



Clean Energy Market Structures

Clean Attribute Procurement Senior Task Force

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New Jersey Board of Public Utilities

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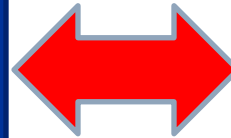




New Jersey Energy Policy

Competitive Mandate:

- Markets drive lowest cost, reliable outcomes
- NJ operates a restructured electricity market



Clean Energy Mandates:

- 100% Clean Energy by 2050
- 50% Renewable Portfolio Standard by 2030
- 30-40% nuclear



How do we harmonize these imperatives?



Findings From New Jersey's Resource Adequacy Investigation

1. Incorporating New Jersey's clean energy goals in the regional market is the most efficient way to provide New Jersey consumers with reliable, affordable, and carbon-free electricity.
2. Existing PJM markets have fulfilled their design objectives to maintain reliability at competitive prices, but do not adequately include state clean energy policies.
3. Without further reform, the PJM market will continue to attract investments in new fossil fuel plants rather than clean energy resources.
4. If a PJM regional solution is delayed or proves infeasible, New Jersey should re-evaluate the option to exit the PJM Capacity Market and implement a single-state or multi-state ICCM under the Fixed Resource Requirement (FRR) alternative.

The Board's charge to Staff was to examine:

"whether New Jersey can achieve its long-term clean energy and environmental objectives under the current resource adequacy paradigm and, if not, recommend how best to meet New Jersey's resource adequacy needs in a manner consistent with the State's clean energy and environmental objectives, while considering costs to utility customers."

- In the Matter of: Resource Adequacy Alternatives, March 27, 2020



Including Customer Clean Energy Demand Results in PJM's Markets Lowers Prices

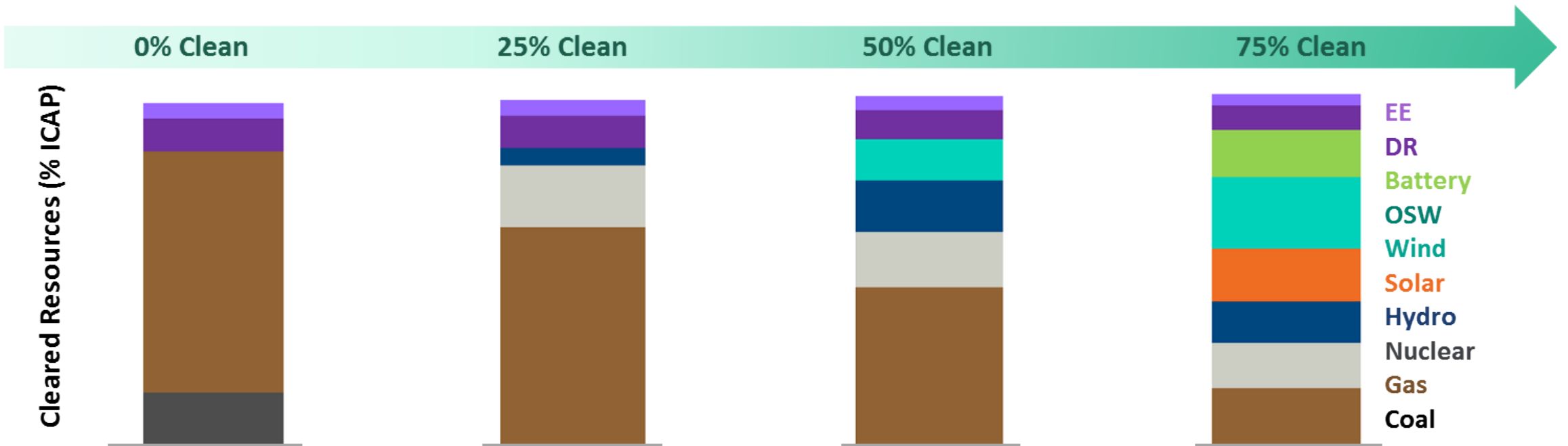
- Today's PJM markets identify a system mix that is:
 - › Lowest cost *and*
 - › Reliable (as determined by PJM's existing metrics)

- Tomorrow's PJM market *should* identify a system mix that is:
 - › Lowest Cost *and*
 - › Reliable (as determined by PJM's existing metrics) *and*
 - › Meets aggregate clean energy demand



Clean Energy Targets Change Optimal System Mix

State mandates for clean energy would increase over time, driving a least-cost pathway to a cleaner grid

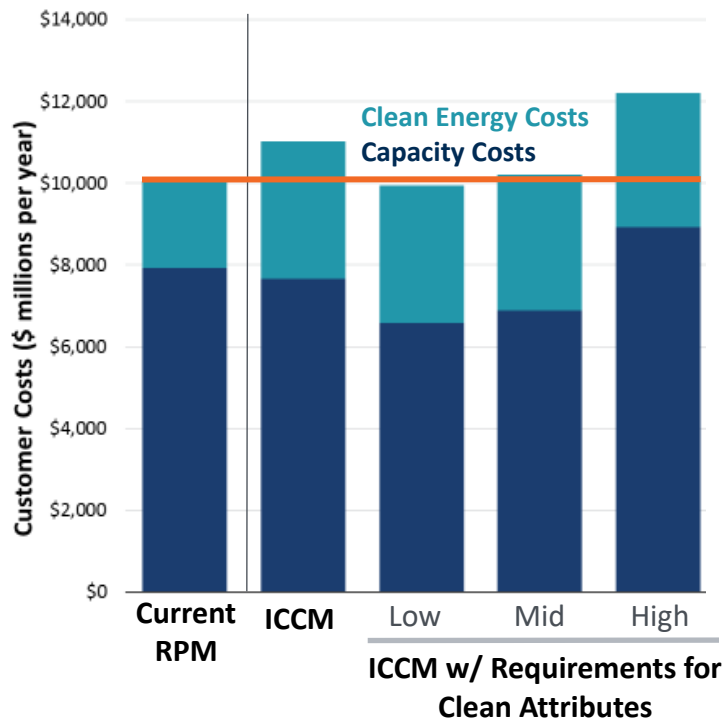




Modeling of an ICCM Structure

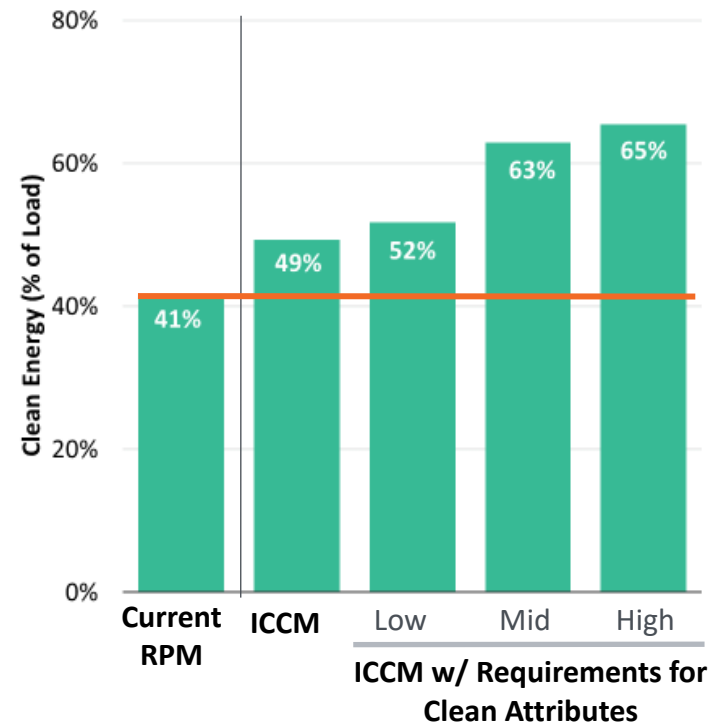
Costs

Customer cost impacts are modest if relying on regional competition



Energy Mix

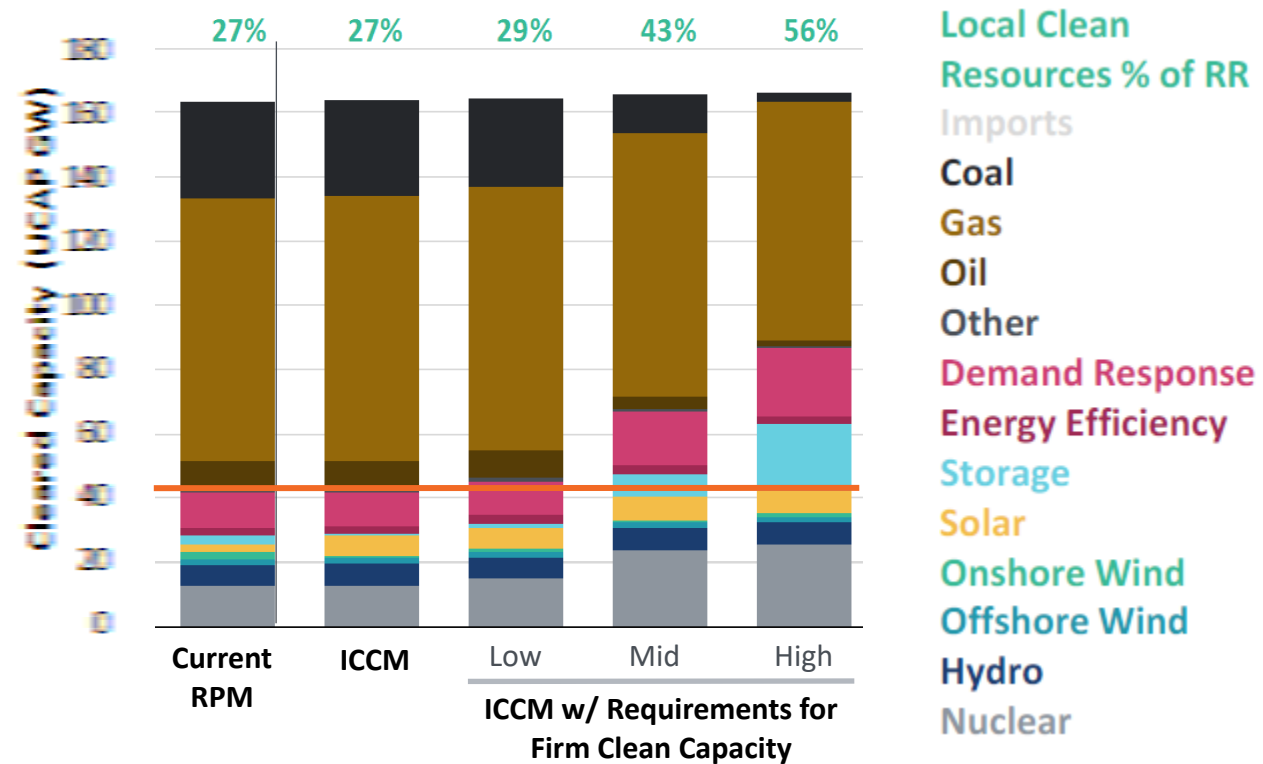
Regional marketplace can substantially accelerate clean energy investment





Modeling of a Clean Capacity Constraint

Capacity Mix
 Clean capacity requirements would shift away from fossil for reliability services





Implementation Roles: ICCM

States

- Set clean energy goals and clean energy resource qualification standards
- Determine quantity of clean energy attributes to buy through the ICCM

RTO

- Determines quantity of capacity needed for reliability (regionally and by location)
- Clears market & determines prices

Buyers & Sellers

- Fossil generation: can sell capacity
- Clean resources: can sell both capacity and clean energy attributes
- Voluntary buyers: (cities, companies): can add clean energy attribute demand



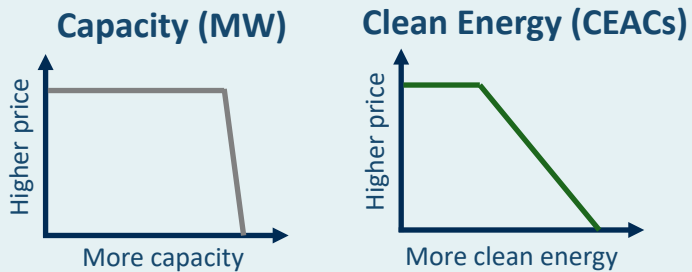
Auction Administrator

- Three-year forward auction
- Least-cost procurement to meet both capacity and clean energy needs
- Separate prices for: (1) MW of capacity, and (2) MWh of clean energy attributes (RECs, ZECs, and CEACs)
- 7-12 year price lock-in for new resources

How would the ICCM meet capacity and clean energy needs at the lowest combined cost?

BIDS

Demand



Supply

- Total annual resource cost (\$)
- Capacity quantity (UCAP MW)
- Clean attribute quantity (CEAC)

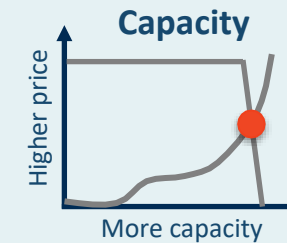
CO-OPTIMIZED AUCTION CLEARING

Similar to Current PJM Capacity Market Clearing

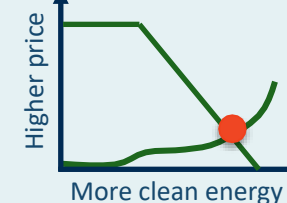
- **Objective function:** Maximize social surplus (area under demand curves minus cleared resource cost)
- **Cleared resources:** Least cost resources for meeting capacity & clean energy demand
- **Price setting:** Marginal cost of meeting incremental demand

CLEARING RESULTS

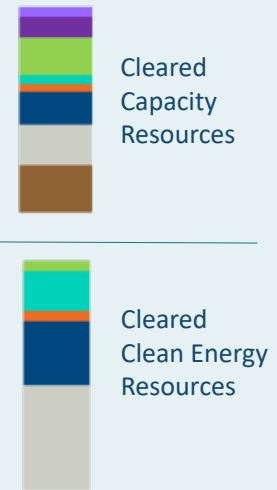
Clearing Prices



Clean Energy



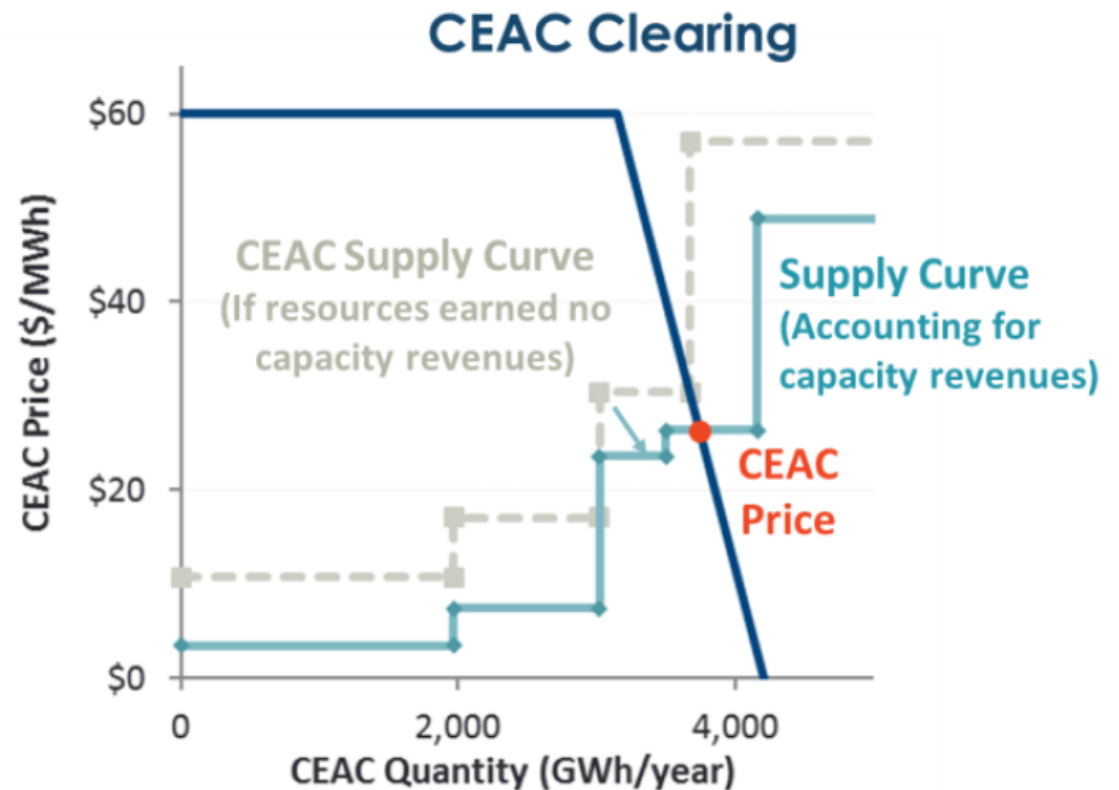
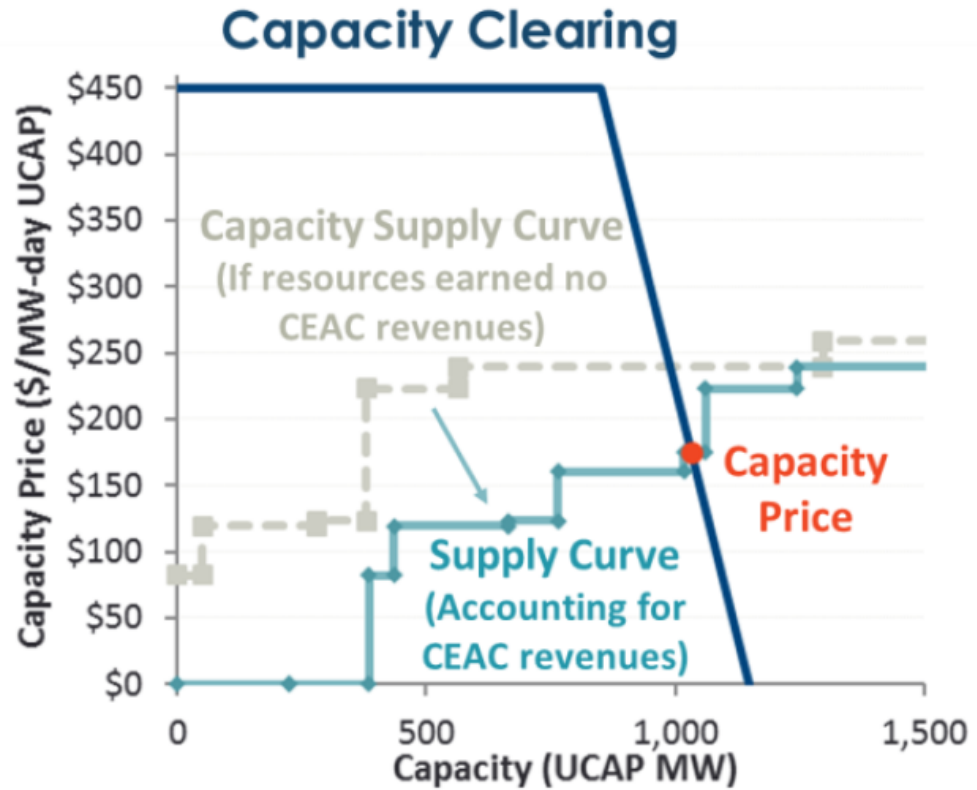
Cleared Resources





One Auction; Two Products

FIGURE 17: CO-OPTIMIZED PRICE FORMATION REFLECTING THE MARGINAL COST OF EACH PRODUCT





Clean Energy Attribute Procurement Price Setting

Clean Energy Attribute Price (\$/MWh)

