



Wildfire Mitigation

2026-2028



Agenda

- SDG&E Wildfire Risk Exposure
- 2024 General Rate Case
- Wildfire Mitigation Strategy
- Risk Assessment and Methodology
- Drivers & Changes in Risk Modeling
- Mitigation Effectiveness
- Wildfire Mitigation Programs
- Summary



Wildfire Mitigation Strategy

Jonathan Woldemariam, Director - Wildfire Mitigation



11/11/2019

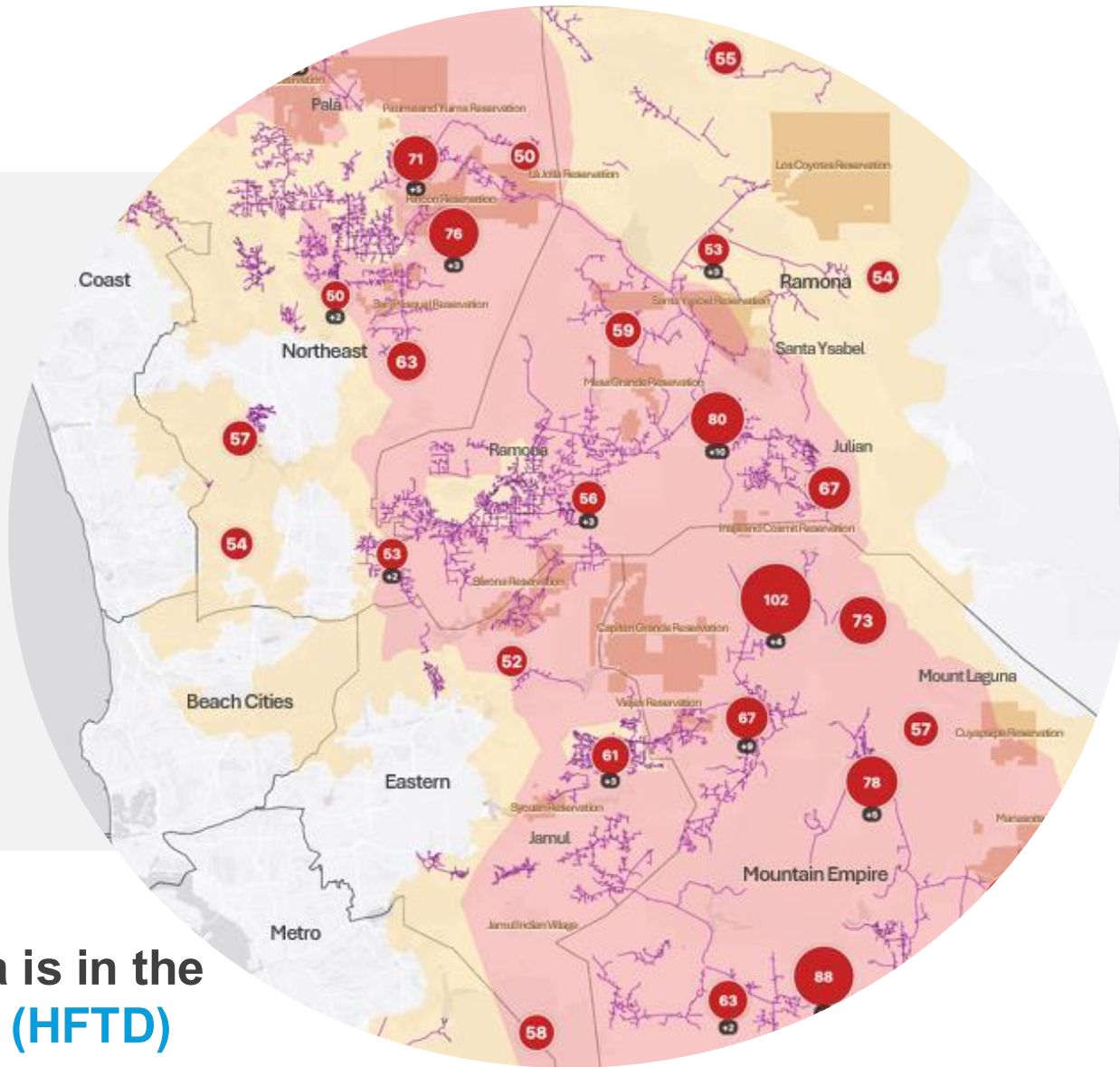
1.5M customer accounts

3,364 miles of overhead lines in HFTD

47% underground infrastructure in HFTD

223 weather stations

51% of inventory trees within HFTD



2026 - 2028 WMP - Our commitment to Wildfire Safety



2026-2028 Base Wildfire Mitigation Plan

17 Years without utility-related catastrophic wildfires

San Diego County has a long-standing history of catastrophic wildfires and continues to have the highest wildfire risk

Evolving strategy from managing wildfire and PSPS risk, to eliminate these risks as much as possible

Advanced Risk-Informed Methodology & Life Cycle Cost Analysis

January RFWs & PSPSs by the Numbers

The driest start to the water year in San Diego's 174 history coupled with multiple high wind events resulted in extreme wildfire conditions on eleven separate days spread over 2½ weeks

Date	Mon 1/06	Tue 1/07	Wed 1/08	Thu 1/09	Fri 1/10	Sat 1/11	Sun 1/12	Mon 1/13	Tue 1/14	Wed 1/15	Thu 1/16	Fri 1/17	Sat 1/18	Sun 1/19	Mon 1/20	Tue 1/21	Wed 1/22	Thu 1/23	Fri 1/24
RFW																			
Extrm FPI*																			

Extreme FPI Red Flag Warning High Wind Warning 1/07-1/08

- Top 20 Avg Gusts: 57 mph
- Wind Records: 13
- **Peak Gust: 71 mph**
- 99% Stations: 83
- PSPS Cust Scope: 65,475
- **PSPS Cust off: 7,267**
- CRCs Opened: 8

Extreme FPI Red Flag Warning 1/09-1/10

- Top 20 Avg Gusts: 62 mph
- Wind Records: 3
- **Peak Gust: 85 mph**
- 99% Stations: 49
- PSPS Cust Scope : 74,652
- **PSPS Cust off: 10,274**
- CRCs Opened: 9

Extreme FPI Red Flag Warning 1/11-1/12

- Top 20 Avg Gusts: 38 mph
- Wind Records: 0
- **Peak Gust: 52 mph**
- 99% Stations: 0
- PSPS Cust Scope : 4,561
- PSPS Cust off: 0
- CRCs Opened: 0

Extreme FPI Red Flag Warning 1/13-1/15

- Top 20 Avg Gusts: 55 mph
- Wind Records: 0
- **Peak Gust: 74 mph**
- 99% Stations: 24
- PSPS Cust Scope : 54,937
- **PSPS Cust off: 5,938**
- CRCs Opened: 4

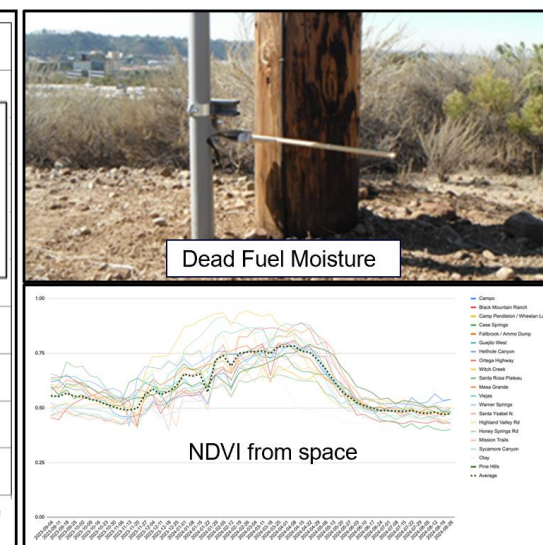
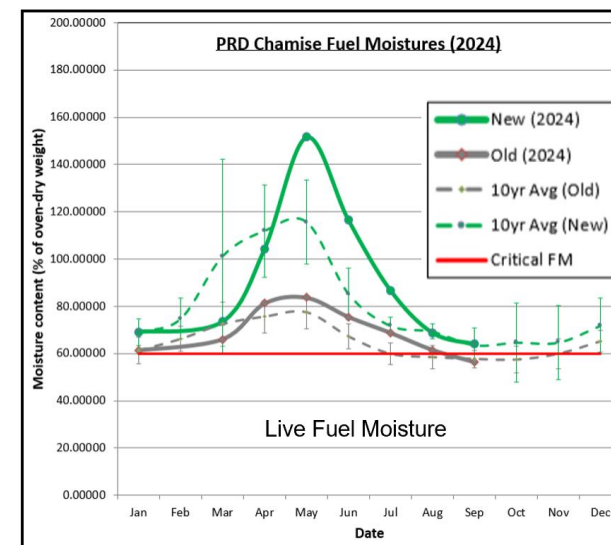
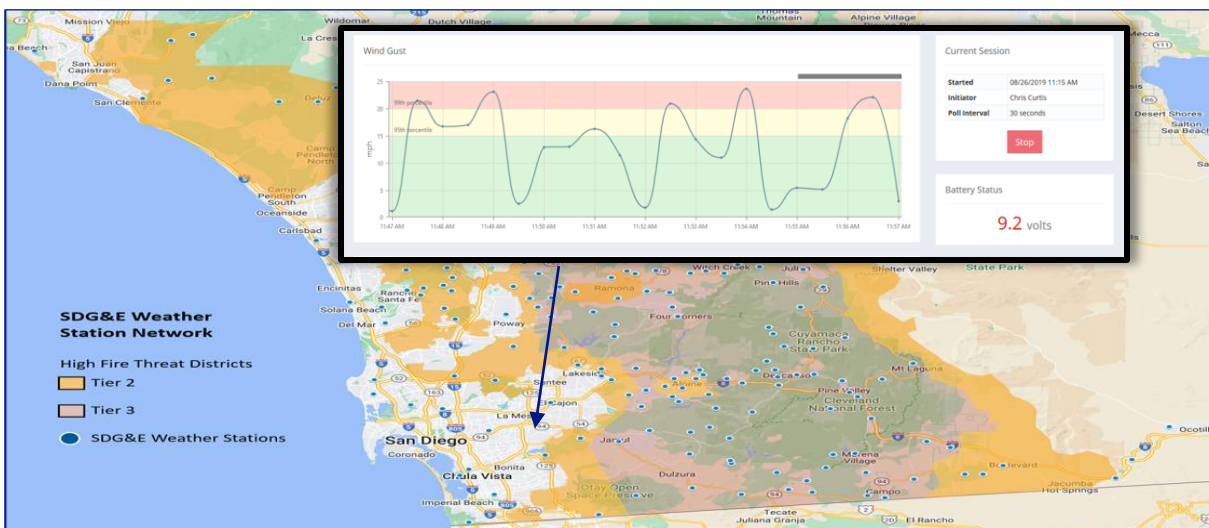
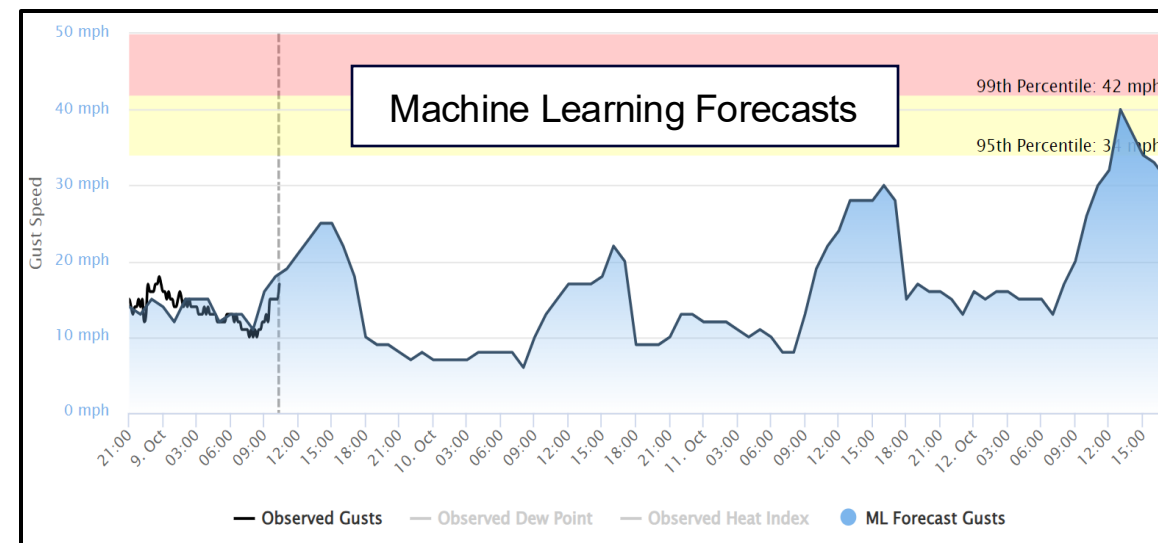
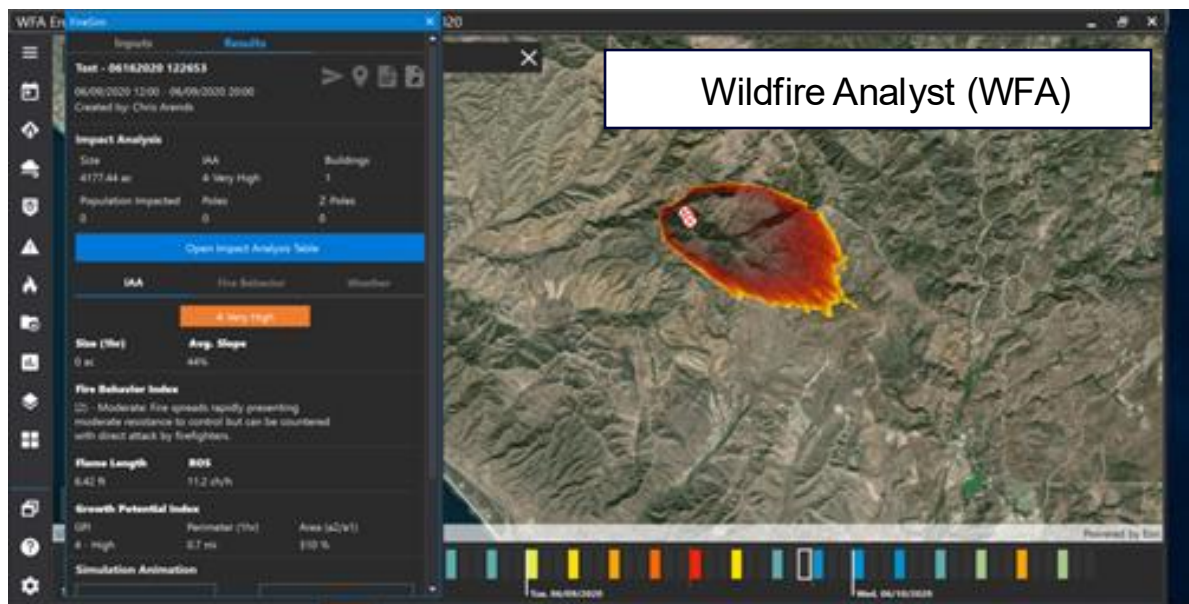
Extreme FPI Red Flag Warning High Wind Warning 1/20-1/21

- Top 20 Avg Gusts: 70 mph
- Wind Records: 30
- **Peak Gust: 102 mph**
- 99% Stations: 116
- PSPS Cust Scope : 83,609
- **PSPS Cust off: 16,733**
- CRCs Opened: 10
- De-energized Transmission

Extreme FPI Red Flag Warning High Wind Warning 1/22-1/23

- Top 20 Avg Gusts: 69 mph
- Wind Records: 16
- **Peak Gust: 97 mph**
- 99% Stations: 127
- PSPS Cust Scope : 83,625
- **PSPS Cust off: 20,460**
- CRCs Opened: 12
- De-energized Transmission

Situational Awareness



Massive Mobilization

- ~350 separate SDG&E EOC responders this season devoting ~20,000 hours of support
- ~300 separate field personnel supported all stages of the event
- Five helicopters were mobilized in support of re-energization on multiple days. Final re-energization on January 24th:
 - ~140 helicopter flight hours
- 2 Blackhawk firefighting helicopters:
 - 36,200 gallons on 4 different fires
- >900 poles flown by drones in over 100 flights - 6 pilots available throughout event

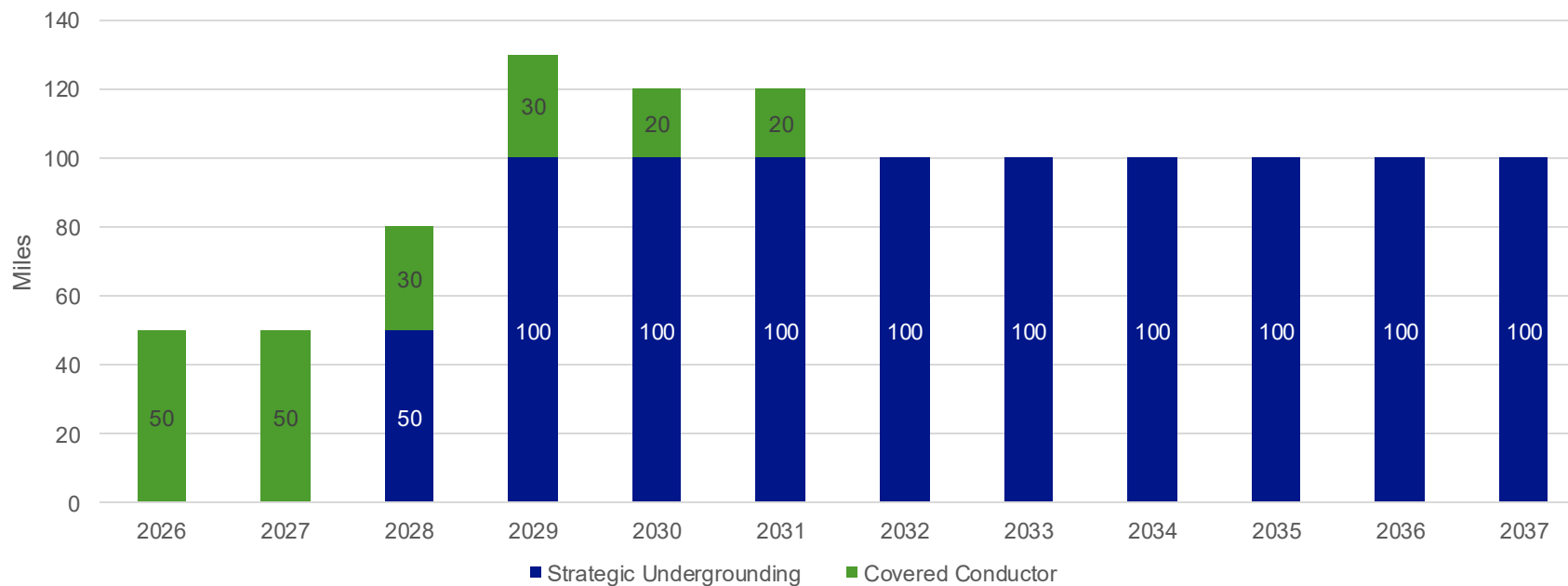
Helicopter re-energization flights and drone flight locations



2024 GRC Impact

Initiative	2026	2027	2028
Strategic Undergrounding	0 miles	0 miles	50 miles
Covered Conductor	50 miles	50 miles	30 miles
Asset Replacements	--	--	--
DCRI	--	--	--
Microgrids	--	--	1

- **Strategic Undergrounding and Combined Covered Conductor** program targets are direct result of GRC decision
- **Asset replacements** such as lightning arrestors, fuses, hotline clamps, and avian protection are integrated into Combined Covered Conductor
- **Microgrids and Distribution Communication Reliability Improvements** have been descoped due to reallocation of funds to higher priority initiatives



Long Term Grid Hardening Strategy

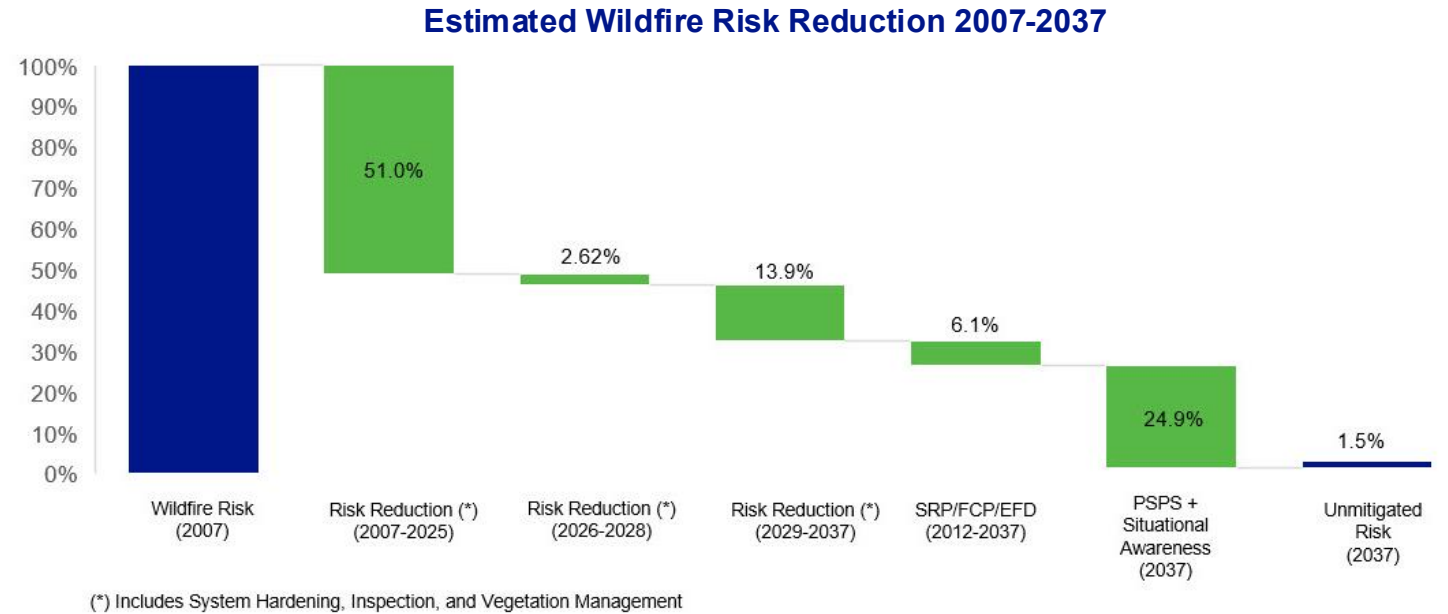
Wildfire Mitigation Strategy

Operational Approach

- PSPS
- Situational Awareness
- Sensitive Relay Profiles (SRP)
- Sensitive Ground Faults (SGF)
- Some of which require human intervention which potentially can introduce human error
- Does not eliminate risk on the system

Sustained Approach

- Aims for a permanent and non-operationally dependent solution
- Strategic Underground and Covered Conductor
- Optimize investments by adding climate, social vulnerability, and risk aversion
- Minimize full life cycle costs not just initial costs





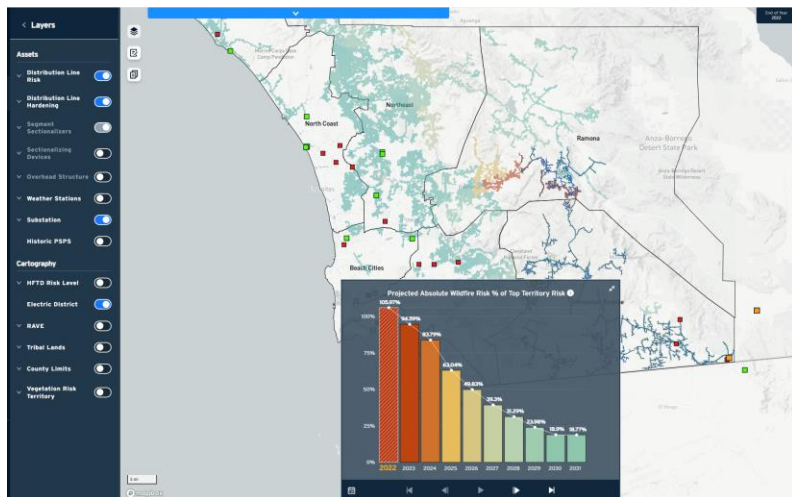
Risk Assessment & Methodology

Joaquin Sebastian, Risk Analytics Manager



Wildfire Next Generation System (WiNGS)

WiNGS - Planning: Shapes SDG&E's long-term hardening strategy to maximize the reduction of wildfire and PSPS risks



WiNGS-Planning Model Overview

- Assesses Wildfire, PSPS, and PEDS impacts at the segment level
- Calculates baseline risk, projected risk reduction, and cost-benefit ratios for SUG and CCC across every feeder segment within SDG&E's service territory.

Visualization Features

- Interactive map with circuit and segment risk insights
- Time-slider showing risk reduction from mitigations over time
- Portfolio tool to compare and adjust mitigation strategies

WiNGS - Ops: Supports real-time operational decision-making during extreme fire weather conditions



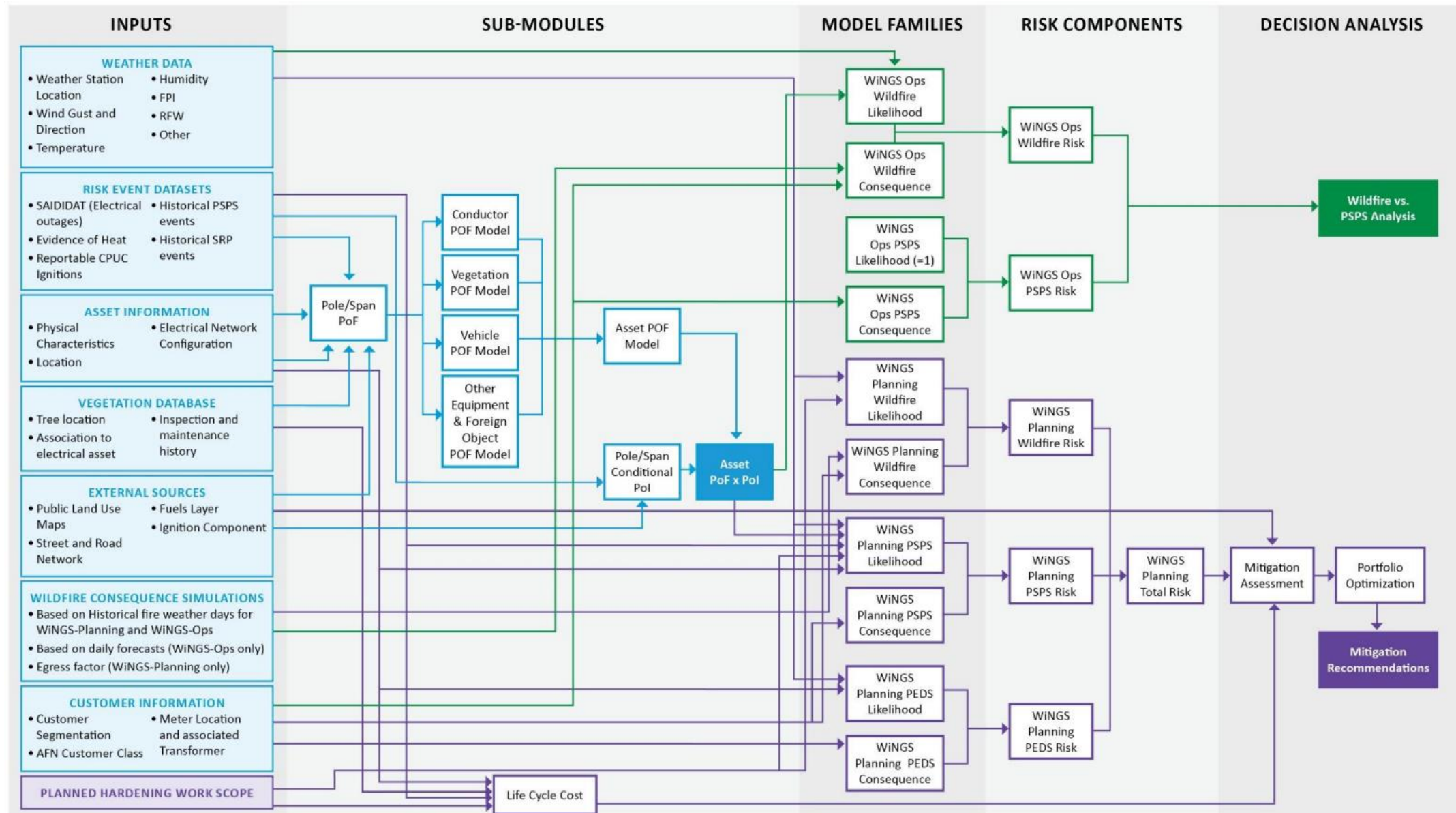
WiNGS-Ops Model Overview

- Calculates wildfire and PSPS risk levels under extreme fire weather conditions
- Identifies and quantifies alert speed thresholds for TCC (Temporary Construction and Compliance) assets

Visualization Features

- Real time weather station data associated with assets
- Interactive map with device hierarchy
- Downstream customer insights (including AFN & generator users)
- Hexagon Map view with daily wildfire risk forecasts

WiNGS-Planning and WiNGS-Ops Integration



LEGEND: Purple: WiNGS Planning related only Green: WiNGS Ops related only Blue: Related to both WiNGS Ops & Planning

Risk Based & Data Driven

MODEL INPUTS



Weather Data



Vegetation Data



Ignition Data



Asset Information Systems



Fire Simulations



Customer Information Systems



Work Scope Data



Input Parameters

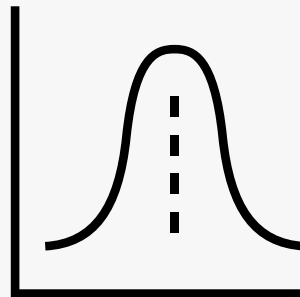


Lifecycle Cost



Risk Aversion

MODEL OUTPUTS



Wildfire, PSPS, PEDS
Likelihood & Consequence

Expected Value

Tail Risk

PROGRAM STRATEGY & PSPS DECISIONS



Mitigation Prioritization
WiNGS- Planning



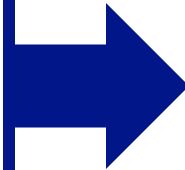
PSPS Implementation
WiNGS- Ops



Drives Risk-Based Programs

Drivers & Changes in Risk Modeling

- Wildfire Mitigation 2026-2028 Guidelines
- Wildfire Mitigation Areas of Continued Improvements
- Risk Assessment Mitigation Phase (RAMP)
- Senate Bill 884 (Electrical Utility Undergrounding Plan)
- Maturity Model Survey
- Utility Risk Assessment Improvement Plan



Model Enhancements

- Aligns with Cost Benefit framework
- Probabilistic framework capturing Tail values
- WiNGS-Ops integration into WiNGS-Planning
- Incorporate PEDS risk

Data Architecture

- Full territory expansion
- Span-level risk assessment
- Code Refactoring
- Increase traceability and auditability

Model Validation

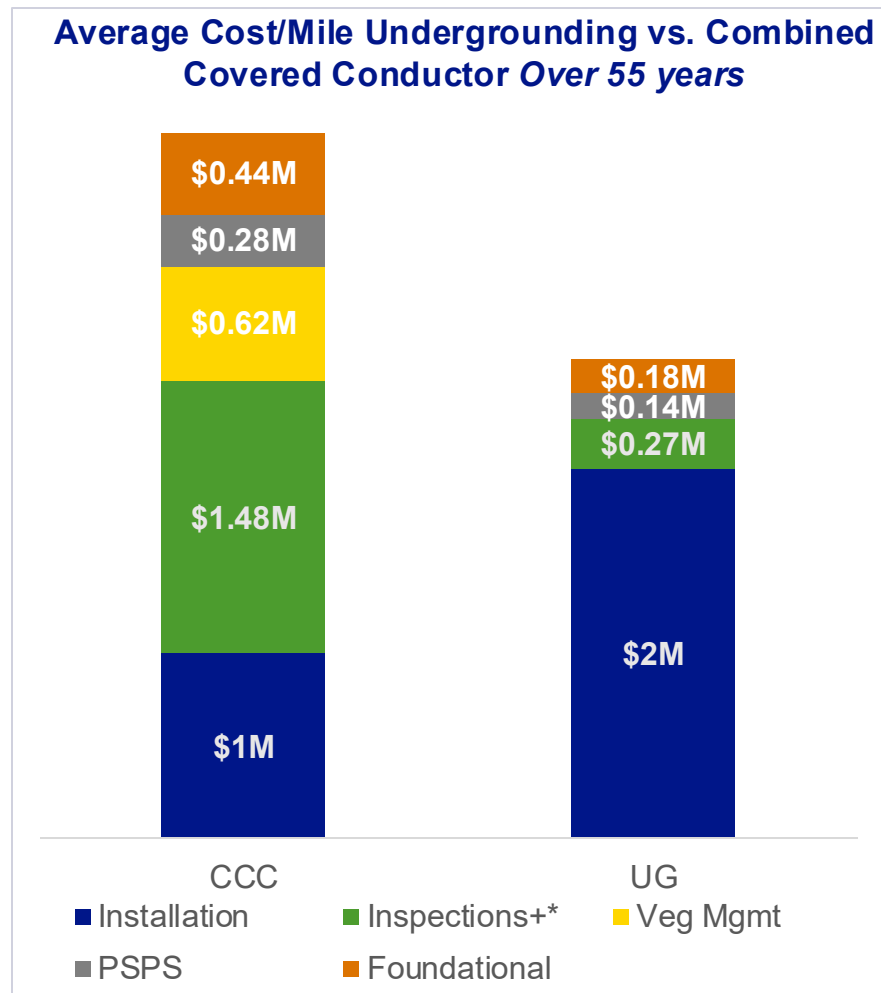
- Model documentation
- Formalized model validation and verification
- Third Party Independent Review

Visualization Platform

- Improved performance and reliability
- Enhanced user experience
- Increased risk reporting sophistication and flexibility

Cost Benefit Framework

SDG&E utilizes the Cost-Benefit framework to quantify wildfire and PSPS risk baselines, risk reductions, and prioritize mitigations at the circuit segment level.



Total lifecycle costs includes **installation** and **long-term operational expenses over 55 years**



Lifecycle analysis shows **undergrounding** is **more cost-effective** than combined covered conductor



Undergrounding reduces/eliminates vegetation management, wood pole inspections, drone/overhead visual inspections, PSPS de-energization costs

*Inspections+ include repair and replacement

Risk Assessment Future Improvements



Risk Assessment Methodology

- Retrain models with new data
- Evaluate new model methodologies
- Implement climate change and population growth projections



Expand Capabilities

- Evaluation of probabilities and uncertainties
- Perform sensitivity analysis
- Standardized model templates to facilitate validation and deployment in cloud services



Risk Presentation

- Expand visualization platform with additional functionality
- Increase SME engagement



Data Engineering Optimization

- Optimize model architecture and pipelines to reduce calculation times
- Track model error

Mitigation Effectiveness

Data-Driven Approach

- Electrical Outage Records
- Reportable and Non-Reportable Ignitions
- Asset attributes and location
- Weather conditions

Individual and Combined Mitigation Analysis

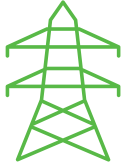
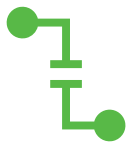





- Calculate individual mitigation effectiveness per risk driver
- Recloser protocol effectiveness
- Impact of Sensitive Relay Settings
- Impact of Early Fault Detection (EFD) and Falling Conductor Protection (FCP)
- Calculate combined covered conductor mitigation effectiveness (Ex: CC + EFD + FCP)

Ongoing Enhancements

- Factor in weather, fuel, and location data
- Improve FCP tracking and system traceability
- Continuously validating studies and updating results as findings occur

Strategic Undergrounding consistently ranks highest in risk reduction

Wildfire Risk Drivers and Mitigation Activity Effectiveness

									
			Equipment /facility failure or damage	Fault (Cause unknown)	Balloon Contact	Animal Contact	Vehicle Contact	Vegetation Contact	High Winds
		Effectiveness							
Sustained	Strategic Undergrounding	99%							
	Combined Covered Conductor	58%							
Operational	Falling Conductor Protection	16%							
	Asset Inspections	29%							
	Traditional Hardening	39%							
	Early Fault Detection	8%							
	Vegetation Inspection	4.95%							

No

Yes

Partial

Strategic Undergrounding Mitigation Effectiveness

Overhead Distribution Ignition drivers	Total Number of Ignitions* [2019-2024]	SME SUG Effectiveness	Estimated Ignitions reduced by SUG
OH Equipment	528	100%	528
UG Equipment	31	95%	29.45
Vehicle Contact (Pole)	16	100%	16
Vehicle Contact (Surface Structure)	5	95%	4.75
OH to UG connection	10	95%	9.5
All Other OH	174	99%	172.26
Other UG Contact	4	75%	3
Vegetation Contact	58	95%	55.1
Animal Contact (UG)	1	80%	0.8
Total	827		818.86

*CPUC Reportable & Non- Reportable Ignitions

- Implementing Strategic Undergrounding eliminates all overhead risk events, ensuring a safer and more reliable infrastructure.
- Risks associated with the underground system are unlikely to cause wildfires due to its enclosed and protected nature
- Continued collaboration between Joint IOUs focuses on optimizing the effectiveness of strategic undergrounding initiatives.

$$\text{Mitigation Effectiveness (\%)} = \frac{\sum_{n=1}^{\infty} ((\text{Number of Ignitions per Driver}) \times (\text{Mitigation Effectiveness}))}{\text{Total number of Ignitions}}$$

$$\text{SUG Mitigation Effectiveness} = \frac{818.86}{827} = 99.02\%$$

Combined Covered Conductor

Distribution Risk Driver	CPUC Reportable Ignitions and Non-Reportable Ignitions							Avg. Risk Events per Year	2024/2025 SME Risk Reduction	Estimated Ignitions reduced by CCC
	2019	2020	2021	2022	2023	2024	Total			
Animal Contact	4	6	1	1	2	1	15	2.50	90%	2.25
Balloon Contact	2	6	6	5	1	2	22	3.67	90%	3.30
Vehicle Contact	4	6	2	1	1	2	16	2.67	90%	2.40
Vegetation Contact	12	18	7	4	5	12	58	9.67	90%	8.70
Other contact	3	7	6	12	4	13	45	7.50	50%	3.75
Conductor	9	12	10	10	13	14	68	11.33	90%	10.20
Equipment-Non conductor	81	65	49	52	59	42	348	58.00	39%	22.62
Other All	42	31	27	27	20	27	174	29.00	10%	2.90
Undetermined	4	6	5	2	1	2	20	3.33	70%	2.33
Total	161	157	113	114	106	115	766	127.67	---	58.45

$$\text{CC Mitigation Effectiveness} = \frac{58.45}{127.67} = 45.78\%$$

$$\text{Combined CC Mitigation Effectiveness} = 1 - [(1 - \text{CC Efficacy}) \times (1 - \text{FCP Efficacy}) \times (1 - \text{EFD Efficacy})] = 1 - [(1 - 0.458) \times (1 - 0.08) \times (1 - 0.16)] = 0.581 \times 100 = 58.1\%$$



Wildfire Mitigation Programs

Lena McMillin, Wildfire Mitigation Programs Manager



Wildfire Mitigation By The Numbers 2026-2028

SUSTAINED



STRATEGIC
UNDERGROUNDING

50 miles

Limited due to GRC Decision



COMBINED COVERED
CONDUCTOR

130 miles

Limited due to GRC Decision

OPERATIONAL



SYSTEM HARDENING

39 miles

Includes Distribution, Transmission
and Distribution Underbuilt



ASSET INSPECTIONS

397K

Includes Distribution, Transmission
and Substation Inspections



VEGETATION MANAGEMENT
INSPECTIONS

765K

Includes 100% of the HFTD



PROTECTIVE EQUIPMENT AND
DEVICE SETTINGS (PEDS)

270 nodes

Includes Advanced Protection and
Early Fault Detection



PSPS SECTIONALIZING ENHANCEMENTS

18 switches

Used to de-energize only sections of
circuits that are experiencing extreme
wind events

Grid Hardening

Traditional Hardening



600+ miles hardened since 2013

2026 planned completion of tier 2 and tier 3 HFTD

39% effectiveness of hardening against wildfires.

Strategic Undergrounding



~300 miles installed since 2020

1200 miles planned by 2037
50 miles planned 2026-2028

99% reduction in risk against wildfires.

Combined Covered Conductor



~180 miles installed since 2020

425 miles planned by 2037
130 miles planned 2026-2028

58% reduction in risk against wildfires

Vegetation Management



Detailed Inspections

Inspections completed since 2020

2.5M

Annual WMP 2026-2028 Target

225K

Prune and Removal

Trees Pruned/Removed since 2020

65K

Pole Clearing

Poles brushed since 2020

179K

Annual WMP 2026-2028 Target

22K

Off-Cycle Patrol

Inspections completed since 2022

>300

Annual WMP 2026-2028 Target

106 VMAs

Fuels Management

Poles cleared since 2020

1,600

Annual WMP 2026-2028 Target

500

QA/QC

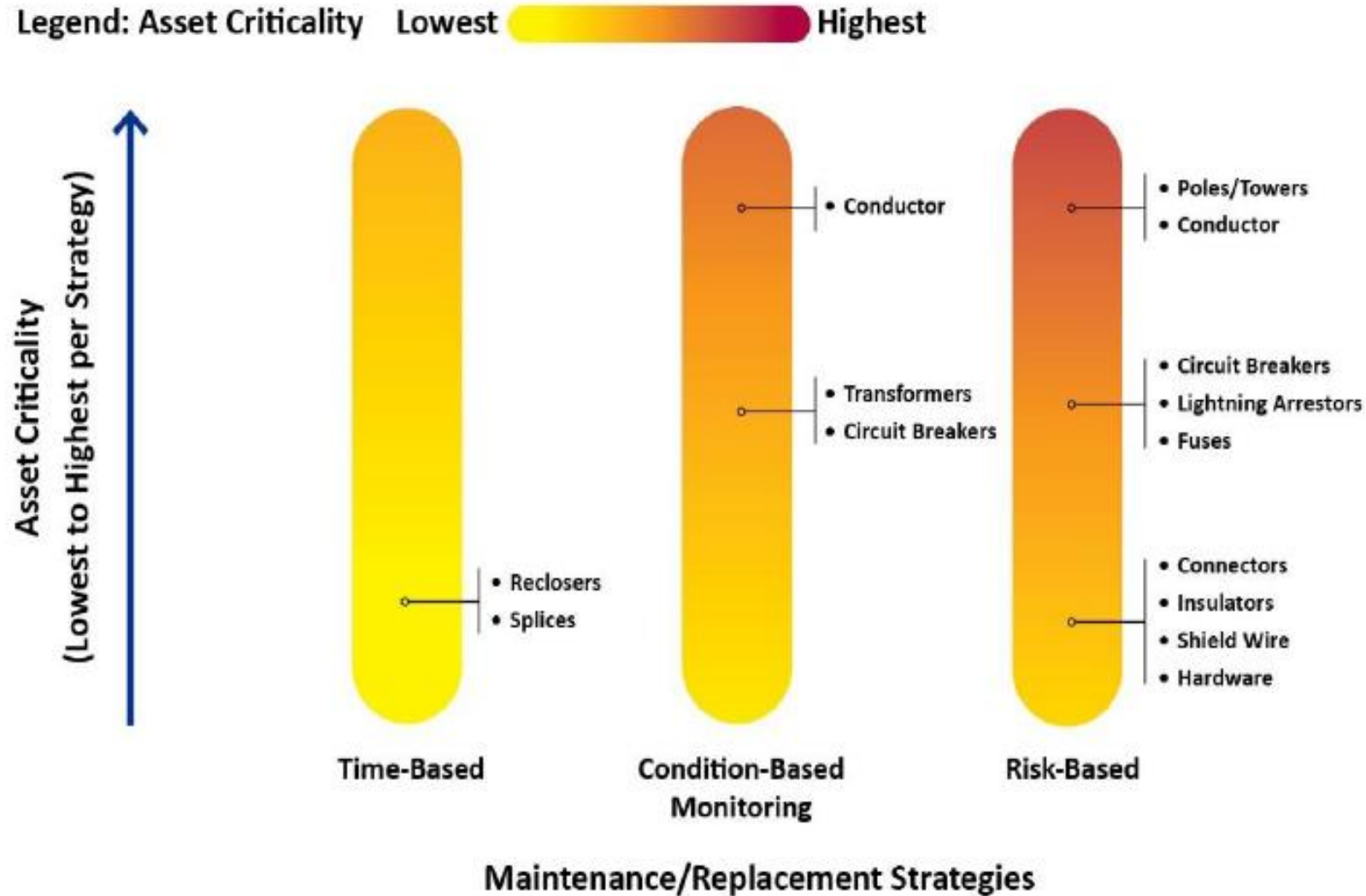
Inspections since 2023

212K

Annual WMP 2026-2028 Targets:

- Detailed Inspections
 - Prune/Removal
 - Pole Clearing
- 15%**

Asset Criticality and Maintenance Strategies



Asset Inspections – Scope & Intervals

Inspections scope and intervals are determined by GO 95 and GO 165; RIDI and EFD are risk-informed programs that consider equipment-specific risk to prioritize inspections.

Type	Inspection	Frequency
Distribution	OH Detailed	5 Years
	Wood Pole Intrusive	10 Years
	OH Patrol	Annually
	Risk Informed Drone (RIDI)	Risk-Based
	Early Fault Detection (EFD)	Ad-Hoc
Transmission	OH Detailed	3 Years
	Wood Pole Intrusive	8 Years
	OH Patrol	Annually
	Infrared	Annually

Traditional Inspections

Detailed OH & UG



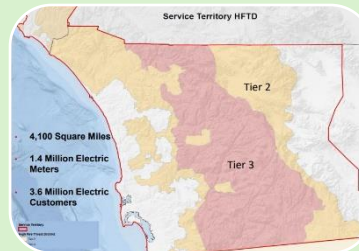
OH & UG Patrols



Wood Pole Intrusive



Enhanced Inspections



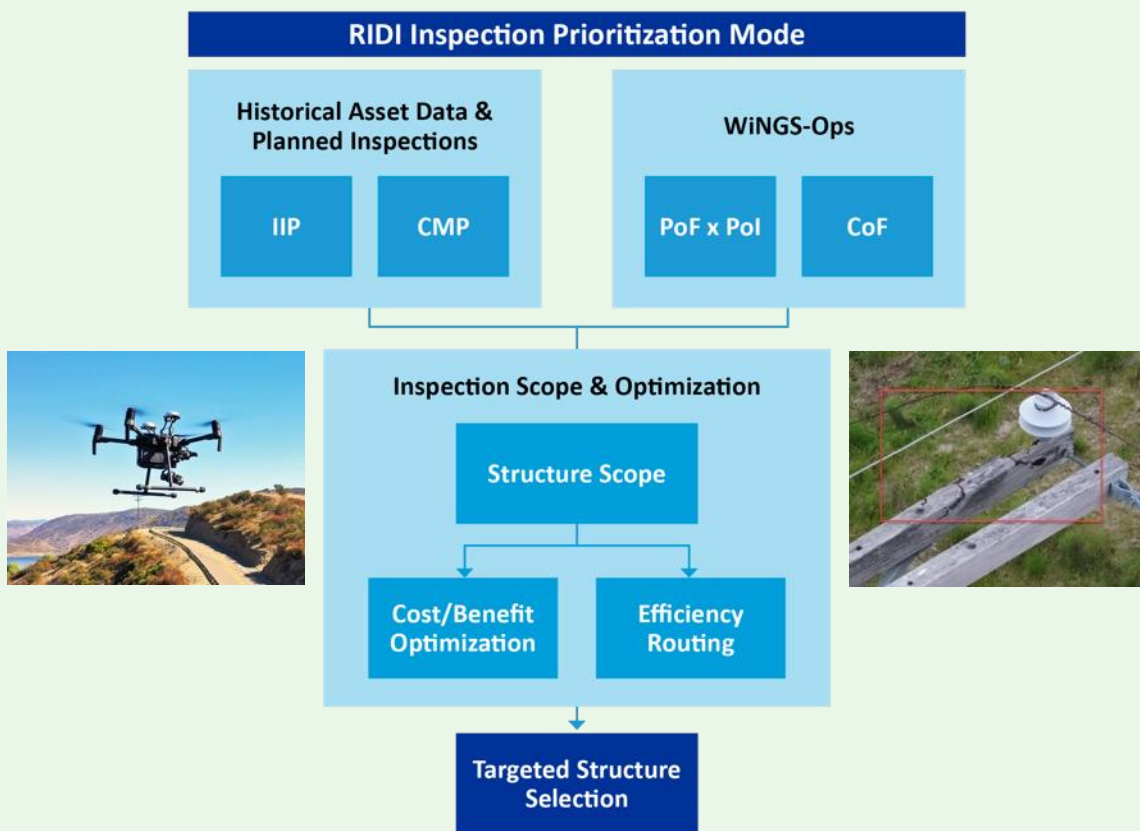
Early Fault Detection



RIDI

Equipment-specific Risk-Informed Inspection and Maintenance

Risk-Informed Drone Inspections (RIDI)



Utilizes risk models to determine scope of high-risk assets for inspection

Early Fault Detection



Utilizes real-time monitoring to detect incipient faults on the system (radio frequency analysis and power quality sensors)

PSPS Mitigation Strategies

Objective: Prevent ignitions during high-fire weather and minimize PSPS impact



Grid Hardening

Strategic Undergrounding Program
PSPS Sectionalizing Enhancement Program
Covered Conductor



Situational Awareness

216 weather stations with 30-second
read capabilities



Risk Analytics

WiNGS-Ops for automated visibility
and decision-making

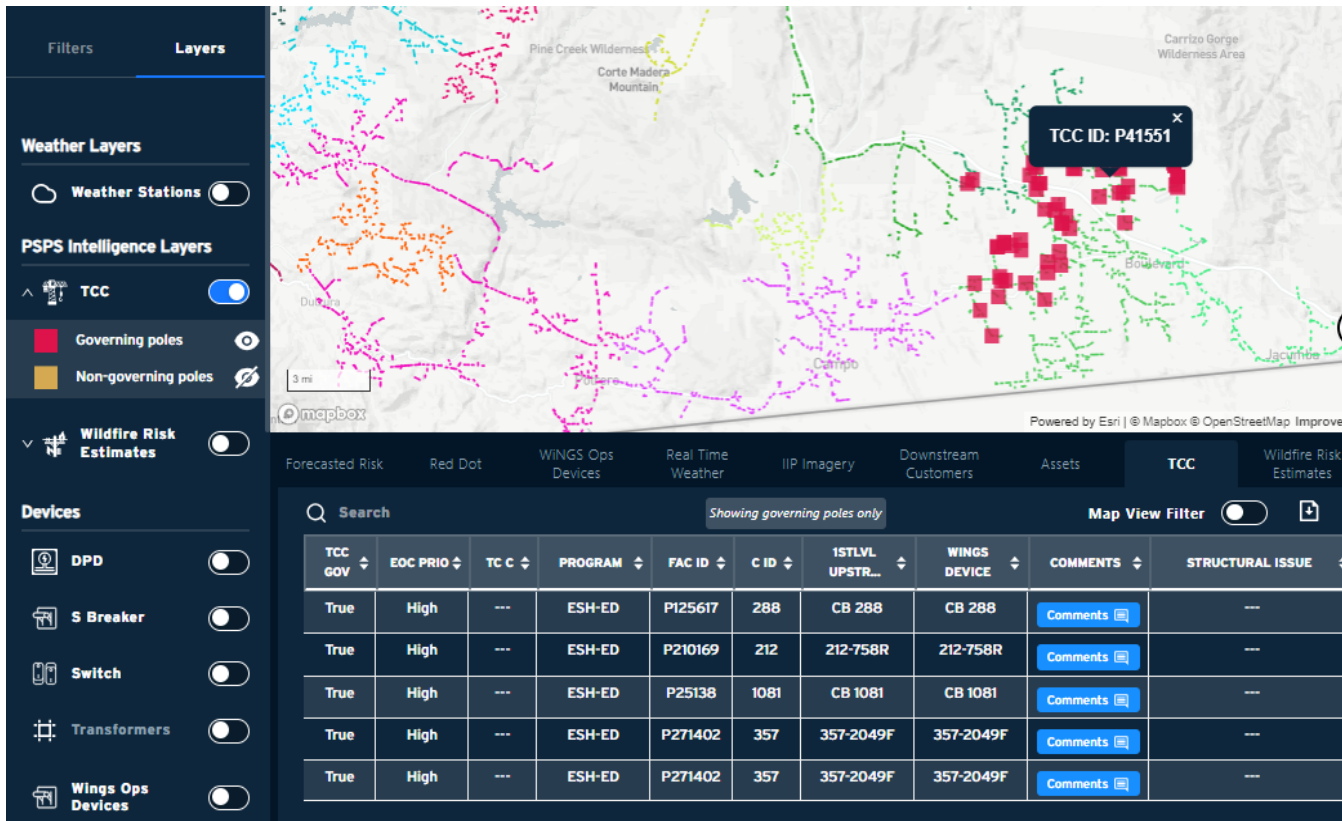


Customer Resiliency

Standby Power Program
Customized Resiliency Assessments
Generator Assistance Program

WiNGS-Ops | Temporary Construction & Compliance (TCC)

Utilization of the TCC layer in WiNGS-Ops allows for risk identification of problematic structures and prioritization of corrective work with greatest impact on reducing the scope of PSPS events.



Map view of all TCC poles with zoom capabilities along with quick reference of information per asset



Visibility to **all governing & non-governing poles**



Filter option for all poles by governing and non-governing within in SDGE territory



IIP Imagery for selected assets



Relevant data per asset breakdown upstream scada device, field comments, VRI impact, P95/P99, EOC priority & circuit ID

Summary

Updates to Risk Models

- Enhancements, architecture, validation, visualization

Mitigation Effectiveness

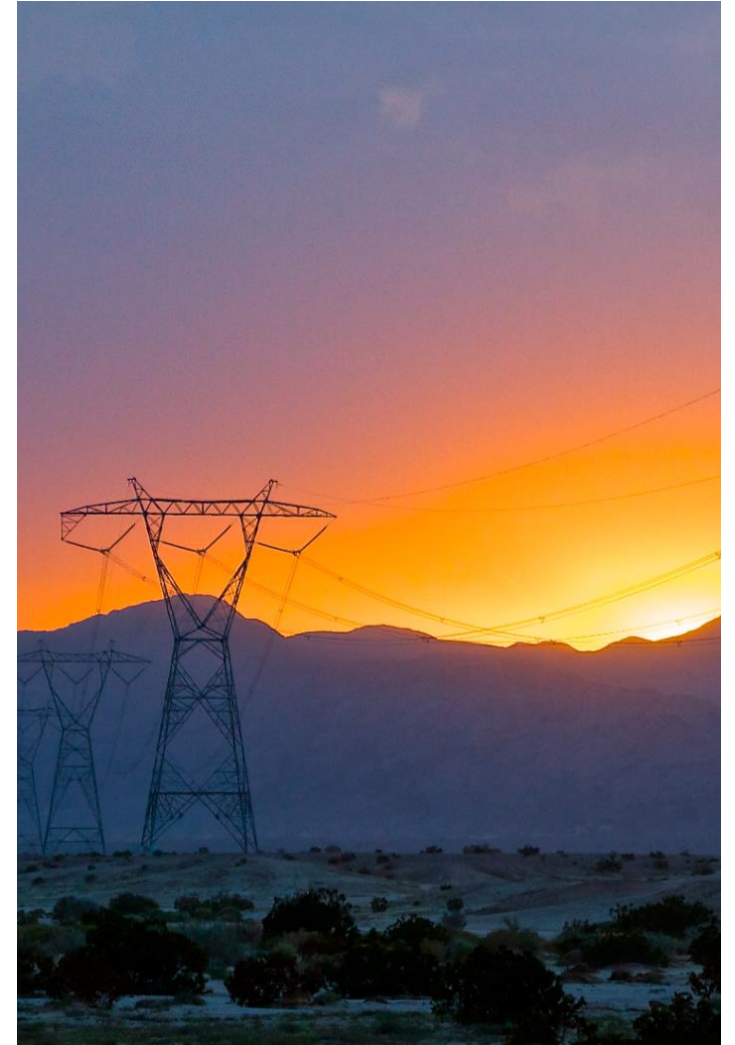
- Data driven, individual and combined analysis, ongoing improvements

Inspections and Findings

- Time-based and risk-informed inspections

Equipment-specific Risk Prioritization of Maintenance

- TCC risk-informed prioritization considers wildfire *and* PSPS risk



Questions



THANK YOU