

Capacity Market Reform

Capacity Coalition Proposal and Framework

April 26, 2023

Key Priorities

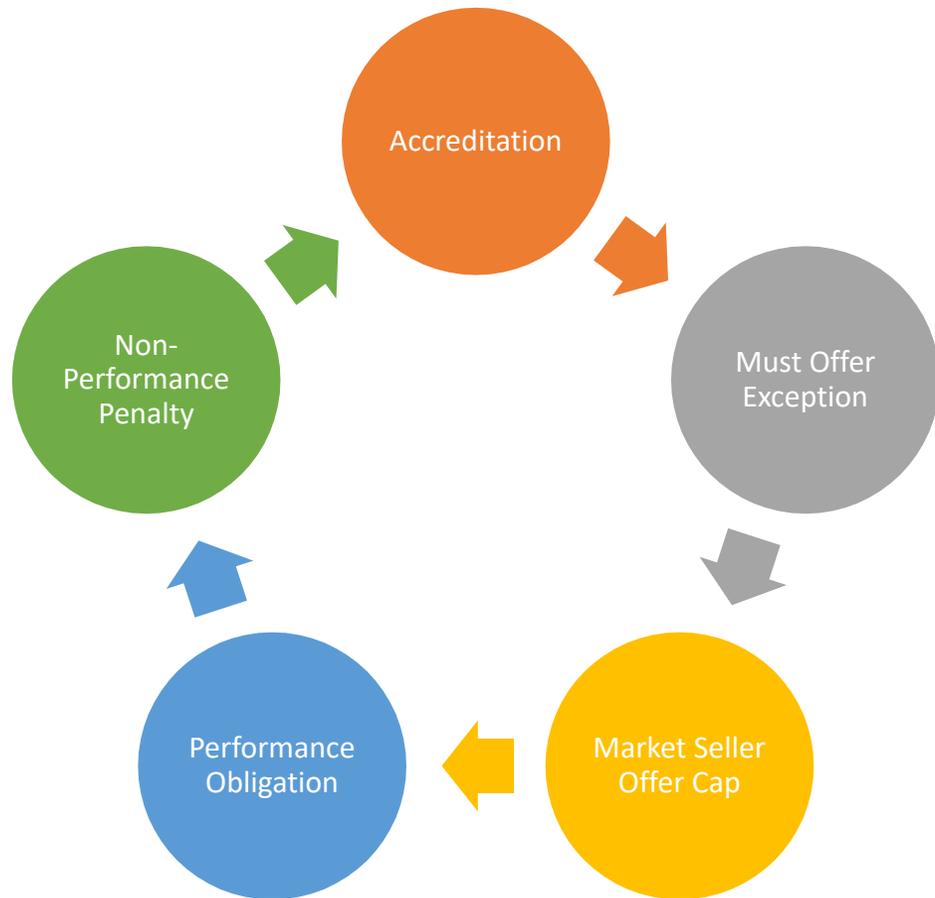
Short Term

1. Maintain Must Offer Exception for renewables as long as Capacity remains an annual product
2. Define PAI triggers and align Capacity Performance (CP) penalty risk with resource performance
3. Allow sellers the flexibility to reflect risk in their Market Seller Offer Caps (MSOC)
4. Support PJM proposal to modify thermal accreditation to align with weather expectations and historical performance

Long Term

1. Transition to a seasonal, with time-of-day Capacity construct by 2030.
2. Align resource accreditation with expected performance during specified time-of-day intervals.

Market components works in balance



- The structural components of the Capacity Market are intrinsically linked and must be internally consistent
- Changes to one without consideration of the others can skew the risks/reward balance of the market, which can impact reliability
- Our recommendations for how to maintain this balance differ for Annual and Sub-Annual market constructs
 - **Short-term priorities** address comprehensive changes we can realistically make today
 - **Long-term priorities** outline a more holistic approach for where we believe the market should go

Capacity Coalition 1

Short Term Priorities
Between now and August 23

Maintain the Must Offer Exception

- Committing resources for times they cannot reasonably be expected to provide capacity is antithetical to the reliability objective of the Capacity Market
- An Annual Capacity Market with a must offer for renewables is unjust and unreasonable as it forces renewables to accept an outsized risk on non-performance
- Variable and limited duration resources should continue to receive the status quo Must Offer Exception into the Capacity Market so they can adjust their capacity offer based on their CP risk tolerance

If the market moves to a sub-annual construct that only commits resources for times when they are expected to be available, then we do not oppose implementing a must offer obligation for variable and limited duration resources

If there is no Must Offer Exception....

- Renewable and limited duration resources would need a new mechanism to mitigate risk.
- If the Must Offer Exception is removed, PJM should consider an excusal policy that accounts for a resource's characteristics
 - Nighttime solar operations should be treated similarly to planned outages.
 - Need to account for storage cycling.

This is not our preferred solution. Movement toward a sub-annual construct would obviate the need for such a mechanism

Performance Assessment Triggers

- Performance Assessment Intervals must be defined by coherent, transparent, and predictable rules that are objectively defined.
- A PAI can only trigger CP Penalties for the intervals when the following conditions are satisfied:
 1. PJM has called a PAI prior to the interval
 2. PJM is not exporting non-firm resources to neighboring systems
 3. PJM does not have adequate reserves on the system (either a MW or \$/MW threshold in the sync reserve market)
- Only resources committed as CP resources are eligible to receive CP bonus payments for performance beyond their commitment

We do not support PJM's tier proposal

- Mandatory 30-hr assessment is overly aggressive and may not align with system need. The PAI assessment periods would need to be focused on times of system stress.
- Retroactive determination of Tier 2 hours may lead to inefficient commitment and presents significant risk to price formation.

Market Seller Offer Cap (MSOC)

- Resource Owners have myriad company structures and risk profiles that are not captured in the current MSOC
- The non-performance penalty risk for the first MW a resource offers into the market is lower than the risk of the last MW
 - This can lead to over-mitigation and depressed clearing prices that cannot send healthy entry and exit price signals
- The current PJM MSOC proposal allow sellers to choose segmented offer caps to reflect Capacity Performance Quantifiable Risk (CPQR) in their unit-specific MSOC
 - The unit specific process has been administratively burdensome
 - A resource class CQPR that allows resources to automatically express risk within the CPQR could minimize this administrative burden

Market Seller Offer Cap as a Weighted Average

Define the CPQR component of the MSOC as the maximum of the MW-weighted average of a resource's capacity offers rather than a flat cap

- A resource class CPQR would reduce administrative burden
 - MSOC is already based on resource class Net ACR so it aligns with current process
 - Stakeholders would need to determine how to develop a reasonable resource class CPQR
- Individual units can still submit unit-specific MSOC values
- Still requires a maximum offer cap (e.g., 2x the MSOC, Net CONE)

e.g., MSOC = \$0, CPQR = \$30/MW-d, Capacity Accreditation = 100 MW

| | 1 | | 2 | | 3 | | 4 | | 5 | | Total | |
|-------------------|-----|----------|----|----------|----|----------|----|----------|----|----------|-------|----------|
| | MW | Offer \$ | MW | Offer \$ | MW | Offer \$ | MW | Offer \$ | MW | Offer \$ | MW | Avg. |
| Offer Structure 1 | 100 | \$ 30 | | | | | | | | | 100 | \$ 30.00 |
| Offer Structure 2 | 50 | \$ - | 50 | \$ 60 | | | | | | | 100 | \$ 30.00 |
| Offer Structure 3 | 30 | \$ - | 30 | \$ 25 | 30 | \$ 50 | 10 | \$ 70 | | | 100 | \$ 29.50 |
| Offer Structure 4 | 20 | \$ - | 20 | \$ 15 | 20 | \$ 30 | 20 | \$ 45 | 20 | \$ 60 | 100 | \$ 30.00 |
| Offer Structure 5 | 40 | \$ - | 20 | \$ 5 | 20 | \$ 30 | 10 | \$ 75 | 10 | \$ 155 | 100 | \$ 30.00 |
| Offer Structure 6 | 35 | \$ - | 30 | \$ 10 | 15 | \$ 30 | 15 | \$ 90 | 5 | \$ 175 | 100 | \$ 29.75 |

e.g., MSOC = \$20, CPQR = \$10/MW-d, Capacity Accreditation = 100 MW

| | 1 | | 2 | | 3 | | 4 | | 5 | | Total | |
|-------------------|-----|----------|----|----------|----|----------|----|----------|----|----------|-------|----------|
| | MW | Offer \$ | MW | Offer \$ | MW | Offer \$ | MW | Offer \$ | MW | Offer \$ | MW | Avg. |
| Offer Structure 1 | 100 | \$ 30 | | | | | | | | | 100 | \$ 10.00 |
| Offer Structure 2 | 50 | \$ - | 50 | \$ 40 | | | | | | | 100 | \$ 10.00 |
| Offer Structure 3 | 30 | \$ - | 30 | \$ 15 | 30 | \$ 40 | 10 | \$ 60 | | | 100 | \$ 10.00 |
| Offer Structure 4 | 20 | \$ - | 20 | \$ 15 | 20 | \$ 25 | 20 | \$ 35 | 20 | \$ 50 | 100 | \$ 10.00 |
| Offer Structure 5 | 40 | \$ - | 20 | \$ 5 | 20 | \$ 15 | 10 | \$ 35 | 10 | \$ 100 | 100 | \$ 9.50 |
| Offer Structure 6 | 35 | \$ - | 30 | \$ 10 | 15 | \$ 30 | 15 | \$ 50 | 5 | \$ 100 | 100 | \$ 10.00 |

Capacity Accreditation

- Short Term
 - Support the PJM-proposed accreditation for thermal resources
 - We are still eager to see the results of the accreditation
- Long Term
 - Accrediting resources based on their expected availability for given season, time-of-day would obviate the need for ELCC
 - More discussion on this in the long-term priorities
 - Would result in a more transparent accreditation methodology that resources and developers can plan to

Any changes to resource accreditation methodology in this CIFP process should not preclude discussions of alternative methodologies under a sub-annual Capacity Market framework in the future.

Reliability Risk Modeling

- Supports the PJM reliability risk modeling proposal using 50 years of historic data **but** with an adjustment to weight weather from more recent years more heavily than years farther in the past.
 - This would better capture recent trends and variability in weather modeling
- Different weighting for summer and winter
 - PJM will be winter peaking in the next decade. Since more severe weather events occur in winter than summer, weight historical winters more heavily than summer
- PJM should continue to revisit assumptions as electrification materializes across the system

Capacity Coalition 1: Short-Term Summary

- Maintain Must Offer Exception for renewables as long as Capacity remains an annual product
- Define PAI triggers and align Capacity Performance (CP) penalty risk with resource performance
- Allow sellers the flexibility to reflect risk in their Market Seller Offer Caps (MSOC)
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Capacity Coalition 2

Long Term Priorities After August 23

Replace Annual Price Signal to Incentivize New Entry to Solve Pending Capacity Shortfall and Ensure Continued System Reliability

Today's Situation

- PJM is anticipating a capacity supply shortfall by 2030.
- The current construct is incredibly complicated, was designed for legacy resources that are retiring and is ill suited to a changing resource mix.
- Insignificant time is available within the remaining 8 CFP sessions to vet a necessary market overhaul.
- PJM needs an additional process to explore, develop, and potentially implement a sub-annual construct.
 - This will likely require a transition period to a new paradigm. (i.e., target transition for the end of the decade rather than the next auction)
 - Simply remanding this work to the RASTF without a specified end date will likely result in stakeholder impasse
- **Any solutions coming out of this CFP process should not preclude future discussion of a sub-annual market**

RPM Can Be Significantly Improved

- Annualized price signal will not get future technology capacity built.
- Current RPM demand does not account for hourly system operational needs nor seasonal changes
- The single annualized auction price fails to match hourly supply/demand needs
- Resource Accreditation methods like ELCC estimations are black box tools, challenging to replicate and implement
- RPM is not aligned with actual resource availabilities, capabilities and risk
- RPM is designed for yesterday's resource mix of legacy units but does not send an appropriate market signal for the future with significant storage, solar, wind, offshore wind, DR, and DER resources.
- New resources must be attracted to PJM to prevent capacity shortfall.

New Construct Design Principles

- Maintain the framework of the current structure, while adopting and implementing a sub-annual/hourly framework
 - Retain 3 year forward market
 - Establish effective Stop Loss Limits and Penalties related to non-performance
 - Utilize PJM's expected enhanced reliability requirements
- Send a more granular market signal to incentivize entry of new products and recognize the resource attributes needed to replace retiring legacy units.
- Encourage competitive market response by utilizing a market that establishes dynamic supply/demand granular prices.
- Reform current RPM pricing to meet seasonal, daily, and even hourly variations
 - Original RPM was designed to meet summer peak loads with annual resources that no longer reflect the system conditions
- Establish new methods for resource accreditation (e.g., exceedance or p70/p95 output) and eliminate attempts to 'annualize' intermittent outputs (ELCC).

Seasonal, Time-Of-Day Market

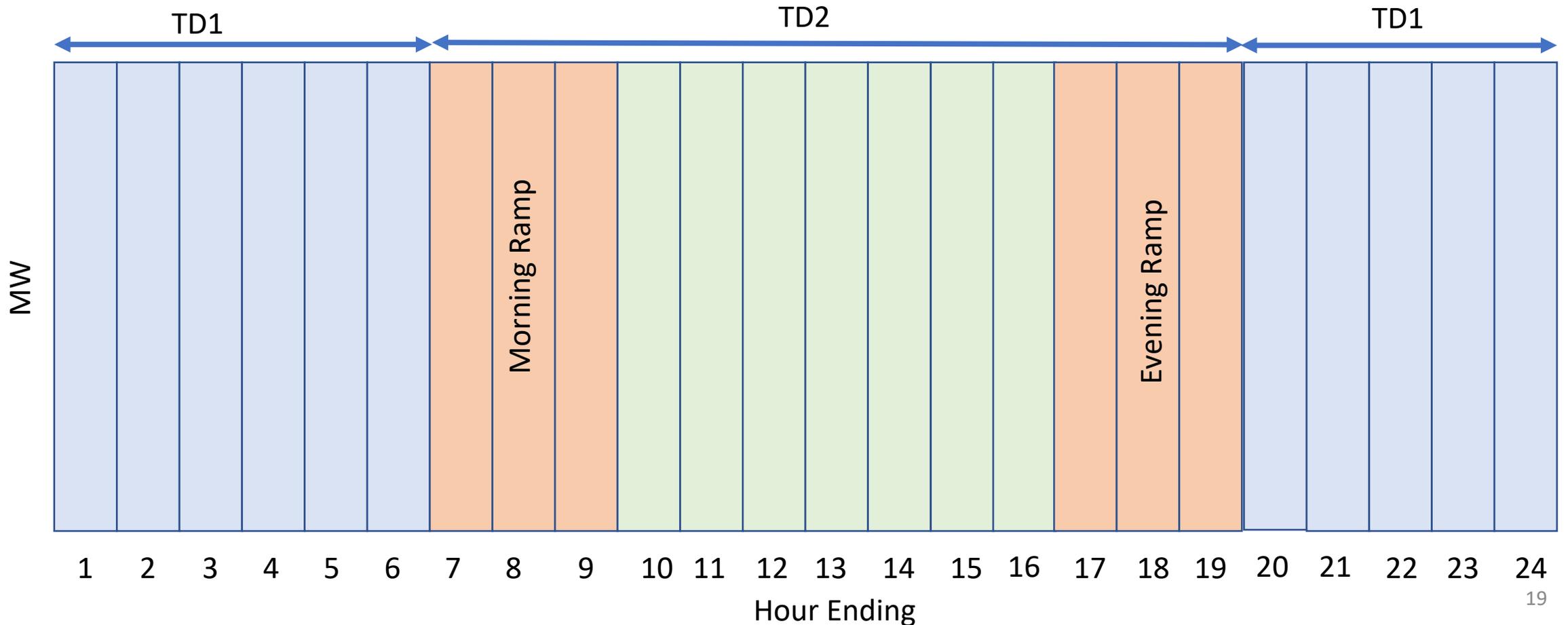
- A more granular Capacity Market could better capture differences in system needs throughout the operating day.
 - Including extreme weather overlays or periods for charging storage batteries.
- Time-of-day Demand Curves would be based on today's Variable Resource Requirements (VRR) curves.
- Reliability Criterion based on either LOLE or EUE from CIFP outcome.
- Supply offers based on expected Unit Unforced Capacity during each time-of-day
 - Obviates need for ELCC
- Supply would be paid for each interval clearing price, which are scaled by the hours in the time-of-day interval for that season
 - Somewhat aligns with the IMM proposal for annual market with hourly payment, but allows market to set interval price
- Penalties for non-Performance during committed intervals and testing
- Must Offer Requirement for all cleared resources under a seasonal, time-of-day model
 - Renewables would have a must offer requirement based on their minimum output during each cleared interval (e.g., based on their 8760 at the p90 value)

Where to Start?

- We recommend a transition from today's annual market to a more granular Capacity Market.
- To eliminate clearing capacity that is unavailable at times, an hourly market would provide the most reliable signal.
- However, moving from Annual to Hourly is not feasible in one auction cycle.
- We recommend that PJM begin the move to Seasonal with a minimum of two time-of-day intervals and four seasons.
- After one or two auctions PJM should move to a monthly time-of-day market with four intervals.
- Future moves to greater granularity will be based on future system needs and auction capabilities.

Ex1: Season with two Time-of-Day intervals (TD)

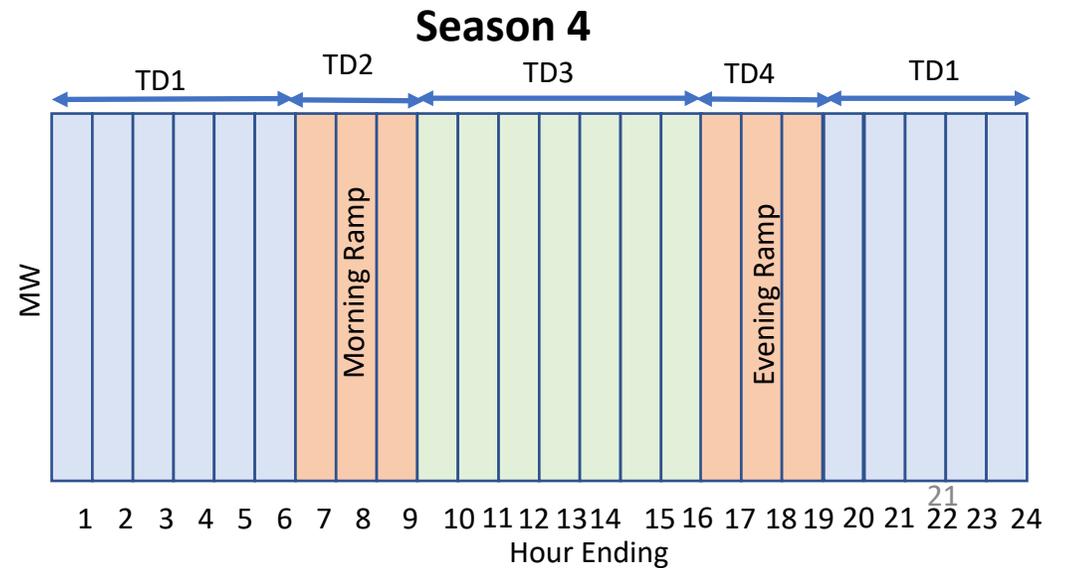
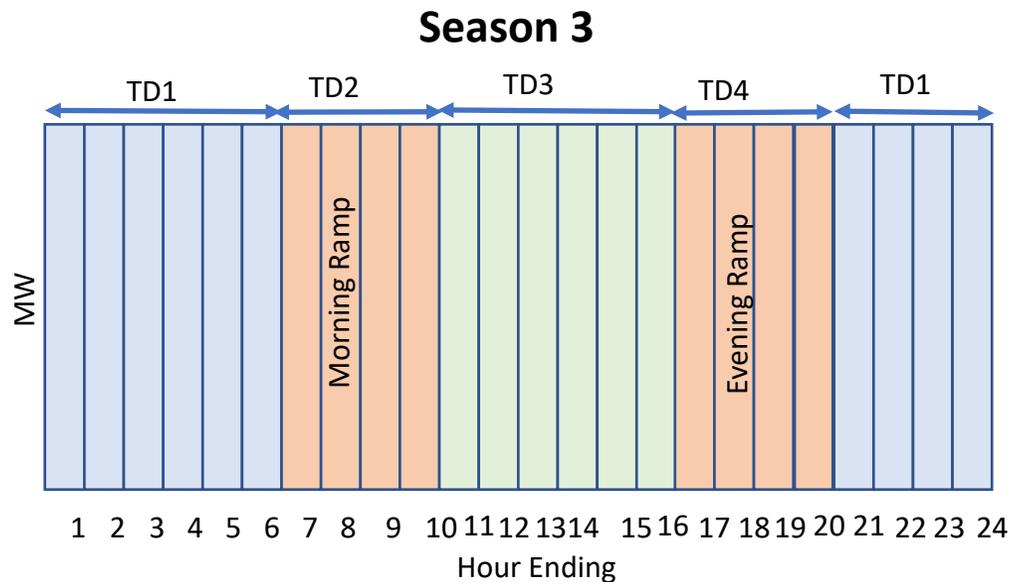
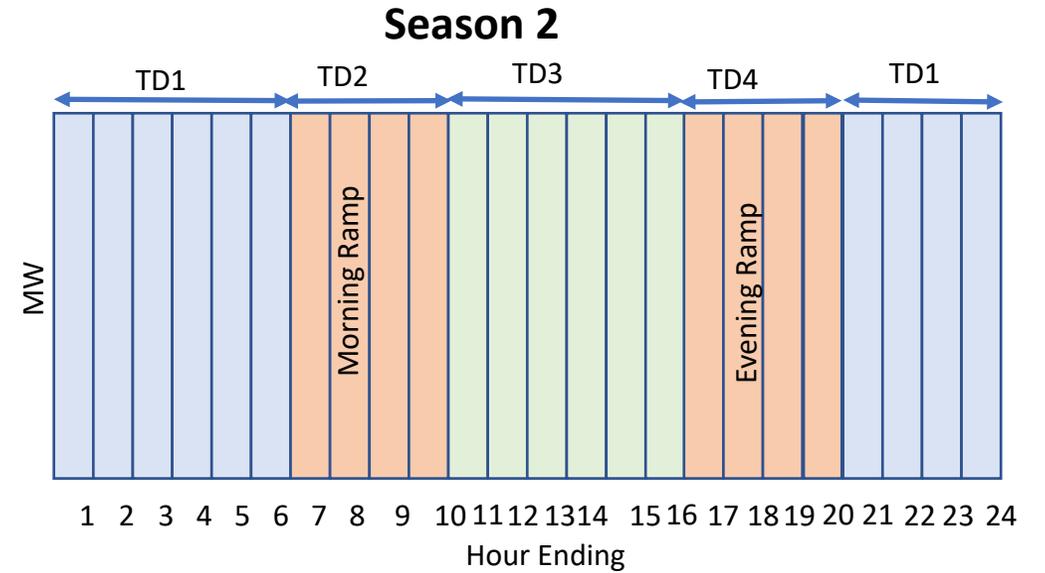
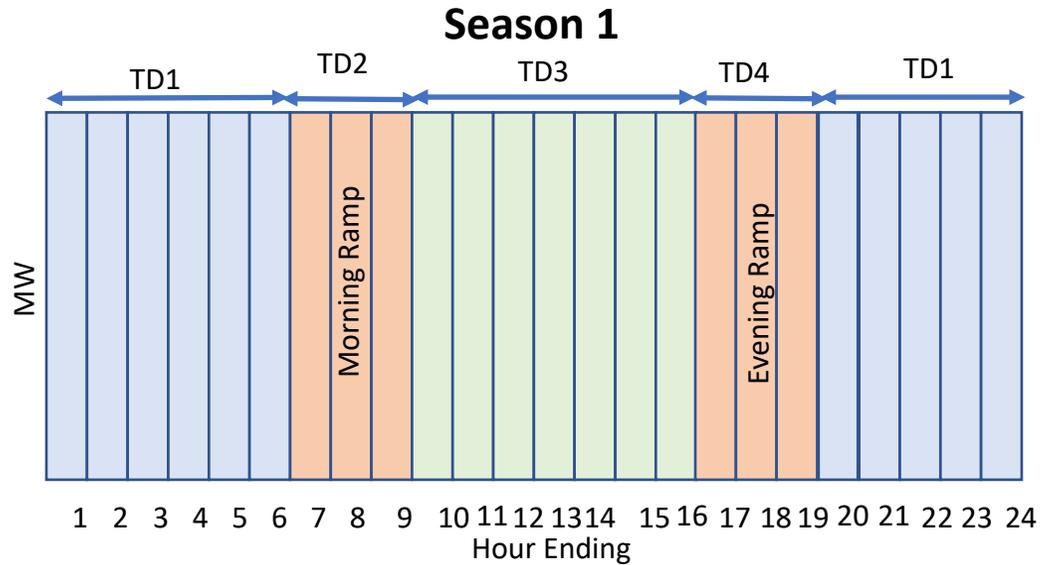
One Season with two Time-of-Day (TD) intervals Off-Peak (TD1) and Peak (TD2)



Transition to Seasonal, Time-of-Day Model

- Annual Market with time-of-day may be the first step to the seasonal construct, but this has limitations
 - Does not recognize hourly demand forecast variation across seasons
 - Does not send an appropriately granular price signal to encourage market responses
 - What is the system value for different intervals of storage in future
 - What hours are most valuable for DER/DR participants or aggregators?
- Initial Seasonal Capacity Auction with granular time-of-day intervals
 - We recommend starting with four seasons
 - The time-of-day interval should be different for each season
 - Demand curves for each season and time-of-day calculated based on the same principles as single season

Ex 2: Four Season with Four DPs



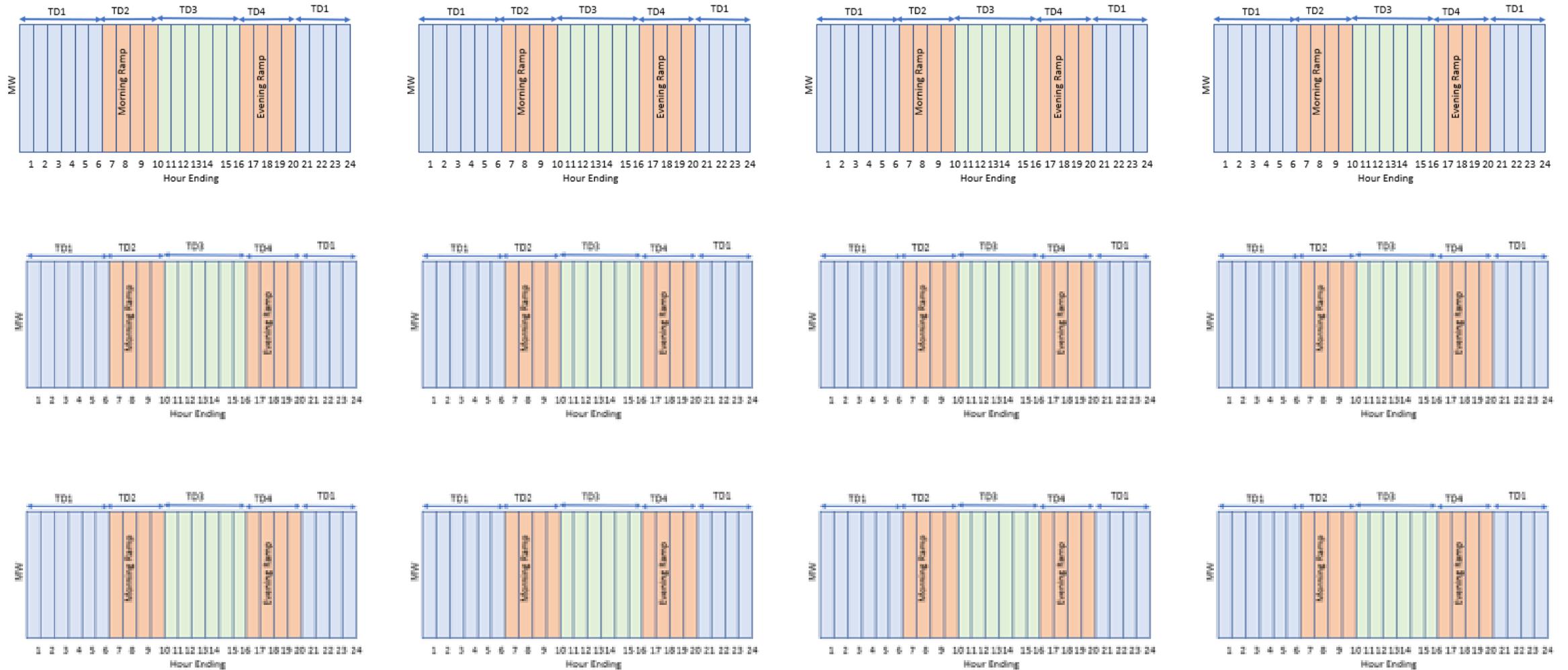
Ex 2: Four Season with Four TDs

- Preferred starting point for seasonal implementation
- Reasonable balance between complexity and reflection of actual unit availabilities
- Retains 3 year forward auction and most RPM rules
- Annual BRA runs simultaneously for each season and time-of-day intervals. Offers can be the same for all intervals if qualified.
- PJM's VRR curve demand is defined for each Season/TD combination per year
 - e.g., 4 seasons x 4 TDs = 16 VRR Demand Curves
- Auction produces different Clearing Prices and MW commitments for each Season/TD combination
- Additional consideration for zonal requirements
- Allows PJM to adjust VRR demand for extreme weather and future battery charging additional demand

For future consideration:

- How many seasons do we ultimately have?
- How does the interval lengths change each season?
- How do we account for locational unit output differences in the time-of day?
- How does this interact with CIRs?

Monthly with Four TDs by 2030 Auction



Capacity Coalition 2: Long-Term Summary

- Annualized price signal will not get future technology capacity built.
- RPM is not aligned with actual resource availabilities, capabilities and risk
- Maintain the framework of the current structure, while adopting and implementing a sub-annual/hourly framework
- Encourage competitive market response by utilizing a market established dynamic supply/demand granular prices
- Institute monthly with four intervals by 2030

Company Supporters

- AES
- Leeward Renewable Energy
- Pine Gate Renewables
- Orsted*
- Cypress Creek Renewables*

* Specifically supporting the Capacity Coalition 1 – Short Term Priorities