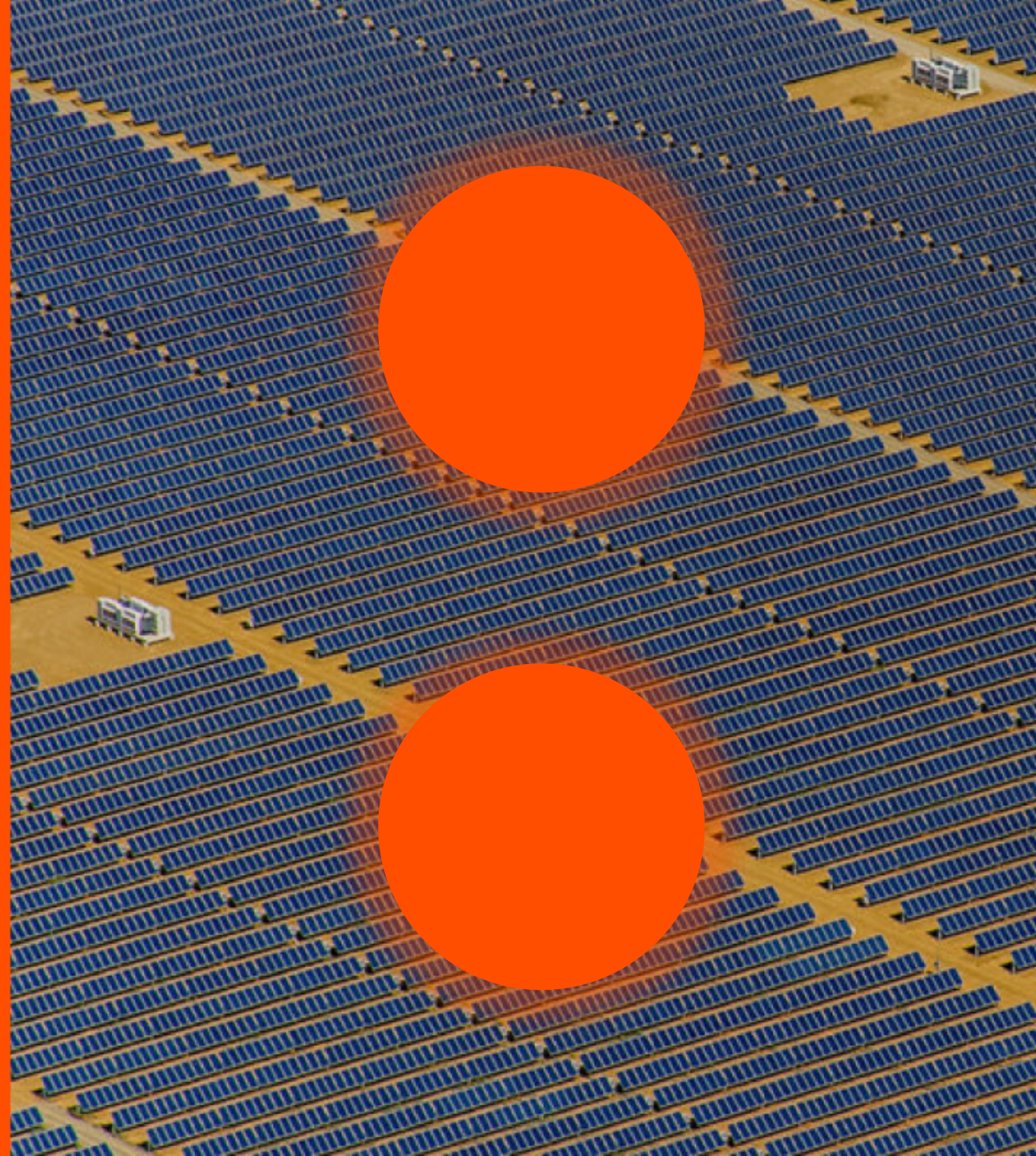
Capacity Market Reform: MN8's Initial Proposal

April 26, 2023

You Got Power



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Priorities and agenda

Our priorities in this process are similar to those of PJM:

- Enhance modelling of reliability risks
- Align accreditation with reliability contribution
- Ensure the CP structure is fit-for-purpose and aligns with MSOC
- Create a more granular market construct that allows for more efficient supply and demand distinctions and is resilient to inevitable forecast error

Agenda:

- Reliability Risk Modelling
- Capacity Accreditation
- Performance Assessments and Testing
- Market Power Mitigation Rules
- Other

Reliability Risk Modelling

Reliability Risk Modeling

We are generally supportive of PJM's proposed enhancements to reliability risk modeling:

- We strongly **support enhancing risk modelling to capture how reliability risks vary with temperature**
- We are directionally **supportive of expanding weather history** (e.g., to 50 years). However, we think that **PJM should provide analysis of weather trends and incorporate their findings into their modelling**. Two approaches for doing so could include:
  - **Assign different weights to weather history,** e.g., weight recent years more heavily. This could include using different weights/discount rates for summer and winter weather history.
  - **Develop representations of future weather-years** based on observed trends in mean temperature and variance about the mean extrapolated forward. If done, this should entail substantial stakeholder education, socialization, and input, and would likely be hard to do for an October filing.
- We are **supportive of moving the EUE as the primary reliability metric**. However, PJM should continue to report on the broader set of metrics, and should be deliberate about how target EUEs are selected.
- We **support PJM's proposed changes to the Reserve Requirement Study.**

Capacity Accreditation

Capacity Accreditation

- PJM's proposed approach to updating thermal accreditation is directionally correct. **We strongly support the incorporation of weather impacts on resource reliability.** The details of how the class-level adjustments are made will be incredibly important and warrants substantial attention – PJM should share the details of this analysis as soon as possible.
- We **support PJM's proposal to compare simulated outcomes to empirical observations by resource class**. Such back-testing is critical given that this is an original undertaking.
- There are a **few areas where we would encourage PJM to consider altering or adding to its current proposal – in terms of (i) how resource flexibility is considered in accreditation, and (ii) how hybrid resources are accredited.** We discuss these on the subsequent slides.
- We are **still assessing PJM's winterization standard but are directionally supportive of introducing common sense standards and requiring proof that they've been met.** We would request that PJM propose a robust protocol for ensuring reliable attestations, and a backstop process that imposes greater scrutiny than an attestation in instances where resources clearly fail in conditions where they were expected to perform.

Accreditation should consider resource inflexibility

Under PJM's current proposal, the **negative impacts that inflexibility (i.e., long lead times) can have on resources' reliability contributions would not be captured due to the proposed excusals policy.** This is worrisome, given recently observed operational challenges and the inevitability of forecast error, coupled with PJM's dual mandate to ensure both a reliable *and efficient system*.

PJM should incorporate resource inflexibility into its accreditation process. For example, PJM could:

- Use a two-step daily dispatch algorithm in its ELCC model to simulate day-ahead and real-time operations. Introduce load/solar/wind forecast error between the day-ahead and real-time steps.
- In the day-ahead step: all slow-start units are available to be "committed" to meet expected need given load/solar/wind forecast.
- In the real-time step: only previously committed slow-start units plus fast-start units are available to meet real-time need.
- With higher load/lower wind/solar in real-time vs. day-ahead forecast, there may be some uncommitted slow-start units that are unavailable to meet real-time load during modeled shortage, resulting in a reduction in ELCC rating.

Illustration: Hybrid Resource Accreditation

PJM's accreditation of hybrid resources may not reflect the reality of how these resources operate. PJM summarized its approach in its ELCC-CIR as follows:

1. ELCC model: cap hourly output of each hybrid at the CIR value during the months of May through October (inclusive), and cap hourly output using the winter deliverability MW during the months of November through April, inclusive.

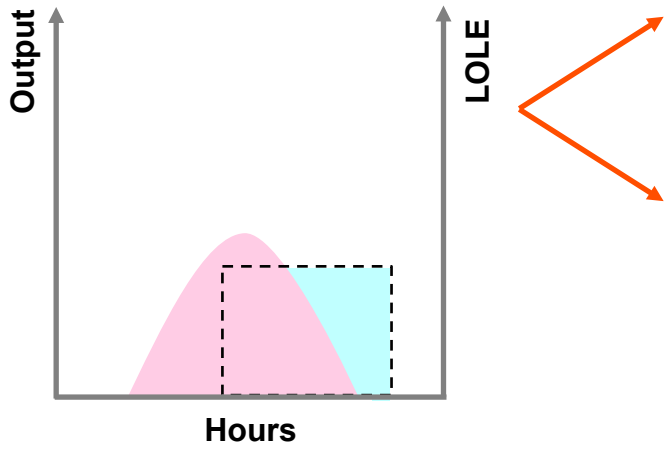
2. UCAP & AUCAP: a) the Effective Nameplate Capacity (ENC) of the storage component cannot exceed the CIR value; b) for May through Oct. (inclusive), ***the hourly output values of the Variable Resource component is capped at CIR value minus storage component ENC; c) for November through April (inclusive), hourly output values of Variable Resource component is capped at the winter deliverability MW minus storage component ENC;*** *d) except that, when the hybrid's total CIR value equals MFO, there is no capping of any ENC or hourly output. Also: UCAP cannot exceed CIRs. An estimate of curtailed MWh is "added back" to the output data in applicable hours.*

Accreditation models should co-optimize hybrid resources *at the unit level behind a single CIR constraint*. This will allow for more efficient use of CIRs and more accurate accreditation.

Example: how would a hybrid facility with 50 MW storage, 100 MW solar, and 50 MW CIRs be treated?

Status Quo – Example

1. ELCC model captures class level accreditation for hybrids



ELCC Unit-specific Allocation:

Storage gets 50 MW CIRs, ~45 MW UCAP

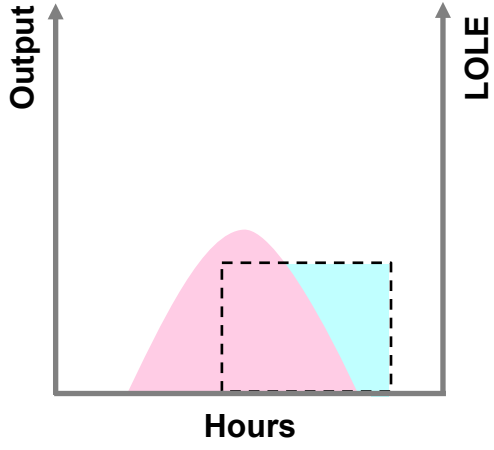
Storage gets 0 MW CIRs, 0 MW UCAP

Total UCAP: 45 MW

In this example, the hybrid resource would get no credit for the solar resource because there were no CIRs applied to it – this is clearly incorrect

Proposed Enhancement – Example

Unit-specific co-optimization of the solar and storage resources behind a common CIR constraint



Total UCAP: 50 MW

If PJM does not allow hybrid resource components to co-optimize the use of their aggregate CIRs, then they should develop a downstream adjustment based on configuration (MFO, CIR, Solar/Storage ENCs), similar to what is done for dispatchable hydro today.

In this example, the hybrid resource would be allowed to efficiently use its CIRs, correctly boosting its accreditation

Request that PJM provides analysis of how they intend to do hybrid accreditation under the new ELCC-CIR approach, and how they're proposing updating this under the CIFP-RA filing, if at all

Performance Assessments and Testing

Performance assessments – guiding principles

We believe that performance assessments ("PA")—some assessment of *actual performance* by capacity resources—are a critical component to a healthy capacity market.

The following guiding principles are helpful for creating a framework that drives a reliable and efficient system:

1. **Incentive accuracy.** PAs should **incentivize performance during times when capacity is needed most** (tight system conditions).
2. **Modelling check.** The reallocation of revenues based on **PAs can be a valuable check on unavoidable modelling uncertainties** (e.g., weather; physical generator and electric and gas system attributes; operational realities; etc.) – "cardboard boxes" should not expect to mint money.
3. **Financeability.** The assessment **framework should not introduce undue regulatory risk or unduly threaten the "financeability" of capacity as a market product** – it should be transparent, understandable, and predictable, and should impose manageable risks.

Performance assessments – comments on PJM's proposal

There are some elements of PJM's proposal that we think reflect improvements over the status quo:

- This **would make the capacity product more financeable** by setting a materially lower stop-loss in any given year, and thus, would reduce the cost of capital that the market facilitates
- This proposal **would increase the sample size of PAIs, which could also improve financeability** insofar as it causes actual performance during PAIs to converge on expected performance during reliability hours (where "expected" means what we should actually expect in light of a resource's physical attributes)

However, there are also elements of PJM's proposal that we have concerns about:

- **Tier 2 PAIs risk making assessments based on hours that are not in fact relevant** from a reliability risk perspective (risk of inaccurate incentive)
- PJM's **excusal policy treats resources in divergent fashions**, which in turn may lead to inefficient BRA results (see Table 1)
- **Failure to consider how resource startup times impact their reliability contributions** creates both reliability and efficiency risks through over-accreditation, particularly given the track record around how this has contributed to actual system risk
- **PJM's proposed triggers for Tier 1 PAIs is concerning** – it is very possible that requiring Reserve Shortages would not in fact trigger PAIs in stressed system conditions, including when PJM has sufficient Operating Reserves during a load shed event.
- **PJM's proposal risks establishing baselines based on performance in periods with de minimis LOLE** – so long as PJM uses variable baselines within market products, they should ensure that these baselines correspond to periods (i) with material modelled LOLE, and (ii) with material differences in risk drivers (e.g., summer-winter, daytime-nighttime).

Table 1: Snapshot of Accreditation-PA Interface

Ex. Resource-Driver	Penalize in accreditation	Penalize in PAI
Solar – weather	Yes	Yes
Storage – duration limits	Yes	Unclear
Thermals – flexibility limitations	No	No

Performance assessments – option set

Triggers	1. Single tier	E.g., Status quo, only one type of PAI; IMM proposal
	2. Multi-tiered	E.g., PJM's proposal for Tier 1 plus the top 30 reserve shortage hours if Tier 1 not filled
Settlements	1. Two settlements	Status quo, first settlement is revenue from auction clearing, second is PAI
	2. Pay-as-you-go	Capacity resources are only paid revenue according to observed performance
Baselines	1. Static	Status quo, flat obligation at compensated UCAP
	2. Variable	Obligation varies seasonally or diurnally
	3. Dynamic	Obligation varies based on real-time, actual conditions
Penalty/Bonus Rate	1. Pegged to Net CONE	Status quo
	2. Pegged to clearing price	PJM proposal for Tier 2 PAI
	3. Varies with severity of event	E.g., if reserves are relatively long, Tier 2 penalty rate is derated accordingly
	4. No bonuses	Penalties are returned to load
Excusals	1. Excuse planned & maintenance outages	Status quo
	2. Excuse resources that were not scheduled	E.g., long lead time resources that PJM did not anticipate needing are excused
	3. Excuse any resource that is not on forced outage	If you were available or on approved outage you are excused from PAI

Given the many inter-related options and plethora of iterations, a deliberate framework is important to tackle this issue

Performance assessments – framework

We propose parsing the fundamentally different paradigms, and then focusing on what works best within each of those.

Settlements	Triggers	Baselines	Penalty/Bonus	Excusals
Two settlements	1 Single tier	Option A, B, C…	Option A, B, C…	Option A, B, C…
	2 Multi-tiered	Option A, B, C…	Option A, B, C…	Option A, B, C…
One settlement (PAYG)	3 Single tier	Option A, B, C…	Option A, B, C…	Option A, B, C…
	4 Multi-tiered	Option A, B, C…	Option A, B, C…	Option A, B, C…

Foundations / Scenarios

Build the best version(s) of each scenario possible

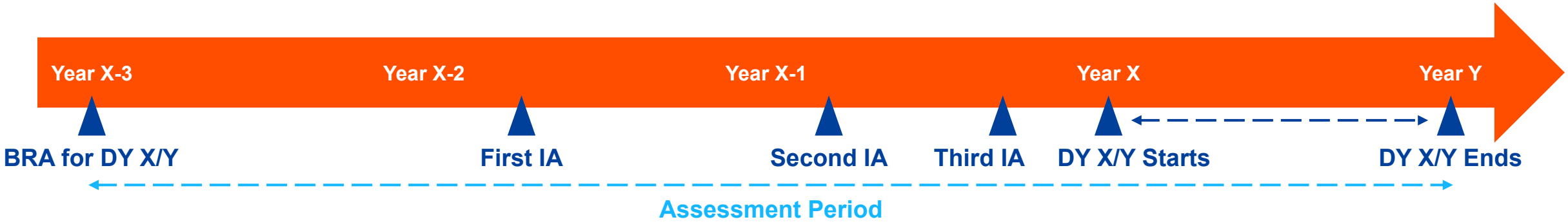
Performance assessments – analysis of each paradigm

Paradigm	Example	Incentive Accuracy	Modelling Check	Financeability
Two settlements, single tier	Status quo	Pro: incentives targeted in hours that matter from a reliability standpoint Con: excusals for PO/MO	Pro: targets the hours that matter Cons: infrequent assessments and small sample size create risk of undue penalties for atypical underperformance	Cons: creates immense amount of risk that is hard to manage and efficiently underwrite; obligations don't match expected performance
Two settlements, multi-tiered	PJM proposal	Pro: T1 given more weight than T2 Cons: ineffective Tier 1 trigger; Tier 2 hours likely to often be low stress; may lead to inefficient gaming; piecemeal excusal policy	Pros: larger sample size; consistent assessments Con: likely to include hours that don't really matter	Pros: likely to result in less variability and more predictability of net penalties/rewards Cons: some underwrite risk remains
One settlement, single tier	IMM proposal	Con: spreads incentives across all hours, as opposed to targeting those with the greatest reliability risk	Pro: Pros: larger sample size; consistent assessments Cons: assessments aren't targeted around tight hours	Pros: likely to result in less variability and more predictability of capacity market revenues; reduces credit risk
One settlement, multi-tiered	PAYG, MN8 Example	MN8 Example described on next slide		

Legend:

Performs well | Mixed performance | Performs poorly

Example of multi-tiered PAYG for DY X/Y – potential design



- Supply and demand established as done under today's two-settlement framework (with adjustments as discussed in CIFP-RA).
- BRA conducted as done today. Clearing price and volume determines aggregate funds available for PAYG.
- At the end of the DY, resources performance during the Assessment Period is evaluated and they receive a performance factor ("PF"), which determines their compensation:
  - If a resource overperforms, they at least collect all cleared revenues (cleared UCAPi * clearing price); all overperforming resources split the uncollected revenues (i.e., revenues not collected due to underperformance); bonus collection based on each resource's share of overperformance (PFi-UCAPi)/Σi(PFi-UCAPi)
  - If a resource underperforms, they only collect a portion of cleared revenues (PFi/cleared UCAPi)
- Performance factors calculated as described on following slide.
- Cleared resources are obligated to provide capacity during the delivery year (energy must-offer).

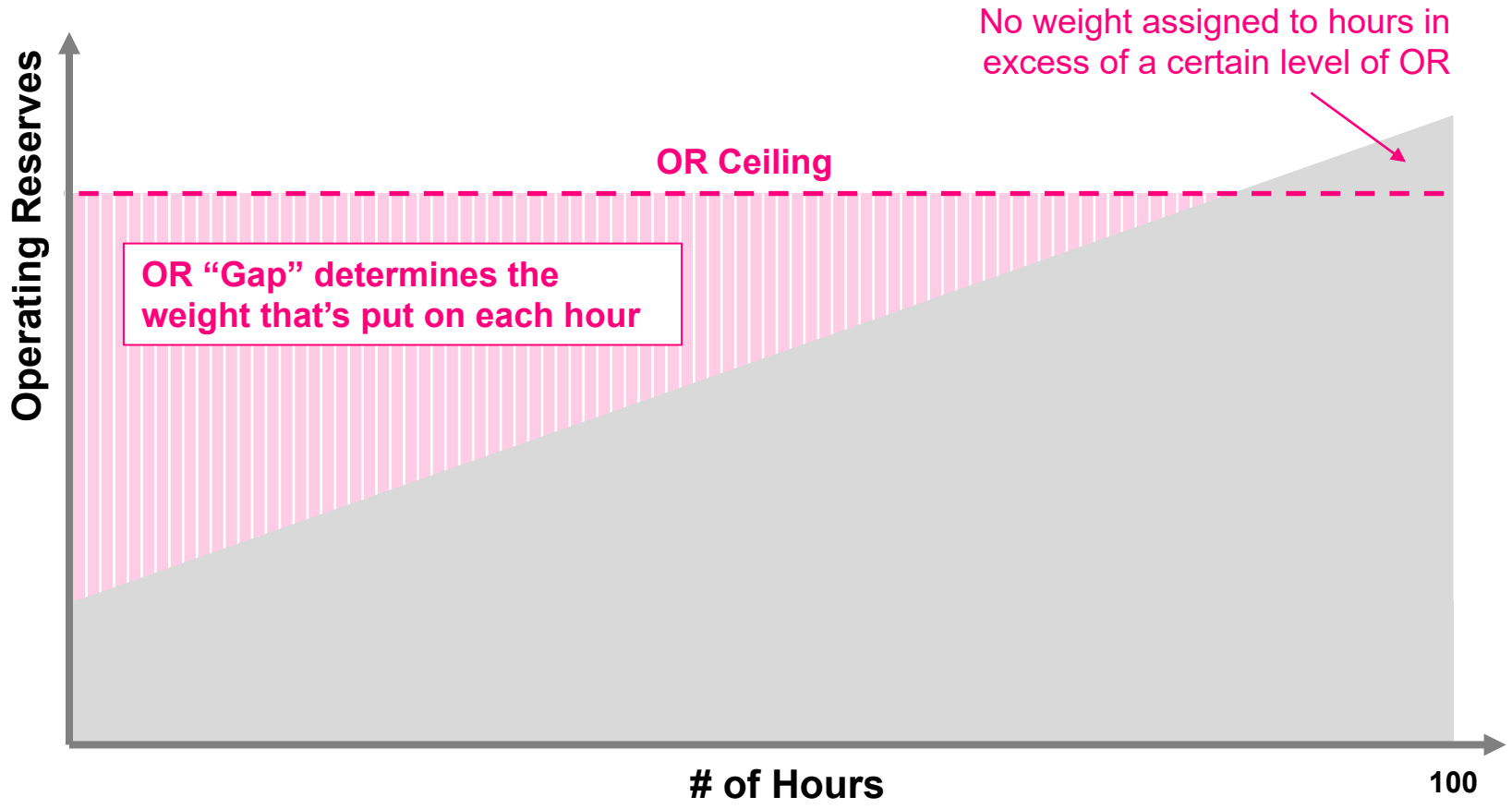
Resource	UCAPi	PFi	Comp
Resource A	20 MW	15 MW	15 MW * BRA Price
Resource B	20 MW	20 MW	20 MW * BRA Price
Resource C	20 MW	25 MW	20 MW * BRA Price + 5 MW-share of uncollected revenues

Example of multi-tiered PAYG for DY X/Y – performance factors

Components:

- **Lookback period:** 3-5 years
- **PAIs:** top X hours (e.g., 100) over the full period; could say that all hours that meet certain extreme conditions (e.g., emergency actions & tight OR) are considered (even if >100)
- **Weighting:** weight hours based on tightness (e.g., OR available); there are different ways to place greater emphasis on tighter hours, including tightness "steps" (everything below a certain level of OR gets more weight) and/or applying exponents to the measure of tightness
- **Baseline:** annual baseline (cleared UCAP)

Example: 4 years; top 100 hours; weighting based on OR "gap"



Performance assessments – analysis of each paradigm

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One settlement, multi-tiered	PAYG, MN8 Example	Pro: more impact for tighter hours Cons: lookback period is a challenging balance – want to pick up sufficient events while not making it unduly backward-looking	Pros: larger sample size; consistent assessments Con: likely to include hours that don't really matter, though this can be managed in part through weighting	Pros: likely to result in less variability and more predictability of revenues; reduces credit risk

Legend:

Performs well | Mixed performance | Performs poorly

Performance assessments – more information and analysis needed

There are numerous viable performance assessment paradigms. A rigorous comparison of these requires evaluating a series of nuanced trade-offs.

For stakeholders to be able to assess these options, it would be helpful if PJM provided more supporting information and analysis, including:

- Historical data on Operating Reserve levels (i.e., 5-minute or hourly data on PJM-wide OR levels over the past 10 years)
- Historical data on aggregate resource class performance across those same intervals – in the case of classes for which PJM cannot provide this data due to confidentiality, PJM should be responsive to stakeholder analysis requests related to how these classes perform under different paradigms and scenarios

This would allow stakeholders to do a rigorous analysis of the trade-offs associated with the different performance assessment options and thereby facilitate consensus-building.

Market Power Mitigation Rules

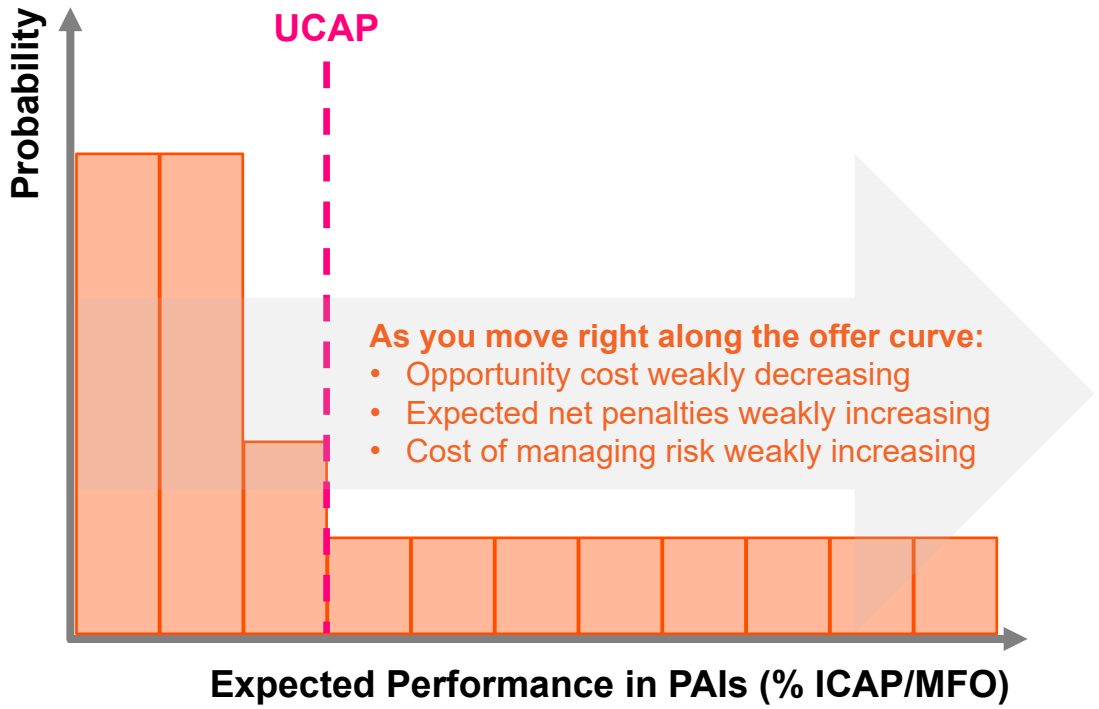
MSOC – proposal

In the case that the capacity product continues to be a two-settlement product with material risk of penalties and opportunity for rewards, it is important that reforms are made to the MSOC, particularly to better incorporate CPQR.

Improvements to CPQR in MSOC should include:

- Introducing a CPQR formula that considers:
  - Opportunity costs (forgone expected rewards)
  - Expected rewards/penalties
  - Costs of managing risks ("Risk Cost" in PJM's 1/31 RASTF presentation)
- Permitting a multi-step offer that does not require unit-specific review, so long as it meets certain Default Offer constraints:
  - Constraints on weighted average (W.A.) and max offers by class
  - If warranted, there could be one or multiple tranches of W.A./max by class set for offer tranches based on % ICAP to reflect variability in incremental CPQR across offer range

Illustrative Resource (100 MW MFO, 30 MW UCAP)



Exp. MWh	0	10	20	30	40	50	60	70	80	90	100
Probability	25%	25%	10%	5%	5%	5%	5%	5%	5%	5%	5%

Capacity must-offer

Removal of the capacity must-offer under status quo conditions would place undue risk on affected resources – many of these resources face material CP risk today and are not able to reflect it in their offers, nor can they offer in such a way that allows them to manage this risk.

Ideally, resources would be able to:

- **Manage CP risk through the introduction of a more granular market construct** that allowed resources to make more precise offers and take on obligations that better aligned with expected performance across periods. Alternatively, switching to a PAYG paradigm would remove CP risk altogether, thus addressing this issue. In the absence of either of these reforms, creating more common-sense baselines would be helpful (e.g., summer/winter, daytime/nighttime), though not sufficient.
- **Allows resources to reflect CP risk through a robust MSOC framework** that allowed resources to incorporate genuine CPQR.

In the absence of these changes, removal of the must-offer exemption risks pushing cost-competitive resources out of the capacity market altogether, since forfeiture of their capacity resource status would be the only way to manage these risks under this scenario.

Other

Seasonal market

- We support moving towards a more granular market construct due to its manifold benefits in terms of market efficiency and reliability.
- We believe that PJM should at least introduce a two-season market initially with the CIFP-RA filing, reflecting the summer and winter months; Jim Wilson's 8/8/2022 RASTF slides are a reasonable starting point that can be built on when approaching this reform.
- We understand that there are challenges but believe that these can all be overcome. Furthermore, in the absence of a seasonal market, assuming that PJM's updated reliability modelling correctly captures risks in both the summer and winter, there will be material challenges to operationalizing supply and demand under an annual BRA. In other words – incorporating seasonal dynamics into an annual market is not trivial; we might as well do it right.