



Dynamic Ramp Capability Product Requirement (Uncertainty Component) (RSC-2024-2)

Reliability Subcommittee
August 28th, 2025

Chen-Hao Tsai, Operations Risk Management
Bing Huang, Markets & Grid Research

Purpose & Key Takeaways



Purpose:

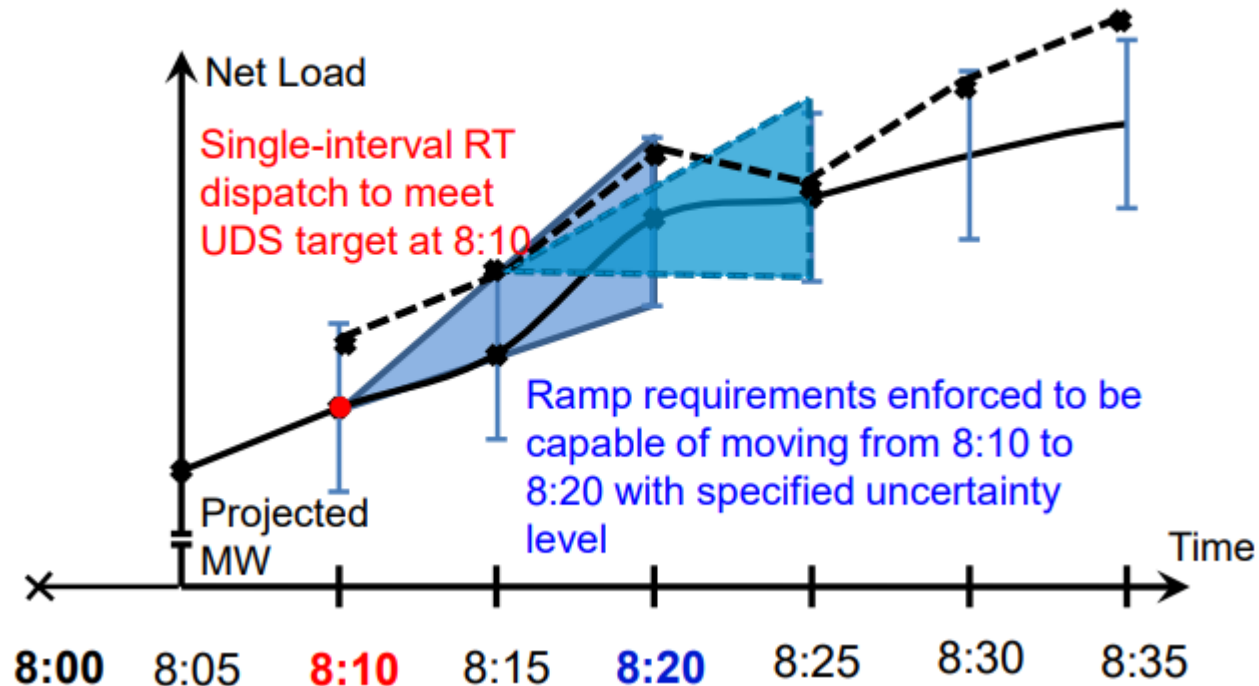
Provide an update on MISO's progress on Dynamic Ramp Capability Product Requirement (Uncertainty Component)

Key Takeaways:

- MISO has completed cost-benefit analysis and market simulation for setting the Uncertainty Component of Dynamic Ramp Capability Product Requirement
- MISO recommends requirements based on two categories of System conditions on the ramp uncertainty: Normal (86%) and High (96%)

Ramp Capability Product Requirement

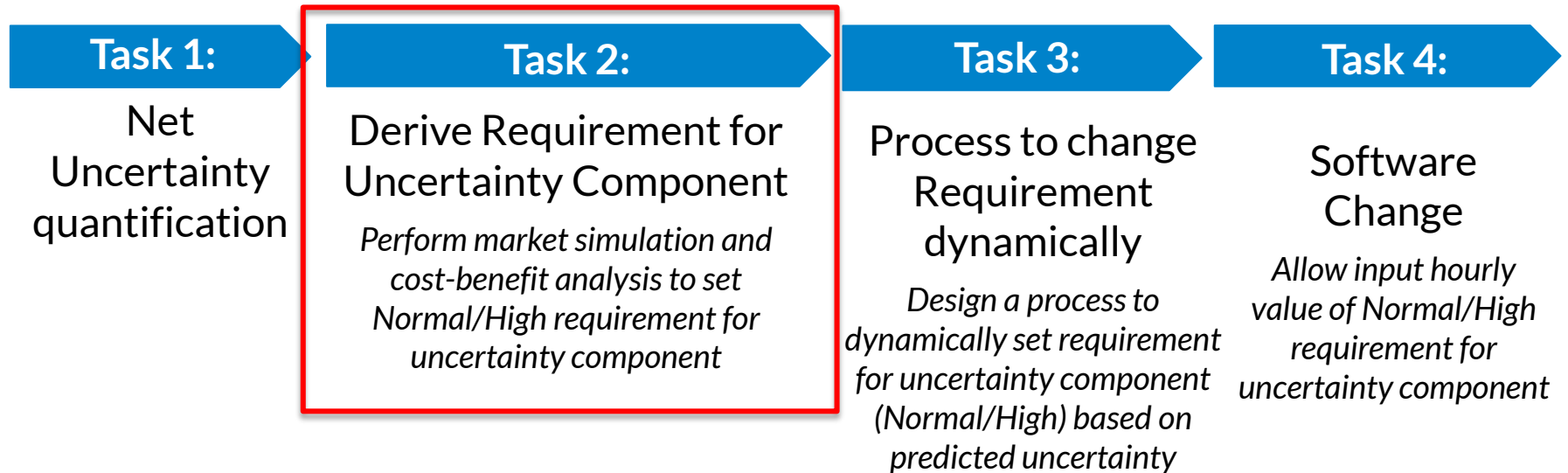
- Ramp Capability Product is designed to manage both expected (variations) and unexpected (uncertainties) in the “net load”



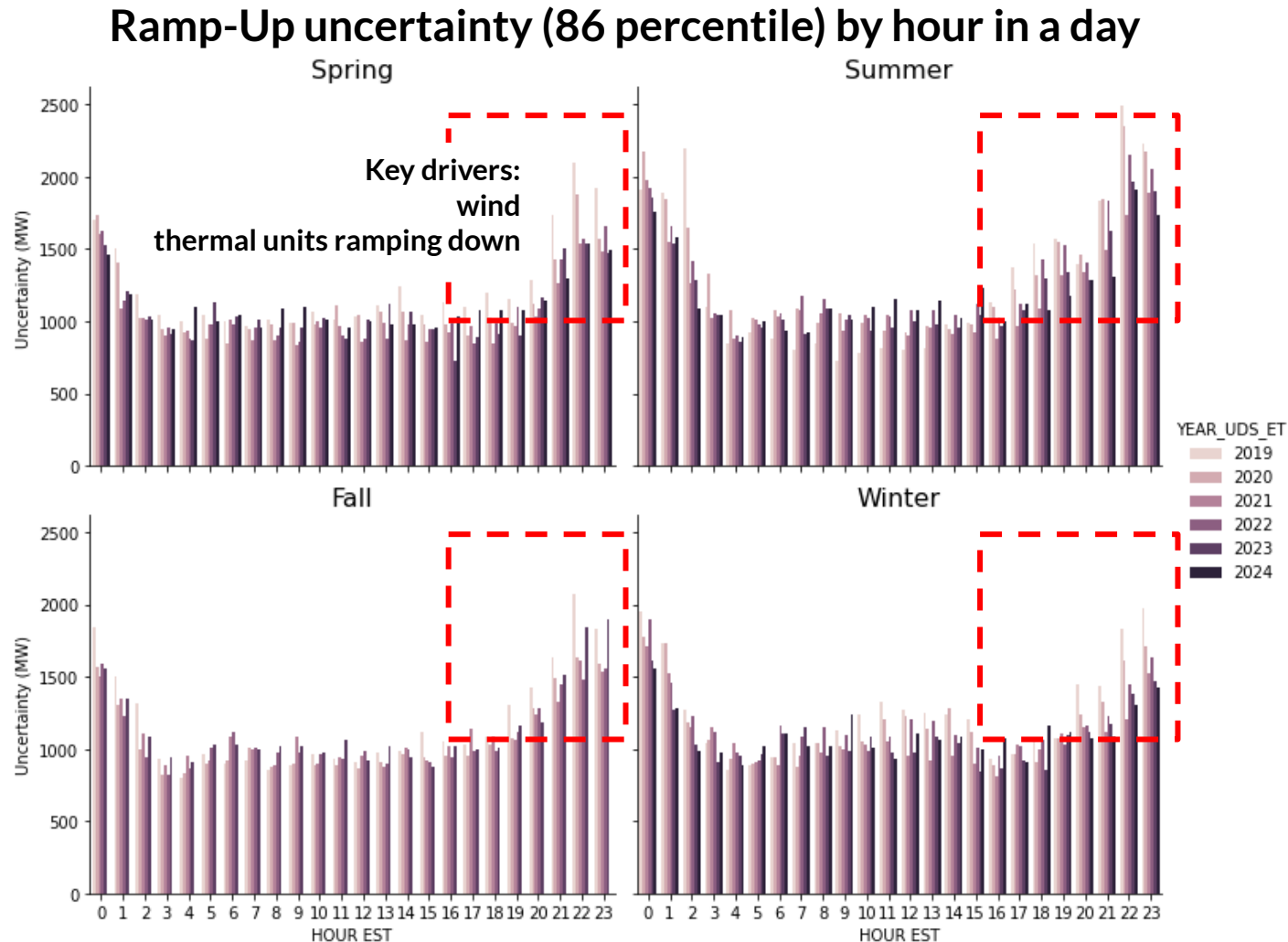
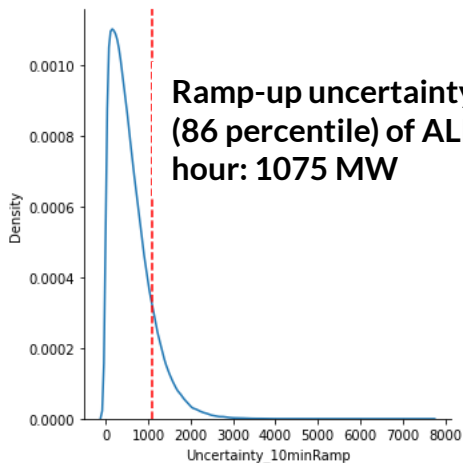
Ramp Capability Product Variability Calculation and Uncertainty Quantification

- Variability component
 - Net load_ $[t+10]$ - net load_ $[t]$
 - where Net load change includes load forecast, renewable generation, and net scheduled interchange
- **Uncertainty** component
 - Quantification: Compare scheduled ramp rate for energy in “LAC interval 10-25 min” and the corresponding energy ramp in UDS
 - **Previously set as a constant at 1075MW**, which corresponding to **86%** ramp uncertainty threshold as in cost-benefit analysis presented on Sept 3, 2021 MSC ([link](#))
 - **Temporarily raised to 1175 MW** since October 2024 for anticipated increase in uncertainty particularly during evening hours

MISO is Developing a Dynamic Process to Set the Ramp Capability Product Requirement (Uncertainty Component)

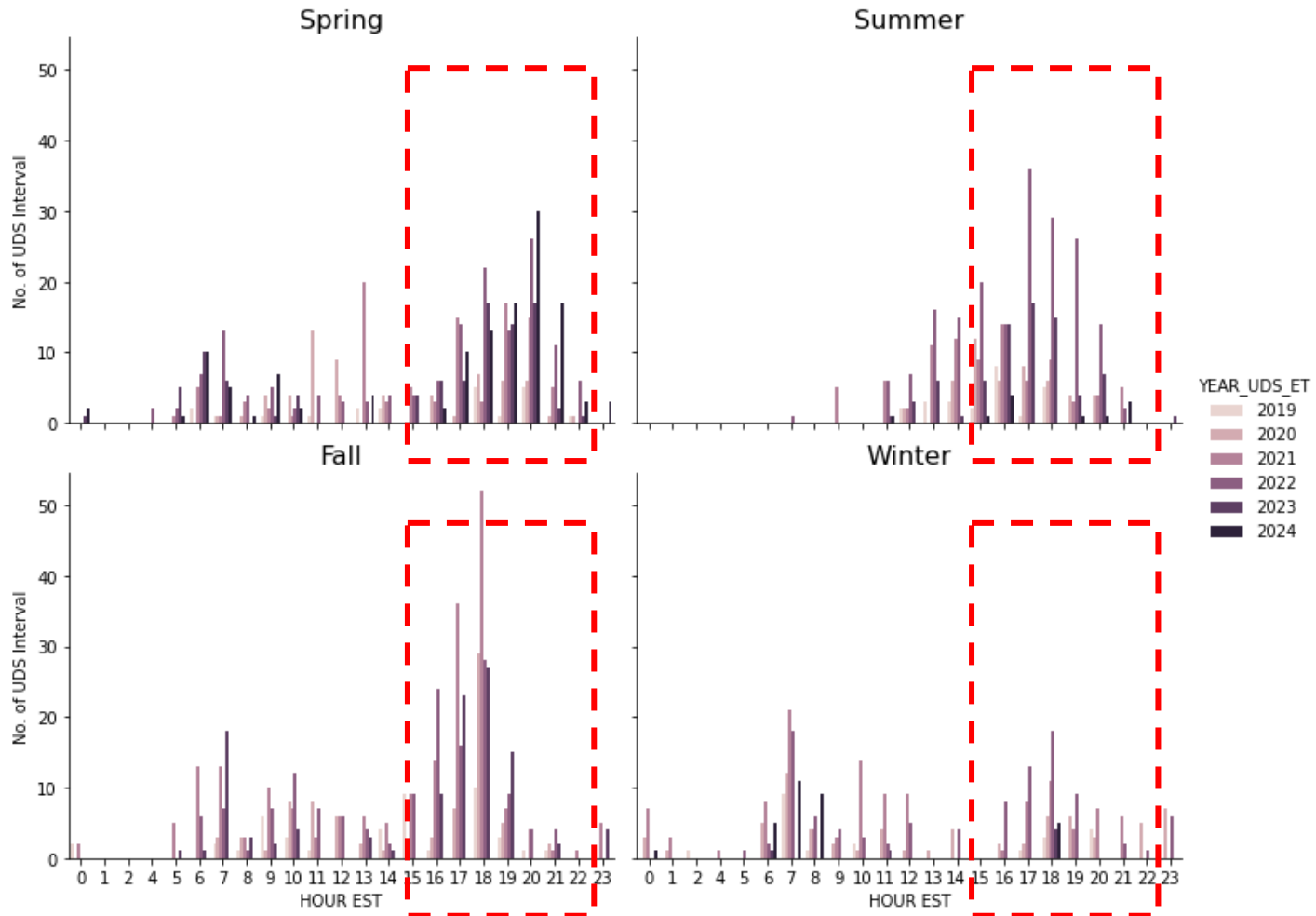


Key finding #1: Materialized 10min ramp-up uncertainty (86 percentile) has exceeded 1075MW during most evening hours



Key finding #2: Elevated ramp-up uncertainty during evening hours coincides with hours of Operating Reserve Shortage

UDS intervals with Operating Reserve Shortage



0.34% of UDS interval has Operating Reserve Shortage
(data: Jan 2019 to Sep 2024)

Cost Benefit Quantification: Production Cost Definition¹

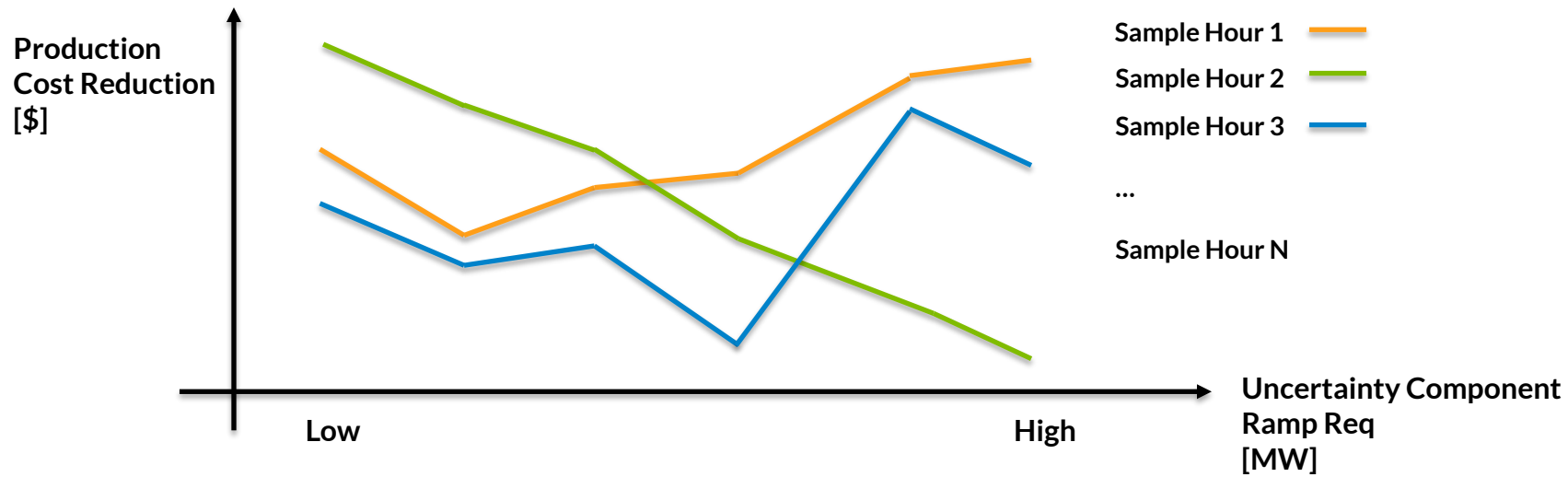
Cost: Increased generation and reserve cost

Benefit: - Generation and reserve cost reduction due to better pre-position,
- Reduced reserve shortages,
- Reduced Transmission violation cost etc.

Production Cost Definition:

- Energy Offer Cost
- Reserve Offer Cost (Offer and mileage costs)
- Violation Penalty (Transmission penalty, ramp rate violation penalty etc)
- Reserve Scarcity Cost (Area difference between cleared and complete demand curve)

Cost Benefit Study Objective: select the optimal value for ramp requirement in Normal/High Uncertainty Conditions



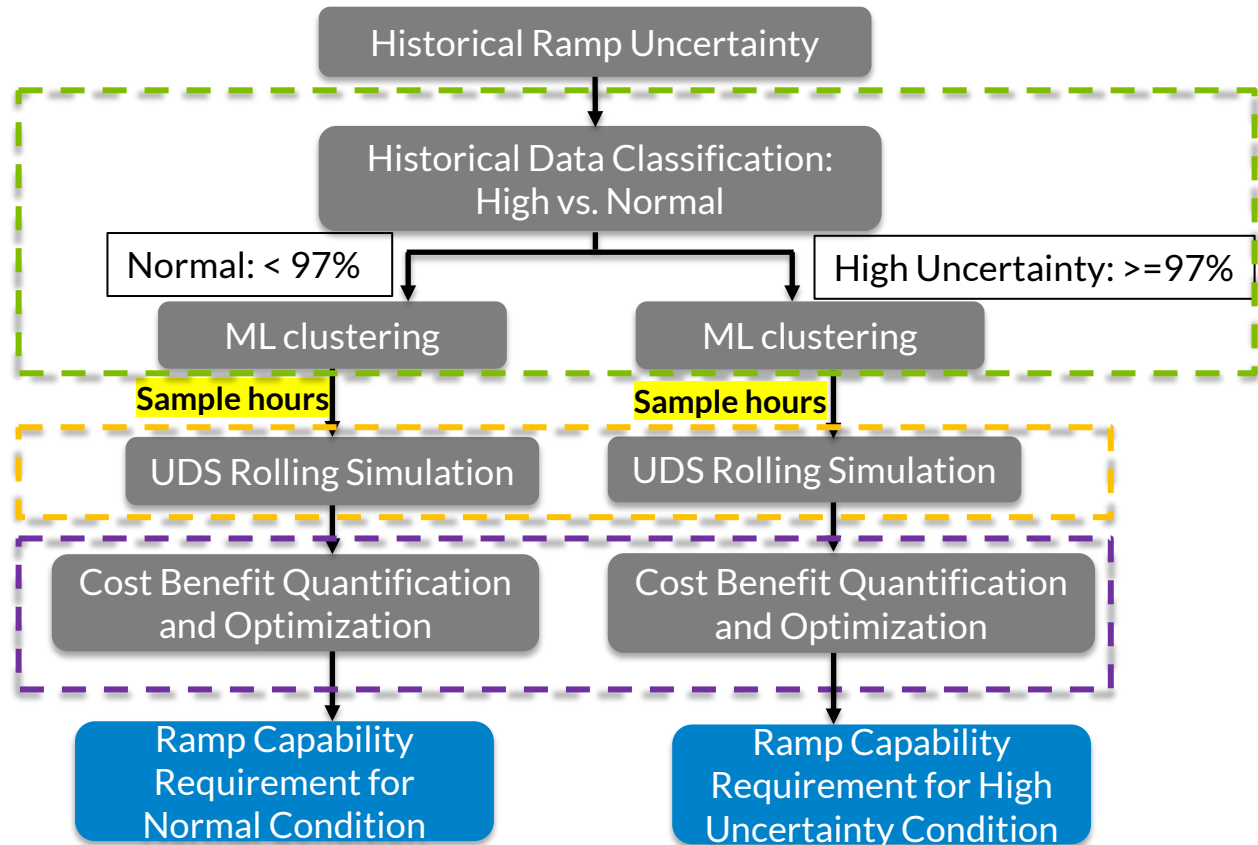
- Only limited number of hours can be simulated. Key is to select samples and calculate weights of each sample.
- UDS simulation is applied to each sample and **Production Cost** is compared to the base case.
- Optimality: The largest total production cost reduction among all weighted samples

Dynamic Ramp Requirement Optimization Framework

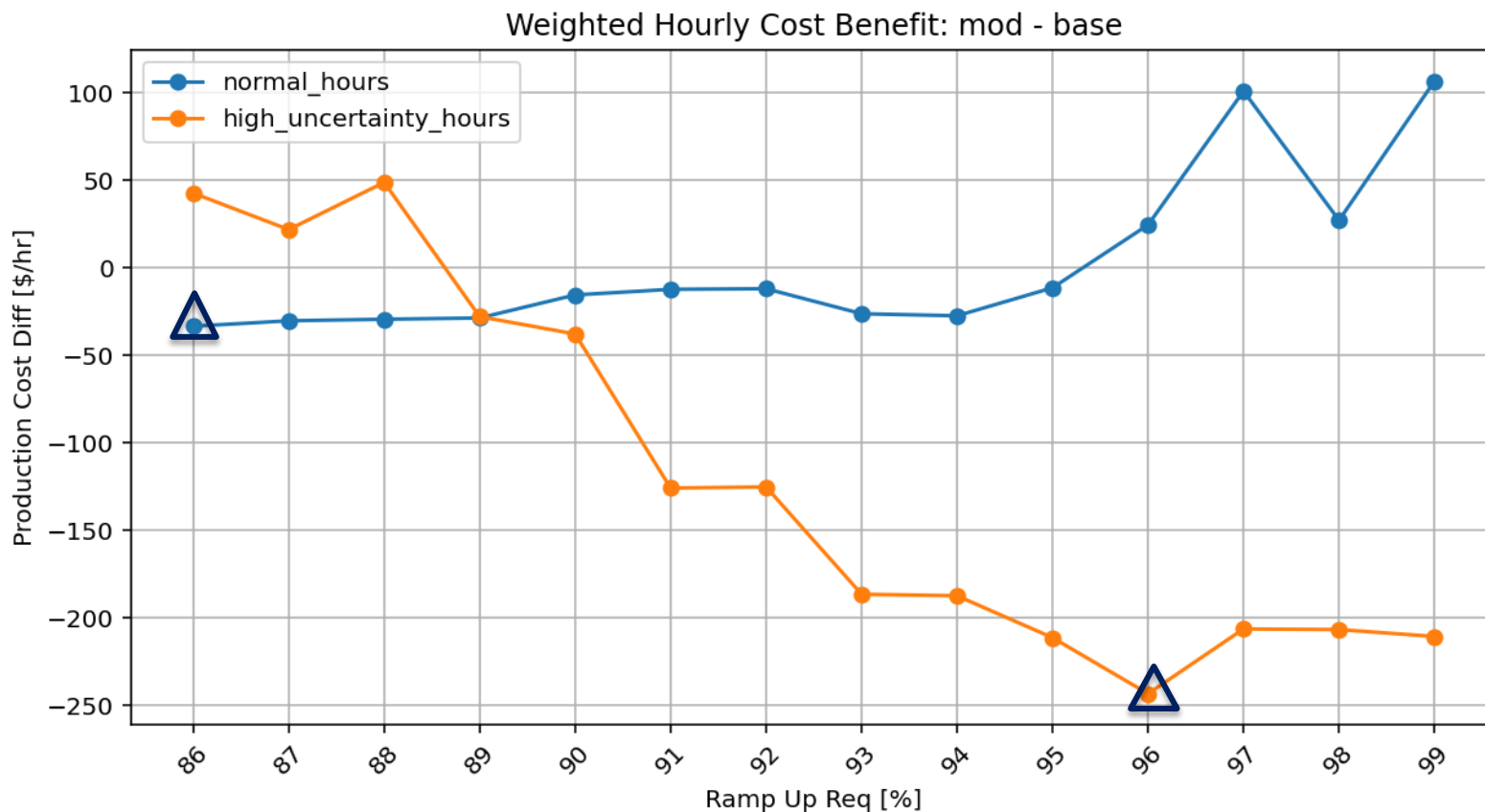
1. Preprocess historical data to select sample hours with corresponding weight

2. Automated Rolling UDS Simulation

3. Cost Benefit Quantification and Optimization



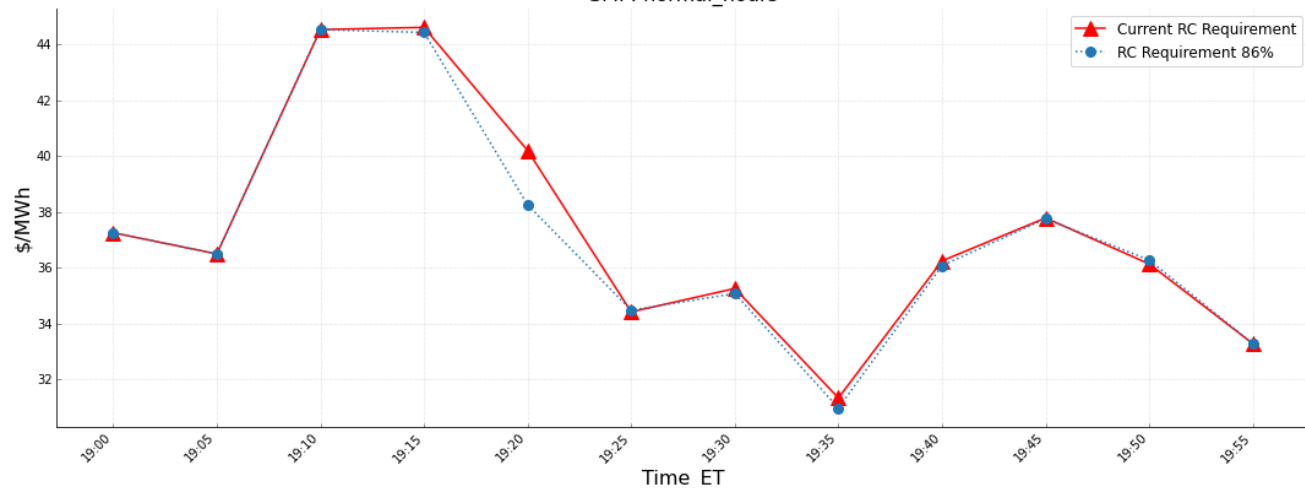
Results Show Ramp Requirement of 86% for Normal and 96% for High Uncertainty Hours Can Address System Uncertainty Increase and Reduce Production Cost



- Normal Hours: RC requirements below 96% do not have significant impact on production cost.
- Seasonal and hourly variations have already shown benefits.
- High Uncertainty Hours: RC requirements above 90% can significantly reduce production cost.
- Expected annual savings \$509,832/year

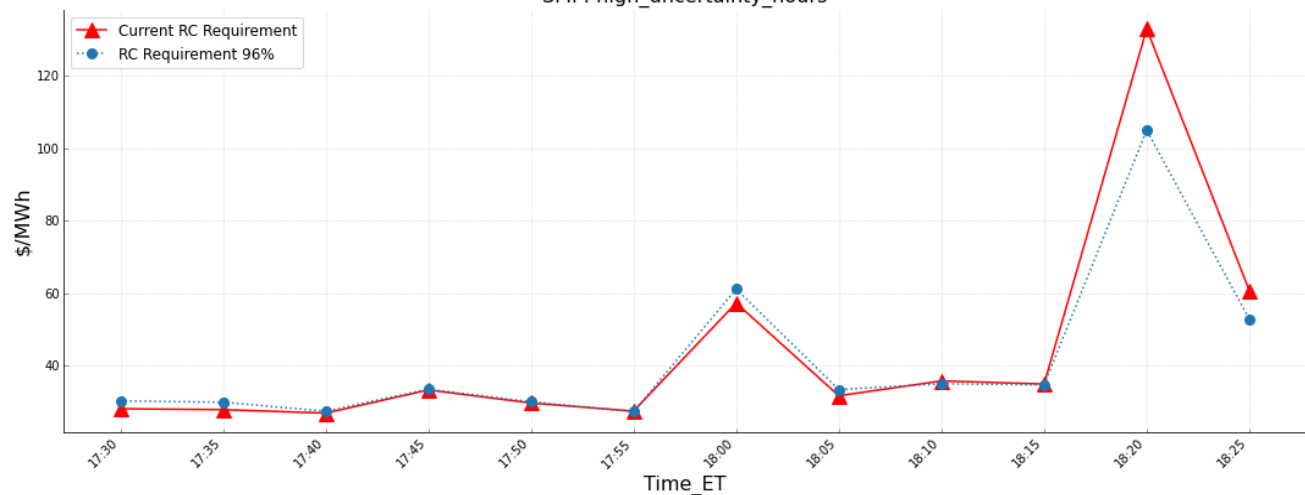
Example Benefits Utilizing Ramp Requirement of 86% for Normal and 96% for High Uncertainty hours

SMP: normal_hours



Top figure: the 86% RC requirement reduces the Energy Price in normal uncertainty hour sample.

SMP: high_uncertainty_hours



Bottom figure:

- the 96% RC up requirement increase the price a bit in some intervals but significantly reduces the price spike at the end.
- The production cost of the whole hour is reduced in a high uncertainty hour sample.

Next steps

- Finalize Ramp Capability Product Requirement (Uncertainty Component) based on 86% for Normal Requirement.

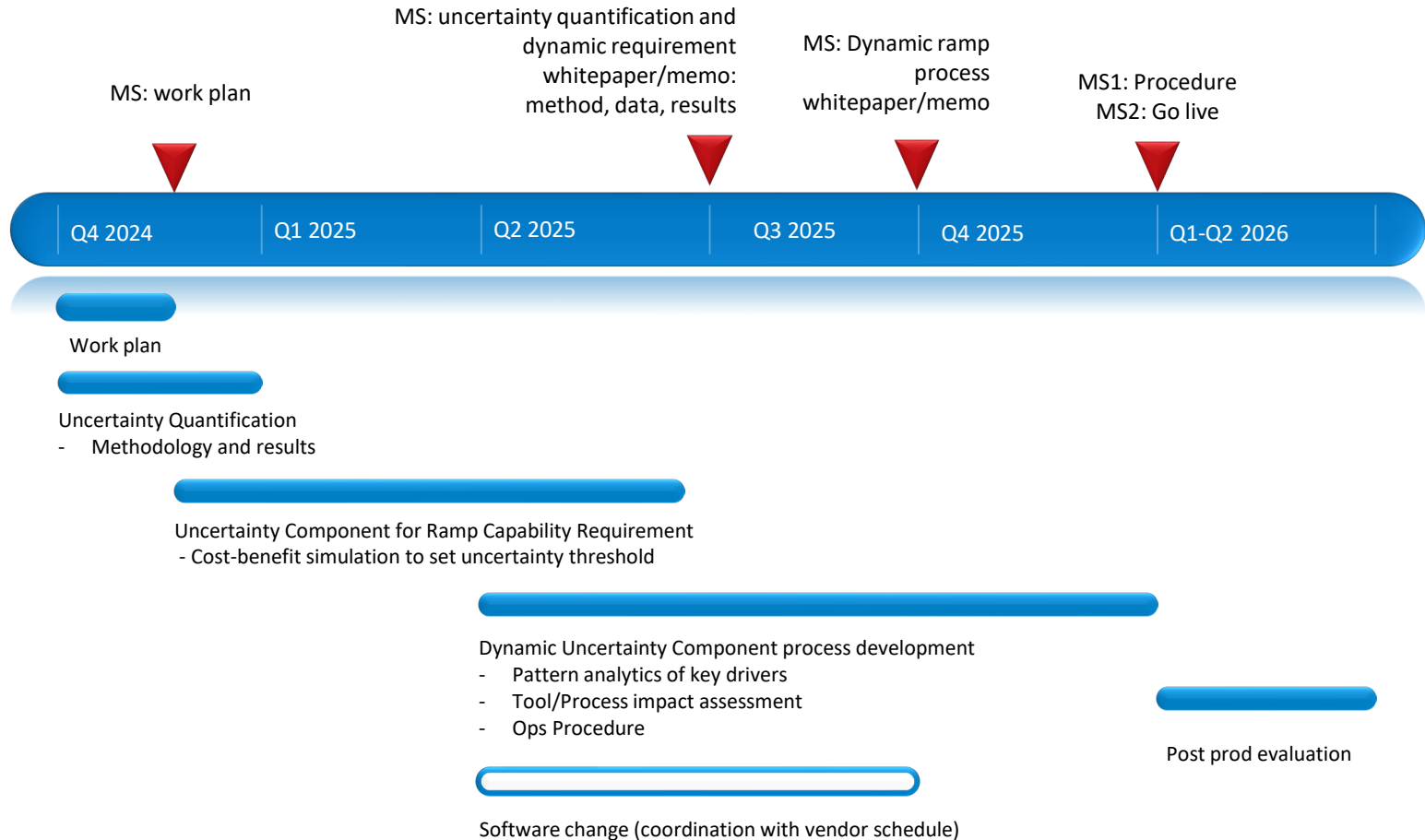
Posting will be under Related Documents on the Market Subcommittee (MSC) page on the MISO website at via the URL below:

Engage > Stakeholder Entities and Workshop > Market Subcommittee > Related Documents

<https://www.misoenergy.org/engage/committees/market-subcommittee/>

- Continue development of dynamic process for elevating ramp capability product uncertainty component requirement from Normal to High requirement.

MISO's Work Plan with Target Effective Date by Beginning of 2026





Questions?

Contact
Chen-Hao Tsai, Operations Risk Management,
ctsai@misoenergy.org
Bing Huang, Markets & Grid Research,
BHuang@misoenergy.org



Appendix

MISO Reserve Products

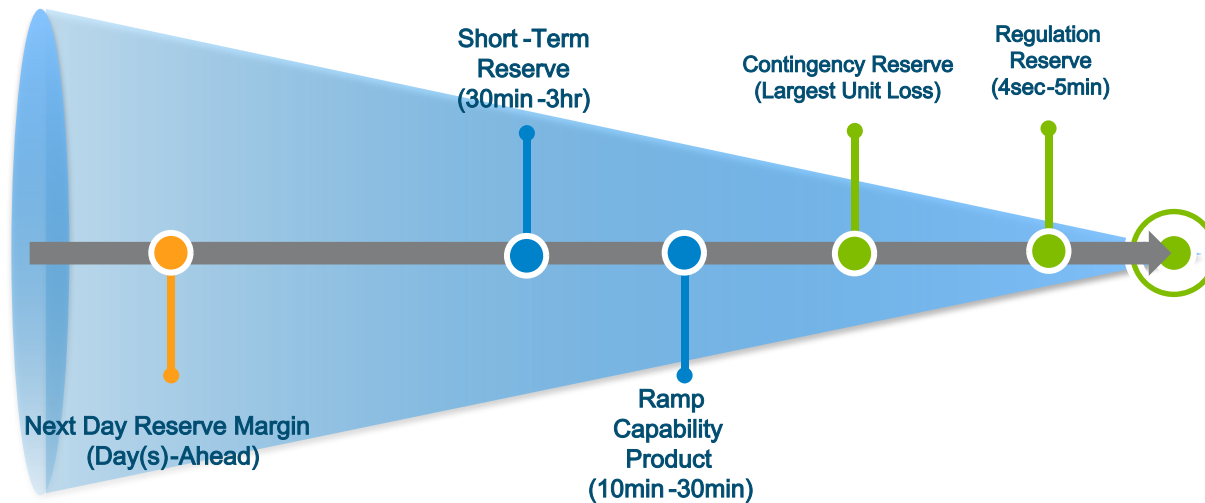
Market product	Uncertainty covered	Resource eligible	Requirement source
Regulation Reserve	4sec-5min	5 min rampable capacity from reg-qualified resource	NERC BAL-001-2
Contingency Reserve	Largest contingency	10 min rampable capacity from online (spin) or eligible offline (supplement*)	NERC BAL-002-2(i)
Ramp Capability Product	10min-30min	10 min online rampable capacity	Good Utility Practice
Short-Term Reserve	30min-3hr	30 min rampable capacity online or eligible offline	Good Utility Practice
(Next Day Reserve Margin**)	Next-Day	Online capacity plus 4hr offline short-lead	Good Utility Practice

Note:

* supplemental reserve can be provided by both online and offline eligible resources whereas spinning reserve has to be online

**Currently managed by ND Operating process. Not a market product yet but both Attributes and the IMM recommended such product

MISO's Energy and Ancillary Service market co-optimizes energy and reserve products that cover uncertainties across different timeframes



MISO is making Short-Term Reserve, Ramp Capability Product and Regulation Reserve “dynamic”

MISO's Latest Progress of Making Reserve Requirements Dynamic

Market product	Reserve Requirement	Process to dynamically set Requirement	In Production
Short-Term Reserve	<ul style="list-style-type: none"> • Systemwide/Regional • Normal/High • Seasonal 	ND FRAC Net Uncertainty Forecast Model	January 2024 (full implementation)
Ramp Capability Product	<ul style="list-style-type: none"> • Systemwide • Normal/High • Seasonal 	In development	Est. Dec 2025 (prototype test)
Regulation	<ul style="list-style-type: none"> • Systemwide • Normal/High • Monthly 	In development	June 2025 (Requirement) Est. Dec 2025 (prototype test)

Note: status as of August 15, 2025

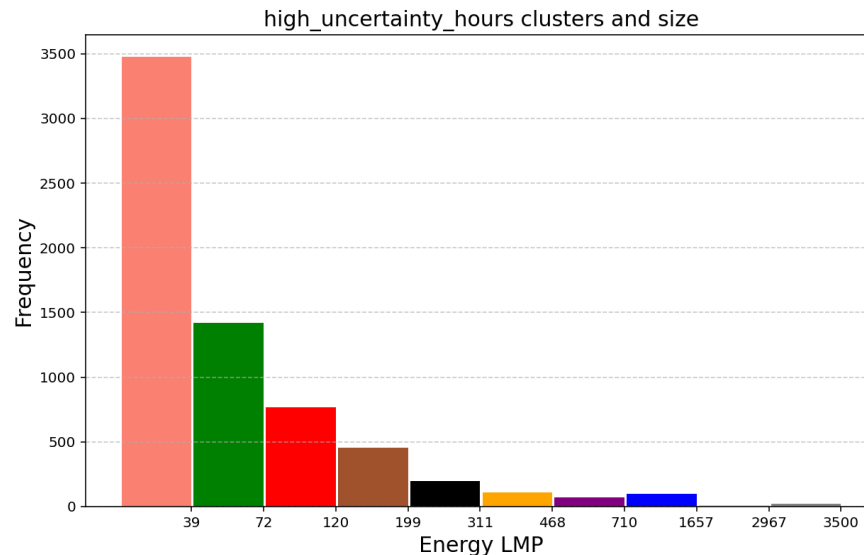
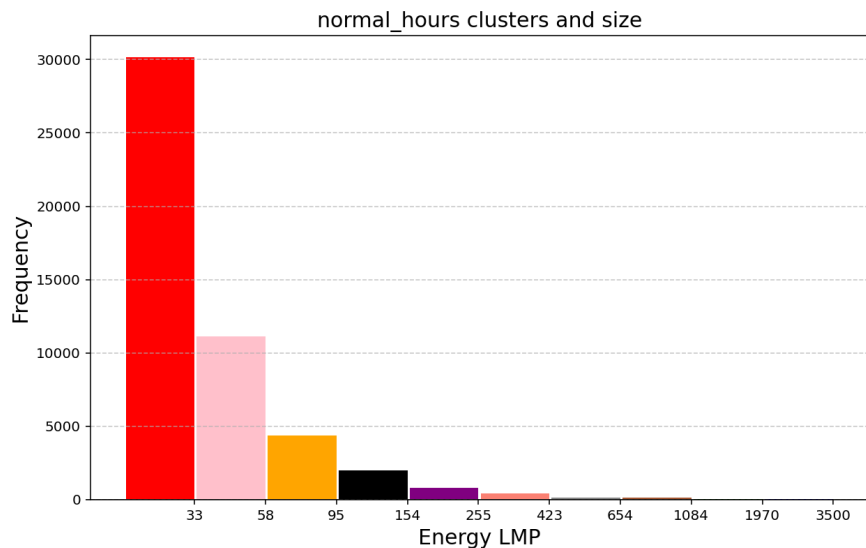
Ramp Requirement Study Approach

Historical Data Preprocess before Clustering and Weighting

	Filter Criteria: Use Hourly Max Ramp Uncertainty	Number of Hours
High Uncertainty	$\geq 97\%$ of historical distribution	6606 (12%)
Normal	$< 97\%$ of historical distribution	49228 (88%)

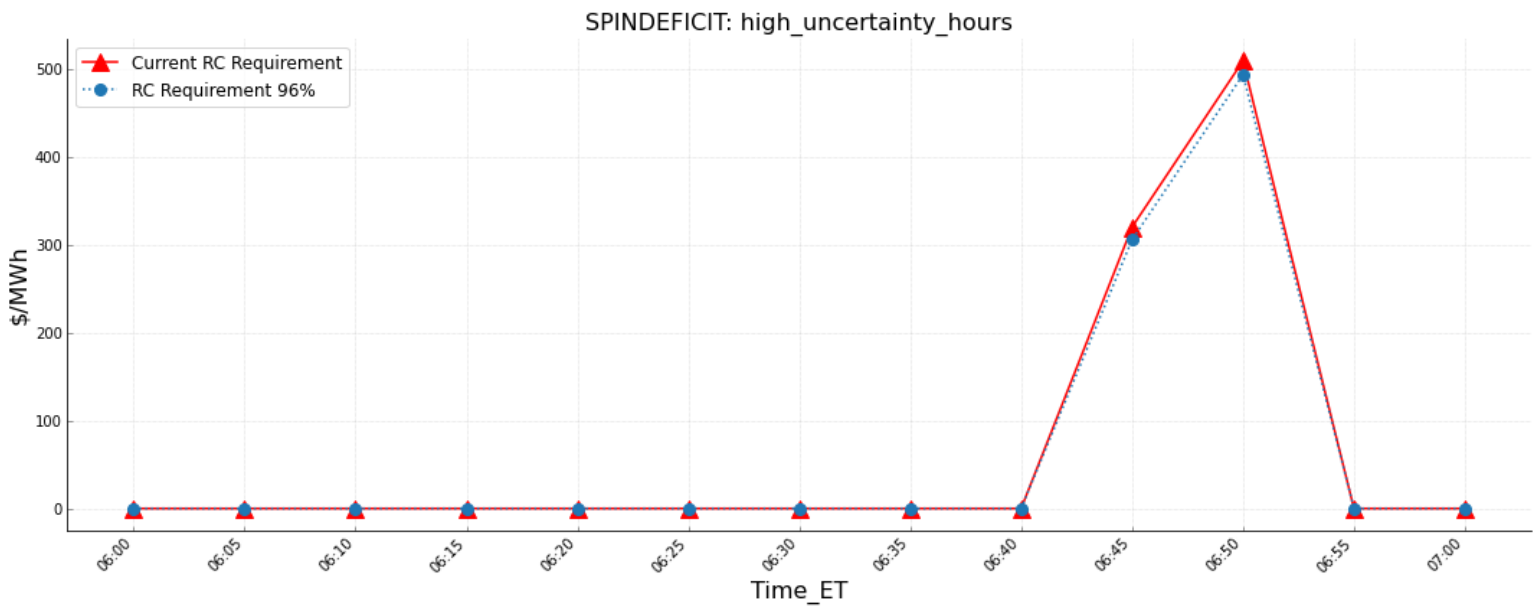
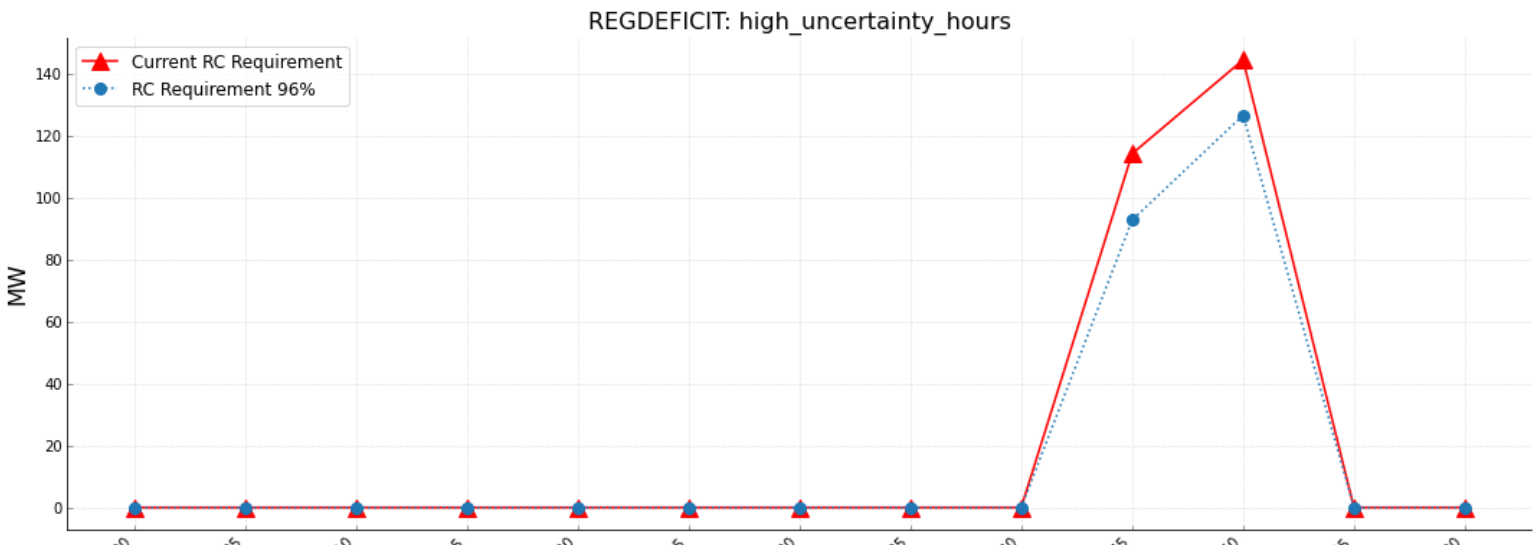
- It is not possible to simulate all historical hours, sampling are necessary for timely research and requirements proposal.
- Samples are selected by clustering, and weighting the results is needed to avoid biasing to certain high risk scenarios.
- Historical UDS interval data from 01-01-2019 ~ current.

Clustering Approach is Used to Create Clusters and Choose Representative Historical Market Hours for Simulation



- Use energy LMP as representation of the system condition to create clusters
- In Normal Condition, Max Energy LMP is concentrated more to the lower end.
- The size of the clusters is used to calculate the weight.

On 04/02/2025, 96% Ramp Capability requirement reduces REG and SPIN Deficit



On 10/02/2024, 96% Ramp Capability requirement reduces Ramp Rate shortage

