MISO Resource Adequacy Seasonal Construct Filing Overview

AES Indiana's Public Advisory Meeting

June 27, 2022

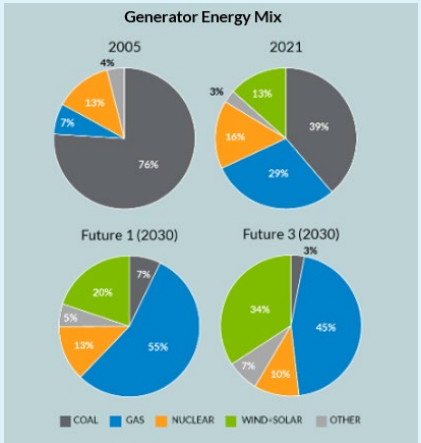
The MISO resource adequacy construct establishes planning requirements, assesses accredited resource value, and helps provide visibility into local and regional capacity sufficiency

Requirements	Accreditation	Visibility
What is needed for reliability	How resources are counted, including thermal and non-thermal resources	Portfolio trends in short-term and long-term, including resource retirements and investments

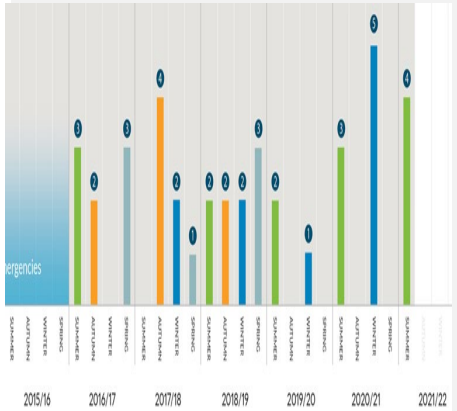
- Planning Resource Auction
- OMS-MISO Survey
- Seasonal Assessments
- Regional Resource Assessment

Changing resource portfolio with rapid growth of intermittent resources drives continued risk profile shifts and an increased need for Resource Adequacy reforms to address reliability imperative

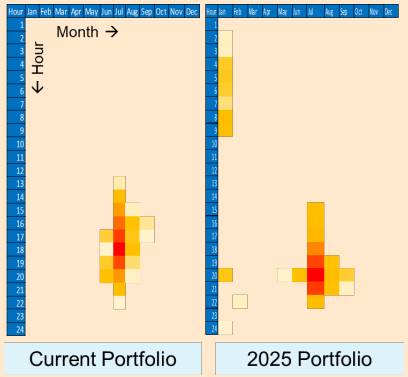
Resource Portfolio continues to evolve with increasing growth of renewables



Historical Emergency Declarations increase across the year

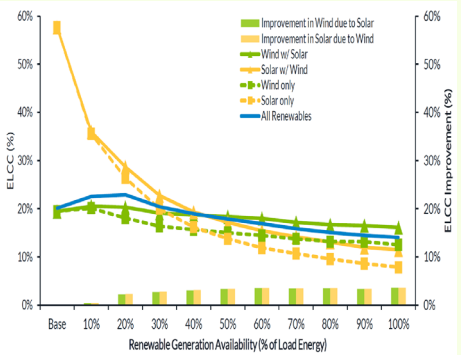


Future portfolio indicates continued shift of reliability risks across the year



Risk Assessment (% of total Expected Unserved Energy MWh)

Renewable reliability contributions vary by penetration and portfolio mix



Change in resource capacity calculation with technology diversity and penetration

MISO Futures Report - MISO's Renewable Integration Impact Assessment (RIIA) - Aligning Resource Availability and Need

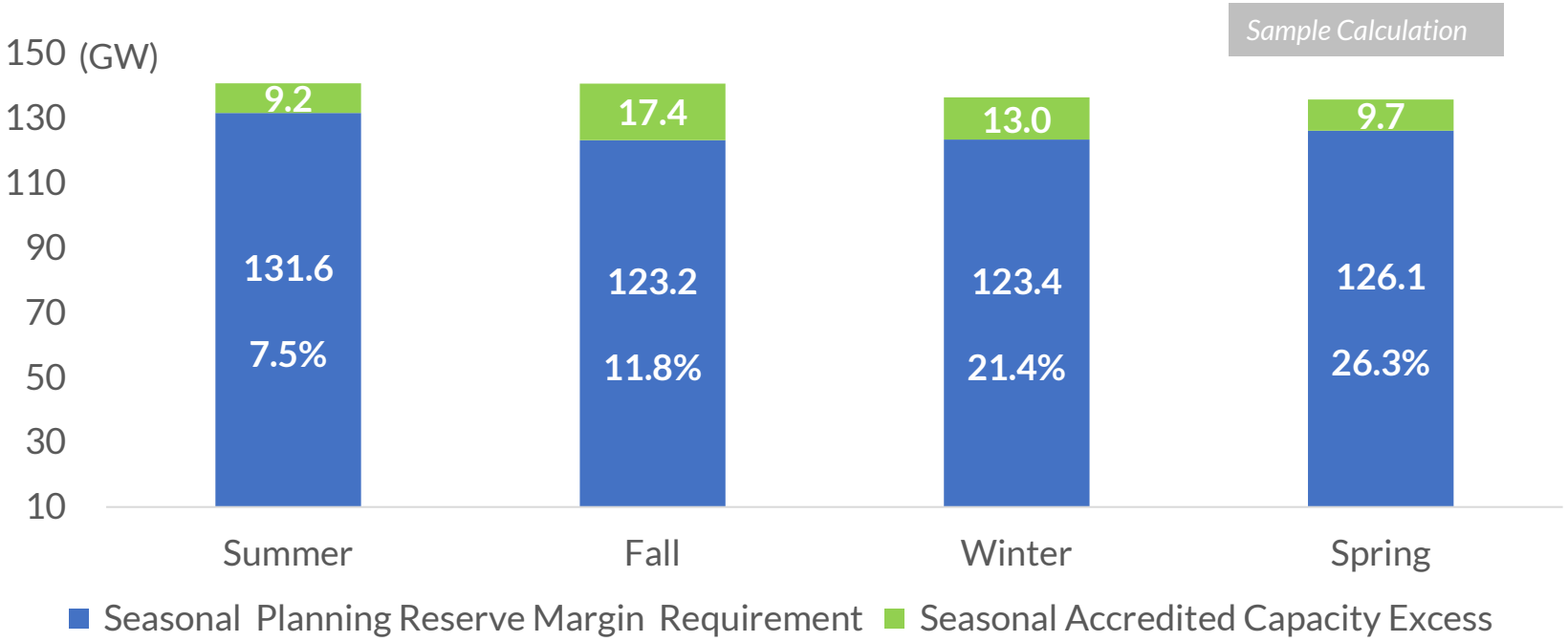
Recently filed reforms to the Resource Adequacy construct will help address today's reliability challenges and prepare for the future

	Current Annual Construct	Filed Sub-annual Construct Proposal
RA Requirements	MISO performs annual LOLE analysis to determine annual resource adequacy requirements.	MISO will calculate 4 distinct sub-annual resource adequacy requirements on a seasonal basis.
Resource Accreditation	MISO accredits conventional resources annually based on a 3-year forced outage rate, excluding planned outages and other exceptions.	MISO will accredit by season based on resource's availability (SAC) to align resource accreditation with availability in the highest risk periods.
Planning Resource Auction	MISO conducts annual Planning Resource Auction to meet annual resource adequacy requirements.	MISO will conduct independent auctions for all seasons at one time to meet seasonal resource adequacy requirements and will require a Minimum Capacity Obligation (MCO) prior to the auction.

LOLE = Loss of Load Expectation | UCAP = Unforced Capacity | SAC = Seasonal Accredited Capacity

Outages[1] includes forced and planned outages, or de-rates reported in the MISO Outage Scheduler.

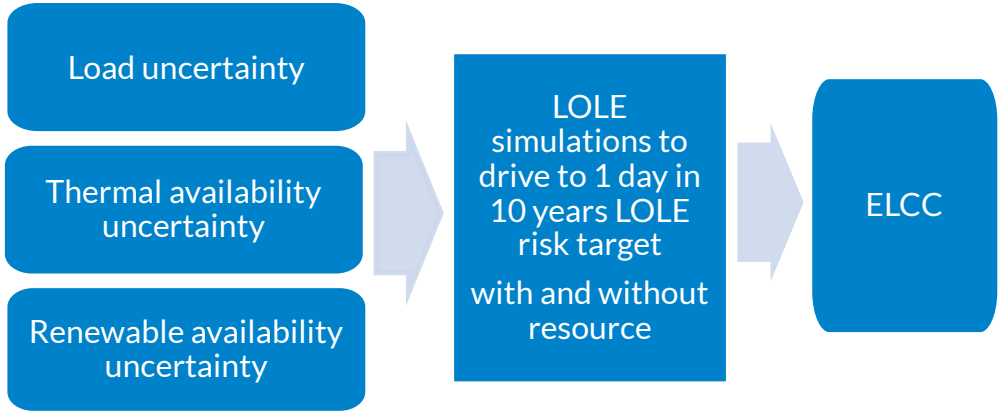
Varying seasonal requirements across the year with availability-based accreditation recognizes different needs during times of the year



MISO conducts annual Effective Load Carrying Capability analysis to determine capacity values for wind resources

Effective load carrying capability (ELCC): The amount of incremental load a resource can dependably and reliably serve, while considering the probabilistic nature of generation shortfalls and random forced outages as driving factors to load not being served*

- Leverages probabilistic methods
- Accounts for uncertainties that affect resource's availability
- Requires numerous years of historical weather data
- Renewable hourly profiles



* MISO's Planning Year 2021-2022, Wind & Solar Capacity Credit, December 2020

MISO is pursuing further renewable accreditation enhancements post Seasonal alignment for non-thermal resources proposed in 2021 RAN filing

Resource Category	Current Annual Accreditation	Seasonal Accreditation proposed in 2021 RAN filing	Further Enhancements currently underway Post-Filing
Wind	Annual ELCC and then allocate to individual wind resources based on performance over 8 peak summer days per year	Seasonal ELCC and then allocate to individual wind resources based on performance over 8 peak days per season	Evaluate ELCC methodology along with other availability-based accreditation approaches
Non-wind intermittent resources, including solar	Three-year, historical availability-based hours 15,16,17 EST from June to August	Three-year, historical availability-based hours 15,16,17 EST for spring, summer and fall. Hours 8, 9, 19, 20 EST for winter	

ELCC = Effective Load Carrying Capability

Contact Information

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MISO utilizes enhanced modeling assumptions to better capture risks across the year

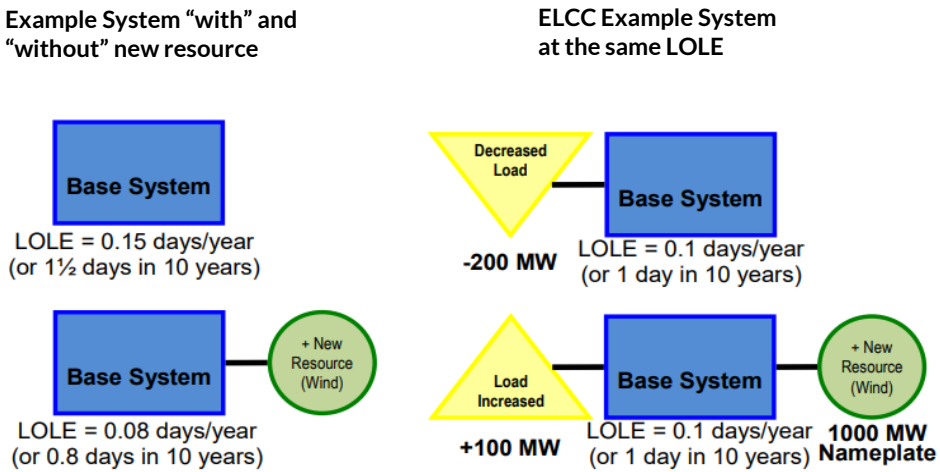
	High-Fidelity Modeling	Purpose
Intermittent Resources	Hourly 8760 wind and solar profiles for 30 weather years vs. monthly fixed ELCC value	Better reflect wind and solar actual availability and variability throughout the year
Non-Firm External Support	Probability distribution modeling based on historical hourly non-firm external support during emergency pricing hours for the last 4 years vs. annual fixed value	Better capture variability of non-firm external support across the year and reflect as a probability, similar to load and weather
Forced Outage Rates	Seasonal outage rates and cold weather adjustments across the year	Better capture seasonality of outage rates and correlation with temperature
Planned Outages	Flexible planned outage scheduling	Better align modeled and actual planned outages to capture flexibility of rescheduling planned outages

ELCC = Effective Load Carrying Capability

Effective Load Carrying Capability (ELCC) is calculated by conducting and comparing two LOLE simulations with and without the resource technology

- Effective load carrying capability (ELCC): *the amount of incremental load a resource can dependably and reliably serve, while considering the probabilistic nature of generation shortfalls and random forced outages as driving factors to load not being served **

- To measure ELCC of a particular resource, isolate its reliability effects by calculating the loss of load expectation (LOLE)* of two different cases: one "with" and one "without" the resource
- In the context of having multiple non-thermal technologies on the system, the individual technology approach may under/ over-credit, but the approach is currently in use
- When more than one non-thermal technology exists, the ELCC methodology is adjusted to account for the interactions and technology diversity benefits



MISO's Planning Year 2021-2022, Wind & Solar Capacity Credit paper, December 2020