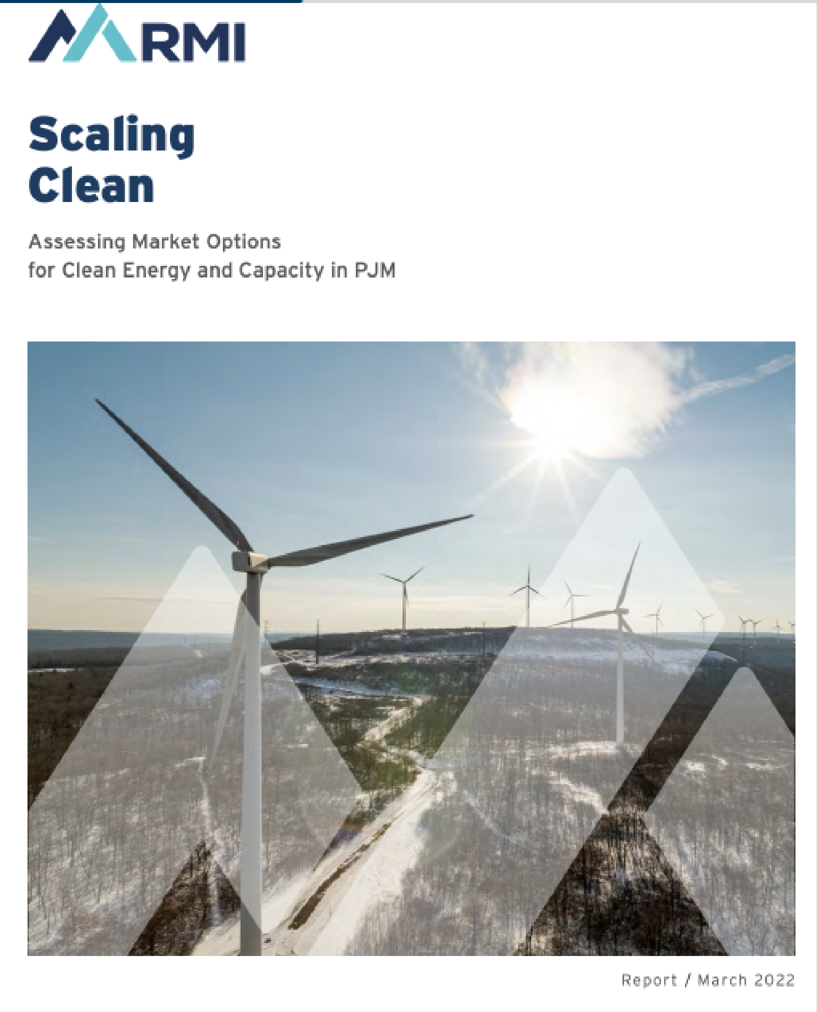
Scaling Clean: Assessing Market Options for Clean Energy and Capacity in PJM

RMI analysis of two clean procurement options (FCEM and ICCM) in PJM

For July 28, 2022 CAPSTF meeting



Presentation Outline

I. RMI report in the context of the current CAPSTF solutions space

II. Background for report development

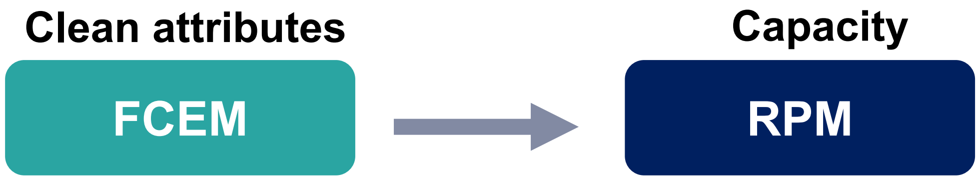
III. Key findings from RMI analysis

IV. Recommendations for CAPSTF in light of report findings

V. How to apply this moving forward

Clean procurement solution set

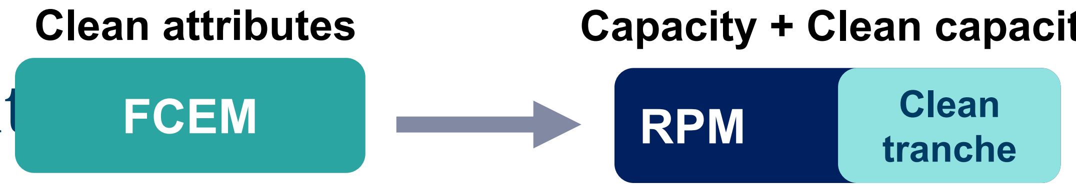
✓Forward Clean Energy Market (FCEM)



✓Integrated Clean Capacity Market (ICCM)

- Clean capacity constraint in RPM

- Hybrid of FCEM + clean capacity constraint



Reformed regional markets are the best way to meet carbon and clean energy goals on time and at least cost

We conducted this analysis in response to concerns about the efficacy of achieving carbon/ clean energy policies set by state and voluntary buyers under existing PJM market structures.

Challenges with the status quo

- Clean energy targets are met through procurement structures that are **time-intensive**, face **transaction costs**, and can be **handicapped by RTO rules** that challenge clean resources' ability to participate in markets.
- Clean energy targets do not always account for the **locational and capacity value** that resources can provide if sited and procured strategically at the regional level.
- Clean energy targets are **challenging for smaller or less sophisticated buyers** to enact, artificially limiting the demand for these resources.

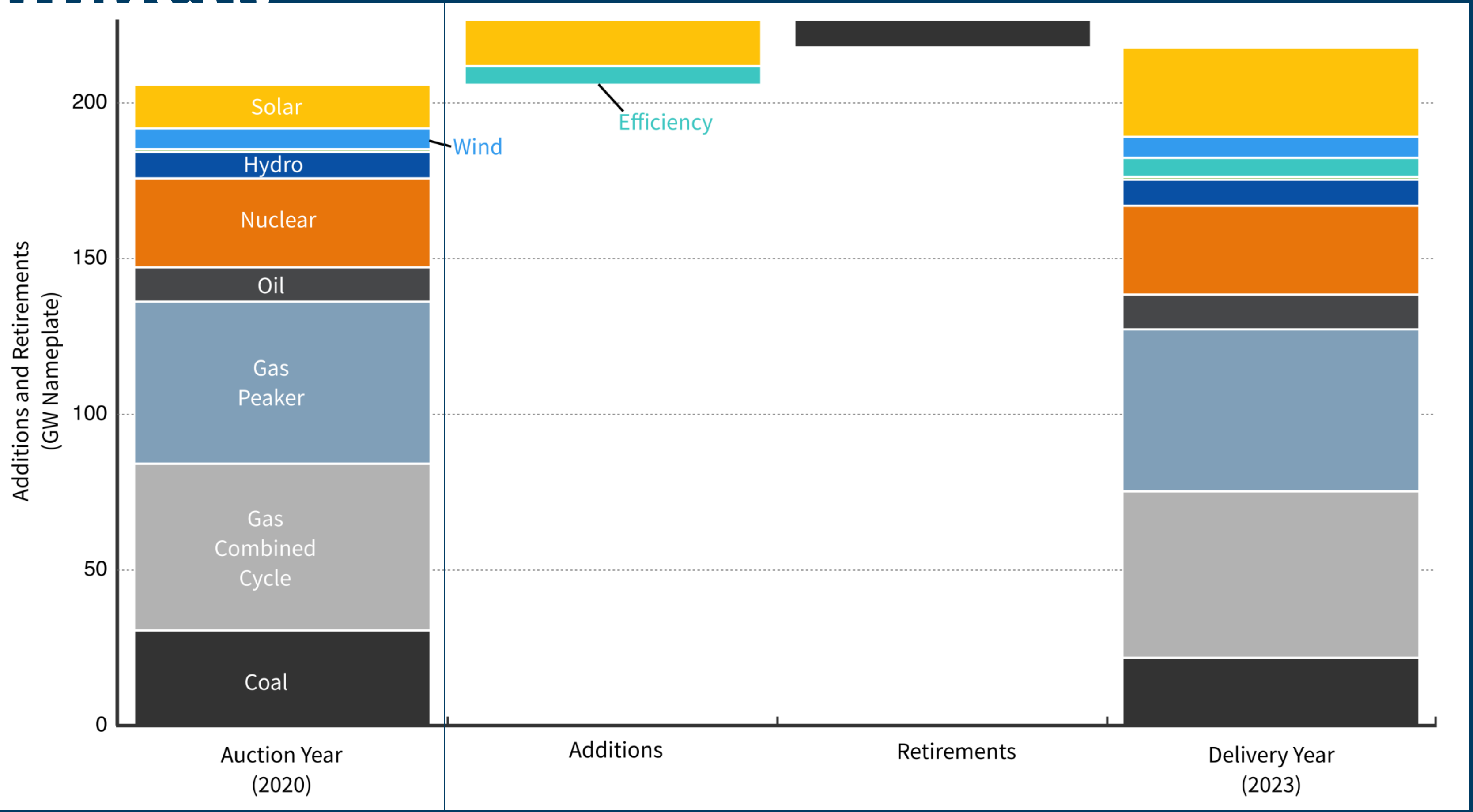
Without market reforms, there is a risk that buyers' goals will be delayed or frustrated, an outcome misaligned with PJM's strategic pillar of facilitating the decarbonization that its customers demand.

RMI modeled FCEM and ICCM designs in a PJM-like system to show cost, reliability, and emissions impacts

Define the existing grid

Run market(s) simulator

Analyze outcomes



We start with this system and run it through our market simulator

Four findings in our analysis support the continued exploration of a clean energy market

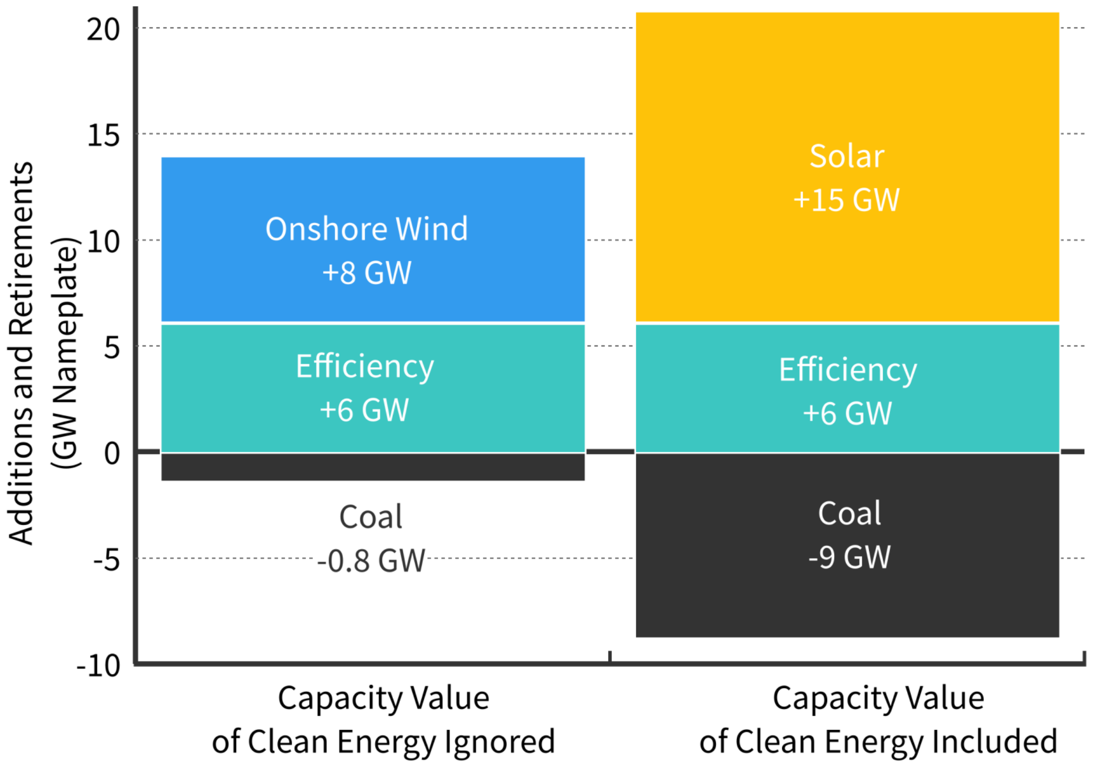
Fully accounting for the capacity value of clean resources lowers clean energy procurement costs and reduces system emissions.

A clean energy market makes it more likely that clean energy procurements are least-cost.

Carve-outs have cost and emissions implications that should be considered carefully with their benefits.

New demand from voluntary buyers can accelerate clean energy deployment, reduce emissions, and reduce costs for all.

Finding 1: Fully accounting for the capacity value of clean resources can reduce cost and emissions



CEAC total costs: ***$2.7 B/Year*** *(left) versus* ***$2.5 B/Year*** *(right)*

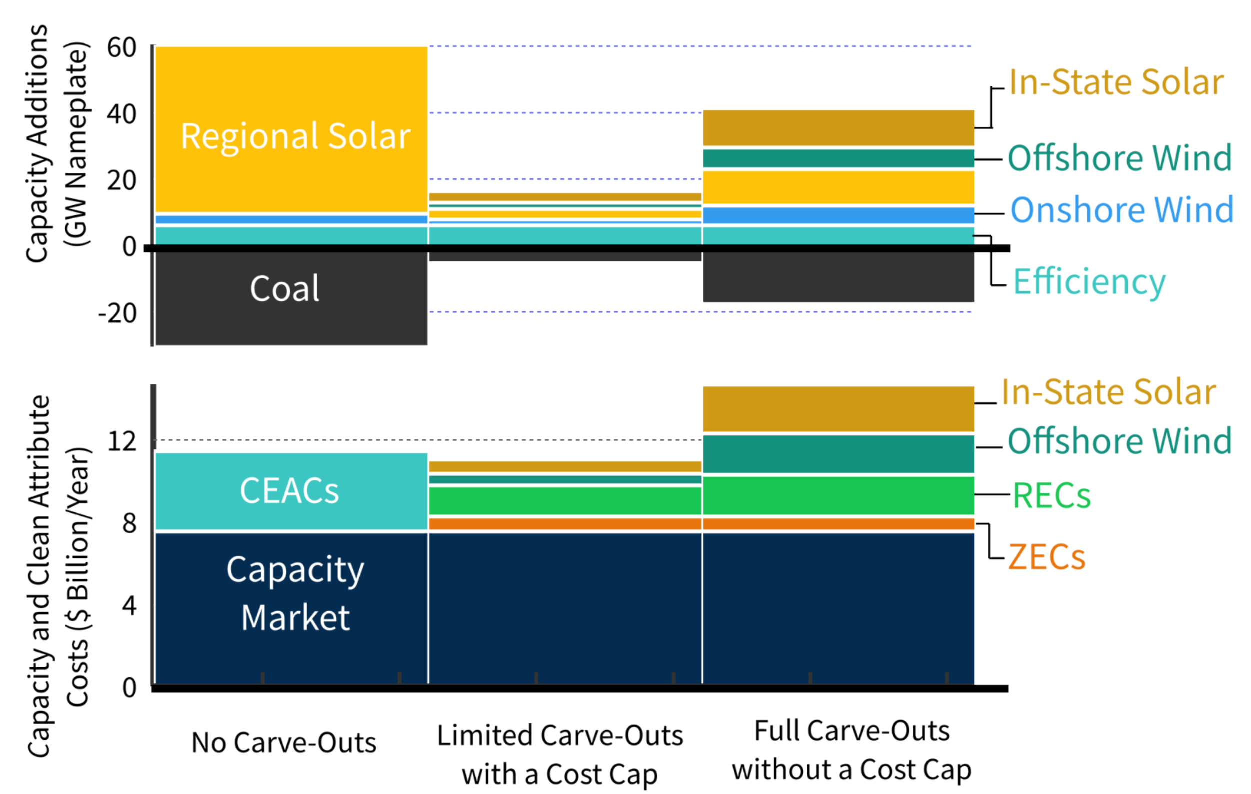
- Both scenarios achieve 40% clean energy generation
- Procuring clean energy with higher capacity value (e.g., solar) lowers costs of clean attributes
- Ensuring that performance obligations are just and reasonable for renewables will encourage their participation in the capacity market. Some of this work is active in the RASTF.

Finding 2: A clean energy market makes it more likely that clean energy procurements are least-cost

Market design	*How must market participants behave for this market to achieve clean energy and capacity targets at least cost?*
Status quo	• REC and ZEC suppliers must accurately predict their capacity market revenues and net these out of REC/ZEC offer prices. • Buyers must choose the least-cost REC and ZEC offers to meet their clean energy targets.
FCEM	• CEAC (clean energy attribute credit) suppliers must accurately predict their capacity market revenues and net these out of CEAC offer prices. This may be easier because the FCEM auction is sequenced with the capacity auction. • Buyers must choose to meet their clean targets through CEAC purchases.

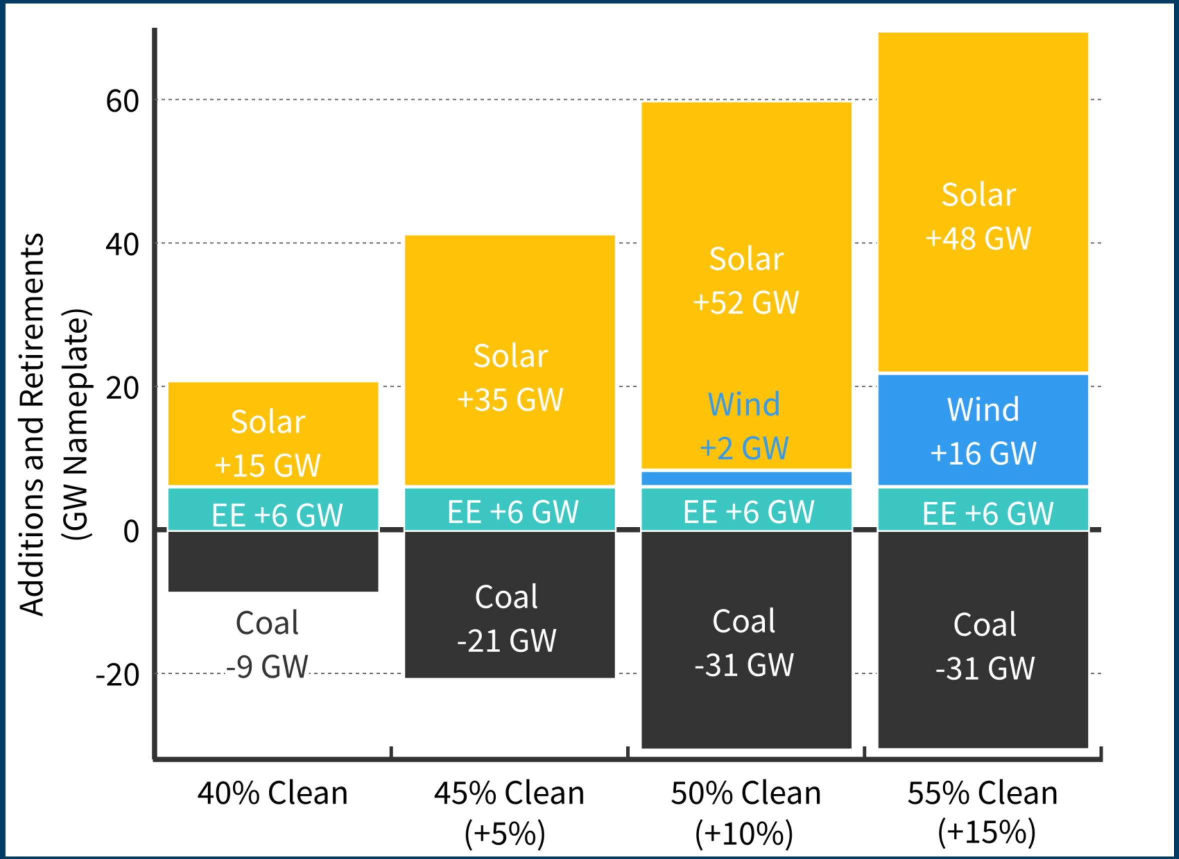
The FCEM and ICCM may better mitigate against imperfect information and non-competitive behavior than the status quo

Finding 3: Carve-outs have cost and emissions implications that should be considered carefully with their benefits



- The "no carve-outs" scenario reduced emissions the most, suggesting that states could reduce carbon emissions faster with a standardized product
  - No carve-outs: 60% CO2 reduction
  - Limited carve-outs: 10% CO2 reduction
  - Full carve-outs: 40% CO2 reduction
- Carve-outs also provide legitimate benefits like local economic development

Finding 4: New voluntary demand can accelerate clean energy deployment, reduce emissions, and lead to cost savings across PJM



- In a clean energy market, cities, corporates, and individuals could also submit demand offers for clean energy attributes
- If voluntary buyers increase clean energy demand from 40% to 55%, system emissions decrease 60%
- Increased clean energy deployment can reduce capacity prices and save PJM customers money

Informed by our analysis, we recommend:

1. PJM and stakeholders should continue exploration of clean procurement options and pursue reforms that remove barriers to the participation of clean energy resources in PJM markets.

2. States and other interested buyers should work together to define a standardized clean energy product (perhaps building from overlap between Tier I REC definitions) that could be competitively procured throughout PJM.

3. Ensure a new clean procurement construct fosters participation from as many willing buyers as possible to maximize competition, cost savings, and emissions reductions.

4. Prioritize approaches that accelerate near-term clean energy deployment (to ensure on-time achievement of clean energy goals), can be adaptable to changing needs as decarbonization progresses, and are politically feasible.

Pros and cons of clean procurement solutions

FCEM

Pro:
As its own separate market, offers flexibility in implementation & governance

Con:
Benefits of competition and least-cost outcomes decline the more products

ICCM

Pro:
Maximizes capacity value of clean procurements

Con:
Implementation poses legal and logistical hurdles (further coordination with RASTF,

Clean capacity constraint

Pro:
Incents all non-emitting resources, including renewables, storage, and EE/DR

Con:
Declining ELCC of clean resources may limit efficacy over time

We hope our analysis supports CAPSTF work by:

- Informing the analysis request and quantitative study that PJM will undertake
- Highlighting some of the fundamental design components this group will need to talk through, for example:

Design Component	Key Question(s)
Product definition	• Is it an attribute or capacity product? • Single/limited, or multiple products? • What information is tracked by the product?
Procurement mechanism	• Existing or new market? • What are the operating rules?
Governance and participation	• Is this market run within or outside PJM? • Who has oversight? • Who can participate?