Reliability Modeling Overview

2027 Integrated Resource Plan

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Topics

Reliability & Capacity Methodologies Overview

- Loss of Load Expectation
- Modeling Breakdown & Capacity Positions
- Effective Load Carrying Capability & Planning Reserve Margin

2027 Integrated Resource Plan - Portfolio Reliability

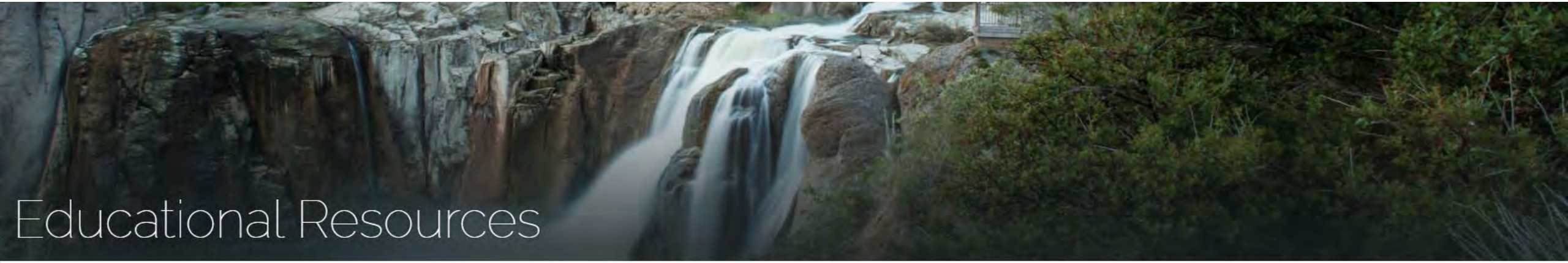
- Model Calibration Process
- Effective Load Carrying Capability Impacts
- Future Reliability Topics

Helpful Acronyms

Acronym	Meaning
EFORd	Equivalent Forced Outage Rate During Demand
ELCC	Effective Load Carrying Capability
ELR	Energy-Limited Resource
IPC	Idaho Power Company
IRP	Integrated Resource Plan
LOLE	Loss of Load Expectation
LOLH	Loss of Load Hour

Acronym	Meaning
LOLP	Loss of Load Probability
L&R	Load & Resource
LTCE	Long-Term Capacity Expansion
MW	Megawatt
PRM	Planning Reserve Margin
RCAT	Reliability & Capacity Assessment Tool
VER	Variable Energy Resource

IRP Educational Resources



Home › Energy and the Environment › Energy › Planning and Electrical Projects › Our 20-Year Plan › Educational Resources

IRP Questions and Responses

Educational Resources

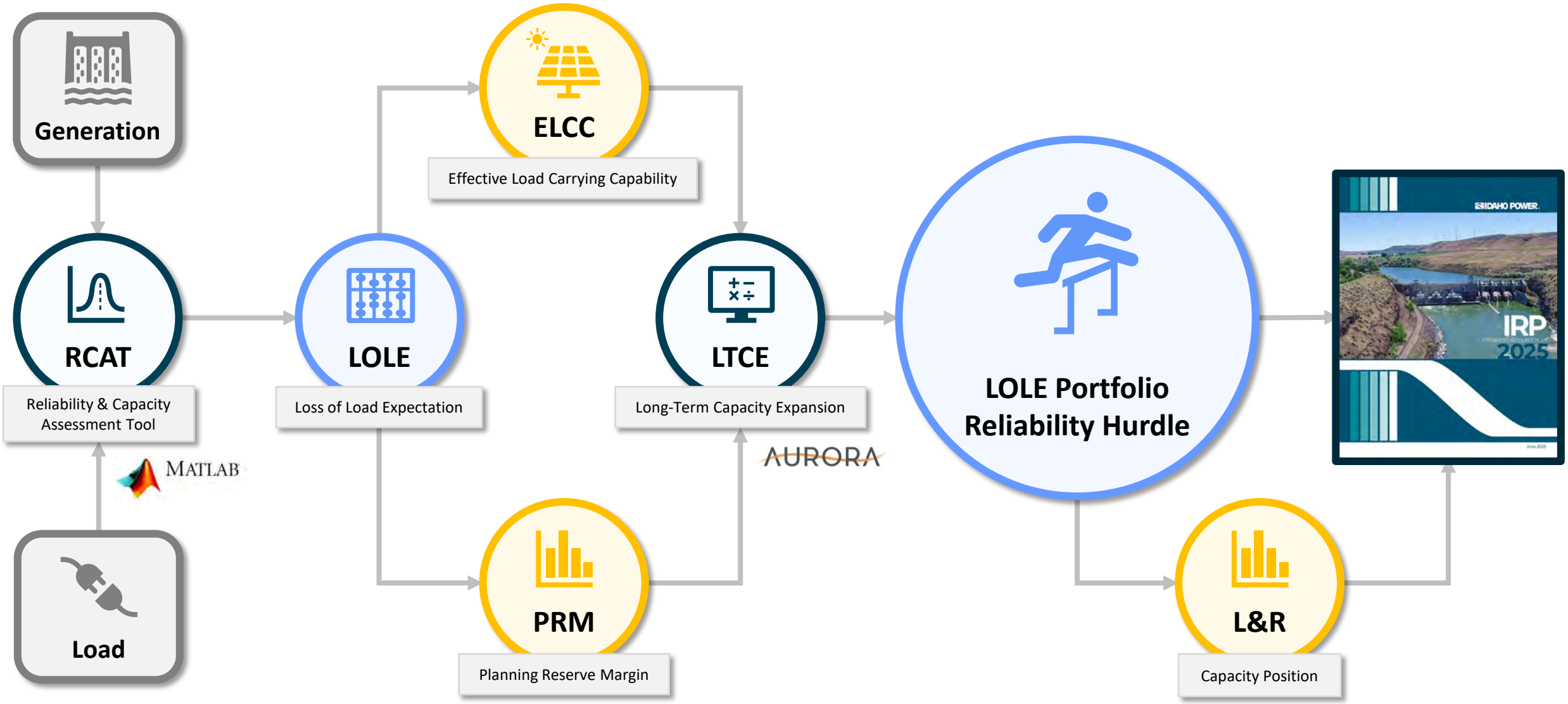
Idaho Power has compiled these resources to help those participating in our *Integrated Resource Plan* (IRP) process or anyone who wants to know more about how their energy is generated and delivered. We will add links, presentations and videos as they become available.



A Deep Dive into How Idaho Power Assesses Reliability & Capacity in the IRP

Educational Resources - Idaho Power

Integrated Resource Plan Relevance



Methodologies Overview

Reliability & Capacity Assessment



Reliability Definitions

LOLP: the probability of system peak or hourly demand exceeding the available generating capacity during a given period

$$LOLP = P_i(G_i - L_i)$$

G_i: *Generation available at hour "i"*

L_i: *Net load at hour "i"*

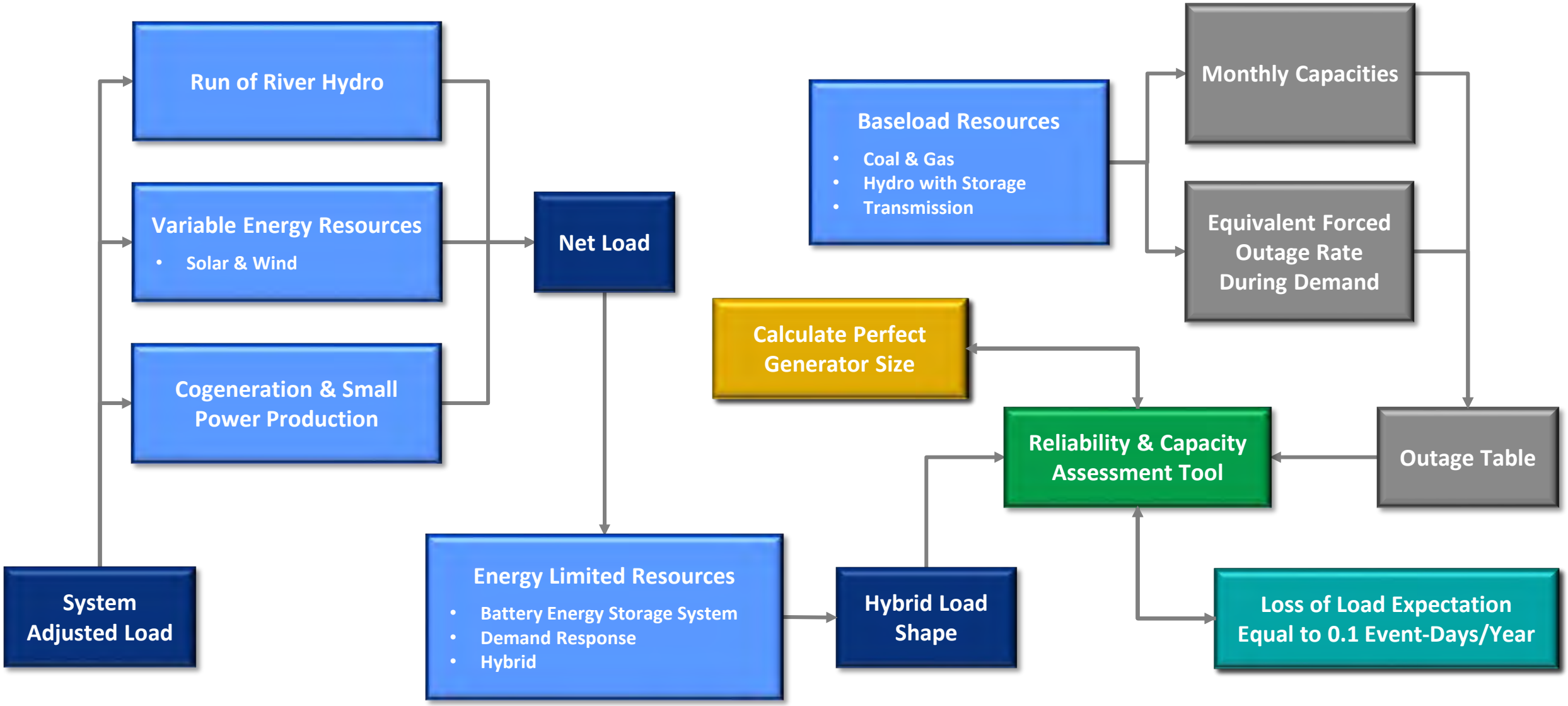
LOLE: the expected number of days per time period for which the available generation capacity is insufficient to serve the demand at least once per day

$$LOLE = \sum_{d=1}^{D} \max[{}_{i=1}^{H}(LOLP_i)]$$

LOLH: the expected number of hours per time period when a system's hourly demand is projected to exceed the generating capacity

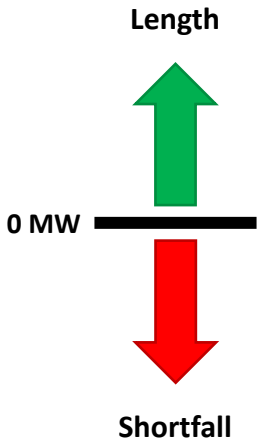
$$LOLH = \sum_{i=1}^{H} LOLP_i$$

Modeling Breakdown

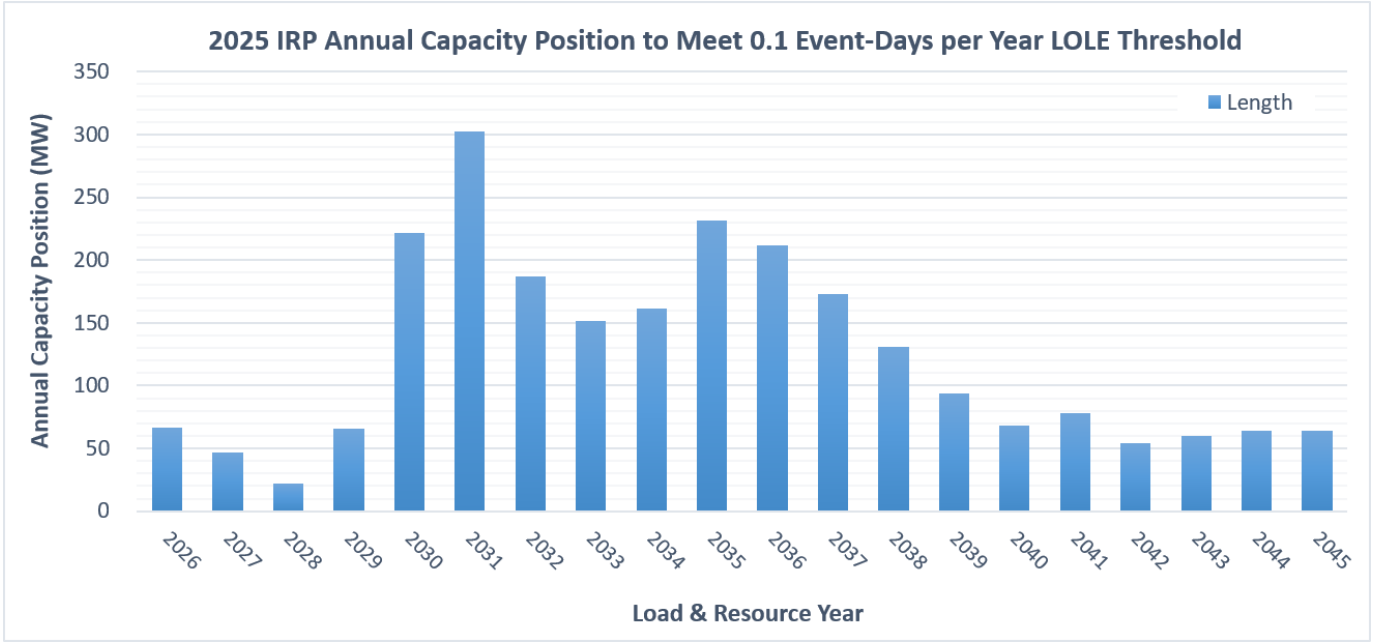


Annual Capacity Positions

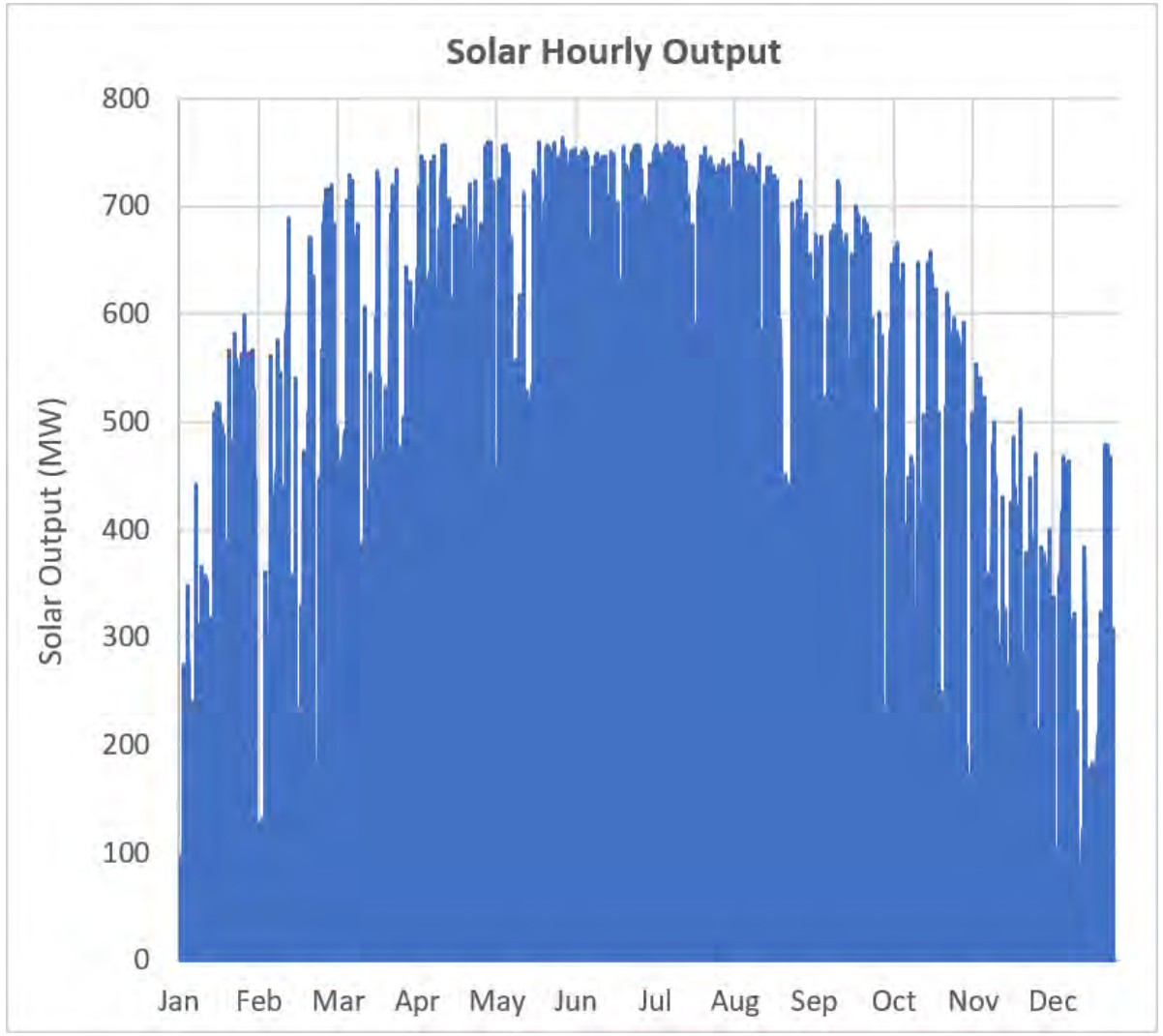
2025 IRP Annual Capacity Position (MW)		
Year	*Existing & Contracted Resources Only*	*Add Preferred Portfolio Resources*
2026	61 Length	66 Length
2027	(54) Shortfall	47 Length
2028	(105) Shortfall	22 Length
2029	(297) Shortfall	66 Length
2030	(677) Shortfall	222 Length
2031	(656) Shortfall	302 Length
2032	(790) Shortfall	187 Length
2033	(874) Shortfall	151 Length
2034	(858) Shortfall	161 Length
2035	(762) Shortfall	232 Length
2036	(797) Shortfall	212 Length
2037	(910) Shortfall	173 Length
2038	(947) Shortfall	131 Length
2039	(977) Shortfall	94 Length
2040	(1011) Shortfall	68 Length
2041	(1047) Shortfall	78 Length
2042	(1077) Shortfall	55 Length
2043	(1146) Shortfall	60 Length
2044	(1171) Shortfall	64 Length
2045	(1265) Shortfall	64 Length

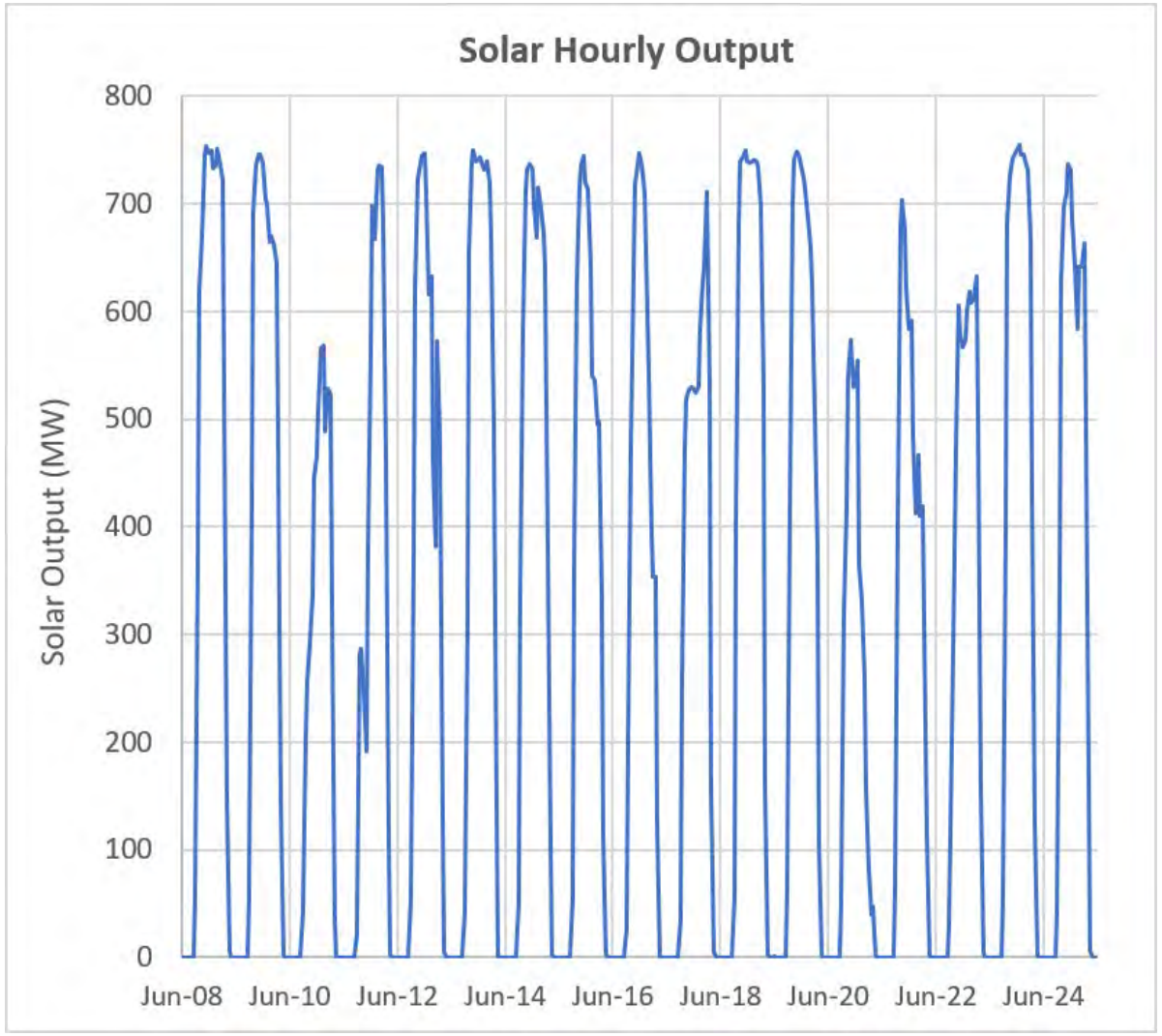


- **All main case portfolios must be in a position of capacity length for each year in the planning horizon to be deemed reliable.**
- **Capacity length does not represent surplus capacity.**
  - Capacity length is the Company's annual position to meet the 0.1 event-days per year Loss of Load Expectation ("LOLE") threshold for a tuned-portfolio.
  - The capacity position calculation considers all fully-subscribed firm transmission, meaning capacity length reflects a decreased need in capacity-driven market imports.

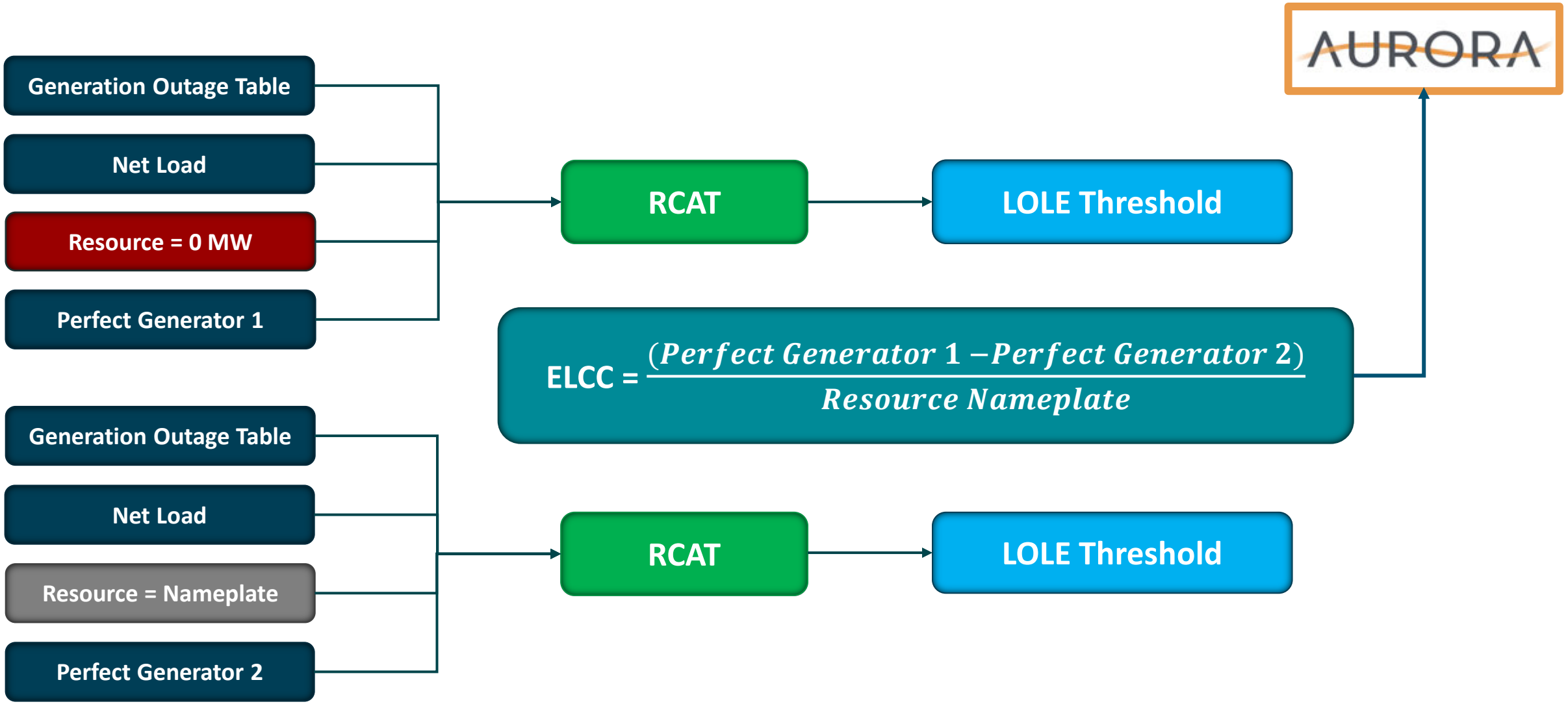


Variable Energy Resources





Effective Load Carrying Capability



How to Calculate the ELCC of a 200 MW Solar Project

It's not about the nameplate size; it's about how much the resource helps when the system is most at risk.

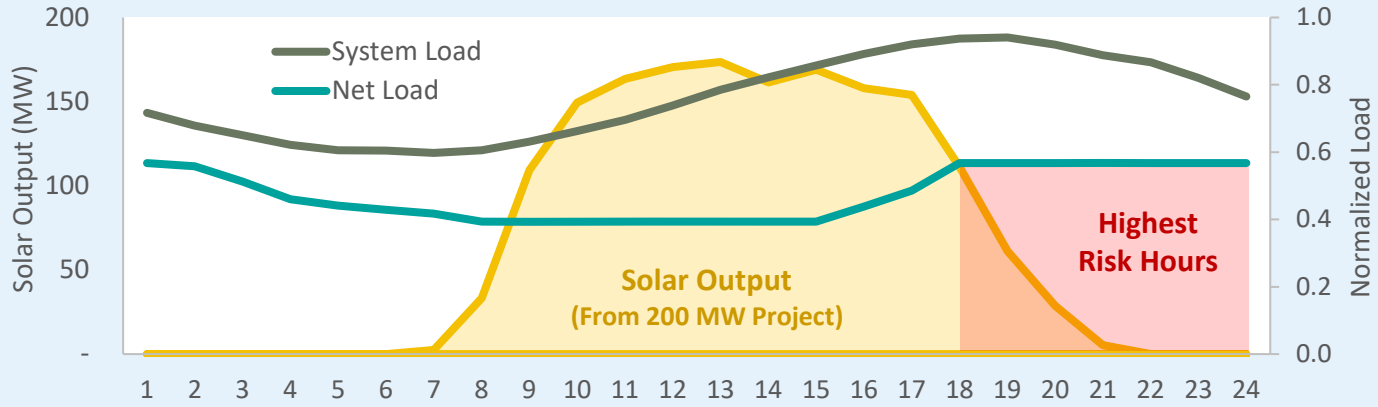
1 The Resource



200 MW Solar Facility
(Nameplate Capacity)

2 Solar Output Versus System Need

Solar produces energy during the day, but the system is often more stressed during the late afternoon or evenings in the summer.



The question isn't **"how big is the solar plant?"**

It's **"how much does it help during the system's highest risk hours?"**

3 The Effective Load Carrying Capability (ELCC) Calculation

* Example based on 2028 reliability profile

Idaho Power uses the RCAT to determine how much perfect capacity can be removed from the system while maintaining the company's reliability threshold when new generation is added.

1. System without solar project



Needs 100 MW of perfect capacity to meet reliability target

61 MW

2. Add 200 MW solar project to system



Run RCAT with the 200 MW solar project included

3. Same reliability, less perfect capacity need



System meets reliability target with less perfect capacity need

44 MW

ELCC = 61 – 44 ≈ 17 MW

This 200 MW solar resource provides the same reliability benefit as approximately 17 MW of perfect dependable capacity.

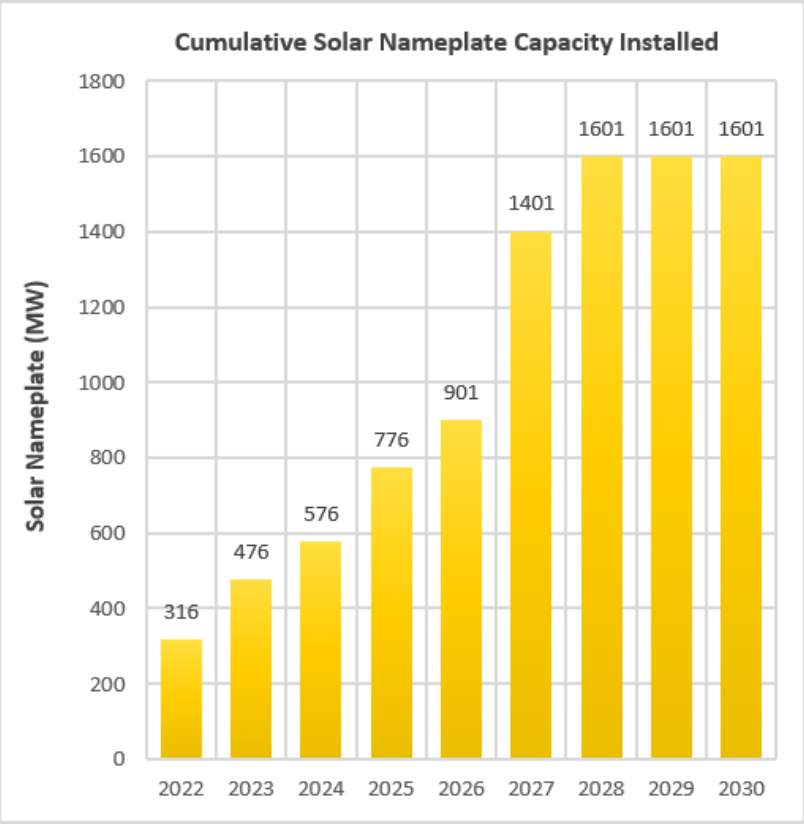
ELCC = 17 ÷ 200 = 8.3%

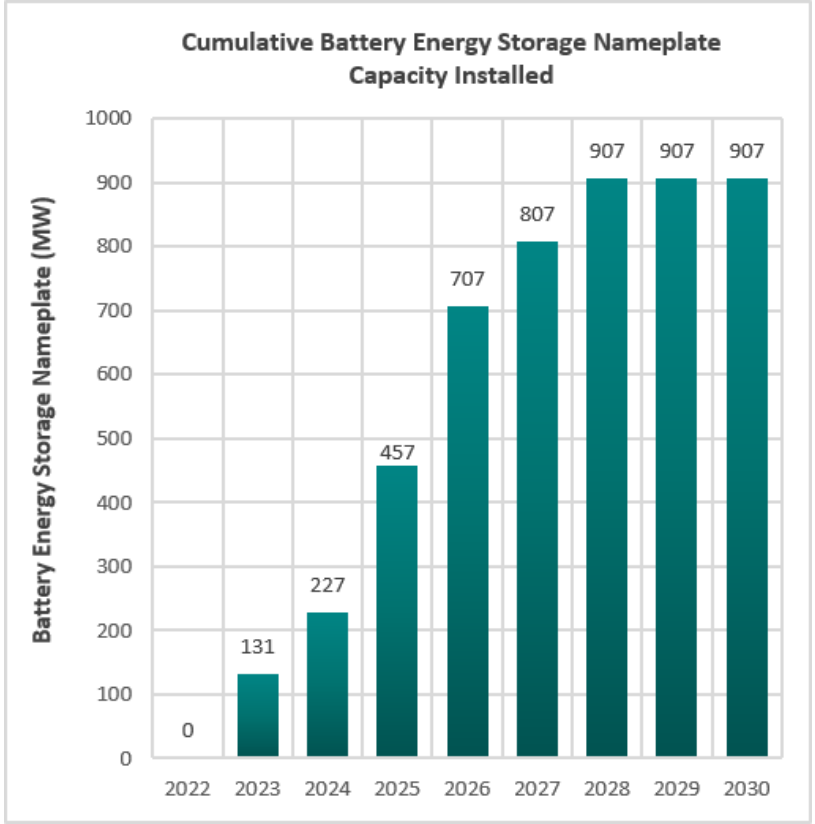
This is the 200 MW solar project ELCC expressed as a percent.

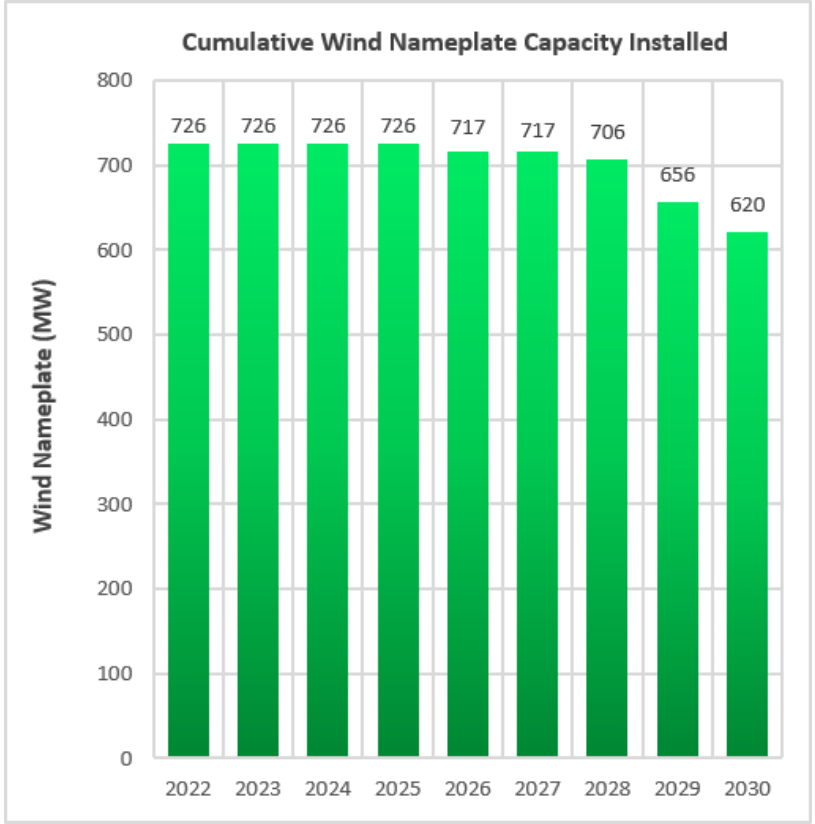
Resource Saturation

* Example based on 2028 load & resource buildout

EXAMPLE CALCULATION







Ratio to Idaho Power Peak:	**35.0%**	**19.8%**	**15.4%**
Sub-Regional Ratio to Peak:	**8.6%**	**5.0%**	**17.4%**

Source: Southwest Power Pool (SPP), *WRAP Advance Assessment: Summer 2028 Results*, November 3, 2026.

Energy-Limited Resources

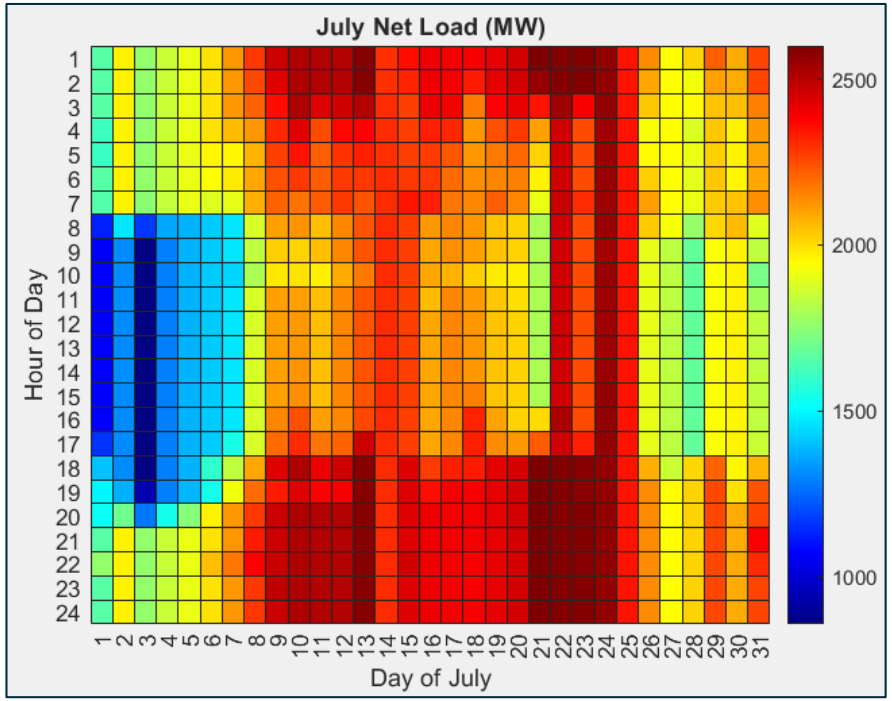
EXAMPLE CALCULATION

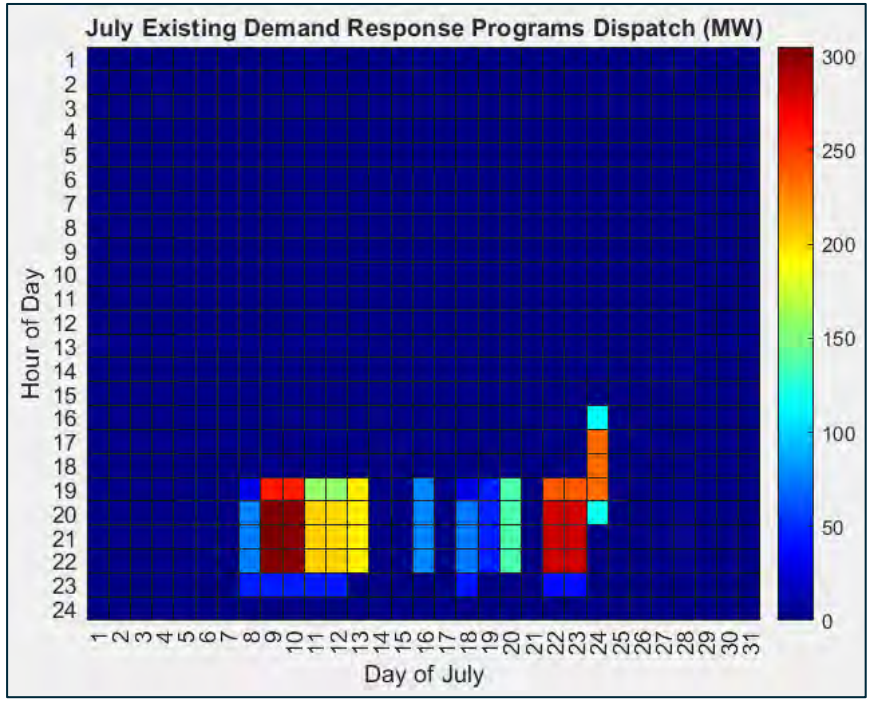




- Years with higher winter risk & increased ELR penetration can reduce the ELCC value.
- Energy-limited resources struggle to support flat net load days.

* Example based on 2028 reliability profile





Planning Reserve Margin

What is a Planning Reserve Margin (PRM)?

A buffer for a reliable tomorrow.

The Planning Reserve Margin (PRM) is the extra amount of electricity generation capacity, above expected peak demand, that a power system plans to have available to maintain reliability.

The PRM provides a cushion for unexpected outages, higher-than-expected demand, and uncertainty in resource performance (e.g., weather, fuel, or maintenance).

"While there is no continent-wide requirement for resource adequacy, many power systems in North America are planned based on a standard of "1-day-in-10-years". This standard requires that there be sufficient generation and transmission resources to serve load during all but one day every ten years. It is frequently implemented as requiring a loss-of-load expectation ("LOLE") of 0.1 days per year. Because directly measuring the LOLE reliability of a system is data-intensive and computationally complex, loss-of load studies are often used to define a planning reserve margin ("PRM"), measured as the quantity of capacity needed above the median year peak load to meet the LOLE standard, to serve as a simple and intuitive metric that can be utilized broadly in power system planning."

Source: Energy + Environmental Economics (E3), *Capacity and Reliability Planning in the Era of Decarbonization: Practical Application of Effective Load Carrying Capability in Resource Adequacy*, Aug. 2020.

Why It Matters

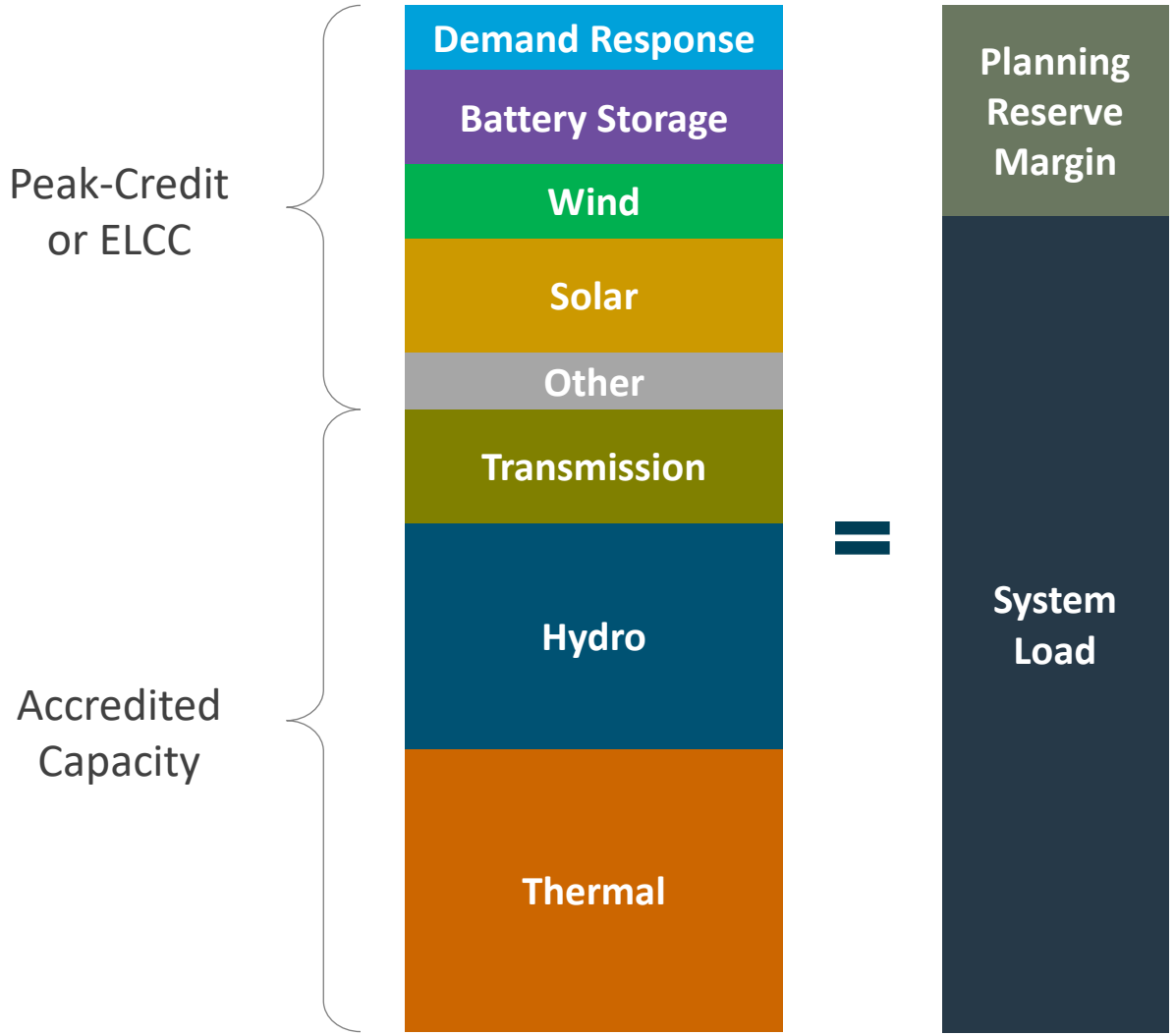
Keeps the lights on
Helps ensure enough capacity is available, even when some resources are unavailable.

Accounts for uncertainty
Provides a buffer for outages, weather events, and higher-than-expected demand.

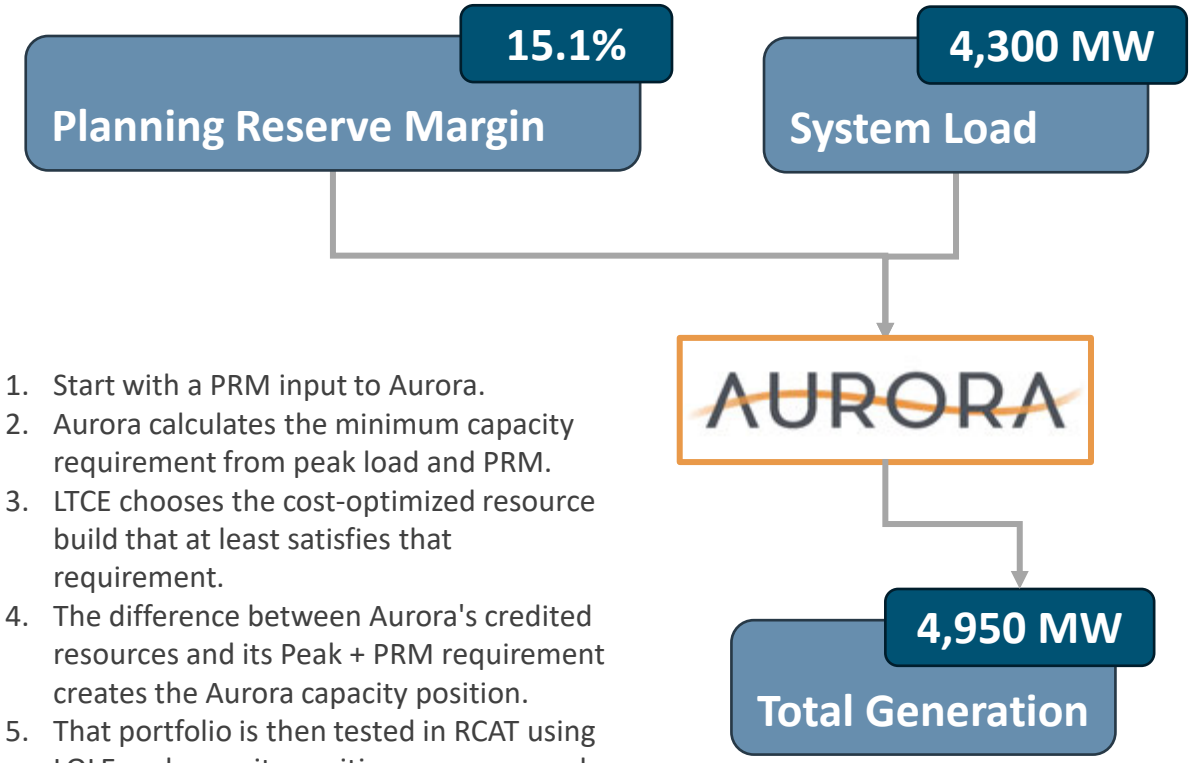
Supports system reliability
Reduces the risk of power shortages and helps maintain reliable service.

Guides long-term planning
Used in resource planning models to determine how much new capacity is needed.

Planning Reserve Margin



EXAMPLE CALCULATION



1. Start with a PRM input to Aurora.
2. Aurora calculates the minimum capacity requirement from peak load and PRM.
3. LTCE chooses the cost-optimized resource build that at least satisfies that requirement.
4. The difference between Aurora's credited resources and its Peak + PRM requirement creates the Aurora capacity position.
5. That portfolio is then tested in RCAT using LOLE and capacity position are compared.

$$PRM = \left|1 - \left(\frac{Generation}{Load}\right)\right| = \left|1 - \left(\frac{4{,}950}{4{,}300}\right)\right| = 15.1\%$$

2027 Integrated Resource Plan: Portfolio Reliability

Reliability & Capacity Assessment



2027 IRP Model Calibration



Figure. The dance between RCAT and Aurora [1]

RCAT
Reliability & Capacity Assessment Tool

MATLAB

LOLE
Loss of Load Expectation

ELCC
Effective Load Carrying Capability

PRM
Planning Reserve Margin

LTCE
Long-Term Capacity Expansion

AURORA

Threshold
Loss of Load Expectation

L&R
Capacity Position

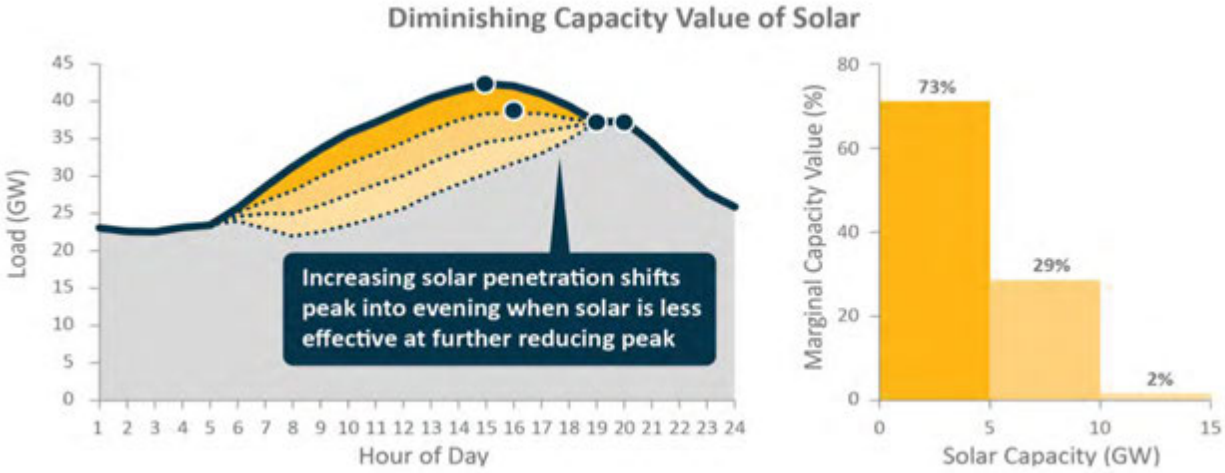
Adjusted ELCC & PRM values throughout iterative Aurora & RCAT calibration process

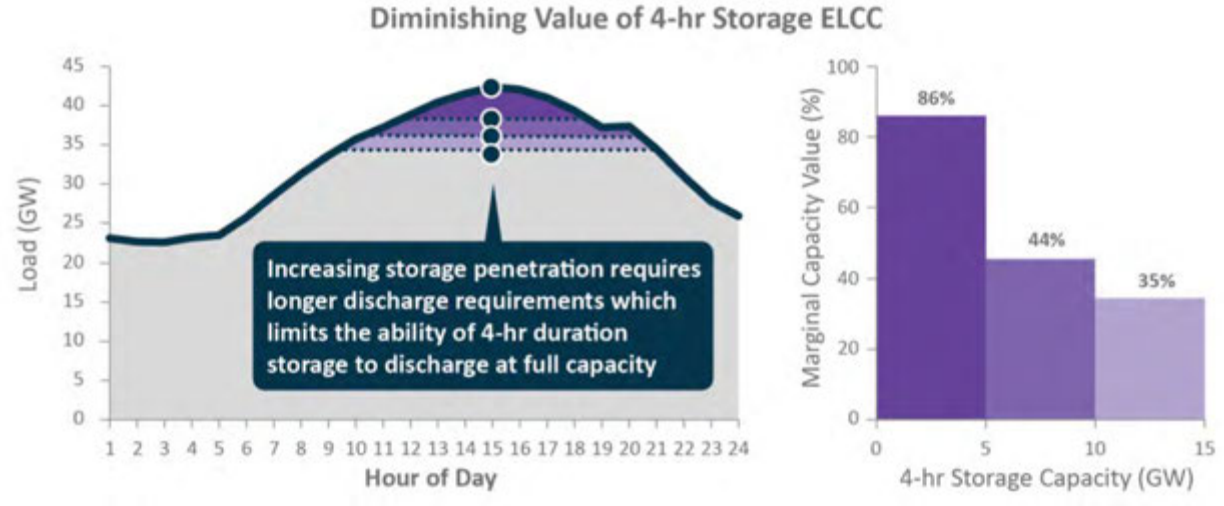
[1] Image generated by Microsoft Copilot

ELCC Calculation

- **Marginal ELCC values change every time a new resource or load is added, which makes the model calibration process intensive in assuring new resources have the proper accreditation.**
- **We determine seasonal ELCC curves for all VER and ELR resource types.**





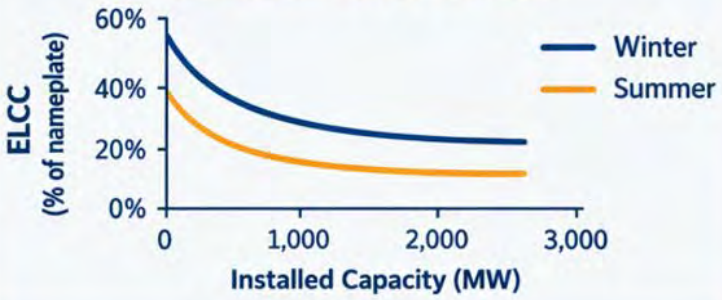


Source: Energy + Environmental Economics (E3), *Capacity and Reliability Planning in the Era of Decarbonization: Practical Application of Effective Load Carrying Capability in Resource Adequacy*, Aug. 2020.

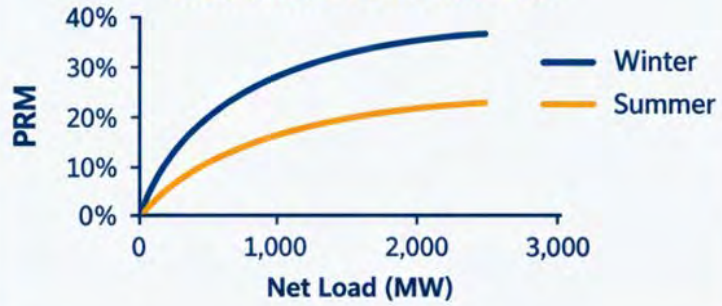
2027 IRP Model Calibration

Seasonal Curves Inform Calibration

Seasonal ELCC Curves



Seasonal PRM Curves



Summer and winter ELCC and PRM curves reflect how resource capacity value and reserve needs vary by season.

Calibrate Capacity Expansion Model



Use seasonal (summer and winter) ELCC and PRM curves to calibrate our model (e.g., Aurora) and optimize the resource plan.

Annual Capacity Position



Meets 0.1 event-days per year LOLE threshold

Result is an annual, cost-optimized capacity position that achieves our reliability target.

Future Reliability Topics

- Demand Response ELCCs to Determine Cost-Effective Programs
- Preliminary ELCC Saturation Curves for the 2027 IRP
- Portfolio Loss of Load Expectation Results
- Portfolio Capacity Positions