Opportunities and Challenges for a Regional PJM Clean Energy Market

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Presentation Outline

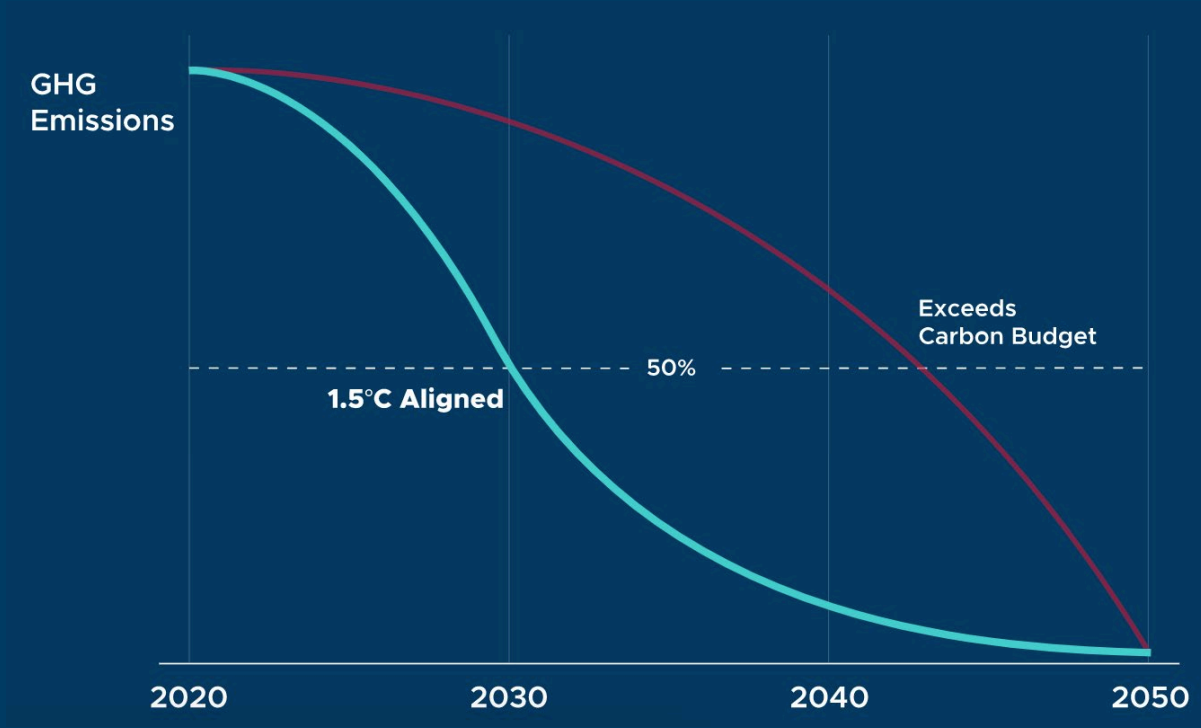
1. Introduction to RMI and our PJM work
2. Summary of our findings, based on analysis and conversations with PJM stakeholders
3. Recommendations to the RASTF

RMI works to catalyze rapid, market-based change at the scale required for a 1.5° C future

RMI MISSION STATEMENT

Transform the global energy system to secure a clean, prosperous, zero-carbon future for all

- **Global programs:**
  - Carbon-Free Electricity
  - Carbon-Free Buildings
  - Carbon-Free Mobility
  - Climate-Aligned Industries
  - Breakthrough Technologies
  - Climate Intelligence
  - Urban Transformation
  - Strategic Engagement & Analysis



Over the last year, we have been conducting analysis and talking with states, developers, utilities, advocates, and PJM

Objective of our recent PJM work

Clarify the opportunities of and challenges for a centralized clean energy market in PJM

Discussions with PJM stakeholders*

- State regulators
- Clean energy developers
- Corporate buyers
- Clean energy advocates
- Utilities
- PJM staff

Analysis of market designs

- Created a "simulator" that shows how the decisions of market participants impact outcomes in different clean energy and capacity procurement approaches
- We plan to publish our findings in early March

*We do not claim to speak for any other group

Our analysis reveals how the decisions of market participants impact outcomes in different market designs

- Our analysis tool uses a *simplified PJM grid* to simulate 1) the status quo; 2) a Forward Clean Energy Market (FCEM); and 3) the Integrated Clean Capacity Market (ICCM).
- Because assumptions about market participant behavior impact the results, our analysis cannot claim to reveal the "best" market design.

Define the existing grid

1. Hourly electricity demand
2. Existing generators
3. Demand for capacity
4. Demand for clean energy
5. The cost to build new resources

Run market simulator

1. Define the bid prices for existing and new resources
2. For the auction year, procure clean energy and capacity per the market rules
3. For the delivery year, simulate 1 year of hourly dispatch

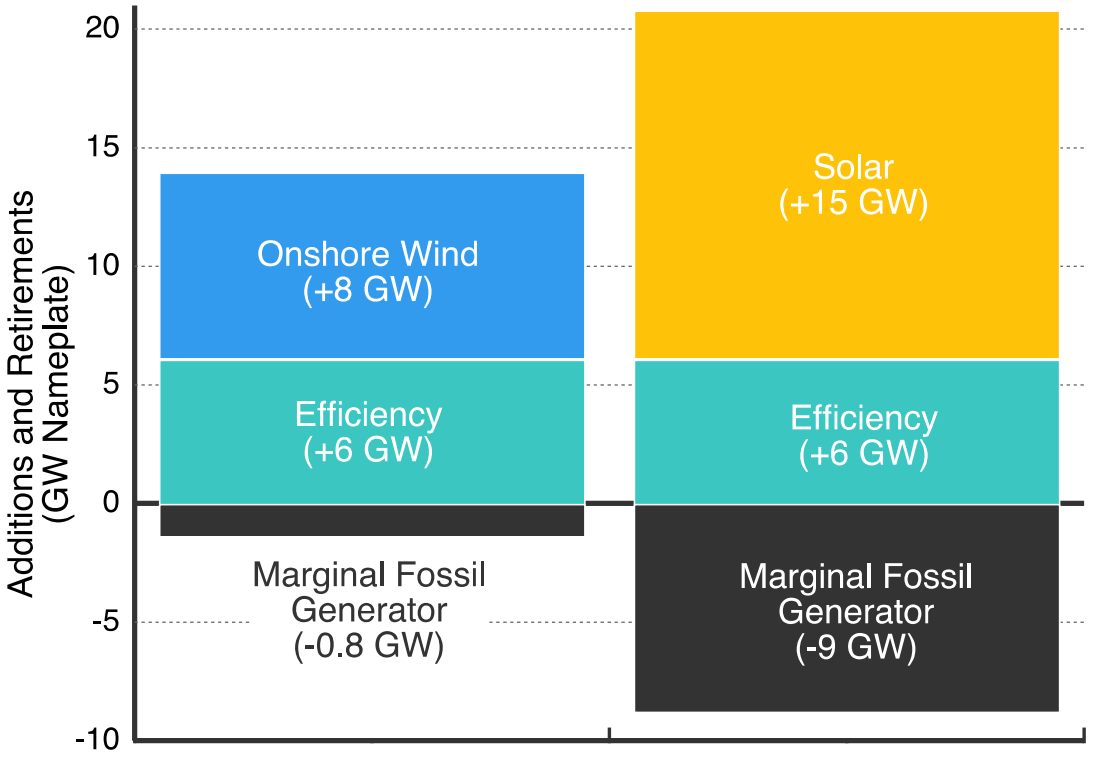
Analyze outcomes

For each market design, compare what clears the auction(s) and how generation is dispatched to meet load

The problem today: Clean energy procurement does not fully account for resources' capacity value

- The many REC definitions limit competition and increase transaction costs and complexity.
- Clean energy procurement often neglects resources full capacity and locational value.
- Some clean energy resources do not participate in the capacity market.
- **Our analysis shows that if capacity values are included in clean energy procurement, it accelerates emissions reductions and reduces system-wide costs.**

Capacity auction results from RMI markets simulator

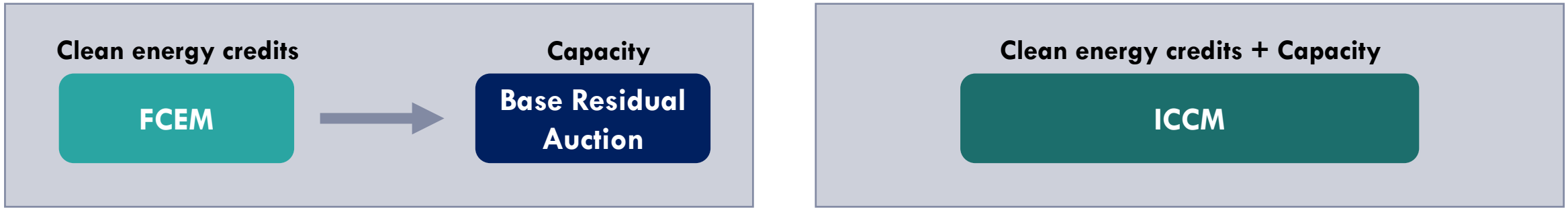


Outcome when clean resource capacity value is ignored

Outcome when clean resource capacity value is included

Both the FCEM and ICCM are likely to better incorporate capacity value into clean energy procurement

Procurement sequencing:



- Both are three-year-forward markets, and thus naturally connected to the capacity market (however, the FCEM is designed to immediately precede the BRA).
- Both designs could help ensure clean energy and capacity procurements select a resource mix that cost-effectively meets both goals.
- Both designs would add transparency and are likely to increase competition.
- The designs also have important differences that merit further study.

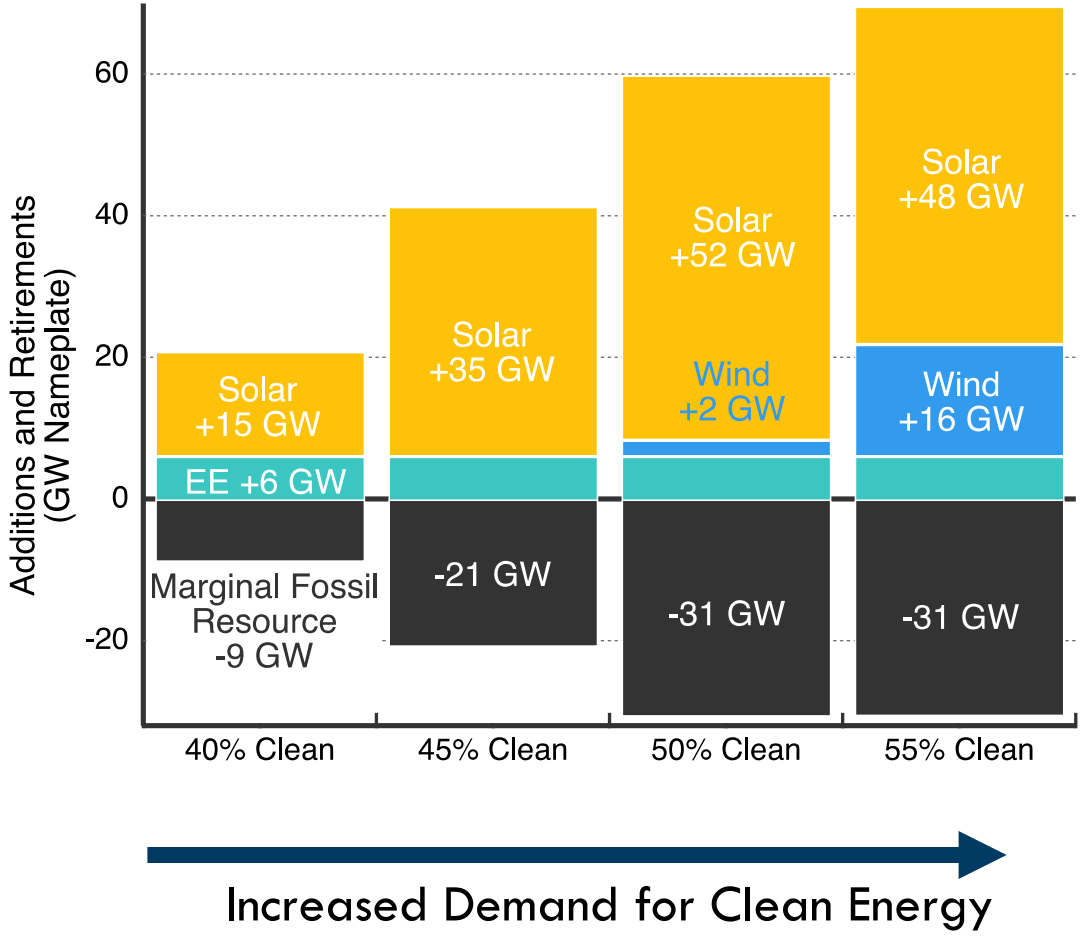
A centralized clean energy market could attract more participation and accelerate emissions reductions

Our "Build it and they will come" hypothesis

If submitting bids to a region-wide clean energy market were simple, competitive, and shown to be both "additive" and effective at reducing emissions, the market would attract more buyers.

Additional demand for clean energy in a market that accounts for capacity value both 1) lowers capacity market prices and 2) encourages more expensive fossil generation to retire.

In an ICCM or FCEM, increased clean energy procurement cost-effectively accelerates emissions reductions



For a centralized clean energy market to be effective, the market design must meet key enabling conditions and buyers & sellers must agree to participate.

Clean energy buyers

- ✓ Agree on a standardized "CEAC" definition that can meet the majority of regional clean energy demand
- ✓ Sustain and grow CEAC demand over time

Clean energy market

- ✓ Increase transparency and competition
- ✓ Support state policy goals
- ✓ Provide the revenue certainty that developers need for financing

Clean energy suppliers

- ✓ Account for their capacity value in CEAC price formation
- ✓ Participate in both clean energy and capacity markets

PJM and stakeholders should continue to explore centralized forward clean energy procurement

Question PJM posed to stakeholders	RMI response
What is the problem to be solved?	Clean energy procurement today is complex and may not fully reflect resources' capacity value.
What is PJM's role?	PJM should support continued discussion and work with stakeholders to define the "product" and evaluate clean energy market designs.
Should forward procurement of clean resource attributes be pursued?	Yes, continued conversations should focus on the relative advantages / challenges of each design and on how the enabling conditions can be met.
What market is the product aligned with and what is the appropriate stakeholder venue?	We believe the RASTF is an appropriate venue for continued conversations because, today, capacity value is not adequately incorporated into clean energy procurement. Of course, the most closely aligned market depends on the product definition.