



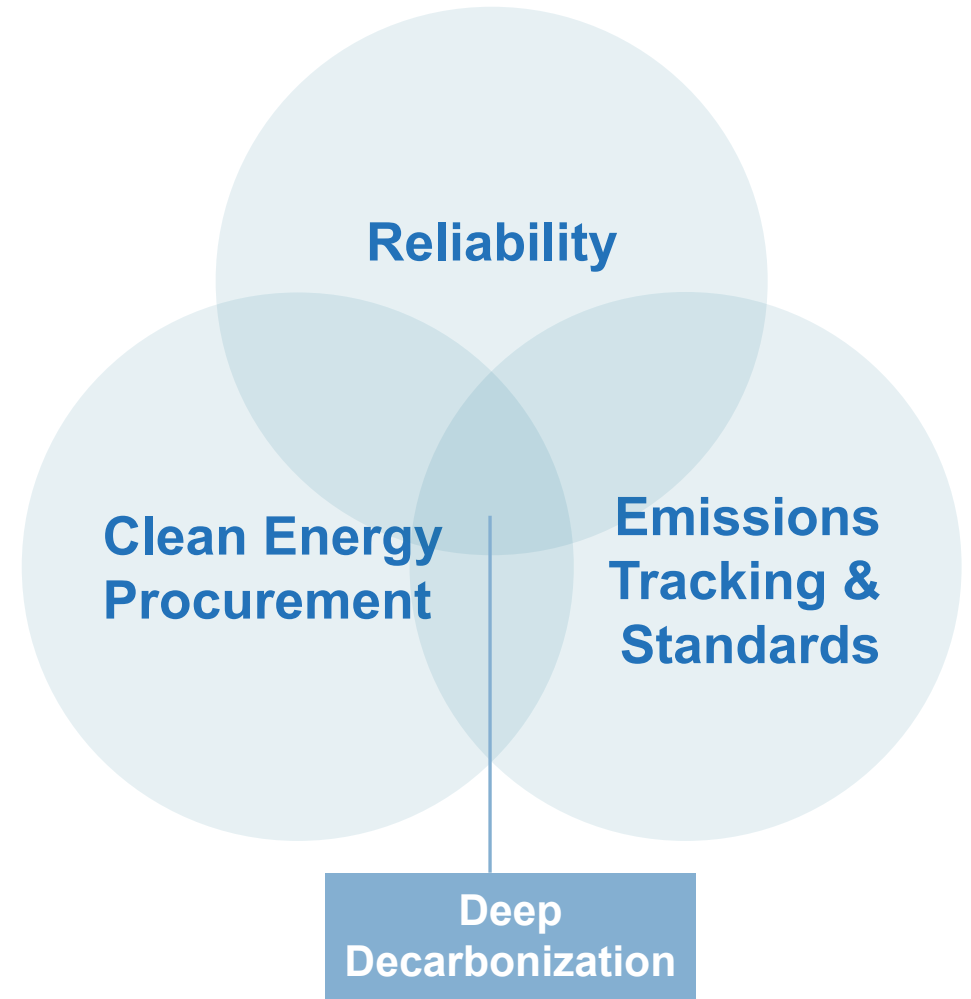
PJM CAPSTF Hourly Attribute Considerations

Constellation

May 2023

Reliability Is a Core Consideration Guiding the Evolution of Attribute Markets

- Ensuring reliability is central to PJM’s mission, and is the focus of a contemporaneous Critical Issues Fast Path (CIFP) process
- Reliability and clean energy procurement are being treated separately, and doing so may be appropriate from a process standpoint, but they are not functionally distinct
 - CAPSTF market design options should be structured to accommodate the solutions implemented as part of the CIFP, in part because CIFP is designed to be concluded by this fall while CAPSTF is not under the same time constraints, and in part because reliability is paramount
- The resource-neutral FCEM design, with the enhancement of structuring the products as blocks of hourly attributes (e.g. FCEM+), is a viable evolution of the current framework
 - It supports reliability by targeting the types of CFE resources that will be available when we need them
- We suggest that after the May discussion, the CAPSTF resume meetings in mid-August. The additional time will allow PJM’s near-term reliability reforms to be the near-term priority and facilitate further analysis of PJM’s data, which will in turn allow for refinement of clean attribute procurement proposals



FCEM+ for Voluntary Hourly Attribute Procurement

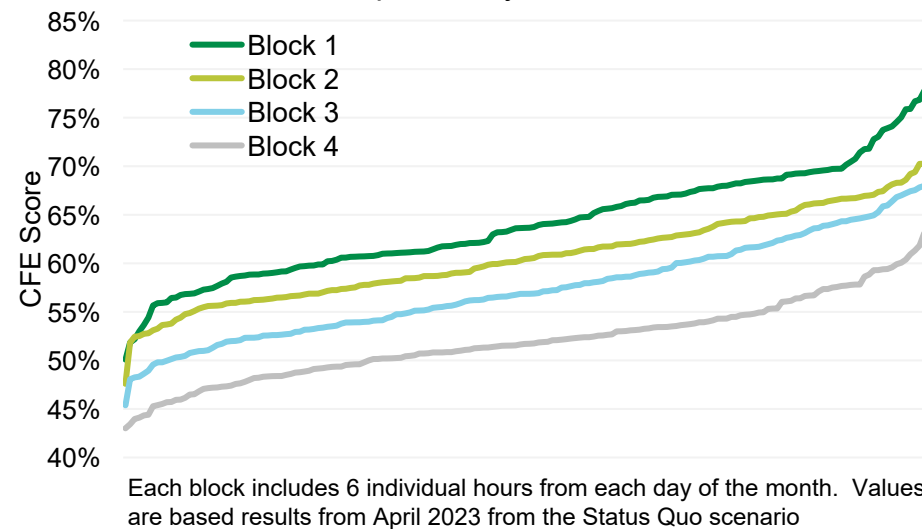
- This basic structure can be adapted to facilitate compliance purchases if states mandate hourly matching as part of RPS/CES, or if compliance entities wish to explore matched procurement for one or more segments of load to be served
- FCEM+ establishes a price signal to spur the development of clean energy resources that align with customer demands
- A true-up to reconcile realized load and actual production from resources selling into the market can be managed bilaterally or through a separate organized exchange

Design Components	Package A: FCEM/FEAM (Voluntary)
Product Definition	<ul style="list-style-type: none"> • Debut with the CEAC product (as the most inclusive and truly resource-neutral) • The geography should be entire PJM region or physically deliverable into the balancing area • Auction horizon could be consistent with RPM, though longer or shorter tenors are possible depending on buyer and seller interest
Demand Participation Model	<ul style="list-style-type: none"> • Representative hourly demand profiles are aggregated to facilitate liquidity • Aggregate profiles can be subdivided into monthly or seasonal blocks, consisting of one or more hours of each day during the block time period • Each block is for 1 MWh, delivered during the relevant time period • Blocks can also be standardized, though the process for identifying the most viable structure will require iteration
Supply Participation Model	<ul style="list-style-type: none"> • Sellers develop offers for as many blocks as they can supply
Procurement Mechanism/Auction Structure	<ul style="list-style-type: none"> • Buyers and sellers submit volume and pricing preferences • Auction is conducted in a single round, with a uniform clearing price for each block
Market Power Monitoring and Mitigation	<ul style="list-style-type: none"> • Buyers and sellers both submit pricing preferences, and blocks with large bid-offer spreads may fail to clear

Identifying the Appropriate Procurement Method Will Require Analysis & Experimentation

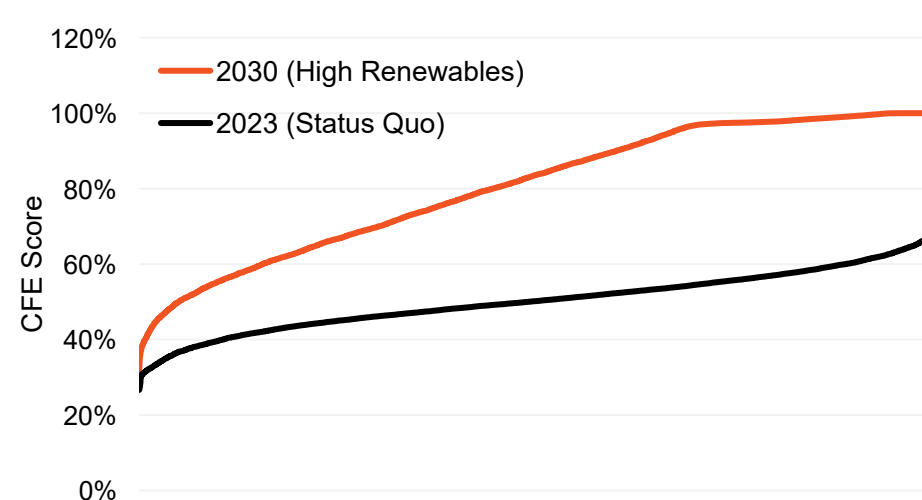
- PJM’s important analytical efforts supporting the CAPSTF, and the voluminous data provided to stakeholders as the result of that work, yield insights on how to structure the forward blocks and other elements of the market
- Here, we use CFE score (CFE gen divided by load, capped at 100%) to identify daily, monthly, and seasonal patterns that may inform the composition of the blocks
 - Blocks with high CFE scores will likely correspond to periods of higher hourly EAC prices, all else equal
 - Within a month or a group of months, hours can be grouped into blocks that balance a potential preference for adjacency (i.e., consecutive hours) with similarity in CFE score, as shown in the top chart
- The block structures will likely evolve over time reflect changes in the demand for carbon free energy and both the composition and quantity of supply, as shown below

Illustrative April Hourly CFE Block Duration Curves



Hour Ending	Block
1	3
2 - 5	2
6	3
7	4
8 - 9	3
10	2
11 - 16	1
17	2
18	3
19 - 23	4
24	3

Illustrative Annual CFE Duration Curves



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