Reliability & Capacity Assessment

2023 Integrated Resource Plan

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Topics

Reliability & Capacity Methodologies Overview

- Loss of Load Expectation
- Effective Load Carrying Capability
- Planning Reserve Margin

2023 Integrated Resource Plan Proposed Changes

- Data Updates
- Loss of Load Expectation (LOLE) Threshold & Load Forecast
- Portfolio Recalibration

Helpful Acronyms

Acronym	Meaning
CBM	Capacity Benefit Margin
CSV	Comma-Separated Values
DR	Demand Response
EFORd	Equivalent Forced Outage Rate During Demand
ELCC	Effective Load Carrying Capability
ESS	Energy Storage System
IRP	Integrated Resource Plan

Acronym	Meaning
LOLE	Loss of Load Expectation
LOLH	Loss of Load Hour
LOLP	Loss of Load Probability
MW	Megawatt
PRM	Planning Reserve Margin
R-CAT	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

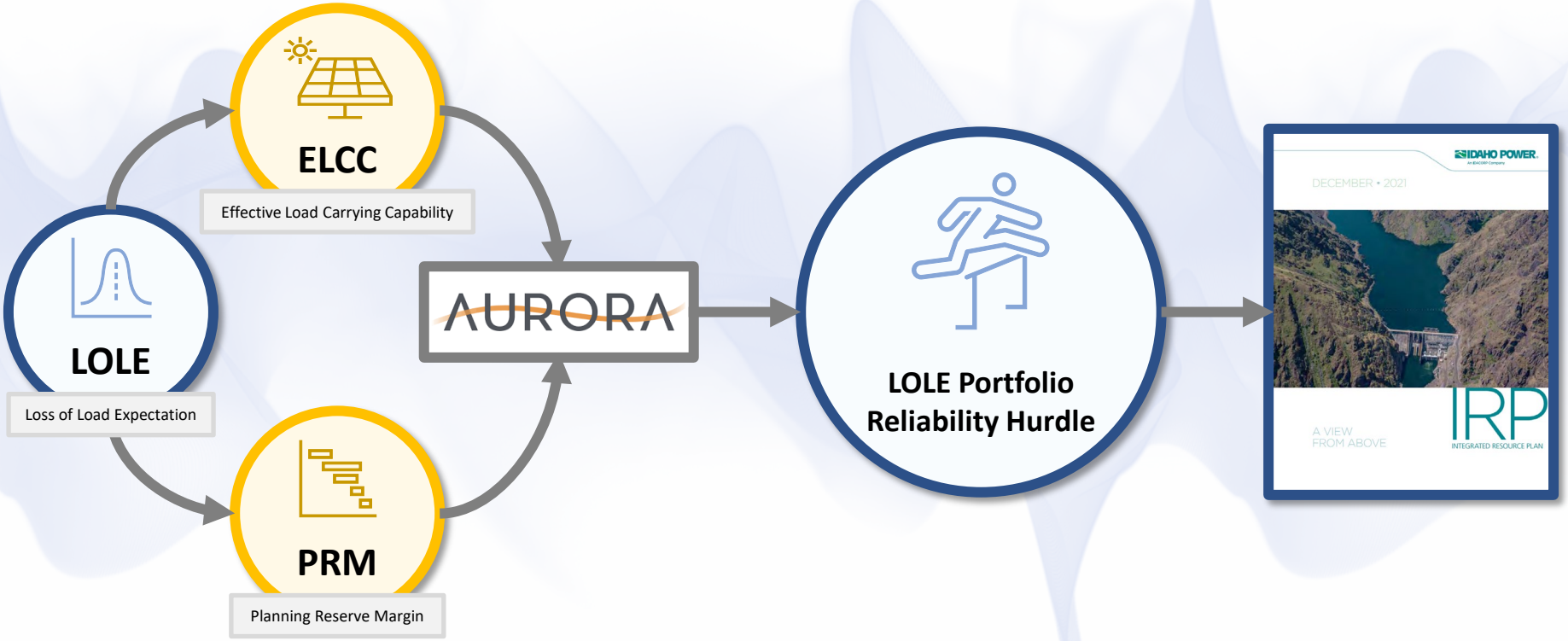
IRP Questions and Responses
Educational Resources
Transmission and Resource

Idaho Power has compiled these resources to help those participating in our *Integrated Resource Plan* 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

IRP Relevance



Reliability & Capacity Methodologies Overview

Reliability Definitions

Loss of Load Probability

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

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

G_i: *Generation available at hour "i"*

L_i: *Net load at hour "i"*

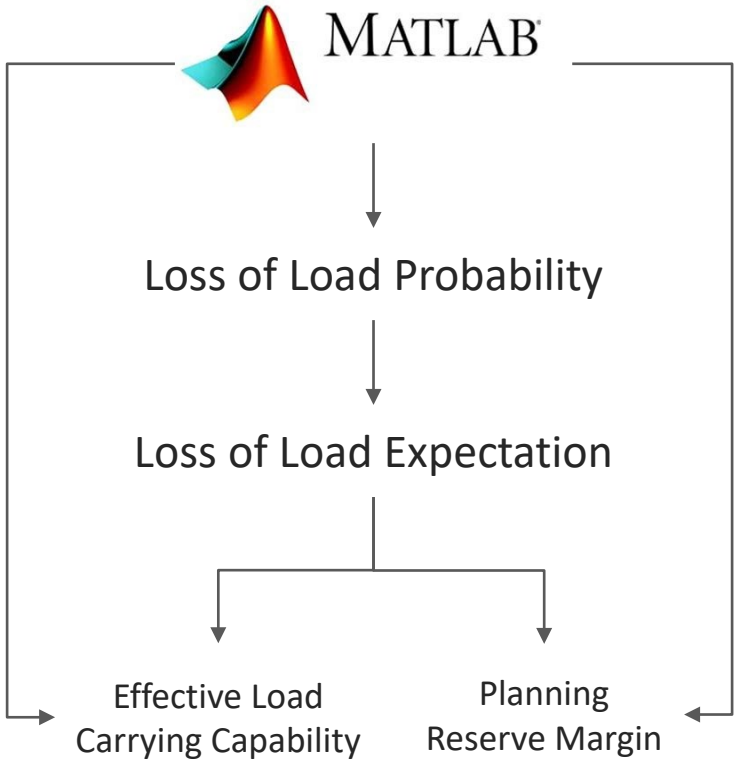
Loss of Load Expecation

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

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

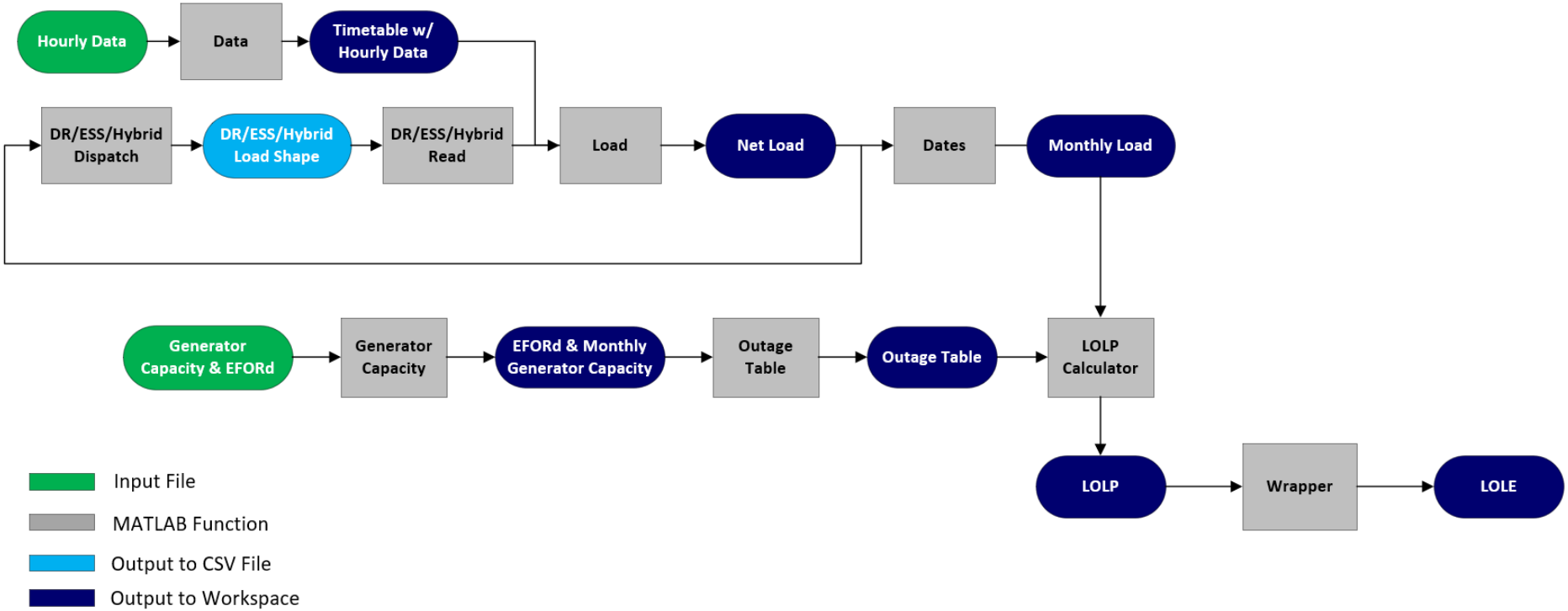
Internally Developed Tool

- Customized to model Idaho Power's system
- Capability to model utility specific resources like Demand Response



Billinton, Roy, and Ronald N. Allan. *Reliability Evaluation of Power Systems*. Pitman Books Limited, 1984.

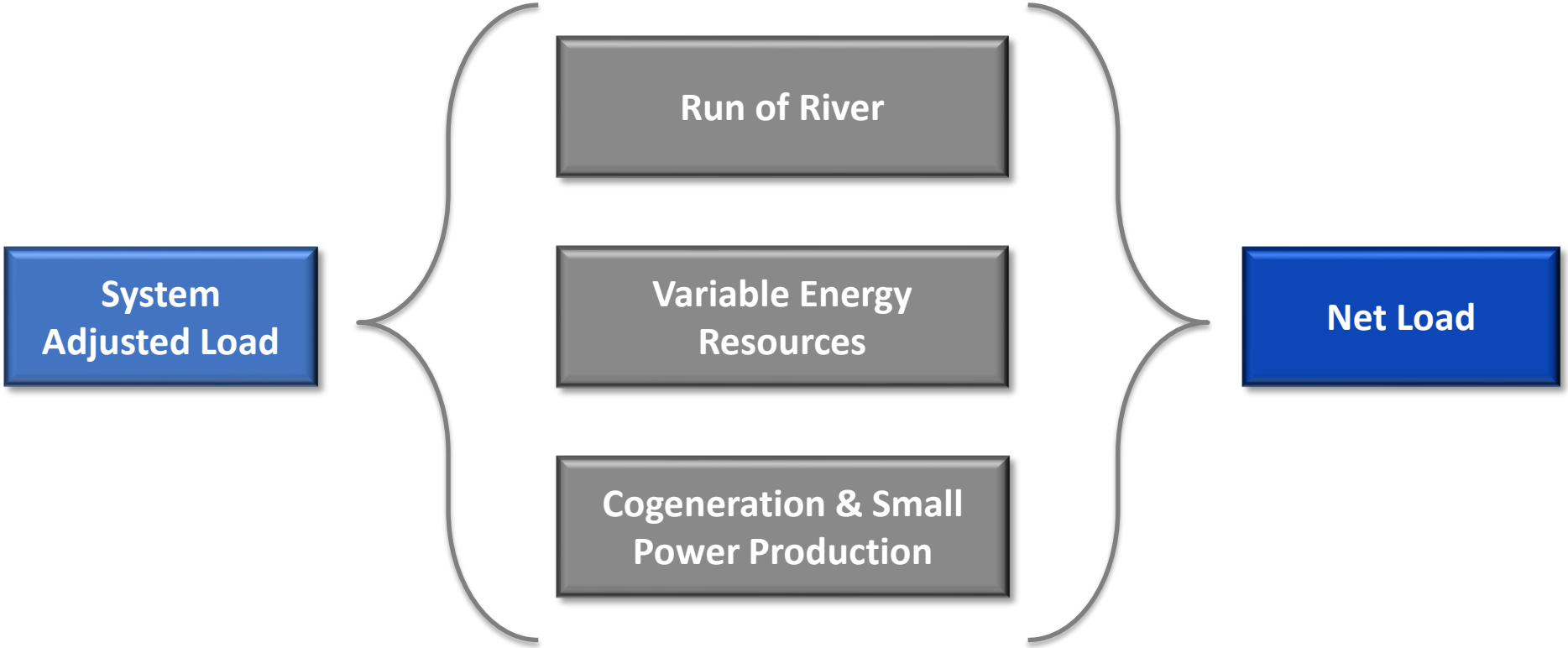
LOLE Algorithm Flowchart



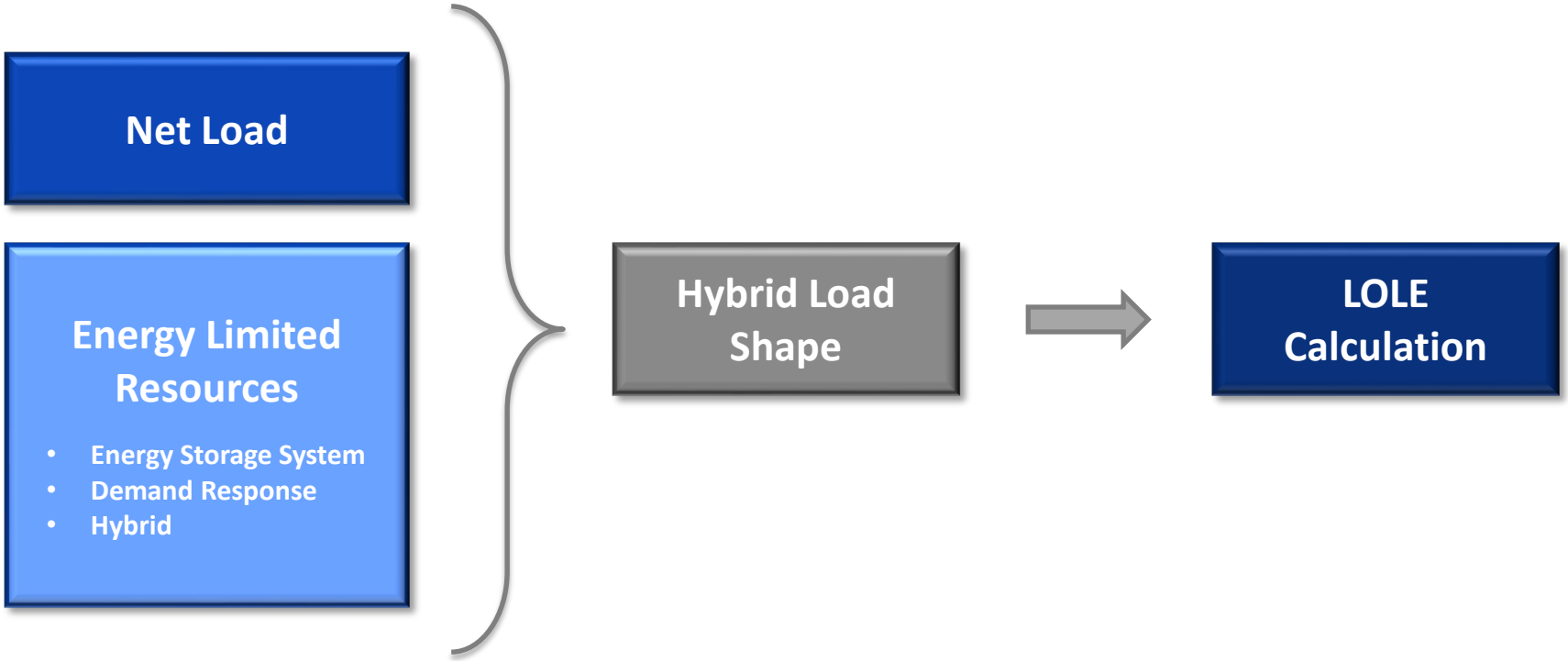
Modeling Hydro

- Run of River
  - Hourly Output
- Hydro with Storage
  - Monthly Capacity
  - EFORd

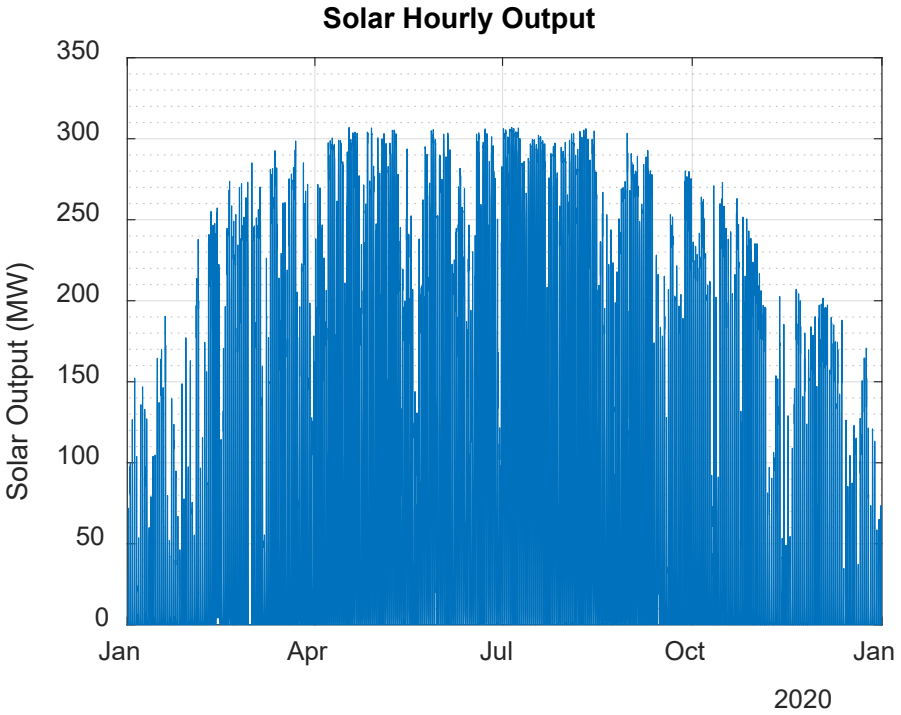
Modeling Net Load

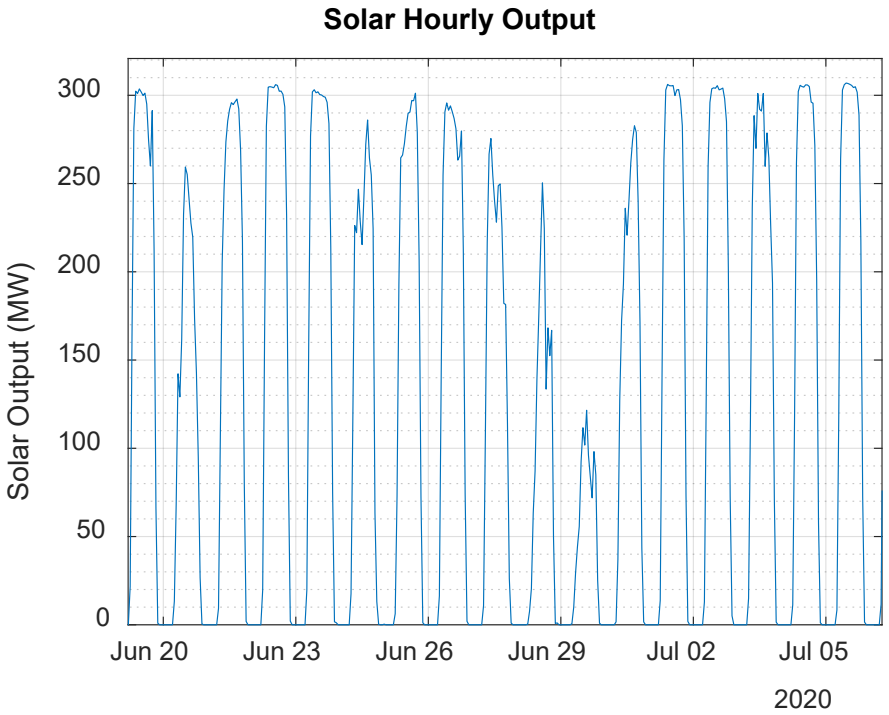


Modeling Energy Limited Resources



Variable Energy Resources



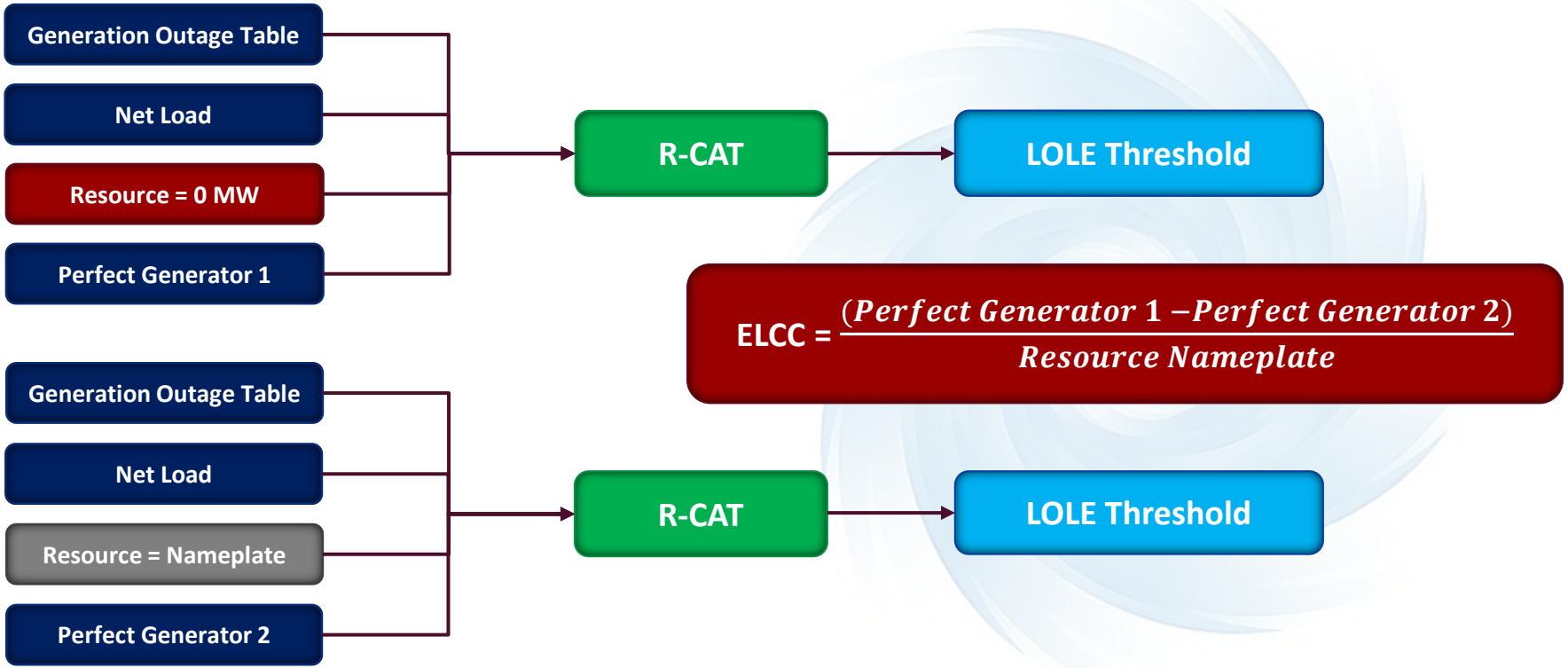


Contribution to Peak Concept

- The capacity value of variable or energy-limited generation is its ability to reliably meet demand during **high-risk hours.**

- Capacity value is measured either in terms of physical capacity (kilowatt [kW], MW, or gigawatt [GW]) or the fraction of the power plant's nameplate capacity (%).

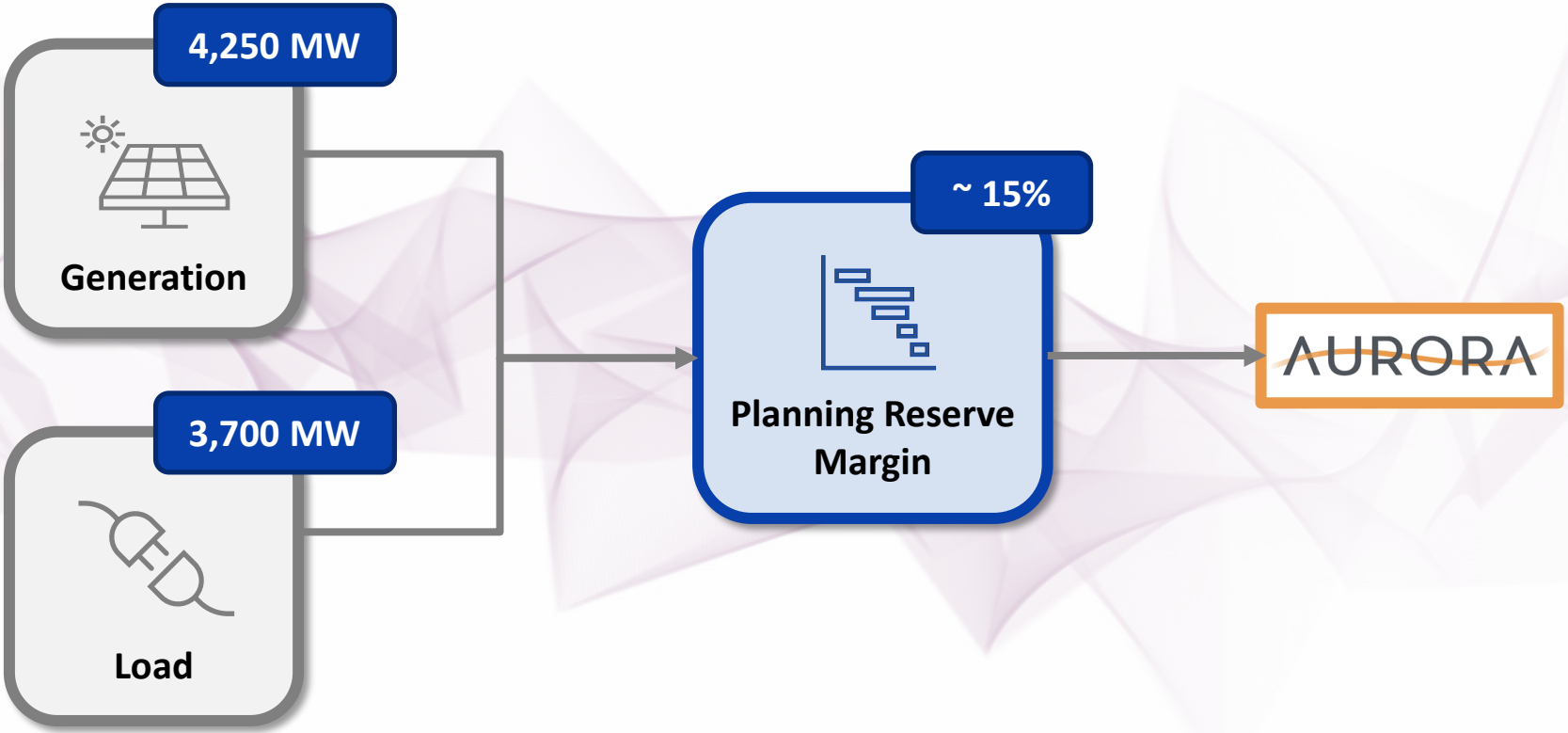
ELCC Calculation Overview



Capacity Contribution Example

200 MW SOLAR PROJECT ELCC CALCULATION BREAKDOWN EXAMPLE				
	Perfect Capacity (MW) without Solar Project	**Perfect Capacity (MW) with Solar Project**	**ELCC (MW)**	**ELCC (%)**
Test Year 1	99	90	9	**4.5%**
Test Year 2	64	50	14	**7.0%**
Test Year 3	137	117	20	**10.0%**
Test Year 4	101	79	22	**11.0%**
Average Effective Load Carrying Capability of the 4 Test Years for the 200 MW Solar Project Example:				**8.13%**

Planning Reserve Margin Example



Planning Reserve Margin Example

Resource Type	Capacity (MW)	Notes
Coal	800	
Gas	700	
Hydro	1,350	Includes Hydro with Storage & Run of River Hydro
CBM	200	Capacity Benefit Margin
Solar	200	ELCC Adjusted Contribution of Solar
Wind	100	ELCC Adjusted Contribution of Wind
Storage	100	ELCC Adjusted Contribution of Storage
Demand Response	150	ELCC Adjusted Contribution of Demand Response
COGEN	150	Estimated Contribution of COGEN
Generation Needed	500	Perfect Generation Needed at LOLE Threshold
Total Generation	**4,250**	Example Total Generation
Load	**3,700**	Example Forecasted Peak Load
PRM	**~ 15%**	Example Planning Reserve Margin Result

$$PRM = \left|1 - \left(\frac{Generation}{Load}\right)\right|$$

$$PRM = \left|1 - \left(\frac{4{,}250}{3{,}700}\right)\right| = 14.8\%$$

2023 IRP Proposed Changes

Proposed Data Updates

2023 IRP Proposed Changes	2021 IRP Data
• Use **6 Test Years** of Historical Data • **Capacity Benefit Margin of 200 MW** • **Update EFORds with Generating Availability Data System (GADS)** (5-Year Rolling Average) Data	• Used **4 Test Years** of Historical Data • **Capacity Benefit Margin of 330 MW**

Generation EFORds

Hydro:	**4.6%**
Combined Cycle Gas Turbines:	**4.1% - 6.7%**
Simple Cycle Gas Turbines :	**9.2% - 10.2%**
Coal:	**9.3%**
*Transmission Access:	**0.1% - 5.8%**

**Transmission Access EFORd comes from TADS*

Generating Availability Data System (GADS) (nerc.com)

Proposed Threshold Changes

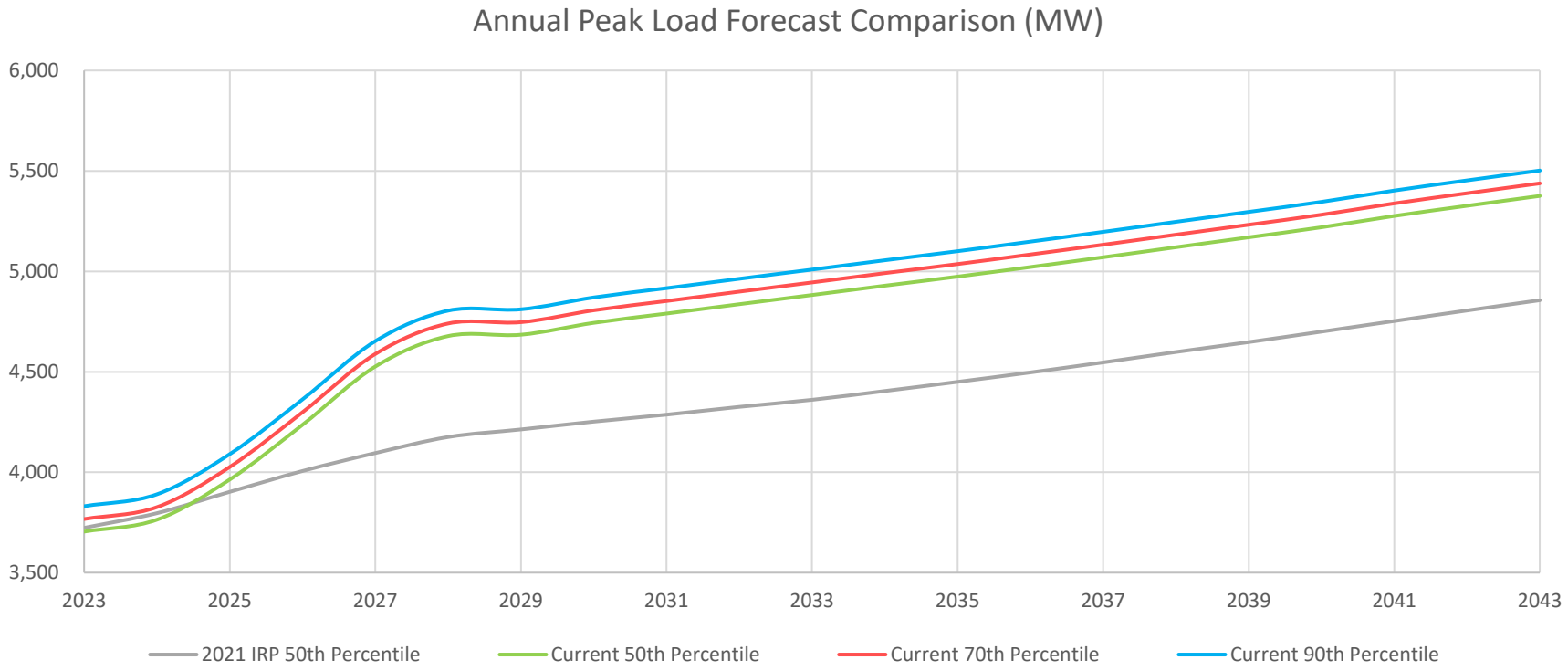
2023 IRP Proposed Changes

- Scale Historical Test Years to **Monthly** Peak of **70th Percentile** Load Forecast
- Utilize a **1 Event in 10 Years** (or 0.1 days per year) LOLE Threshold

2021 IRP Methodology

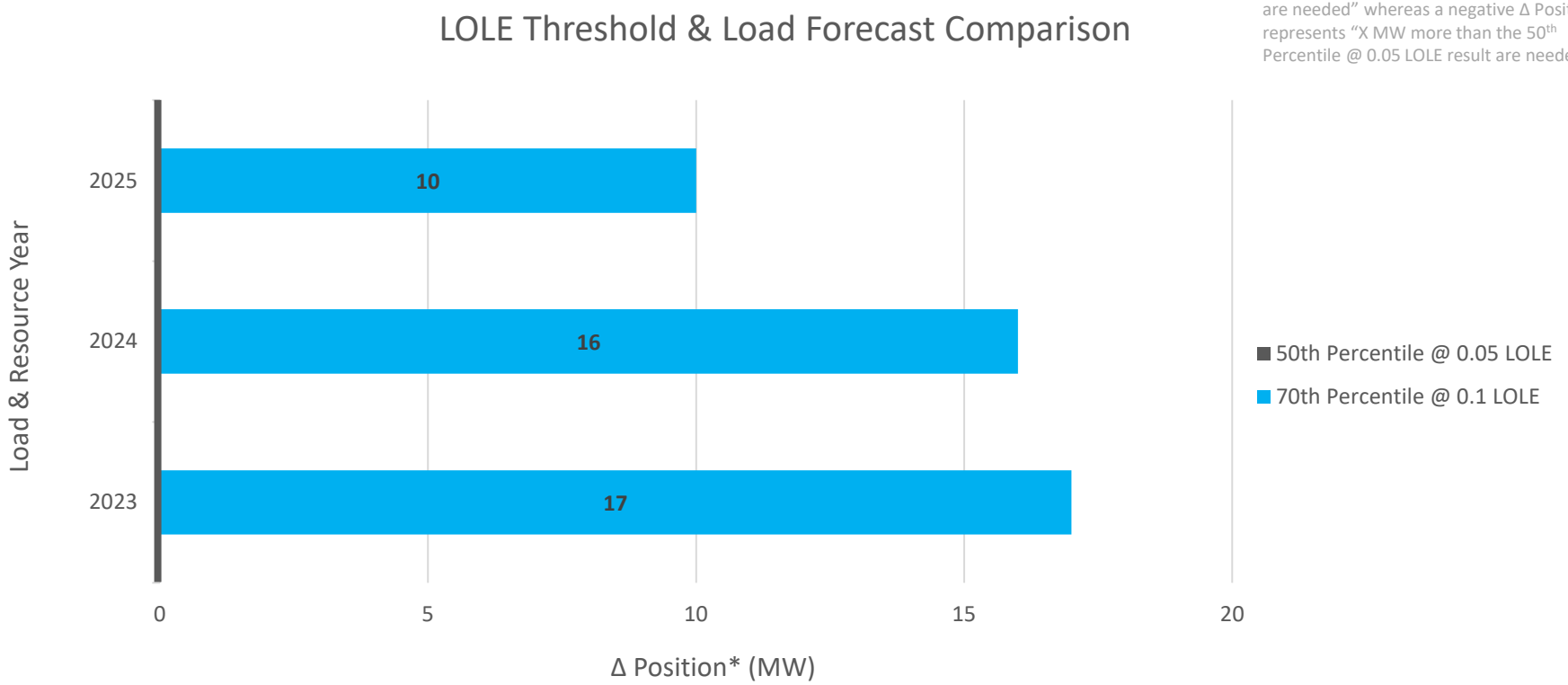
- Scaled Historical Test Years to **Annual** Peak of **50th Percentile** Load Forecast
- Utilized a **1 Event in 20 Years** (or 0.05 days per year) LOLE Threshold

Peak Load Forecast Comparison



Example Position Difference

*Positive Δ Position represents "X MW less than the 50th Percentile @ 0.05 LOLE result are needed" whereas a negative Δ Position represents "X MW more than the 50th Percentile @ 0.05 LOLE result are needed"



Portfolio Recalibration Example