Accreditation Methodology: PJM Proposal

ELCCSTF

June 30, 2025

Today's Presentation

- Continue review and discussion of PJM's proposed solution package on accreditation methodology improvements that are targeting implementation with the 2028/29 BRA scheduled for June 2026.

- In addition to feedback on the PJM proposal as a full package, PJM is seeking feedback on each part (1. Weather Rotations, 2. Generator Winter Ratings, and 3. Performance Weighting) to the extent stakeholders are more supportive of some parts than others.

Key Accreditation Design Principles

- Reflects resources' expected contribution to resource adequacy and ability to perform during periods of reliability risk during the Delivery Year
- Captures correlated outage risks and the relationship between weather, load, and resource performance
- Compensates resources in a manner that incentivizes cost-effective investment and retirement of resources
- Accredits different resource types and resources in a non-discriminatory manner
- Sufficiently transparent and stable to enable investors to make informed decisions when considering going forward investments

Proposal Summary

1. **Weather Rotations:** Improve the alignment of load and resource performance draws for each weather day across all weather rotations in ELCC/RRS analysis
2. **Generator Winter Ratings:** Incorporate the incremental winter capability above summer capacity of thermal and other generation in the ELCC/RRS analysis and market rules
   A. Tracking of Winter ICAP values, assessment of winter deliverability, winter must offer requirements and capability testing, etc.
   B. Improve the ability for winter capability to be recognized and cleared in the annual capacity market by allowing a generator's annual Accredited UCAP to exceed summer CIRs (while continuing to apply seasonal CIR / deliverability caps in ELCC analysis), removing the need for seasonal offers and pairing to clear in the auctions.
3. **Performance Weighting:** Apply a higher weight on more recent performance of resources within each temperature bin in the ELCC/RRS model to more quickly capture changes in fleet, class, and individual resource performance over time

Weather Rotations

Weather Rotations: Review of Status Quo

Each ELCC study (and RRS) is run for a future Delivery Year (e.g. 2026/27)

Forecast Year 2026/27
June 1, 2026
June 2, 2026
…
Aug 9, 2026
…
May 31, 2026

Weather scenarios are simulated within the ELCC analysis back to 1993/94.

Simulated Weather Years
1993/94
1994/95
:
2010/11
:
2024/25

Resource performance profiles are drawn in the analysis from historical observations of performance back to 2012/13 based on a temperature binning methodology.

Weather Day	Temp Bin
June 1, 2010	Max32
…	…
Aug 8, 2010	Max32
Aug 9, 2010	Max34
…	…
May 31, 2010	Max28

100 Monte Carlo draws of resource performance from Temp. Bin "Max34"

Forecast Date	Load Scenario	Weather Date
Aug 9, 2026	M2010	Aug 3, 2010
Aug 9, 2026	L2010	Aug 4, 2010
Aug 9, 2026	K2010	Aug 5, 2010
Aug 9, 2026	J2010	Aug 6, 2010
Aug 9, 2026	I2010	Aug 7, 2010
Aug 9, 2026	H2010	Aug 8, 2010
Aug 9, 2026	A2010	Aug 9, 2010
Aug 9, 2026	B2010	Aug 10, 2010
Aug 9, 2026	C2010	Aug 11, 2010
Aug 9, 2026	D2010	Aug 12, 2010
Aug 9, 2026	E2010	Aug 13, 2010
Aug 9, 2026	F2010	Aug 14, 2010
Aug 9, 2026	G2010	Aug 15, 2010

Weather rotations (+/- 6 days) are used in Load Forecast model and ELCC study to develop **13 load scenarios** (A-M) for each historical weather year and forecast date.

Key Takeaway: In this example using a Forecast Date of Aug. 9, 2026 and Weather Year of 2010/11, resource performance for each of the 13 load scenarios are being drawn from Temp. Bin "Max34". As such, the "A2010" load scenario fully aligns the weather date used for projected load and resource performance, but the other load scenarios with weather rotations are not fully aligned and instead rely on weather conditions in surrounding days. This tends to **underrepresent the relationship between weather, load, and resource performance** in the current model.

Weather Rotations: Proposal

Proposal: Fully align the weather days used to draw resource performance with the weather days used for each load scenario and weather rotation in the ELCC/RRS model to better capture the relationship between weather, load, and resource performance.

- In the example on the prior slide, this proposed change would align each weather rotation date across the load scenarios with the weather date used to draw resource performance in the analysis (e.g. the "H2010" load scenario would be based on Aug. 8, 2010 weather and use the corresponding temperature bin of "Max32" for Aug. 8, 2010 when drawing resource performance)
- Slides 11-15 of the May 22nd ELCCSTF meeting provide additional information on this proposed change and sensitivity results: [20250522-item-02---elcc-accreditation-methodology-update-on-sensitivity-analyses---pjm-presentation.pdf]
- The sensitivity results of this proposed change generally showed an overall increase in system risk and a greater share of winter risk

Generator Winter Ratings

Recap of Status Quo & Opportunity to Enhance Methodology

- The modeled hourly output of resources has historically been limited to levels assessed in PJM RTEP deliverability studies, which is equivalent to a Summer ICAP / CIRs for some resources all year around. This approach may underrepresent some resources' full winter capability.

- Capturing winter capability of all resources in accreditation would allow the capacity market to more fully reflect the reliability benefit of those resources.

- Changes to winter deliverability test procedures in the RTEP and interconnection process will study higher winter output, presenting an opportunity to do the same in resource adequacy modeling.

Deliverability Caps	Unlimited	Limited Duration	Variable & Combination
Summer	CIRs	CIRs	CIRs
Winter Daytime	**CIRs**	**CIRs**	Assessed Deliverability
Winter morning & evening peaks	**CIRs**	**CIRs**	Assessed Deliverability

* CIRs include transitional capability awarded for the delivery year

* Changes that require a sub-annual market are out of scope per the issue charge.

Generator Winter Ratings Proposal Summary

Incorporate the incremental winter capability above summer capacity of thermal and other generation in the ELCC/RRS analysis and market rules with two key components:

(A) Define & Apply Winter ICAP

- Define Winter ICAP based on today's approach for winter rated capability.
- Assess winter deliverability and allocate additional CIRs for the winter of each delivery year.
- Winter ICAP reflected in ELCC model, flowing into calculation for annual accredited UCAP.
- Annual capacity market offers in UCAP terms, with seasonal AUCAP factors and seasonal ICAPs.
    - Status quo PAI Expected Performance calculation utilizing committed UCAP.
- Energy Must Offer Requirement as seasonal ICAP equivalent of committed UCAP.
- Capability testing, verification testing, and outage reporting reflective of Winter ICAP.

(B) Improve Ability for Winter Capability to be Recognized and Cleared in the Annual Capacity Market

- Allow a generator's annual Accredited UCAP to exceed summer CIRs (while continuing to apply seasonal CIR / deliverability caps in ELCC analysis), removing the need for seasonal offers and pairing to clear in the auctions.

Unlimited Resources: Proposed Definition of Winter ICAP

Winter ICAP set to winter rated capability for capacity resources based on a specified set of winter conditions defined in M21B today

- Winter rated capability determined by adjusting the generator capability for generator site conditions coincident with the dates and times of the last 15 years PJM winter peaks.
- These are the conditions currently prescribed under the Winter Net Capability Verification Test.
- A review and verification process would require Generation Owner to submit Winter ICAP. PJM would review against Winter Net Capability Verification Test data to confirm the value.
- Winter ICAP may not exceed MFO or studied winter deliverability and granted Winter CIRs.

This approach is consistent with the definition and application of Summer ICAP.

Analysis comparing Summer ICAP, Winter ICAP, and MFO to observed capability that supports PJM's rationale for utilizing Winter ICAP (discussed at previous meetings) is in Appendix slides 41 - 43.

Update to Approach for Winter CIRs

Status Quo

- Winter CIRs are only available to Intermittent Resources and Environmentally Limited Resources which seek to obtain additional CIRs related to the winter period for purposes of submitting sell offers as winter-period capacity.
- Requested Winter CIRs are studied and granted based on values submitted through a solicitation process ahead of each delivery year. This is separate and distinct from the winter generator deliverability test.
- More details in Appendix slide 46

Proposal

- For purposes of ensuring deliverability of Winter ICAP to be represented in the calculation of Accredited UCAP, Winter CIRs for each delivery year will be granted to all Generation Capacity Resources based on levels assessed in winter generator deliverability tests.
- Status quo solicitation and separate study process will be sunset.

Winter Generator Deliverability Test Overview

To become a capacity resource, a generator must pass generator deliverability tests under summer, winter, and light load conditions. Equivalent rigor is applied to the defined test level for each set of conditions.

As part of this proposal, deliverability of Winter ICAP will be confirmed via PJM planning winter generator deliverability tests.

- Status quo generator deliverability test is applicable for 2029/30 and beyond, where winter deliverability above CIRs is already the studied test level for all resources.
- A transitional study is needed to test higher winter output for all resources (i.e. not just wind) for 2028/29 the target delivery year for this proposal.

2029/2030+ Winter Generator Deliverability Test

The RTEP and interconnection process will both study up to higher winter generator deliverability test levels for all resources beginning with 2024 RTEP cycle, with full alignment for the 2029/30 delivery year.

- RTEP studies up to the new test levels beginning in 2029 winter RTEP model
- Interconnection studies up to the new test levels beginning with Transition Cycle 2 (2028 winter model)
- More background in Appendix slide 44

No changes to the status quo winter generator deliverability test levels for 2029 and beyond (see next slide) are being included in this proposal, given the complexity and additional time needed to vet such changes with stakeholders. An additional stakeholder process will be needed to more holistically align winter planning studies with the use of Winter ICAP. This may dovetail with the deferred CETL Issue Charge.

As part of this proposal, there will be no separate solicitation and study for Winter CIRs as there is today, given the higher winter output studied in the RTEP.

Status Quo Winter Generator Deliverability Test Levels

Capacity Resource Type	Contingency Type	Winter Gen Deliv Test Levels	
		Old	New in 2029
All Thermal	single common mode	CIR CIR	MFO MFO
Onshore Wind**	single common mode	80% MFO MFO	p90%* p90%*
Solar (Fixed & Tracking)**	single common mode	10% MFO MFO	5% MFO 5% MFO
Offshore Wind**	single common mode	80% MFO MFO	p80%* p80%*
Batteries	single common mode	CIR MFO	MFO MFO
Pumped Storage / Hydro	single common mode	CIR CIR	MFO MFO
Hybrid Resource	All	Based on test levels for each resource type	MFO

*p90% for onshore wind in 2025 RTEP is 71% MFO for MAAC, 84% MFO for PJM West and 77% MFO for Dominion

*p80% for offshore wind in 2025 RTEP is 95% MFO for MAAC and 97% for Dominion

** Already assessed at new winter generator deliverability test levels

Transitional Study of Winter Capability for 2028/2029

A study process for the 2028/29 deliver year to “backfill” 2028 RTEP winter generator deliverability study with higher winter output; impacts existing capacity resources and planned capacity resources providing binding offer notification (NOIs):

1. Collect and confirm Winter ICAP ratings to be utilized in the study
   a. For this new transitional study for the 2028/2029 delivery year, PJM proposes utilizing test levels of Winter ICAP instead of MFO for a more accurate representation of resource capability and more efficient allocation of system headroom.
2. Run the winter generator deliverability test
3. Determine winter deliverability and grant Winter CIRs for all generation using the following conditions:
   a. If a resource's Winter ICAP only contributes to flowgates with a post-study loading less than 100% or has less than a 5% DFAX contribution to an overloaded facility, the resource's Winter ICAP is fully deliverable and will be allocated Winter CIRs.
   b. Winter CIRs will be allocated, considering each resource's DFAX, the total additional winter MW above annual CIRs, and the remaining facility headroom.
      i. When multiple resources are contributing to an overloaded facility, this approach maximizes the amount of additional MW with minimum impact on the overloaded facility.
      ii. This allocation approach is consistent with the approach for the summer transitional system capability study.

Transitional Study of Winter Capability for 2028/2029 Test Levels

Capacity Resource Type	Contingency Type	Winter Gen Deliv Test Levels	
		Already Studied	New for Transitional Study
All Thermal	single common mode	CIR CIR	Winter ICAP Winter ICAP
Onshore Wind	single common mode	p90%* p90%*	p90%* p90%*
Solar (Fixed & Tracking)	single common mode	5% MFO 5% MFO	5% MFO 5% MFO
Offshore Wind	single common mode	p80%* p80%*	p80%* p80%*
Batteries	single common mode	CIR MFO	Winter ICAP Winter ICAP
Pumped Storage / Hydro	single common mode	CIR CIR	Winter ICAP Winter ICAP
Hybrid Resource	All	Based on test levels for each resource type	Winter ICAP

*p90% for onshore wind in 2025 RTEP is 71% MFO for MAAC, 84% MFO for PJM West and 77% MFO for Dominion

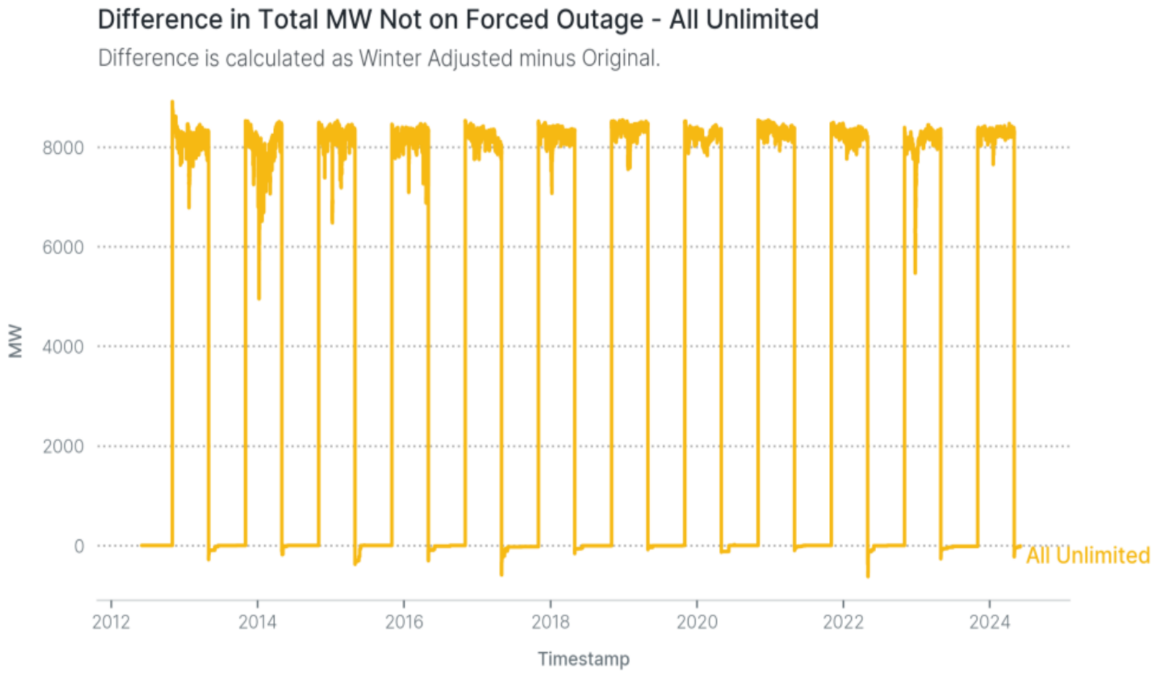
*p80% for offshore wind in 2025 RTEP is 95% MFO for MAAC and 97% for Dominion

Unlimited Resources: Application in Accreditation Model

During the winter period (November through April) resource capability will be based on Winter ICAP, adjusted for outages.

- In hours with no outages, resource will be available up to Winter ICAP adjusted for ambient derates.
- Winter ICAP will be used to calculate outage rates used in the ELCC model during the winter. Outages will be applied in the same manner as today.
- Planned and maintenance outages during the winter period will account for Winter ICAP values

Example of availability from [sensitivity analysis, slides 16-18]:



Unlimited Resources: Downstream Requirements

Reporting Requirements

- eDART reporting reflective of Winter ICAP
- GADS reporting should reflect higher capability during winter months

Winter Testing and Verification Requirements

- Status quo approach to Winter Net Capability Verification Testing, with the shortfall calculation utilizing the committed Winter ICAP

Energy Must Offer Requirement

- Status quo calculation, ICAP equivalent of cleared UCAP, utilizing seasonal Accredited UCAP Factors to convert from committed UCAP to seasonal ICAP equivalent.

Variable, Combination and Limited Duration Resources

To apply a consistent application of winter capability across resources types, some additional modeling and process changes would be needed for variable, combination, and limited duration resources:

- Winter ICAP would be defined as equal to the Effective Nameplate Capacity of the resource, not to exceed studied winter deliverability and granted Winter CIRs.

- The separate Winter CIR request and study process would be consolidated with process utilized to assess winter deliverability for all resource types, as described in slide 12.

Annual Capacity Market Offers in UCAP Terms with Seasonal AUCAP Factors and Seasonal ICAPs

Status Quo

Capacity market offers are in ICAP terms and resource Accredited UCAP Factors (calculated as Accredited UCAP / Installed Capacity) are utilized in auction clearing and calculation of daily positions.

Proposal

To simplify RPM auction offers, given proposed use of seasonal ICAPs, offers would be submitted in UCAP terms (rather than having separate seasonal ICAP offers that need to be converted into annual UCAP). Seasonal Accredited UCAP Factors would be calculated to apply downstream in RPM.

- Summer Accredited UCAP Factor = Accredited UCAP / Summer ICAP
- Winter Accredited UCAP Factor = Accredited UCAP / Winter ICAP
- Seasonal ICAPs and seasonal AUCAP Factors utilized to calculate annual available owned UCAP to support offers

Proposal Example: Thermal Resource

	Status Quo	Proposal
MFO	210 MW	210 MW
Summer ICAP & Annual CIR	180 MW	180 MW
Deliverable Winter MW	200 MW	200 MW
Winter ICAP and Granted Winter CIRs	N/A	200 MW ICAP 20 MW Winter CIRs granted
ELCC Model Output Cap	180 MW in all hours	180 MW in summer, 200 MW in winter
ELCC Rating	75%	80%
Annual Accredited UCAP	180 x 0.75 = 135 MW	180 x 0.8 = 144 MW
Committed Capacity	180 MW annual ICAP 135 annual MW UCAP	144 MW annual UCAP 180 MW summer ICAP 200 MW winter ICAP
Energy Must Offer Requirement	180 MW ICAP	180 MW in summer, 200 MW in winter
PAI Expected Performance	135 MW UCAP	144 MW UCAP

Enhanced Approach for Recognizing Accredited UCAP Above Annual CIRs

Status Quo: Limits incremental UCAP above annual CIRs to just the winter season

Annual offers are allowed up to annual AUCAP, which utilizes an annual AUCAP factor multiplied by annual ICAP and may not exceed annual CIRs.

Intermittent resources with accredited capability above annual CIRs are eligible to reflect incremental winter capability as winter-period capacity, which may offer into RPM auctions as winter-only offers and may clear if matched with summer-only offers. In practice, this primarily applies to wind.

In recent auctions, we have observed a significant portion of winter-only offers not being matched and not clearing the auctions. For example, ~1 GW UCAP of winter offers were not matched with summer offers in the 2025/26 BRA.

Proposal

Allow a generator's annual Accredited UCAP to exceed summer CIRs (while continuing to apply seasonal CIR / deliverability caps in ELCC analysis), removing the need for seasonal offers and pairing to clear in the auctions.

Benefits relative to status quo

- More fully recognizes the resource adequacy value provided by resources that have incremental winter capability above annual CIRs
- Enables more winter capacity to clear and take on a capacity obligation during the Delivery Year, particularly given the relatively low amount of seasonal matching that has occurred in recent auctions
- Simplifies certain aspects of the market construct in place today that were added to facilitate participation by certain resources with significant differences in seasonal performance prior to moving to ELCC accreditation

Proposal Example: Wind Resource with AUCAP > Annual CIRs

Corrected for clarification since 6/17

	Status Quo	Proposal
MFO = ENC	100 MW	100 MW
Summer ICAP & Annual CIR	20 MW	20 MW
Deliverable Winter MW	70 MW	70 MW
Winter ICAP	N/A	70 MW
Winter CIRs	20 MW	50 MW
ELCC Model Output Cap	20 MW in summer, 70 MW in winter	20 MW in summer, 70 MW in winter
ELCC Rating	40%	40%
Annual Accredited UCAP	100 x 0.4, capped at annual CIR = 20MW	100 x 0.4 = 40 MW
Committed Capacity	20 MW annual UCAP 40 MW UCAP in winter	40 MW annual UCAP
PAI Expected Performance	20 MW UCAP in summer 40 MW UCAP in winter	40 MW UCAP

Treatment of Summer-Only Demand Response When Seasonal Capacity Pairing is Sunset

Within the PJM proposal, all winter capability would be reflected as annual capacity, sunsetting the need for winter-only and summer-only resources to pair to clear as an annual resource. This leaves no winter-only generation resources to pair with summer-only DR.

To continue to allow UCAP of excess summer demand response to be recognized, PJM would:

1. Calculate an annual equivalent ELCC rating of any excess summer-only DR to allow summer only DR to be recognized in an annual UCAP offer (in a manner equivalent to annualized treatment of different seasonal capabilities of generation under this proposal).

   Example: If an incremental 100 ICAP MW of summer-only DR provides an expected EUE reduction of 10 MWh in the ELCC analysis, while 100 MW of “perfect” annual capacity provides 50 MWh EUE reduction, summer-only DR would receive an annual equivalent ELCC rating of 20% (10 MWh / 50 MWh).

2. In order to calculate committed ICAP for purposes of performance assessment of DR:

   a. Annual ICAP Committed = $\frac{\text{Annual UCAP}_{\text{Committed}}}{\text{Annual UCAP}_{\text{Owned}}} \times \text{Registered Annual ICAP}$

   b. Summer-Only ICAP Committed = $\frac{\text{Annual UCAP}_{\text{Committed}}}{\text{Annual UCAP}_{\text{Owned}}} \times \text{Registered Summer ICAP}$

Timing Considerations for 2028/29 Delivery Year

- **Remaining ELCCSTF Work Plan**
- **Activities to Support Proposal Implementation for 2028/29 Delivery Year**

July 2025
- ELCCSTF Vote
- MRC / MC First Read

Aug 2025
MRC / MC Vote

Sept 2025
FERC Filing

Nov 2025
Anticipated FERC Order

ASAP
Open window to collect and confirm Winter ICAP values

Nov 2025
Finalize Winter ICAP values

Dec 2025
- NOI Deadline
- Finalize Transition Study of Winter Deliverability
- Begin ELCC Analysis

Jan 2026
MC Votes on IRM & FPR

Feb 2026
Planning Parameters Posted

June 2026
BRA for 2028/2029 Delivery Year

Q: Does allowing annual Accredited UCAP to exceed annual CIRs present a reliability concern from a Planning studied deliverability perspective?

A: No, we do not believe this creates a reliability concern given the level of studied deliverability and CIRs for generation will still be respected in the underlying risk analysis for the respective time periods.

- Annual CIRs are based on a summer generator deliverability test, and those CIRs will continue to set the cap on availability or performance during summer months in the ELCC analysis as it does today.
- For resources that are studied and deliverable in the winter at a level above annual CIRs, that higher level of studied deliverability will be respected in the ELCC analysis during the winter months.
- As such, the risk analysis used in the Reserve Requirement Study and ELCC accreditation is not relying on hourly output from generation above studied deliverability for the respective season or time period.

Q: If the ELCC analysis limits performance to studied deliverability, how can a resource receive an annual ELCC rating and Accredited UCAP greater than its annual CIRs?

A: Generally speaking, annual ELCC ratings and AUCAP values reflect resources' **average expected performance during hours of resource adequacy risk** on the system across the year.

- The underlying analysis used in determining those values is hourly and considers the differences in resources' availability or expected performance throughout the year under different weather conditions and studied deliverability.
- Today, most risk falls in the winter season, and for resources that are studied to be deliverable and perform considerably above annual CIRs during winter risk hours, the higher winter performance can result in an annual average expected performance that exceeds annual CIRs.

Wind Example (100 MW MFO)	**Summer**	**Winter**
Seasonal Studied Deliverability (cap on performance)	20 MW (Annual CIRs)	70 MW
Seasonal Average Performance during Risk Hours	10 MW	47.5 MW
Seasonal Percentage Share of Risk Hours	20%	80%
Annual Average Performance during Risk Hours	**40 MW (AUCAP)**	

Q: If annual AUCAP is allowed to exceed annual CIRs, is there a reliability concern that the committed UCAP obligation for a resource can exceed its seasonal ICAP or studied deliverability / CIRs in one of the seasons, or even what the resource can physically provide at certain times of the year?

A: We do not believe this creates a reliability concern for a few reasons:

- The underlying risk analysis used to set the IRM/FPR and ELCC accreditation is not relying on committed UCAP from each resource in every hour, but rather considers the expected differences in performance and studied deliverability throughout the year.
- Committed UCAP represents a financial obligation (not physical) with which resources are assessed against during PAIs and reflects the average expected performance from a resource across hours of risk. It is expected and planned for that resources will underperform relative to their committed UCAP in some hours and over-perform in others. This is the case for all generation, but solar provides one clear example of this where in some risk hours (e.g. summer afternoon), solar is generally expected to exceed their AUCAP while in other hours (e.g. at night), solar would not be able to physically meet it's committed UCAP level.
- Committed resources still have the physical requirement to make their full committed ICAP or capability available to PJM for dispatch (adjusted for any outages). As such, even though some resources are expected to have a UCAP commitment that exceeds their physical capability in certain times of the year, other committed resources are expected and must make available to PJM their capability beyond committed UCAP at those times.

Performance Weighting

Reflect improvements or changes in performance in the accreditation and risk model as it happens, and quicker than status quo

- Under status quo, all historical days in a temperature-performance bin are weighted equally when making Monte Carlo draws
- By using a weighting approach, more recent historical days in a temperature-performance bin can receive a higher weight, making such days to be more likely to be drawn by the Monte Carlo (and therefore, older historical days in a bin, less likely to be drawn)
- This increases investment incentives given more recent observations of performance will now hold greater weight when determining the capacity value of resources and the capacity compensation they can receive going forward

Review: Approach to Weight Years (Exponential Smoothing)

As an example, let's assume there are 11 historical days in a temperature-performance bin from 11 different Delivery Years

Delivery Year Rank (Performance Temperature bin)	Weight	alpha = 0.1	alpha = 0.2
1	α	0.1000	0.2000
2	$\alpha(1-\alpha)$	0.0900	0.1600
3	$\alpha(1-\alpha)^2$	0.0810	0.1280
4	$\alpha(1-\alpha)^3$	0.0729	0.1024
5	$\alpha(1-\alpha)^4$	0.0656	0.0819
6	$\alpha(1-\alpha)^5$	0.0590	0.0655
7	$\alpha(1-\alpha)^6$	0.0531	0.0524
8	$\alpha(1-\alpha)^7$	0.0478	0.0419
9	$\alpha(1-\alpha)^8$	0.0430	0.0336
10	$\alpha(1-\alpha)^9$	0.0387	0.0268
11	$\alpha(1-\alpha)^{10}$	0.0349	0.0215

Interpretation:
If alpha=0.1, the Monte Carlo method will sample 0.1/0.0387, which is 2.6 times more often from performance in a day in Delivery Year Rank 1 than from performance in a day in Delivery Year Rank 10

Review: Performance Weighting and Sensitivities

- A review of the performance weighting methodology using exponential smoothing and prior sensitivity analyses against the old 26/27 BRA case run back in June 2024 can be found below:
  - 20250219-item-04---continued-discussion-on-accreditation-reforms---weighting-approach---pjm-presentation.pdf
- At the April 22nd ELCCSTF meeting, an initial set of sensitivity results against the following case were provided (see https://www.pjm.com/-/media/DotCom/committees-groups/task-forces/elccstf/2025/20250422/20250422-item-03---accreditation-reforms---sensitivity-analyses-of-weighting-approach---pjm-presentation.pdf):
  - The 26/27 BRA case using preliminary 24/25 weather, load and resource performance data
  - The above case using performance weighting alpha values of: 0.1, 0.2 and 0.3

Review: Performance Weighting and Sensitivities (cont’d)

- At the May 30 ELCCSTF, the latest set of sensitivity results on Performance Weighting were provided that incorporated the following:
  - The 26/27 BRA case +
  - DR changes DR changes recently accepted by FERC in Docket No. ER25-1525 +
  - Improved Weather Rotation Alignment or “Align” sensitivity (as described in slides 11-15 at https://www.pjm.com/-/media/DotCom/committees-groups/task-forces/elccstf/2025/20250522/20250522-item-02---elcc-accreditation-methodology-update-on-sensitivity-analyses---pjm-presentation.pdf) +
  - Generator Winter Ratings or “WICAP” sensitivity (as described in slides 15-18 at https://www.pjm.com/-/media/DotCom/committees-groups/task-forces/elccstf/2025/20250522/20250522-item-02---elcc-accreditation-methodology-update-on-sensitivity-analyses---pjm-presentation.pdf) +
  - Preliminary 2024/25 weather, load and resource performance data (repeated once and twice)
  - Performance weighting alpha values of: 0.2 and 0.3

Review: May 30 Performance Weighting Sensitivity Results

Results	24/25 Data* x1 No Alpha	24/25 Data* x1 Alpha=0.2	24/25 Data* x1 Alpha=0.3	24/25 Data* x2 No Alpha	24/25 Data* x2 Alpha=0.2	24/25 Data* x2 Alpha=0.3
Solved Load	160,476	160,759	160,242	160,560	160,682	161,087
IRM	19.2%	19.0%	19.4%	19.2%	19.1%	18.8%
Overall Winter LOLH Share	69%	68%	77%	64%	68%	59%
LOLH Risk Contribution of Jan 7, 2014 Performance Pattern	32%	16 %	12%	27%	14%	10%
LOLH Risk Contribution of Dec 24, 2022 Performance Pattern	34%	49%	63%	35%	51%	46%
Conditional Probability of Drawing PV1 or WSE Performance	9.1%	9.9%	10.6%	8.3%	8.1%	7.9%
Conditional Probability of Drawing 2024/25 winter perf (x1 or x2)	9.1%	17.6%	24.4%	16.7%	32.5%	43.9%
Weight in Perf. Adj. Calculation of 2024/25 winter performance (x1 or x2)	6.1%	11.9%	18.7%	10.5%	21.8%	25.5%

** The 24/25 data to calculate loads, temperature bins and resource performance is preliminary. For some hours, estimated values have been used*

Performance Weighting: Proposal

Proposal: Apply a higher weight to more recent observations of performance within each temperature bin in the ELCC/RRS analysis using exponential smoothing and an alpha value equal to 0.2.

- Reflects improvements or changes in fleet, class, and resource performance more quickly in the ELCC accreditation and RRS results
- Continues to rely on demonstrated performance of resources during extreme weather conditions and does not require erasing / re-writing of history, or making assumptions of improved performance in future
- Increases incentives for resources to invest or improve performance of their resources relative to status quo given the most recent observations of performance during the more extreme weather conditions that drive resource adequacy risk will have the greatest weight on accreditation value and compensation going forward
- Given current data and sensitivity runs, we believe exponential smoothing with an alpha equal to 0.2 provides a balanced approach of (a) gradually reducing the impact of older performance patterns in the risk analysis and accreditation, and (b) more quickly reflecting the impact of recent performance patterns in ELCC/RRS without making such recent performance patterns the overwhelming driver of the results

Follow-up Discussion on Weather Scenarios and Policy Decisions on Reliability Targets and Costs

RA Modeling Assumptions & The 1-in-10 Standard

Question 1	Question 2
How do we best model reliability risk? (Technical & Modeling)	What is the appropriate reliability target? (Policy & Value Judgement)
This is a discussion about the **technical foundation** for achieving an established reliability standard. **Focus:** Best representation of delivery-year reliability outcomes, reflecting the full distribution of potential events. **Key Questions:** • What are the most appropriate input assumptions (weather, load, correlated outages)? • How do we best account for "tail risk" or extreme events (e.g., Winter '94, WSE22)? • Are our models and methods accurately capturing system physics and performance? **Forum:** Technical stakeholder bodies (e.g., ELCCSTF, RAAS). **PJM's Role:** Provide objective, expert analysis on modeling choices and their impact.	This is a discussion about the **desired level of reliability** and the associated cost trade-offs. **Focus:** Capturing and reflecting load-side preferences for reliability vs. cost. **Key Questions:** • Is the 1-day-in-10-years standard the right objective for the entire PJM footprint? • What is the value of lost load (VOLL), and how much are customers willing to pay to avoid outages? • Should different zones or regions have different reliability targets based on local preferences? **Forum:** Broader policy discussions with load representatives, regulators, and consumer advocates. **PJM's Role:** Facilitate the conversation and implement the chosen objective.

PJM's View: To ensure a productive dialogue, we are best served by differentiating questions regarding the technical representation of risk (**Question 1**) from those on changes to the risk tolerance itself (**Question 2**). The analysis on the next slide quantifies a technical risk; we invite feedbackfrom load-side representatives to determine if that risk is acceptable for the associated cost savings.

Illustrative Example: The Impact of Modeling Assumptions (Excluding Winter ’94 Extreme Weather)

This analysis helps inform the **Question 2** discussion.

- **Scenario:** We change a planning assumption by removing the 1993/94 winter from the historical weather set.
- **Procurement Impact:** To meet the same 1-in-10 target, PJM would procure **~1,200 MW less** capacity.
- **Reliability Risk:** If a winter like 1993/94 *were to occur* under this lower procurement level:
  - **LOLE (days/yr):** 0.10 to 0.129 (+29%)
  - **EUE (MWh/yr):** 1,752 to 2,307 (+32%)

Commentary: This analysis provides the technical 'what'—it quantifies the risk of a modeling decision, which can help inform the **Question 2** issue of whether a 30% increase in reliability risk is an acceptable trade-off for the cost savings of 1,200 MW of capacity. That is the value judgment we believe is best discussed in a broader policy forum.

Note also previous similar analysis from CIFP-RA Presentation, slide 59.

Appendix

Acronyms

ELCC	Effective Load Carrying Capability
RRS	Reserve Requirement Study
LOLP	Loss-of-Load Probability
LOLE	Loss-of-Load Expectation (days / year)
LOLH	Loss-of-Load Hours (hours / year)
EUE	Expected Unserved Energy (MWh / year)
DR	Demand Resources
NOI	Binding Notice of Intent to offer submitted by market sellers
THI	Temperature Humidity Index
ENC	Effective Nameplate Capacity
ICAP	Installed Capacity
CIRs	Capacity Interconnection Rights
MFO	Maximum Facility Output

Overview of Loss-of-Load Risk Model

Model Inputs

Weather Scenarios

Historical weather patterns captured back to 1993 (30 years)

Load Scenarios

Hourly load profiles derived from PJM's Load Forecast model for each historical weather scenario

- *Weather patterns shifted +/- 6 days to account for day of the week / holiday variables*

Projected Resource Mix and Performance

Unit, class, and fleet performance for thermal and variable generation modeled as a function of temperature by resampling against historical availability back to 2012 using a binning methodology

- *Dispatch of Demand Resources and Limited Duration Resources simulated in model*

Loss-of-Load Risk Modeling

System simulated under thousands of alternative scenarios to capture a broad range of potential system conditions and reliability outcomes.

30 Alternative Weather Years *
13 Alternative Load Scenarios *
100 Alternative Resource Performance Draws
= 39,000 Simulated Years

Patterns of Risk

LOLE vs. LOLH vs EUE

- *Summer vs. winter? Morning vs. midday vs. evening? Long vs. short events? Deep vs. shallow?*

ELCC Ratings

Measure of resources' contribution to reliability given patterns of loss-of-load risk

Weather Scenarios

- PJM purchases weather data from vendor (DTN)
- Historical weather patterns back to June 1, 1993 are used to derive the Weather Scenarios used in the loss-of-load risk analysis (ELCC/RRS studies)
- The Weather Scenarios are used in the model to:
  - Construct hourly load scenarios using latest PJM Load Forecast Model
  - Characterize historical resource performance as a function of temperature back to 2012 using a binning methodology
  - Capture the observed relationship that weather has on both load levels and resource availability in the simulated analysis

Notable Extreme Weather Days used in Model

Summer		
Date	**HE**	**Temp.**
July 15, 1995	15	97
July 21, 2011	15	95
July 5, 1999	17	96
Aug. 1, 2006	16	94

Winter		
Date	**HE**	**Temp.**
Jan. 19, 1994	8	-11
Jan. 7, 2014	7	-1
Feb. 20, 2015	8	-2
Dec. 23, 2022	23	5

Temp. columns reflects maximum or minimum hourly RTO-weighted average temperatures for the day

Load Scenarios

- Hourly load scenarios constructed from historical weather years using Load Forecast Model

- Weather rotations are applied where the historical weather is shifted 6 days forward and 6 days backward. This results in 12 additional load scenarios, or 13 in total, for each weather year providing **390 unique annual hourly load profiles** (30 weather years * 13 load scenarios)
  - Weather rotations allow the model to capture the fact that an extreme weather day that historically occurred on a weekend or holiday (e.g. Winter Storm Elliott) could potentially occur on a weekday where the resulting load profiles may be quite different (or vice versa). Example of rotations provided to the right.
  - Hourly load profiles published on [Load Forecast Webpage]

Forecast Date	Weather Date	Scenario
August, 9, 2024	August 3, 2010	M2010
August, 9, 2024	August 4, 2010	L2010
August, 9, 2024	August 5, 2010	K2010
August, 9, 2024	August 6, 2010	J2010
August, 9, 2024	August 7, 2010	I2010
August, 9, 2024	August 8, 2010	H2010
August, 9, 2024	August 9, 2010	A2010
August, 9, 2024	August 10, 2010	B2010
August, 9, 2024	August 11, 2010	C2010
August, 9, 2024	August 12, 2010	D2010
August, 9, 2024	August 13, 2010	E2010
August, 9, 2024	August 14, 2010	F2010
August, 9, 2024	August 15, 2010	G2010

shift weather 6 days backward

shift weather 6 days forward

- Load variability is modeled in the analysis to account for Load Forecast Error. When drawing the hourly load profiles from a load scenario for a day, the load is randomly sampled from a normal distribution with mean zero and standard deviation equal to approximately 1.2%.

Winter Capability Analysis Approach

PJM performed analysis to determine how much winter capability can be reasonably relied upon for resource adequacy.

For each Unlimited Resource in the 2026/27 portfolio:

1. Estimated **"Winter ICAP"** as the maximum Winter Net Capability Test since 22/23 DY, capped at Maximum Facility Output (MFO).

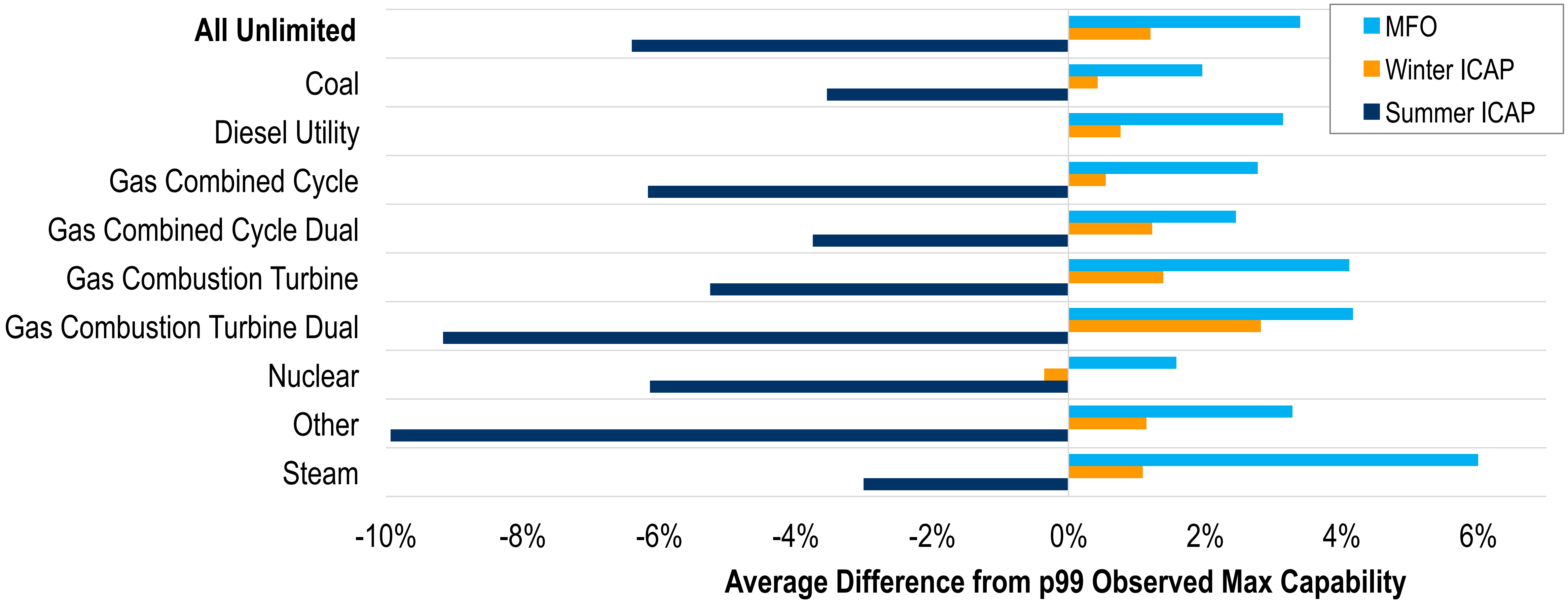
2. Calculated hourly **"Observed Max Capability"** as the maximum of actual output or emergency max, in hours where the unit had no outages. This was calculated using all available data for each unit back to 2012, November through April.

3. Compared these metrics to Summer ICAP and MFO.

The delta between Summer ICAP and "Winter ICAP" for Unlimited Resources in this portfolio is 8,561 MW. See sensitivity analysis, slides 16-18.

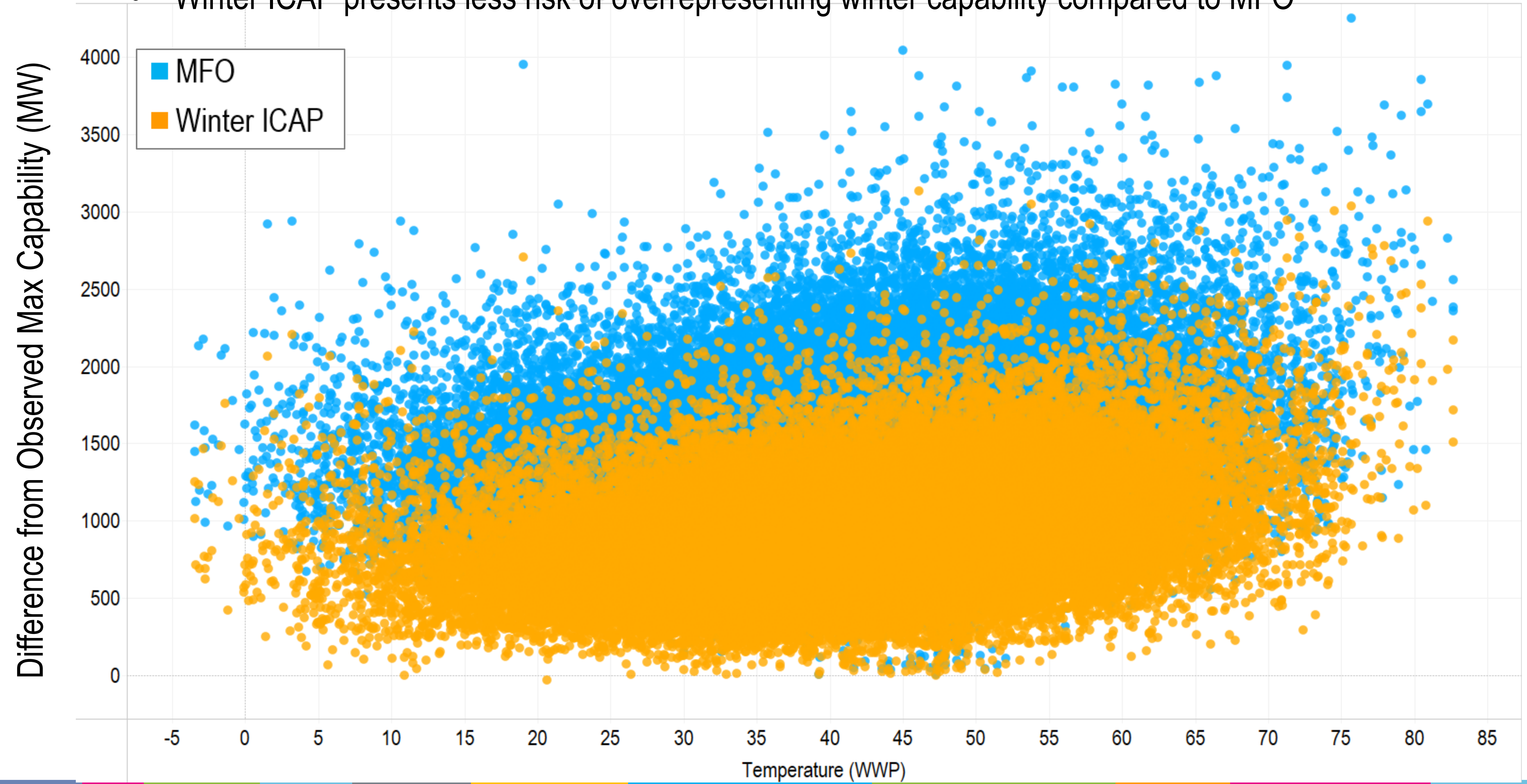
Winter ICAP is Most Aligned with Observed Winter Capability

Unlimited resources' 99th percentile observed max capability in winter is on average
6.4% (11 GW) higher than Summer ICAP, **3.4% (6 GW) lower than MFO**, and **1.2% (2 GW) lower than Winter ICAP**.



Comparison of Winter ICAP and MFO to Observed Max Capability

- Some decreased variability between observed max capability and ratings as temperature decreases
- Winter ICAP presents less risk of overrepresenting winter capability compared to MFO



Winter Generator Deliverability Test Background

- In early 2023, stakeholders approved changes to PJM's generator deliverability test procedures.
  - Changes started to be implemented with the 2023 RTEP
  - Changes will be implemented starting with Transition Cycle 2 in the interconnection process
- The changes were primarily approved to update the test to better handle the evolving resource mix.
- One of the changes that was approved was consideration of seasonal output capabilities and expected operating levels of generators.
  - Summer, winter and light load
  - Summer single contingency testing continues to be limited to the CIR level

Preliminary Assessment of Deliverability of Additional Thermal Winter Capability

Sensitivity study of the 2026 Winter RTEP Case with status quo generator deliverability test levels:

- The total MFO MW for thermal units in 2026 is 165,069 MW.
- The total annual CIR MW for thermal units was 155,230 MW, resulting 9,839 MW being assessed for deliverability.
- The total additional MW determined to be deliverable in winter was 6,307 MW. This is **64% of MFO.**

Caveats

- This assessed deliverability cannot be guaranteed for the official 2028/2029 study (target delivery year for implementation of this proposal) given the changes to various input substantial increase in data center load, updated generation profiles, recent deactivations, and available transmission projects.
- For the new transitional study for the 2028/2029 delivery year, PJM proposes utilizing test levels of Winter ICAP instead of MFO for a more accurate representation of resource capability and more efficient allocation of system headroom.

Status Quo Winter CIR Solicitation & Study Process

Who?

Generation Owners of Intermittent Resources and Environmentally Limited Resources

Existing resources & planned resources eligible for BRA

When are Winter CIRs requested?

Modified auction schedule
10-day request window opening 145 days prior to the BRA

3-Year auction schedule
Request window is Aug. 31 – Oct. 31 of the year prior to the May BRA

What?

Eligible to request additional CIRs for the winter period of each delivery year.

Requests for CIRs greater than 40% of MFO must provide supporting documentation to verify the facility is capable of reliably achieving the requested output

Study details

- Single contingency generator deliverability study is performed
- Winter RTEP model for the delivery year under study (latest winter peak load forecast, winter transmission facility ratings)
- Additional/requested Winter CIRs are found either fully deliverable, partially deliverable, or not deliverable
- Results are published prior to the DR Sell Offer Plan due date

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