-cooling centers in rural schools or stores • Fund transportation shuttles or rideshare vouchers for rural residents to get to cooling centers • Promote cooling centers more effectively, particularly to low-income communities
Fund and Establish Partnerships with External Mitigation Efforts and Programs	• Partner and co-fund each county to create a climate plan • Lobby the state Legislature to require counties to have climate plans in place • Lobby state legislature to legally require landlords to have to offer A/C, especially in hotter areas • Coordinate efforts with local governments and food banks to ensure that food banks are secure during high fire risk, such as receiving extra food preemptively (rather than after the hazard), provide generators and batteries, and vehicles to deliver food • Fund and co-lead formal hazard management training for CBOs and government agencies • Collaborate with relevant agencies to provide workshops on financial resources for farmers whose crops get damaged from climate hazards • Collaborate with relevant agencies to co-fund community grants for water trucks in areas with extreme heat • Co-fund shelters or hotel vouchers upfront for residents evacuating from wildfires in high risk counties • Play a leadership role in coordinating local government and CBO coalitions to give out emergency resources during climate hazards • Ensure more money can be passed through municipalities and directed to already engaged CBOs instead of creating new coalitions (using RTAG and COVID response coalitions as model networks) • Co-invest to expand telecommunications infrastructure so coastal residents can receive phone alerts • Co-fund and participate in efforts like Listos, a state program providing emergency preparedness information via in-language CBO partnerships • Co-fund providing disaster kits/disaster backpacks with the state

Improvement Category	Participant & Insight-driven Recommendations
Expanded, funded multilingual marketing/ messaging, education, and outreach	• Increase community partnerships with CBOs and churches not already part of PG&E's grantee network • Focus on reaching communities of color and low-income customers with information and institute program enrollment at community sites; rely less on expecting customers to come to events or workshops • Create farmworker specific outreach efforts that go onsite to farms to discuss emergency preparedness • Hire Mixteco, Zapotec, and Triqui speaking staffers or contractors for ongoing outreach efforts • Use WhatsApp voice messages, video, radio ads, and graphics to reach Mixteco, Zapotec, and Triqui speakers • Have stronger promotion for outage and emergency alerts, including promotions to get folks opted into those alerts before a hazard via English and Spanish radio/TV ads, 211, and Facebook (for Spanish speaking seniors) • Create a multilingual app to issue alerts and information • Make it easier for customers to receive immediate hazard-related information, such as a dial-in number (or 211 partnership) for less tech savvy individuals • Notify customers about outages further in advance, so they can prepare better with supplies • Institute alarms or emergency horns in wildfire prone areas with instructions to tune into AM radio stations like at the Diablo Canyon plant • Work with phone companies to make text alerts with preventative tips and emergency information automatic and more widespread in multiple languages • Replicate best practices, like San Luis Obispo County's Office of Emergency Services who plan to notify people about emergency information via reverse 911 calls • Depolicitize outreach materials language used in more conservative communities to not use "climate change". Personalize the climate hazards to each community
Recalibrate community relations	• Reduce PG&E's repetitious climate plan processes to focus on implementation to reduce engagement fatigue • Plan robust community engagement efforts upfront when planning/implementing future investments • Adjust the approach to partnerships with CBOs to a stance of humility, partnership, bringing funding, and acknowledgement that feels less extractive and demanding, building on the RTAG process • Layer learnings from each community engagement effort into future projects so networks/knowledge don't need to be built from scratch each time • Ensure PG&E staff and contractors design responsive engagement efforts with realistic expectations around capacity while strategically utilizing CBOs, building on the lessons learned from the RTAG process

Appendix G: Engagement Plan & Forms

Participant Expectations Form

Project Overview

In response to California Public Utilities Commission (CPUC) climate change planning mandates for each investor-owned utility, PG&E is conducting a climate vulnerability assessment (CVA). The purpose of the CVA is to identify vulnerabilities within Pacific Gas and Electric (PG&E) infrastructure and learn from communities within PG&E's service area on how climate impacts affect them, and what policies and programs PG&E should consider to improve the resilience of impacted communities. The purpose of the Resiliency Together Advisory Groups (RTAG) is to learn from community-based organizations (CBOs) and their communities and gather their lived experience and input on PG&E's climate resilience needs and strategies. InterEthnica and Farallon Strategies, in consultation with PG&E, (Project Team) are working to develop and implement the Community Engagement Plan, with the input of RTAG members. RTAG is an invite-only working group of 10 representatives from CBOs that work with climate vulnerable communities in PG&E's service area.

Purpose & Goals

The Project Team will convene an RTAG in each region to implement PG&E's Community Engagement Plan by providing input in a series of meetings and conducting on-the-ground engagement activities with climate vulnerable communities. The goals of RTAG include:

1. Learn from communities served by PG&E about how customers experience the impacts of energy disruptions that result from climate hazards and how PG&E can improve customer resilience through existing or new programs.
2. Review and distill community insights and recommendations that will be used to inform PG&E's Climate Vulnerability Assessment.
3. Strengthen relationships and build trust with the communities served by PG&E.

Representation

The RTAG is composed of active CBOs or community leaders in PG&E's service area by region (see appendix list). Fiscally sponsored organizations are eligible. Organizations should have community relationships with those vulnerable to climate impacts and who are part of under-represented demographic groups, as well as deep experience in community outreach and racial and/or economic equity efforts.

Responsibilities and Timeline

RTAG members will conduct outreach between September 19 to November 18, 2022. RTAG members' required responsibilities include:

- Provide a work plan using the provided template
- Coordinate engagement activities with the Project Team and other outreach partners to avoid duplication of effort

- Participate in an orientation meeting
- Complete the provided reporting template at the end of the Outreach Period
- Attend 5 RTAG meetings of up to 2.5 hours during the project period.

Region 2: San Joaquin Valley dates are listed before Region 3: North Valley, Sacramento & Sierra dates:

1. Meeting #1 September 19th/20th
2. Meeting #2 October 4th/5th
3. Meeting #3 November 1st/2nd
4. Meeting #4 November 15th/16th
5. Meeting #5 November 29th/30th

RTAG members' outreach strategies listed in their work plan that can be considered can include a mix of the following (with a goal of engaging 200 people per RTAG member):

- Conduct surveys
- Conduct outreach via social media
- Facilitate small group listening sessions
- Facilitate community meetings
- Table at community events

Compensation

RTAG member organizations will be compensated $10,000 for designing, leading, and implementing engagement during the Outreach Period. There will be additional funding for secondary costs, including meeting costs (i.e., space reservation, food, and beverages, etc.) at $250 for each hosted community event and up to $2,000 for community survey/focus group participation prepaid gift card stipends. Outreach material printing/delivery and live interpreter costs will be paid for by the Project Team separately. One payment of $5,000 will be made at the start of the Outreach Period upon attending the first RTAG meeting and submitting an outreach plan and the second payment of $5,000 will be made upon completion of the outreach.

RTAG members

Separately, individual RTAG members attending on behalf of their organization will be compensated $500 per RTAG meeting (total of 5) for their participation. This compensation is intended to cover review time, meeting time and follow-up tasks. Note: anyone serving in a government official capacity (appointed, elected, etc.) may not be compensated per PG&E policy.

Process

To finalize your organization's participation in the RTAG, please fill out and submit the Outreach Plan Form and include your completed W-9 and organizational logo to allison@interethnica.com by September 2, 2022.

Outreach Plan Form

Please attach your completed W-9 and organizational logo separately from this form.

Lead Staffer's Name and Organization____

If fiscally sponsored, please list fiscal sponsor here_______________________________

Who should PG&E administer meeting stipends to ($500/meeting, 5 meetings)? Please submit a W-9 for the person/organization that will receive the RTAG meeting stipend.

- Individual (list name, cannot be a government employee) ____________________
- Organization
- Fiscal Sponsor

Who should PG&E administer outreach stipends to ($10,000)? Please submit a W-9 for the person/organization that will receive the RTAG outreach stipend.

- Individual (list name) ____
- Organization
- Fiscal Sponsor

Mailing address (preferred address for receiving outreach materials)

____

Lead Staffer's Email____

Lead Staffer's Phone Number____

Please briefly indicate in 1-2 sentences the communities you serve or represent, including which cities/counties/neighborhoods you serve. ____
____
____
____

Work Plan

In the table below, describe your outreach approach, which can include how existing outreach programs/ membership meetings can be leveraged. Indicate the expected reach and which community you would reach from each activity.

Outreach Activity	Date of Outreach Activity	Communities Reached	Expected Reach From Activity (#)	Estimated Outreach Activity Costs

Outreach Materials Request

Please specify the quantities of outreach materials you would like to receive, and when you would need outreach materials by. Outreach materials that will be made available for this effort are described below:

1. **Outreach Boards** - Boards to display at tabling events/workshops where participants place stickies next to climate impacts they experience and resilience strategies they support.
2. **Project Overview Two Pager** - Two-pager (double sided) that provides an overview of the project.
3. **Survey** - Short survey to learn how community members are experiencing impacts of climate hazards and their ideas for resilience strategies. Survey is also available online.
4. **Wildfire Flyer** - Informational flyer about ongoing efforts PG&E is undertaking to address wildfires.

Please add any missing languages your organization needs in the "{add language}" field below.

Outreach Materials	# Requested	Date Needed By
Outreach Boards - English		
Outreach Boards - Spanish		
Outreach Boards - add language ____________________		
Outreach Boards - add language ____________________		
Two Pager - English		
Two Pager - Spanish		
Two Pager - add language ________________________		
Two Pager - add language ________________________		
Two Pager - add language ________________________		
Survey Hard Copy - English		
Survey Hard Copy - Spanish		
Survey Hard Copy - add language ___________________		
Survey Hard Copy - add language ___________________		
Survey Hard Copy - add language ___________________		
PG&E Wildfire Flyer - English		

Appendix H: Glossary of Terms

Adaptive Capacity: The California Public Utilities Commission (CPUC) defines adaptive capacity as "the broad range of responses and adjustments to daily and extreme climate change-related events available to communities. This includes the ability and resources communities have to moderate potential damages, take advantage of opportunities, and cope with consequences."

Americans with Disabilities Act (ADA): The Americans with Disabilities Act (ADA) is a federal civil rights law that prohibits discrimination against people with disabilities in everyday activities. The ADA guarantees that people with disabilities have the same opportunities as everyone else to enjoy employment opportunities, purchase goods and services, and participate in state and local government programs.

Baseline Resilience Indicators for Communities Index (BRIC Index): "The BRIC index considers six broad categories of community disaster resilience: social, economic, community capital, institutional, infrastructural, and environmental at the county level. Used as an initial baseline for monitoring existing attributes of resilience to natural hazards, BRIC can be used to compare places to one another, to determine the specific drivers of resilience for counties, and to monitor improvements in resilience over time."

California Alternate Rates for Energy Program (CARE): CARE is a PG&E program that provides a monthly discount of 20% or more on gas and electricity. Participants qualify through income guidelines or if enrolled in certain public assistance programs.

California Public Utilities Commission (CPUC): The CPUC regulates privately owned electric, natural gas, telecommunications, water, railroad, rail transit, and passenger transportation companies in California to ensure customers have safe, reliable utility service at reasonable rates, to protect against fraud, and to promote the health of California's economy.

California Workforce Development Board (CWDB): The California Workforce Development Board is the Governor's agent for the development, oversight, and continuous improvement of California's workforce development system. The CWDB assists the Governor in setting and guiding workforce development policy, developing innovative initiatives through statewide programs, and expanding the High Road vision through its field branch.

Climate Vulnerability Assessment (CVA): PG&E defines a Climate Vulnerability Assessment as a tool to examine exposure to the forces of climate change, including: flooding during severe storms, sea level rise, land subsidence, heat waves, changes in precipitation patterns, and wildfire damage. The purpose of this CVA is to assess and identify how PG&E's assets and operations are vulnerable to these climate driven hazards, as well as how the communities it serves are impacted by the cascading impacts from these hazards.

Climate Vulnerable Communities: Communities that are most vulnerable to climate hazards, beyond the Disadvantaged Vulnerable Communities data classification, as defined by the Project Team. These include low-income communities, unsheltered communities, communities of color, non-English speaking communities, Indigenous communities, youth, seniors, essential workers, outdoor workers, undocumented communities, people with disabilities, small business, and rural communities.

Community-Based Organizations (CBOs): Community-based organizations are defined in this report as organizations that are locally based, or have local chapters, and serve a function to better life for community members.

Communities of Color: Communities of color (Black, Latinx, Asian, Indigenous, and others) face systemic barriers and disinvestment, including often being frontline communities who are most impacted by climate change. By engaging voices across diverse communities of color, better representation of unique experiences of environmental racism and community grounded solutions can be identified. There may be a level of distrust of government agencies within these communities, so engaging them will be most successful with a trusted source, such as a CBO.

Community Engagement Plan (CEP): OIR 18-04-019 orders IOUs as part of the CVA to develop a Community Engagement Plan, or CEP. The CEP documents how

IOUs engaged with DVCs to inform the development of the CVA. CEPs must be filed every four years, on year before the filing date of the CVA.

Community Resilience Centers: Community Resilience Centers are community-serving centers that are augmented to support community-building activities as well as coordinate resource distribution and services before, during, or after a natural hazard event.

Continuous Positive Air Pressure (CPAP) machine: A CPAP machine is a treatment option for sleep apnea. CPAP machines provide air at a pressure just high enough to prevent collapse of the airway while sleeping. The pressurized air is provided through a mask that seals with the user's mouth or nose. This allows the user to breathe without much effort and sleep without waking up.

Cooling Center: A location that community members can freely access to cool down during hot summer days or extreme heat events. Cooling centers can include government-run senior centers, community centers, parks and recreation sites, or public buildings, such as libraries.

Disadvantaged Vulnerable Communities (DVC): Defined by the CPUC, a disadvantaged vulnerable community includes:

- Communities in the 25 percent highest scoring census tracts according to the most recent version of CalEnviroScreen as well as California tribal lands
- Census tracts with median household incomes less than 60 percent of state median income
- Census tracts that score in the highest 5 percent of CalEnviroScreen Pollution Burden but do not receive an overall CalEnviroScreen score due to unreliable public health and socioeconomic data
- All Tribal Land

Distributed Energy Resources (DERs): As defined by California code, DERs include distributed generation, energy efficiency, energy storage, electric vehicles, and demand response technologies connected at the distribution level.

Domestic Workers: Domestic workers are those workers who perform work in or for a private household or households. Their work may include tasks such as cleaning the house, cooking, washing and ironing clothes, taking care of children, or elderly or sick members of a family, gardening, driving for the family, or taking care of household pets.

Electric Vehicle (EV): For this report, electric vehicles include both battery electric vehicles and plug-in hybrid electric vehicles.

Essential Workers: Essential Workers or frontline workers are employees who physically show up to their jobs, are critical to keeping critical services running, and have greater exposure to climate hazards, and therefore are more likely to be impacted. Some examples include people that work in grocery stores, operate public transit, work on farms, or work in healthcare. Much of the essential work in the communities is performed by low-wage workers, and most often by women, immigrants, and people of color.

Equity Prioritization Framework: The Equity Prioritization Framework is a set of criteria that will help PG&E operationalize or implement recommended actions to benefit the diverse needs of climate vulnerable communities across its service area.

Family Electric Rate Assistance Program (FERA): FERA is a PG&E program that provides a monthly discount of 18% on electricity only. Participants qualify through income guidelines and must be a household with three or more people.

High-rise Apartment or Condo Building: High-rise apartments or condo buildings are represented by four stories or more.

Indigenous Communities: Indigenous communities have historically been left out of the environmental movement, despite being a population that has worked to advance land preservation efforts. As the original residents, stewards, and community of this area for thousands of years, Indigenous communities have a lot to teach us regarding ecological knowledge that should inform adaptation to our changing climate.

Investor-Owned Utility (IOU): Privately-owned electric utility that has publicly traded stock. The IOU is rate-regulated and authorized to achieve an allowed rate of return. PG&E is an IOU regulated by the CPUC.

Limited English Proficient Communities: Residents who do not speak, read, or write English may face barriers in getting important information or communicating their needs, if in-language communication is not provided.

Low-income Communities: Low-income communities are often the most vulnerable to environmental hazards and have the least access to resources. Feedback from the community survey and the RTAGs indicated the critical role housing affordability plays in this vulnerability as well as the impacts of changing utility rates and existing environmental hazards such as air pollution and extreme heat.

Low Income Home Energy Assistance Program (LIHEAP): LIHEAP is a federally funded assistance program overseen by the California Department of Community Services and Development (CSD) and administered by 31 Action Agencies throughout California. LIHEAP offers assistance via home weatherization, help with residential utility bill payment, and emergency assistance with residential energy-related crisis (utility shut-off notices and energy-related life-threatening emergency). LIHEAP may also prioritize applicants based on the greatest need and income, as well as households with vulnerable populations, including the elderly, disabled and households with young children.

Low-rise Apartments or Condo Buildings: Low-rise apartments or condo buildings are represented by three stories or fewer.

Medical Baseline Program: The Medical Baseline Program is a PG&E assistance program for residential customers who depend on power for certain medical needs.

Order Instituting Rulemaking (OIR): The Order Instituting Rulemaking, R.18-04-019, is a guiding document of the CPUC. The purpose of the OIR is to provide guidance to investor-owned electric and gas utilities on how to incorporate climate adaptation into their planning and operations. The OIR will broadly consider how best to integrate climate change adaptation into the larger investor-owned electric and gas utilities' planning and operations to ensure safety and reliability of utility service.

Outdoor Workers: Outdoor workers encompass workers in the agricultural, forestry, and construction fields as well as workers in other outdoor occupations such as street vendors. Outdoor workers are directly exposed to wildfire smoke and extreme heat, and are therefore more likely to experience negative health impacts.

Outreach Partner: An advisory group member who was expected to reach or engage at least 200 community members as part of their outreach efforts.

People with Disabilities: There are many forms of disabilities that can make everyday activities more difficult or limit interaction with the world around them. The term disability covers a wide range of conditions that may limit a person's ability to do certain activities. People with disabilities may be more vulnerable to climate change than the general population because emergency warnings and other important messages may not be designed with accessibility in mind. Individuals with disabilities may require medical care, which can be disrupted during a hazard event.

Public Safety Power Shutoff (PSPS): A Public Safety Power Shutoff occurs when PG&E turns off power during severe weather to help prevent wildfires. High winds can bring tree branches and debris into contact with energized lines, damage equipment and ignite a wildfire, so a PSPS is a precautionary safety measure.

Resilience: Resilience in this report is defined as the ability to recover from an event, such as a natural disaster or other climate hazard, and return to previous levels of well-being or higher.

Resilient Together Advisory Group (RTAG): Resilient Together Advisory Groups consist of community leaders and CBO representatives who advised the Project Team on the methodology for the Resilient Together initiative, and supported the implementation of the Community Engagement Plan by conducting on-the-ground outreach in the communities they serve. Some advisory group members only served an advisory role due to capacity constraints.

Risk Assessment Mitigation Phase (RAMP): RAMP is the regulatory review and public-vetting process required for each of California's four major investor-owned utilities by the CPUC Safety Policy Division. Risk reports are submitted to the Commission on a four-year-cycle basis, which inform and enable applications for approval of system-wide utility operating and capital budgets.

Rural Communities: Rural communities often have a higher rate of agriculture and recreation-based jobs that make their economies vulnerable to climate impacts. Physical isolation (impacting access to goods/services) limited economic diversity, higher poverty rates, and an aging population makes rural communities more vulnerable to climate change.

Seniors: Seniors can be some of the most vulnerable people in the community due to limited physical mobility, social isolation, low-income status, health, and limited ability to use digital forms of communication. Senior populations who do not speak English or speak English as a second language may be even more isolated.

Small Business: Climate hazards can cause costly repairs, displacement, job loss, and loss of productivity, all of which can negatively impact small business owners.

Subsidence: Land subsidence is a gradual settling or sudden sinking of the Earth's surface. The ground sinks because of underground material movement. Subsidence is often a result of soil compaction, earthquakes, erosion, or the removal of water or other resources by humans.

Unsheltered Communities: Unsheltered communities are extremely vulnerable to climate change impacts such as extreme temperatures, unhealthy air, and more. It is important to consider their experiences as the number of people without or at risk of losing their housing is rising.

Wildfire Construction Hardening: Addressing potential vulnerabilities to wildfires in order to make the structure more fire resistant.

Youth: Children are more susceptible to the effects of climate hazards than adults, with immediate and lifelong impacts on their physical and mental health.

Acronyms:
ADA: Americans with Disabilities Act
BRIC: Baseline Resilience Indicators for Communities
CARE: California Alternate Rates for Energy Program
CBOs: Community-Based Organizations
CEP: Community Engagement Plan
CPAP: Continuous Positive Air Pressure (machine)
CPUC: California Public Utilities Commission
CVA: Climate Vulnerability Assessment
DERs: Distributed Energy Resources
DVC: Disadvantaged Vulnerable Community
EV: electric vehicle
IOU: Investor-Owned Utility
FERA: Family Electric Rate Assistance Program
LIHEAP: Low Income Home Energy Assistance Program
OIR: Order Instituting Rulemaking
PG&E: Pacific Gas and Electric
PSPS: Public Safety Power Shutoffs
RAMP: Risk Assessment and Mitigation Phase
RTAG: Resilient Together Advisory Group

Appendix I: Survey Questions

1. What is your zip-code?
    - a Fill-in answer

2. Do you currently get financial assistance on your energy bill? Learn more about low-income energy assistance at (800) 933-9555.
    - a Yes
    - b No
    - c Unsure

3. What impacts of power outages have you experienced or are most concerned about?
    - a Medical Equipment Issues
    - b No Air Conditioning
    - c Loss of Work & Childcare
    - d Other (please specify)

4. What impacts of wildfire smoke have you experienced or are most concerned about?
    - a Health Concerns
    - b Poor Indoor Air Quality
    - c Harsh Outdoor Working Conditions
    - d Other (please specify)

5. What impacts of extreme heat have you experienced or are most concerned about?
    - a Health Concerns
    - b Poor Indoor Air Quality
    - c Harsh Outdoor Working Conditions
    - d Other (please specify)

6. Has your mental health been impacted by extreme climate events (heat, increased rain and flooding, wildfires, drought, landslides)?
    - a Yes
    - b No
    - c Unsure

7. Thinking about hotter days, where do you go to cool off?
    - a Home
    - b School
    - c Park
    - d Work
    - e Community Center
    - f Other (please specify)

8. How comfortable is your home on hotter days?
    - a Not at all comfortable
    - b Slightly uncomfortable
    - c Comfortable
    - d Very comfortable

9. Do you have access to an air-conditioned space now?

- **a** Yes
- **b** Sometimes
- **c** No, but I need air conditioning
- **d** No, and I don't need air conditioning

10. What kind of solutions can PG&E consider to help communities deal with extreme weather? Choose your top two.

- **a** Add Generators/Places to charge phones in public spaces
- **b** Better emergency alert systems
- **c** Access to air-conditioned Spaces/Cooling center
- **d** More personal safety equipment (masks, batteries, etc.)
- **e** Other (please specify)

11. What kind of solutions can PG&E consider to help you deal with extreme weather at your home? Choose top two.

- **a** Payment for power outages
- **b** Home air filtration systems
- **c** Information to make my home safer
- **d** Other (please specify)

12. Please tell us how you heard about this survey[1]

- **a** Camptonville Community Partnership
- **b** Habitat for Humanity Yuba/Sutter Inc.
- **c** Sacramento Area Congregations Together
- **d** Sacramento Environmental Justice Coalition
- **e** Ukrainian Assistance Center/Slavic Community Center
- **f** Website
- **g** Social Media
- **h** Other (please specify)

For Regions 2-5, an optional page was added with demographic questions.[2]

13. What is your racial background?

- **a** Black or African American
- **b** Native American, American Indian, or Alaska Native
- **c** Asian
- **d** Latinx or Hispanic
- **e** White
- **f** Native Hawaiian and Pacific Islander
- **g** Two or more races
- **h** Other (please specify)

1 The options for this question are tailored for each region. The options here are for region 2-5. For Region 1, the options include: Website, Social Media, Rise South City, CARAS, Multicultural Center of Marin, American Indian District, Chinese Newcomers Service Center, Sonoma Valley Collaborative, Climate Resilience Network, Support Life Foundation, Other (please specify).

2 The paper and online surveys for Region 1 and the online survey for Regions 2–5 did not include demographic questions.

14. How would you describe your income level?
- **a** Extremely low income
- **b** Low income
- **c** Moderate income
- **d** High income

15. Do you own your home?
- **a** Yes
- **b** No

16. What type of home do you live in?
- **a** Single-family home
- **b** Duplex/Triplex
- **c** Low-rise apartment or condo building (3 stories or fewer)
- **d** High-rise apartment or condo building (4 stories or more)
- **e** Mobile home
- **f** Unhoused/homeless
- **g** Other (please specify)

17. How many people live in your household?
- **a** Fill-in answer

18. Are there any other children under 18 in your household?
- **a** Yes
- **b** No

19. Does anyone in your household depend on electric medical equipment?
- **a** Yes
- **b** No

20. How often do you receive information from PG&E on existing initiatives or programs?
- **a** Too often
- **b** Not enough

21. How often would you like to receive information from PG&E on existing initiatives or programs?
- **a** Weekly
- **b** Monthly
- **c** Quarterly
- **d** Once a year
- **e** I'm not interested in receiving information

22. Where do you currently receive information/news from PG&E?
- **a** Mailers
- **b** Community events
- **c** Website
- **d** Social media
- **e** Emails
- **f** Other (please specify)

Appendix J: Outreach Board Questions

Outreach board participants place a dot next to the experience that concerns you the most or add your other thoughts with a sticky note.

Which of these climate related impacts have you experienced?*

1. **Power Outages**

 a Loss of Work
 b No Air Conditioning
 c Childcare
 d Poor Indoor Air Quality
 e Unsafe Outdoor Working Conditions
 f Evacuations
 g Emergency Response & Planning
 h Other

2. **Extreme Heat**

 a Loss of Work
 b No Air Conditioning
 c Childcare
 d Poor Indoor Air Quality
 e Unsafe Outdoor Working Conditions
 f Evacuations
 g Emergency Response & Planning
 h Other

3. **Wildfire Smoke**

 a Loss of Work
 b No Air Conditioning
 c Childcare
 d Poor Indoor Air Quality
 e Unsafe Outdoor Working Conditions
 f Evacuations
 g Emergency Response & Planning
 h Other

As your region experiences more extreme hot days and nights, how will you manage the heat?

4. **Where do you go to cool off?**

 a Home
 b School
 c Park
 d Community Center
 e Other

5. How comfortable is your home on hotter days and nights? (Scale)

Very Uncomfortable / Very Comfortable
I feel Unsafe ----------------------- / I Feel Safe

6. Do you have access to an air-conditioned space right now?

- **a** Yes
- **b** Sometimes
- **c** No

7. As it gets hotter, will you need access to an air-conditioned space?

- **a** Yes
- **b** No

What solutions should PG&E consider to help build community safety in extreme weather events?

8. What can be done in the community?

- **a** Access to Air-Conditioned Spaces/Cooling Centers
- **b** Add Generators/Places to Charge Phones in Public Spaces
- **c** Better Emergency Alert System
- **d** More Personal Safety Equipment (Respiration Masks, Batteries, etc.)
- **e** Other

9. What can help you at home?

- **a** Payment for Power Outages
- **b** Home Air Filtration
- **c** Information to Help Make My Home Safer
- **d** Other

PG&E Climate Adaptation and Vulnerability Assessment Appendix D

Climate Vulnerability Assessment Community Engagement Plan

Order Instituting Rulemaking (OIR) to Consider Strategies and Guidance for Climate Change Adaptation (R. 18-04-019)

Submitted to the California Public Utilities Commission
Submitted by Pacific Gas and Electric Company (PG&E)
Lead Author: Jimmy O'Hare, Expert, Climate Resilience Team
May 15, 2023

Contents

Executive Summary

Pacific Gas and Electric Company (PG&E, or "the Company") is conducting a Climate Vulnerability Assessment (CVA) to explore how the Company is vulnerable to climate-driven hazards, like wildfire, extreme heat events, torrential rainstorms, drought, and others. This is a critical first step in creating climate adaptation plans that will help the Company continue to provide Central and Northern California with safe, clean, reliable, affordable energy in a climate-altered future.

The CVA Community Engagement Plan (CEP, or "the Plan") outlines how we plan to collaborate with climate-vulnerable community stakeholders to develop a deeper understanding of the impacts of energy failures and climate hazards, as well as to center community resilience in our climate adaptation strategy.

This Plan seeks to achieve the following goals:

- **Share** information with the communities we serve about how climate change may impact the resilience of our energy system.
- **Learn** how our most vulnerable customers are experiencing the impacts of increasingly frequent and severe climate-driven hazards.
- **Embed** community insights and recommendations within the CVA and our ongoing climate adaptation work.
- **Build trust** with communities by sharing and collaborating with the communities we serve.

The Plan provides a roadmap for meaningful community engagement. In each of our five service regions, we will (i) conduct research interviews with community leaders, (ii) convene regional advisory groups, composed of local community-based organizations (CBOs) that serve the target communities, (iii) distribute and collect surveys through CBO partnerships, and (iv) survey our CBO partners to understand how we can better support them in future collaborations.

Further, the Plan describes our ongoing partnership with tribal governments and climate resilience-specific engagement, distinct from other non-tribal community engagement. We are committed to tribal partnership and collaboration, beyond the scope of this plan.

Execution of the Plan should result in over forty in-depth research interviews, over 5,000 survey responses, and direct engagement with over 70 CBOs and dozens of tribal leaders. **This data is critical in identifying (i) impacts of climate hazards and energy outages, (ii) strategies to build local resilience, and (iii) effective and culturally appropriate engagement methods.**

***

We will incorporate the results of the Plan into two specific sections of the CVA: the Community Resilience Chapter and specific Climate Adaptation Recommendations. Further, we seek to continue to foster community partnerships built in this process through participation in other PG&E programs, direct engagement with ESJ stakeholders, as well as through grant opportunities. We recognize that adapting to a rapidly changing climate will necessitate new partnerships and welcome future collaborations.

I. Introduction

Climate vulnerability assessments are increasingly being undertaken by governments, businesses, and other organizations. These entities are concerned about the impact that climate-driven natural hazards – like wildfire, extreme heat events, torrential rainstorms and drought - will have on their work and the people they serve.

In 2020, the California Public Utilities Commission (CPUC or Commission) became one of the first utility regulators in the nation to require investor-owned energy utilities (Utilities) to assess their vulnerability to climate-driven natural hazards. The assessment is an important first step toward identifying actions the Utilities will need to take to continue to serve customers safely, affordably, and reliably into a future altered by climate change.[1]

As a core element of our Climate Vulnerability Assessment (CVA), the Community Engagement Plan (CEP, or "the Plan") outlines how we intend to learn about the lived experiences of customers regarding climate hazards and energy service, and how those community perspectives will inform our CVA and decision-making about climate adaptation going forward.

The Community Engagement Plan is organized as follows:

Goals defines our goals for CVA-related community engagement, as well as for how the engagement process is implemented. These goals and the project's commitment to distributional and procedural equity inform the CEP methodology.

Methodology provides a detailed roadmap of community engagement and implementation across the Company's five regional service areas. Engagement activities will be conducted in CPUC-identified *disadvantaged, vulnerable communities (DVCs)*, as well as with critical climate-vulnerable populations, as identified by local community leaders.

The CEP geographically aligns the CVA outreach approach with our regional service model and organizes outreach by the model's five distinct regions. The Methodology section also describes our ongoing partnership with tribal leaders and governments and CVA-specific engagement which is distinct from non-tribal community engagement. The CEP highlights our institutional commitment to tribal partnership and collaboration, beyond the scope of this plan.

Next Steps and Conclusion illustrates our plan for integrating both non-tribal community and tribal engagement results into the CVA, and specifically into the CVA adaptation recommendations. The CVA will also highlight lessons learned through the CEP planning process and how we intend to leverage this process to inform the Company's community resilience strategy beyond the CVA.

We look forward to sharing the results of this community engagement plan with the Commission and communities across its service area following the submission of the CVA.

[1] "Rulemaking 18-04-019: Decision on Energy Utility Climate Change Vulnerability Assessments and Climate Adaptation In Disadvantaged Communities (Phase 1, Topics 4 And 5)" (California Public Utilities Commission, 2020).

II. Goals

Our CEP goes beyond the Commission's compliance requirements and inform how the Company equitably promotes community resilience through its climate resilience strategy. The Plan is designed to center procedural and distributional equity throughout the community engagement process.

Outcome Goals

Our outcome goals intend to ensure the results of the Plan fulfill the Commission's requirements and result in practical, actionable learnings for inclusion in our CVA:

1. **Learn how our most vulnerable communities** experience the impacts of climate hazards and energy outages, and what strategies they need to increase their adaptive capacity at a household and community scale. Our CVA would be incomplete without being informed by both technical analyses, as well as the lived experiences and perspective of the communities we serve. By bringing those two narratives together, we can begin to develop adaptation plans that continue to serve customer needs as well as the operational challenges of climate change.
2. **Share information with the communities we serve** about how climate change is expected to impact the resilience of the energy system and further the conversation about how our customers would like to see us address those impacts.
3. **Develop actionable recommendations** to center community resilience in the CVA and to advance community engagement practices across the company.

Process Goals

Our process goals intend to (i) align the Plan with the Commission's DACAG Guiding Principles and Environmental Social Justice (ESJ) Action Plan and (ii) ensure procedural equity in engagement with our customers:

1. **Incorporating space for community perspectives in the process** to the greatest extent possible, moving up the spectrum of engagement[2] from *informing and consulting* to *involving, collaborating, and sharing ownership* of the process.
2. **Respecting the value of customers' time** by coordinating engagement activities with existing PG&E community engagement initiatives to the extent possible, and planning outreach that facilitates community members participation.
3. **Deepening our existing relationships with community-based organizations (CBOs)** by learning from established partners about building climate resilience at a local level and developing new partnerships.
4. **Respecting the value of our CBO partners' expertise** through fair compensation for sharing insights and expertise, joining meetings and research interviews, conducting outreach, and providing feedback on our CEP.
5. **Building trust with the customers we serve** by setting clear expectations about how this process can benefit both the Company and customer participants.
6. **Conducting high-quality outreach while ensuring costs remain reasonable and sufficient.** We respect the Commission's direction to keep the costs of this effort separate and distinct from

[2] Rosa Gonzalez & Facilitating Power, "The Spectrum of Community Engagement to Ownership", (Movement Strategy Center, 2019), https://movementstrategy.org/resources/the-spectrum-of-community-engagement-to-ownership/ .

existing outreach efforts, while also making sure we are meeting CPUC and community expectations for authentic and meaningful engagement.

CPUC Alignment

Sharing the Commission's commitment to environmental justice and equitable climate action, our Plan aligns with both the DACAG Guiding Principles and ESJ Action Plan. There are many connections between these two policy statements and our climate resilience work (Table 1).

Table 1. Disadvantaged Communities Advisory Group Guiding Principles[3]

1.	Increase access to clean energy technologies for disadvantaged communities.
2.	Maintain or enhance the affordability of energy service in disadvantaged communities by considering potential rate impacts of a proposed program.
3.	Increase the benefits of clean energy programs in disadvantaged communities (e.g., by supporting growth in local employment and small business development, as well as other non-energy benefits including reducing pollutants with health risks).

We view the CVA process as most directly relevant to DACAG Guiding Principle 2 in that preparing the energy system to provide safe, clean, affordable, reliable power in the face of increasingly severe and frequent climate hazards will require significant investment. The costs of adapting to climate change may put additional upward pressure on California's energy rates, which are already high compared to the national average and to which low-income customers devote a greater percentage of their income than others.[4] We anticipate that the execution of the Plan will surface many perspectives regarding how various options may or may not contribute to access to clean energy technologies (Guiding Principle 1) or increase the benefits of clean energy programs in disadvantaged communities (Guiding Principle 3).

Our Plan closely aligns with the Commission's nine goals to advance environmental and social justice detailed in Table 2.

Table 2. Nine Goals of the CPUC Environmental and Social Justice Action Plan[5]

1.	Consistently integrate equity and access considerations throughout CPUC proceedings and other efforts.
2.	Increase investment in clean energy resources to benefit ESJ communities, especially to improve local air quality and public health.
3.	Strive to improve access to high-quality water, communications, and transportation services for ESJ communities.
4.	Increase climate resiliency in ESJ communities.
5.	Enhance outreach and public participation opportunities for ESJ communities to meaningfully participate in the CPUC's decision-making process and benefit from CPUC programs.
6.	Enhance enforcement to ensure safety and consumer protections for ESJ communities.
7.	Promote economic and workforce development opportunities in ESJ communities.
8.	Improve training and staff development related to ESJ issues within the CPUC's jurisdictions.
9.	Monitor the CPUC's ESJ efforts to evaluate how they are achieving their objectives.

---

[3] https://www.cpuc.ca.gov/uploadedFiles/CPUCWebsite/Content/UtilitiesIndustries/Energy/EnergyPrograms/Infrastructure/DC/DACAG%20Charter%20(Updated%20March%202020).pdf

[4] *Designing Electricity Rates for an Equitable Energy Transition*. Next 10 and UC Berkeley Energy Institute at Haas. February 2021.

[5] https://www.cpuc.ca.gov/esjactionplan/

PG&E seeks to advance the spirit of Commission's ESJ Action Plan Goals 1 and 5 via a meaningful and authentic community engagement process as outlined in Sections 1 and 3. The Company's regional approach (see Section III Methodology) combined with participant feedback surveys also provides an opportunity for continuous improvement as contemplated in Goal 9.

In 2022, we developed our ESJ Action Plan, which is updated annually. Our ESJ Action Plan addresses action areas 1, 2, 4, 5, 6, 7 and 8 in the Commission's plan.

We view the CVA and the Plan as directly responsive to the Commission's ESJ Action Plan Goal 4. Integrating community perspective in the outcomes of the CVA is a critical step in informing both near- and long-term priorities for building the resilience of the energy system and building community resilience through the energy system.

We have invested in staff development related to ESJ competency specifically as part of this effort (Goal 8) and recognizes the necessity and value of educating its employees regarding racial, social, and environmental equity. The Company expanded its Corporate Sustainability Team to include an ESJ manager position and two tribal liaisons to further the company's connection with historically marginalized populations. Over 400 staff members and officers have taken an ESJ training to improve ESJ awareness and cultural competency. See Section III for additional information on our internal capacity building.

In summary, we have incorporated the Commission's ESJ Action Plan and DACAG Guiding Principles as additional guidelines and considerations in the development of the Plan. We are aligned with the Commission, and DACAG in the pursuit of equitable engagement and outcomes.

III. Methodology

The Plan's methodology exceeds industry best practices and maintains flexibility so the plan can adapt as the project team learns from community partners. In this document, "community engagement" reflects both tribal and non-tribal engagement, unless specifically delineated.

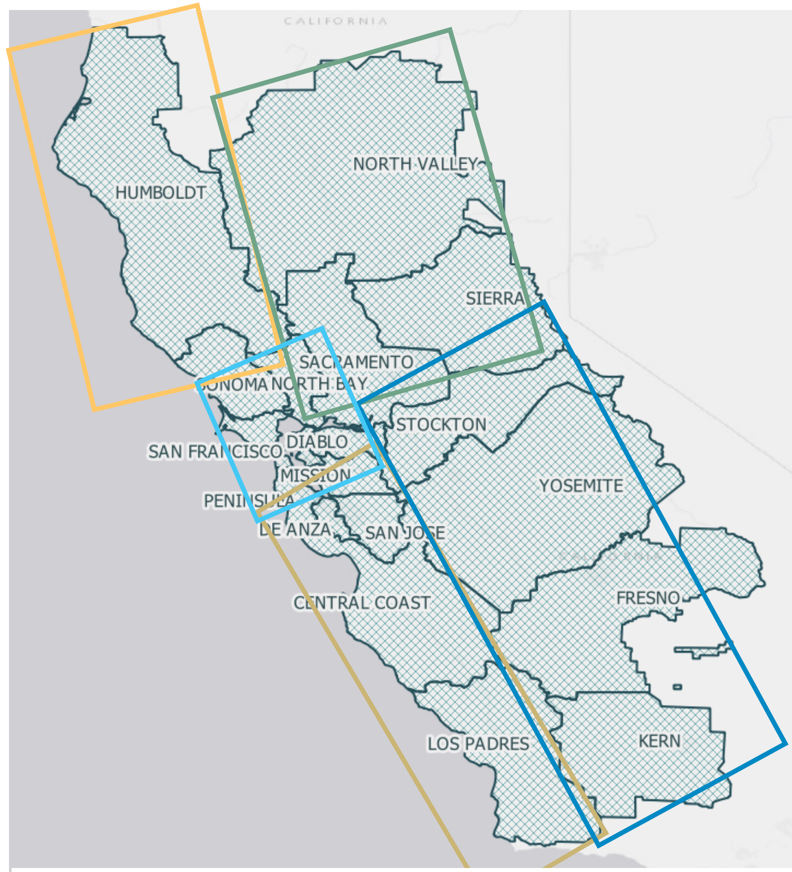


Figure 1. Map of Outreach Region Designations for the PG&E Community Engagement Plan

The Plan centers on engagement with DVC communities, as defined and required by the Commission. The Plan also provides opportunities for community leaders to further add to the definition of and identify climate-vulnerable communities.

Given our 70,000 square mile service area and diversity of customers, engagement is structured to generally align with the Company's Regional Service Model.[6] These regions also serve as the CVA technical study regions, and include:

1. Bay Area
2. Central Valley
3. North Valley, Sierras, Sacramento
4. North Coast
5. Central Coast

See Appendix B for a list of counties within each region.

Defining Disadvantaged Vulnerable Communities

While most if not all Californians are exposed to some level of climate-driven hazards, not all Californians are impacted by these hazards to the same extent or in the same way.

Historically marginalized communities with fewer resources are more vulnerable to a wide range of hazards, including climate change.[7] For this reason, the Commission has directed the Utilities to target outreach to "disadvantaged vulnerable communities" or DVCs. The Comission defines a DVC as: [8]

- Communities in the 25% highest scoring census tracts according to the most recent version of CalEnviroScreen

---

[6] The CVA process started before the finalization of PG&E's Regional Service model structure. As such, the regional designations included in the CVA CEP do not fully align with the regional service model designations.

[7] Executive Order B-30-15 Resiliency Guidebook, Vulnerable Populations.

[8] CPUC Decision 20-08-046, p. 108.

- Census tracts with median household incomes less than 60% of state median income
- Census tracts that score in the highest 5% of CalEnviroScreen Pollution Burden but do not receive an overall CalEnviroScreen score due to unreliable public health and socioeconomic data.
- All Tribal lands

We expanded outreach efforts beyond the DVC-designated census tracts to include vulnerable communities that are excluded from the Commission definition. The project relies on local leaders and their expertise to help identify vulnerable communities

See Appendix B for the complete list of DVCs and Appendix C for map of DVC areas within our Service Area.

Stakeholders may view a map of the DVC communities within our service area by visiting the project website (https://www.resilienttogether.us/. In conjunction with the submission of the CVA in May 2024, PG&E will update its Climate Resilience webpage (https://www.pge.com/en_US/about-pge/environment/what-we-are-doing/fighting-climate-change/fighting-climate-change.page) to publicly share the CVA results and map of DVC communities.

Non-Tribal Engagement

Project Team

Our "Project Team" refers to both the PG&E Climate Resilience team and our consultant partners, InterEthnica Inc. and Farallon Strategies LLC. Together, the two external firms provide deep expertise in equitable engagement, research and data analysis, community organizing, multicultural marketing and culturally appropriate outreach, and multi-lingual translation.

Engagement Methods

The Plan employs a range of engagement methods to achieve the project's Outcome Goals. Primarily, the Plan relies on Regional Advisory Group Meetings, Research Interviews, and Surveys to engage with and learn from DVC communities. Each of these activities are structured to achieve the following aims:

1. Learn from communities we served about how customers experience the impacts of energy disruptions that result from climate hazards and how we can improve customer resilience through existing or new programs.
2. Review and distill community insights and recommendations that will be used to inform our CVA, which will underpin further adaptive action.
3. Strengthen relationships and build trust with the communities we served.

Regional Advisory Group Meetings

For each region, the Project Team convenes regional advisory groups to implement the Plan by providing input in a series of meetings and conducting on-the-ground engagement activities with climate-vulnerable communities.

Compositions of the advisory groups are intended to represent the region's counties and DVC areas, both geographically and demographically. Invited organizations have community relationships with those vulnerable to climate impacts and who are part of under-represented demographic groups, as well as deep experience in community outreach and racial and/or economic equity efforts.

Participation in a regional advisory group includes the following responsibilities:

- Provide a community outreach work plan to describe the activities, target communities, expected number of participants, languages/materials needed, timing, and required costs per activity.
- Coordinate engagement activities with the Project Team and other outreach partners to avoid duplication of effort.
- Participate in an orientation meeting.
- Complete reporting at the end of the outreach period to include community feedback in a reporting template, provided by the Project Team.
- Attend 5 advisory group meetings of up to 2.5 hours during the project period.

Through interactive activities during meetings, advisory group members build organizational capacity through peer-to-peer sharing, outreach scenario role playing, and deepening understanding of climate resilience in California. Furthermore, the advisory group provides an opportunity for community leaders to take on meaningful engagement and leadership roles in the development of our CVA.

Not all participating CBOs are able to conduct community outreach, given constrained organizational capacity. In these circumstances, invited CBO leaders are able to share expertise and feedback through advisory group meeting activities.

See Appendix E for the current list of participating community-based organizations.
See Appendix G for Regional Advisory Group Schedule.

Research Interviews

Prior to convening Advisory Group meetings, the Project Team aims to conduct 1-hour interviews with community leaders and potential CBO partners. Research questions intend to explore topics related to community resilience, adaptive capacity, and how climate hazards are impacting vulnerable communities within their city, county, or region. By understanding the demographics, languages spoken, and priorities of the populations most impacted by climate hazards and energy outages, we can develop a deeper understanding of how to support resilience and promote equity in these communities.

See Appendix H for a list of research interview questions.

Surveys

CBO partners distribute and collect surveys within their communities. In total, the Project Team is targeting at least 5,000 responses from DVC areas across our service area. Surveys are available both online and distributed in print. Materials will be translated into different languages to promote participation in DVC areas. At minimum, surveys will be translated into the following languages:

- Arabic
- Chinese
- English
- Russian
- Samoan
- Spanish
- Tagalog
- Tongan
- Vietnamese

See Appendix I for a complete list of survey questions.

Other Outreach Material

In addition to community surveys, the Project Team provides a range of outreach materials to allow for flexibility of types of engagement. Outreach materials include interactive boards for in-person events, open-ended comment cards, informational fliers about the project, as well as templates for social media posts. CBO partners are encouraged to use outreach material that is best suited for soliciting feedback their communities.

Best Practices for Meaningful Engagement

To advance the Plan's Process Goals and ensure equitable access, the Project Team relied on the following best practices for community engagement:

Outreach Materials: To clearly capture community perspective in this process and respect the value of customers' time, outreach materials prompt individuals to reflect on their own lived experience with extreme heat, wildfire smoke, and energy outages. Materials used simple, straightforward language, so all community members could engage without technical expertise or specialized background knowledge.

Flexibility and Support: To deepen our existing network of CBO relationships, the Project Team designs outreach materials and engagement targets to be adaptable to CBOs' organizational capacity. The Project Team works closely with CBOs to troubleshoot any challenges or logistics with schedules and timing. Participation expectations and transparency about how we intend to use outreach results are both critical to building trust with CBO leaders.

Compensation: To respect the value of CBO partners' expertise, participating CBOs are paid for meeting attendance, conducting outreach, and additional in-person meeting and supply fees. See Appendix D for full compensation schedule.

Accessibility: To build trust with the customers we serve, accessibility of advisory group meetings and outreach materials continues to be an area of growth. Outreach materials are provided in over 10 languages to ensure non-English speaking and monolinguist community members are able to fully participate. Learning from disability community advocates, the Project Team continues to incorporate accessibility strategies like providing closed captioning and visual aids in meetings to increase accessibility for visually impaired advisory group members.

Increasing Internal Capacity on ESJ Issues

PG&E continues to increase internal capacity and understanding of environmental and social justice (ESJ) issues across the company. As part of this effort, PG&E's Climate Resilience team participated in an internal ESJ training, led by PG&E Environmental and Social Justice Senior Manager. Additionally, the Climate Resilience team community engagement manager also completed a comprehensive training with International Association of Public Participation (IAP2) on equitable public participation planning and techniques.

The Climate Resilience team is an active participant in PG&E's internal ESJ Working Group, which contributed to the development of the updated PGE& ESJ Policy. The ESJ Policy is available to read here: https://www.pge.com/includes/docs/pdfs/about/environment/pge_ej_policy.pdf

Remote Organizing: To conduct high-quality outreach while ensuring costs remain reasonable, all Advisory Group meetings and CBO participant support are conducted remotely through online platforms.

Simple Paperwork: Templates for CBO onboarding, outreach plans, and reporting forms are simple and straightforward to facilitate CBOs spending more time on community engagement and minimizing time on paperwork and administration.

Tribal Engagement

We approach its engagement with tribal governments in a fundamentally different way than non-tribal community outreach. There are 62 federally recognized tribes in PG&E service area, and 40 non-federally recognized tribes. As an organization, we are committed to ongoing partnership with tribal governments, communities, and organizations.

Our Bay Area Regional Vice President joined the Regional Tribal Occupation Committee (RTOC) for US Environmental Protection Agency (US EPA) Region 9 in April 2023. In the meeting, PG&E was privileged the opportunity to present the CVA and solicit input on the following discussion questions:

- How can PG&E as a company learn from tribal climate adaptivity and planning?
- How can we partner in this work?
- How are your communities most impacted by climate hazards, including extreme heat, wildfire, flooding, and others?

In addition to the EPA RTOC meeting, the Company's Regional Vice Presidents, Tribal Liaisons, and Climate Resilience teams will reach out to tribal governments and offer opportunities to discuss climate hazards, energy outages, and community resilience strategies. Results of this engagement will be incorporated into the CVA Community Resilience Chapter.

In partnership with other California investor-owned utilities, we are organizing a Tribal Energy Summit in 2023. We intend to convene tribes, California state agencies, including the Commission, and federal agencies, including the Department of Energy. Learnings from this summit will be integrated into the CVA.

Our engagement with tribes is not siloed to climate adaptation work, but instead is part of regular operations. Some examples include:

- PG&E staff routinely engage with tribes before, during, and after Public Safety Power Shutoff (PSPS) events.
- Cultural Resource Specialists ensure PG&E regulatory compliance on projects and interact with tribal representatives on a regular basis.
- Environmental and Public Affairs staff engage with tribes on project related permitting and outreach activities, as well as emerging policy and regulatory development that may impact tribal interests.
- Gas, Electric, Energy Supply, and Remediation staff ensure that PG&E provides safe, reliable, and affordable energy services for all customers, including our tribal customers.
- PG&E's Land Department has land surveyors, land agents, right of way agents, land consultants, and transaction specialists that provide stewardship of the Company's land and land rights. Staff implement the CPUC's new land disposition policy, giving tribes the "first right of offer" for land transactions.

IV. Next Steps and Conclusion

Once community and tribal engagement activities are complete, we will incorporate into the CVA the rich feedback and knowledge shared in advisory group activities and direct community outreach. Engagement findings will be used in two areas of the CVA - the Community Resilience Chapter and Adaptation Recommendations – and will be shared across departments to inform other community engagement programs.

The Community Resilience Chapter of the CVA will summarize the Plan's results, present recommendations for increasing adaptive capacity and promoting equity withing DVCs, as well as document lessons learned related to equitable engagement practices.

To connect the Plan's results with the technical analysis, we will use the emerging themes from community engagement outcomes as lens to prioritize adaptation recommendations in the CVA.

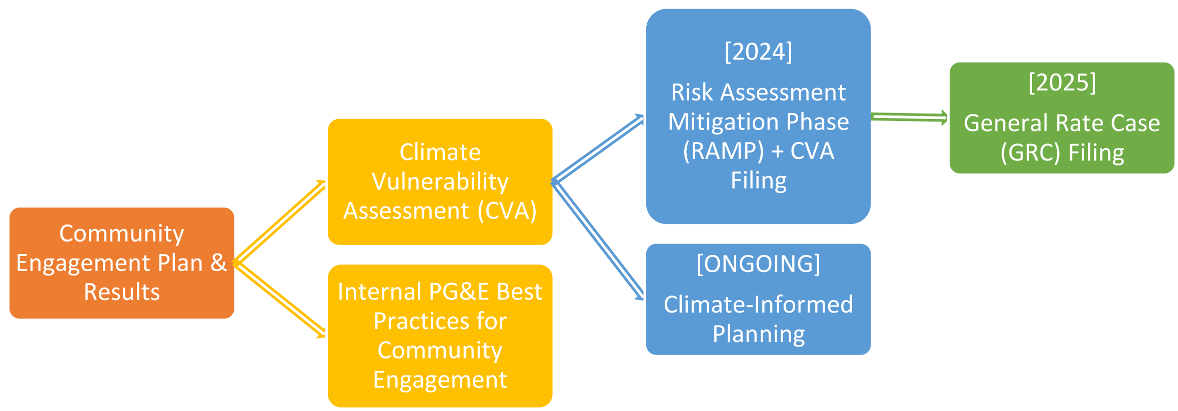


Figure 2. Integration of CEP Results into Short- & Long-Term Planning

Appendix E includes the initial list of PG&E teams who are actively engaged and learning from this process.

We plan to host an online webinar to present the final draft of the CVA results with the community partners who participated in research interviews, advisory groups, or other engagements. In this meeting, participants will have the opportunity to review and ask questions about the influence of their community outreach and advisory group recommendations.

Across the Company, dozens of teams engage with tribal and non-tribal community groups, leaders, and governments. To achieve the goal of responsiveness to customers and serving our hometowns, we intend to continue to deepen our relationship with community partners after the CVA is submitted to the Commission:

- We will share the Plan's results about impacts of climate hazards across departments, as well as best practices for community outreach and reducing barriers to engagement.
- We seek to continue to foster community partnerships built in this process through contracting future outreach work, participation in other PG&E advisory groups, direct engagement with ESJ stakeholders, as well as through grant opportunities.

- Following the CVA submission in 2024, we plan to host a series of events to present key findings, share how results have influenced our operations and planning, re-engaged with community partners, and engaged with local tribal and non-tribal governments.

As documented in Appendix E, we have shared lessons learned and initial Plan results across the organization, and fostered new CBO connections.

* * * * *

We consider the completion of the Plan an important opportunity to put the Company's climate and environmental justice commitments into action, by deepening partnerships with customers and communities, improving best practices for outreach and engagement, and centering community resilience in climate adaption planning.

The planning and execution of the Plan could not be possible without our community partners around central and northern California: Thank you for your partnership and commitment to a safer, more resilient, and equitable future.

We look forward to sharing the results of this plan and key findings with the Commission upon CVA submission.

Appendix

A. CVA CEP Regions

Counties within PG&E Service area have been organized into the following outreach regions. The CVA process started before the finalization of the Company's Regional Service model structure. As such, the regional designations included in the Plan do not fully align with the regional service model designations:

Table 3. List of Counties by Regional Engagement Area for the Community Engagement Plan

1. Bay Area	2. Central Valley	3. North Valley, Sierras, Sacramento	4. North Coast	5. Central Coast
Alameda Contra Costa Marin Napa San Francisco San Mateo Santa Clara Solano	Alpine Amador Calaveras Fresno Kern Kings Madera Mariposa Merced San Joaquin Stanislaus Tulare Tuolumne	Butte Colusa El Dorado Glenn Lassen Nevada Placer Plumas Sacramento Shasta Sierra Siskiyou Sutter Tehama Yolo Yuba	Humboldt Lake Mendocino Sonoma Trinity	Monterey San Benito San Luis Obispo Santa Barbara Santa Cruz

B. List of Disadvantaged Vulnerable Communities (DVCs) within PG&E Service Area

Table 4. List of Counties, Cities, CDPs by Region and Tribal Lands

Region	Counties	Cities / Census Designated Places (CDP)
Bay Area	Alameda Contra Costa Marin Santa Clara	Antioch Berkeley Daly City Gilroy Hayward Martinez Marin City Morgan Hill Oakland Oakley Pittsburg Redwood City

		Richmond San Bruno San Francisco San Jose San Pablo San Raphael Santa Clara South San Francisco
Central Valley	Fresno Kern Kings Merced San Joaquin Stanislaus Tulare	Arvin Atwater Bakersfield Ballico CDP Benton Park CDP Bystrom CDP Calwa CDP Cantua Creek CDP Caruthers CDP Casa Loma CDP Ceres Choctaw Valley CDP Clovis Corcoran Cottonwood CDP Country Club CDP Crows Landing CDP Cutler CDP Del Rey CDP Delano Diablo Grande CDP Dinuba Dos Palos Y CDP East Bakersfield CDP East Niles CDP East Orosi CDP Edmundson Acres CDP Empire CDP Fairfax CDP Firebaugh Ford City CDP Fowler Fresno Garden Acres CDP Hanford Hillcrest CDP Home Garden CDP Kennedy CDP Kerman

		Keyes CDP Kingsburg La Cresta CDP Lathrop Laton CDP Le Grand CDP Lemoore Lincoln Village CDP Lindsay Livingston Lodi London CDP Los Banos Lost Hills CDP Malaga CDP Manteca Mayfield CDP McFarland Merced Modesto Monmouth CDP Oakdale Oildale CDP Organ Cove Parklawn CDP Parlier Patterson Planada CDP Porterville Potomac Park CDP Raisin City CDP Reedley Rexland Acres CDP Ripon Riverbank Riverdale CDP Rouse CDP Sanger Santa Nella CDP Selma Shafter South Dos Palos CDP South Taft CDP Stevinson CDP Stockton Strathmore CDP Taft Tarina CDP

		Three Rocks CDP Turlock Wasco Waterford Waukena CDP Weedpatch CDP West Modesto CDP West Park CDP Westside CDP Winton CDP Woodlake
North Valley, Sierras, Sacramento	Butte Nevada Sacramento Shasta Solano Sutter Tehama Yolo Yuba	Anderson City Arden-Arcade CDP Carmichael CDP Cerokee CDP Chico Concow CDP Florin CDP Foothill Farms CDP Fruitridge Pocket CDP Grass Valley Lemon Hill CDP Linda CDP Marysville McClellan Park CDP Olivehurst Oroville Palermo CDP Paradise Parkway CDP Rando Cordova Red Bluff Redding Rosemont Sacramento Shasta Lake Vallejo West Sacramento Woodland Yuba City
North Coast	Humboldt Lake Mendocino Sonoma Trinity	Arcata Benbow CDP Clearlake Clearlake Oaks CDP Eureka Hoopa CDP Lakeport

		Laytonville CDP Rio Dell Ruth CDP Shelter Cove CDP Ukiah
Central Coast	Monterey San Luis Obispo Santa Barbara Santa Cruz	Lompoc Marina Pajaro CDP Salinas San Luis Obispo Santa Cruz Spreckels CDP
Tribal Land	Auburn LAR Berry Creek LAR Big Bend LAR Big Lagoon LAR Big Sandy LAR Big Valley LAR Blue Lake LAR Buena Vista LAR Chicken Ranch LAR Chico LAR Cloverdale LAR Cold Springs LAR Colusa LAR Cortina Indian LAR Coyote Valley LAR Dry Creek LAR Elem LAR Enterprise LAR Graton LAR Greenville LAR Grindstone Indian LAR Guidiville LAR Hoopa Valley LAR Hopland LAR Jackson LAR Karuk LAR Laytonville LAR Lytton LAR Manchester Point Arena LAR Middletown LAR Montgomery Creek LAR Mooretown LAR Northfork LAR Paskenta LAR Picayune LAR Pinoleville LAR	

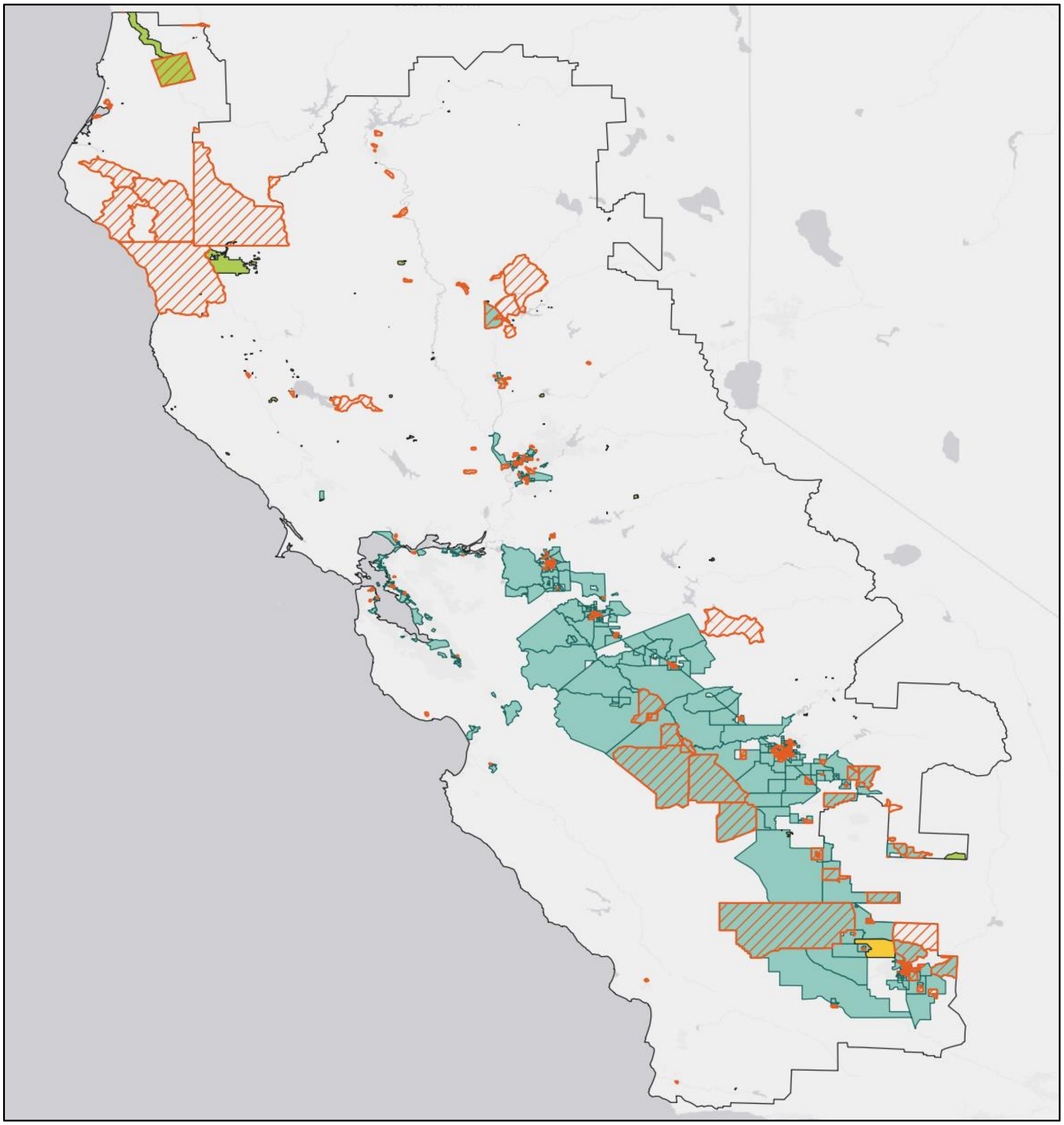
	Potter Valley LAR Redding LAR Redwood Valley LAR Roaring Creek LAR Robinson LAR Rohnerville LAR Round Valley LAR Santa Rosa LAR Santa Ynez LAR Scotts Valley LAR Sheep Ranch LAR Sherwood Valley LAR Shingle Springs LAR Stewarts Point LAR Table Bluff LAR Table Mountain LAR Trinidad LAR Tule River LAR Tuolumne LAR Upper Lake LAR Wilton LAR XL Ranch LAR Yocha Dehe Wintun LAR Yurok LAR

C. Map of DVCs with PG&E Service Area

CPUC defines a disadvantaged vulnerable community as:

- Communities in the 25% highest scoring census tracts according to the most recent version of CalEnviroScreen (CES)
- Census tracts with median household incomes less than 60% of state median income
- Census tracts that score in the highest 5% of CES Pollution Burden but do not receive an overall CES score due to unreliable public health and socioeconomic data.
- All Tribal lands

DVCs within PG&E Service Area



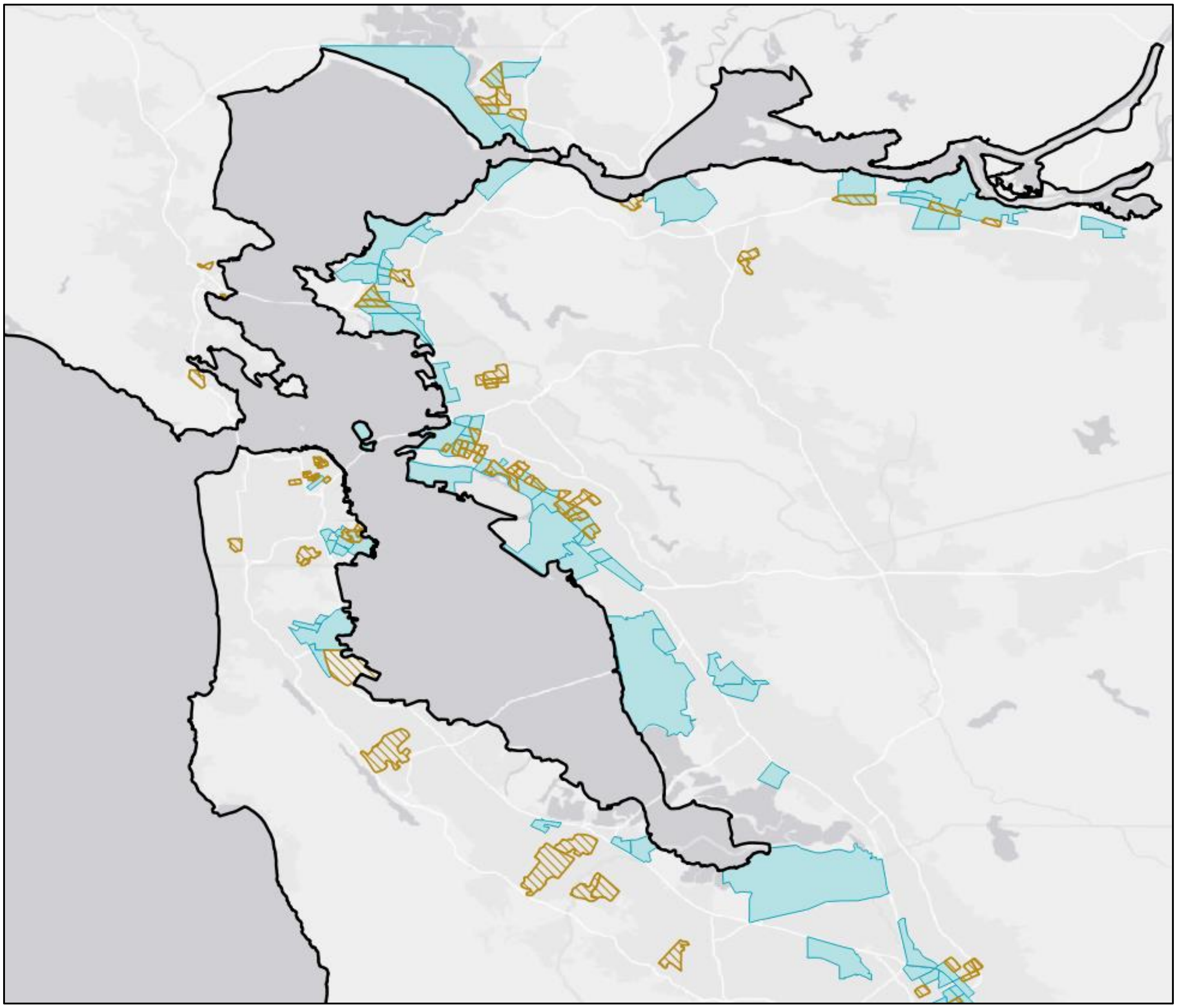
Tribal lands

Top 25% of CES score

Top 5% pollution score

MHI < 60% of CA average MHI

DVCs within Bay Area Region



Median household income less than 60% of median state income
Top 5% Pollution Burden score & no CES score
Top 25% CES score
Tribal land

DVCs within North Valley, Sierra, Sacramento Region

DVCs within Central Coast Region

Tribal lands

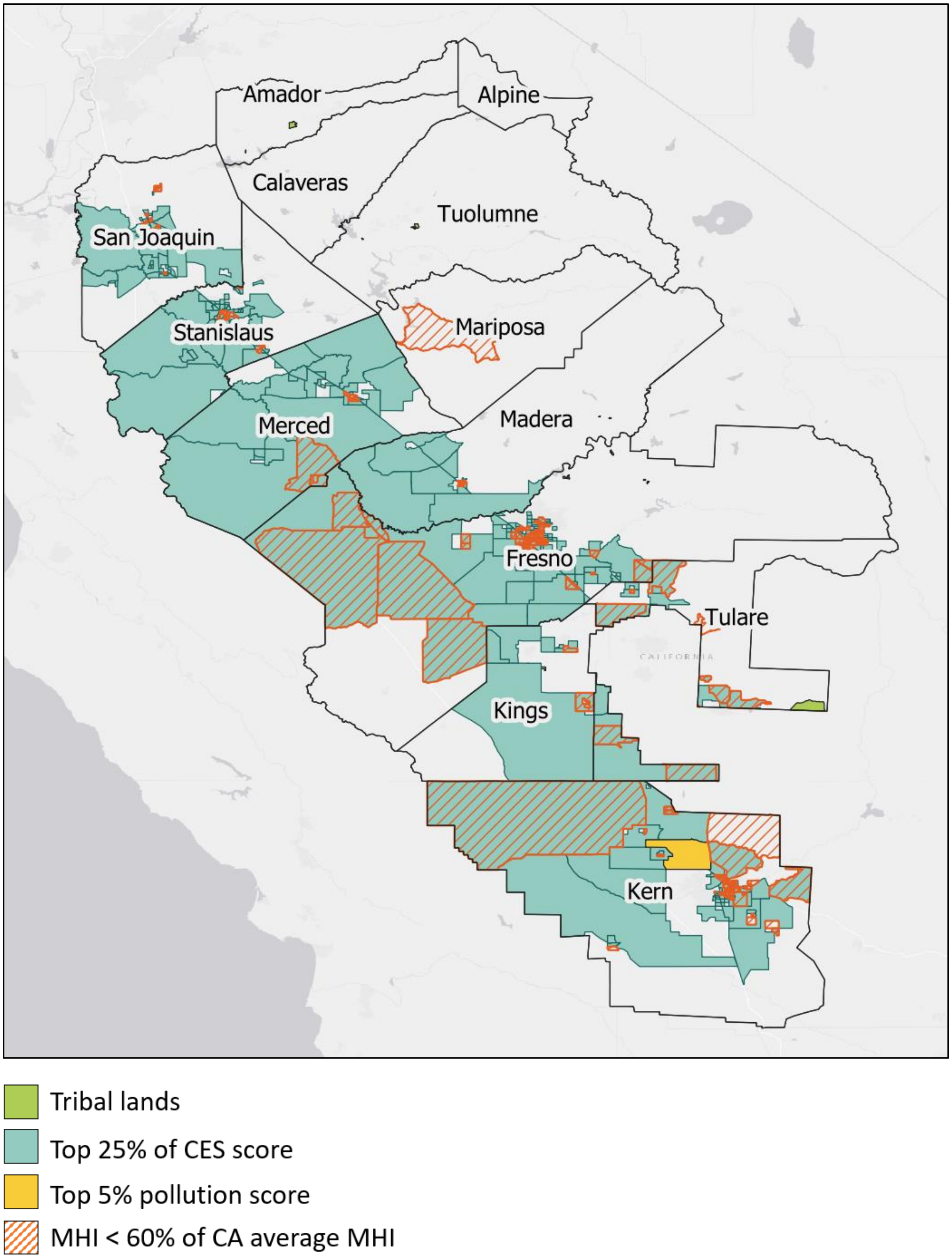
Top 25% of CES score

Top 5% pollution score

MHI < 60% of CA average MHI

DVCs within North Coast Region

DVCs within San Joaquin Valley Region



D. Compensation Schedule

Table 5. Compensation Schedule for Community Based Engagement

Phase I (Bay Area)	
Advisory Group Attendance (2-3 hours)	$500
Conducting Outreach (3-month period)	$9,000
Supplies for Events	$250/in-person event
Phase II	
Interviews (1 -1.5 hours)	$100-150
Advisory Group Attendance (2-3 hours)	$500
Conducting Outreach (3-month period)	$10,000
In-Person Event Budget	$250/event (up to $5,000 total)

E. List of all parties consulted (internal and external)

Internal Engagement

The Project team has engaged with the following internal PG&E teams in the development and execution of the CVA CEP. In development, planning, execution, and sharing initial findings. This is an incomplete list, given that community engagement is underway, and the Project team will continue to share results with internal parties. The final list will be submitted with the CVA in 2024.

- Clean Energy Transportation
- Communication
- Community Relations
- Corporate Sustainability
- Enterprise Risk
- Environmental Social Governance Committee
- Environmental Social Justice Working Group
- Income Qualified Programs
- Local Government Affairs
- Multicultural Marketing
- Public Affairs
- Regional Operations
- Stakeholder Engagement and Advocacy
- Stakeholder Engagement Working Group
- Systems Planning and Resources

External Engagement

As part of community engagement research and outreach, PG&E has engaged with the following community-based organizations. This is an incomplete list, given that community engagement is underway. The final list will be submitted with the CVA in 2024.

- Acterra*
- African American Network of Kern County
- American Indian Cultural District
- Arcata House Partnership
- California Farmworker Foundation
- California Public Utility Commission
- California Urban Partnership
- Camptonville Community Partnership
- CARAS*
- The Center For Independent Living
- Central California Environmental Justice Network
- Chinese Newcomers Services Center
- Climate Resilient Communities
- Communities for a Better Environment
- Community Food Bank of San Benito County
- Disability Justice League- Bay Area
- Fresno Center
- Fresno Economic Opportunities Commission*
- Friends of Calwa
- GRID Alternatives North Valley*
- Habitat for Humanity Yuba/Sutter Inc
- Hands of Hope: Resources for Homeless Families
- Humboldt Area Foundation
- Independent Living Center of Kern
- Institute for Local Government
- Leadership Council for Justice and Accountability
- Little Manila Rising
- Mixteco Indigena Community Organizing Project (MICOP)
- Mujeres En Acción
- Multicultural Center of Marin
- NAACP-Santa Rosa Sonoma County Branch
- New Voices Are Rising
- NorCal Resilience Network

- North Coast Opportunities, Inc.
- Northern Rural Communities Development, Inc.
- Organization of Chinese Americans - Sacramento
- Public Health Advocates
- Regeneración Pajaro Valley
- Rise South City
- Rising Sun Center of Opportunity
- Sacramento Area Congregations Together
- Sacramento Environmental Justice Coalition
- San Joaquin Valley Clean Energy Organization
- Self-Help Enterprises*
- Sierra Business Council
- Slavic Center of Sacramento
- Sonoma Valley Collaborative
- Stone Soup Fresno
- Support Life Foundation
- Tahoe Truckee Community Foundation
- United Way of Northern CA
- United Way of the Wine Country
- Valley Clean Air Now*
- Veterans In Business*
- Yuba Fire Safe Council

*Indicates that the community-based organization is also a member of the Company's Community Perspectives Advisory Council

F. Project Timeline

- 2020-2023: Infrastructure, Operations, and Services components of CVA completed and reviewed by internal subject matter experts.
- 2021-2023: Community Engagement planning and execution
- 2023: Tribal Energy Summit
- 2023: Integration of Community and Tribal Engagement and CVA Results
- 2024: Submission of CVA to California Public Utility Commission

G. Regional Advisory Group Schedule

Advisory Group members are expected to conduct engagement and participate in 5 meetings over a two-and-a-half-month period. The 5 Advisory Group meetings will adhere to the following schedule:

- Meeting #1: Introductions to Advisory Group members, Project team, and Project
- Meeting #2: Advisory Group members to share outreach plans, review outreach materials, and troubleshoot any challenges
- Meeting #3: Peer mentoring on outreach, presentation on PG&E Income-Qualified Programs and eligibility
- Meeting #4: Activity to explore and prioritize community resilience strategies
- Meeting #5: Summary of outreach results, discussion of lessons learned, and brainstorm engagement after advisory group meetings end

H. Research Interview Questions

Interview questions are used to guide interviewers and are not meant to be used as a script.

1. Can you please share a bit about the work you do with [organization/communities]?
2. While there is census data on your community out there, it often misses the nuances of 'who' lives in an area and the communities within that area. Can you share with me 'who' makes up your community?
3. Are languages other than English spoken in your area? If so, which ones?
4. Is there anything about the environmental landscape of your area that creates certain climate hazards in certain neighborhoods/communities?
5. Generally speaking, who would you say is "most vulnerable" to climate hazards in your area?
6. What would you consider is the number one climate hazard amongst wildfires, extreme heat, and power outages that your community experiences?
7. When communities experience a [climate hazard noted in response], talk to me about how they are impacted by it.
8. How equipped would you say your community is in preparing for a climate hazard?
9. What are some ways PG&E can reduce the negative climate impacts your community currently experiences?
10. What sorts of programs or investments do you think would be most important to protecting the community?
11. Are there any existing good programs or supports that PG&E could build upon
12. What information, community projects, reports, or data exist currently that you think should be included in their final report?
13. What data do you think still needs to be gathered, if any?

I. Community Survey Questions

PG&E is seeking your input to ensure that as climate hazards increase in frequency and severity, those who are most vulnerable have access to services and resources that keep community members safe. This quick survey will inform PG&E's approach to climate resilience and infrastructure planning, helping to focus PG&E's investments to create a safer, more equitable and reliable energy system.

This survey should take less than 5 minutes. Thank you for your time.

1. What is your zip code? [Open ended]
2. Do you currently get financial assistance on your energy bill? Learn more about low-income energy assistance at (800) 933-9555.
    a. Yes
    b. No
    c. Not Sure
3. What impacts of **power outages** have you experienced or are most concerned about?
    a. Medical Equipment Issues
    b. No Air Conditioning
    c. Loss of Work & Childcare
    d. Other?
4. What impacts of **wildfire smoke** have you experienced or are most concerned about?
    a. Health Concerns
    b. Poor Indoor Air Quality
    c. Harsh Outdoor Working Conditions
    d. Other?
5. What impacts of **extreme heat** have you experienced or are most concerned about?
    a. Health Concerns
    b. Unsafe Indoor Environments
    c. Unsafe Outdoor Working Conditions
    d. Other?
6. What impacts of flooding or sea level rise have you experienced or are most concerned about?
    a. Health Concerns
    b. Loss of Work
    c. Evacuation
    d. Emergency Response and Planning
    e. Water Damage to Home
    f. Other
7. Has your mental health been impacted by extreme climate events (heat, increased rain and flooding, wildfires, drought, landslides)?
    a. Yes
    b. No
    c. Unsure
8. Thinking about hotter days, where do you go to cool off?
    a. Home
    b. School
    c. Park

    d. Work
    e. Community Center
    f. Other?
9. How comfortable is your home on hotter days?
    a. Not at all comfortable
    b. Slightly uncomfortable
    c. Comfortable
    d. Very Comfortable
10. Do you have access to an air-conditioned space now?
    a. Yes
    b. Sometimes
    c. No, but I need air conditioning
    d. No, and I don't need air conditioning
11. What kind of solutions can PG&E consider to help **communities** deal with extreme weather? Choose your top two.
    a. Access to air-conditioned spaces / cooling center
    b. Add generators/ places to charge phones in public spaces
    c. Better emergency alert systems
    d. More personal safety equipment (masks, batteries, etc.)
    e. Other?
12. What kind of solutions can PG&E consider to help you deal with extreme weather at your **home**? Choose top two.
    a. Payment for power outages
    b. Home air filtration systems
    c. Information to make my home safer
    d. Other?
13. Please tell us how you heard about this survey
    a. Website
    b. Social Media
    c. [List of all participating CBO partners]
    d. Other (please specify)

The following questions are optional, and any data collected will be used anonymously to help PG&E evaluate how they're reaching their customers.

14. What is your racial background?
    a. Black or African American
    b. Native American, American Indian, or Alaska Native
    c. Asian
    d. Native Hawaiian and Pacific Islander
    e. Latino/x or Hispanic
    f. White
    g. Two or more races
    h. Other (please specify)
    i. Prefer not to answer

15. How would you describe your income level?
    a. Extremely low income
    b. Low income
    c. Moderate income
    d. High income
    e. Prefer not to answer
16. Do you own your home?
    a. Yes
    b. No
    c. Prefer not to answer
17. What type of home do you live in?
    a. Single family home
    b. Duplex/Triplex
    c. Low-rise apartment or condo building (3 stories or fewer)
    d. High-rise apartment or condo building (4 stories or more)
    e. Mobile home
    f. Unhoused/homeless
    g. Prefer not to answer
18. How many people live in your household? __________
19. Are there any other children under 18 in your household?
    a. Yes
    b. No
20. Does anyone in your household depend on electric medical equipment?
    a. Yes
    b. No
21. How often do you receive information from PG&E on existing initiatives or programs?
    a. Too often
    b. Not enough
22. How often would you like to receive information from PG&E on existing initiatives or programs?
    a. Weekly
    b. Monthly
    c. Quarterly
    d. Once a year
    e. I'm not interested in receiving information
23. Where do you currently receive information/news from PG&E?
    a. Mailers
    b. Community events
    c. Website
    d. Social Media
    e. Emails
    f. Other: _____________________

J. CPUC Recommended "Outline of Community Engagement Plan"

As part of Rulemaking 18-04-019[9] – Components of Climate Adaptation Community Engagement Plans, CPUC has recommended the inclusion of the following components. In this document, we include or address every component. See the following table for specific locations.

Table 6. Mapping of CPUC Requirement Sections to our Community Engagement Plan

CPUC Section	CPUC Subsection	Location within PG&E CEP
1. Disadvantaged Vulnerable Communities	a. Describe the DVC, including location, boundaries, population, other salient characteristics of the community, and history of any safety, affordability, and/or reliability problems related to utility infrastructure, operations and services in the DVC.	Appendix B. List of Disadvantaged Vulnerable Communities (DVCs) within PG&E Service Area
	b. Describe potential impacts to the IOU infrastructure, operations and services in the DVC.	Section IV. Next Steps and Conclusion
	c. Describe how the IOU will promote equity relative to climate adaptation of its infrastructure, operations and services in DVC based on the community's adaptive capacity	Section IV. Next Steps and Conclusion
2. Community Engagement	a. Explain how information obtained from community engagement will inform vulnerability assessment (VA).	Section IV. Next Steps and Conclusion
	b. Explain how IOU community engagement on climate adaptation will be coordinated with other IOU community outreach.	Section IV. Next Steps and Conclusion
	c. Explain how IOU will document DVC community engagement.	Section III. Methodology, Engagement Methods
	d. Describe IOU's plans to make DVC community engagement accessible (approach to scheduling and plans for location, facilitation, translation, remote access).	Section III. Methodology, Engagement Methods
3. Continuing and Planned Outreach Efforts to CBOs and Other Entity	a. Describe outreach efforts to other local entities if no CBO, local government, relevant state agencies in area.	Section III. Methodology, Engagement Methods
	b. Describe how IOU personnel or consultant have been or will be trained in community engagement.	Section III. Methodology, Increasing Internal Capacity on ESJ Issues
	c. Describe methods to ensure "meaningful" community engagement.	Section III. Methodology, Engagement Methods
	d. Describe how IOU will implement the Commission's existing Environmental and Social Justice Action Plan and Disadvantaged Communities Advisory Group Equity Framework.	Section II. Goals, CPUC Alignment
	e. Summarize the input received from parties to the Commission's proceeding, R.18-04-019 (or successor proceeding), DVCs, and affected communities on the	N/A – not using CEP to solicit feedback on CPUC tools

[9] https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/climate-change

	Environmental and Social Justice Action Plan goals and Disadvantaged Communities Advisory Group Equity Framework.	
	f. Describe how IOU will ensure communities and CBOs are involved in scope analysis, goal development, implementation, administration and review of the utility vulnerability assessments, as well as taking leadership roles in their areas of expertise on vulnerability assessments and consideration of climate adaptation implementation in DVCs.	Section III. Methodology, Engagement Methods
	g. List best practices relied upon for outreach after the IOU conducts outreach to DVCs, CBOs, and their representatives.	Section III. Methodology, Engagement Methods
	h. Where concerns exist that local government is not sufficiently engaged with its disadvantaged residents, the [Investor-Owned Utilities'] community engagement shall include persons or organizations that are non-governmental. The Community Engagement Plans shall list the non-governmental organizations contacted and the reason contacted.	Section III. Methodology, Engagement Methods
4. Proposed Timeline for Community Engagement	a. Describe timeline for community engagement with DVCs with identified impacted utility infrastructure, operations and services	Appendix F. Project Timeline
	b. Describe timeline for community engagement with DVCs with no identified impacted utility infrastructure, operations and services.	Appendix F. Project Timeline
5. IOU's Use of Community Engagement	a. Acknowledge and summarize all input received from CBOs, DVCs, and parties to R.1804-019 (or successor proceeding).	Appendix E. List of all parties consulted
	b. Gauge interest and availability of CBOs or other members of the community for meaningful leadership roles in the vulnerability assessments and climate adaptation, and discloses any CBO or community member interest in such roles	Section III. Methodology, Engagement Methods
	c. Describe how IOU will inform DVCs on whether feedback influenced VA.	Section IV. Next Steps and Conclusion
	d. Describe how IOU will present community feedback in the VA.	Section IV. Next Steps and Conclusion
	e. Describe how IOU will engage DVCs after the IOU submits its VA to the Commission.	Section IV. Next Steps and Conclusion

K. PG&E's 2021 Climate Vulnerability Assessment Community Engagement Proposal I

PG&E Climate Resilience Team submitted the following proposal and presented the following slides to CPUC DACAG on March 19, 2021.

2020-2024 Climate Vulnerability Assessment Community Engagement Proposal

Table of Contents

A. Executive Summary

PG&E is conducting a Climate Vulnerability Assessment (CVA) to understand how the Company is vulnerable to climate driven hazards like wildfire, extreme heat events, torrential rainstorms, drought, and others. This is a critical first step in creating climate adaptation plans that will help PG&E continue to provide Northern California with safe, clean, reliable, affordable energy into the climate-altered future.

This document, PG&E's CVA Community Engagement Proposal (CEP) provides a framework for how PG&E and climate-vulnerable community stakeholders may work together to build mutual trust and engage in authentic and meaningful exchange regarding the expected climate resilience *of* the energy system and building community resilience *through* the energy system.

The CVA community engagement process is an opportunity for PG&E to practice engagement that moves beyond informing and consulting community to involving and collaborating with community. This document is explicitly offered as a proposal rather than a plan to invite collaboration with stakeholders that represent disadvantaged and vulnerable communities at the outset of the process.

This CEP is a good-faith effort to frame how engagement could be structured to promote authentic and meaningful interactions with the communities we serve while also preserving flexibility to approach each region in an appropriately customized way. It is also informed by practical considerations like costs and regulatory requirements.

PG&E looks forward to working with community members and the CBOs that represent them to understand how this process can best serve their energy and climate-related needs. PG&E has a number of goals, but they can be summarized as:

- Sharing information with the communities we serve about how climate change is expected to impact the *resilience of* the energy system
- Learning how some of our most vulnerable customers are experiencing the impacts of increasingly frequent and severe climate-driven hazards. In other words, begin to understand how PG&E might contribute to customer resilience *through* the energy system.
- Building trust with the communities we serve by moving from informing and consulting with community to involving, collaborating, and sharing ownership of the process, relying on best practices regarding meaningful community engagement, and setting clear expectations about how this process can benefit both PG&E and customer participants.

PG&E is looking forward to exploring what the communities we serve are thinking, feeling, and doing about the physical risks of climate change in their communities, and how we can be responsive to their needs as we invest in a climate resilient energy system on their behalf.

Section 1. The Origin and Purpose of PG&E's Climate Vulnerability Assessment (CVA) Community Engagement Proposal (CEP)

Overview: PG&E's Climate Vulnerability Assessment (CVA) Community Engagement Proposal (CEP) provides a framework for how PG&E and community stakeholders may work together to build mutual trust and engage in authentic and meaningful exchange regarding the expected climate resilience *of* the energy system and building community resilience *through* the energy system.

A. Why is PG&E Creating a Climate Vulnerability Assessment (CVA) Community Engagement Proposal (CEP)?

Climate vulnerability assessments (CVAs) are increasingly being undertaken by governments, businesses, and other organizations that are concerned about the impact that climate-driven natural hazards – like wildfire, extreme heat events, torrential rainstorms, drought, and others - will have on their work and the people they serve.

In 2020, the California Public Utilities Commission (CPUC or Commission) became one of the first utility regulators in the nation to require investor-owned energy utilities (IOUs) to assess their vulnerability to climate-driven natural hazards. This is an important first step toward identifying actions the IOUs will need to take in order to continue to serve customers safely, affordably, and reliably into a future altered by climate change.[1] Additionally, the CPUC recognized that while CVAs are complex efforts involving climate projections and technical knowledge of utility assets and operations, the ultimate goal is simple: to learn how we might serve communities better in the context of adapting to climate change.

This Community Engagement Proposal (CEP) – so called because stakeholder input is required before it can be solidified into a "plan" - is an important element of PG&E's overall Climate Vulnerability Assessment that outlines how PG&E intends to learn about the lived experiences of customers with regard to climate hazards and energy service, and how those community perspectives will inform PG&E's CVA and decision-making going forward. This document also provides an anchor for discussion regarding PG&E's community engagement approach among CPUC and community stakeholders Finally, this document provides an illustrative framework for community engagement to be tailored based on the specific characteristics of the communities within each of PG&E's five CVA study regions.[2]

B. Who will Participate in CVA-Related Community Engagement? Who is "Climate Vulnerable?"

While most if not all Californians are exposed to some level of climate-driven hazard,[3] not all Californians are impacted by these hazards to the same extent or in the same way. Individuals and communities with relatively fewer resources to absorb and recover from climate-driven hazards have lower *adaptive capacity* than better-resourced communities, and therefore are more *vulnerable* to climate impacts given the same level of exposure and even sensitivity to a given hazard.

It is well-understood that historically marginalized communities with fewer resources are more vulnerable to a wide range of hazards, including climate change.[4] For this reason, and consistent with the CPUC's Environmental and Social Justice (ESJ) Action Plan goals and Disadvantaged Community Advisory Group (DACAG) Guiding Principles, the CPUC has directed the IOUs to target outreach to "disadvantaged vulnerable communities" or DVCs. A community may be considered a DVC based on the following CPUC-defined criteria: [5]

- Communities in the 25% highest scoring census tracts according to the most recent version of CalEnviroScreen as well as California tribal lands
- Census tracts with median household incomes less than 60% of state median income
- Census tracts that score in the highest 5% of CalEnviroScreen Pollution Burden but do not receive an overall CalEnviroScreen score due to unreliable public health and socioeconomic data.

Stakeholders may view a map of the DVC communities within PG&E's service territory by visiting [link from Digital Strategy pending].

C. What Are the Goals of CVA Community Engagement?

PG&E has clearly defined goals for pursuing authentic and meaningful engagement with the communities we serve as part of this CVA effort. These include the following **outcome goals**:

1. **Sharing information with the communities we serve** about how climate change is expected to impact the *resilience of* the energy system PG&E has the privilege of managing on their behalf, and begin a conversation about how our customers would like to see PG&E address those impacts.
2. **Learning how some of our most vulnerable communities** are experiencing the impacts of increasingly frequent and severe climate-driven hazards. In other words, begin to understand how PG&E might contribute to customer resilience *through* the energy system. PG&E's Climate Vulnerability Assessment would be incomplete without being informed by both technical analysis as well as the lived experiences and perspective of the communities we serve. Bringing those two narratives together is how PG&E can begin to develop adaptation plans that are responsive to customer preferences as well as the challenges of climate change.

PG&E has also set out **process goals**:

3. **Incorporating space for community perspectives in the process** to the greatest extent possible and moving up the spectrum of engagement from informing and consulting to involving, collaborating, and sharing ownership of the process. PG&E anticipates engaging with community stakeholders at the program level of this effort on questions like the criteria used for evaluating third party facilitators or the sequencing of study regions. It also includes direct input from community members regarding climate resilience of and through PG&E's energy system, input that will be included in the final CVA document.
4. **Respecting the value of customers' time** by coordinating engagement activities with existing PG&E community engagement initiatives to the extent possible and planning outreach that makes it as easy as possible for community-members to participate.

5. **Widening and deepening PG&E's existing network of CBO relationships** by learning what existing CBO partners are doing on the issue of climate resilience and identifying climate resilience-focused organizations with which we have not engaged previously.
6. **Respecting the value of our CBO partners' expertise** by explicitly requiring PG&E's outreach partners to include CBO-led services in their program budgets, and fairly compensate CBOs that provide ongoing advice and consultation.as part of the process
7. **Conducting high-quality outreach while ensuring costs remain reasonable and incremental.** PG&E must respect CPUC direction to keep the costs of this effort "incremental" to existing outreach efforts while also making sure we are meeting CPUC and community expectations for authentic and meaningful engagement.
8. Most importantly, **building trust with the customers we serve** by relying on up-to-date best-practices regarding equity and the spectrum of engagement in outreach, and setting clear expectations about how this process can benefit both PG&E and customer participants. PG&E views this process as an opportunity to practice community engagement that moves beyond informing and consulting community to involving and collaborating with community.

PG&E acknowledges that this is a multi-stakeholder process and that the communities we serve likely have many of their own objectives related to energy and climate resilience. The goals above are not listed to the exclusion of other priorities that may be surfaced by communities as part of this effort.

D. What will Result from the CVA Community Engagement Effort? Why Participate?

PG&E understands that many Californians mistrust our Company for harms both historical and recent. Additionally, we understand that members of historically marginalized communities may particularly mistrust institutional actors like PG&E based on past experiences of unmet expectations. Building trust with the communities we serve is one of PG&E's core goals in this process. During the workshops that led to this CEP, having clear expectations about outcomes was highlighted as a critical element of successful, trust-enhancing community engagement.[6] To that end an individual community member participating in this process can expect:

- Their contributions will inform the CVA Report for their respective region. They can also expect:
  - follow-up engagement after outreach for a region has been completed to share results and pursue further discussion.
  - an opportunity to provide feedback on the process and content of the outreach.
- Community contributions to the CVA will in turn inform PG&E's Risk Assessment Mitigation Phase (RAMP) filing.[7] In California, a utility's RAMP filing constitutes its best measurement of risks facing the company and provides a basis for utilities to prioritize investment and maintenance activity. Risk mitigation activities that reduce the most risk the most cost effectively are prioritized to support affordability while keeping safety consequences at the core of the process.
- The RAMP filing in turn informs the General Rate Case (GRC) filing. This is the most important filing a California utility provides to the CPUC because it contains most of the work a utility proposes to accomplish for the next three years as well as the amount of money to be recouped from customers to complete that work. [8]

In short, customer perspectives are a critical part of PG&E's CVA. DVC customer views have an opportunity to influence PG&E decision-making by informing its RAMP and GRC filings.

PG&E recognizes that the chain of influence in this process is extended; however, the link between this process and RAMP and GRC filings provides a new and tangible way for community perspectives to enter the conversation between IOUs and the CPUC about what work to prioritize and fund.

Ultimately, PG&E is committed to a process that meets community members where they are and that raises up their contributions and concerns as a step forward in building community adaptive capacity and in support of California's climate resilience efforts.

E. Is this Plan Final? Does it have Buy-In from Disadvantaged Vulnerable Community (DVC) Stakeholders?

This document is not final. This document is explicitly offered as a proposal rather than a plan to invite collaboration with stakeholders that represent disadvantaged and vulnerable communities at the outset of the process. A guiding principle for PG&E in this effort is to practice engagement that moves beyond informing and consulting community to involving, collaborating, and sharing ownership with community to the greatest extent possible.

As of early March 2021, this proposal has not been reviewed by stakeholders external to PG&E. PG&E will seek feedback from the DACAG on this proposal on March 19, 2021, and had intended to propose partnering with the DACAG on program-level considerations that require input from DVC representatives. However, PG&E understands that there are many important issues competing for the time and attention of the DACAG and as such the DACAG may not be available to partner. We are aware of the need to identify another appropriate group of ESJ representatives to collaborate on program-level considerations and will be reaching out to ESJ stakeholders that participated in the utility climate adaptation rulemaking to explore options.

F. What Does it Mean for Utilities to "Promote Equity" regarding Climate Adaptation?

Considering Equity in the Context of Climate Vulnerability Assessment

What does **"equity"** mean in the context of climate vulnerability assessment and adaptation? According to California's 2020 Adaptation Planning Guide,

*"**Equity** means that all people are justly and fairly included in society and that everyone is able to participate, prosper, and achieve their full potential.[24] It recognizes that everyone enjoys different advantages and faces different challenges, and that everyone should be treated justly and fairly according to their circumstances. Equitable climate adaptation planning involves identifying persons who may be most vulnerable to climate change and ensuring that planning processes, distribution of resources, and efforts to address systemic wrongs are all conducted in an equitable manner (APG pg. 28)."*

A related concept is **"climate justice,"** which in California is defined by the APG as "the concept that no group of people should disproportionately bear the burden of climate impacts or the costs of mitigation and adaptation."

It can be helpful when thinking about equity to consider the different aspects of the concept, all of which connect in some way to the context of climate vulnerability assessment and adaptation.

- **Procedural equity** is concerned with creating fair, open, inclusive, and transparent processes in developing and implement programs, plans, or policies.
- **Distributional equity** is concerned with the fair distribution of resources, benefits, and burdens, prioritizing resources to communities that have the greatest unmet needs and/or bear the brunt of more than their fair share of negative impacts.
- **Structural equity** relates to addressing deeply rooted systems and institutions that cause or perpetuate social and racial inequities. A commitment to structural equity may require a commitment to acknowledge and correct historical harms as well as working to prevent future harms.

Over the last decade, California's policy leaders have elevated equity as a fundamental consideration in many policy areas including climate adaptation planning. This growing emphasis is reflected in requirements for the IOUs to directly address equity considerations related to climate adaptation in this CEP.[9] [10] One requirement is that the CEP address "how IOUs promote equity related to the IOUs' climate adaptations in DVCs based on the communities' adaptive capacity".[11]

PG&E interprets this requirement as guiding CVA community engagement to include discussion of how PG&E may support community climate resilience *through* the energy system in way that addresses the specific needs of a given vulnerable community. PG&E agrees that this topic will likely be a key element of the engagement process.

To address the concept of equity directly in this CEP, though, it is useful to think about equity has having multiple facets (see text box on page 10 for more details). PG&E views this community engagement proposal as promoting **procedural equity** by leaving as much space as possible for authentic and meaningful collaboration and shared ownership of the community engagement process.

This CEP promotes **distributional equity** in that community engagement will be targeted specifically to communities that the CPUC has designated most vulnerable to climate hazards. Additionally, PG&E is committed to fairly compensating CBO partners that contribute to this effort.

The concept of **structural equity** is important as well. Structural equity is concerned with changing the systems and institutions that perpetuate social and racial injustices, so consideration of structural equity is important when thinking about how PG&E can support the communities we serve in not just building back from climate-driven hazards but building back better.

Equity in the context of climate adaptation is multifaceted, and PG&E looks forward to working with other stakeholders to keep equity at the center of this process.

Section 2. The Disadvantaged Communities Advisory Group (DACAG) Guiding Principles and Environmental and Social Justice (ESJ) Action Plan PG&E's Community Engagement Proposal

An important requirement for this CEP is that it address how DACAG Guiding Principles and ESJ Action Plan goals will be represented in this effort.[12] There are many connections between these two policy statements and PG&E's CVA and CEP.

Table 1. Disadvantaged Communities Advisory Group (DACAG) Guiding Principles

1. Increase access to clean energy technologies for disadvantaged communities.
2. Maintain or enhance the affordability of energy service in disadvantaged communities by considering potential rate impacts of a proposed program.
3. Increase the benefits of clean energy program in disadvantaged communities (e.g., by supporting growth in local employment and small business development, as well as other non-energy benefits including reducing pollutants with health risks).

Source: https://www.cpuc.ca.gov/uploadedFiles/CPUCWebsite/Content/UtilitiesIndustries/Energy/EnergyPrograms/Infrastructure/DC/DACAG%20Charter%20(Updated%20March%202020).pdf

PG&E views the CVA process as most directly relevant to DACAG Guiding Principle 2 in that preparing the energy system to provide safe, clean, affordable, reliable power in the face of increasingly severe and frequent climate hazards will require significant investment. The costs of adapting to climate change may put additional upward pressure on California's energy rates, which are already high compared to the national average and to which low-income customers devote a greater percentage of their income than others.[13] The CVA represents an important initial step in understanding the climate hazards facing our energy system, and will inform subsequent adaptation activity. While PG&E anticipates that the costs of adapting the energy system to climate change will be significant, the CVA supports affordability by arming PG&E with the climate risk information needed to begin adaptation planning as soon as possible. Research shows that investing in resilience sooner rather than later often has significant benefits in the form of avoiding larger costs in the long run.[14]

Additionally, this CEP contemplates engaging community with regard to high-level adaptation options, and PG&E anticipates that communities will have many perspectives regarding how various options may or may not contribute to access to clean energy technologies (Guiding Principle 1) or increase the benefits of clean energy programs in disadvantaged communities (Guiding Principle 3).

Table 2. Nine Goals of the CPUC Environmental and Social Justice (ESJ) Action Plan

1. Consistently integrate equity and access considerations throughout CPUC proceedings and other efforts.
2. Increase investment in clean energy resources to benefit ESJ communities, especially to improve local air quality and public health.
3. Strive to improve access to high-quality water, communications, and transportation services for ESJ communities.
4. Increase climate resiliency in ESJ communities.
5. Enhance outreach and public participation opportunities for ESJ communities to meaningfully participate in the CPUC's decision-making process and benefit from CPUC programs.
6. Enhance enforcement to ensure safety and consumer protections for ESJ communities.
7. Promote economic and workforce development opportunities in ESJ communities.
8. Improve training and staff development related to ESJ issues within the CPUC's jurisdictions.
9. Monitor the CPUC's ESJ efforts to evaluate how they are achieving their objectives.

Source: https://www.cpuc.ca.gov/esjactionplan/

The CPUC ESJ Action Plan consists of nine goals, many of which share a nexus with the CVA effort. PG&E will work to advance the spirit of ESJ Action Plan **Goals 1** and **5** via a meaningful and authentic community engagement process as outlined in Sections 1 and 3 of this document. PG&E's region-by-region approach (see Section 3) combined with participant feedback surveys also provides an opportunity for continuous improvement as contemplated in **Goal 9**.

Additionally, PG&E views the CVA and CEP as directly responsive to ESJ Action Plan **Goal 4**. Community contributions to the CVA effort are a critical step in informing both near- and long-term priorities for building the resilience of the energy system and building community resilience through the energy system.

PG&E does not anticipate investing heavily in staff development related to ESJ competency specifically as part of this effort (**Goal 8**), but generally recognizes the necessity and value of educating its employees regarding racial, social, and environmental equity. In recent years PG&E has expanded its Corporate Sustainability Team to include an ESJ policy manager position as well as two tribal liaisons recognizing that the Company must do more to connect with customer groups that have been historically marginalized. As part of the CVA CEP process, PG&E is committed to supplementing existing outreach capabilities with an expert third-party facilitation partner that has demonstrated connections to the communities in question and experience in reaching out to historically marginalized groups.[15]

In summary PG&E respects that the DACAG Guiding Principles and CPUC ESJ Action Plan represent the priorities of vulnerable communities as articulated by the DACAG and expects and welcomes these and related ideas as part of the community engagement process.

Section 3. PG&E's Community Engagement Proposal

Overview: PG&E proposes to conduct CVA-related outreach on a region-by-region basis between 2021 and 2023 starting with the San Francisco Bay Area (Region 1) then proceeding to the San Joaquin Valley and Central Sierras (Region 2), followed by the Inland North (Region 3), North Coast (Region 4), and finally the Central Coast (Region 5). PG&E shares how and why these preliminary decisions about the structure of CVA community engagement were made.

PG&E will execute a stakeholder-informed request-for-proposal (RFP) process to select a qualified third-party facilitator to coordinate community engagement in partnership with CBOs. The regional approach allows for the possibility that different outreach coordinators may be utilized depending on the region in question.

The proposed community engagement framework is designed to provide as much flexibility and opportunity for community ownership as possible while also taking into account practical constraints like costs, capacity, and regulatory deadlines.

A. Community Engagement Process Overview

In Section 1, PG&E established the following goals for community engagement associated with the CVA:

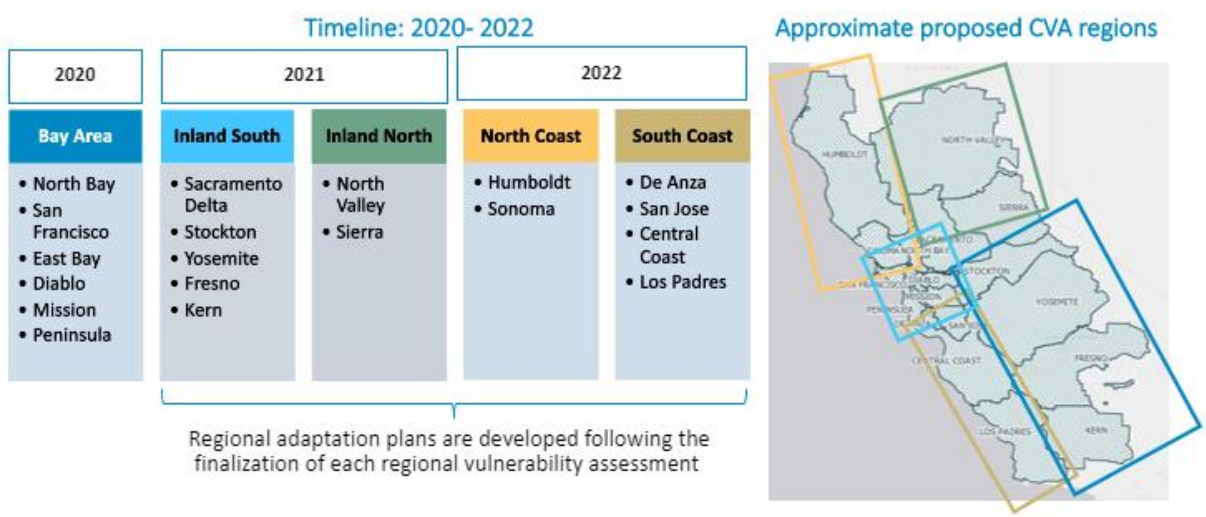
- facilitate two-way communication between PG&E and vulnerable customers regarding the expected climate resilience *of* the energy system and how community resilience could be enhanced *through* the energy system.
- build trust with the communities we serve by meeting community members where they are and involving, collaborating, and sharing ownership of the process to the greatest extent possible

This section provides PG&E's initial vision of how community outreach could be structured to achieve these goals.

B. Timeline Overview (2020-2023) – When and Where will CVA Community Engagement Occur?

Starting in 2020, PG&E is required to file a Climate Vulnerability Assessment (or update) every four years. PG&E's CVA Community Engagement Plan (this document) must be filed a year prior. However, PG&E intends to bring community stakeholders into the process from the outset regarding the overall structure of the outreach process ("program level" engagement) as well as when developing region-specific engagement plans. This document will necessarily shift and adapt over time as input is received and learnings result in adjustments to approach.

June 2023 – when PG&E's CVA must be filed with the CPUC – is useful deadline from which to backwards plan. The graphic below shows PG&E's proposed high-level timing for engagement within each region, advancing in roughly six month increments between late 2020 and the end of 2022. This timing leaves an additional six months for final synthesis of engagement outcomes prior to PG&E's June 2023 filing deadline.



In anticipation of the CPUC decision on climate adaptation, and recognizing that the CVA would take multiple years given PG&E's large service territory and complex asset base, PG&E began assessing the climate vulnerability of its assets, operations and services in the Bay Area in 2020, prior to finalization of the Commission requirements for the CVA process. Thus, the technical work of the Bay Area CVA has not yet been informed by stakeholder perspectives. PG&E will rectify this in the first half of 2021 and will update the CVA documents to reflect the information and perspectives gathered through the community engagement process.

The next section shows a more detailed potential framework for CVA community engagement within a given region.

How Did PG&E Decide on a Regional Approach to CVA Community Engagement?

Creating this Community Engagement Proposal required PG&E to make some preliminary decision about how CVA outreach might proceed. While many of these decisions are not final, it is still valuable to shed some light on what led us to the approach proposed in this Section.

- **Capacity:** With DVC-designated communities making up almost 25% of the communities within PG&E's expansive service area, PG&E's Climate Resilience Team recognized that engagement would have to be broken down and done in targeted phases given the scope of the task.
- **Customization:** PG&E serves a geographically large and ecologically and sociologically diverse area. Breaking the process down by region leaves more room in the process for considering the kinds of outreach that are most appropriate given unique regional and community characteristics.
- **Impact Alignment:** As part of PG&E's emergence from bankruptcy the Company is committed to elevating the voices of local customers through a regional model designed to make PG&E more accessible to the communities we serve. The CVA regions align with PG&E's new regional boundaries, which in turn align with county boundaries rather than PG&E-designated operational divisions as was the case previously. Aligning climate vulnerability analysis with the new regional approach will empower incoming regional leaders with information that can help them create climate adaptation plans responsive to the unique customer and system needs in a given region.
- **Sequence:** PG&E's Climate Resilience Team considered factors like density of customers, density of assets and relative level of exposure to climate hazards in choosing a starting region for the CVA. The Bay Area was selected due to its exposure to multiple climate hazards, a high concentration of PG&E assets, a disproportionately large number of customers, and also a diverse spectrum of communities including a significant number of DVCs. The perspectives of DVC customers from every region are important, and PG&E looks forward to engaging across all regions over the course of this process.

C. How are PG&E's Climate Vulnerability Assessment and Community Engagement Plan Related?

It is important to remember that this community engagement proposal is part of a broader climate vulnerability assessment being conducted by California's investor-owned utilities. Assessing climate risk is a critical first step in adapting to climate-driven hazards, but for this effort to be useful it must present information about climate risk in terms that enable PG&E to take adaptive action while also considering community needs.

Accordingly, PG&E's CVA consists of two interrelated tracks: a technical track focused on analysis of climate projections and PG&E data to identify priority climate-driven risks and eventually inform PG&E's adaptation plans; and the community engagement element intended to elevate the perspectives of DVCs and inform how adaptive action can potentially increase the resilience *of* the energy system while also promoting community resilience *through* the energy system.

Figure A: The Two Interrelated Tracks of PG&E's Climate Vulnerability Assessment

PG&E understands that some stakeholders may be concerned about the apparently bifurcated nature of this effort, and that this plan does not currently contemplate the direct involvement of DVC stakeholders within the technical analysis effort. However, the technical and community aspects of this process are deeply related with both necessarily informing the other. This process relies on the methodology and findings of the CVA's technical track being shared openly with community members during the outreach process, who will have the opportunity to share their feedback on the analysis and its implications for them as PG&E customers. This feedback *will* be explicitly incorporated in PG&E's official CVA work products.

D. Detailed Engagement Framework – What are the Specific Steps in the Engagement Process?

PG&E offers the following detailed framework for how CVA-related community engagement could flow. While it is focused on the specifics of engagement within a given region, it occasionally mentions important programmatic steps when needed for context.[16]

1. **Assemble a project team:** Armed with an RFP informed by DVC representatives at the program level, PG&E contracts with a highly qualified third party facilitator to develop a region-specific community engagement plan in collaboration with area stakeholders. The facilitator might be a CBO or a private business, but either way will be required to incorporate grassroots-level organizations into their approach and compensate them.

2. **Develop an outreach plan tailored to the region's needs:** Once established, the project team considers how to approach specific DVCs within a given region based on shared climate exposures and community characteristics, and the outreach tactics that would be most effective given the specific characteristics of each community grouping.
3. **Engage with vulnerable customers:** While the specific strategies utilized to engage with climate vulnerable customers will differ from region to region and potentially even community to community, the goals of engagement are consistent throughout – discuss how climate change will impact the resilience of the energy system and vulnerable communities, and how PG&E may contribute to community resilience through the energy system. The table below shows how this might work in a given region, relying on the State's recommended steps for climate vulnerability assessment to provide structure, starting with exposure and advancing through sensitivity and adaptive capacity to an understanding of overall vulnerability to various climate hazards.[17]

Potential Engagement Topics	Climate Hazard Exposure Today and in the Future	Energy System and Community Sensitivity to Climate Impacts and Existing Adaptive Capacity	Energy system and Community Climate Vulnerabilities – Discussion of Customer Perspectives on Adaptation	(Pause in engagement to allow for report synthesis)	Presentation of results, community feedback on report, community feedback on engagement process
Community Affiliation A	April week 1	May week 1	June week 1		October week 1

Community Affiliation B	April week 2	May week 2	June week 2		October week 2
Community Affiliation C	April week 3	May week 3	June week 3		October week 3
Community Affiliation D	April week 4	May week 4	June week 4		October week 4

4. **Share results and assess the effectiveness of engagement:** Once a regional assessment is complete PG&E will return to share results with the contributing communities. Additionally, PG&E will gather qualitative and quantitative feedback from engagement participants in order to learn how we can improve upon our process for engagement in the next region. .[18]

5. **Maintain relationships with community partners:** A key goal of this process for PG&E is broadening and deepening our relationships with organizations working to build climate resilience in the communities we serve. While it is difficult to anticipate the specific nature of continued engagement beyond the scope of the CVA, PG&E anticipates many opportunities for continued partnership as California collectively addresses increasingly severe and frequent climate-driven hazards.

Section 4. Finding Appropriate Partners – Qualifications and Roles in CVA Community Engagement

Overview: PG&E's CVA community engagement process is being led by PG&E's Climate Resilience Team. Given PG&E's existing capacity, this CEP recognizes the need for a qualified third-party facilitator with authentic relationships to CBOs and the communities they serve to support the process. While PG&E is ultimately responsible for choosing an organization to coordinate outreach in a given CVA region, PG&E intends to bring stakeholders into this critical part of the process by iterating with them on how to select the right outreach experts for the job.

A. PG&E CEP Project Team Qualifications – Who at PG&E is Responsible for this Effort?

PG&E's Climate Vulnerability Assessment is managed by PG&E's Climate Resilience Team as led by Heather Rock (Director, Climate Resilience).[19] Nathan Bengtsson (Principal, Climate Resilience) is the project lead for CVA community engagement and is assigned to this work full-time. Mr. Bengtsson will also be supported by a dedicated senior specialist for which the team is currently hiring.

Mr. Bengtsson was selected to lead PG&E's CVA community engagement effort having been deeply involved in the CPUC's utility climate adaptation proceeding and intimately acquainted with the requirements of Decision 20-08-046. Mr. Bengtsson does not have recent formal training regarding authentic engagement with traditionally marginalized populations. However, in addition to his knowledge of PG&E's climate adaptation initiatives and the requirements of the climate adaptation proceeding, he has participated in hundreds of hours of training related to diversity and inclusion, implicit bias, equity, and related issues of social justice and identity as an alumnus of Teach for America as well as the graduate-level CORO Fellows Program for Public Affairs. Both programs require participants to excel in full-time employment while also engaging with program content on nights and weekends. Additionally, Mr. Bengtsson's early career was spent at a public affairs firm specializing in public communications and outreach., giving him a strong basis in "traditional" community outreach approaches.

PG&E will update this CEP with qualifications of the person hired to fill the Senior Specialist position as soon as possible.

B. What Evaluation Criteria Are Most Important in Selecting a Qualified Third-Party Facilitator?

PG&E is a large company, so some stakeholders might question why PG&E would propose a community engagement approach that relies on third-party facilitation. The reality is that PG&E – and many other stakeholders – recognize that equity-centered outreach is not the Company's core competency. With this in mind, PG&E has a vision for the kind of expert outreach organization that would be ideal to support this effort. However, given the critical role this organization will play, PG&E is seeking input from representative DVC voices on how to evaluate potential outreach partners before it moves forward with selecting an outreach organization.

To select this community outreach organization, PG&E offers potential criteria in the table below as a starting point for discussion.

Potential Criteria	**Reasoning**
Legal and fiduciary considerations	PG&E has practical limitations on the types of organizations with which it can contract.
Demonstrated expertise regarding effective outreach to historically marginalized communities.	A core requirement given the nature of the effort.
Demonstrated success collaborating with CBOs on community outreach	A core requirement given the intent to share ownership with DVC participants to the greatest extent possible.
Scalability of services	Flexibility is important given the intent to accommodate community perspectives to the greatest extent possible. Additionally, there may be differing needs and levels of interest from community to community.
Demonstrated familiarity with local or regional adaptation initiatives	Ideally, a strong outreach partner would be aware of existing local and community-led climate adaptation efforts and incorporate these into the outreach approach.
Value/Affordability	The CPUC requires that the costs of this effort be "incremental" to existing PG&E outreach efforts, so some weight may be afforded to the proposed costs of qualified third party facilitation.
Equity and Inclusion	An outreach partner should demonstrate a successful track record of supporting equity, inclusion and diversity in their past work, and a commitment to ensuring an equitable approach is taken in CVA community engagement.
Geographic Location	It may be important to some stakeholders that potential partner organizations demonstrate their physical connection to a region or community, though this may be less important given that outreach may be conducted remotely due to COVID-19 considerations.
Demonstrated success synthesizing community input into high-quality synthesis products that elevate the perspectives of participants	One of the primary benefits for community members that participate in CVA community engagement is the opportunity to influence how PG&E considers climate adaptation from a customer perspective. A strong outreach partner should be able to demonstrate how they have effectively and coherently synthesized top-down and bottom-up together.
Other?	*Intentionally left blank in recognition of the many other criteria that may be of interest.*

C. How Will Stakeholders Come to Agreement on Partner Evaluation Criteria?

PG&E views reaching agreement on outreach partner evaluation criteria as a critical step in the overall CVA community engagement process and had hoped that the DACAG might be able to partner with PG&E on this and other important program-level considerations. However, PG&E understands that the DACAG has many priorities to manage and may not have the bandwidth or interest in partnering on this topic. In this case, PG&E proposes forming an advisory group composed of the ESJ stakeholders involved in the Climate Adaptation OIR itself. PG&E acknowledges that this also constitutes a demand on the time of these stakeholders and the organizations they represent, and is open to discussing whether this is interesting or even feasible with the representatives of CEJA, LCJA, APEN, Greenlining, and others that lent their voices to the Climate Adaptation rulemaking process.

V. Wrapping Up – CVA Community Engagement Goals and Outcomes Revisited

In PG&E's view, the goals of the CVA community engagement process can be summarized as:

- building trust with the communities we serve by meeting community members where they are and sharing ownership of the process to the greatest extent possible
- facilitating two-way communication between PG&E and vulnerable customers regarding the expected climate resilience *of* the energy system and how community resilience could be enhanced *through* the energy system.

This Community Engagement Proposal represents PG&E's best foot-forward regarding how the company and community stakeholders might work together to achieve these and other goals.

PG&E recognizes that these goals are distinct from specific outcomes and direct benefits that may be of interest to customers residing in DVCs. The chain of impact from this community engagement process to a specific adaptation project or resilience program is undeniably long; PG&E understands that some customers may not feel it is worth their time to participate. However, PG&E recognizes the value of customer perspectives and as such is committed to meeting DVC customers where they are to ensure their viewpoints are included in the CVA process, and in turn have the opportunity to inform PG&E's most important risk and investment plans filed with the CPUC.

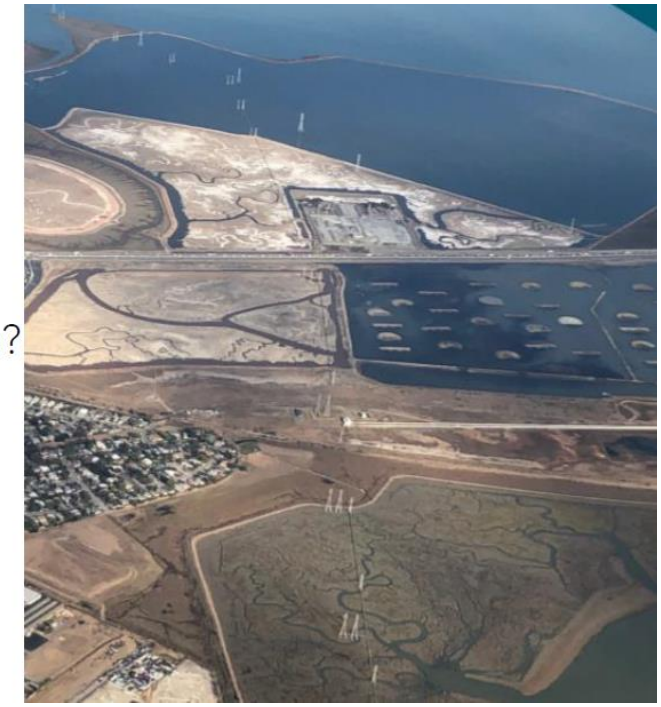
Finally, we are excited to explore what our customers are thinking, feeling, and doing about the physical impacts and risks of climate change in their communities, and how we can be responsive to customer needs as we invest in a climate resilient energy system on their behalf. PG&E looks forward to engaging with the Commission and stakeholders alike to make this effort a shared success.

Presentation Slides:

- Who works on PG&E's CEP?
- What has been done to-date?
- What happens next?

PG&E's Climate Vulnerability Assessment
Community Engagement Proposal (CEP)

March 19, 2021



Who works on CVA Community Engagement at PG&E?

Chief Executive Officer

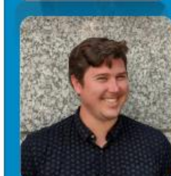
SVP of External Affairs

Chief Sustainability Officer

Corporate Sustainability

Climate Resilience

Heather Rock
Director, Climate Resilience
RACI: "Accountable" for CVA/CEP



Nathan Bengtsson
Principal, Climate Resilience
RACI: "Responsible" for CEP

Hiring
Senior Rep, Climate Resilience
RACI: "Responsible" for CEP tasks

What has been done to date? — CEP Goals Overview

CPUC Utility Climate Adaptation Decision (Aug 2020) → **PG&E Climate Vulnerability Assessment Planning (2020-2021)** → PG&E CVA Execution (2020 – 2024) → CVA-Informed RAMP Filing (2024) → General rate Case Filing (2025)

Track A: Technical Analysis (Climate Vulnerability Assessment)

Track B: Vulnerable Community Perspective (Community Engagement Proposal)

Proposed Process Goal Summary:

- **Practice** inclusive, equity-informed engagement

Proposed Outcome Goal Summary:

PG&E's CVA is informed by authentic, meaningful engagement regarding:

What has been done to date? — CEP Framework Overview

Bay Area	Inland South	Inland North	North Coast	South Coast
• North Bay • San Francisco • East Bay • Diablo • Mission • Peninsula	• Sacramento Delta • Stockton • Yosemite • Fresno • Kern	• North Valley • Sierra	• Humboldt • Sonoma	• De Anza • San Jose • Central Coast • Los Padres

Assemble Program-Level Partner Team → Assemble Region-Specific Partner Team → Execute Tailored Engagement Plan → Survey and Synthesize Findings → Revisit Findings with Community → Findings included in CVA

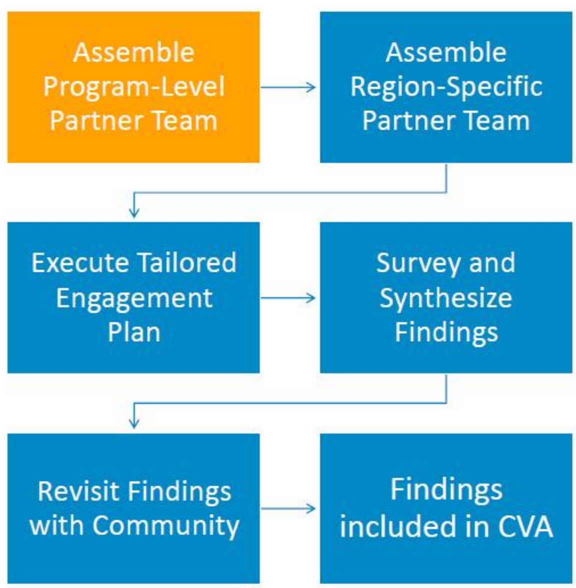
What has been done to date? Potential RFP Criteria

- PG&E's process requires qualified, equity-informed facilitation support
- PG&E looks forward to collaborating with ESJ stakeholders on criteria to help procure an excellent facilitation partner

Potential Criteria
Legal and fiduciary considerations
Demonstrated expertise regarding effective outreach to historically marginalized communities.
Demonstrated success collaborating with CBOs on community outreach
Scalability of services
Demonstrated familiarity with local or regional adaptation initiatives
Value/Affordability
Equity and Inclusion
Geographic Location
Demonstrated success synthesizing community input into high-quality synthesis products that elevate the perspectives of participants
Other?

What happens next?

Bay Area	Inland South	Inland North	North Coast	South Coast
• North Bay • San Francisco • East Bay • Diablo • Mission • Peninsula	• Sacramento Delta • Stockton • Yosemite • Fresno • Kern	• North Valley • Sierra	• Humboldt • Sonoma	• De Anza • San Jose • Central Coast • Los Padres



Appendix E: CAVA Responses to Order Instituting Rulemaking (OIR) (R.)18-04-019

Appendix E: CAVA Responses to Order Instituting Rulemaking (OIR) (R.)18-04-019

Pursuant to Order Instituting Rulemaking (OIR) (R.)18-04-019 to Consider Strategies and Guidance for Climate Change Adaption, PG&E has provided the following chart to identify where PG&E has addressed relevant Ordering Paragraphs from D. 20-08-046, *Decision on Energy Utility Climate Change Vulnerability Assessments and Climate Adaptation in Disadvantaged Communities (Phase 1, Topics 4 and 5)* as well as D. 19-10-054, *Decision on Phase 1 Topics 1 and 2.*

OP #	(D.) 20-08-046 Action	Section
#1a	Pacific Gas and Electric Company shall refer to disadvantaged communities in the utility climate adaptation context as “Disadvantaged Vulnerable Communities,” or “DVCs.”	Section 1; Section 2; Appendix C; Appendix D
#1b	The Commission adopts and PG&E shall apply the following definition of Disadvantaged Vulnerable Communities for this purpose: Disadvantaged Vulnerable Communities consist of communities in the 25% highest scoring census tracts according to the most recent version of the California Communities Environmental Health Screening Tool (CalEnviroScreen), as well as all California tribal lands, census tracts with median household incomes less than 60% of state median income, and census tracts that score in the highest 5% of Pollution Burden within CalEnviroScreen, but do not receive an overall CalEnviroScreen score due to unreliable public health and socioeconomic data.	Appendix D
#2	Place maps on their websites illustrating the service territory area covered by their respective Disadvantaged Vulnerable Communities	www.pge.com/climateresilience
#3	Define "adaptation context": The broad range of responses and adjustments to daily and extreme climate change-related events available to communities. This includes the ability and resources communities have to moderate potential damages, take advantage of opportunities, and cope with consequences.	Section 1; Section 2; Appendix C; Appendix D
#4	Consult with and consider advice from Disadvantaged Vulnerable Communities and the other parties to this proceeding (or successor proceeding) that submitted comments on the issue in determining levels of adaptive capacity.	Section 2; Appendix C; Appendix D
#5	Prepare, file, and serve in this proceeding (or successor proceeding) their Community Engagement Plans every four years, one year before the filing date of their vulnerability assessments.	--
#5	Provide the Director of the Commission’s Energy Division with a copy of the Community Engagement Plan on the date filed.	--
#5	The Community Engagement Plan shall be to identify and prioritize utility climate adaptation investments in Disadvantaged Vulnerable Communities (DVCs). The IOUs shall conduct community engagement in all DVCs.	Section 2; Appendix C; Appendix D
#5	The Community Engagement Plan shall include, at a minimum, the following:	--
#5a	Discussion of how PG&E promote equity relative to climate adaptation of their infrastructure, operations and services in DVCs based on the communities’ adaptive capacity.	Appendix D
#5b	Description of how PG&E personnel or consultant have been or will be trained in community engagement.	Appendix D

Appendix E: CAVA Responses to Order Instituting Rulemaking (OIR) (R.)18-04-019

#5c	Description of how PG&E will implement the Commission's existing Environmental and Social Justice Action Plan and Disadvantaged Communities Advisory Group Equity Framework.	Appendix D
#5c	PG&E shall consult with the Disadvantaged Communities Advisory Group (DACAG) and the relevant Commission staff when developing their Community Engagement Plans.	Appendix D
#5c	PG&E shall ensure their Community Engagement Plans are on an appropriate DACAG meeting agenda in time for meaningful review and to obtain feedback on the Community Engagement Plan.	Appendix D
#5c	PG&E shall include in their Community Engagement Plan a summary of the input received from parties to this proceeding (or successor proceeding), DVCs, and affected communities on the Environmental and Social Justice Action Plan Goals and Disadvantaged Communities Advisory Group Equity Framework.	Appendix D
#5d	Discussion that acknowledges and summarizes all input received from community-based organizations (CBOs), DVCs, and parties to this proceeding (or successor proceeding).	Appendix D
#5e	Discussion that gauges interest and availability of CBOs or other members of the community for meaningful leadership roles in the vulnerability assessments and climate adaptation, and discloses any CBO or community member interest in such roles.	Appendix D
#5f	Description of how PG&E will ensure communities and CBOs are involved in scope analysis, goal development, implementation, administration and review of the utility vulnerability assessments.	Appendix D
#5f	as well as taking leadership roles in their areas of expertise on vulnerability assessments and consideration of climate adaptation implementation in DVCs.	Appendix D
#5g	List of best practices relied upon for outreach after PG&E's conduct outreach to DVCs, CBOs and their representatives that have participated in this proceeding.	Appendix D
#5h	Where concerns exist that local government is not sufficiently engaged with its disadvantaged residents, PG&E's community engagement shall include persons or organizations that are non-governmental.	Appendix D
#5h	The Community Engagement Plans shall list the non-governmental organizations contacted and the reason contacted.	Appendix D
#6	When preparing Community Engagement Plans, Pacific Gas and Electric Company shall act as follows:	--
#6a	Meet with community-based organizations (CBOs), Disadvantaged Vulnerable Communities (DVCs), and parties participating in this proceeding (or successor proceeding) to develop an outline of what the Community Engagement Plans should include, using the outline attached hereto at Appendix C and the requirements set forth in this decision as a starting point for the discussion; and	Appendix D
#6b	Disseminate a draft of the Community Engagement Plan widely to all relevant CBOs, DVCs, and to parties on the service list of this proceeding (or successor proceeding) before filing the plan in this proceeding for comment.	--
	The final version of the Community Engagement Plan filed with the Commission shall summarize the input on the draft by DVCs, COBs, and parties on the service list of this proceeding (or successor proceeding).	--
#7	Include the results of the surveys in a survey report.	Appendix C

Appendix E: CAVA Responses to Order Instituting Rulemaking (OIR) (R.)18-04-019

#7	The IOUs shall file and serve the survey reports on the service list of this proceeding (or successor proceeding), DVCs, and relevant COBs	Appendix C
#7	The IOUs shall attach a copy of the prior survey report to the subsequent Community Engagement Plan when filed in this proceeding (or successor proceeding). In preparing the survey report, the IOUs shall, at a minimum, act as follows:	Appendix C
#7a	Assess and describe in the survey report the effectiveness of the community outreach and engagement discussed in this decision.	Appendix C
#7b	Ask communities and individuals to which PG&E has conducted outreach and community engagement if the outreach and community engagement was effective in helping them with the vulnerability assessment process. Include results in the survey report.	Appendix C
#7c	Provide survey responses in the survey report categorized by type of outreach – e.g., community meetings, over the air broadcast information, social media, print media, etc. – so that there is data in the proceeding showing what outreach and community engagement is most effective that the Commission and stakeholders may use to direct future outreach.	Appendix C
#7d	Prior to conducting the survey, PG&E shall gather input from the parties to this proceeding on appropriate survey questions and methodology through a meet and confer process that is open to all parties. This meet and confer process shall conclude no later than 30 days before the surveys are conducted.	Appendix C
#7e	Use metrics to determine the reach of PG&E's outreach and community engagement efforts.	Appendix C
#7e	One set of metrics shall be quantitative in nature, and include data related to website visits, click rates, conversions, in-person meetings, radio spots, number of partners, number of customers reached, customer acknowledging information, read receipts, video shares, and other quantitative measurement.	Appendix C
#7e	Another set of metrics shall document comprehension of the vulnerability assessment process.	Appendix C
#7e	Such metrics can be more qualitative in nature and include metrics collected from surveys and post-event interviews/sessions with stakeholders and partners.	Appendix C
#7e	Metrics shall capture satisfaction with outreach and engagement from the utility, understanding of information and whether communities or individuals feel equipped to act, and whether communities or individuals feel connected to resources relevant to vulnerability assessments.	Appendix C
#7e	The metrics and the results shall be included in the survey reports.	Appendix C
#8	Pacific Gas and Electric Company shall take the lead on the development of vulnerability assessments related to their infrastructure, operations and services.	Section 1; Section 3
#9	Pacific Gas and Electric Company shall file every four years, as detailed herein, a vulnerability assessment that includes, at a minimum, the following:	--
#9a	Consider and identify climate risks to PG&E operations and service as well as to utility assets over which PG&E has direct control.	Section 1; Section 3

Appendix E: CAVA Responses to Order Instituting Rulemaking (OIR) (R.)18-04-019

#9a	In addition to reviewing its infrastructure, PG&E shall conduct an exposure analysis on all its services and operations as a means of identifying in the vulnerability assessment which operations and services it shall include for further analysis.	Section 3.2
#9a	The vulnerability assessments shall include an array of options for dealing with vulnerabilities, ranging from easy fixes, where applicable, to more complicated, longer term mitigation, and an indication of PG&Es plans for potential next steps.	Section 3; Section 4
#9b	Identify facilities they have third-party contracts with for power, capacity, or reliability in their vulnerability assessments.	Section 3.3
#9b	During the vulnerability assessment process, PG&E shall communicate with the operators of these third party contract facilities and ask them to report the facility's exposure to climate risk.	Section 3.3
#9b	In the vulnerability assessment, the risk assessment shall include any exposure to climate risks that facility operators report,	Section 3.3
#9b	and PG&E's contingency planning in case the third-party asset experiences failure due to climate change.	Section 3.3
#9c	Address the key time frame to be considered by the vulnerability assessment of the next 20–30 years.	Section 1; Section 3
#9c	Also address the intermediate time frame of the next 10-20 years and the long-term time frame of the next 30–50 years.	Section 1; Section 3
#9d	Consider and identify the green and sustainable remedies for the vulnerable infrastructure identified in assessing mitigation measures in the vulnerability assessments.	Section 1; Section 3; Section 4
#9e	Include an analysis of how PG&E promotes equity in Disadvantaged Vulnerable Communities (DVCs) based on the communities' adaptive capacity.	Appendix C
#9e	PG&E shall also address whether extra funding for this purpose is or will be sought and shall identify extra outreach and education needed so that PG&E promote equity in the DVCs.	Appendix D
#9f	Include in the vulnerability assessments the plan for engaging DVCs and providing for community engagement work that allows community-based organizations, community members, and government entities in those communities to participate in vulnerability assessments in their areas of expertise by, among other things, suggesting sources of data or other information to be used in the assessments, reviewing and contributing to the text of vulnerability assessments, and commenting on the vulnerability assessments.	Appendix D
#9g	Include a summary of PG&Es community engagement with DVCs before, during, and after the process of completing the vulnerability assessment and attach the previously filed Community Engagement Plan.	Appendix D
#9h	Address in the vulnerability assessments "actual or expected climatic impacts and stimuli or their effects on utility planning, facilities maintenance and construction, and communications, to maintain safe, reliable, affordable and resilient operations," as required by Commission Decision 19-10-054, Ordering Paragraph No. 1.	Section 1; Section 3

#9i	Use DWR's two-step vulnerability assessment methodology that 1) combines exposure and sensitivity to determine risk, and 2) combines risk and adaptive capacity to determine vulnerability.	Section 1; Section 3
#9j	Include off-ramps for assets with low climate risk but also a mechanism to reassess assets that may require further risk assessment as climate risks change.	Section 1; Section 3
#9k	Consider the following minimum set of criteria in the vulnerability assessments (each item below is followed by examples that provide illustrative context; this does not constitute a comprehensive list):	--
#9k.i	a. Temperature: PG&E shall analyze hourly maximum temperature and also evaluate other temperature changes for their impacts on infrastructure, operations and personnel.	Section 1; Section 3; Appendix A; Appendix B
#9k.ii	b. Sea level: PG&E shall consider height of high tide sea level and also evaluate contingencies like the impact of storm surge, king tides, salt corrosion, etc.	Section 1; Section 3; Appendix A; Appendix B
#9k.iii	c. Variations in precipitation: Variations in precipitation include, among other things:	Section 1; Section 3; Appendix A; Appendix B
#9.k.iii.a	i. Snowpack – precipitation falling as rain instead of snow increases short-term water flow into hydroelectric dams while decreasing water flow later in the season, impacting hydroelectric generation.	Section 1; Section 3; Appendix A; Appendix B
#9.k.iii.b	ii. Extreme precipitation events – bigger storms pose a threat to PG&E assets and operations.	Section 1; Section 3; Appendix A; Appendix B
#9.k.iii.c	iii. Long-term precipitation trends – higher or lower long-term precipitation may impact localized flooding and hydroelectric generation, among other important factors.	Section 1; Section 3; Appendix A; Appendix B
#9.k.iii.d	iv. Drought – drought may impact hydroelectric generation, and act as a compounding factor on other risks, such as wildfires and subsidence.	Section 1; Section 3; Appendix A; Appendix B
#9.k.iii.e	v. Subsidence – decreased groundwater may cause localized subsidence, posing a physical threat to infrastructure as the ground shifts.	Section 1; Section 3; Appendix A; Appendix B
#9.k.iv	d. Wildfire: PG&E shall use wildfire risk assessments from other proceedings in their vulnerability assessments.	Section 1; Section 3; Appendix A; Appendix B
#9.k.v	e. Cascading impacts: PG&E shall consider cascading impacts (e.g., wildfires burn hillsides and rainstorms cause mudslides) that have multiple negative impacts that are greater than the sum of the parts relevant to their service territory.	Section 1; Section 3; Appendix A; Appendix B
#10	Pacific Gas and Electric Company shall file a Tier 1 Advice Letter with the Commission's Energy Division to establish a memorandum account, titled "Climate Adaptation Vulnerability Assessment Memorandum Account – CAVAMA" for the purpose of tracking costs directly related to the vulnerability assessments and any incremental costs related to the community engagement, the Community Engagement Plans, and the related community engagement surveys ordered in this decision.	--
#10	The effective date of the memorandum account shall be the date the Tier 1 Advice Letter is filed.	--
#10	The memorandum account shall not be used for other costs or assessments.	--

#14	Take steps to identify risks and obtain information from the facility operator when IOUs sign new contracts for power, capacity or reliability Beginning with contracts executed in in 2022 when PG&E enters a new long-term contract of 15 years or more for power, capacity, or reliability.	Section 3.3
#14	PG&E shall seek to obtain an acknowledgment in the new contract that the operator has considered long-term climate risk.	Section 3.3
#14	PG&E shall include, if available, a facility safety plan considering climate risks when PG&E submits the power purchase agreement to the Commission for approval.	Section 3.3
#14	A statement that PG&E engaged in this due diligence shall be included in PG&Es assessment of risk for that particular asset.	Section 3.3
#14	If PG&E is unable to obtain this information, PG&E shall demonstrate in its submissions of the power purchase agreement to the Commission that it exercised reasonable efforts to obtain it and provide the reason those efforts were unsuccessful.	Section 3.3
#14	PG&E must include a chart in their vulnerability assessment with the names of all third party contact facilities, whether or not the facility provided a safety plan and acknowledgement and if not, what was the reason.	Section 3.3

OP #	(D.)19-10-054 Action	Section
#3	The energy utilities shall adhere to at least the same climate scenarios and projections used in the most recent California Statewide Climate Change Assessment when analyzing climate impacts, climate risk, and climate vulnerability of utility systems, operations, and customers.	Section 1; Appendix A; Appendix B
#3	Third party analyses or datasets used by the energy utilities should be derived from or based on the same climate scenarios and projections as the most recent Statewide Climate Change Assessment.	Section 1; Appendix A; Appendix B
#3a	The Fourth Assessment uses 10 Global Climate Models and two Representative Climate Pathways to simulate California's historical and projected temperatures, perception, and other climate outcomes such as relative humidity and soil moisture.	N/A
#3b	If the Fifth Assessment or future Assessment updates these climate scenarios and projections, the energy utilities shall align their analyses with the newly adopted scenarios and projections.	N/A
#4	Use the business-as-usual Representative Concentration Pathways 8.5 for planning, investment, and operational purposes.	Section 1; Appendix A; Appendix B
#5	Prioritize peer-reviewed methodologies over non-peer reviewed methodologies.	Section 1; Appendix A; Appendix B
#6	If the Fifth Assessment or a future Assessment updates these models, representative concentration pathways, climate scenarios or projections, the energy utilities shall align their analyses with those updates by filing a Tier 3 Advice Letter with Energy Division within six months of the new Assessment update.	N/A