TRANSITION TO NEW ENGLAND'S FUTURE GRID

Forward Clean Energy Market

A MARKET-BASED OPTION FOR STATES TO ACHIEVE THEIR CLEAN ELECTRICITY GOALS

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Full studies:

HIGH-LEVEL FCEM PROPOSAL AND NEW ENGLAND ECONOMIC IMPACT ANALYSIS (LINK)

DETAILED FCEM DESIGN PROPOSAL WITH STATE DESIGN OPTIONS (LINK)

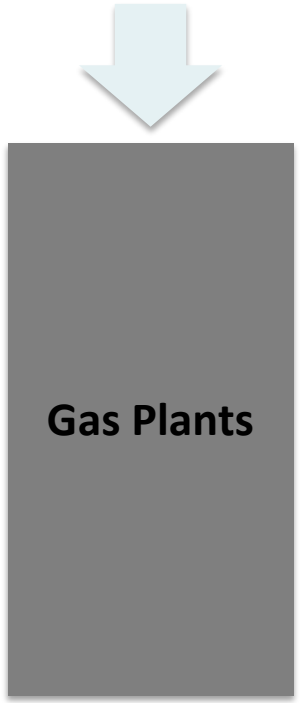
THE Brattle GROUP

First: What Are We Trying to Do Here?

Current ISO Markets Are Designed to Achieve:

Reliable & Low-Cost Electricity

Markets designed for this purpose will attract and retain….



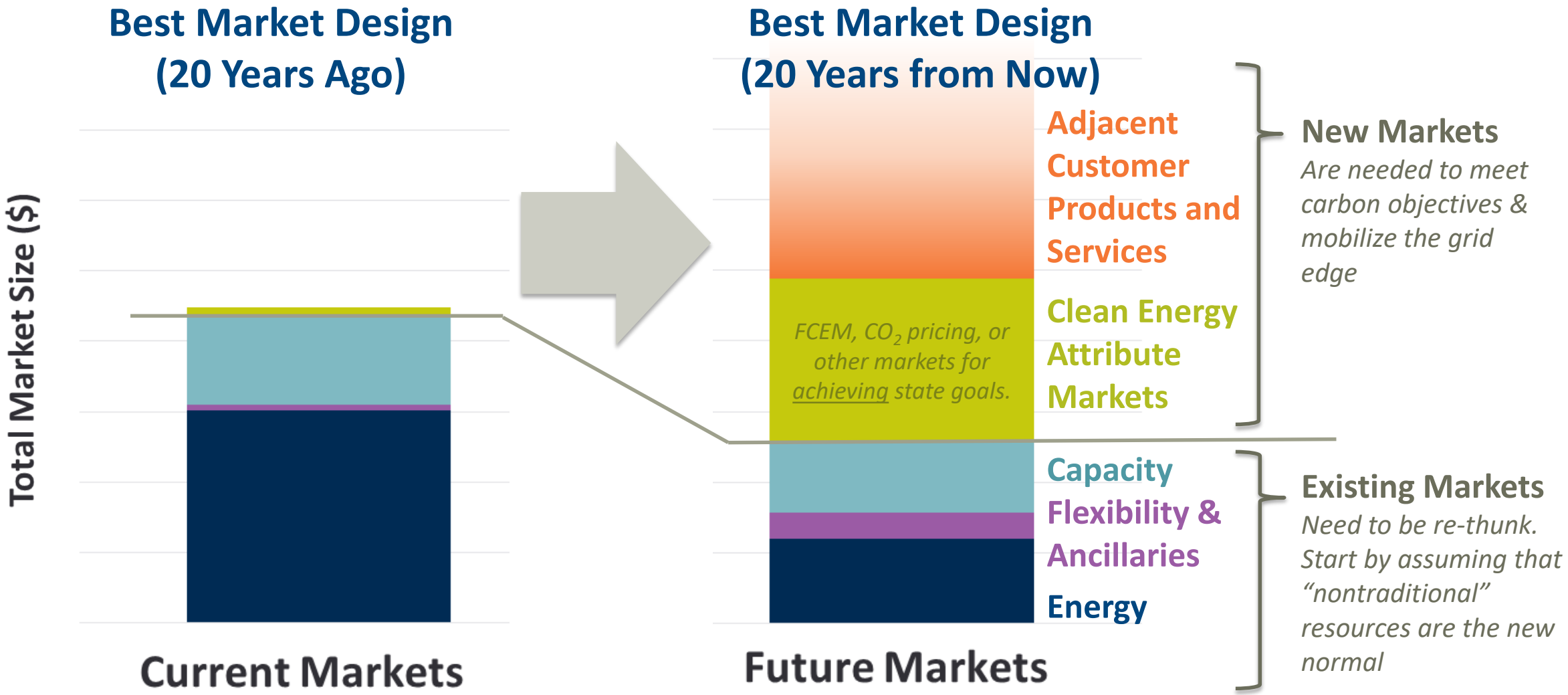
Market forces may drive carbon emissions up or down

But by 2050 New England Needs:

Reliable, Low-Cost & Carbon-Free Electricity

Market drives 80% carbon reductions at least cost

Second: What Do the "Future Markets" Look Like?

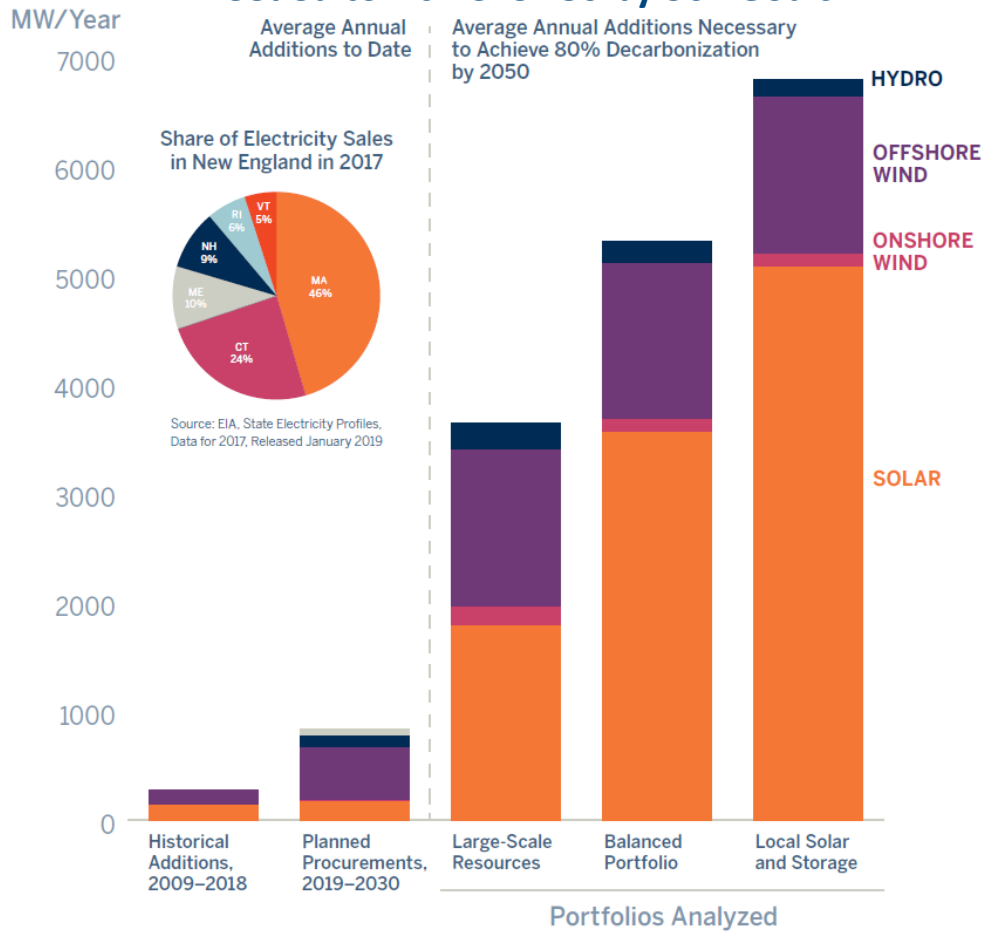


Third: How Do We Get There?

- **Thousands of MW of new clean resources** will need to be built every year to meet policy goals and customer demand
- **Missing building block in the "future markets":** Some of the states may want to utilize a market-based option achieve their policy goals (not just accommodate)
- We developed the Forward Clean Energy Market (FCEM) as one tool that states could use for mobilizing private investment to meet their goals through a competitive market

New England Clean Energy Needs

Average Annual Clean Energy Additions Needed to Achieve "80 by 50" Goals



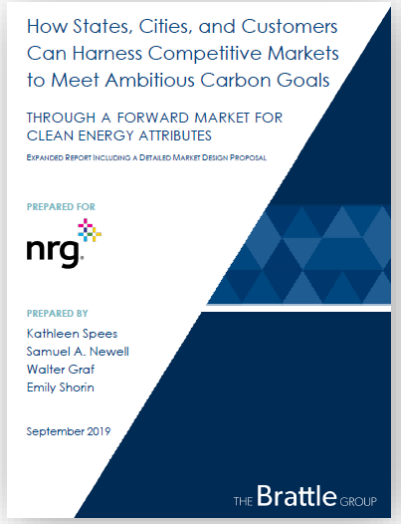
Source: Brattle Study "Achieving 80% GHG Reduction in New England by 2050"

Refresher: What is the Forward Clean Energy Market?

Design concept originated in the IMAPP process with input from many states & stakeholders. Developed across two studies…

HIGH-LEVEL FCEM PROPOSAL AND NEW ENGLAND ECONOMIC IMPACT ANALYSIS (LINK)

DETAILED FCEM DESIGN PROPOSAL WITH STATE DESIGN OPTIONS (LINK)



How Does FCEM Fit into the Range of "Achieve" Options that the States Might Consider?

FCEM is one promising option for New England states to consider for part or all of their clean energy procurement goals

Integrated Resource Planning

State Contracting

More Targeted	More Competitive
Bundled contracts	Unbundled attributes
Technology-specific	Regional
Regionally limited	Technology neutral

Forward Clean Energy Attribute Market

More Targeted	More Competitive
Technology-specific or new resource carve-outs	Region-wide Technology neutral

Carbon Pricing

More Targeted	More Competitive
Electricity sector only	Region-wide
Lower carbon price	Economy-wide
	Higher carbon price

FCEM is a family of approaches that can be tailored to the specific needs of each state and the broader New England region

What is the Forward Clean Energy Market?

The FCEM would be a centralized, forward auction in which buyers and sellers could voluntarily exchange clean energy attribute credits (CEACs)

- 3-year forward auction
- Unbundled CEAC product
- 7-12 year price lock-in for new resources

Design Overview

The FCEM could incorporate the best practices of existing wholesale electricity markets while enabling states to express their own policy goals

- **Unbundled Clean Energy Attributes** to maximize competition across markets and technologies
- **States and Customers Choose** their own demand quantities and willingness to pay (no costs shifted to non-participants)
- Broad **regional competition**
- **Technology-neutral** qualification and payments (option for technology carve-outs)
- Mechanisms to **mitigate regulatory risk** and ensure financeability at competitive costs
- Option for **product definition** that matches the underlying objective (carbon abatement), or combine with higher carbon prices to achieve similar outcomes
- **Alignment with energy, ancillary, and capacity markets**

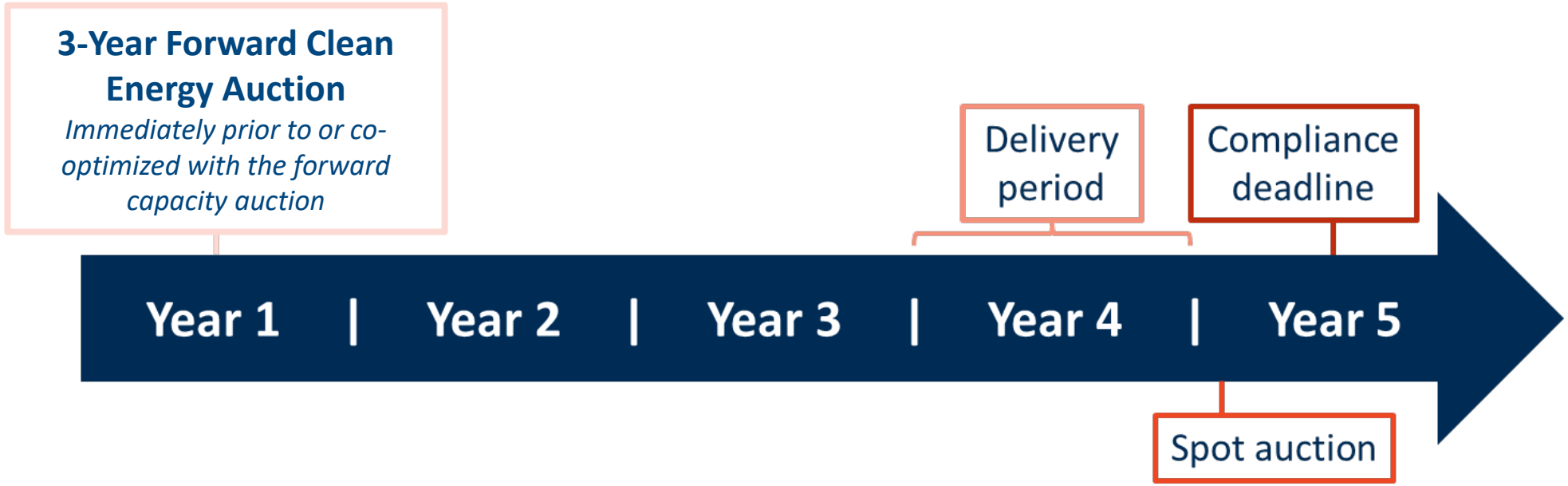
Design Overview: Basic Framework is Straightforward, But There are a Number of Options to Consider

Design Element	Approach
Product Definition	• The product is an unbundled Clean Energy Attribute Credit (CEAC), similar to an unbundled Renewable Energy Credit (REC) • Optional Variation: Design option for a "dynamic" CEAC accounting approach that awards more CEACs to resources that displace more carbon emissions. This approach can readily enable batteries and focus incentives toward achieving more carbon abatement faster
Demand Participation in the Forward Auction	• State demand would be expressed as a sloping demand curve that will buy higher quantities if supply is available at lower cost • Additional voluntary demand bids can be submitted by cities, public power entities, customers, companies, retail providers, or others. These bids are expressed as price-quantity pairs, representing the willingness to pay for CEACs • Optional Variation: Buyers will have an option to submit a preference for "targeted" resource types, for example to meet carve-outs for preferred technologies such as storage or offshore wind. The auction may procure these resource types even if they are higher cost than "base" resources, although the buyer can specify a limited willingness to pay such a premium
Technology-Neutral Supply Participation	• Resources are not restricted by type, location, or generation profile; any new or existing clean resources can participate, including hydro, wind, solar, nuclear, storage, or other • Storage resources can participate if their charging and discharging profiles displace system carbon emissions; they offer the value of carbon abatement when discharging, net of any additional carbon emissions they cause when charging
Forward Auction	• Forward auction three years before the one-year delivery period to align with development timeline of new clean resources • 7-12 year commitment period is available to new resources, over which time the price is locked-in to guarantee revenue stability
Bilateral and Spot Markets	• Ongoing trading before and during the delivery year, with a final spot auction after the delivery year. Producers can adjust their positions until the spot auction when any net deficit must be remedied; retailers can continually adjust their positions until the compliance deadline at which point retailers must meet their clean energy obligation or face a compliance penalty
Monitoring and Mitigation	• Targeted mitigation measures to prevent large suppliers from exercising market power through physical or economic withholding
Wholesale Market Alignment	• Operates well with existing wholesale markets and maintains incentives to maximize energy, flexibility, and reliability value to the grid • CEAC-based revenues are counted as "in-market" in the capacity market, i.e. not subject to minimum offer price rule (MOPR) provisions
Competitive Retail Market Alignment	• In states with retail choice, the CEAC is implemented as an obligation on retail providers to meet a certain fraction of their delivered load through clean energy, e.g. 50% by 2030 • Retailers can comply either by making their own CEAC supply arrangements (with self-supply volumes netted out of auction settlements), or by relying on the centralized auctions (passing the costs on to customers) • Retailers compete to offer innovative retail energy options to customers, including additional (up to 100%) clean energy. Retailers can participate in forward, bilateral, and spot markets and develop hedging strategies to minimize cost and risk

What Are the Key Design Features and Choices?

Procurement and Compliance Timeline

Three-year forward procurements are designed to align with developer needs, while fully enabling bilateral agreements retailer self-supply at all timeframes

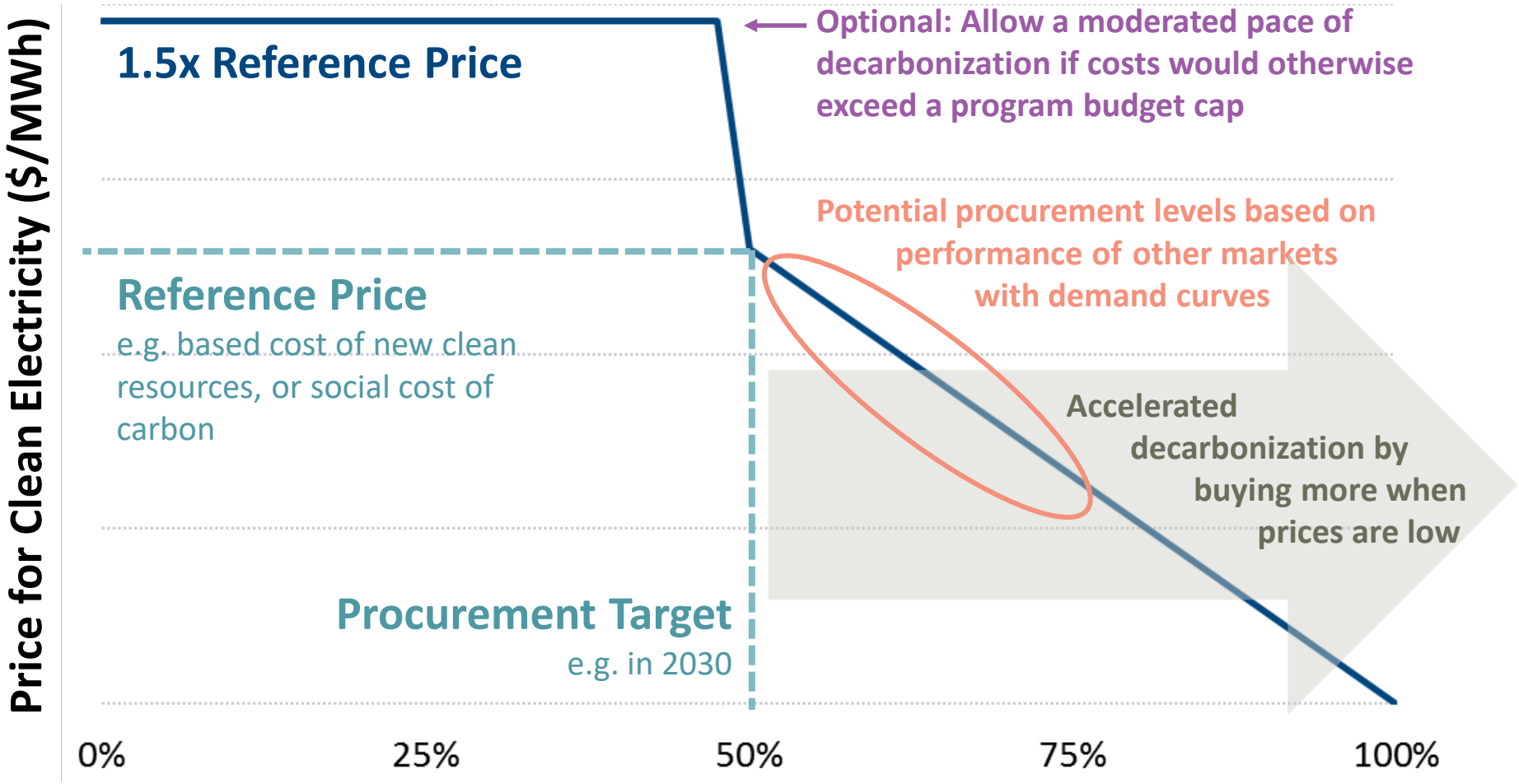


Pre-auction: Voluntary long-term contracts and forward hedges

Post-auction: Producers and retailers use exchange trades and short-term contracts to manage position relative to obligations and banking value

Each State Could Translate Its Own Procurement Target into a Downward-Sloping Demand Curve

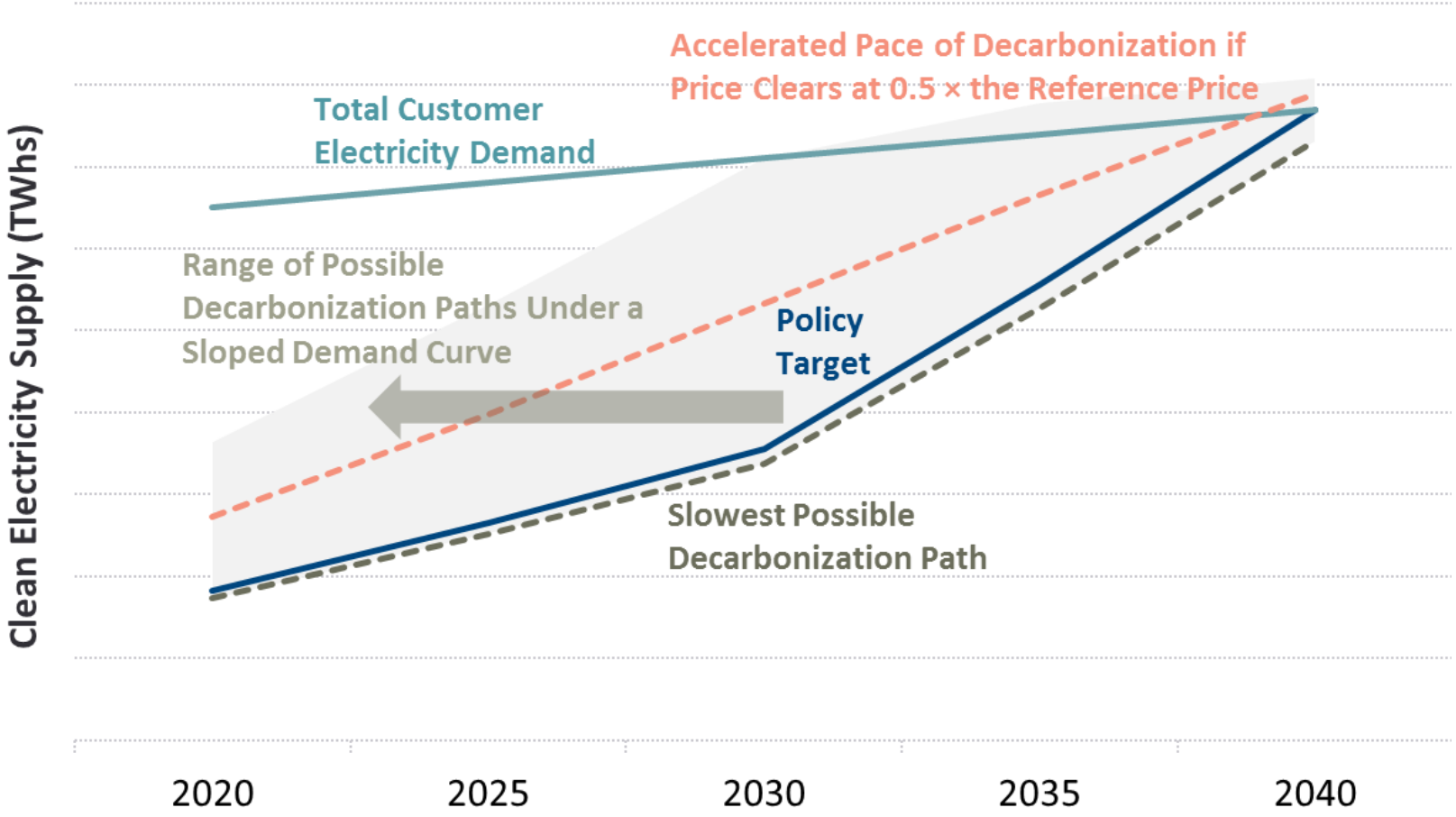
Illustrative State Demand Curve for CEACs



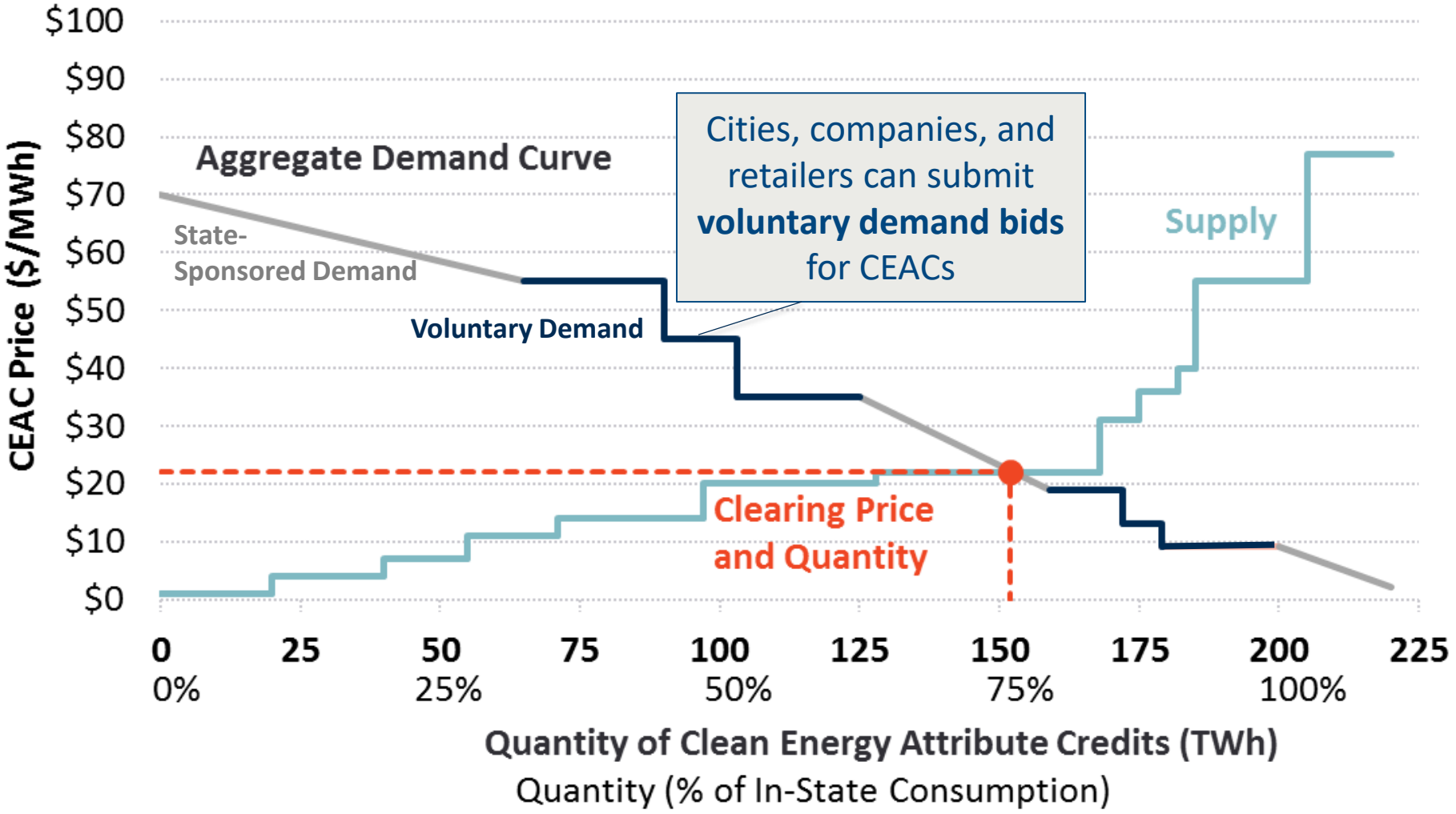
By How Much Could a Demand Curve Accelerate a State's Clean Electricity Goals?

Potential Pathways to Decarbonization with a Sloping Demand Curve

Example of a State with Clean Energy Targets of 25×2030, 50×2030, and 100×2040



Auction Clearing at a Competitive Price



Design Option: "Targeted" Resources to Comply with Technology-Specific Requirements

States submit the demand for clean energy and the maximum willingness to pay. States can choose to purchase:

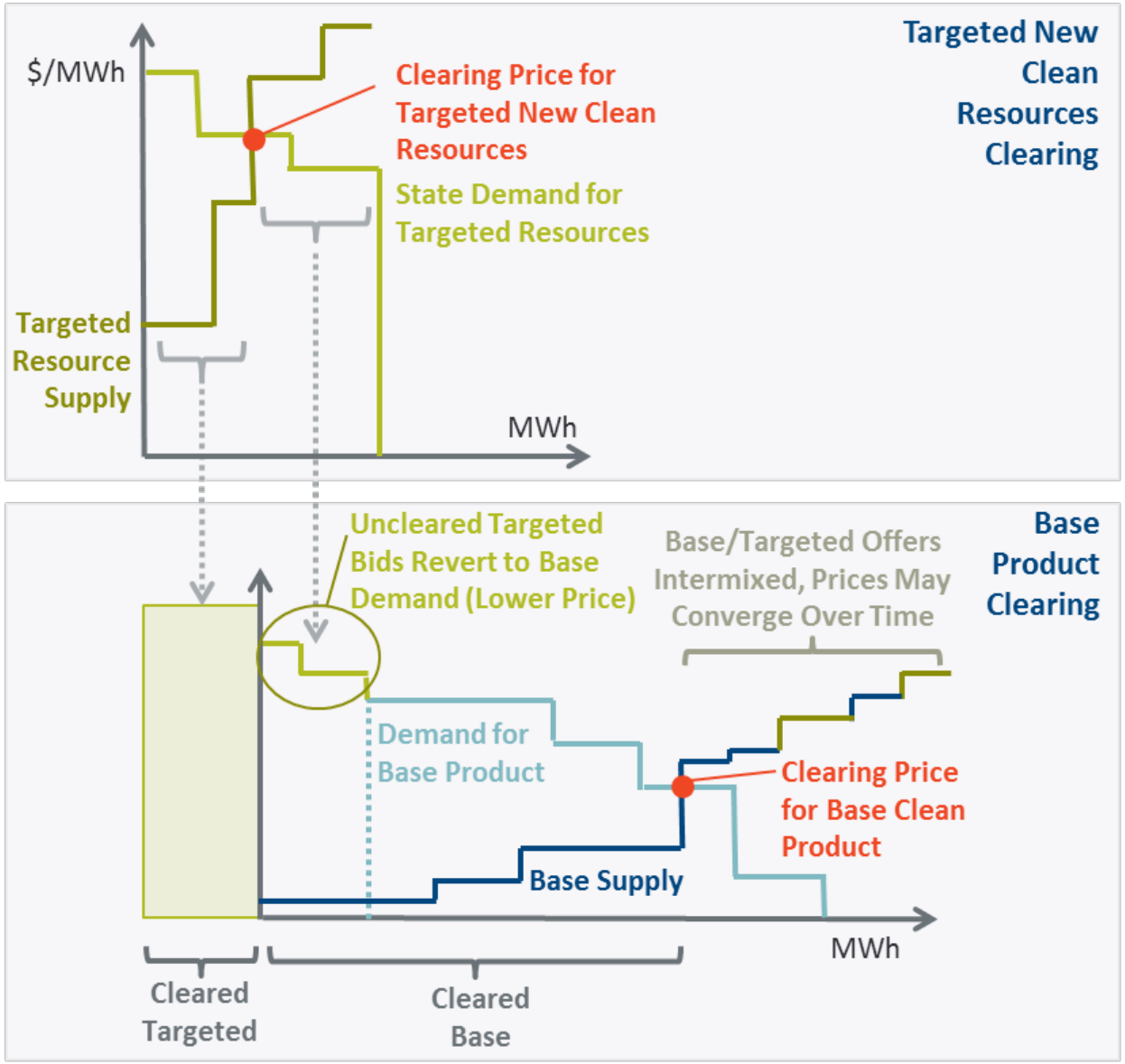
"Base" Resources

- Procures the least cost clean supply, whether new or existing
- All resources can participate (hydro, wind, solar, nuclear, storage), no restrictions by type or location
- 1-year commitments for existing resources; ~7-12 year price lock-in for new
- State commitment to submit demand bids in future years, e.g. for 10 years

"Targeted" Resources

- State carve-outs for new resources
- State has option to define a specific type (e.g. for emerging technologies)
- ~7-12 year anchor price lock-in (resources eligible as "base" supply in years 8+)
- No state commitment to submit demand in future years
- "Contingent bid" option: If targeted resource prices are too high, demand will revert to purchase lower-cost "base" resources

Illustration of Auction Clearing with Targeted Resources



Risk Sharing and Financeability

The FCEM intentionally places most **fundamentals-based and asset-specific risks on sellers** who would then manage the risks. A few key **design features could be used to mitigate regulatory risks and support financeability**:

- **Multi-Year Commitment Period** of around 7-12 years locks in prices for new resources
- **Multi-Year Forward Period** supports development and financing of new resources
- **Sloped Demand Curve** mitigates year-to-year price volatility, improving revenue certainty over time
- To enhance confidence in the market, states could make **durable commitments** to rely on the FCEM for a minimum timeframe & quantity

Allocate Risks to Customers	Allocate Risks to Sellers	
Regulatory Risks	**Market Fundamentals**	**Asset-Specific Risks**
• Unanticipated changes to state policy • Unpredictable changes to state demand bids • Rule changes	• Resource mix • Load growth • Fuel prices • Transmission development • Energy, capacity, and ancillary service prices	• Construction delays • Unanticipated asset costs • Asset performance

How Does FCEM Compare to the Other Options for Achieving State Goals?

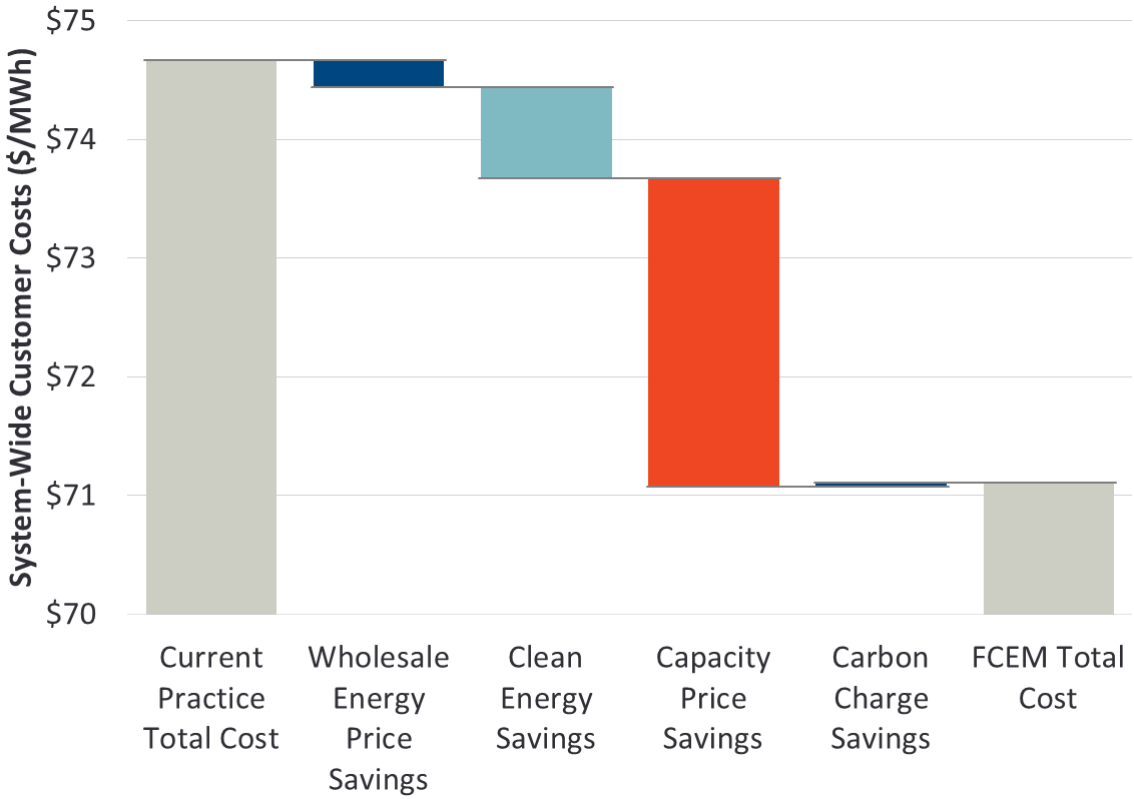
Customer Cost Savings Relative to Current Practice

Our New England simulations in Brattle's GridSIM model estimated that **FCEM could save customers $3.60/MWh** *or approximately* **$4,500 million** *over ten years compared to current practice*

gridSIM

Example: New England Customer Cost Savings

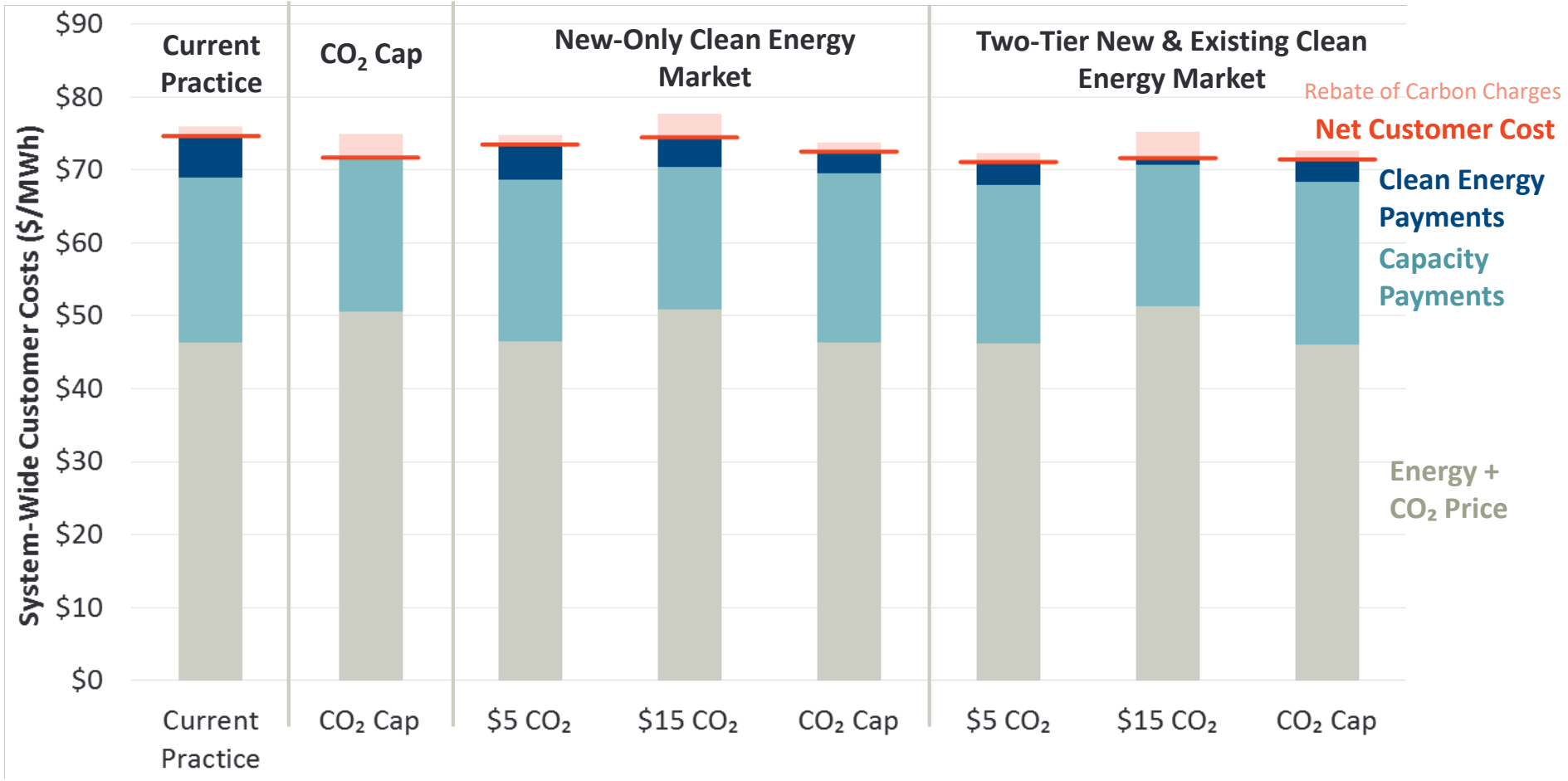
Forward Clean Energy Market vs. Current Practice



Source: Kathleen Spees, Judy Chang, DL Oates, and Tony Lee, "A Dynamic Clean Energy Market in New England," November 2017, The Brattle Group. Modeling results reported over a ten year period 2020-2029.

Size of Customer Benefits Varied Depending on Carbon Price and FCEM Design Choices

Our modeling analysis indicated that a range of market-based FCEM and carbon pricing approaches achieved customer benefits. Some more than others!



Note: Simple average of nominal costs from 2020-2029.

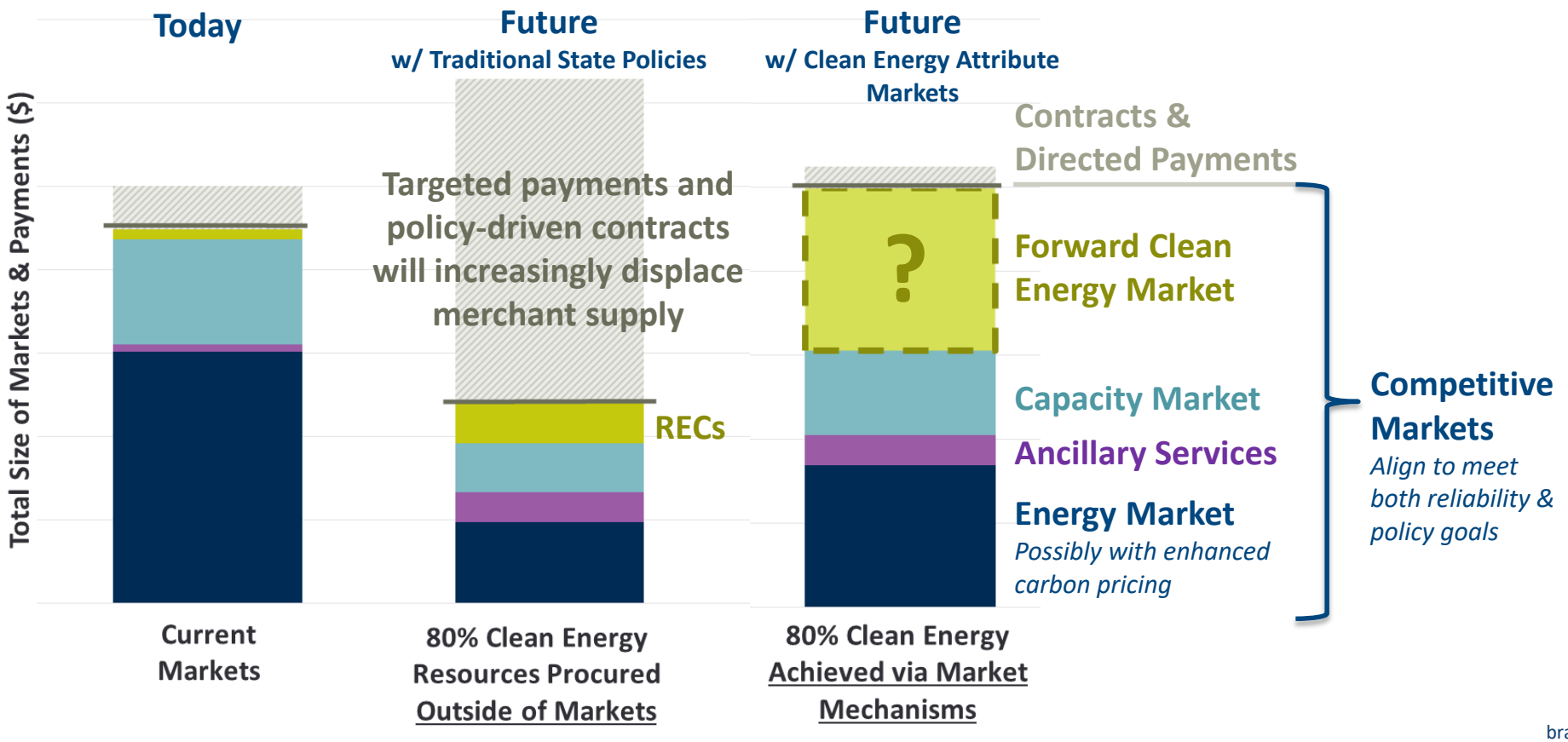
FCEM Can Be Implemented With or Without Higher Carbon Prices

Many economists will advise to focus exclusively on carbon pricing to meet policy goals (and our simulations demonstrate the value). But FCEM offers several benefits beyond considering carbon pricing alone:

- Carbon pricing maximizes benefits if implemented regionally and economy-wide (may not be politically feasible in the near term)
- Carbon prices acceptable to all states are likely too low to achieve policy goals
- FCEM does not require states, cities and companies to agree on a common price or policy goal
- FCEM avoids the “leakage” problems from carbon prices that differ between markets
- States & customers pay to meet their own goals (no cost-shifting to non-participants)
- Lower developer risk with FCEM than carbon pricing

Alignment with Wholesale Markets

The FCEM can align with the merchant investment model, competitive retail markets & enable competitive co-optimization with energy and capacity markets



Why Consider Variations of the FCEM?

FCEM offers a few advantages specifically in the New England region

- States don't have to agree on a single goal or carbon price
- States can opt in to the design (or not)
- States can choose how much to buy via FCEM (versus contracts or other approaches)
- Buyer-pays approach ensures no cross-subsidization among the states
- Leverages design features proven to attract new investments at competitive prices in the power sector (demand curve, forward auction, price lock-in, broad competition)
- Fills in one of the critical missing building blocks of the decarbonized "future markets"

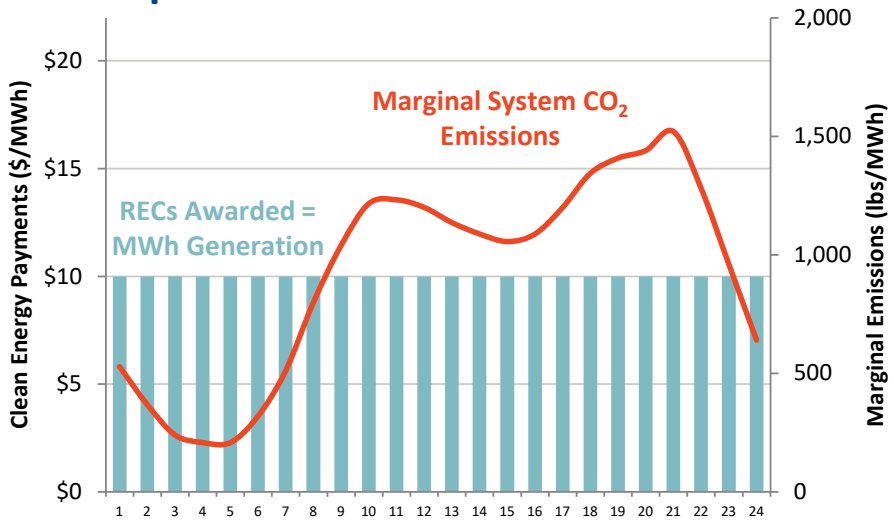
Review the full study: Linked Here

Appendix:
Dynamic Clean Energy Attribute Product Definition

Dynamic CEAC Product: Achieves More Carbon Abatement at Lower Cost

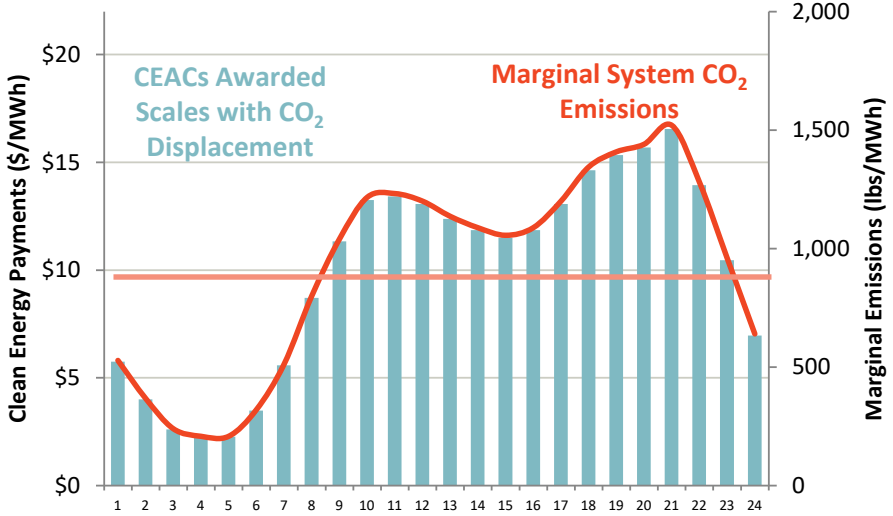
Design Option: Transition to a more advanced product design that focuses incentives on carbon abatement

Traditional RECs: Equal Incentives Across all Hours



- Flat incentives over every hour
- Incentive to offer at negative energy prices during excess energy hours when displacing other clean supply

"Dynamic" CEACs: Incentives Scale to Carbon Displacement



- Payments scale in proportion to marginal CO_2 emissions (by time and location)
- Incentive to produce clean energy when and where it avoids the most CO_2 emissions
- No incentive to offer at negative prices

Dynamic CEACs

Clean energy suppliers earn CEAC awards (and thus payments) that scale in proportion to carbon abatement value:

$$\text{CEACs} = \text{Physical Generation} \times \frac{\text{Realized Abatement Rate}}{\text{Standard Abatement Rate}}$$

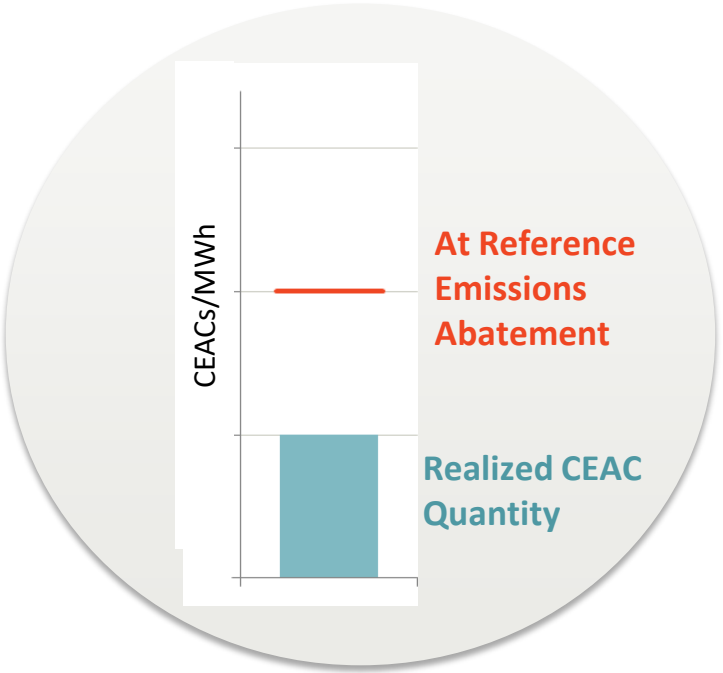
- **CEACs:** annual quantity of CEACs awarded to the clean resource. The rate of CEACs awarded per physical MWh produced may be greater than the average across all clean suppliers (if displacing primarily coal) or less than the average across all clean suppliers (if displacing primarily other clean supply)
- **Physical Generation:** the as-metered MWh produced by the clean resource
- **Standard Abatement Rate:** the standard quantity of marginal carbon displacement required to produce one CEAC (e.g. 1,100 lbs/MWh). This value adjusts over time with the average abatement value across the clean fleet
- **Realized Abatement Rate:** the measured marginal carbon abatement value of the resource in question, based on the time and place of clean energy production

Incentives for Clean Energy in the **Right Locations**

Varying the CEAC awards across locations in a way that reflects carbon emissions displaced will focus incentives to develop new clean energy where they are most valuable

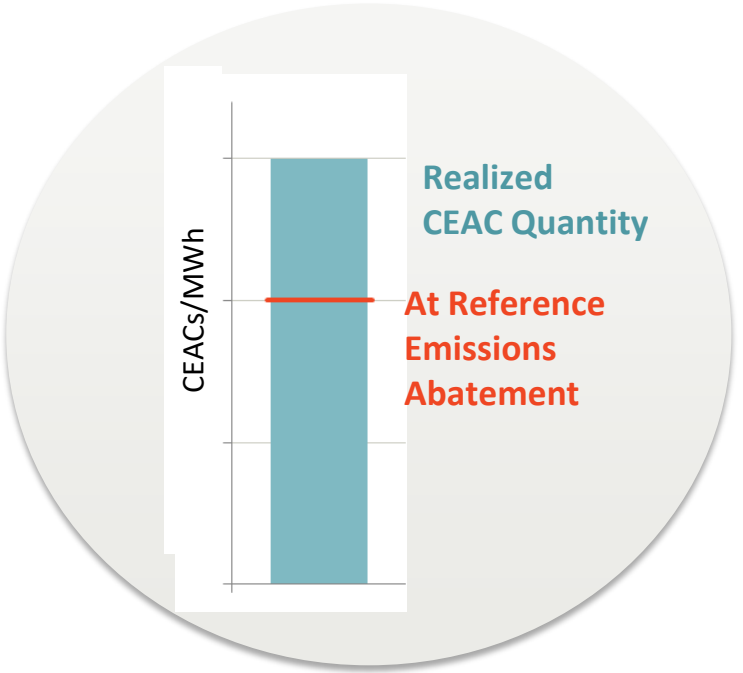
Low-Emitting Location

Generation pocket that is already saturated with wind. New clean energy will mostly displace the generation of existing wind resources (and will earn fewer CEACs)



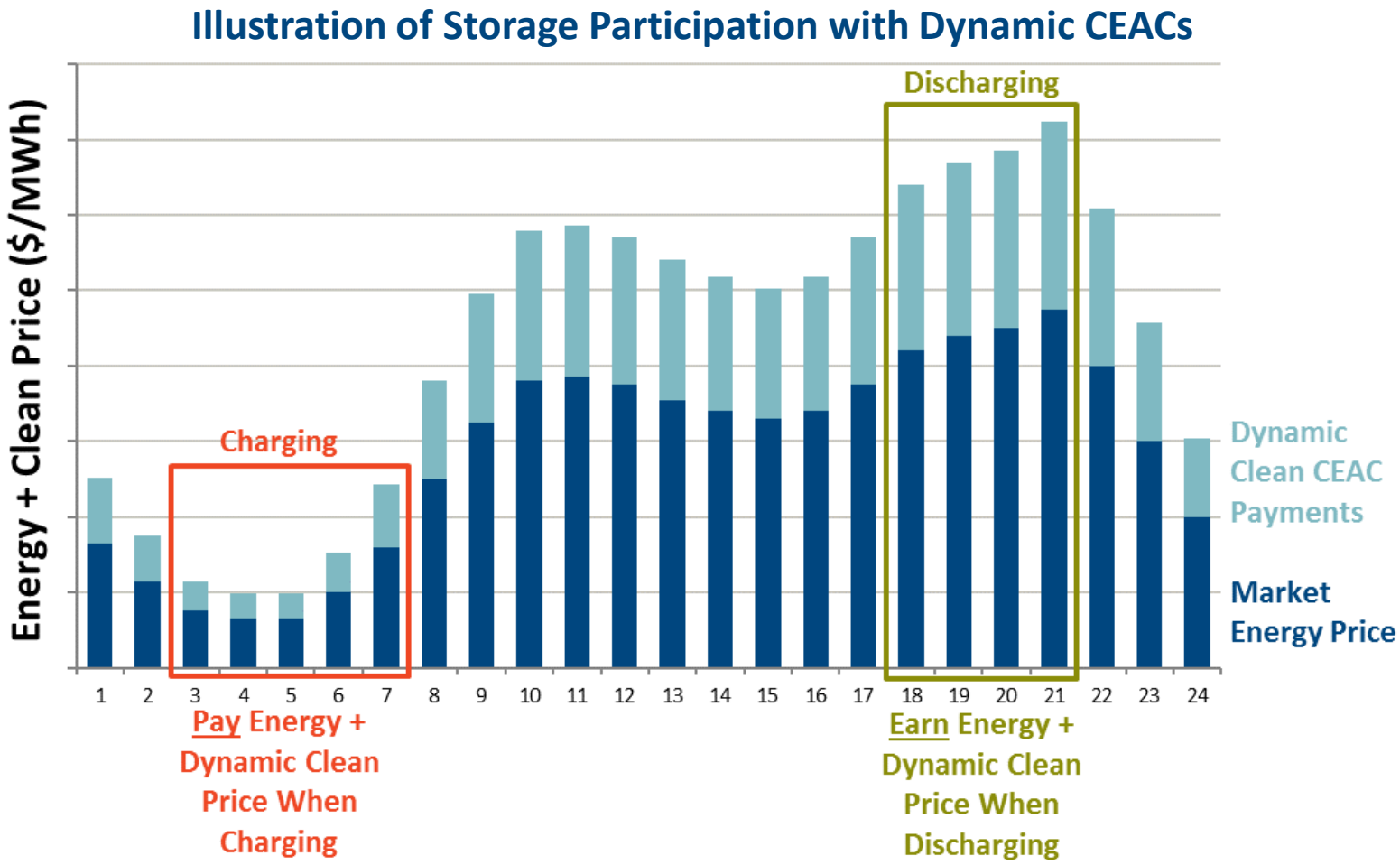
High-Emitting Location

Load pocket where high-emitting steam oil units are often called on. Clean energy will displace more emissions (and earn more CEACs)



Incentives at the **Right Times** (Including for Storage)

Dynamic CEACs incentivize clean energy at the right times to displace the most CO_2 emissions, enabling storage to compete with other technologies



Further Reading

How States, Cities, and Customers Can Harness Competitive Markets to Meet Ambitious Carbon Goals Through a Forward Market For Clean Energy Attributes

Sponsored by NRG (link)

A Dynamic Clean Energy Market in New England

Sponsored by Conservation Law foundation, Brookfield Renewable, NexEra Energy Resources & National Grid (link)

Harmonizing Environmental Policies with Competitive Markets: Using Wholesale Power markets to Meet State and Customer Demand for a Cleaner Electricity Grid More Cost Effectively (link)

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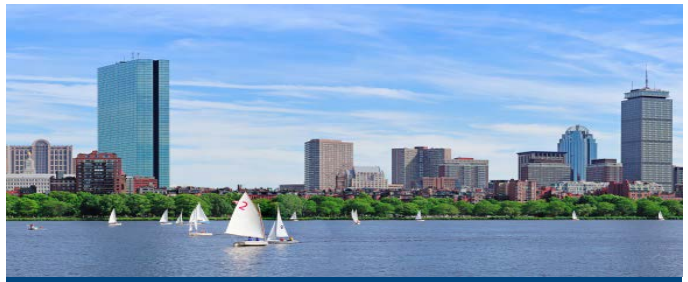
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