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Evaluation of Sub-Annual Designs for PJM's RPM

Sub-Annual Market Designs Across Other ISOs/RTOs

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Agenda

- Overview
- Context of Capacity Markets in NYISO, MISO and ISO-NE
- Overview of Sub-Annual Capacity Market Designs
- Next Steps

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Overview

- Assess developments in sub-annual (seasonal) design in other centralized capacity markets
  - NYISO
  - MISO
  - ISO-NE
- Provides useful information for potential development of sub-annual markets in PJM
  - Identifies alternative approaches to sub-annual market design
  - Provides experience with operation of sub-annual markets
- Important differences in market context
  - Historical development
  - Role of markets in resource adequacy

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Context of Capacity Markets

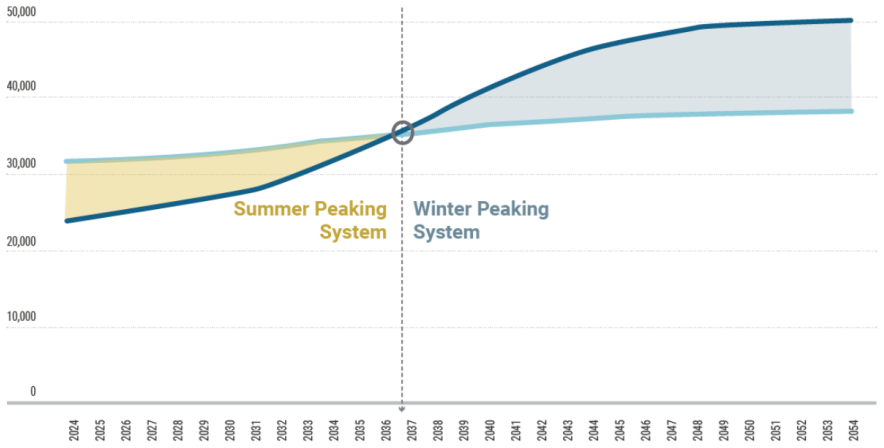
NYISO, MISO and ISO-NE

NYISO's Installed Capacity (ICAP) Market

Historical Context

- Since its inception, NYISO has operated a monthly, spot, sequential capacity market[A]
- NYISO LSEs rely on the spot market, voluntary auctions and bilateral arrangements to satisfy capacity requirements
- Until recently, supply offers and demand curve generally reflected annual parameters with no seasonal variation
- Multiple factors have prompted enhancements to increase seasonality in market design:
  - Increasing load year-round due to electrification of transport and space heating
  - Increase in intermittent resources / storage, reduction in dispatchable resources
  - In part, driven by regulatory changes (e.g., policies mandating 100% GHG-free electricity by 2040)
- NYISO has introduced multiple seasonal adjustments to annual parameters (e.g., seasonal ICAP-to-UCAP adjustment)
- Since January 2025, NYISO has engaged in the Winter Reliability Capacity Enhancement Project, considering introducing additional seasonal components to the market to improve winter adequacy risk

Peak Load Forecast for Summer and Winter (MW)



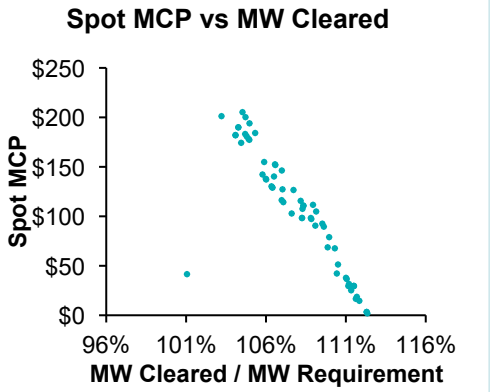
Notes: [A] The ICAP market also includes two voluntary, prompt auctions: (a) strip auction that clears capacity for six-month capability periods, and (b) a monthly auction covering the remaining balance in the capability period. Capability periods include Summer and Winter.

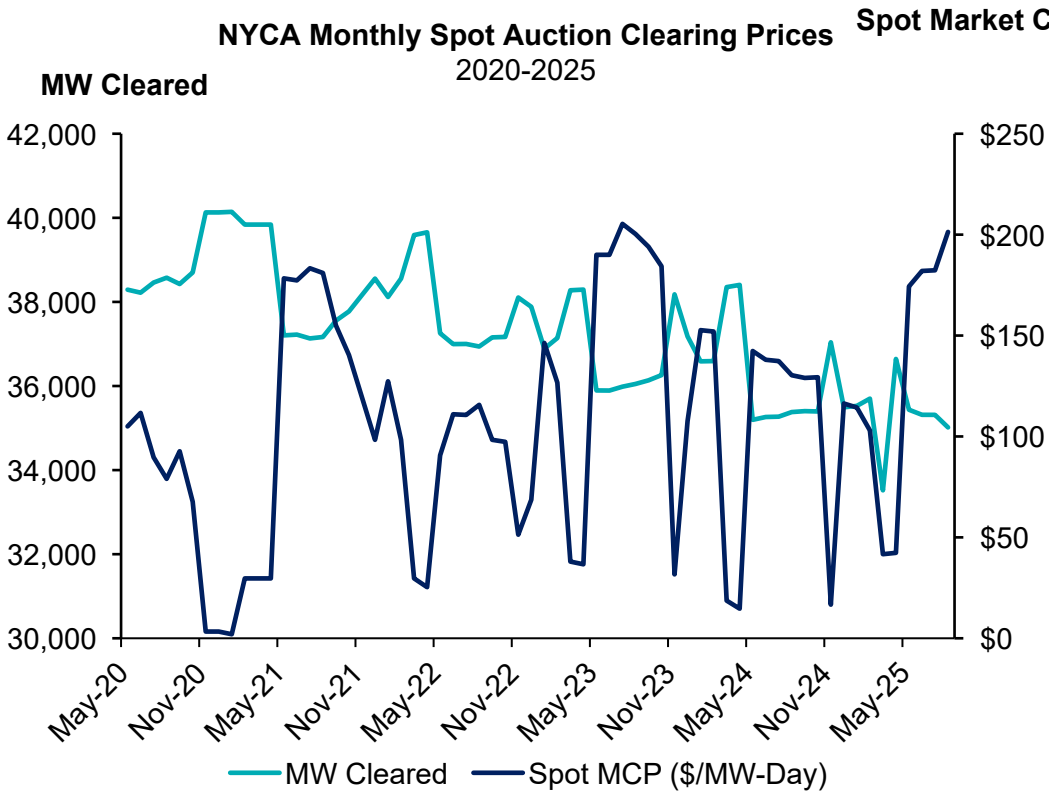
Source: [1] NYISO, 2023-2042 System & Resource Outlook.

NYISO's Installed Capacity (ICAP) Market (cont.)

ICAP Market Historical Price Outcomes

- Variance in MCPs driven largely by supply fundamentals
- Supply changes reflect entry, exit and seasonal ICAP-to-UCAP adjustment factors (including six-month Summer/Winter average forced outage rates)





Source:

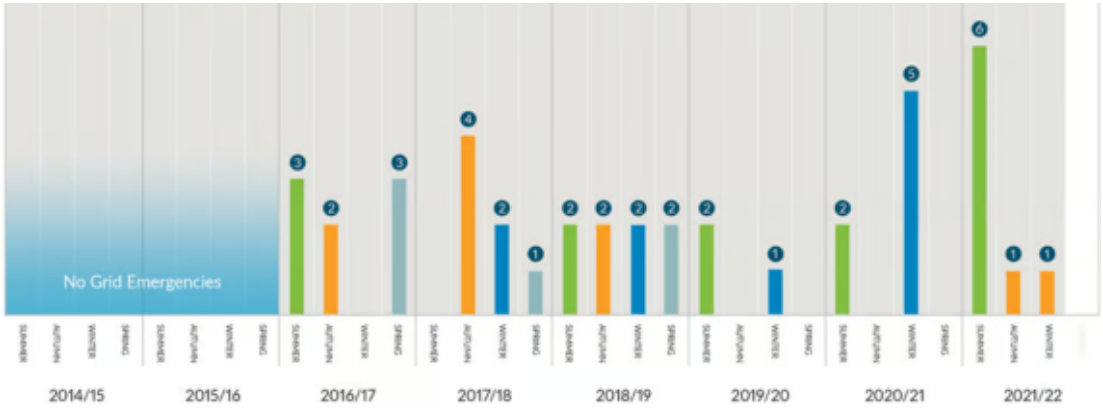
[1] NYISO, Installed Capacity Data, Monthly UCAP Reports, https://www.nyiso.com/installed-capacity-market.

MISO's Planning Resource Auction (PRA)

Historical Context

- At inception, MISO's PRA was a prompt, annual capacity auction, allowing LSEs to balance capacity requirements
  - Unlike PJM, the majority of load obligations are met through self-supply by vertically integrated utilities (> 90% in 2022/23)[1]
- Multiple factors prompted MISO to consider a seasonal design, including increased reliability risk in all seasons due to extreme weather events (e.g., 2014 Polar Vortex), intermittent generation and planned outages
  - Reliability risks in all seasons, with 68% of emergency events ("MaxGen Events")[A] in 2016-2021 outside of summer season

MaxGen Events (2016 – 2021)



- MISO has experienced shoulder reliability events: for example, 37% of the 41 MaxGen declarations[A] 2016-2021 occurred in shoulder seasons
- The chart indicates the number of days under a MaxGen alert, warning or event

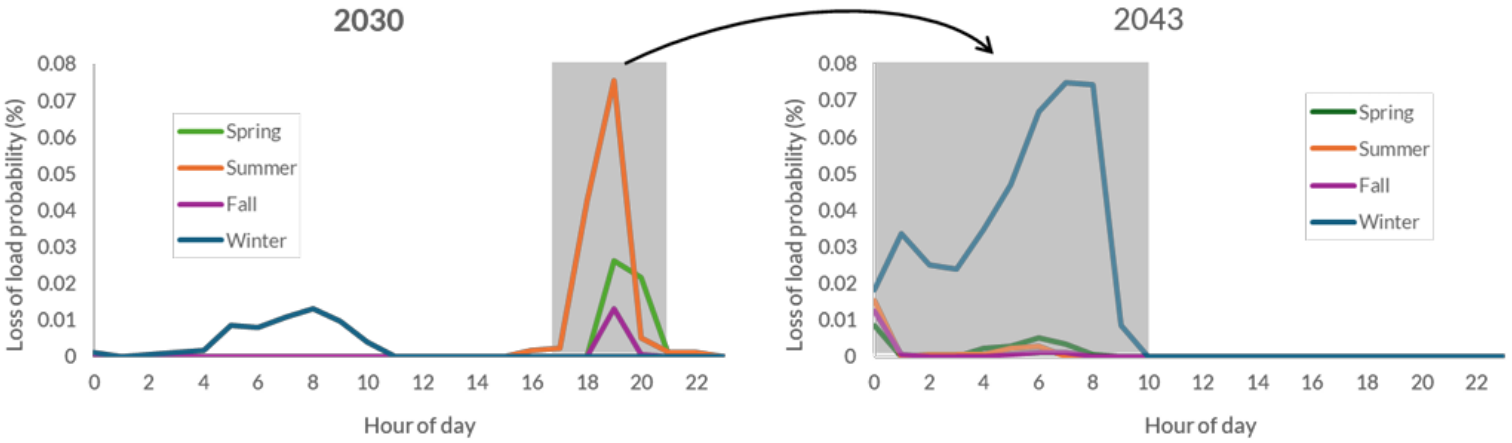
Note: [A] Maximum Generation declarations (alters, warnings and events) reflect instances of projected capacity shortfalls.
Sources: [1] "Making sense of MISO's recent capacity auction", ICF, Exhibit 3a, [2] MISO, "Overview of Winter Storm Elliot December 23, Maximum Generation Event", 1/17/2023

MISO's Planning Resource Auction (PRA) (cont.)

Historical Context

- In 2023, MISO enhanced the PRA to include a four-season auction
- In 2025, MISO first used sloped demand curves (seasonal, system-wide and zonal)
- MISO continues to evaluate its resource adequacy construct and its ability to address resource adequacy (and other reliability) risks given evolving seasonal and resource risk, noting the value of a flexible system

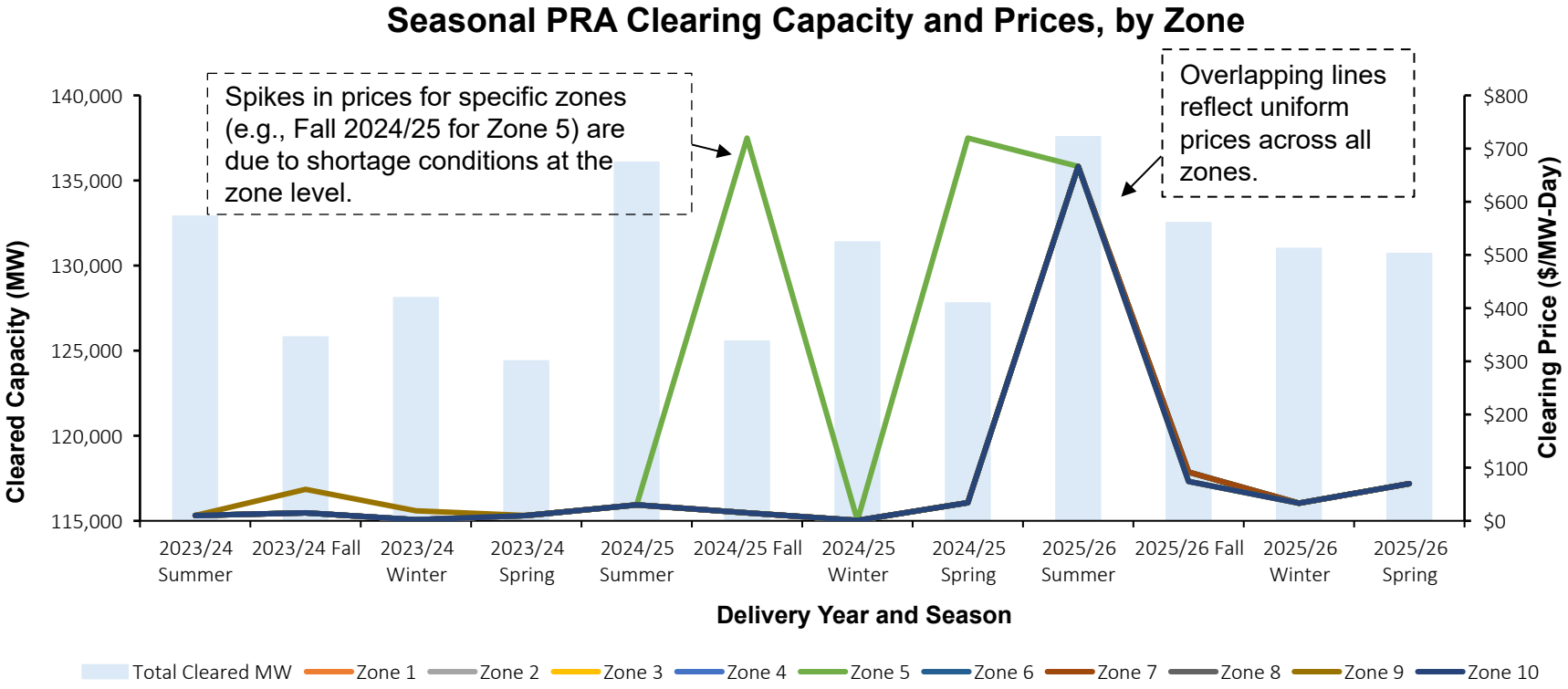
Loss of Load Probability by Season and Hour of the Day, 2030 and 2043



Source: MISO, 2024 Regional Resource Assessment.

MISO's Planning Resource Auction (PRA) (cont.)

PRA Price Outcomes



Note: Clearing prices across MISO's External Resource Zones are not included in this figure.

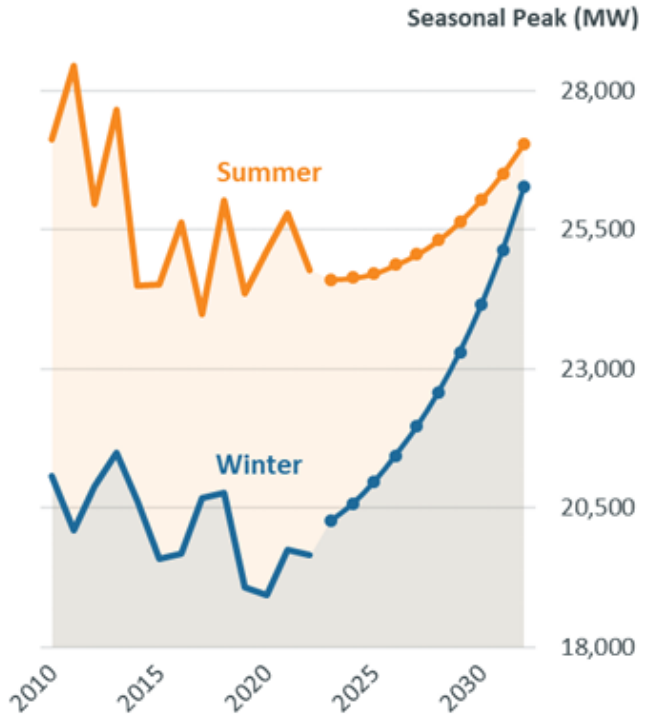
Source: MISO, Results for Planning Year 2025-26, April 2025, https://cdn.misoenergy.org/2025%20PRA%20Results%20Posting%2020250529_Corrections694160.pdf.

ISO-NE's Capacity Market

Historical Context

- Like PJM, ISO-NE has operated a forward, annual capacity market, which is relied on to achieve resource adequacy
- Multiple factors caused ISO-NE to pursue capacity market reforms:
  - State policies (e.g., Massachusetts' Climate Act 2021)
  - Increased intermittent resources, storage; reduced dispatchable resources
  - Increasing winter risks due to energy constraints / increasing winter peaks
- ISO-NE is currently pursuing a ***prompt***, ***seasonal*** market
- ISO-NE is in a stakeholder consultation process to design a prompt, seasonal market; targeting a tariff filing for the prompt component in Q4 2025 and for the seasonal component in Q4 2026
- ISO-NE has so far proposed the following seasonal design components, with more details to come:
  - **Bi-annual construct:** summer and winter season
  - **Sequential auction:** sequential auction, immediately ahead of the season
- Capacity accreditation and seasonal changes are being aligned within the design process

ISO-NE Forecast of Summer and Winter Net Peak Demand



Sources: [1] ISO-NE, "Capacity Auction Reforms", October 16, 2024, https://www.iso-ne.com/static-assets/documents/100016/a05_mc_2024_10-16_car_presentation.pdf. [2] ISO-NE 2023 Regional System Plan.

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Overview of Sub-Annual Capacity Market Designs

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Overview

Capacity Market	Auction Structure	Number Auctions / Seasons	Demand Curve	Offer Structure	Capacity Accreditation
NYISO	Sequential spot/prompt auctions (days before delivery month)	Monthly auctions Summer and winter capability periods	Sloped demand curves for two capability periods (winter, summer) for NYCA and Localities Relative position of seasonal demand reflects estimated summer/winter parameters	Monthly offers reflect avoidable cost and net EAS offset	Annual, MRI-based accreditation
MISO	Annual, simultaneous auction, independently clearing all seasons	Four seasons	Sloped, MRI-based, by Zone Relative position of seasonal demand reflects seasonal MRI	Seasonal offers for each season, reflecting avoidable cost and net EAS offset	Seasonal, MRI-based accreditation
ISO-NE	Sequential auctions (proposed)	Bi-annual structure, with winter and summer seasons (proposed)	Seasonal MRI-based demand curve, by Zone (proposed)	TBD	Seasonal, MRI-based accreditation (proposed)

Auction Structure and Timing

Market	
NYISO	▪ Compulsory spot/prompt auction held several days prior to the start of each month ▪ Voluntary auction clears bilateral offers to buy and sell capacity ▪ Six-month seasonal capability periods affect demand curves and supply offers: summer (May to October) and winter (November to April)
MISO	▪ Has always operated a prompt auction ▪ Starting with 2023 auction, has operated a seasonal construct ▪ Single capacity auction held annually in April ▪ Independently, simultaneously clears capacity for four upcoming seasons: Summer (June to August), Fall (September to November), Winter (December to February), and Spring (March to May)
ISO-NE	▪ Historically operates a forward, annual auction held three years in advance of the commitment period (June 1 to May 31) ▪ Currently designing a prompt, seasonal construct ▪ Current proposal: two independent, sequential auctions for a summer season (May 1st to October 31st) and a winter season (November 1st to April 30th)

Auction Structure and Timing (cont.)

Auction Sequence and Optimization

	Sequential	Simultaneous
Independent	NYISO ISO-NE (proposed)	MISO
Co-optimized (Offer Selection)	**Not Feasible**	

Independent: Offers are cleared independently in each sub-annual auction

Sequential: Sub-annual auctions are cleared at different points in time, one after the other

Co-optimized: Offers for sub-annual products are cleared jointly within the same auction/optimization

Simultaneous: Multiple sub-annual products are cleared in auction(s) occurring at one point in time

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Demand

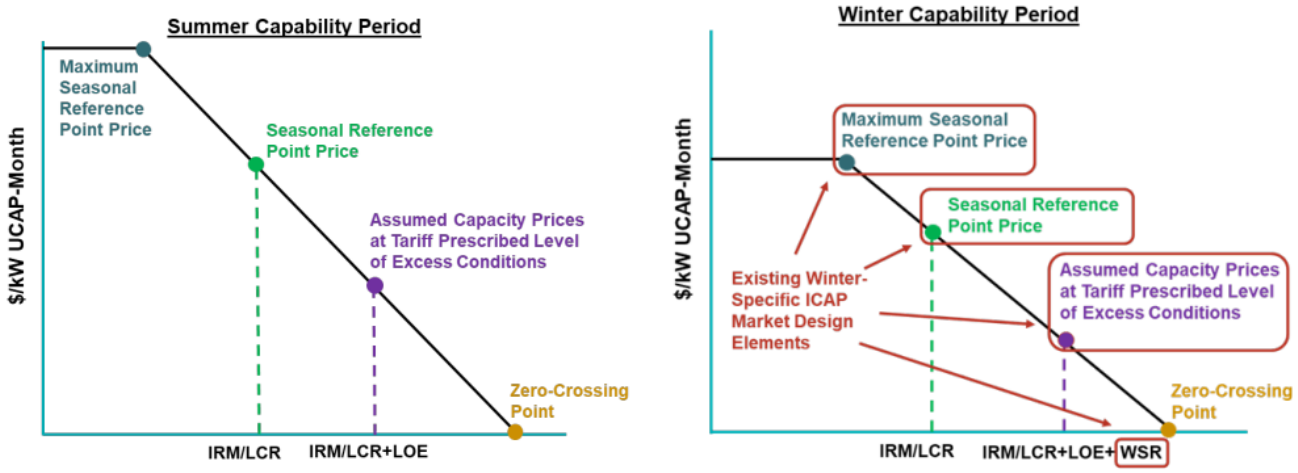
Demand Curves

Market	
NYISO	▪ ICAP Demand Curves reflect multiple administratively-determined parameters ▪ NYISO has and continues to adjust parameters to incorporate seasonality (see next slide): 1. Historical seasonal features: e.g., ICAP-to-UCAP adjustment (e.g., to reflect summer/winter forced outage rates), 2. 2025-26 adjustments: e.g., Reference Point Prices (to account for summer/winter risk proportions) 3. Currently developing summer and winter capacity requirements, transmission limits and LCRs ▪ Four sloped, administratively-set ICAP demand curves, determined system-wide and by Localities (NYC, LI, G-J), which reflect forecasted summer peak load and an annual IRM
MISO	▪ Seasonal, MRI-based demand curve for each Zone (first used in 2025/26 PRA) ▪ Demand curve calculated as MRI curve values multiplied by a scalar to ensure new entrant covers cost of new entry at aggregate 1-in-10 reliability standard (see Slide 16) ▪ Zones clear at net CONE (vertical intercept) during shortage conditions
ISO-NE	▪ Currently utilizes MRI-based demand curves ▪ Has proposed seasonal demand curves, by Zone ▪ Design TBD, proposing to maintain MRI approach with details to come (design expected for Q1 2026)

Demand (cont.)

NYISO's Administrative Demand Curves

- NYISO's ICAP demand curves are derived formulaically using multiple individual parameters
- Parameters increasingly reflect seasonal rather than annual measurements (denoted by red boxes in figure)
- Other components are set on an annual basis, with some being proposed for modification to seasonal measurements

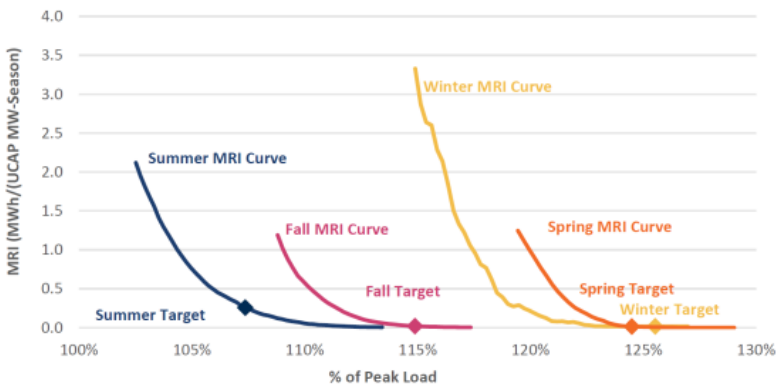


Demand (cont.)

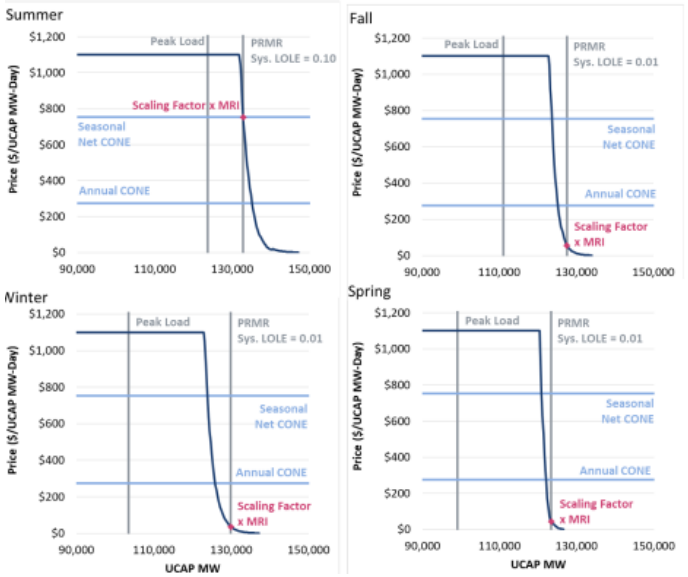
MISO's Reliability Based Demand Curves (RBDCs)

- MISO's RBDCs are derived through rescaling of seasonal MRI curves
- MRI values/curves are derived from resource adequacy models
- Uniform rescaling to reflect a constant economic value (willingness-to-pay) of lost load risk across seasons (necessary to achieve net CONE at the system-wide 1-in-10 resource adequacy standard)

Seasonal MRI Curves, Illustrative



Seasonal RBDCs, Illustrative 2023-24



Source: MISO Reliability Based Demand Curve Filing, Brattle Testimony, September 2023.

Demand (cont.)

Cost Allocation

Market	
NYISO	▪ NYISO allocates capacity obligations to LSEs based on their share of forecasted annual peak load, adjusted for locational capacity requirements. ICAP is translated to UCAP for summer and winter capability periods
MISO	▪ MISO calculates capacity obligations for LSEs (their seasonal planning reserve margin requirements) within each Zone based on their share of seasonal forecasted peak load ▪ MISO is currently proposing to instead allocate obligations based on LSEs' historical load during high-risk hours
ISO-NE	▪ ISO-NE currently calculates capacity obligations for LSEs within each zone based on their share of forecasted peak annual load, adjusted for zonal capacity requirements ▪ Seasonal design is TBD

Demand (cont.)

Seasonal Price Caps

Market	
NYISO	▪ Price cap is 1.5 times the monthly value of the peaking plant gross cost of new entry (CONE) ▪ Cap values (in $/kW-month) differ for winter and summer due to differences in parameter values
MISO	▪ Uniform price cap across seasons, set at annual net CONE divided by the number of days in season ▪ Allows recovery of annual net CONE if clearing in only one season ▪ Provisions to cap prices if Zones clear at shortage pricing (net CONE) in more than one season (including provisions to avoid price separation across Zones if application of cross-season cap is not uniform across Zones) ▪ Some stakeholder concern about potential for resources to recover costs in excess of net CONE
ISO-NE	▪ Seasonal design is TBD

Supply

Offers and Accreditation

Market	
NYISO	▪ Suppliers submit offers for upcoming month ▪ Offered supply reflects seasonal components, including seasonal testing (used to determine ICAP values) and seasonal derating factors (used to translate ICAP to UCAP) ▪ Resources are accredited based on an MRI approach, with constant accreditation factors across the year (seasonal accreditation was considered but deferred at present) ▪ Offer prices reflect avoided costs/going-forward costs
MISO	▪ Resources are accredited based on availability in resource adequacy hours in each season (MRI approach) ▪ Offer prices submitted for each season, with the opportunity to recover all annual costs in one season
ISO-NE	▪ ISO-NE is developing its framework for capacity accreditation and avoidable costs that can be included in offers ▪ ISO-NE has proposed to continue with MRI-based accreditation, with accreditation values for each season ▪ Gas availability is being addressed through a market constraint, rather than accreditation

Supply (cont.)

MISO's Seasonal Offer Curves

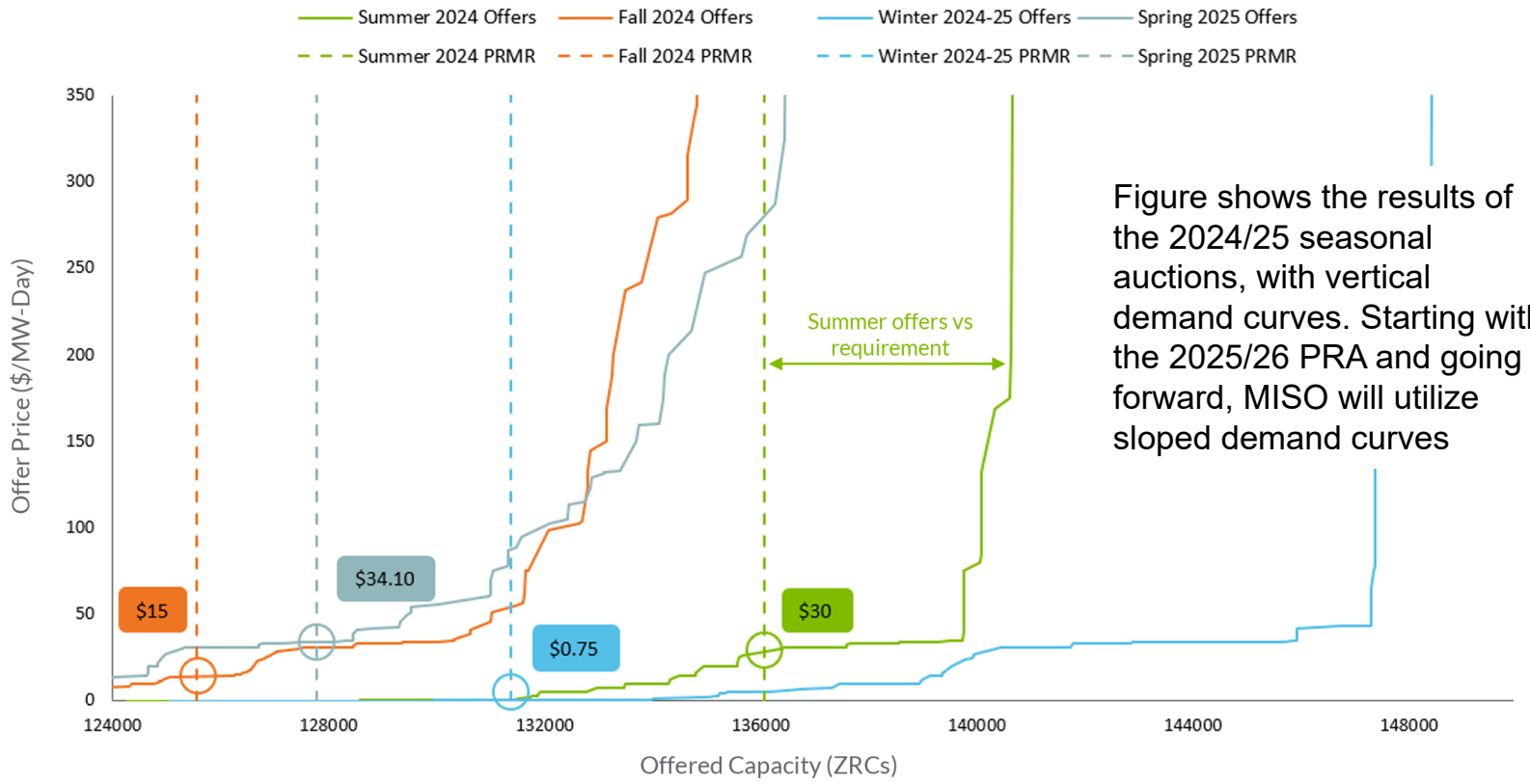


Figure shows the results of the 2024/25 seasonal auctions, with vertical demand curves. Starting with the 2025/26 PRA and going forward, MISO will utilize sloped demand curves

Source: MISO 2024/25 PRA Results, https://cdn.misoenergy.org/2024%20PRA%20Results%20Posting%2020240425632665.pdf.

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Next Steps

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Next Steps

- Stakeholder presentations in October, November and December
- Final Report posted on December 19, 2025; Report review in January

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Thank You

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