SCE Wildfire and PSPS Risk Models

Prepared for: Office of Energy Infrastructure Safety
Wildfire Risk Modeling Workshop Oct. 5-6, 2021

Executive Summary

- SCE has continuously improved its risk models since 2018, adding more granular asset-level data, advanced fire propagation algorithms, and several other enhancements
- SCE's Wildfire Risk Reduction Model (WRRM) Framework is SCE's primary means to estimate wildfire risk
- The WRRM has two primary components: 1) POI and 2) Consequence
  - The probability of ignition (POI) component is comprised of a series of machine learning models designed to estimate the probability of an ignition occurring from individual assets
  - The consequence component is designed to estimate the consequence if an ignition were to occur from that particular asset
- Additionally, SCE has developed a PSPS risk model which is used to calculate risk spend efficiency (RSE) and to inform PSPS decisions by comparing the risk of wildfire to the risk of PSPS during a PSPS event

Agenda

Safety Moment

Evolution of Wildfire Risk Models

SCE's Wildfire Risk Reduction Model (WRRM) Framework

Multi-Attribute Value Framework (MAVF)

WRRM: Probability of Ignition (POI) Modeling

- POI Model Creation Processes
- POI Model Data Sources
- POI Model Validation and Accuracy

WRRM: Wildfire Consequence Modeling

WRRM: PSPS Risk Modeling

Collaboration

Internal / Third-Party Validations

Planned Future Improvements

Safety

Are you Earthquake Prepared?

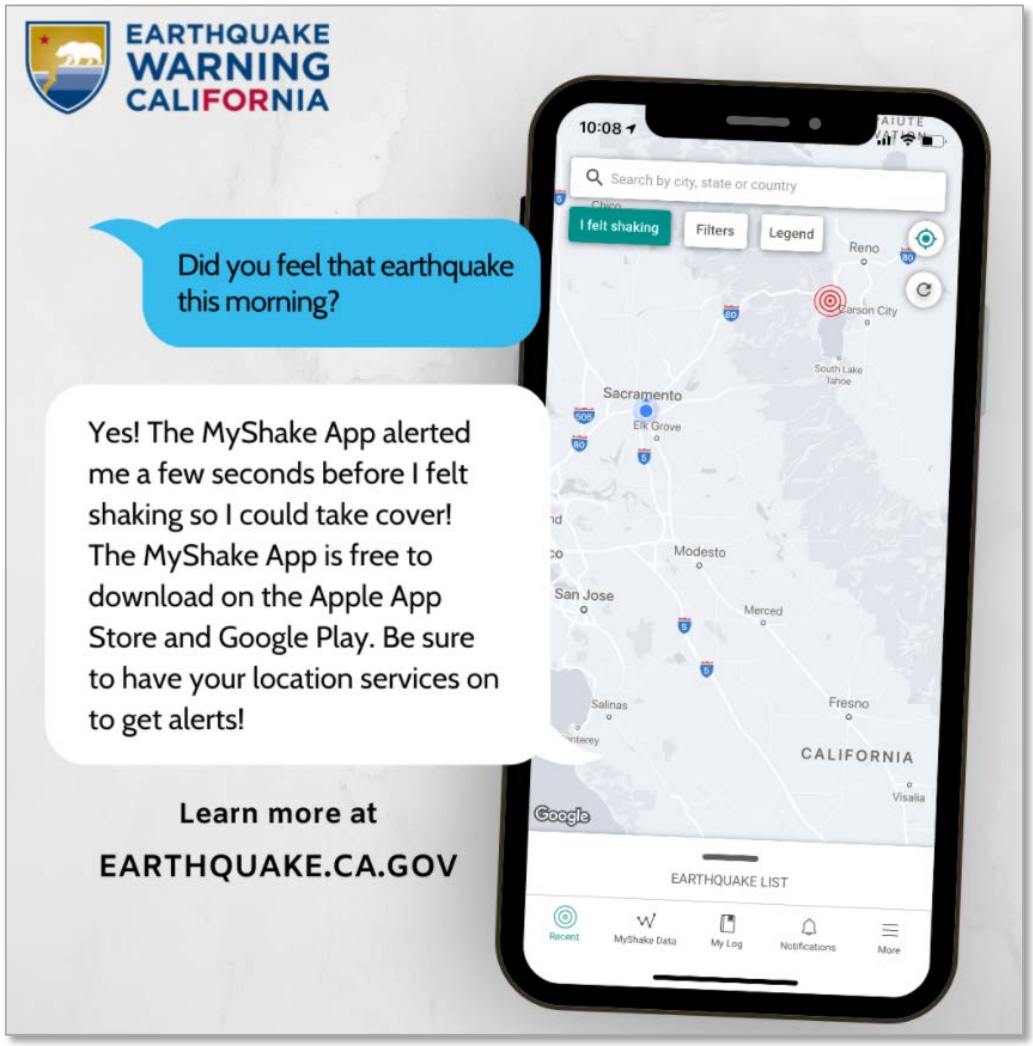
Download the MyShake App
- The app is available on the Apple App Store and Google Play

Turn on location services
- The app used seismic sensors throughout California to alert users based on their location

Receive earthquake alerts
- The app will automatically send users alerts for 4.5 magnitude or greater earthquakes

In the event of an earthquake:

Drop, **Cover**, and **Hold**

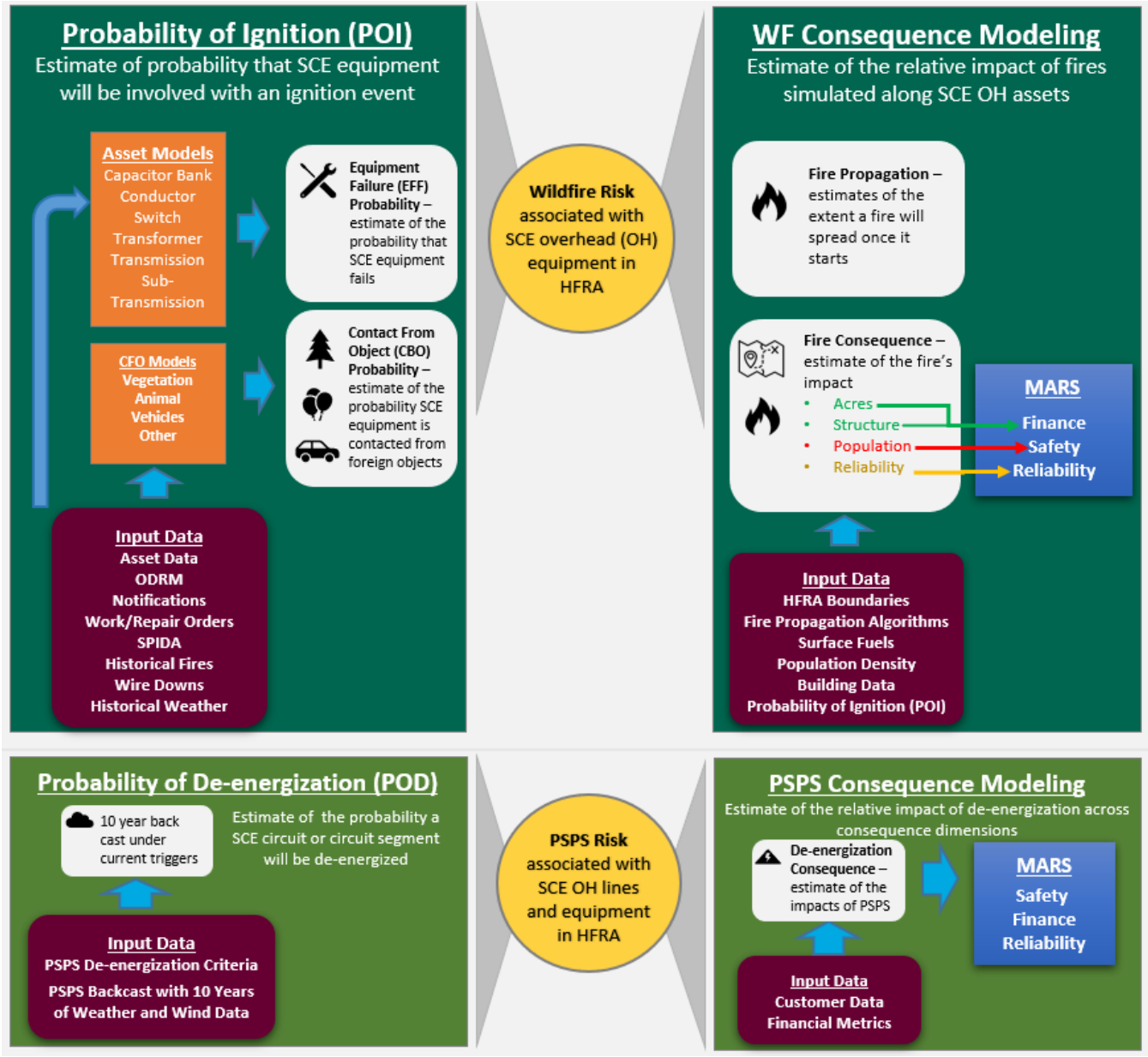


SCE Continues to Evolve its Risk Modeling Capabilities

2018 GSRP	SMAP / RAMP	2019 WMP	2021 GRC	2020-2022 WMP	2021 WMP Update	2022 WMP Update
Fault-to-Fire Mapping Mitigation-to-Fault Mapping Mitigation Effectiveness / Cost Mitigation Ratios High Fire Risk Area (HFRA) Definition 	*System-wide* Bowtie (Drivers, Outcomes, and Consequences) Multi Attribute Risk Score (MARS) Mitigation Risk Spend Efficiency (RSE) 		*Circuit and Circuit Segment Level* Asset risk prioritization to inform mitigation deployment Probability of Ignition for Distribution assets REAX Fire Propagation Algorithm 	Fire Incident Analysis (FIPA) Enhanced Mitigations and Tranching RSE Calculation Enhancements Began transition to Technosylva Fire Propagation Algorithm 	Probability of Ignition for Transmission and Sub transmission assets Inclusion of PSPS reduction to circuit prioritization PSPS Risk Modeling *Wildfire + PSPS Risk*	Updates for 2021 WMP Progress Report items: - Joint utility working groups (RSEs, Risk Modeling, & Covered Conductor) - Updated Risk Analysis - Mitigation Optimization Technosylva Fire Propagation refinements - Updated fuel layer - 400+ additional wind & weather scenarios
Sept 2018	Nov 2018	Feb 2019	Aug 2019	Feb 2020	Feb 2021	Feb 2022

SCE Wildfire Risk Reduction Model (WRRM) Framework

The WRRM leverages the risk bowtie to organize various components and is the foundation for risk information prioritization of mitigation activities.



Multi Attribute Value Framework (MAVF)

- A **Multi-Attribute Value Framework (MAVF)** is used to convert natural unit consequences into a "unit-less" risk score. SCE's MAVF is referred to as a **Multi-Attribute Risk Score (MARS)**.

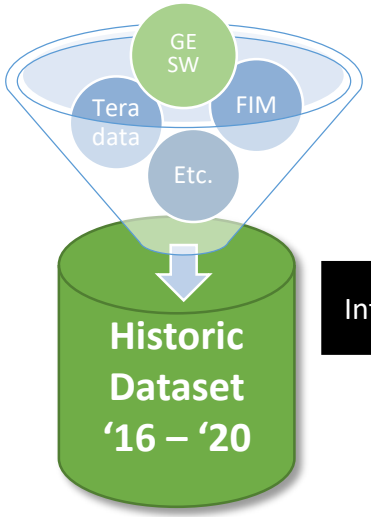
- MARS values are used to (1) compare relative risk across risk types, and (2) to compare relative risk reduction as a result of mitigation activities.

		Weights Relative importance of each attribute relative to each other	**Range** of potential impacts (annually)	**Scaling Function** converts the natural units of each attribute to a generic unit-less range from 0-100
Attribute	**Unit**	**Weight**	**Range**	**Scaling**
Safety	Index*	50%	0 – 100	Linear
Reliability	CMI	25%	0 – 2 Billion	Linear
Financial	$	25%	0 – 5 Billion	Linear

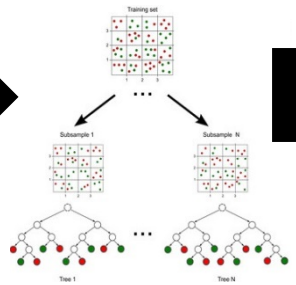
Safety Index = 1.0 * (# of fatalities) + ¼*(# of serious injuries)

POI Modeling: The Processes

The POI model uses past successes & failures to understand relevant conditions (asset characteristics). It learns from these observations so it can predict the future successes & failures. This means there must be consistency in the data used for characterizing assets for the historic dataset & for the dataset we want to predict outcomes for (existing infrastructure/assets).



Inform Model



Apply to existing assets

Conductor Segment ID	Cond. Size	Dist from Sub	Etc	Prob Of Ignition
Segment A	8	10 ft		0.05
…	…	…	…	0 – 0.05
Segment ZZ	336	2500 ft		0.0001

"The Data"

Multiple data sources are collected & packaged as data inputs, based on SME input

"The Model"

A machine learning model is created in order to predict failures

"The Model Output"

The model output is a ranking of individual assets, with assigned probabilities of failure

WRRM: POI Models, Data Input and Output

Ignition drivers - Equipment/Facility Failure (EFF) and/or Contact From Object (CFO) – are assessed through component-specific models with machine learning algorithms. The result is an estimate of the Probability of Ignition (POI) at individual locations. SCE refers to this as Functional Location (FLOC)-level POI with FLOC which is typically a structure location with equipment.

EFF/CFO Models (Dist.)

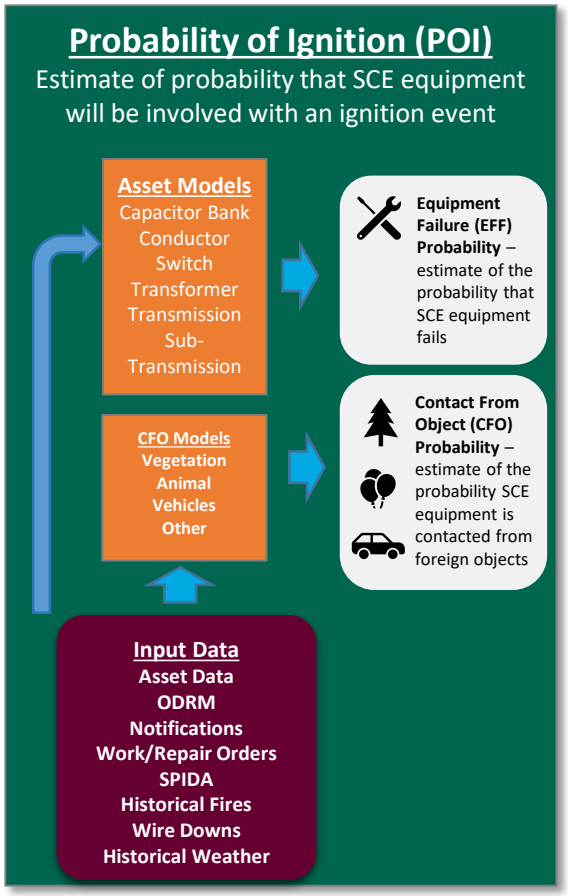
Transformer Model
- Algorithm: Random Forest Model
- Data: SAP/GIS/Weather/AMI/OMS

OH Conductor Model
- Algorithm: Random Forest Model
- Data: SAP/GIS/Weather/Net9/ODRM
- Wind force data significantly improved the model performance

Switch Models
- Algorithm: Random Forest and Gradient Boosting Models
- Data: SAP/GIS/Weather/OMS

Capacitor Bank Model
- Algorithm: Random Forest Model
- Data: SAP/GIS/Weather/AMI/OMS

CFO Model
- Algorithm: Random Forest
- Data: SAP/GIS/Weather/Net9/ODRM/Vegetation



POI Modeling: Data Sources Used (CFO Example)

POI model leverages big data and machine learning algorithms to improve model accuracy

Cable/Conductor Databases

- ~1.2M segments
  - ~700K primary conductor
  - ~500K cable

Geospatial Databases

- Length, Material etc.

Asset Data

- ~2M FLOCs with active D/T Poles and SL
- Pole Features
- Lat/Long

Operation Data

- Switch counts

NCAR / WRF Weather Data

- ~22.3B raw data points
- ~500K wind values

Outage Data

- ~500 outage cause codes
- ~150K historical outages

Avian/Animal Incidents

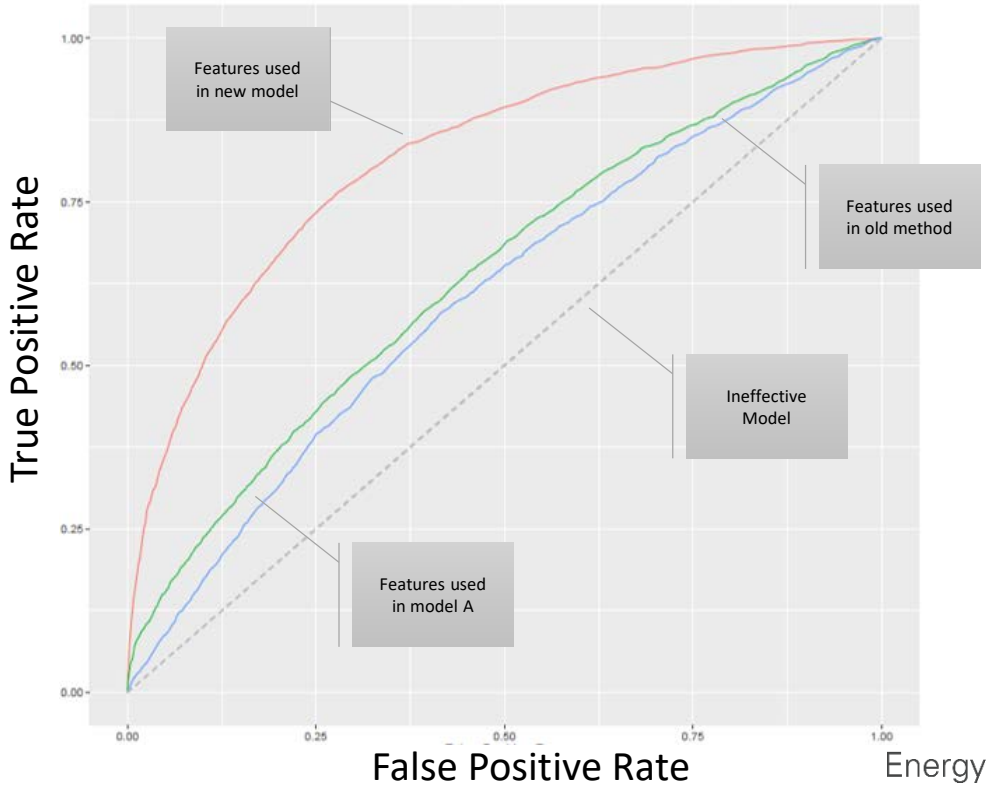
Vegetation-Distance from Lines

Traffic incidents

Data as of 08/02/2021 (subject to change)

POI Modeling: Validation And Accuracy

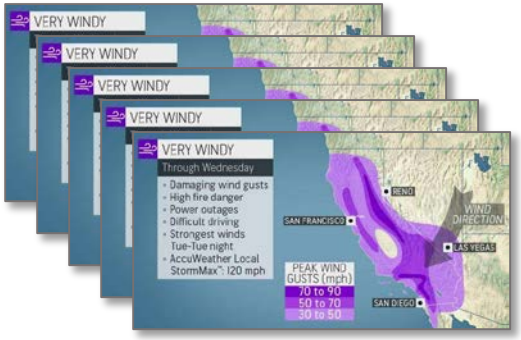
POI model validation is performed throughout each model creation/update cycle. Model performances are measured by AUC (Area Under of Curve) of the ROC plot.



WRRM: Wildfire Consequence

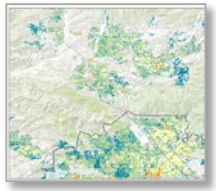
The consequence module simulates the potential progression of an ignition, including the acres, buildings, and population which could be impacted by a fire event. These ignitions are simulated in proximity to every asset over an 8 hour burn period, across several weather and wind scenarios. These scenarios reflect known climate change conditions to date.

Catalog of Fire Weather and Wind Conditions

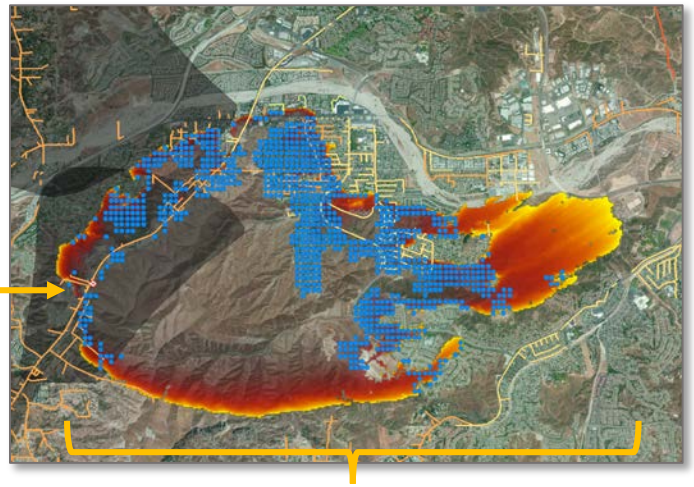


Buildings

Population



Surface fuels



(1) Simulated ignition point

(2) Simulated fire shed

(3) Acres, buildings, and population within the simulated fire shed

WF Consequence Modeling

Estimate of the relative impact of fires simulated along SCE OH assets

Fire Propagation – estimates of the extent a fire will spread once it starts

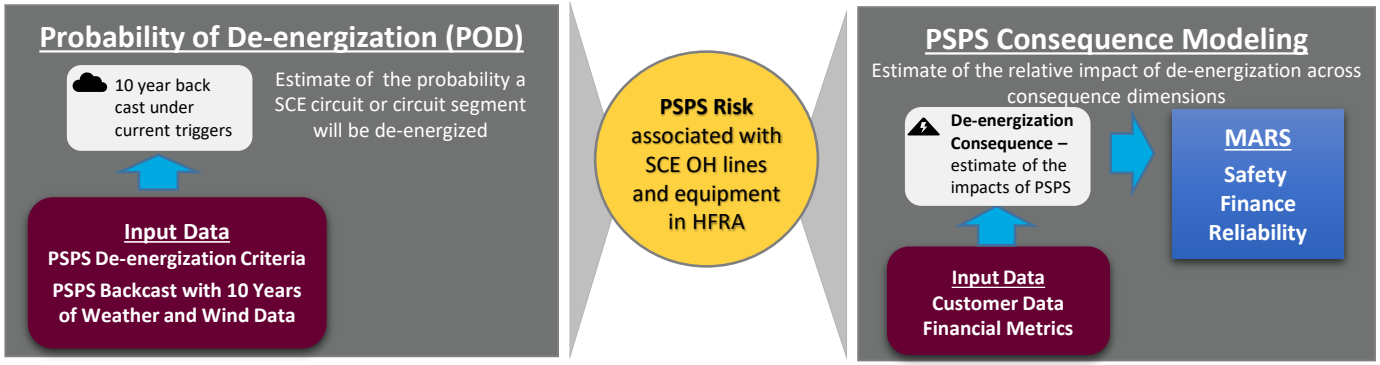
Fire Consequence – estimate of the fire's impact
- Acres
- Buildings
- Population

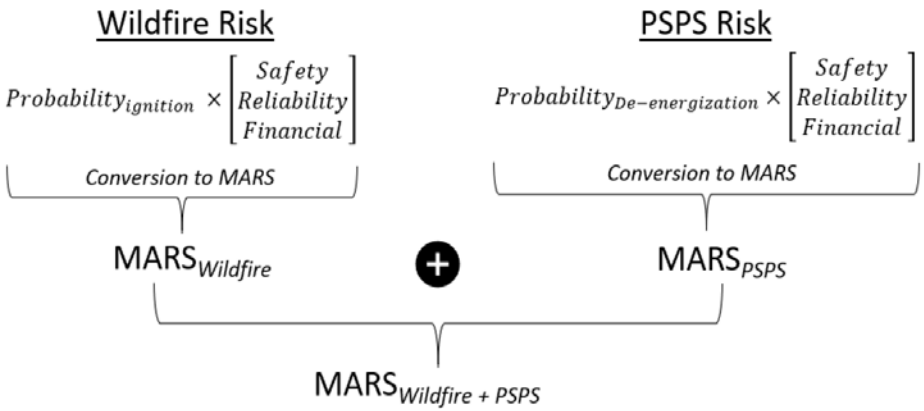
Input Data
HFRA Boundaries
Fire Propagation Algorithms
Surface Fuels
Population Density
Building Data

WRRM: PSPS Risk Modeling

PSPS risk model is based on a back cast of wind and weather conditions which could lead to a PSPS de-energization decision based on 2020 criteria (wind speeds, FPI, etc.).

At present, SCE utilizes a PSPS Model to inform RSE calculations to understand initiatives that reduce the impact of PSPS on customers. SCE will consider incorporating the PSPS risk model in mitigation scoping in 2023 for remaining segments.





IOU Collaboration

- Since the 2019 WMP process, SCE, PG&E and SDG&E have conducted wildfire-related benchmarking sessions on various topics, including risk modeling, mitigation effectiveness, vegetation management activities, and PSPS operations
- PG&E, SCE and SDG&E collaborated on at least 10 occasions in 2021 on risk assessment and modeling alignment opportunities
- IOUs have evaluated elements of risk modeling where near-term alignment could be achieved
- Currently developing a common vision (end-state) for long-term alignment on risk modeling, while recognizing differences

Internal / Third-Party Validations

- SCE's Enterprise Risk Management (ERM) organization provides input to and oversight of the wildfire risk model.
  - ERM provides independent input and review during model development
  - For major updates, prior to implementation, ERM runs a challenge session or "red-team" review to pressure test changes.
  - Updates to the consequence models performed and tested by a cross-functional team of experts, including fire science, data scientists, and risk management (e.g., REAX to Technosylva, updates to Technosylva, and new use cases)
  - Additional third-party validation also performed to validate changes to statistical and machine learning models
  - Governance of model changes includes review and discussion with senior management prior to implementation

Planned Future Improvements

- Updates for 2021 WMP Progress Report
  - Joint Utility Risk Working Groups (RSEs and Risk Modeling)
  - Updated Risk Analysis
  - Mitigation Optimization

- Updates for 2022 WMP Update
  - Technosylva Fire Propagation refinements
    - Updated fuel layer
    - 400+ additional wind & weather scenarios

- Related Proceedings/Filings
  - PSPS OII
  - Risk OIR
  - 2022 RAMP Filing

Questions?