Reliability & Capacity Assessment Update

2023 Integrated Resource Plan

Dr. Andrés Valdepeña Delgado
System Planning Engineer

Shelby McNeilly
Resource Planning Engineer

Topics

Reliability & Capacity Methodologies Overview

- Integrated Resource Plan Relevance
- Loss of Load Expectation
- Effective Load Carrying Capability

2023 Integrated Resource Plan Preliminary Results

- Reliability Threshold & Planning Reserve Margin
- Resource Capacity Contribution
- Western Resource Adequacy Program Modeling

Helpful Acronyms

Acronym	Meaning
CCCT	Combined Cycle Combustion Turbine
CSPP	Cogeneration & Small Power Production
DR	Demand Response
EFORd	Equivalent Forced Outage Rate During Demand
ELCC	Effective Load Carrying Capability
ELR	Energy Limited Resource
ESS	Energy Storage System
IRP	Integrated Resource Plan
LOLE	Loss of Load Expectation

Acronym	Meaning
LOLP	Loss of Load Probability
LTCE	Long-Term Capacity Expansion
L&R	Load & Resource
MW	Megawatt
PRM	Planning Reserve Margin
R-CAT	Reliability & Capacity Assessment Tool
SCCT	Simple Cycle Combustion Turbine
VER	Variable Energy Resource
WRAP	Western Resource Adequacy Program

Acronyms Used in the Integrated Resource Plan

Energy Storage Update

- Hemingway
- Black Mesa
- Weiser
- Elmore
- Filer
- Melba

Reliability & Capacity Methodologies Overview

IRP Educational Resources

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

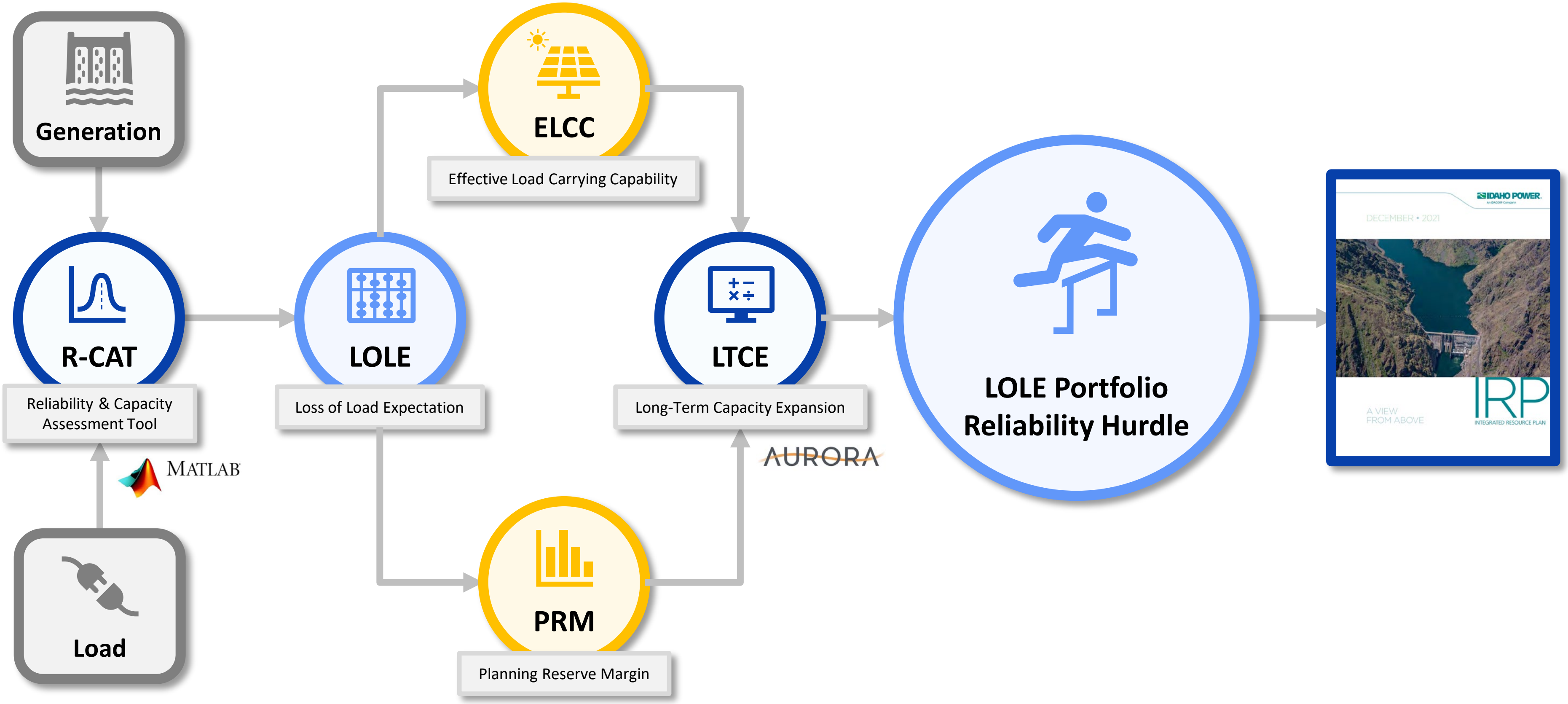
IRP Questions and Responses
Educational Resources
Transmission and Resource

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 Definitions

Loss of Load Probability

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

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

Generation available at hour "i"

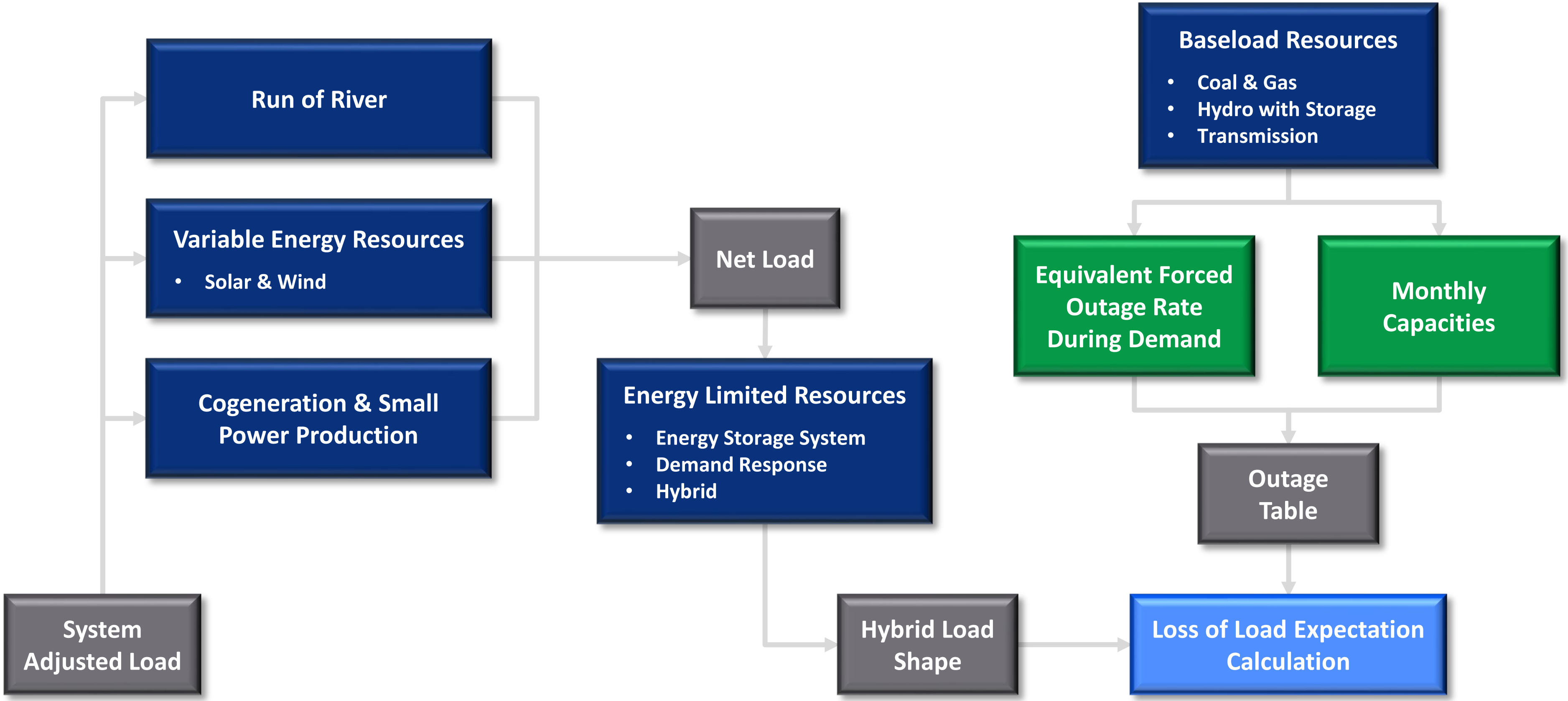
Net load at hour "i"

Loss of Load Expectation

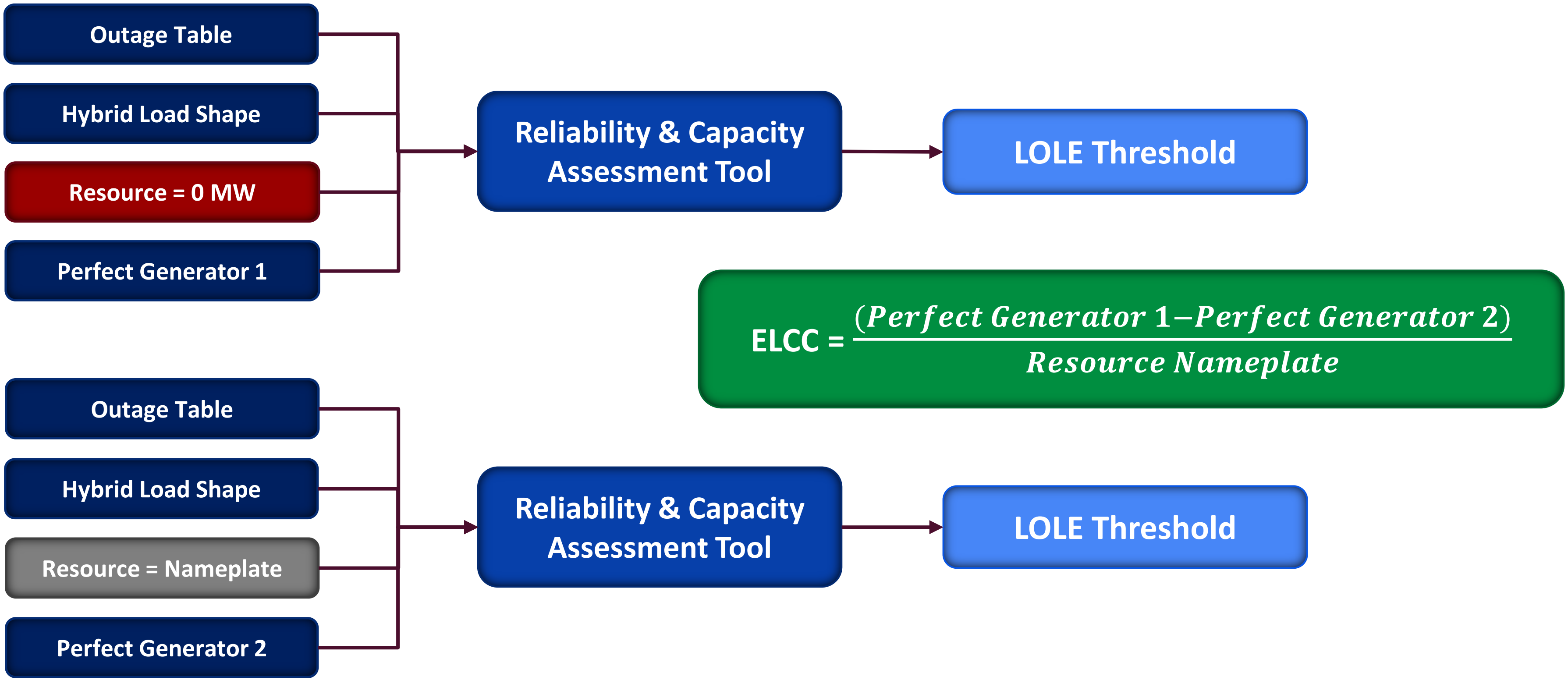
LOLE: the expected number of days per time period for which the available generation capacity is insufficient to serve the demand at least once per day

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

Modeling Breakdown



ELCC Calculation Overview



$$\text{ELCC} = \frac{(Perfect\ Generator\ 1 - Perfect\ Generator\ 2)}{Resource\ Nameplate}$$

Capacity Contribution Example

DEMONSTRATION PURPOSES ONLY

EXISTING SOLAR EFFECTIVE LOAD CARRYING CAPABILITY CALCULATION BREAKDOWN EXAMPLE				
	Perfect Capacity (MW) without Existing Solar	**Perfect Capacity (MW) with Existing Solar**	**ELCC (MW)**	**ELCC (%)**
Test Year 1	340	50	290	66.5%
Test Year 2	260	20	240	55.0%
Test Year 3	270	55	215	49.3%
Test Year 4	255	10	245	56.2%
Test Year 5	350	100	250	57.3%
Test Year 6	460	230	230	52.7%
Average ELCC of the 6 Test Years for Existing Solar Example:				**56.2%**

Existing Solar Nameplate = 436.25 MW

2023 IRP Preliminary Results

Flexible Generation

PRELIMINARY RESULTS
Based on 2024 L&R

$$Available\ Capacity = Seasonal\ Rating\ * (1 - EFORd)$$

Existing Idaho Power Flexible Resources	Highest Risk Month Nameplate Capacity (MW)	EFORd	Available Capacity (MW)
Hydro with Storage	1,100	4.55%	**1,050**
Coal	488	9.30%	**443**
Gas CCCT	312	4.06%	**299**
Gas SCCT	771	9.23%–10.15%	**699**

Variable & Energy Limited Resources

PRELIMINARY RESULTS
Based on 2024 L&R

Existing Idaho Power Variable & Energy Limited Resources	Value (MW)	Capacity Contribution (MW)
Run of River Hydro	268	**268**
Cogeneration & Small Power Production	146	**146**
Demand Response	340	**144**
Wind	725	**135**
Solar	436	**245**
Solar + 4-Hour Battery Storage (1:1)	40	**39**
Solar + 4-Hour Battery Storage (1:0.6)	100	**92**
4-Hour Battery Storage	103	**95**

Total Capacity = 750 MW

Reliability Threshold & PRM

PRELIMINARY RESULTS
Based on 2024 L&R

	Capacity Contribution (MW)
2024 Forecasted 70th Percentile Peak Load	**3,830**
Hydro with Storage	1,050
Coal	443
Gas	998
Run of River Hydro	268
Variable & Energy Limited Resources	750
Cogeneration & Small Power Production	146
Emergency Transmission	188
Resource Need	463
2024 Total Generation	**~4,307**
Planning Reserve Margin	12.44%
Reliability Threshold	**0.1 event-days/year**

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

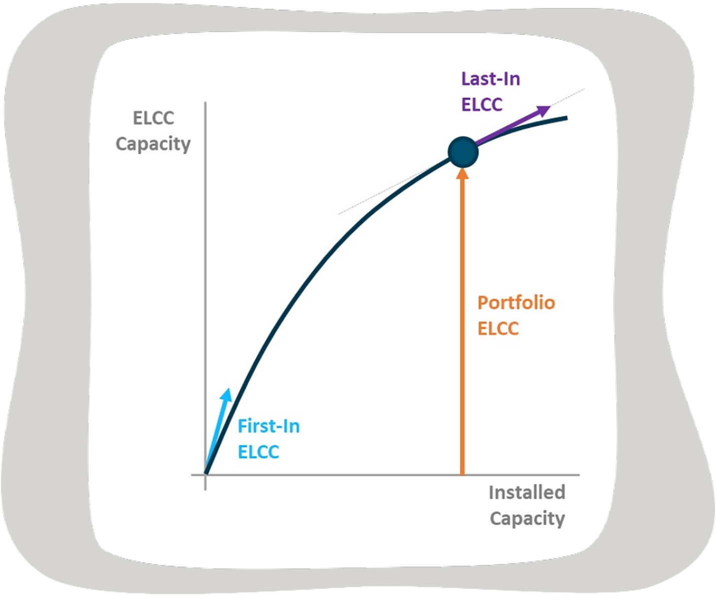
$$PRM = \left|1 - \left(\frac{4{,}307}{3{,}830}\right)\right| \approx 12.44\%$$

Last-In ELCC

- Definition of Last-In ELCC
  - The marginal ELCC of each individual resource when taken in context of the full portfolio

Portfolio ELCC:	Existing Solar	**56.2%**
Last-In ELCC:	[1] Additional 100 MW Solar	**13.0%**

[1] *Considers 100 MW of solar added after the signed solar projects*



Source: N. Schlag, Z. Ming, A. Olson, L. Alagappan, B. Carron, K. Steinberger, and H. Jiang, "Capacity and Reliability Planning in the Era of Decarbonization: Practical Application of Effective Load Carrying Capability in Resource Adequacy," Energy and Environmental Economics, Inc., Aug. 2020

Marginal ELCC

PRELIMINARY RESULTS
Based on 2024 L&R

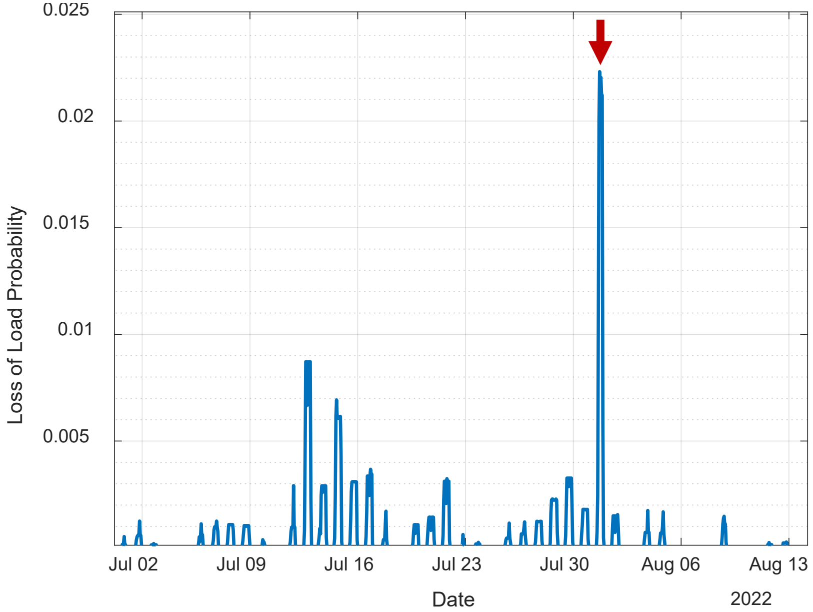
Resource	ELCC	Notes
Solar	13.0%	Considers 100 MW of solar added after the signed solar projects
Wind (Idaho)	15.7%	Historical Idaho wind data utilized to create future shape
Wind (Wyoming)	26.0%	Simulated Wyoming wind data utilized to create future shape
4-Hour Battery Storage	85.8%	4-hour stand-alone battery storage projects
8-Hour Battery Storage	93.2%	8-hour stand-alone battery storage projects
Demand Response	21.7%	Represents an additional 50 MW of demand response

WRAP Modeling Methodology

PRELIMINARY RESULTS
Based on 2024 L&R

1. Find the day of highest risk in each of the six test years
2. Add 100 MW of perfect capacity to the identified highest risk day (available for 24-hours)
3. Recalculate the annual capacity need
4. Solve for the overall reduction in capacity need

WRAP Benefit = 14 MW starting 2027



WRAP Modeling Example

DEMONSTRATION PURPOSES ONLY

	0 MW WRAP	14 MW WRAP
2024 Forecasted 70th Percentile Peak Load	3,830	3,830
Available Generation	~3,844	~3,844
Resource Need	**463**	**449**
2024 Total Generation	~4,307	~4,293
Planning Reserve Margin	**12.44%**	**12.07%**
Reliability Threshold	**0.1 event-days/year**	