Reliability Analysis for IRP Planning Reserve Margin (PRM)

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Together, Building a Better California

PG&E Reliability Analysis for IRP
Draft PRM Results and Key Takeaways

PG&E PRM vs. Energy Division (ED) PRM to achieve a 0.1 Loss of Load Expectation (LOLE)

	PG&E's Draft Results	ED's Draft Results	Delta
PRM	13%	14%	1%

1. **PG&E supports ED's proposed PRM methodology changes:**
   a) PRM based on gross peak. Behind-the-Meter Photovoltaic (BTM PV) treated as a resource
   b) PRM based on perfect capacity modeling
2. ***PG&E's PRM results largely aligned with ED's***
   a) For 2030 IRP benchmarking, ED's 1% higher PRM would result in ~600 MW of incremental CAISO perfect capacity need
3. **Resource accreditation will be critical in ensuring an appropriate reliability framework**

PG&E Reliability Analysis for IRP
PG&E's Strategic Energy & Risk Valuation Model (SERVM) Model

- ED's 2020 Reference System Plan (RSP) SERVM model used as a starting point
- RSP SERVM model modified with the following major updates:
  - *Resource Portfolio matches 2022 Preferred System Plan (PSP), inclusive of North/South split*
  - *Load, Solar and Wind* profiles
    - Added recent year (2018, 2019, 2020, 2021) weather data
    - Calibrated load duration curve to 2021 Integrated Energy Policy Report (IEPR) or the Interagency Working Group (IAWG) High-Electrification forecast
    - Calibrated solar and wind profiles using historical production data
  - *CAISO Imports*
    - Net-imports limited to 4,000 MW during Months 6-9, hours ending (HE) 17-22 & ramp down constraint between Maximum Import Capability (MIC) and 4,000 MW limit
      - Approximates rest of Western Electricity Coordinating Council (WECC) regions at 0.1 LOLE
    - Net import allocation to North and South calibrated to 2020
  - *Storage forced and planned outages & constraints adjusted to match ED's 2021 PSP Update*
    - Storage outage rate assumptions: 5% average outage rate to all storage categories (batteries, both paired and stand-alone, BTM batteries).
    - Pumped storage calibrated to historical – outages embedded.
    - Battery discharge constraint (non-binding during unserved energy events): 90% discharge cap to batteries, both paired and stand-alone (but not pumped storage hydro)
- Updated hydro de-rates, and increased operating reserve requirement from 4.5% to 6% (regional requirement and based on managed load)

PG&E Reliability Analysis for IRP
PSP Scenarios Analyzed

In addition to analyzing aPRM requirement using the 2021 IEPR AAEE Scenario 3 – AAFS Scenario 3 Forecast, PG&E's study included scenario analysis for different load forecasts

Year	#	Forecast and Study Year Scenarios	PRM Calculation	Resource Accreditation for PRM
2030	1	2021 IEPR Additional Achievable Energy Efficiency (AAEE) Scenario 3 – Additional Achievable Fuel Substitution (AAFS) Scenario 3	x	x
	2	2021 Inter-Agency Working Group (IAWG) High Electrification	x	
	3	2021 IEPR AAEE Scenario 3 – AAFS Scenario 3 & High EV	x	
2035	4	2021 IEPR AAEE Scenario 3 – AAFS Scenario 3	x	x

$$PRM = \frac{\textbf{Perfect Capacity Needed to Acheive a 0.1 LOLE}}{\textbf{Gross Peak } (sales - load\ modifiers + BTM\ PV)} - 1$$

PG&E Reliability Analysis for IRP

PG&E and ED Comparison – ED Results Estimated

In 2030, using the IEPR load forecast, ED's draft PRM would result in ~580 MW of incremental perfect capacity at the CAISO-level

2030 PRM Estimation for 2021 IEPR AAEE Scenario 3 – AAFS Scenario 3

	PG&E's Draft Results	ED's Draft Results	Delta
Perfect Capacity Needed to Achieve a 0.1 LOLE (MW)	*65,499*	*66,079*	*580*
CAISO Gross Peak	*57,964*	*57,964*	
PRM	**13%**	**14%**	**1%**

$$\boldsymbol{PRM} = \frac{65{,}499}{57{,}964} - 1 = 13\%$$

$$\boldsymbol{PRM} = \frac{66{,}079}{57{,}964} - 1 = 14\%$$

PG&E Reliability Analysis for IRP
Loss of Load Expectation (*LOLE) Results*

The PSP portfolio includes sufficient capacity to achieve a 0.1 LOLE across different load forecast scenarios

PG&E Draft PSP LOLE Results

	PSP w/2021 IEPR AAEE Scenario 3 – AAFS Scenario 3		PSP w/IAWG High Electrification	
Metric	**2030**	**2035**	**2030**	**2035**
Found LOLE	*0.02*	*0.003*	*0.02*	*0.07*
Thermal Capacity Removed to Achieve 0.1 LOLE	*(~2,700)*	*(~4,200)*	*(~2,100)*	*(~950)*

Appendix

PG&E Reliability Analysis for IRP
Key Modeling Assumptions

ED's 1% higher PRM is largely driven by a more conservative operating reserve requirement and the weather years modeled

	ED PSP Model	PG&E Model	More Conservative PRM Assumption
Supply Resources	PSP Portfolio	○ PSP Portfolio ○ Capacity split North and South based on PSP ratio	N/A
Weather Years	1998-2020	1998-2021	CPUC
Net-Import Constraints	Net-imports limited to 4,000 MW during Months 6-9, hours ending 17-22 & ramp down constraint between MIC and 4,000 MW limit	○ Net-imports limited to 4,000 MW during Months 6-9, hours ending 17-22 & ramp down constraint between MIC and 4,000 MW limit ○ Net-import allocation split between North & South based on the 2020 historical data	N/A
Load Forecast	IEPR 2021 Scenario 3 – AAFS Scenario 3	1. IEPR 2021 Scenario 3 – AAFS Scenario 3 + High EV 2. IAWG High Electrification 3. IEPR 2021 IEPR Scenario 3 – AAFS Scenario 3	N/A
Forced Outages	NERC GADS Outage Database	Calibrated to August 2020 Resource Outage Rate	N/A
Operating Reserves Requirement	6% on Gross Load – Regional Requirement	~5.5% on Gross Load to replicate 6% on Managed Load – Regional Requirement	CPUC
Renewable and Hydro Profiles	N/A	2020 RSP profiles calibrated to historical CAISO data	N/A
Storage Assumptions and Constraints	○ 5% average outage rate to all storage categories (batteries, both paired and stand-alone, BTM batteries, PSH). ○ Battery discharge constraint (non-binding during unserved energy events): 90% discharge cap to batteries, both paired and stand-alone (but not PSH)	○ 5% average outage rate to all storage categories (batteries, both paired and stand-alone, BTM batteries). ○ PSH calibrated to historical – outages embedded. ○ 90% discharge cap to batteries, both paired and stand-alone (but not PSH, non-binding during reliability events)	N/A

Reliability Analysis for IRP PRM
SERVM Stochastic Framework to Capture Uncertainty

- The LOLE for a given study year is based on a weighted average of the LOLE from all associated simulated 8760 scenarios
- ***The weather years modeled, and the underlying load forecast for the weather years will have the greatest impact on the LOLE results and subsequent PRM***
- ***PG&E organized its reliability study to ensure an appropriate PRM was informed by different potential load forecasts and study years***

SERVM Iterations for a single study year

24 **Weather Years** **(1998-2021)** (Equal Probability)	x	**5** **Load Uncertainty Points** **(0%, ±2.5%, ±1.5%)** (Associated Probabilities)	=	**120** **Load Scenarios** (Associated Probabilities)		
120 **Load Scenarios**	x	**15** **Scenario Iterations** (Captures Random Draws)	=	**1800** **8760 Hour Simulations**		