Loss of Load Expectation (LOLE) Studies

IRP Contemporary Issues Technical Conference

June 6, 2024

Purpose & Topics

Purpose:

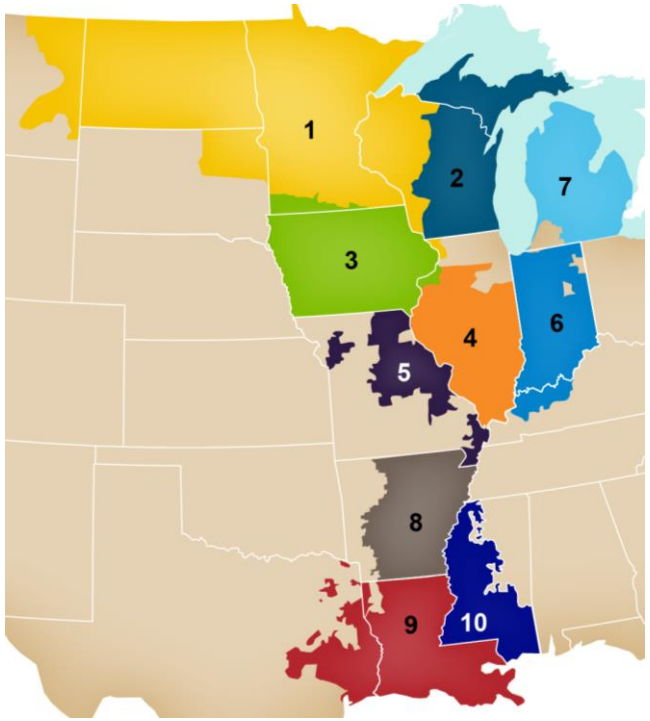
Provide an overview of the various probabilistic LOLE studies conducted by Resource Adequacy at MISO

Topics:

- Resource Adequacy Overview
- LOLE Model Data
- Planning Reserve Margin (PRM)
- Local Reliability Requirement (LRR)
- Implementation of PRM and LRR in Planning Resource Auction
- Effective Load Carrying Capability (ELCC)
- Current Accreditation Methodologies

What is Resource Adequacy? And why is it important?

Supply



MISO Local Resource Zones

Demand

Resource Adequacy aims to determine what volume of available capacity resources are needed to maintain system reliability and to serve demand during real-time operations considering generation performance, weather variability, and load uncertainty.

Resource Adequacy establishes planning requirements and resource accreditation values, as well as helps provide visibility into capacity sufficiency

Requirements

- What volume of resources are needed for reliability?
- Quantifies target reliability requirement during tight operating conditions
- Established at the MISO system and zonal level

Accreditation

- How does a resource contribute towards maintaining system reliability?
- Seasonal Accredited Capacity (SAC) dependent on type of resource and its individual performance when it is needed most

Visibility

Portfolio trends in short-term and long-term, including resource retirements and investments

Examples:

- OMS-MISO Survey
- Seasonal Resource Assessments
- NERC Long-Term Reliability Assessment (LTRA)
- NERC Probabilistic Assessment (ProbA)

Planning Resource Auction

Mechanism used to validate resource sufficiency vs. planning requirements. Provides a platform for incremental purchases and sales. Determines the zonal dollar per megawatt-day pricing for capacity resources.

Loss of Load Expectation (LOLE) Study Model Data

Capacity

- Resource seasonal capabilities
- Seasonalized forced outage rates
- Annualized planned outage rates
- Suspension/retirement dates
- Future resources with signed Generator Interconnection Agreements (GIA)
- Firm external imports
- Hourly profiles for wind and solar
- Planning Resource Auction results
- Granted Independent Market Monitor exclusions for small subset of resources

Load

- Historical load at the Local Balancing Authority level
- Peak load forecasts submitted by the MISO Load Serving Entities at the zonal level

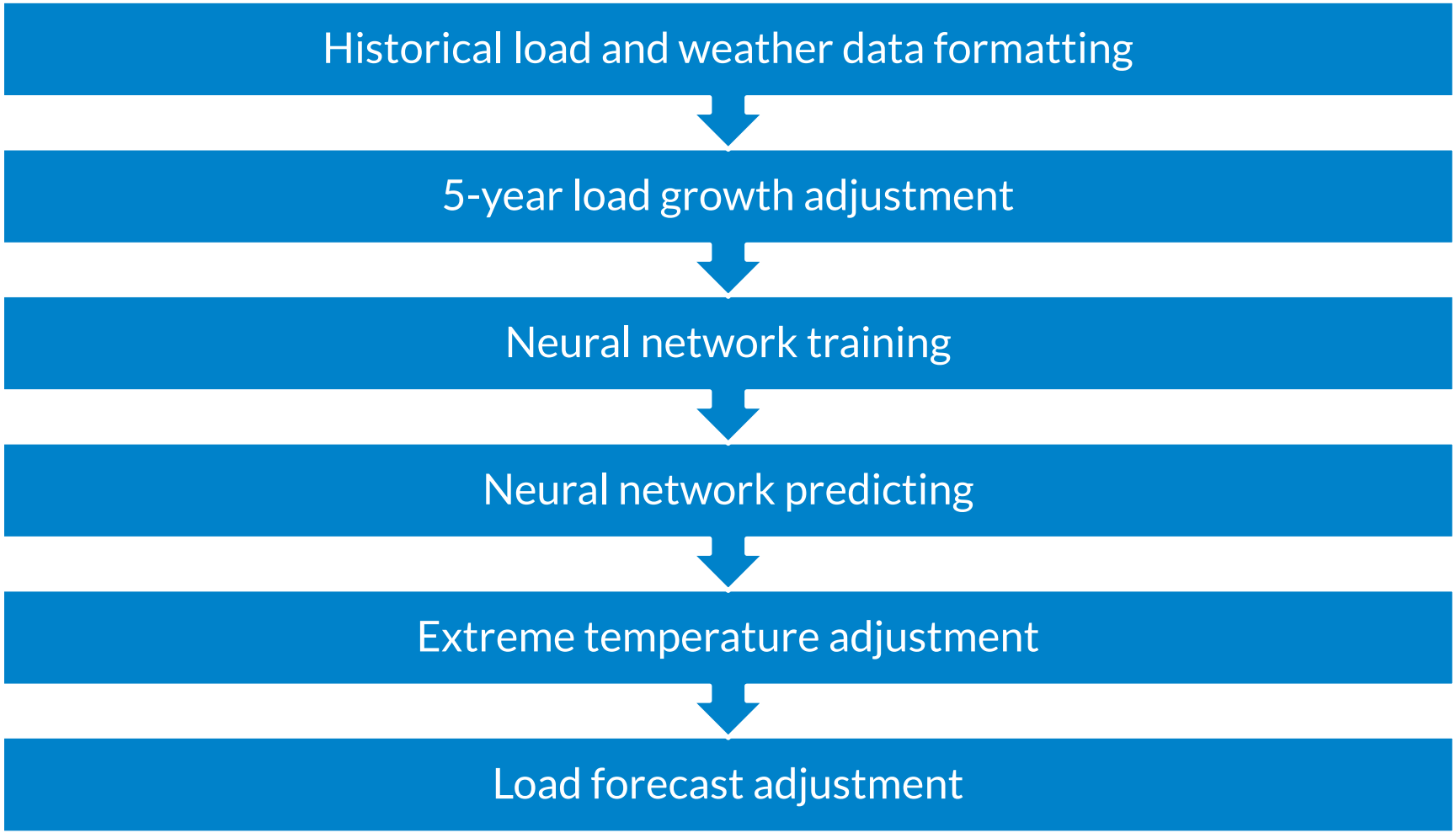
Capacity Modeling in LOLE Study

- Resource-specific characteristics
  - Physical Local Resource Zone (LRZ) location, in-service/retirement dates, resource type
- Resource types
  - Thermal (Gas, Coal, Nuclear, Combined Cycle, Reservoir Hydro)
  - Curtailable Load (Demand Response)
  - Intermittent Resources (Wind, Solar, Run-of-River Hydro, Storage, Biomass)
- Seasonalized forced outage rates
  - Percentage of season resource forced offline (unavailable for dispatch)
- Annualized planned outage rates
  - Percentage of year resource on scheduled maintenance (unavailable for dispatch)
- Profiles for wind and solar generation
  - Captures intermittent nature of wind and solar resources
  - Profiles specific to each Local Resource Zone to capture geographic diversity

Load Uncertainty in LOLE

- Loss of Load Expectation (LOLE) analysis is largely driven by two factors:
  - Generation Uncertainty
  - Load Uncertainty
- Recent historic load and temperature data used to capture load uncertainty
  - Variance in peak demand
  - Variance in load shape
  - Variance in temperatures
- Train load and temperature data from recent years utilizing neural network software to predict correlations between load and temperature for use in the LOLE model

Load Development Process



Load Forecast Adjustment

- Predicted load shapes scaled so that the monthly and zonal peak averages of the load shapes match each Local Resource Zone's monthly Zonal Coincident Peak Load Forecast
  - Load reductions from LMRs are included in the LSE-provided gross load forecasts
- Ratio of prompt year Non-Coincident Peak Forecast to Zonal Coincident Peak Forecast applied to future years Non-Coincident Peak Forecast to develop outyear load forecast scalars
- Zonal load shapes developed for the prompt year probabilistic analyses, as well as for the outyear analyses
  - This year's LOLE modeling efforts will cover PY25-26 (prompt year), PY28-29 (outyear 4), and PY30-31 (outyear 6)

LOLE Study Deliverables for MISO Planning Resource Auction

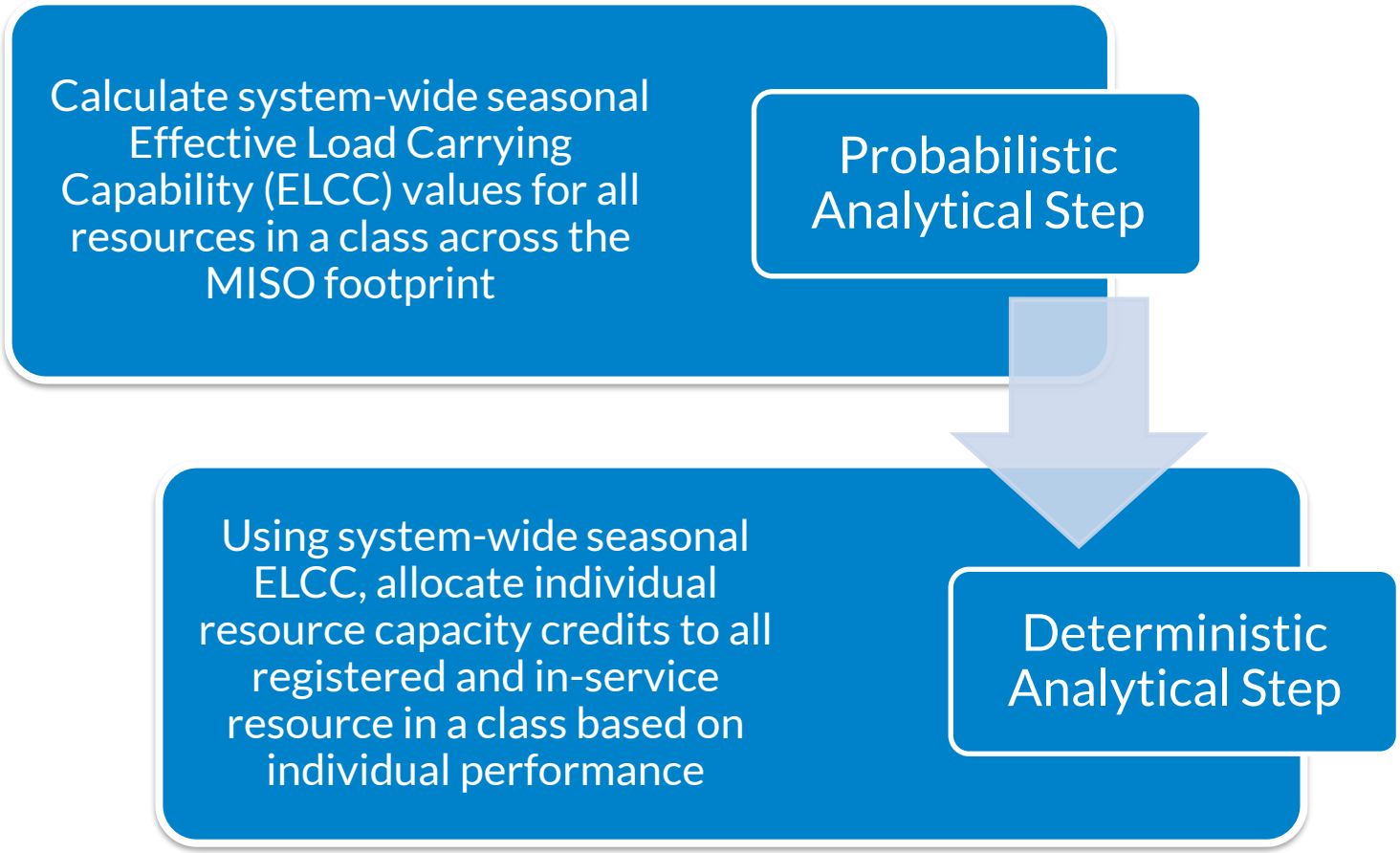
- Loss of Load Expectation (LOLE) study determines system-wide and zonal reserve margin needs for each season of the upcoming Planning Year
  - Probabilistic Monte Carlo simulations to meet 1-day-in-10-year LOLE criterion
  - Various generation assumptions and load profiles used to model system risk
  - Tariff requirement to publish results by November 1
- Separate transfer analyses determine zonal Capacity Import Limits (CIL) and Capacity Export Limits (CEL)
  - CIL acts as a reduction to the zonal requirements and represents each zone's ability to import energy from external neighboring entities, as well as from other Local Resource Zones (LRZ) within MISO
- LOLE deliverables are established once a year and on a seasonal basis
  - These include the system-wide Planning Reserve Margin (PRM) and zonal Local Reliability Requirements (LRR)

LOLE Study Report PY 2024-2025
https://cdn.misoenergy.org/LOLE%20Study%20Report%20PY%202024-2025631112.pdf

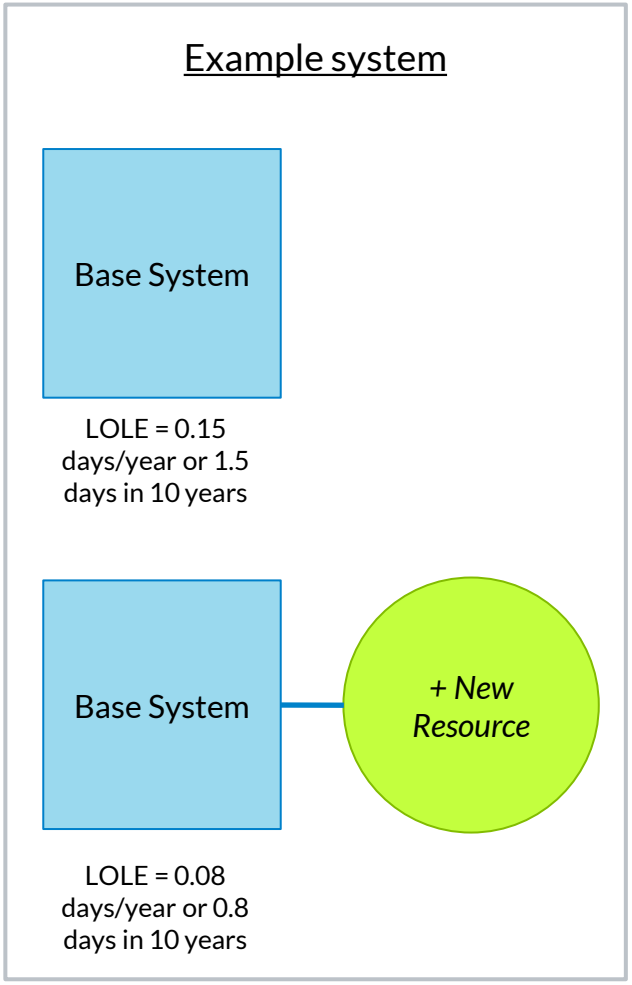
LOLE Study Deliverables for MISO Planning Resource Auction

- Planning Reserve Margin (PRM)
  - System-wide LOLE analysis, reserve sharing between Local Resource Zones
  - PRM established for each season of upcoming Planning Year (starting in June and ending in May)
- Local Reliability Requirement (LRR)
  - Zonal LOLE analysis, no reserve sharing between Local Resource Zones
  - Capacity Import Limit (CIL) reduces zonal requirement on a 1-to-1 MW basis
- System-wide Planning Reserve Margins and zonal Local Reliability Requirements are inputs to the Planning Resource Auction (PRA) held at the end of March every year
- LOLE deliverables are applied to updated peak demand forecasts submitted by Load Serving Entities to calculate Resource Adequacy Requirements in the PRA

Effective Load Carrying Capability (ELCC)

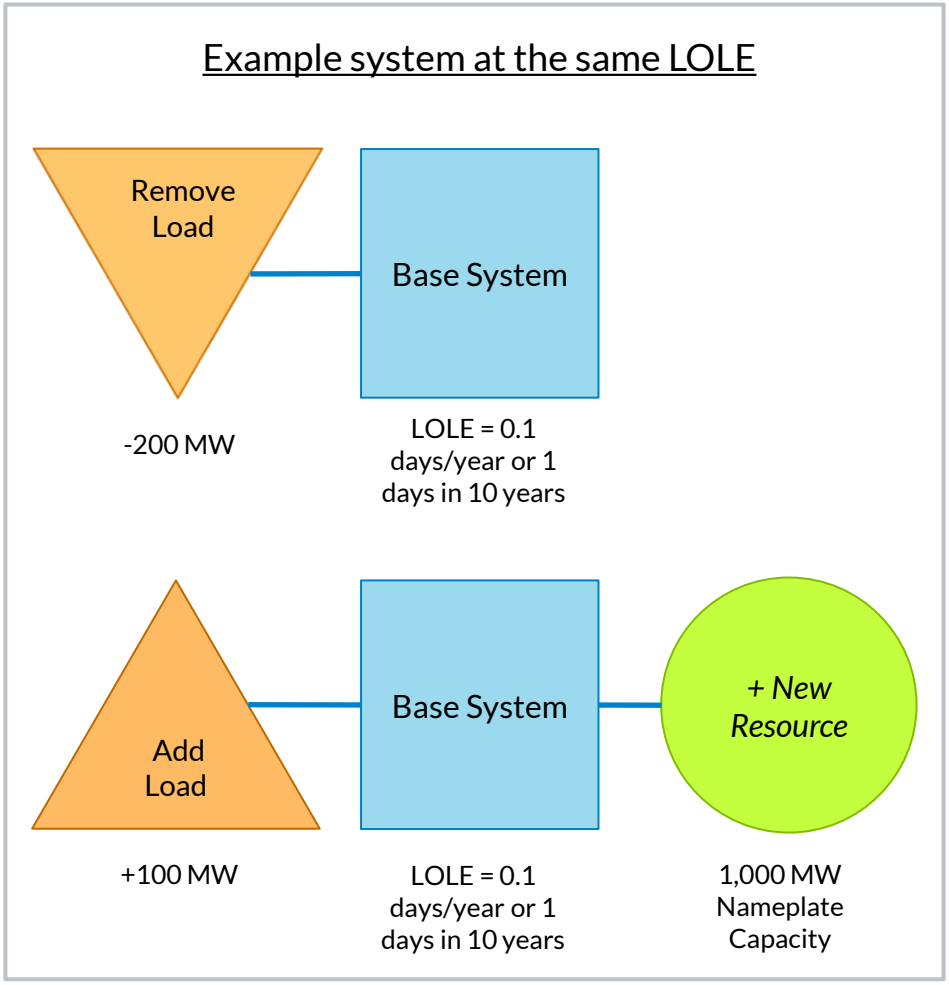


Effective Load Carrying Capability (ELCC)



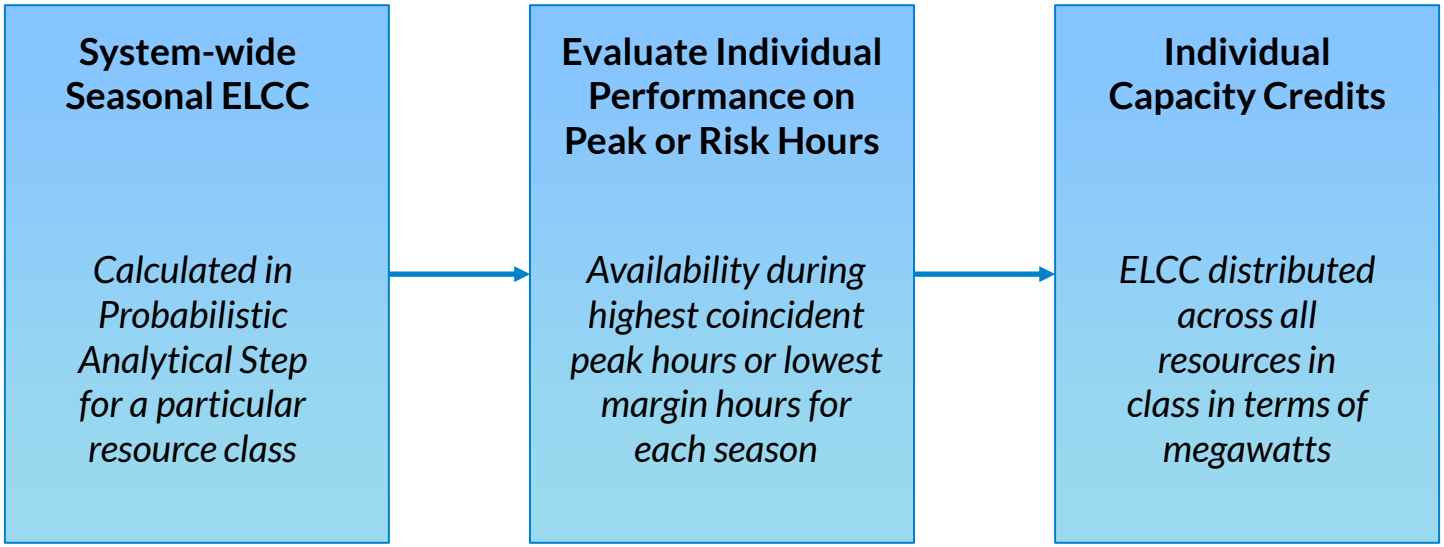
- Effective Load Carrying Capability (ELCC) is defined as the amount of incremental load a resource can dependably and reliably serve
- To measure the ELCC of a particular resource, the reliability effects need to be isolated for the resource in question from those of all the other resources through probabilistic analysis
- The case with the new resource will be more reliable and have less LOLE
- In the example, the system was made 0.07 days/year more reliable from the addition of the new resource

Effective Load Carrying Capability (ELCC)

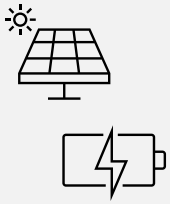


- Next, establish a common baseline reliability level (0.1 day/year LOLE) and adjust the load in the two cases
- The difference between the load adjustments is the amount of ELCC expressed in megawatts
- ELCC can be expressed as a percentage by dividing by the nameplate capacity of the new resource
- ELCC = 300 MW or 30% in this example

Effective Load Carrying Capability (ELCC)



MISO's current accreditation methodologies differ by resource class and include periods with minimal system reliability risk

	Class-Level	Resource-Level
Thermal 	Unforced Capacity (5-year forced outage rate)	Based on actual performance with historical high-risk hours weighted more heavily (Schedule 53)
Wind 	Probabilistic Method (Average ELCC)	Based on performance in peak hours
Solar & Storage 	N/A	Based on performance in peak hours
Demand Response 	N/A	Based on demand reduction capability during high-risk hours

Contact Info

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Appendix

References

- LOLE Study Report (Planning Year 2024-2025)
  https://cdn.misoenergy.org/LOLE%20Study%20Report%20PY%202024-2025631112.pdf

- Wind and Solar Capacity Credit Report (Planning Year 2024-2025)
  https://cdn.misoenergy.org/Wind%20and%20Solar%20Capacity%20Credit%20Report%20PY%202024-2025632351.pdf

- MISO Resource Adequacy Business Practice Manual (BPM 011)
  https://www.misoenergy.org/legal/rules-manuals-and-agreements/business-practice-manuals/

- MISO Tariff (Module E-1 & Module E-2)
  https://www.misoenergy.org/legal/rules-manuals-and-agreements/tariff/