

Wildfire Program Governance

October 23, 2020



Together, Building
a Better California



Safety



Earthquake

Duck, Cover & Hold



Speak Up Environment

Safe space for inclusive, open & honest dialogue



24/7 Nurse Care Line

If you experience a work-related discomfort or injury, call 1-888-449-7787 and notify your supervisor.



Wash your hands!



Wear a Mask



Practice social
Distancing

Meeting Agenda

Date:	10/23/2020			
Desire Outcomes:	<ul style="list-style-type: none">• Inform: Start governance process for the team• Decide: Identify lead for inspections workstream• Decide: Approve or identify gaps in wildfire risk model			
Meeting Agenda				
What - Content		Who - Facilitator(s)	Page(s)	Duration
1	Introduction and safety moment	Andy Abranches	2	5 min
2	Wildfire governance committee charter and structure	Andy Abranches	3-6	5 Min
3	Review of worksteam expectations and timeline	Andy Abranches	7-8	10 Min
4	Overview of wildfire risk model	Jon Eric Thalman	9-11	15 Min
5	Model Validation and Approval	Jon Eric Thalman, Andy Abranches	12-18	25 Min

Wildfire Risk Governance will support the effective and efficient execution of key mitigation programs

The Wildfire Risk Governance forum will support:



Ensuring mitigation implementation aligns to overall organizational objectives of aggressive risk reduction



Assessing effectiveness and prioritization across work-streams



Standardizing activities, deliverables, and reporting to develop justifications and documentation needed for internal and external communication



Coordinating efforts of cross-functional teams to support ongoing activities

Wildfire Governance Steering Committee Charter

Meeting Purpose:

Drive decision making on:

- **Risk:** Ensure that there is alignment on the approved risk frame in use to guide the work. Provide a forum to review key risk based assumptions and associated impacts
- **Work:** Ensure workplan is comprised of the highest priority, risk-mitigating work consistent with investment & asset strategy.; guide choices as needed

Immediate impacts:

- Integrate individual wildfire mitigation workstream meetings into a single governance session

Meeting topics and supporting material will adjust based on discussion and request from Voting Members

Attendees:

- **Chair:** Chief Risk Officer
- **Voting Members:**
 - VP, Asset, Risk Management & Community Wildfire Safety Program
 - VP, Major Projects and Programs, Electric Operations
 - VP, Wildfire Safety and Public Engagement
 - VP, Chief Audit Officer
- **Non-Voting Members:**
 - Sr. Director, Electric Asset Strategy
 - Sr. Director, Major Programs & Project Delivery
 - Sr. Director, Veg Management
 - Director, CWSP & WMP
- **Workstream Leads:**
 - System Hardening: Director, Distribution Strategy
 - Enhanced Vegetation Management: Director, Vegetation Management
 - Inspections: **TBD**
- **Facilitator:**
 - Sr Director, Electric Business Operations

How decisions are made:

- 50% of voting members must be in attendance for decision to be made
- A simple majority vote by attending committee members
- Tie-breaker: Chair hold the tie break vote tie

Meeting Logistics:

- **Frequency/Duration:** Weekly (Every Friday)
- **Materials:**
 - Pre-read materials sent 1 day before meeting;
 - Action items/meeting minutes sent within 2 days *after* meeting.
- **Agenda:** Sr. Director, EBO to approve final agenda.

The following individuals have been identified as representatives from each function to be part of this effort

Steering Committee and Implementation Team Leadership

Steering Committee

Voting Members

Facilitation and PMO

Andy Abranches,
Sr. Director, EO Business Ops
Project Coordinator

Ryan Flynn-deOnis
KPMG
PMO

Sumeet Singh,
Chief Risk Officer

Debbie Powell,
VP, Asset, Risk Management &
Community Wildfire Safety Program

Ahmad Ababneh,
VP, Major Projects and Programs
Electric Operations

Aaron Johnson,
VP, Wildfire Safety and
Public Engagement

Mark Esguerra,
Sr. Director,
Electric Asset Strategy

Jonathan Seager,
Sr. Director, Major Programs &
Project Delivery

Michael Ritter,
Sr. Director, Veg Management

Matt Pender,
Director, CWSP & WMP

Workstream Leadership

System Hardening

Jeff Borders,
Director, Distribution Strategy

Inspections

TBD

Enhanced Vegetation Management

Matt Sanders,
Director, Vegetation Management

Steering Committee Responsibilities

The steering committee will be responsible for the oversight of the individual workstreams as well as approval of 2021 risk-informed work plan for System Hardening, Inspections and Enhanced Vegetation Management and other governance related activities. The full steering committee will discuss key decisions, with ultimate accountability being held by the voting members.

The governance structure will provide close support for the workstreams and regular feedback and approvals



Steering Committee

A cross functional risk steering committee to provide oversight and approval for workstreams focused on:

- Ensuring key programs for the wildfire mitigation work address the highest risk areas
- Operationalizing and implementing most effective RSE mitigations



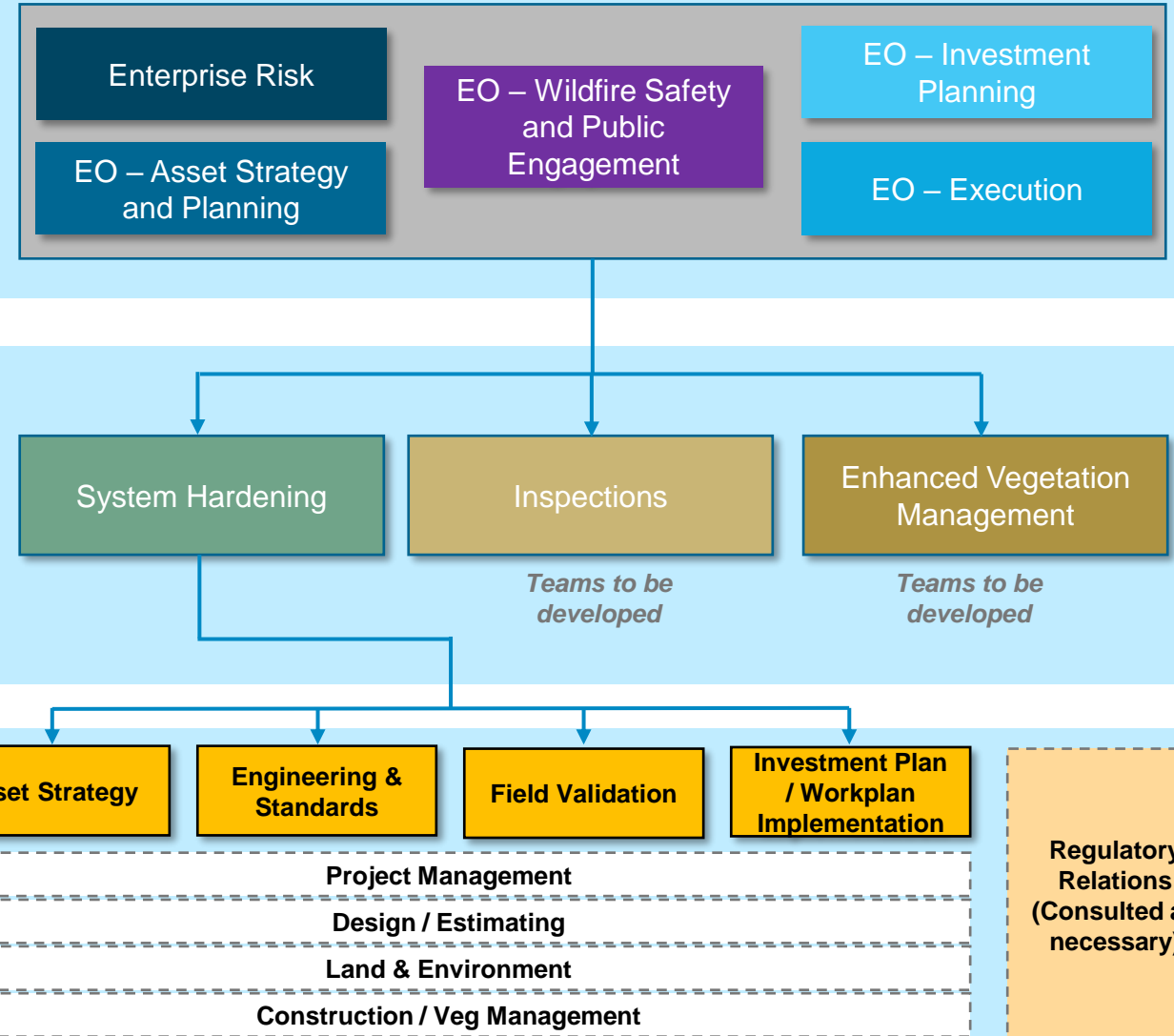
Implementation Teams

Dedicated workstreams oversee key activities, deliverables and reporting for each program



Cross Functional Support

Cross functional teams support the ongoing workstream activities and provide detailed Subject Matter Expert input and analysis



Each workstream will be responsible for answering the following key questions

System Hardening

1. What is the list of projects that are going to get worked ?
2. For each project how did the team arrive at the most effective mitigation work?
3. Relative to the overall unmitigated wildfire risk – what percentage of risk will be eliminated under the current approved risk model?

Deliverable:

- Full list of projects for 2021 and type of mitigation proposed for each project
- Percent risk reduction expected based on the project list

Enhanced Vegetation Management

1. What are the circuit protection zones targeted within the budget allotment?
2. How did the team arrive at the most effective mitigation type?
3. What percentage of risk will be eliminated under the current approved risk model?
4. How does this work and system hardening work complement each other and combined how much wildfire risk reduction is eliminated?

Deliverable:

- List of circuit protection zones targeted and proposed type of mitigation
- Percent of risk reduction expected from the full portfolio of work

Inspections

1. What are the volumes of Tier 3 and Tier 2 Inspections that are planned for 2021?
2. What are the volumes of Tier 1 Inspections that are planned for 2021? How has risk been incorporated to determine the plan
3. What are the various types of inspections that will be used for Tier 2/3 and how has this be informed by the work completed in 2019 and YTD 2020?

Deliverable:

- Inspection plan for each Tier (1,2,3) for 2021 execution

The initial sprint will cover 8 weeks to review the proposed 2021 wildfire mitigation work plans

Activities		Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8
1	Evaluation of risk governance organization proposal								
2	Standardization of high-level workstream assessment frameworks								
3	Information gathering and presentation development for individual workstream work prioritizations								
4	Final review and approvals of proposed workstream risk models and portfolios								
5	Documentation of finalized risk models, portfolios, and teams								

Key Stage-Gates		Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8
1	Assessment of standardized wildfire risk model								
2	Review of workstream assessment framework								
3	Workstream assessment and prioritization review								
4	Individual workstream work prioritization approval								
5	Documentation and justification review								

Risk Model Overview



Objective and Outline

Objective: Committee has clear and common understanding of the improved capabilities and areas for future improvement of the 2021 Distribution Risk Model to the end that the model can be approved for use in developing 2021 workplans

Mission: The mission of the Risk and Data Analytics team is to:

- Empower mitigation work to focus on locations where risk is concentrated
- Enable risk-informed decision making workplans and in the budget planning process
- Allow PG&E to track and report risk reduction to regulatory entities

Outline:

- Model Improvements
- Model Performance
- Model Insights



Improvement of Distribution Wildfire Risk Models

Main Improvements:

1. Risk score for measurement and prioritization – improved statistical and machine learning methods along with data sets that better describe factors attributed to ignitions and fires
2. Wildfire consequence model that better predicts historical destructive wildfires
3. Model granularity – base level is 100 meter pixel level that can be aggregated to circuit protection zones or circuits or higher
4. Risk score is calibrated to the System MAVF risk scores used in the RAMP filing

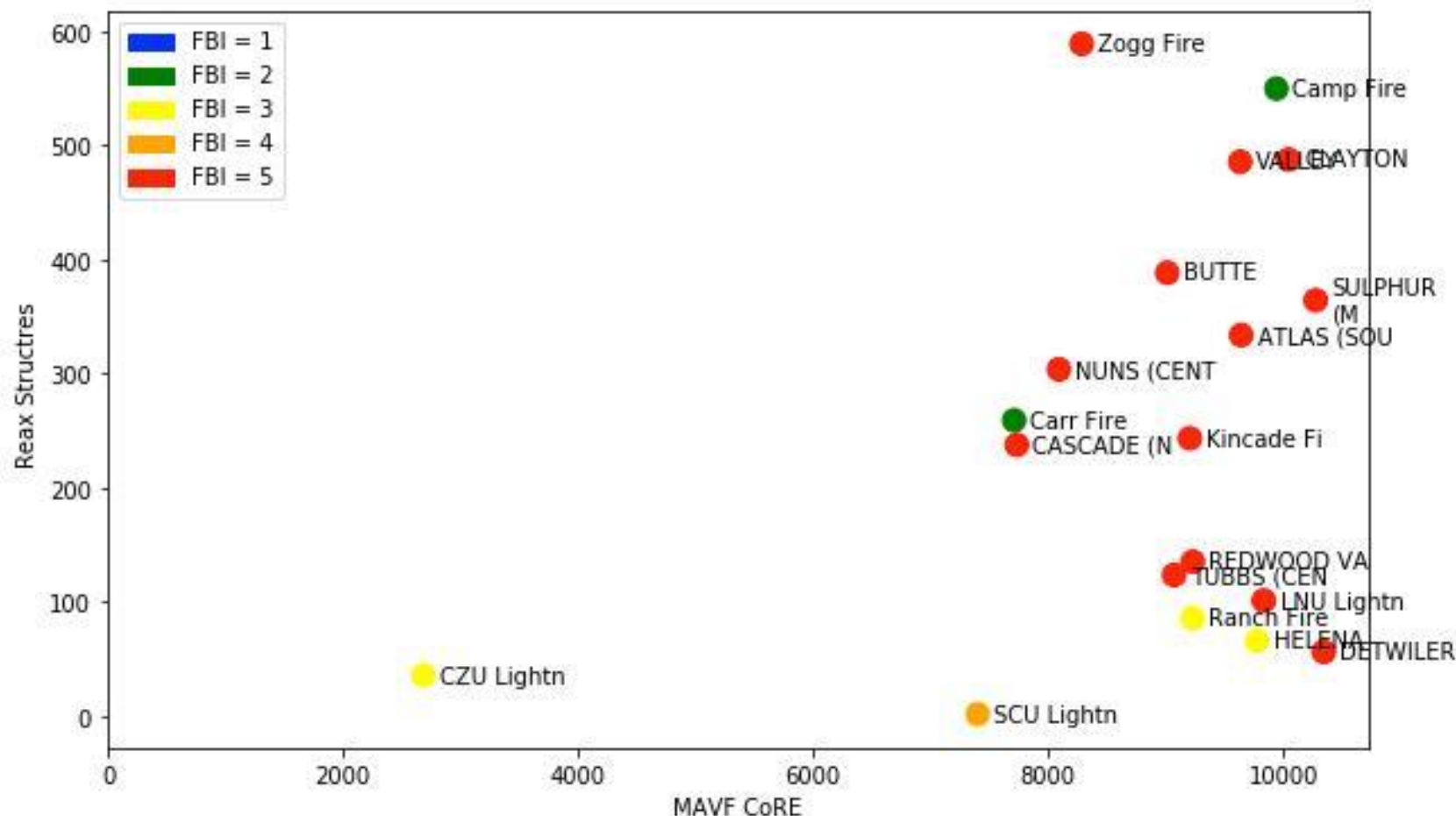
Short-comings, future improvements:

1. Establishing external validation process
2. Re-introducing an egress as part of the wildfire consequence model
3. Ability to measure mitigation risk reduction at a project/circuit protection zone level
4. Combine veg and equipment risk model to form composite model view of combined risk at a point on the distribution grid. This will provide the ability to compare mitigations.

Wildfire Consequence - Comparison of REAX Structures and MAVF CoRE Consequence Data Sets

Technosylva based wildfire consequence data better identifies historical destructive fire locations

MAVF CoRE vs Reax Structures (10km Max) of destructive fires



REAX

- Previous models used the REAX wildfire consequence model
- Relies on fuels as a main parameter to determine wildfire spread
- REAX scores a portion of historical fires high

MAVF CoRE

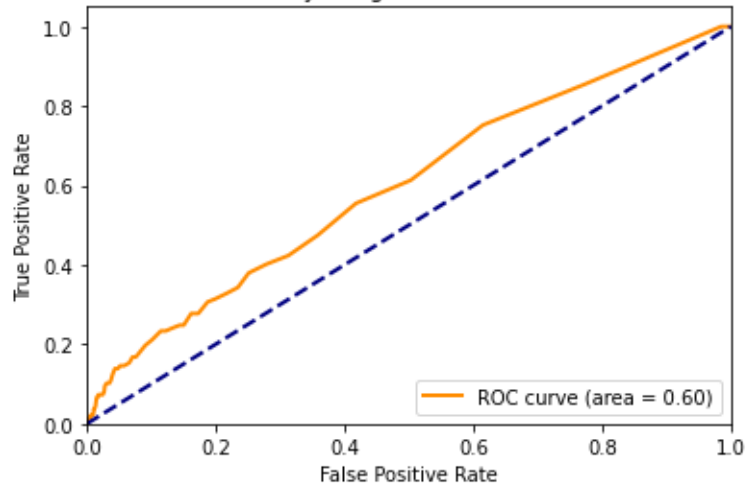
- Uses the Technosylva model which models ladder effect of fire moving from grass to scrub to tree-tops
- MAVF scores most historical catastrophic fires high

Probability of Equipment Caused Ignition

Modeling improvements have resulted in a marked improvement in predictive capability

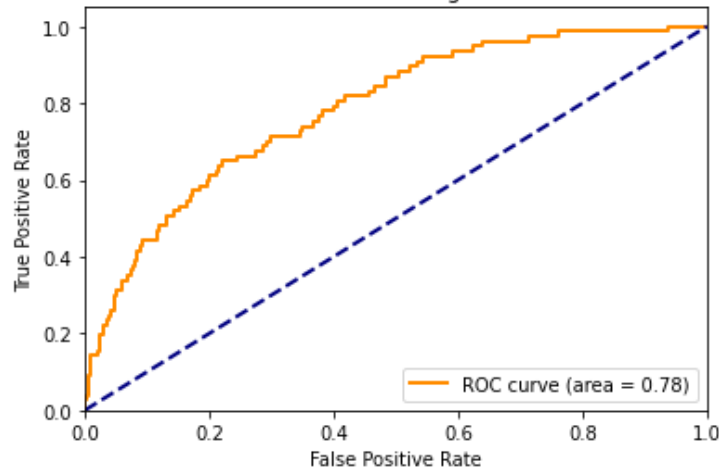
2019 Distribution Model

Receiver operating characteristic
2018 full year ignitions - KPMG model



2021 Dx Model

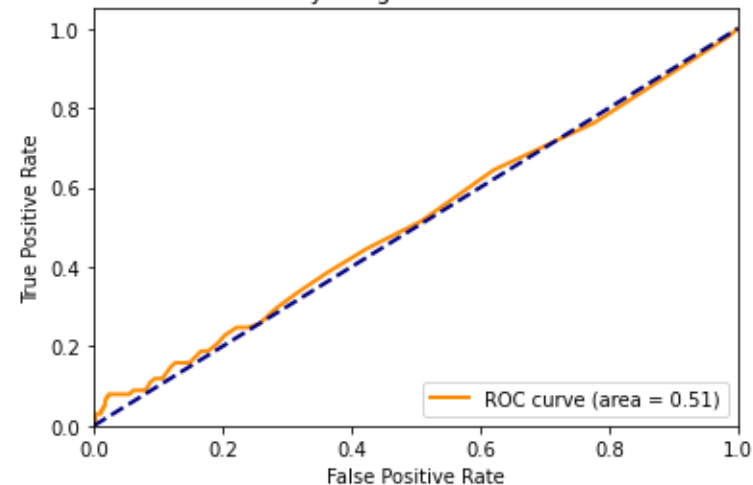
Receiver operating characteristic
2018 wildfire season conductor ignitions - DXARM model



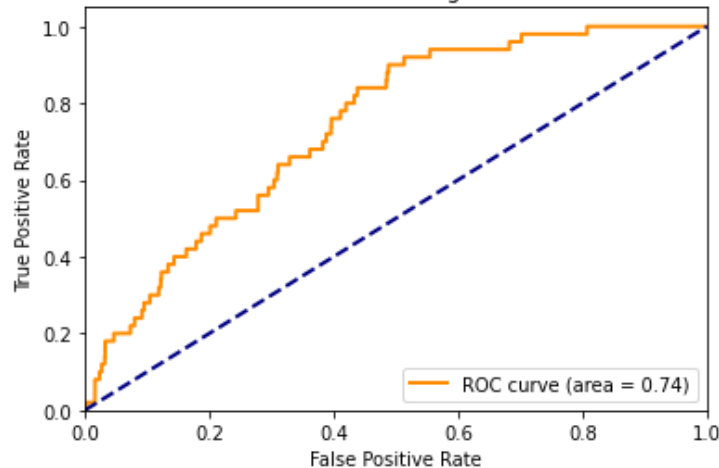
Model Comparison

- Although the 2019 model did not document a precision metric, an AUC measure was calculated using the actual 2018 and 2019 ignitions.
- Comparing the 2019 Distribution Model on the left to the 2021 Dx Model results on the right, model improvements have **resulted in a marked improvement in predictive capability.**

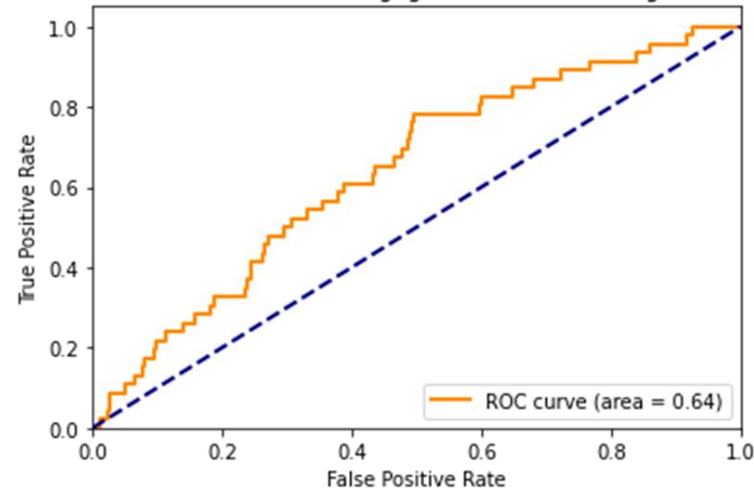
Receiver operating characteristic
2019 full year ignitions - KPMG model



Receiver operating characteristic
2019 wildfire season conductor ignitions - DXARM model

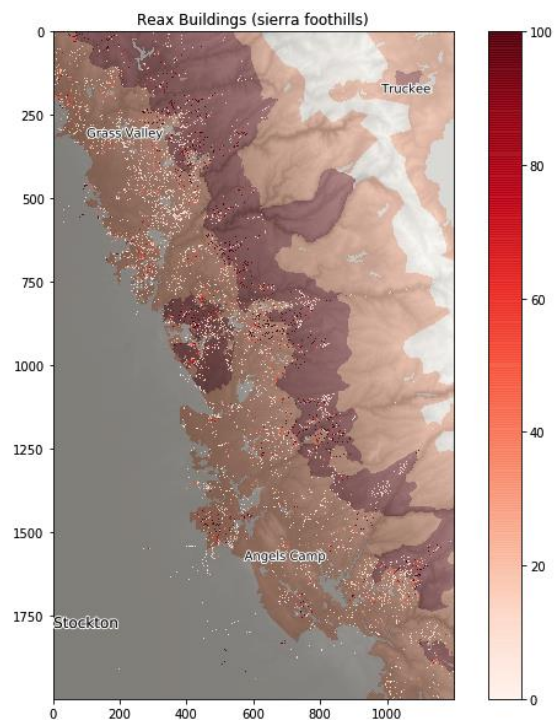


Receiver operating characteristic
2019 wildfire season veg ignitions - DXARM veg model

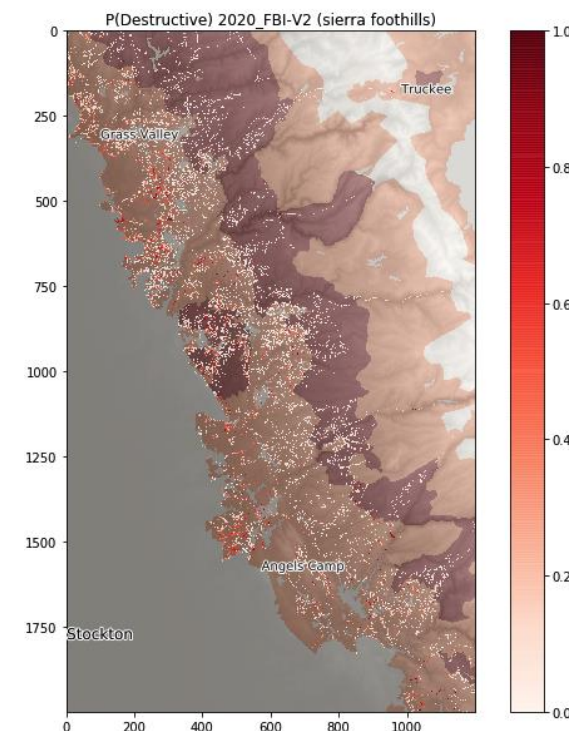


Wildfire Risk (REAX vs. Technosylva)

REAX identifies highest risk in tree dense areas based on fuels



MAVF identifies locations in the foothills based on ability of ignitions to 'ladder' from grass to Chaparral to trees more readily

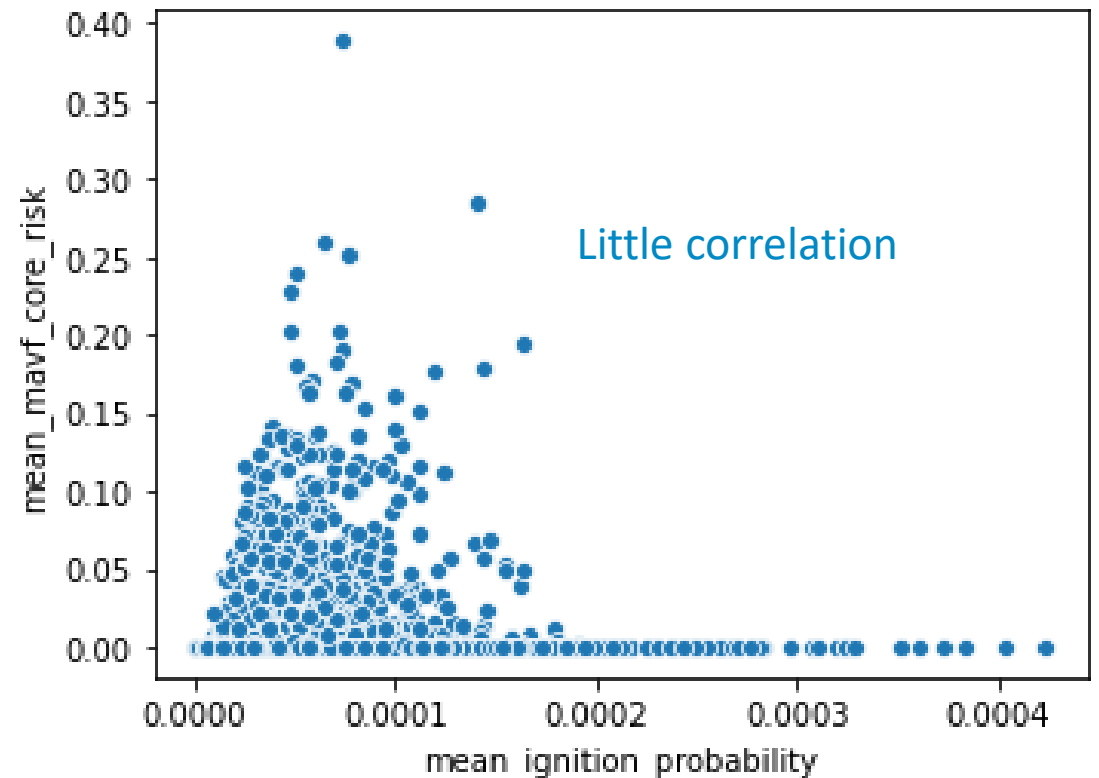
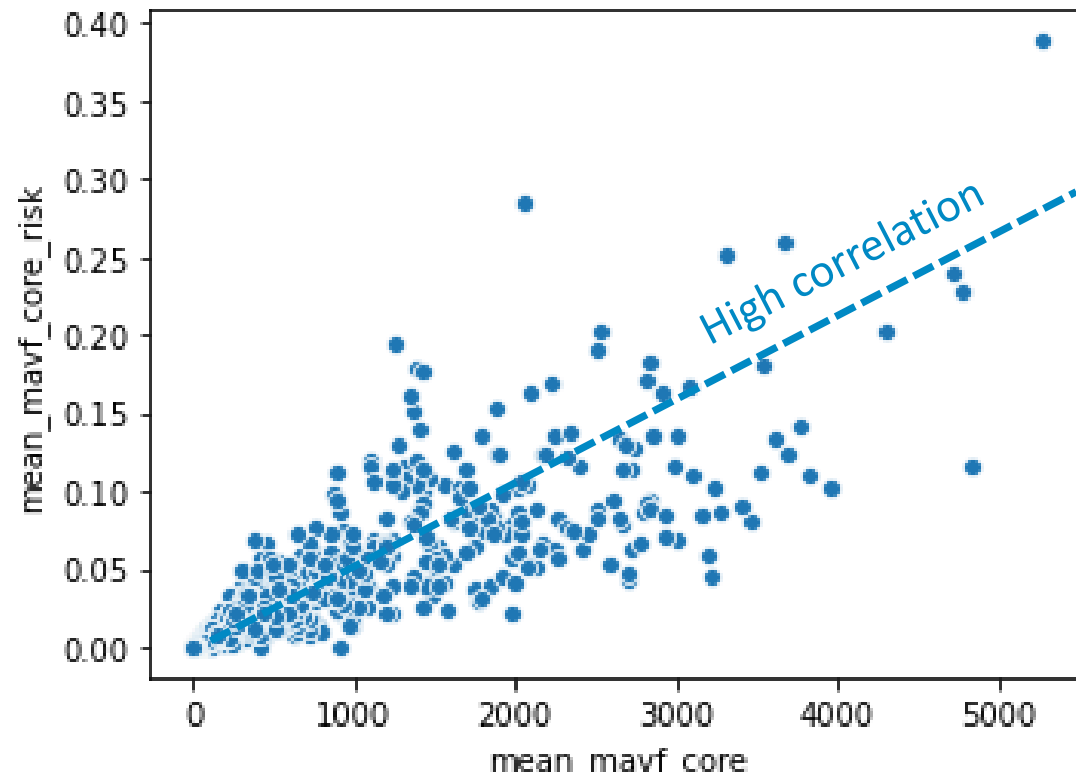


Key Insights

- While densely forested areas have the fuels to support a catastrophic fire, it is **more difficult for an ignition to propagate** to the tree-tops where the fuel resides.
- Foothill regions have an even higher wildfire consequence due to the more readily available fuel ladder to tree-tops.
- **Wildfire risk and vegetation ignitions are not highly correlated.**
- In many areas of highest wildfire risk the probability of ignition is low. Therefore, **mitigations to reduce the probability of an ignition may have a marginal impact on reducing overall wildfire risk.**
- Vegetation ignitions are still highly correlated with trees and fuels.
- Conductor ignitions are correlated with conductor type and age.

Vegetation Failure Risk Model Identifies that Vegetation Ignition Probability and Wildfire Risk are not tightly correlated

- Risk scores are dominated by consequence values – Wildfire spread and Wildfire risk are highly correlated
- Little correlation between ignitions and wildfire risk - a program focused on wildfire risk reduction may not reduce the number of ignitions



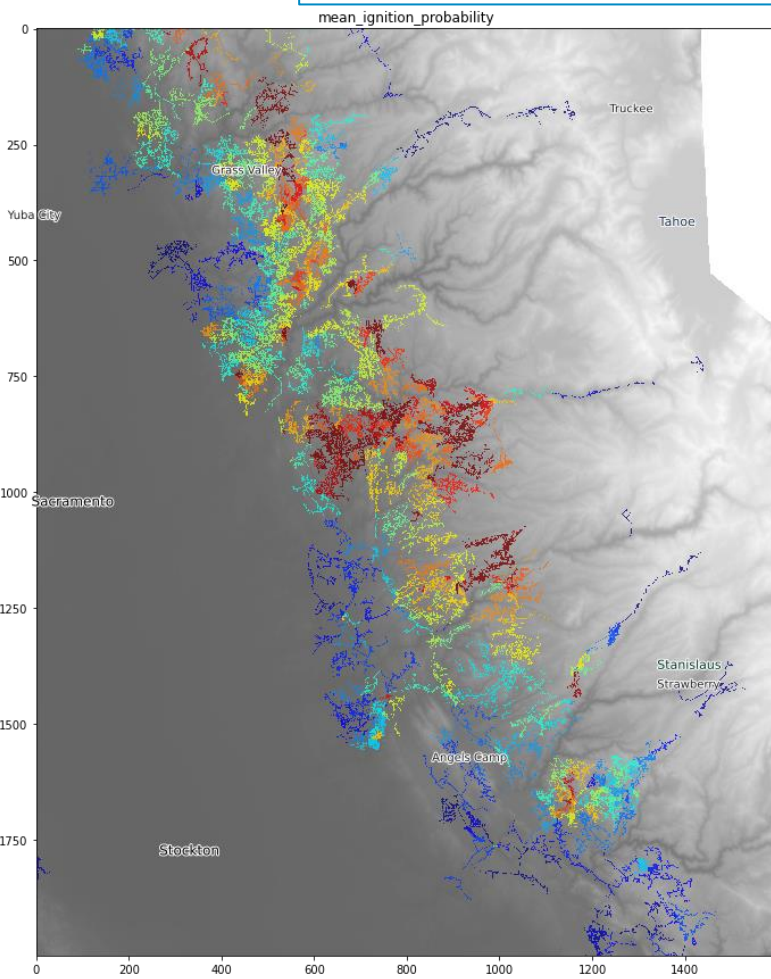
3 most important variables for vegetation caused ignition:

1. Tree height
2. Dryness (atmospheric)
3. Fuel content

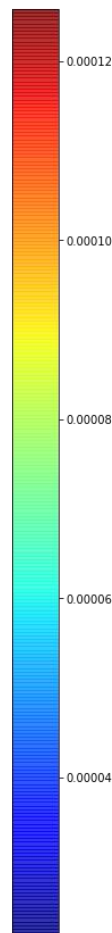
Variable	Permutation importance
tree-height-max	26.1
100-hour-fuels-avg	24.1
vapor-pressure-deficit-avg	21.6
gusty-summer-day-pct	6
hftd	4.2
precipitation-avg	3.1
impervious	2.8
specific-humidity-avg	2.4
burn-index-avg	2.3
wind-max	1.9
temperature-avg	1.6
windy-summer-day-pct	1
local-topography	0.8
tree-height-avg	0.8
1000-hour-fuels-avg	0.6
energy-release-avg	0.4
wind-avg	0.2

Vegetation Caused Ignition Insights

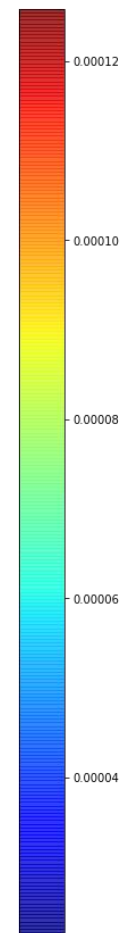
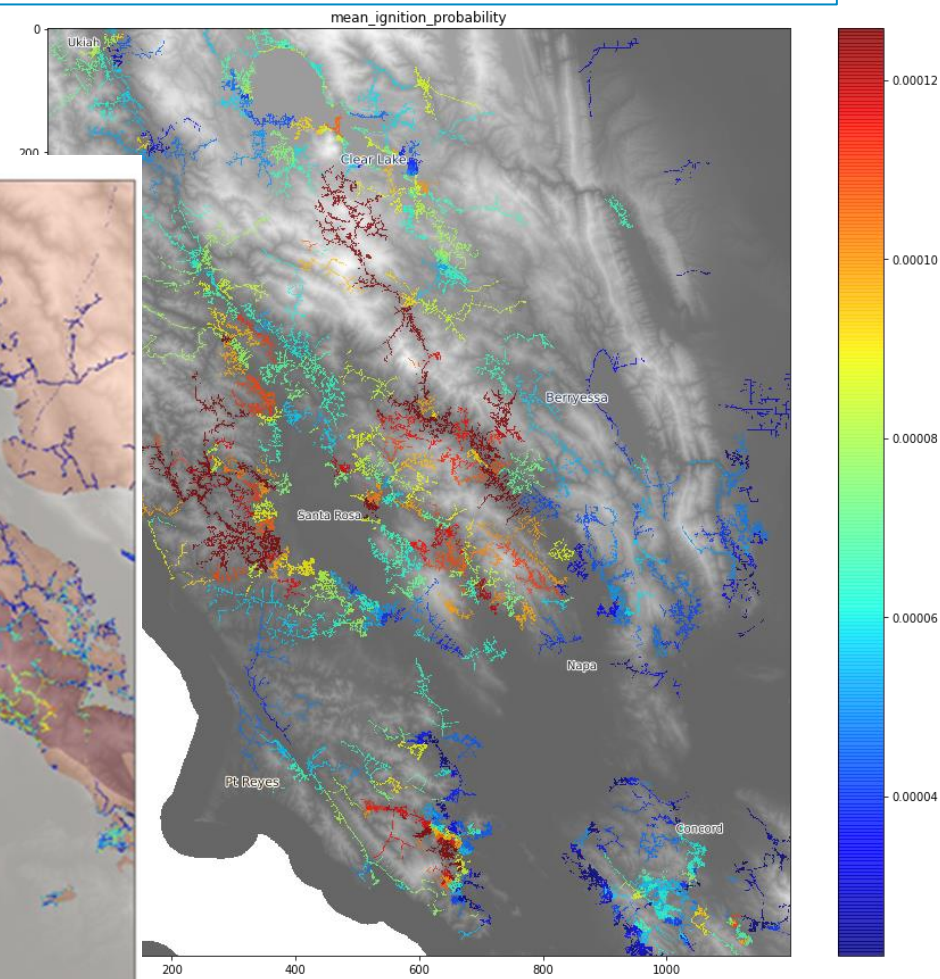
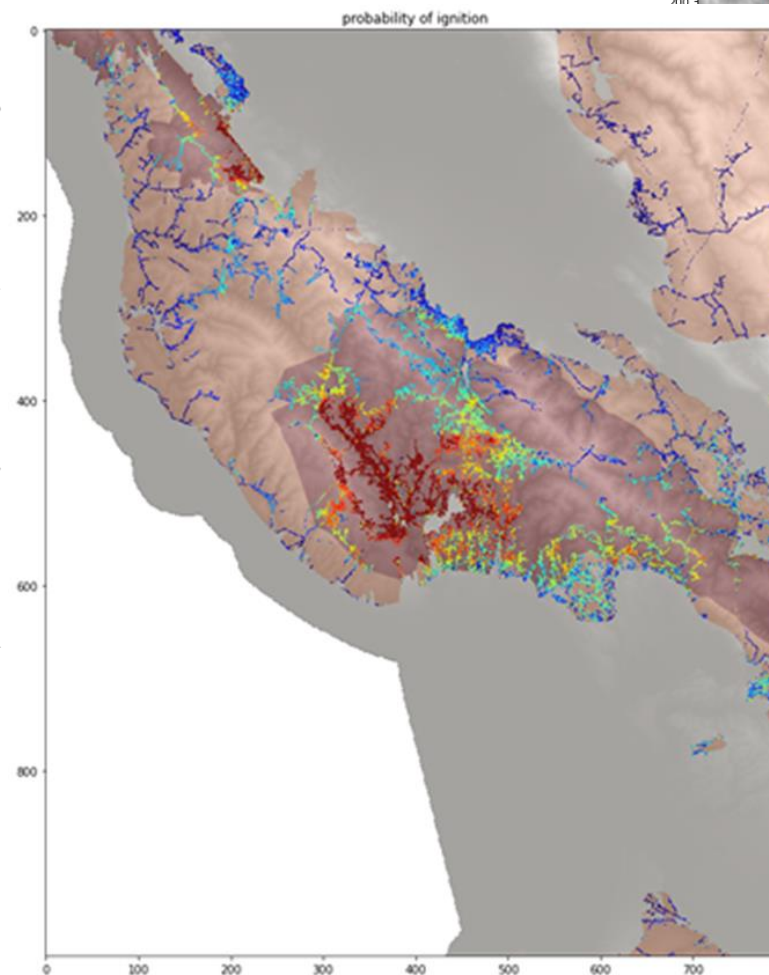
Protection zones with highest ignition probabilities are highlighted in red and orange



Sierra Foothills



Santa Cruz Mountains



Bay Area

Model Insights – Conductor Caused Ignition Probability

3 most important variables for conductor caused ignition:

1. Ground type (unburnable)
2. Average Precipitation
3. Conductor Age

Variable	Percent contribution	Permutation importance
unburnable	28.1	30.8
precipitation-avg	24.3	29.8
conductor-material-al	11.8	0
estimated-age	11.4	8.9
conductor-material-acsr	4.9	9.7
splice-record-exists	4.2	4.3
conductor-size-4	3.7	1.6
conductor-size-2	3.6	3.4
tree-height-max	2.4	4.3
vapor-pressure-deficit-avg	1.7	4
specific-humidity-avg	1.4	0
100-hour-fuels-avg	1	1.1
max-temperature-avg	0.5	1
conductor-size-6	0.3	0.1
coastal	0.3	0
conductor-material-cu	0.3	0
local-topography	0.2	0.2
wind-avg	0	0.9

Appendix

A Prototype Model has been developed using Technosylva Fire spread simulation data:

- Enhance the current tranche level (HFTD) Consequence MAVF scores to spatial 100m resolution scale using Technosylva Fire Spread data.
- MAVF score = f (Destructive Fire Probability)
 - Destructive Fire Probability = f (Acres, buildings, FBI)
 - FBI = f (Flame Length, ROS)

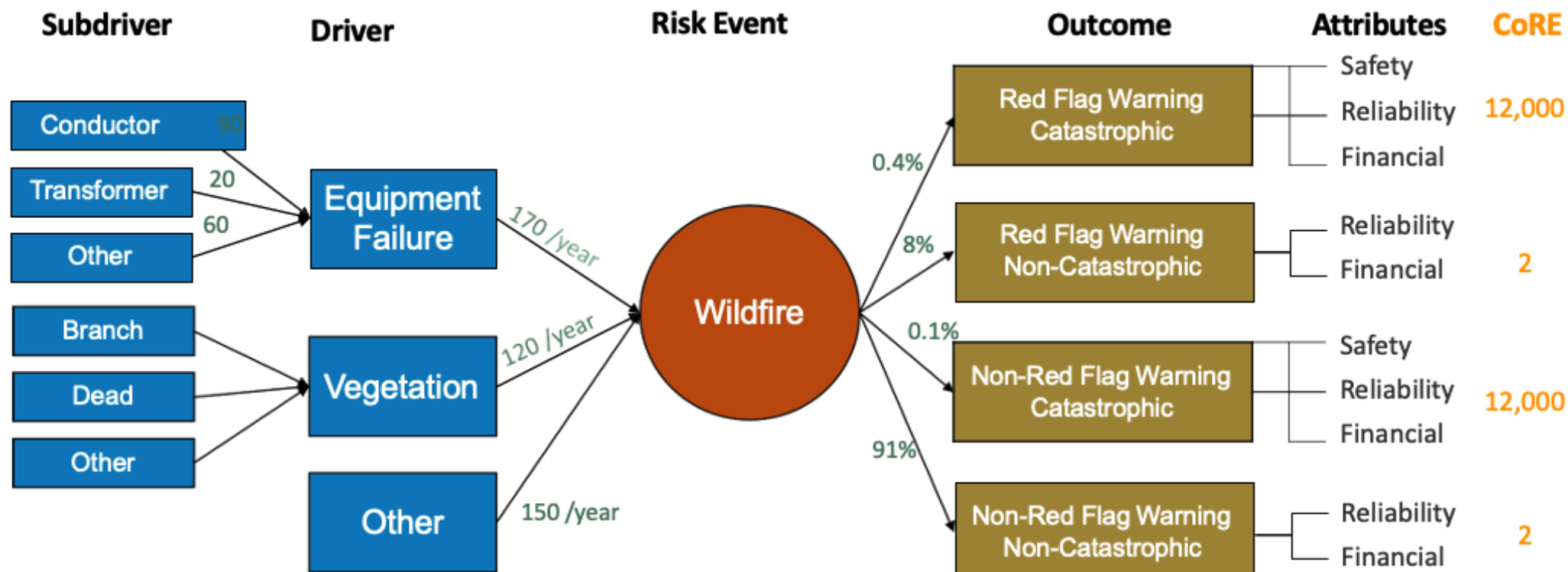


What is Wildfire Consequence?

- A prediction of damages that would occur if a wildfire started at a given point.
- PG&E uses the MAVF (Multi-Attribute Value Function) to calculate the consequence of the event. The consequence attributes are
 - Financial (25%)
 - Safety (50%)
 - Electric Reliability (25%)

Simple Wildfire Bow Tie, Quantified

$$\text{Risk Score} = \text{Frequency} \times \text{CoRE}$$



$$\text{Risk Score} = 440 \times 55 = 24,200$$

$$\text{Event CoRE} = \text{Weighted Average of Outcome CoRE} = 55$$

$$(0.4\% \times 12,000 + 8\% \times 2 + 0.1\% \times 12,000 + 91\% \times 2)$$



Improvement of Distribution Wildfire Risk Models

2021 Dx Model continues advancement of risk model capabilities compared to earlier models based on CPUC Maturity Survey Categories

CPUC Maturity Survey Categories	2021 Dx Model	2019-2020 Distribution Models	
Ignition Risk Estimation	<ol style="list-style-type: none"> 1. Annual Probability of Ignition for EVM and Conductor failures based on up to date asset, precipitation, amount of vegetation fuel present, wind strength and tree data. 2. Model evaluation done using data science best practices to use a quantitative metric of performance evaluated on data that the model has not been trained on – this can simulate an unknown future by separating data into independent train and test datasets 	<ol style="list-style-type: none"> 1. 0-1.0 value representing outage probability based on tagged trees and historical outages ranging from 0.8 to zero. 2. Regression model trained on all outage data with no test set – potential risk of overfitting. 	Statistical methods
Estimation of Wildfire Consequences on Communities	1. MAVF CoRE consequence set uses Technosylva wildfire spread model that represents ladder effect of ignitions moving from scrub to tree-tops. Able to better predict historical catastrophic fires.(see slide 2)	1. REAX wildfire spread model based on fuels.	Wildfire Consequence Model
	2. Does not include egress model.	2. Includes egress model.	
	3. Risk values tie to RAMP system and tranche risk values.	3. Independent, normalized risk scale	MAVF Risk Score
	4. Quantified risk value for prioritization and measurement.	4. Risk values for prioritization but not quantified for measurement.	
Estimation of Wildfire and PSPS Risk-Reduction Impact of Initiatives	1. Model able to measure program level risk reduction for mitigations	1. Not available	
Risk-based grid hardening and cost efficiency	1. Prioritize EVM program based on estimated risk reduction and SH program on circuit protection zone risk.	1. Able to prioritize circuits within SH and EVM programs.	
Data Validation and Granularity	1. Model base level at 100 meter pixel level that aggregated to updated Circuit Protection Zone (new sectionalization zones)	1. Circuit level and Circuit Protection Zone level.	Granularity
	2. Area-Under-the-Curve (AUC) precision metric (see slide 3)	2. No documented precision metrics	
	3. No 3rd party validation completed at this time.	3. No documented 3rd party validation	
Level of Systemization and Automation	1. Model code integrated into PG&E AWS environment with automated connection to PG&E data sources.	1. Software as a service.	
Approach to learning and updates	1. Developed with iterative approach with VM and Asset Strategy SMEs.	1. Developed with SME input and review	

Risk is proportional to two primary elements

- Probability of the event happening
- Consequence of the event if it does happen

$$\text{Risk} = \text{Probability} \times \text{Consequence}$$

- Developed distinct risk models for vegetation failure and equipment or conductor failure wildfire risk. Both of these are built by developing the probability of a vegetation or conductor caused ignition and combining that probability with wildfire consequences.
- Consider the predictive power of the wildfire consequence, probability of vegetation caused ignition and the probability of an equipment caused ignition.

Sample Team structure for the mitigation identification and delivery team

