MISO'S LOLE AND RESOURCE ADEQUACY ASSESSMENT STUDY

ZHI ZHOU

AUDUN BOTTERUD
Argonne National Laboratory

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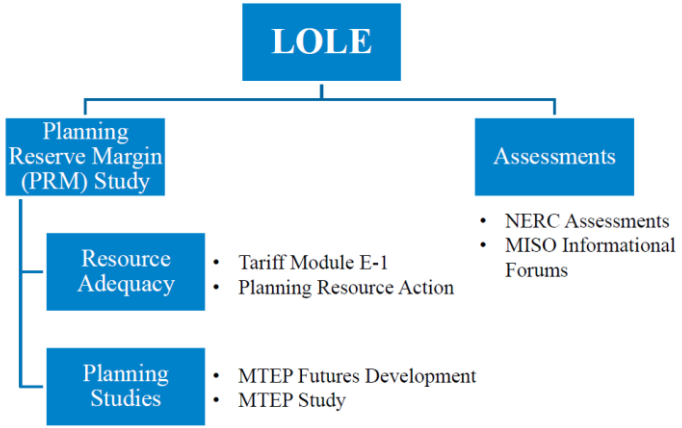
ANALYSIS OF LOSS-OF-LOAD EXPECTATION (LOLE) AND PLANNING RESERVE MARGIN REQUIREMENT (PRMR)

- Purpose:
  - Determine the amount of firm generation, storage, demand-side resources, and net imports required to meet the reliability target for loss of load.
- Tool:
  - Strategic Energy & Risk Valuation Model (SERVM)
  - SERVM calculates the Planning Reserve Margin (PRM) for both the MISO system and each Local Resource Zone (LRZ) by simulating the year chronologically.



- Key Inputs
  - (1) generation, (2) load; (3) load modifying and energy efficiency resources; (4) equipment forced outages; (5) planned and maintenance outages; (6) weather and economic uncertainty; (7) external support.
- Key Outputs
  - Base case models:
    - For future planning year 1, 4, and 6: SERVM produces (1) Seasonal MISO PRM in installed capacity (ICAP), (2) Seasonal MISO PRM in unforced capacity (UCAP); and (3) Local Reliability Requirements (LRRs) for each Load Resource Zone (LRZ).
  - Sensitivities:
    - Evaluates how specific inputs and assumptions affect model results.

MISO, 2018, LOLE 101: Probabilistic Analyses, https://cdn.misoenergy.org/LOLE%20101%20Training624875.pdf

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EVOLUTION OF MISO'S LOLE STUDY

2021–2022

- Annual framework
- Risk implicitly summer-weighted
- Planned outages:
- Monthly wind ELCC

2022–2023

- Annual framework remains
- Flexible planned outage methodology introduced conceptually
- GLT rules updated

2023–2024

- Major transition from annual to seasonal construct
- Seasonal PRM and LRRs begin
- More focus on winter and shoulder-season risk
- More granular outage modeling
- More detailed load modeling

2024–2025

- Seasonal framework continues
- Dynamic zonal LRRs and transfer capability
- Refined DR and storage treatment
- More realistic dispatch / run-limit representation

2025–2026

- Refined treatment of winter risk
- Improved forced outage assumptions / performance
- Storage additions and thermal changes reflected
- Updated load shapes
- Winter risk timing shifts relative to wind / solar

2026–

- Future direction: DLoL-based accreditation
- Two-step Individual level resource accreditation
- Broader move toward RA-hour / critical-hour performance-based accreditation

Overall evolution: Annual → Seasonal | Summer-centric risk → Year-round risk | Simplified assumptions → Granular modeling | Static accreditation → Performance-based DLoL

DATA SOURCES, INPUT, AND OUTPUTS

- Sources* (Year 2021-2026):
  - Annual LOLE Study Reports
  - Regional Resource Adequacy Study
  - Resource Accreditation Documentation
- Key Inputs:
  - Peak demand, Zonal transfer capability, EFORd
- Key Outputs:
  - Intermediate outputs: LoLE distribution by season and by zone.
  - LOLE study outputs:
    - PRM (%, MW)
    - LRR(%, MW)
  - Capacity accreditation outputs
    - UCAP under SAC, ELCC, and DLOL

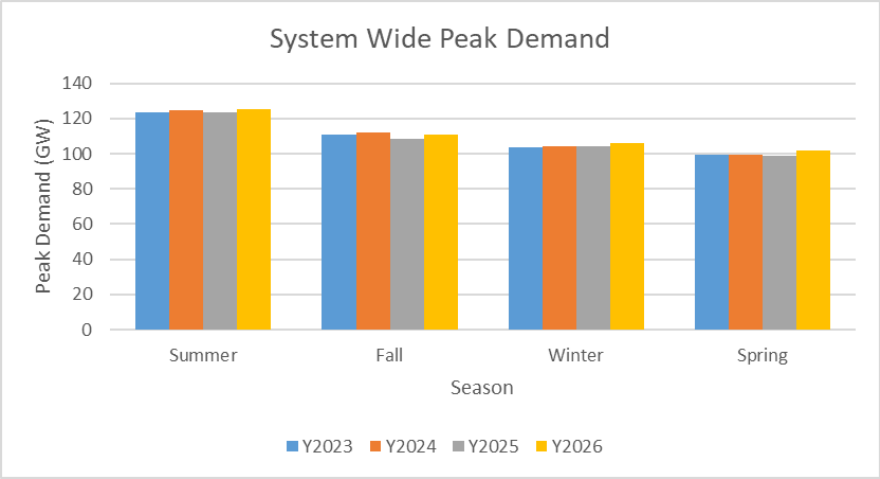
* See data spreadsheet “readme” tab for references to data sources.

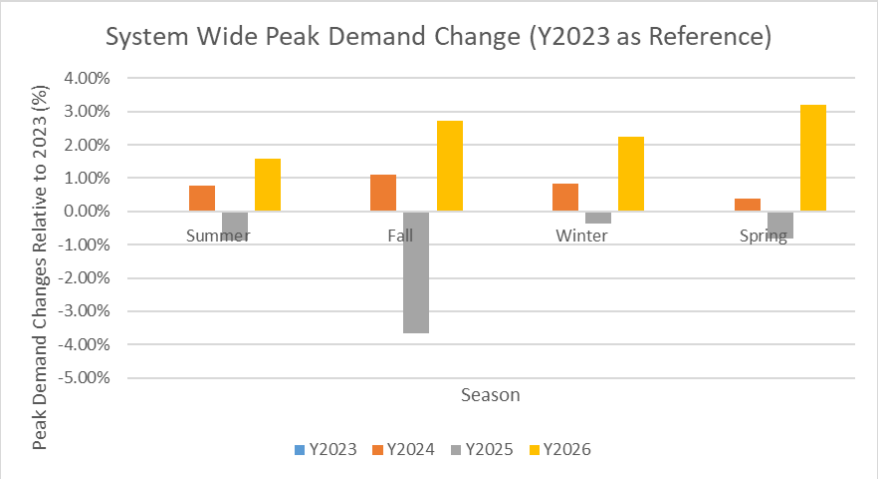
DATA COLLECTION LESSON LEARNED

- Pursued three pathways to obtain more detailed data from MISO:
  - Direct engagement with MISO: Requires execution of "Attachment EE" under MISO's tariff.
  - Existing NDA between ANL and MISO: Determined to be not applicable to this project.
  - FERC waiver: The expected approval timeline was too long to support project needs.
- ANL unable to obtain direct inputs and outputs from MISO's LoLE studies
- Instead, the analysis relied on publicly available sources, primarily
  - Annual LOLE study reports (2021-2026),
  - Annual DLOL study report (2023, 2025, and 2026)
- Using public data, ANL conducted:
  - Input outlook analysis, including peak demand, reliability target distribution, zonal import/export ability
  - Statistical analysis of outputs, including PRM, LRR, UCAP, capacity credits, etc. at system and local resource zone levels.
  - Assessment of potential impacts on capacity markets under the future capacity accreditation metric (DLOL).

DATA OVERVIEW – SYSTEM PEAK DEMAND

- Peak demand- System





Takeaways:

1. System peak demand is stable overall
2. 2025 is the clear low peak demand year
3. 2026 rebounds across all seasons, with especially strong demand gains in Spring and Winter.
4. Summer remains the highest peak demand season.

DATA OVERVIEW – PEAK DEMAND TREND (SYSTEM AND LRZ)

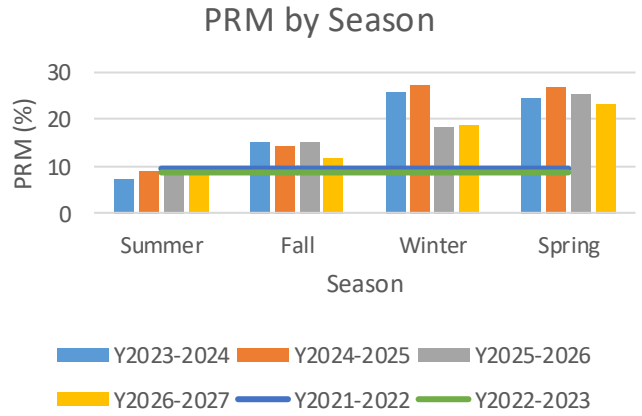
Peak Demand	2024/2023				2025/2024				2026/2025			
	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring
System	0.77%	1.10%	0.82%	0.39%	-0.88%	-3.67%	-0.38%	-0.82%	1.58%	2.71%	2.25%	3.22%
LRZ1	4.30%	3.66%	3.89%	7.08%	-5.12%	-2.12%	0.85%	6.47%	5.80%	5.38%	3.43%	5.01%
LRZ2	2.40%	1.11%	2.94%	2.00%	-2.28%	-2.47%	-0.50%	1.31%	1.42%	2.12%	0.98%	1.54%
LRZ3	3.10%	1.06%	4.83%	2.27%	1.28%	-0.03%	-1.01%	2.64%	2.64%	4.27%	7.88%	4.78%
LRZ4	0.27%	-8.02%	2.23%	-3.46%	-5.40%	-4.97%	0.55%	-3.24%	0.10%	7.09%	-1.64%	4.51%
LRZ5	1.43%	1.67%	7.74%	2.85%	0.76%	2.97%	-1.22%	4.17%	4.47%	0.78%	3.99%	6.54%
LRZ6	-2.71%	-3.97%	-2.44%	-3.03%	1.60%	2.07%	-0.32%	0.32%	0.99%	0.61%	-1.20%	1.04%
LRZ7	1.46%	1.17%	1.73%	-0.30%	-0.98%	-0.31%	-0.06%	1.14%	0.28%	3.48%	1.34%	1.46%
LRZ8	8.94%	10.60%	10.24%	11.20%	1.34%	-0.63%	-0.20%	1.19%	-2.73%	-0.86%	1.56%	0.19%
LRZ9	4.58%	4.35%	5.34%	2.38%	-0.06%	-6.84%	0.51%	3.13%	0.58%	9.43%	2.20%	2.82%
LRZ10	4.22%	2.64%	3.97%	3.80%	9.63%	9.46%	11.67%	12.02%	0.37%	2.50%	4.42%	3.86%

Takeaways:

1. System peak demand is relatively modest and stable overall
2. Zone-level trends are much more volatile than the system, with LRZ8 (AR) and LRZ10 (MS) showing the strongest surges, while LRZ4 (IL) and LRZ6 (IN) are persistently weak.
3. 2025 is the year with largest reductions in demand, especially in Fall, while 2026 show broad recovery, particularly in Spring and Fall.

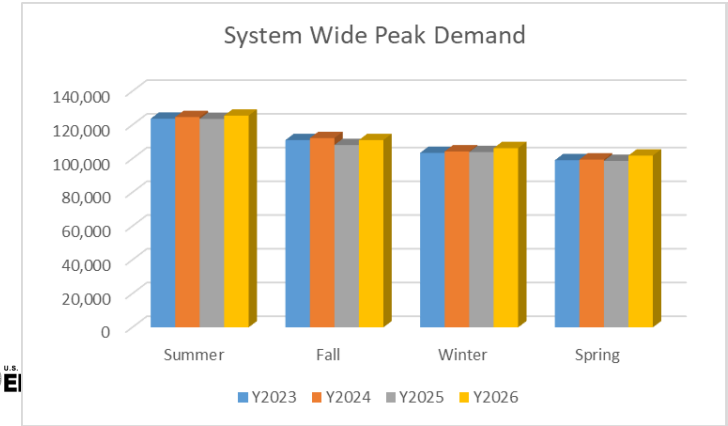
RESULTS OVERVIEW – PRM AND UCAP

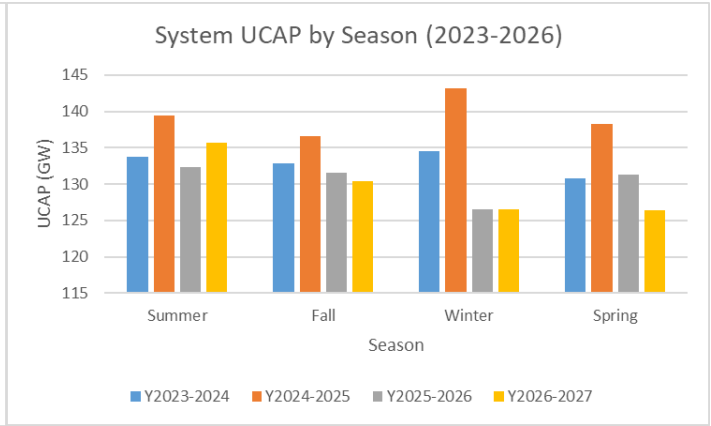
- PRM



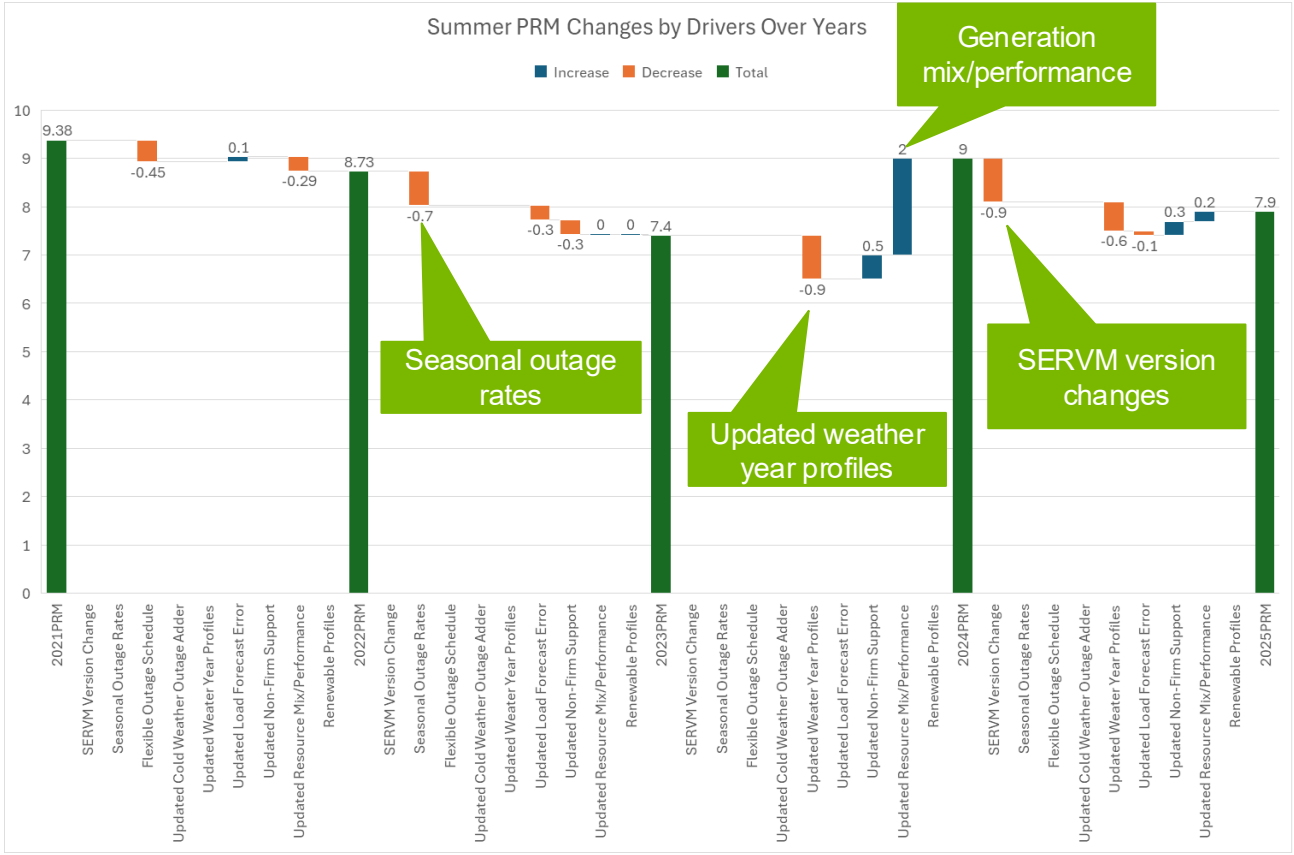
Takeaways:

1. Summer PRM UCAP is the lowest season each year
2. High winter PRM in 2023-2024 and 2024-2025:
    1. Use higher winter EFORd instead of annual one;
    2. Cold-weather outage adders;
    3. Improved planned outage scheduling in simulation (from optimistic to realistic setting);
3. Decreased winter PRM in 2025-2026 and 2026-2027
    1. Improved forced outage rate
    2. Increased thermal capacity and storage additions
    3. Updated load shapes under improved load development (winter risk shifted in time, different coincidence with wind/solar)





SYSTEM PRM YEAR-OVER-YEAR OVERALL TREND (SUMMER)



Takeaways:

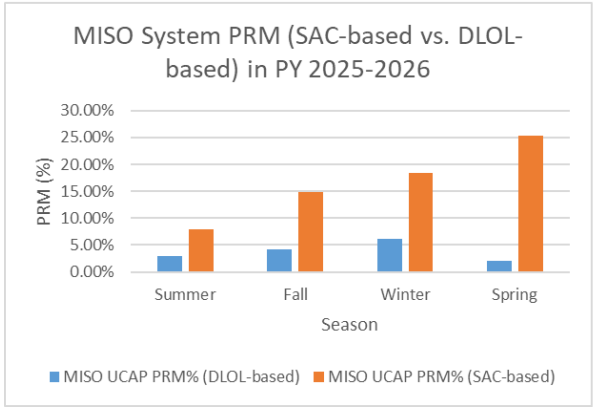
1. Factors considered:
    1. SERVM version changes
    2. Seasonal outage rates
    3. Flexible outage schedule
    4. Updated cold weather outage adder
    5. Updated load forecasting error
    6. Updated non-firm support
    7. Updated Resource mix/performance
    8. Renewable profiles
    9. Accounting improvement for cold weather outage adder.
2. Declines overall from 2021 to 2025, despite a rebound in 2024.
3. Major recurring drivers:
    1. Resource mix/performance
    2. Weather assumptions
    3. Model/methodology changes

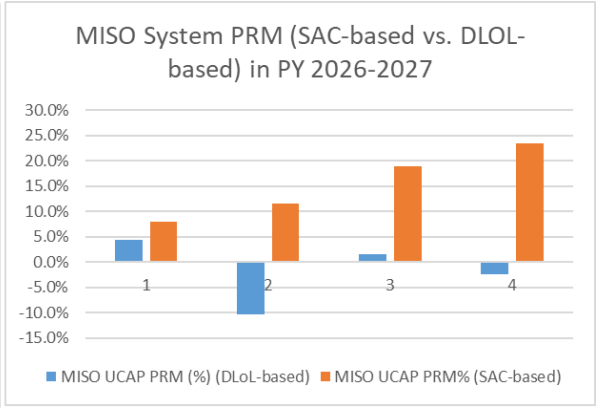
DLOL BASED PRM AND UCAP

Takeaways:

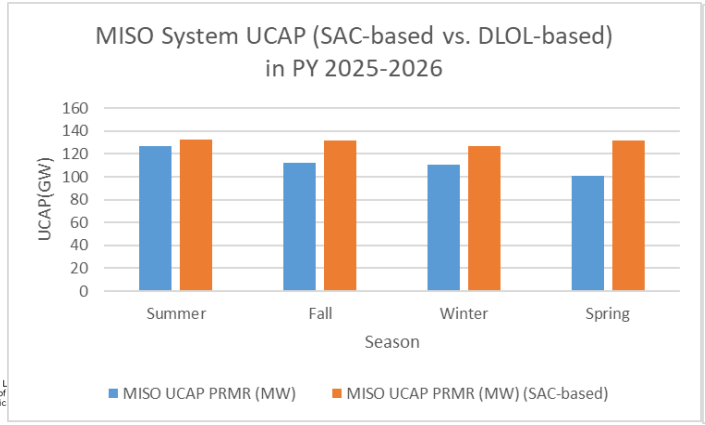
1. DLoL-based PRM/UCAP is generally lower at system level.

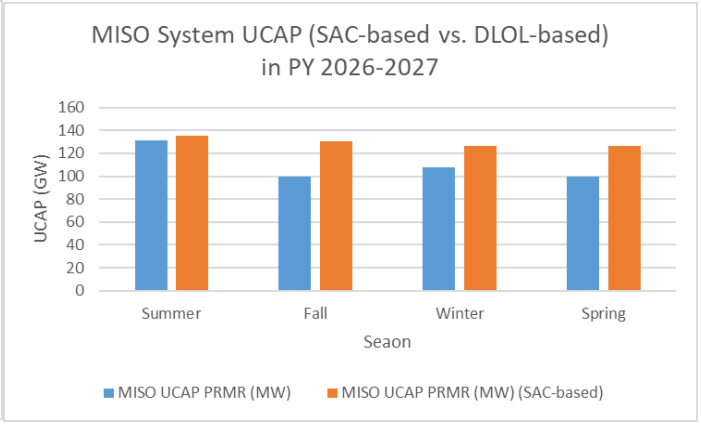
- PRM





- UCAP





CONCLUSION AND DISCUSSION

- Data collection
  - A challenge if the states explore the methodologies and sensitivity of inputs of interest.
- Analysis:
  - Load growth is mild, major drivers of PRM changes across years: (1) Updated weather year profiles; (2) Updated resource mix/performance; (3) SERVM version change; (4) Cold weather outage adder for winter.
  - Seasonal construct captures reliability risk in seasons other than the summer, mostly winter.
  - Capacity accreditation metrics will have impact at resource and system levels.
  - Need better understanding of the export and import ability assessment method and outcomes.