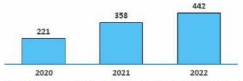
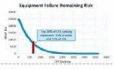
Public Safety
Long Term Incentive Plan (LTIP)
Target Setting

November 13, 2020

Together, Building
a Better California

Evolution of the LTIP metric from units of work completed to amount of risk being reduced

	2020-2022 LTIP Plan	2021-2023 LTIP Plan
System Hardening	▪ **Risk Exposure** – Count of circuit miles system hardening in High Fire Threat Districts (HFTD) and High Fire Threat Areas (HFRA). Goal was ~1,021 circuit miles over 3 years; 235 miles hardened YTD in 2020 	▪ **Risk Exposure –** Count of circuit miles system hardened in the HFTD and HFRA areas. Less focus on number of miles and more on risk ▪ **Risk Profile** – Majority of system hardening miles in the top 20 % of the HFTD CPZ's, Fire impacted areas and PSPS impacted circuits ▪ **Risk Effectiveness -** Prioritizes high risk mitigation options (Undergrounding and Line removals)  
Substation Enablement	▪ Number of substations out of possible 64 substations that are "energizable" during a Transmission-Level PSPS event ▪ 62 high priority substations are now operationally ready within 48 hours (LTIP 3-yr 2.0 target = 50 substations	▪ Improved identification of high-risk fire conditions and better tailoring of operational actions to respond to high-risk threats and events has decreased the need for substation energization during PSPS events in 2020 ▪ Replace the Substation Enablement metric for the 2021-2023 LTIP Period with EVM Risk Reduction Public Safety Metric
Enhanced Vegetation Management (EVM)	▪ No metric was established for EVM	▪ Quantifies the risk reduction obtained at the location level and counts the number of miles worked in fire impacted areas to address repeat fire danger from partially burnt fuel ▪ Assumes execution of the 10-year Enhanced Vegetation Management Plan averaging 2,120 circuit miles annually for 2021-2030

Risk Model and Risk Quantification

Wildfire Risk Models calculates risk units in CPUC framework

LoRE

- The likelihood of a risk event (LoRE) is the relative frequency of a specific risk event occurring.
- In the case of **wildfire risk**, this is the relative **likelihood of a ignition occurring**.

CoRE

- The consequence of a risk event (CoRE) is the average impact of the risk should it materialize across key metrics (Safety, Reliability, Financial).
- In the case of wildfire risk, **consequence contains serious injuries, fatalities , property damage**, and impacts to reliability.

Risk = LoRE X CoRE

- Risk is the product of the likelihood and consequence of a risk event.
- This method produces an expected value of impact across the consequence metrics, and when combined results in a multi-attribute score that can inform risk based decision making

Methodology

Ignition Model

- Likelihood of ignition
  - Ignition likelihood was determined based on 2021 modeling predicting ignitions at the circuit protection zone

✖

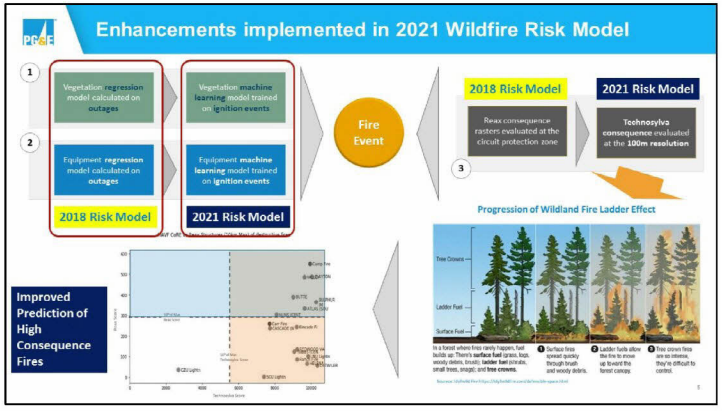
Fire Model

- Likelihood of Spread
  - Spread likelihood was determined based on a study conducted by PG&E and Technosylva
- ✖ Consequence
  - Consequence considerations focused on the potential impact of a wildfire

✖

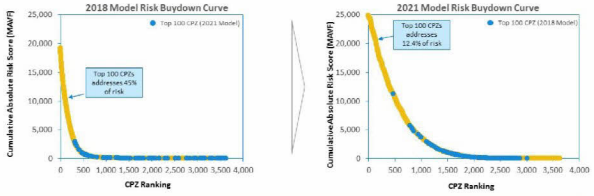
Other Considerations

- Operational Factors
  - Factored in additional operational constraints


Enhancements implemented in 2021 Wildfire Risk Model
1
Vegetation regression model calculated on outages
Vegetation machine learning model trained on ignition events
2
Equipment regression model calculated on outages
Equipment machine learning model trained on ignition events
2018 Risk Model
2021 Risk Model
Fire Event
2018 Risk Model
2021 Risk Model
Rwax consequence rasters evaluated at the circuit protection zone
Technosylva consequence evaluated at the 100m resolution
3
Progression of Wildland Fire Ladder Effect
Tree Crowns
Ladder Fuel
Surface Fuel
Improved Prediction of High Consequence Fires

Risk models provide risk buydown curves to guide workplan

The risk buydown curve shows ***the amount of risk that can be addressed*** with every subsequent mile or CPZ that is mitigated. This view shows the relative magnitude of potential projects and can compare impacts of programs with varied effectiveness. The visualization helps to highlight the consolidation of risk by mile as you move down the prioritization list.



System Hardening Risk Buydown curves highlight the significant shift of where the top 100 CPZ's are between the two models

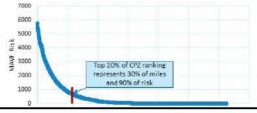
The risk model is used to develop risk buydown curves for EVM and System Hardening

The risk buydown curve shows ***the amount of risk that can be addressed*** with every subsequent mile or CPZ that is mitigated. This view shows the relative magnitude of potential projects and can compare impacts of programs with varied effectiveness. The visualization helps to highlight the consolidation of risk by mile as you move down the prioritization list.

[redacted] Do you happen to have the 2018 and 2021 Buydown curves for System Hardening and EVM

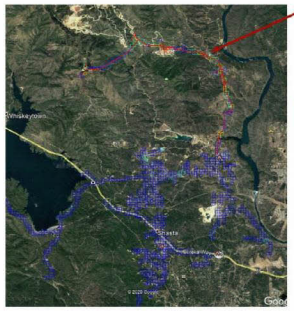
Equipment Failure Remaining Risk

Enhanced Vegetation Remaining Risk



Project Example

Project Example: Keswick 11011586 Circuit Protection Zone

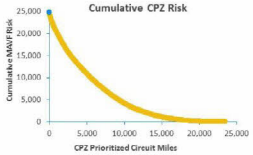


Keswick 11011586 Circuit Protection Zone

- 6.6 Miles in total, the 100m X 100m squares are the absolute risk values for each section of that protection zone
- The total protection zone absolute risk score is 48.84 risk units (sum of all the 100m squares along the circuit)
- Average risk score of all the squares gives the CPZ mean risk score of 1.25

Keswick (6.6 Miles)	No System Hardening	Overhead Hardening	Undergrounding	50-50 OH / UG
Total CPZ Risk Score After Mitigation	48.84	30.28	48.35	39.32
Total CPZ Residual Risk Value	48.84	18.56	0.49	9.52
Overall Milgs	6.6	6.6	6.6	6.6
OH System Hardening [redacted] /mile)	$ -			
UG System Hardening [redacted] /mile)	$ -			
Total Cost	$ -			
Simple Risk Spend Efficiency	n/a			

The top 50 miles of CPZs will be targeted for 25 miles of system hardening in 2021



Protection Zone Name	Miles	Cumulative Miles	Mean MAVF Score	Total CPZ Mavf	% total risk reduced (62%)
OREGON TRAIL 1103CUS391	0.02	0.02	3.16	3.16	**0.01%**
CALPINE 1144276-G	0.01	0.03	1.88	1.88	**0.01%**
MARIPOSA 210190130	0.08	0.12	1.69	1.69	**0.02%**
SHEPHERD 2111688294	0.01	0.13	1.44	1.44	**0.02%**
MIDDLETOWN 1103CB	0.05	0.18	1.30	5.20	**0.03%**
UPPER LAKE 1101CB	1.00	1.17	1.26	3.77	**0.04%**
KESWICK 11011586	6.66	7.83	1.25	48.84	**0.17%**
MIDDLETOWN 1102302610	4.21	12.04	0.92	48.56	**0.29%**
KONOCTI 1102965078	5.61	17.65	0.88	51.70	**0.42%**
MARIPOSA 2102241564	0.64	18.29	0.77	10.81	**0.44%**
BUCKS CREEK 1101CB	4.29	22.58	0.73	9.55	**0.47%**
DEL MAR 210937846	0.09	22.67	0.73	2.19	**0.47%**
MIDDLETOWN 1102CB	0.42	23.08	0.72	8.70	**0.49%**
MIDDLETOWN 1103830	24.80	47.88	0.72	151.83	**0.87%**

Key Takeaways

- Mitigating 25 of the 50 riskiest miles within PG&E's service territory would reduce ~0.5% of PG&E's total wildfire risk.
- Some of these segments are relatively small and may be the result of edge effects. However trends in the data, such as the Middletown circuit, highlight areas of high risk were more extensive remediation can occur
- The team recommends creating a strike team to assess the most effective way to address and mitigate the wildfire risk across these circuits and locations to complete these in 2021 as a stretch target

Our first condition puts a focus on identifying projects that are in the top 20% of riskiest CPZs

CPZs

Remaining Risk

The table summarizes the CPZ ranking along the risk curve

CPZ Ranking %	Risk %
10%	72%
20%	90%
50%	99%
80%	100%
95%	100%

Map View of CPZ **TBD**

Can we say anything here to describe this CPZ such as likelihood of fire ignition (tree species, canopy shape etc.), likelihood of spread (wind, fuel type), asset condition and type – to bring this CPZ more to life?

Selected Project

CPZ Attributes

- Quantified Risk Value:
- Estimated number of miles

Project Attributes

- Number of miles considered:
- Total addressable risk value:

Our second condition puts a focus on the method considered for System Hardening

Overhead Hardening

Overhead Hardening may include: replacement of bare overhead conductors, poles, primary line equipment, and existing transformers to lower fire ignition risk

Execution Complexity	Cost of Solution	Residual Risk
⇩	⇨	⇨

Underground

Undergrounding is the replacement of the primary (and some secondary) overhead conductors and cables, eliminating the need for overhead lines altogether

Execution Complexity	Cost of Solution	Residual Risk
⇧	⇧	⇩

Remote Grid

Remote Grid uses stand-alone, distributed energy sources and utility infrastructure for 24/7/365 reliable energy delivery in lieu of traditional wires

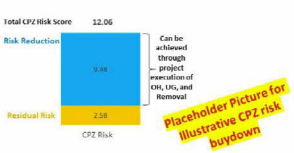
Execution Complexity	Cost of Solution	Residual Risk
⇧	⇩	⇩

⇧ High ⇨ Medium ⇩ Low

MITIGATION METHODS	MILES	EFFECTIVENESS
System Hardening - Underground	X	99%
System Hardening - Overhead	Y	60%
Line Removal	Z	99%

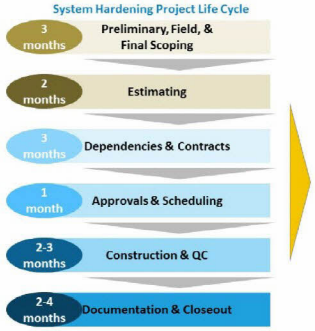
Examples of factors to determine Undergrounding, OH Hardening, and Removal:

- Past PSPS occurrences
- Lifecycle cost considerations
- Number of customers
- Miles of work
- Timeline considerations



Placeholder Picture for Illustrative CPZ risk buydown

The process for identifying and scoping specific projects has a very long lead time, between 12-18 months



Project Status	Number of Projects	Project Miles	High Risk Area Miles	MAVF Risk	Risk per Mile
In Construction	47	47.5	3.27	7.91	0.17
ECOP (In Estimating)	20	104.9	25.05	40.30	0.38
PSPS Mitigation	12	14.5	14.5	17.46	1.21
Top 20% MAVF CPZ	7	30.4	30.4	49.70	1.63
Construction Ready	25	34.6	-	0.73	0.02
Estimating Complete	7	12.8	-	0.25	0.02
Other In-Flight Keep	28	55.8	-	8.21	0.03
2021 Proposed Portfolio	145	304.6	73.2	124.55	0.41
ECOP (Future)	74	340	25.02	92.37	0.27

Target Setting

Approach to the 2021 work plan attempts to balance with maximized risk reduction

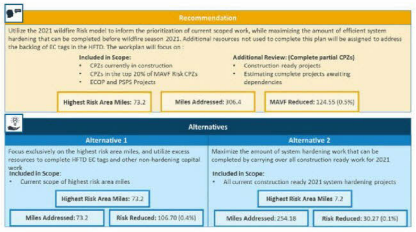
Conditions

Risk Exposure Expanded
- All 25,000 HFTD miles were evaluated within the 2021 Risk Model

Risk Proportion Focused
- Majority of system hardening miles in the top 20% of the HFTD CPZ's; remaining in Fire impacted and PSPS impacted CPZ's (Fire rebuild
- 2021 is a transition year given risk model enhancements and evolution

Risk Effectiveness Enabled
- Prioritizes high risk mitigation options (Undergrounding and Line removals)
- 5%, 10% and 15% of Undergrounding work in the System Hardening project portfolio in 2021, 2022 and 2023, respectively

2021 System Hardening Workplan



The LTIP targets for system hardening are set based on 2021 risk area miles and program funding assumptions

Program Funding
- Forecast of [redacted] Wildfire Mitigation capital spend (bulk of which is System Hardening) in 2021 consistent with the Settlement for the 2020-2022 GRC. 2022 forecast escalates 2021 by 15% and 2023 forecast escalates 2021 by 30%.

Unit Costs
- Assumes [redacted] per circuit miles of Overhead SH work and [redacted] for Underground work

Program Duration
- Execution of the **13-year** plan focusing on top 20% CPZs by **2032**

System Hardening LTIP Targets

	LTIP 0.5	LTIP 1.0	LTIP 2.0
2021	305	320	350
2022	350	368	403
2023	396	416	455
2021-2023	1,051	1,103	1,209

Targets are miles of system hardening work for specific risk-prioritized work

The total mileage of the proposed 2021 Project Portfolio was set as the threshold goal (LTIP 0.5) for 2021. 2022 and 2023 LTIP 0.5 goals reflect escalation of program funding level. The target and stretch goals (LTIP 1.0, 2.0) were set as 5% and 15% higher, respectively.

The LTIP targets for EVM are set based on work to be completed over the remaining ten years of the program

Program Funding
- Forecast o[redacted] spend on EVM program in 2021, 2022 and 2023 respectively (in alignment with POR)

Unit Costs
- TBD (can we say anything here about cost assumptions?)

Program Duration
- Assumes execution of the 12-year Enhanced Vegetation management Plan **(2019-2030)**

Enhanced Vegetation Management LTIP Targets

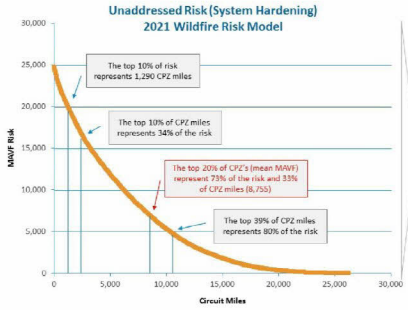
	LTIP 0.5	LTIP 1.0	LTIP 2.0
2021	2,120	2,226	2,438
2022	2,120	2,226	2,438
2023	2,120	2,226	2,438
2021-2023	6,360	6,678	7,314

Targets are miles of EVM work for specific risk-prioritized work.

The total mileage of the proposed 2021 Project Portfolio was set as the threshold goal (LTIP 0.5) for 2021. The target and stretch goals (LTIP 1.0, 2.0) were set as 5% and 15% higher, respectively.

Appendix

The Wildfire Risk Model is used to develop a Risk Buydown curve for potential System Hardening projects



Buydown Curve Conceptual Overview

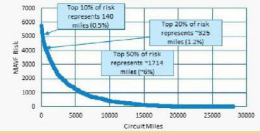
The risk buydown curve shows ***the amount of risk that can be addressed*** with every subsequent mile or CPZ that is mitigated. This view shows the relative magnitude of potential projects and can compare impacts of programs with varied effectiveness. The visualization helps to highlight the consolidation of risk by mile as you move down the prioritization list.

The following table summarizes the mileage and CPZ coverage (%) along the risk curve

Risk %	Mile %	CPZ %
10%	2%	2%
20%	5%	4%
50%	18%	11%
80%	40%	24%
95%	62%	40%

Risk Buydown curves have also been developed for EVM to identify number of miles and CPZs to be targeted

Circuit Miles



The following table summarizes the mileage along the risk curve:

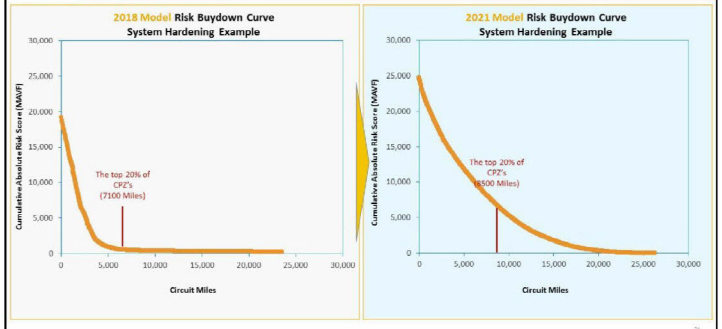
Risk %	Mile %
10%	1%
20%	1%
50%	6%
80%	19%
95%	42%

CPZs

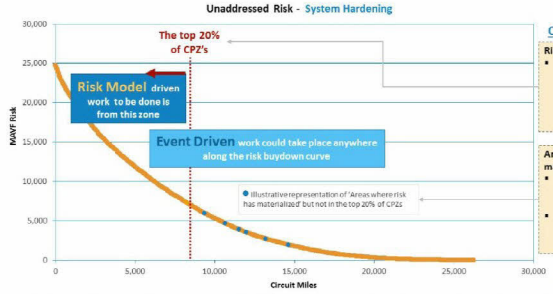
The following table summarizes the CPZ ranking along the risk curve:

CPZ Ranking %	Risk %
10%	72%
20%	90%
50%	99%
80%	100%
95%	100%

As a result of modeling enhancements risk buydown curves have evolved



Public Safety metrics require that risk reduction will be focused on areas were risk has materialized or that are in the top 20% of CPZs



Condition #1 Factors*

Risk model driven
- 20% of the population of risk-ranked system hardening protection zones as determined by the approved risk model

Areas where risk has materialized
- System hardening work performed in fire rebuild areas
- Circuits impacted multiple times by PSPS actions in 2019 and 2020

LTIP score is 0 if condition not met

*Condition 1 does not apply to work performed in 2021 as it's a transitional year due to the adoption of a new risk model and a long lifecycle of System Hardening projects

Public Safety metrics require that a portion of the mitigation focus on alternate hardening strategies

Underground	Remote Grid
	
Undergrounding is the replacement of the primary (and some secondary) overhead conductors and cables, eliminating the need for overhead lines altogether	**Remote Grid** uses stand-alone, distributed energy sources and utility infrastructure for 24/7/365 reliable energy delivery in lieu of traditional wires

Condition #2 Factors

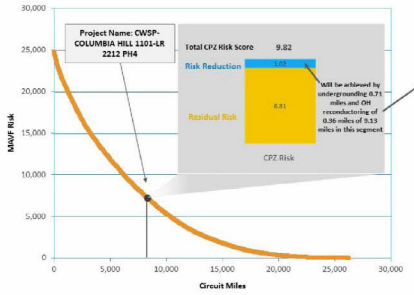
Mitigation Method

- At least 5%, 10%, and 15% of undergrounding or line removal work in the system hardening project portfolio in 2021, 2022, and 2023, respectively

LTIP score is 0 if condition not met

Sample System Hardening Project

Unaddressed Risk - CWSP-COLUMBIA HILL 1101-LR 2212 PH4



Project Plan

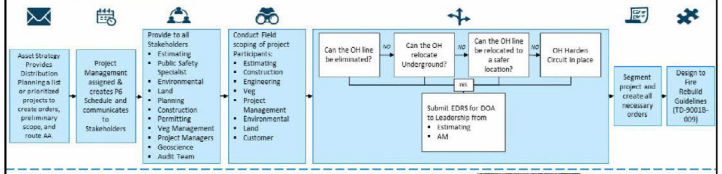
Map View of CPZ Columbia Hill

MITIGATION METHODS	MILES	EFFECTIVE-NESS
System Hardening - Overhead	0.357	97%
System Hardening - Undergrounding	0.712	99%

Project Scope:

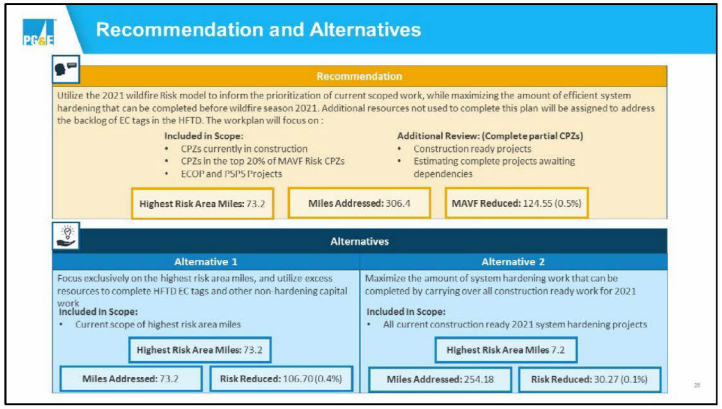
- Install 3,761' of 3-1/0A EPR & 1-4" Conduit 12kV
- Install 1,546' of 3-1/0A TW 12kV
- Install 335' of 2-1/0A TW 12kv
- Replace/install 10 poles
- Replace/install 1 transformers
- Replace/install 2 fuses

Projects are often a combination of mitigation methods of hardening



Example – Shingle Springs 2109 LR 9372 (El Dorado County)

CPZ	2018 Risk Rank	2021 Risk Rank	Consequence: Technosylva Fire Area	Consequence: MAVF Core
LR 35598	554	159	296	2,054
LR 9372	554	227	351	1,860
LR 13322	554	1,018	153	1,048

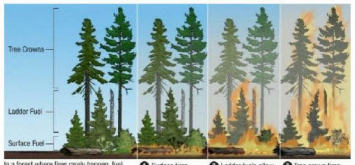


Ladder Effects

Ladder effects in wildland fires create the conditions for low **lying fast burning fuels to intensify** as they move from up the canopy and into more energy dense fuel sources. Accounting for this effect in wildfire modeling **de-emphasizes areas of dense fuels** as high risk for ignition, due to lack of potential surface fuels.

Additionally, locations that have large amounts of surface fuels that can **sustain high temperatures** are rated more highly as these are more likely to ladder into difficult to contain crown fires.

Progression of Wildland Fire Ladder Effect



In a forest where fires rarely happen, fuel builds up. There's **surface fuel** (grass, logs, woody debris, brush); **ladder fuel** (shrubs, small trees, snags); and **tree crowns.**

❶ Surface fires spread quickly through brush and woody debris.

❷ Ladder fuels allow the fire to move up toward the forest canopy.

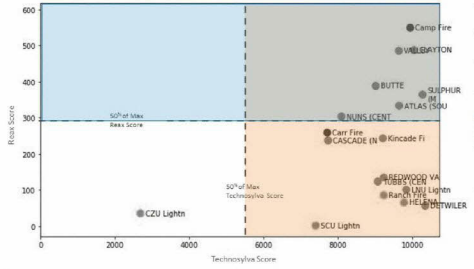
❸ Tree crown fires are so intense, they're difficult to control.

Source: Idyllwild Fire https://idyllwildfire.com/defensible-space.html

Technosylva more accurately predicts high consequence fires as having high risk

Technosylva based wildfire consequence data better identifies historical destructive fire locations

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



REAX Score

- 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

Technosylva Score (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

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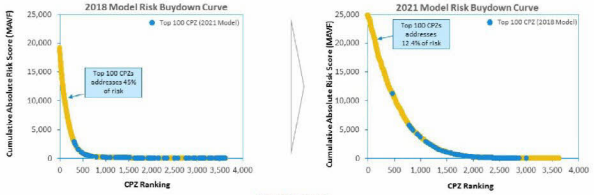
Risk Model Action Items

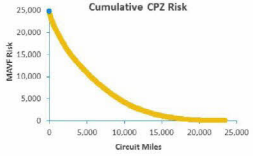
Workstream	Action Item	Description	Responsible party	Resolution	Date
Risk Models	Risk models comparison WSE – 10/30/2020	Create risk comparison between the 2018 risk model and 2021 risk model to highlight movement of CPZs (Targeting top 100 circuits or CPZs)	Jon Eric Thalman	Complete – See the Risk Model Follow-up Section	11/13/2020



Key Takeaways

- No CPZs in the top 100 overlap
- This will result in significant change to the prioritization and expected risk buydown of mitigations
- The 2018 risk results were not distance weighted, where the 2021 prioritization included a distance factor.

The top 50 riskiest miles represent 4.9% of the system risk.



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KESWICK 11011586	6.66	7.83	1.25	48.84	**0.17%**
MIDDLETOWN 1102302610	4.21	12.04	0.92	48.56	**0.29%**
KONOCTI 1102965078	5.61	17.65	0.88	51.70	**0.42%**
MARIPOSA 2102241564	0.64	18.29	0.77	10.81	**0.44%**
BUCKS CREEK 1101CB	4.29	22.58	0.73	9.55	**0.47%**
DEL MAR 210937846	0.09	22.67	0.73	2.19	**0.47%**
MIDDLETOWN 1102CB	0.42	23.08	0.72	8.70	**0.49%**
MIDDLETOWN 1103830	24.80	47.88	0.72	151.83	**0.87%**

Key Takeaways

- Mitigating 25 of the 50 riskiest miles within PG&E's service territory would reduce ~0.5% of PG&E's total wildfire risk.
- Some of these segments are relatively small and may be the result of edge effects. However trends in the data, such as the Middletown circuit, highlight areas of high risk were more extensive remediation can occur
- The team recommends creating a strike team to assess the most effective way to address and mitigate the wildfire risk across these circuits and locations to complete these in 2021 as a stretch target