The Integrated Clean Capacity Market

A Design Option for New England's Grid Transition

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PRESENTED TO

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What is an "Integrated Clean Capacity Market"?

Design Concept: Three-year forward market that attracts the optimal resource mix for reliability and state policy goals. Market would maintain key elements from today's market, but would be a fit-for-purpose market for achieving the 80-100% clean electricity future

How does the Integrated Clean Capacity Market compare to other options in consideration?

Any useful path forward for New England will have to include a package of at least one solution meeting both of the central design objectives:

Solutions for Achieving **Resource Adequacy Objectives**	Solutions for Achieving **State Policy Objectives**
Energy-only market	Carbon pricing
Integrated planning & contracting	Integrated planning & contracting
Forward capacity market	Forward clean energy market

Integrated Clean Capacity Market
is a natural "package" for achieving a clean, reliable resource mix

What is an "Integrated Clean Capacity Market"?

The **Integrated Clean Capacity Market** would be a centralized, three-year forward market for procuring capacity and clean energy needs

Demand

- **Capacity:** ISO-NE establishes the quantity of capacity need (mandatory)
- **Clean Energy:** States & customers establish demand for unbundled clean energy attribute credits (CEACs)

Co-Optimized Auction Clearing

- Broad regional market
- Three-year forward auction
- Co-optimized procurement of unbundled capacity and CEACs
- 7-12 year price lock-in for new

Supply

- All resources can compete
- Fossil resources can sell only capacity
- Clean resources can sell both capacity and CEACs

Key design elements

Design Element	Resource Adequacy Objectives	Clean Electricity Objectives
Responsible Entity for Defining the Need	• **ISO New England**	• **State policymakers** • **Voluntary buyers** (retailers, companies)
Product Definition	• Unforced capacity (UCAP MW) • Keep locational specificity (as today) • *Consider also specifying*: separate summer and winter products & "flexible" capacity needs	• Clean energy attribute credit (CEAC) • States would make an effort to align definitions into a uniform product to the extent possible (though multiple products would be accommodated as needed) • *Consider*: "dynamic" CEAC product
Supply Eligibility	• All clean and fossil resources are eligible • ELCC-based accounting for resource-neutral capacity values (by location, season, and flexibility)	• All clean resources are eligible for a "base" product • All revenues are considered "in market" • States can specify technology (but aim to limit the number and size to maximize competition)
Quantity to Procure	• Quantity needed to support 1-in-10 • Based on advanced reliability modeling that considers resource characteristics & flexibility needs in the clean grid	• States and customers decide the quantity needed • Pre-existing contracts are fully accounted for in this market as self-supply
Willingness to Pay	• Sloping demand curves for each capacity product • Hierarchy of needs reflected in price formation (e.g. import-constrained and "flexible" capacity prices are equal or greater than system/traditional capacity prices)	• States submit sloping demand curves for state-mandated CEAC demand • Voluntary buyers can submit price-quantity pairs to exceed state mandates

How might the capacity market need to evolve to align with the 80-100% clean electricity future?

What FCM elements will…

Continue to work well?

- Broad regional market
- Unbundled products
- Technology-neutral competition
- Co-optimized, value-maximizing auction clearing
- Transmission constraints reflected
- Marginal-cost-based pricing
- Private sector takes most investment risk

Likely need evolution?

- Incorporate a new design objective: policy goals
- Define separate summer and winter capacity products (separate demand and supply accounting)?
- Define "flexible" capacity requirements?
- Adopt more accurate supply accounting for all resources based on effective load carrying capability (ELCC) and accounting for plant outage rates
- Advanced reliability modeling for the clean grid
- Eliminate out-of-market interventions
- Fully enable all emerging technologies

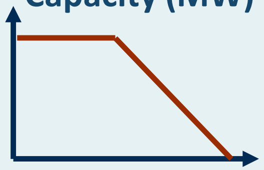
Example: Integrated Clean Capacity Market Auction Clearing

Co-optimized procurement of capacity and clean energy

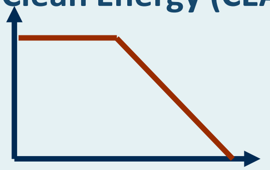
BIDS

Demand

Capacity (MW)



Clean Energy (CEACs)



Supply

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

CO-OPTIMIZED AUCTION CLEARING

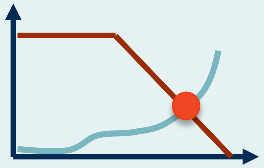
Similar to the FCM Clearing

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

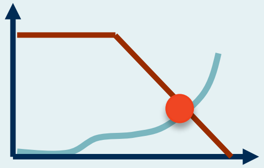
CLEARING RESULTS

Clearing Prices

Capacity (MW)



Clean Energy (CEACs)

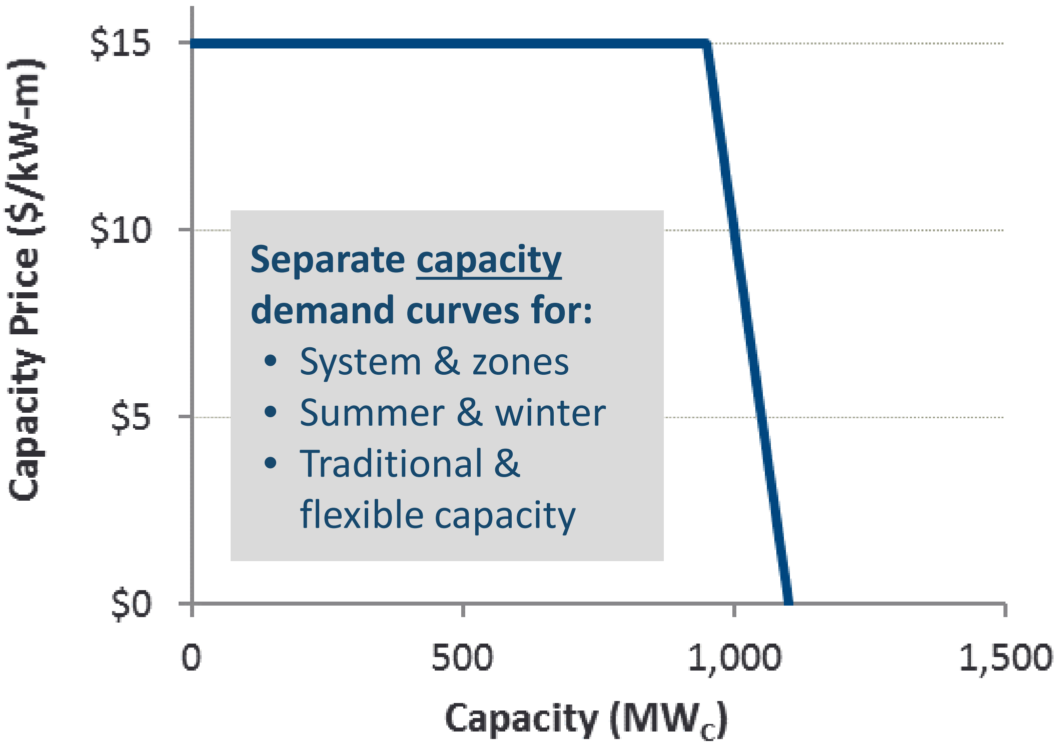


Cleared Resources

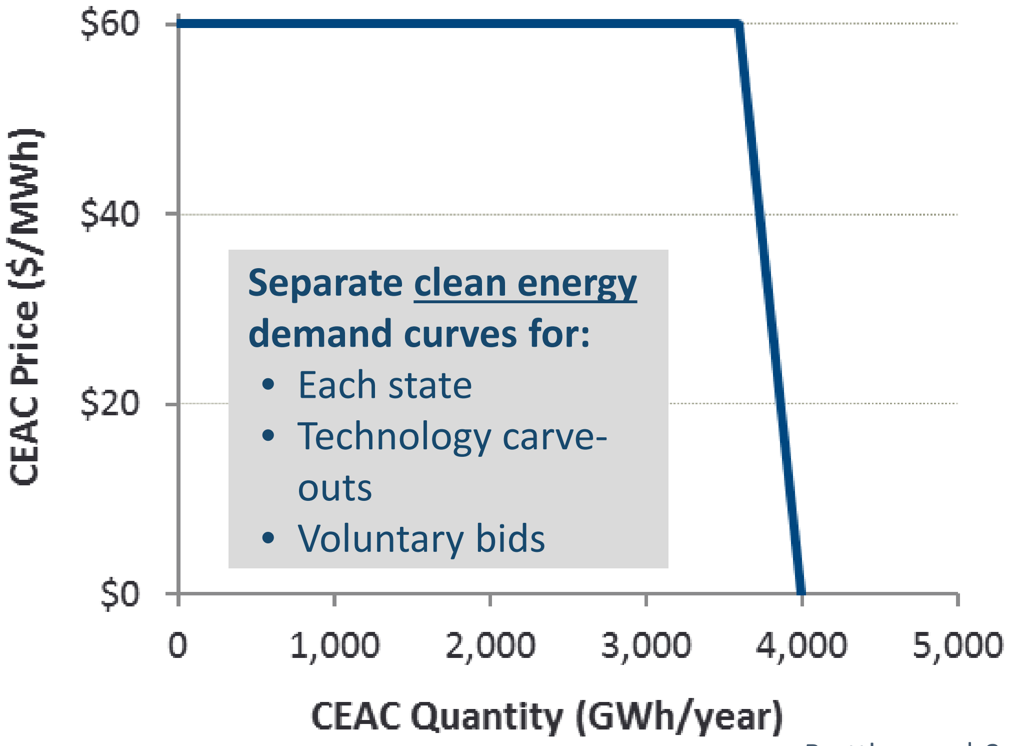
How is demand for capacity and clean energy expressed?

Separate demand curves would be used for each product

Capacity Demand Curve



Clean Energy Demand Curve



Note: Simplified example. Not intended to reflect New England.

How would resources offer?

Offer structure is <u>one price for two products</u>

- Offer price is total annual going-forward revenue requirement
- Unbundled CEAC and UCAP products clear at different prices
- Seller is presumed indifferent whether revenues are earned from selling capacity or CEAC

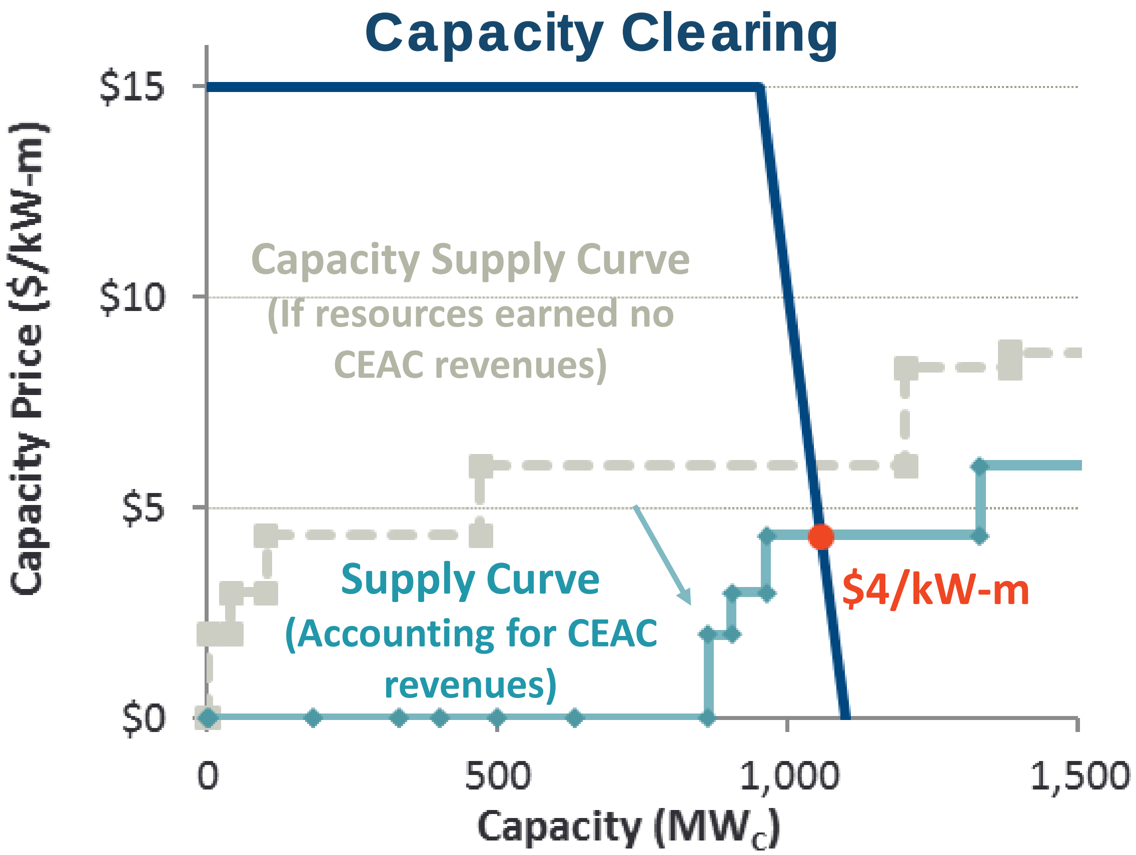
Example: Resource Offers

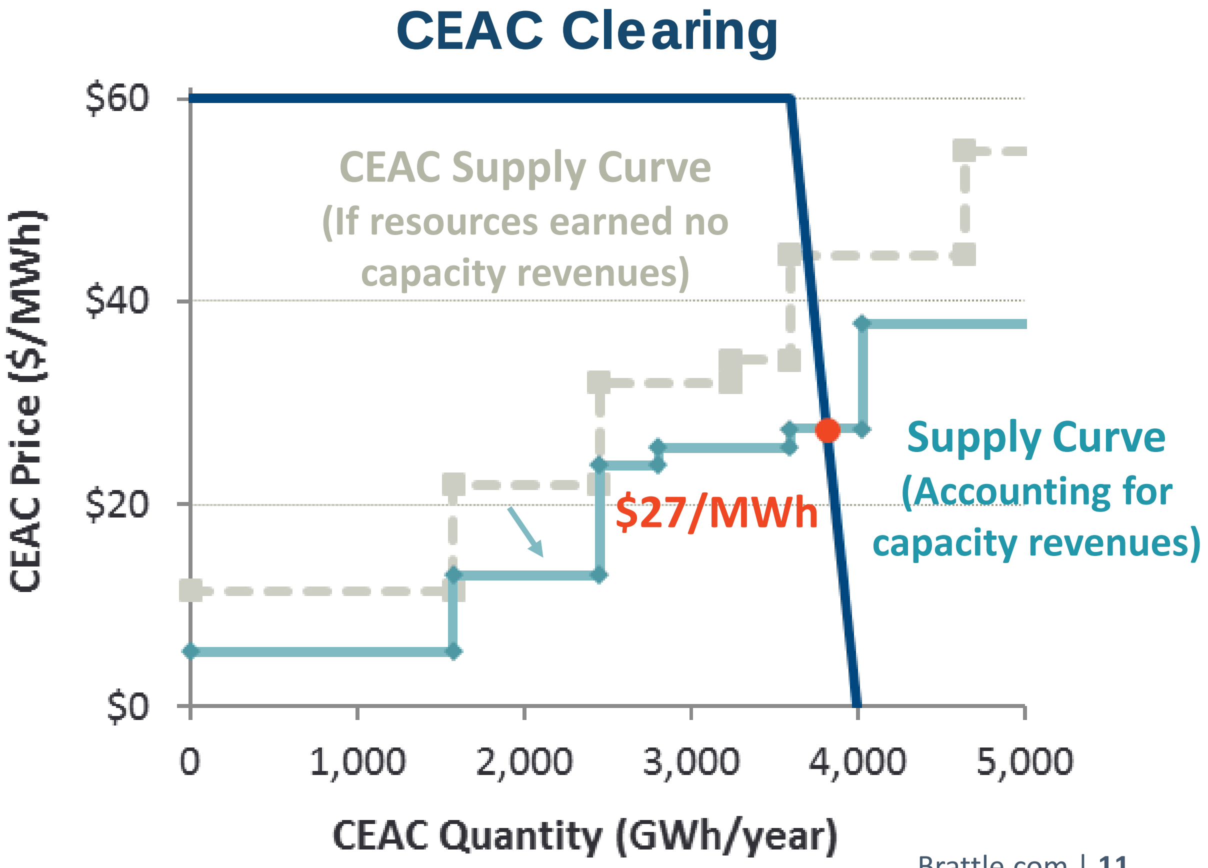
Type	Size *(ICAP MW)*	Qualified Capacity Rating *(UCAP MW)*	Qualified Clean Energy *(CEAC GWh)*	All-in Cost (less E&AS Revenues) *($/ICAP kW-y)*
Existing Gas	400	368	0	$48
New Gas	800	733	0	$66
Nuclear	200	180	1,577	$90
Solar	200	70	350	$60
Hydro	200	150	876	$96
Onshore Wind	300	96	788	$84
Offshore Winc	300	135	1,051	$156
Storage	250	230	438	$96
DR	60	60	0	$36
EE	40	40	0	$24
Total	**2,750**	**2,062**	**5,081**	

Note: Simplified example. Not intended to reflect New England.

How are prices set?

Co-optimized price formation reflects marginal cost of each product.





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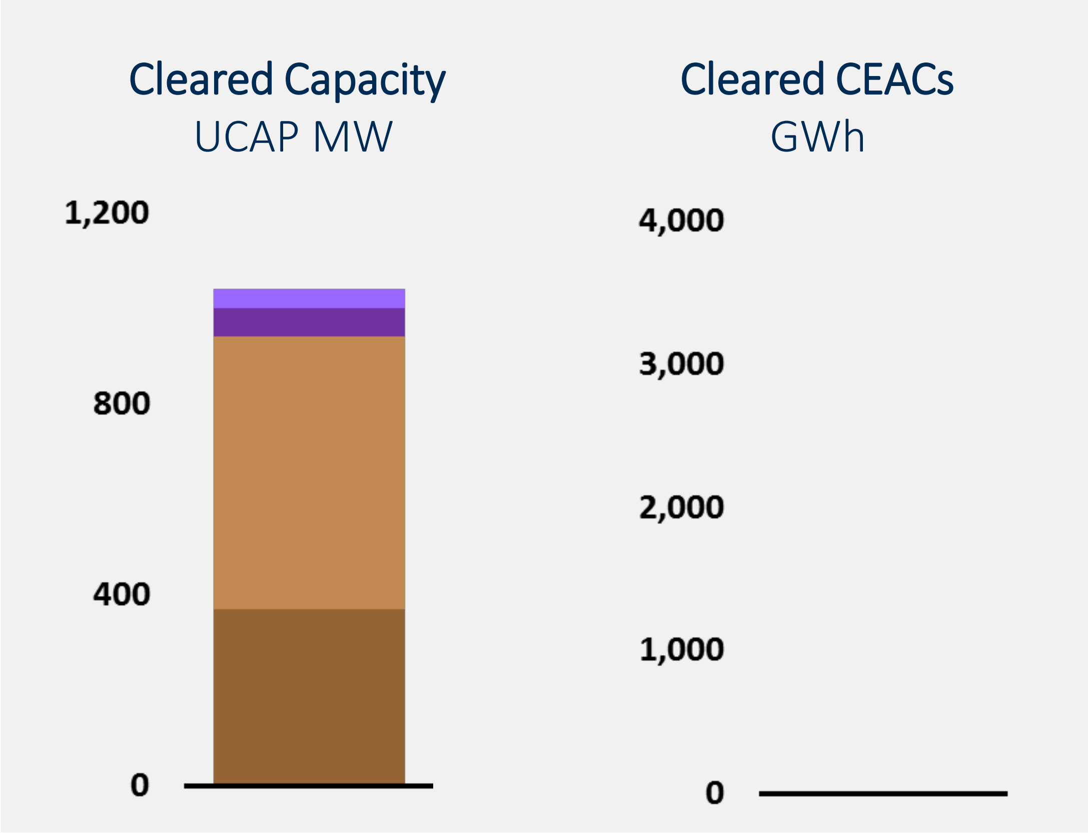
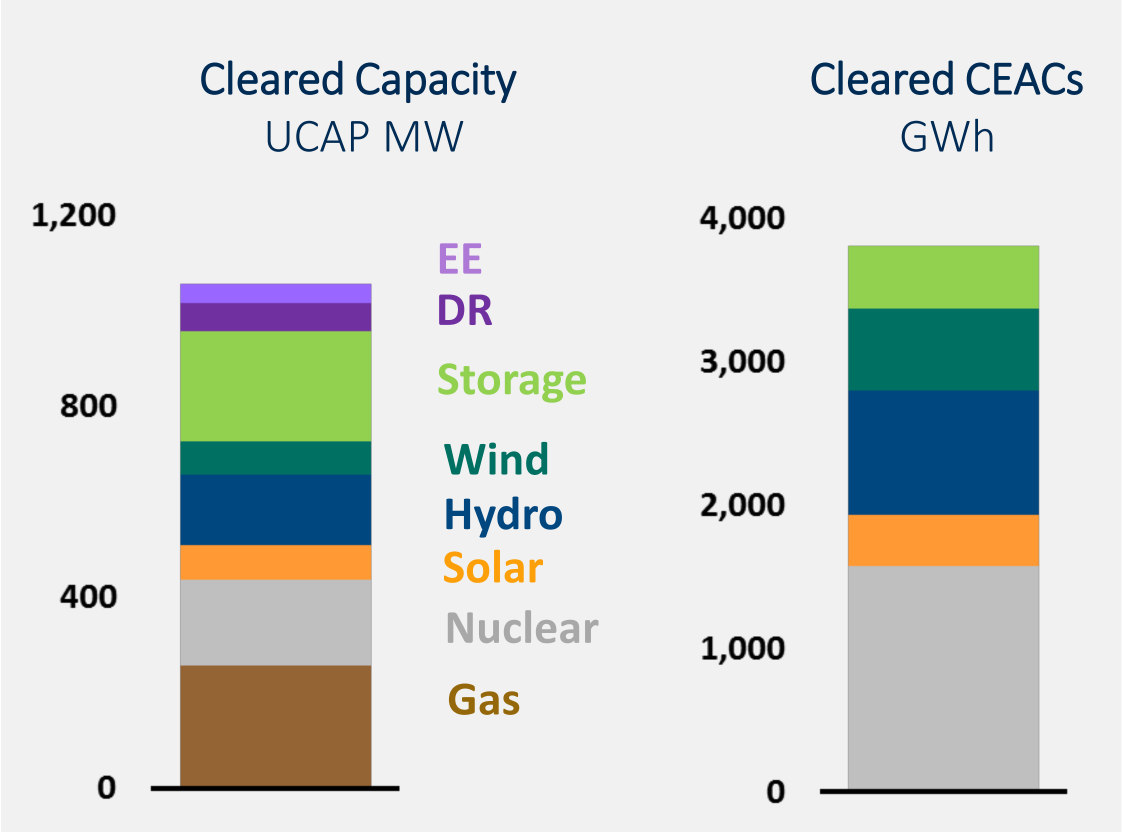
What resources clear?

Traditional Capacity Market



Integrated Clean Capacity Market



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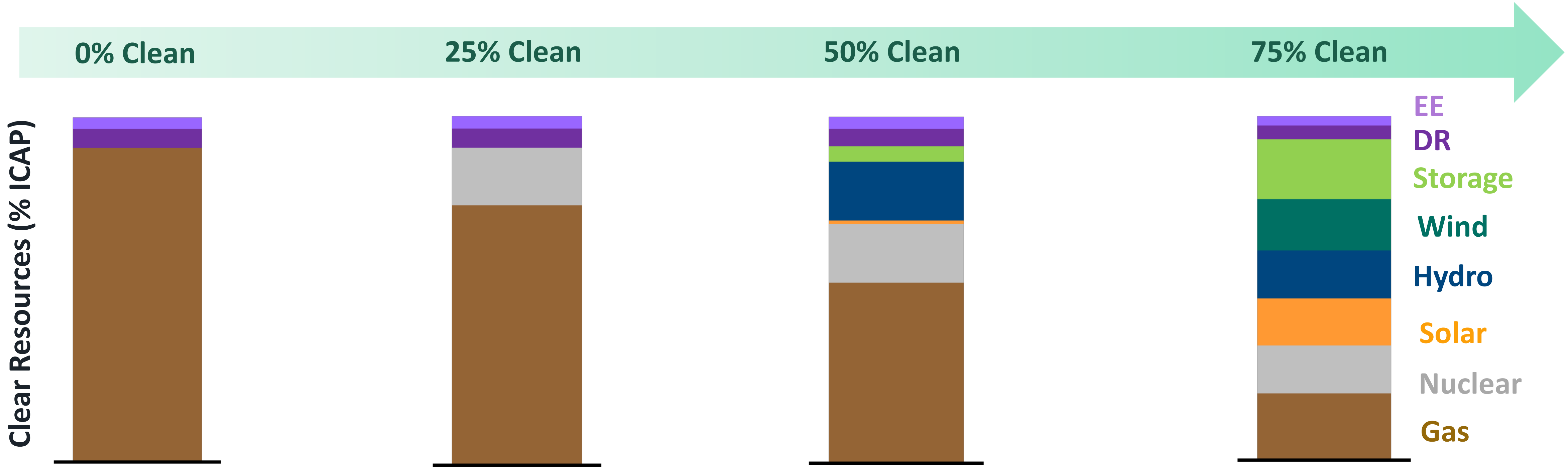
How could an Integrated Clean Capacity Market guide the energy transition?

Extended simplified example illustrates the different resource mix cleared as the quantity of required CEACs increases*



*Simplified example is identical to prior slides other than the quantity of CEACs required. A full time series analysis would consider how offer prices and UCAP values change over time.

Pros and Cons

Advantages and challenges to consider if pursuing an Integrated Clean Capacity Market

Advantages

- Efficiency benefits of co-optimization
- Builds on demonstrated successes from the current capacity market (broad competition, ability to attract investment)
- Flexible framework can accommodate variety of state preferences & evolving reliability needs
- Offer states an in-market solution to meet policy
- Economically balance signals to attract new clean resources, retain flexible gas plants in transition, and prevent uneconomic oversupply of capacity

Challenges

- Complexity
- Requires states and ISO to work together
- Governance
- Transitional challenges to identify and mitigate near-term impacts on customers and existing resources

Appendix: Example Detail

Example Detail: Integrated Clean Capacity Market Clearing

Resource Offers and Clearing

		Existing Gas	New Gas	Nuclear	Hydro	Solar	Onshore Wind	Offshore Wind	Storage	DR	EE
Offered Quantity											
ICAP	*(MW_N)*	400	800	200	200	200	300	300	250	60	40
UCAP	*(MW_C)*	368	733	180	150	70	96	135	230	60	40
CEACs	*(GWh/year)*	0	0	1,577	876	350	788	1,051	438	0	0
Offer Price	*(\$/kW-m_N)*	$4.0	$5.5	$7.5	$8.0	$5.0	$7.0	$13.0	$8.0	$3.0	$2.0
Cleared Quantity											
ICAP	*(MW_N)*	371	0	200	200	200	300	0	129	60	40
UCAP	*(MW_C)*	341	0	180	150	70	96	0	119	60	40
CEACs	*(GWh/year)*	0	0	1,577	876	350	788	0	226	0	0
Percent Cleared	*(%)*	93%	0%	100%	100%	100%	100%	0%	52%	100%	100%
Revenues											
CEACs	*(\$M/year)*	$0	$0	$43	$24	$10	$22	$0	$6	$0	$0
Capacity	*(\$M/year)*	$18	$0	$9	$8	$4	$5	$0	$6	$3	$2
Total	*(\$M/year)*	$18	$0	$53	$32	$13	$27	$0	$12	$3	$2
Total	*(\$/kW-m_N)*	$4	$0	$22	$13	$6	$7	$0	$8	$4	$4

ICAP = Installed capacity
UCAP = Unforced capacity
CEAC = Clean Energy Attribute Credit
N = Nameplate
C = Capacity rating

System-Wide Results

	Cleared Quantity	Offered Quantity	Clearing Price
Capacity	2,750 *(MW_N)*	1,500 *(MW_N)*	$4.3 *(\$/kW-m_N)*
CEAC	5,081 *(GWh/year)*	3,817 *(GWh/year)*	$27.4 *(\$/MWh)*

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Dr. Kathleen Spees is a Principal at The Brattle Group with expertise in designing and analyzing wholesale electric markets and carbon policies. Dr. Spees has worked with market operators, transmission system operators, and regulators in more than a dozen jurisdictions globally to improve their market designs for capacity investments, scarcity and surplus event pricing, ancillary services, wind integration, and market seams. She has worked with U.S. and international regulators to design and evaluate policy alternatives for achieving resource adequacy, storage integration, carbon reduction, and other policy goals. For private clients, Dr. Spees provides strategic guidance, expert testimony, and analytical support in the context of regulatory proceedings, business decisions, investment due diligence, and litigation. Her work spans matters of carbon policy, environmental regulations, demand response, virtual trading, transmission rights, ancillary services, plant retirements, merchant transmission, renewables integration, hedging, and storage.

Dr. Spees earned her PhD in Engineering and Public Policy within the Carnegie Mellon Electricity Industry Center and her MS in Electrical and Computer Engineering from Carnegie Mellon University. She earned her BS in Physics and Mechanical Engineering from Iowa State University.