A Dynamic Clean Energy Market

Straw Proposal for a Long-Term IMAPP Design

PRESENTED AT

NEPOOL Integrating Markets and Public Policy Forum

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May 17, 2017

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Background and Introduction

- As a part of the IMAPP process, The Brattle Group is working with CLF, Brookfield and NextEra to develop a centralized clean energy market design for New England to support and help meet the states' public policy needs
- The long-term objectives of this design include providing states the:
  - **Opportunity to use a centralized market** to purchase clean energy
  - **Ability to procure the least cost** clean energy resources
  - **Ability to attract new and retain essential resources** to cost-effectively reduce GHG emissions
  - **Visibility of competitive prices** by placing resources on equal footing
  - **Participation of innovative technologies and resources**
  - **Ability to share costs** in alignment with state objectives
- This approach can be adapted to states' evolving goals while providing suppliers an opportunity to obtain sufficient revenue certainty to invest in the resources needed to meet New England's long-term GHG emission reduction goals
- We are seeking input and suggestions for improvements and refinements….

Overview of Proposed Design Package

This market design has the following key elements:

- Auction procures the **clean energy attribute only** (not bundled with energy)
- Purchases via this market **fulfill majority of states needs,** but possibly less than 100%
- Enable **competition among *all* clean energy resources** to yield least cost portfolio to meet the states' policy goals
- **Auction procures two (or more) products:** "Base" product for all existing or new clean energy resources, and "Premium" product for new resources
- States/utilities submit **demand bids** that specify the quantity needed, and the price they are willing to pay; can also use a sloping demand curve
- **Work seamlessly with the energy and ancillary service markets**

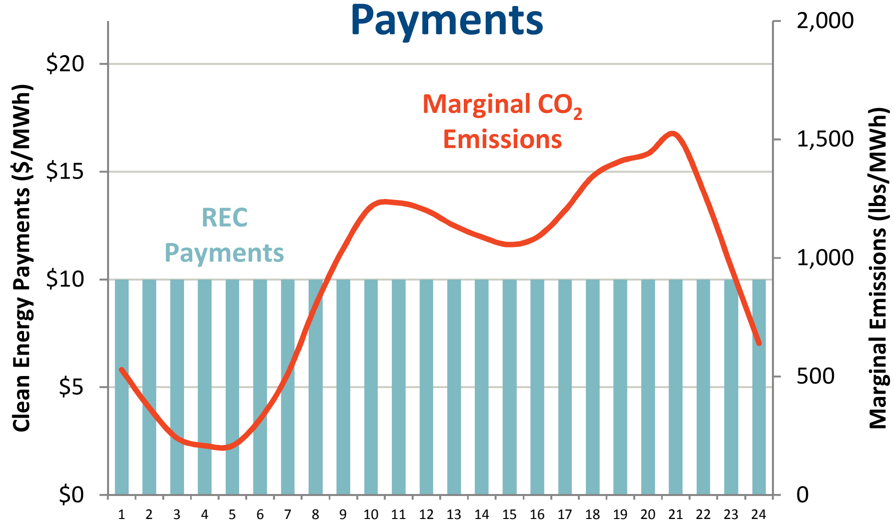
A note on carbon pricing: This coalition continues to recommend enhanced CO_2 pricing as a means to efficiently contribute to achieving decarbonization goals. This clean energy market can work well alongside enhanced CO_2 pricing, or on a stand-alone basis

Design Concept

"Dynamic" Clean Energy Payments

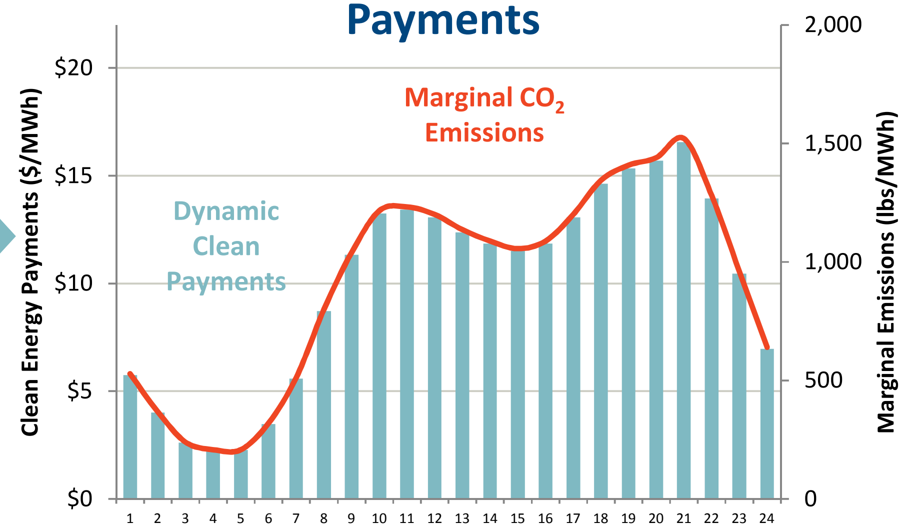
The centerpiece of this design proposal is a new "carbon-linked" dynamic clean energy payment

Illustrative Traditional REC Payments



- Flat payments over every hour
- Incentive to offer at negative energy prices during excess energy hours

Illustrative "Dynamic" Clean Payments



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

Design Concept

Anchor Price and Dynamic Payments

- A **Reference Emissions Rate** is set prior to the forward auction (for example, at the average system-wide marginal emissions rate, such as 1,100 lbs/MWh)
- Clearing price in the forward market sets an **Anchor Price** based on the Reference Emissions Rate
- **Realized Payments** to individual resources scale dynamically in proportion to realized **Marginal Emissions Rate** at the time and place of delivery (mimics CO_2 pricing incentives for clean energy resources)
  - The ISO would calculate the marginal emissions rate along with calculating energy prices at every node (both day-ahead and real time)
- Clean energy suppliers earn:

$$\text{Payments} = \frac{\text{Marginal Emissions Rate}}{\text{Reference Emissions Rate}} \times \text{Anchor Price}$$

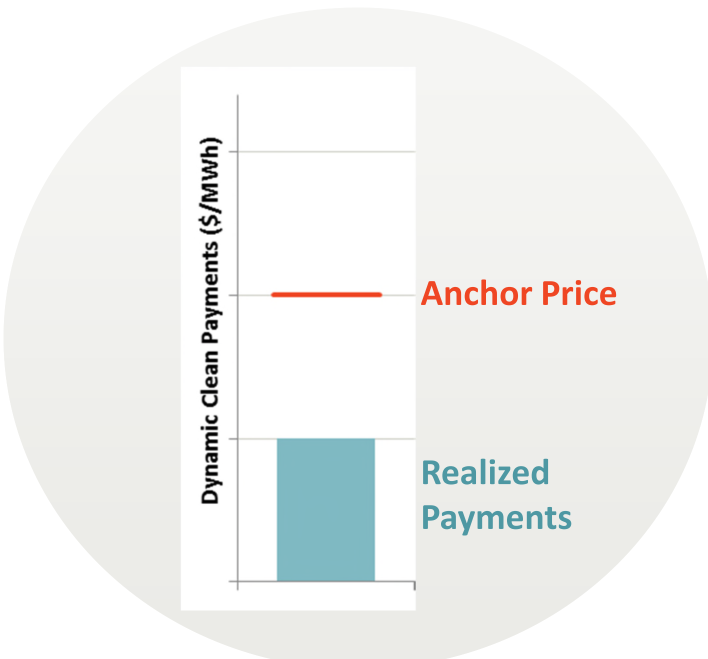
Design Concept

Incentives for Clean Energy in the Right Locations

Location-specific payments will focus incentives to develop new clean energy where they will displace the most CO_2 emissions

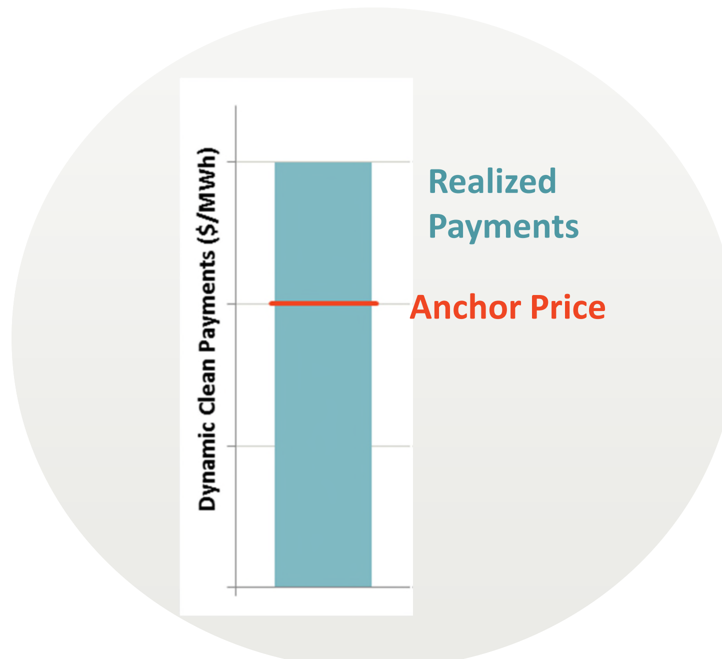
Low-Emitting Location

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



High-Emitting Location

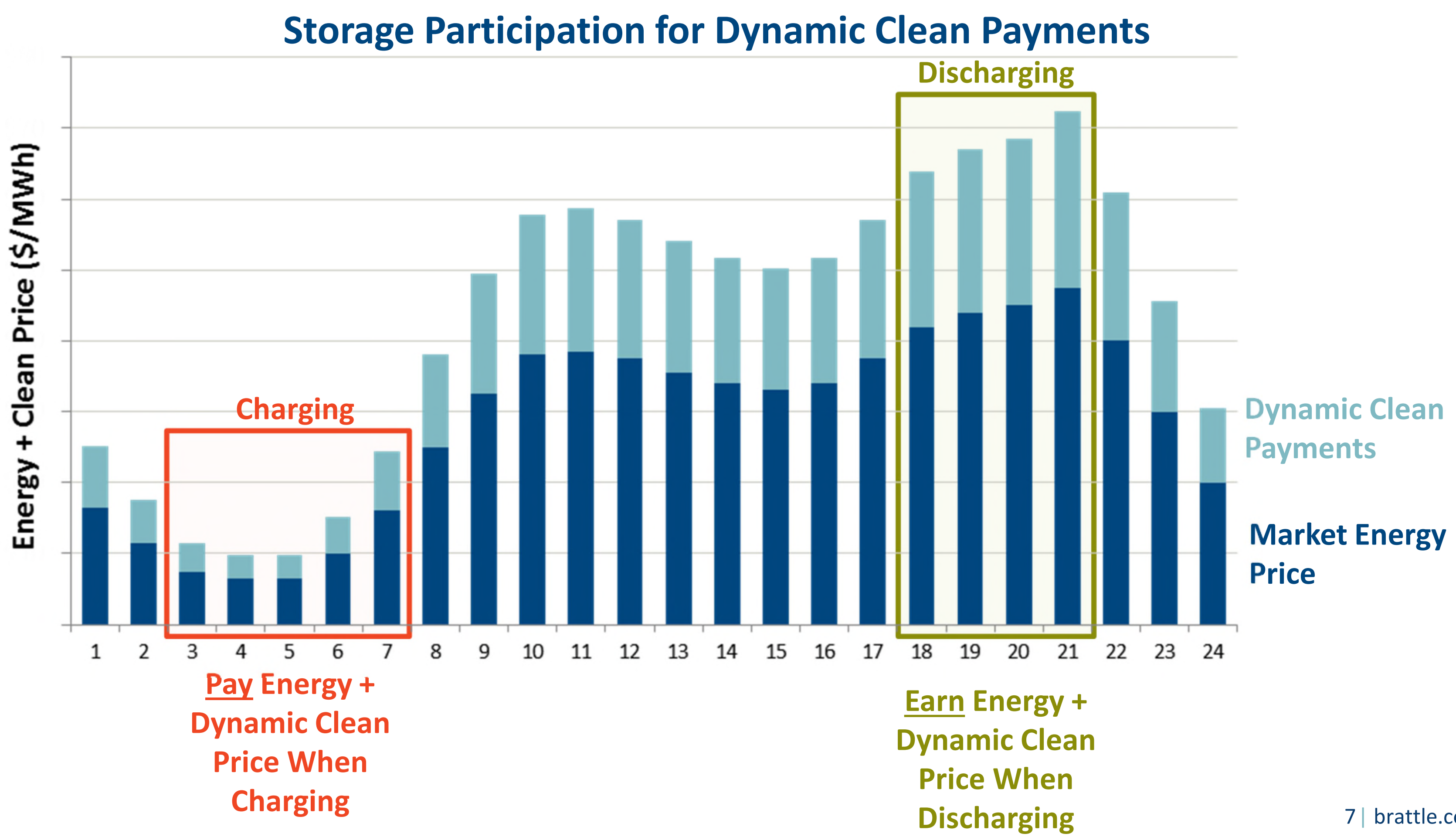
Load pocket where high-emitting steam oil units are often called on. Clean energy will displace more emissions (and earn more payments)



Design Concept

Incentives at the Right Times (Including for Storage)

Dynamic payments incentivize clean energy at the right times to displace the most CO_2 emissions. Unlike other policies, storage can compete with other technologies



Base and "Premium" Clean Energy Products

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

"Base" Product

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

"Premium" Product

- <u>New</u> non-emitting resources
- State has option to define a specific technology type
- ~7-12 year anchor price lock-in
- No state commitment to submit demand in future years
- Option for a "contingent" bid. If premium prices are too high, the state can choose to purchase the lower-cost "base" product instead

Forward Clean Energy Auction

Supply Offers

- Sellers offer in $/MWh
- Offer prices consider sellers' expectations of other revenue streams: capacity, ancillary, and energy (including CO_2 price)
- All sellers qualify as "Base", a subset of new resources can qualify as "Premium"

Auction Clearing

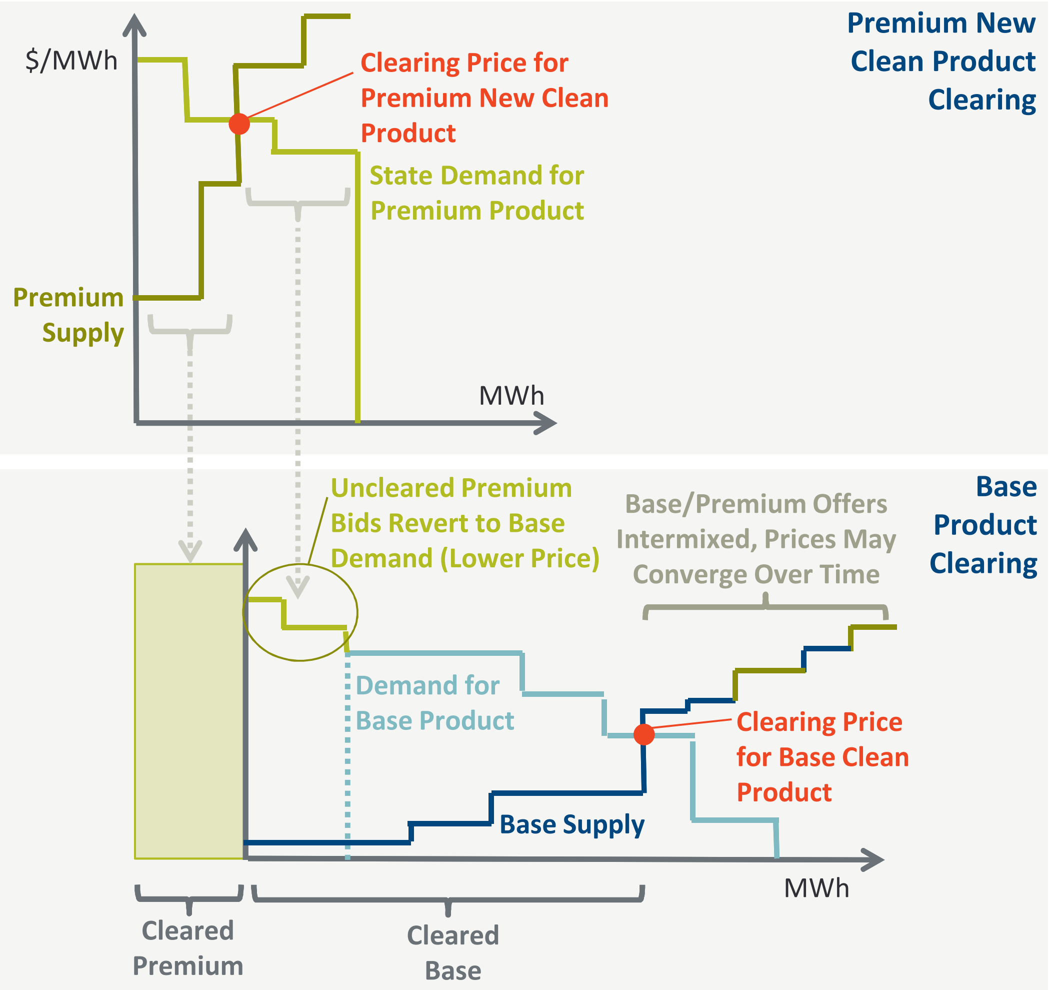
- Co-optimized clearing for all states' demand
- Conducted immediately prior to the FCM
- Uncleared clean resources have the option for a separate capacity-only offer in FCM

Cost Allocation & Supply Accounting

- States pay for their own cleared demand
- Emissions accounting: States can only take credit for clean energy procured in this auction or outside PPA (no state can claim the clean value of uncleared existing supply)

Example: Auction Clearing

Assume: Only One Premium Product, with All "Contingent" Bids



Pros and Cons of Dynamic Clean Product

Advantages	
Incentives for Clean Resources that Displace the Most CO_2 Emissions	• Clean payments scale in proportion to marginal CO_2 abatement
No Negative Offer Prices	• Unlike many types of clean energy incentives and PPAs, there are no incentives for clean energy to offer negative into the energy market
Economic Efficiency	• Incentives similar to the efficient outcomes from a CO_2 price (at least for covered resources)
Suppliers Bear Most Fundamentals-Based Investment Risk	• Locational energy price risk, fleet mix, technology change, fuel price, and load growth risks mostly borne by suppliers
Customers Take on Most Regulatory Risks	• Risk of policy certainty mostly borne by customers (via price and demand bid lock-ins) • Over- and under-performance risk also borne by customers
Storage Can Participate	• Storage has opportunities to participate if charge/discharge cycle displaces CO_2 emissions

Disadvantages	
Complexity	• Less intuitive and more complex than historical approaches or CO_2 pricing alone • New product and market pose implementation costs and risks
Lack of Competition between Premium and Base Resources	• Higher-cost premium new resources might get built while lower-cost base resource opportunities are forgone/retire • The more premium categories are introduced, the less competition (and higher societal costs) could be incurred
Losing Some Efficiencies Compared to Enhanced CO_2 Pricing	• May forgo lower-cost CO_2 avoidance options for non-covered resources (e.g. energy efficiency, some types of DR) • No incentives for fossil plants to avoid CO_2 emissions

Further Considerations

We hope to continue working with a variety of stakeholders to refine and improve this design proposal.

Further considerations and design refinements include:

- Robustness and longevity of demand
- Transmission upgrade cost representation in offers or market clearing
- Lock-in term for premium resources and demand bids
- Method for determining marginal CO_2 emissions and auction parameters
- Interactions with energy and capacity markets
- Interactions with RECs and clean energy contracts (existing and future)
- Delivery obligations and reconfiguration auctions
- Qualification standards and quantities

APPENDIX

Components of the Dynamic Clean Energy Market

	Design Element
Carbon Pricing	• This coalition continues to recommend enhanced CO_2 pricing as a means to efficiently contribute to achieving decarbonization goals, although it is not the subject of this proposal • The dynamic clean energy market will work well in concert with enhanced CO_2 pricing, but can also be pursued on a stand-alone basis
Dynamic Clean Energy Market	**Product Definition:** • Clean attribute only (not bundled with energy) • Anchor price determined in the forward auction, but realized payments scaled in proportion to marginal CO_2 emissions rate at the time and place of delivery (replicates the incentives from a CO_2 price) **Supply and Demand:** • "Base" product that includes all qualified clean resources (new and existing), 1-year price lock-in • Base demand quantity should not decrease over time to provide regulatory certainty (perhaps for 10 years) • States have the option to specify "premium" products (new resources or specific types of new resources), defined over a longer price lock-in period such as ~7-12 years – shorter than typical PPA commitments • States or their designated entities, such as utilities, determine the quantity and price of demand bids • States can submit "contingent" demand bids for premium products. If the state's bid for a newer higher-cost premium product does not clear, then the MWh of demand can revert to buying the cheapest "base" clean energy that is available **Procurement Auction:** • Forward clean energy auction conducted immediately prior to the FCM • Transmission development costs can be incorporated into offers or auction clearing

Base and "Premium" Clean Energy Products

	Base Product	Premium Products
Qualified Resources	• All non-emitting resources • New and existing • Storage is qualified (must pay the clean price when charging, earns clean price when discharging)	• New resources • States can determine a specific technology type if desired
Price Lock-in	• 1 year	• Premium products have a longer lock-in period (e.g. ~7-12 years) for cleared resources
Demand Bid Longevity	• Demand would increase, not decrease, over ~10 years • Limits placed on the size of demand reductions in future years	• Demand may exist for only 1 year and does not need to be resubmitted the following year (but any cleared resources have a price lock-in for ~7-12 years)
Entity Submitting Demand Bids	• State or designated entity (e.g. utility)	• State or designated entity (e.g. utility)
Price and Quantity	• Price-quantity pairs or sloped curve defined by state • ISO-NE to work with each state to determine what input parameters and analytical support is desired each year (e.g. estimate of clean Net CONE or needed quantities)	• Price-quantity pairs or sloped curve defined by state • ISO-NE to work with each state to determine what input parameters and analytical support is desired each year (e.g. estimate of premium product Net CONE)
"Contingent" Demand Bids	• n/a	• States have the option to designate bids as "contingent" • Contingent demand bids will procure "premium" new clean resources as long as the premium resources are available at or below the bid price. If not enough premium supply clears, then the uncleared quantity will be procured from the lower-price "base" product • If reverting to demand for the "base" product, the price lock-in period will revert to 1 year and the demand bid can revert to a lower price

Product Definition

Example: Dynamic Clean Energy Payments

Concept: Simulate operational and investment incentives for clean energy that mimics the incentives from a CO_2 price

- Clean energy payment is additive to energy payments (not a bundled product)
- Product definition assumes a pre-defined Reference Emissions Rate (e.g. 1,100 lbs/MWh), based on the average marginal emissions rate in the last delivery year (across all delivered clean MWh)
- Realized payments scale dynamically in proportion to marginal emissions displacement at the time and place of delivery (i.e. proportional to the CO_2 component of LMP)
- Sellers displacing more CO_2 earn proportionally higher payments per MWh for the clean product (and in the energy market with CO_2 price), sellers displacing less CO_2 earn less
- Clean energy buyers take on the risk of over- and under-performance in aggregate

Example: Clean Energy Incentives

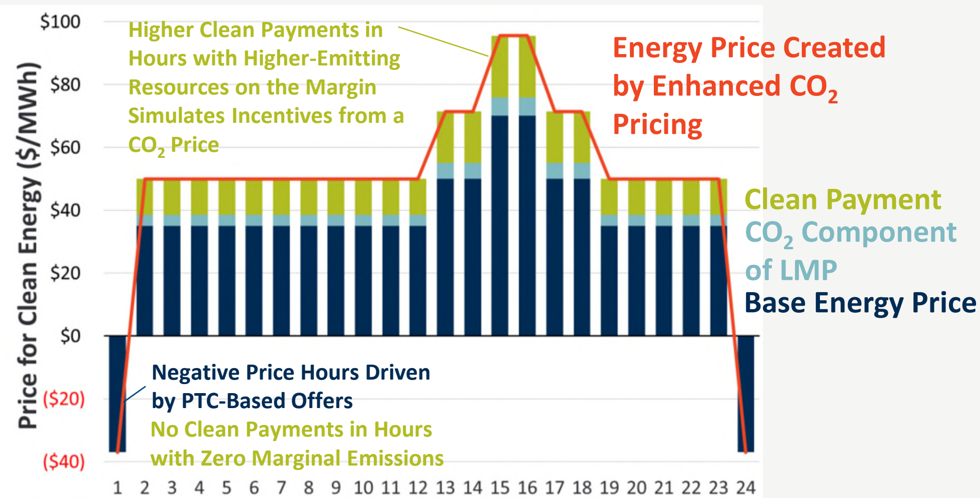
Market and Product Parameters

Reference Emissions Rate	1,100	*(lbs/MWh)*
CO_2 Price in Energy Market	$7	*($/ton)*
Clean Energy Anchor Price	$13	*($/MWh)*
Simple Average Energy Price	$38	*($/MWh)*

Realized Revenue

		Wind	Solar
Base Energy Payments	*($/MWh)*	$24	$49
CO_2 Component of LMP	*($/MWh)*	$3	$4
Clean Energy Payments	*($/MWh)*	$10	$14
Total	***($/MWh)***	**$37**	**$67**
Avoided Emissions Rate	***(lbs/MWh)***	**869**	**1,231**

Marginal Incentives in a Typical Day



Biography and Contact Information

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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.

Kathleen earned a B.S. in Mechanical Engineering and Physics from Iowa State University. She earned an M.S. in Electrical and Computer Engineering and a Ph.D. in Engineering and Public Policy from Carnegie Mellon University.

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Ms. Judy Chang is an energy economist and policy expert with a background in electrical engineering and 20 years of experience in advising energy companies and project developers with regulatory and financial issues. Ms. Chang has submitted expert testimonies to the U.S. Federal Energy Regulatory Commission, U.S. state and Canadian provincial regulatory authorities on topics related to transmission access, power market designs and associated contract issues. She also has authored numerous reports and articles detailing the economic issues associated with system planning, including comparing the costs and benefits of transmission. In addition, she assists clients in comprehensive organizational strategic planning, asset valuation, finance, and regulatory policies.

Ms. Chang has presented at a variety of industry conferences and has advised international and multilateral agencies on the valuation of renewable energy investments. She holds a BSc. In Electrical Engineering from University of California, Davis, and Masters in Public Policy from Harvard Kennedy School, is a member of the Board of Directors of The Brattle Group, and the founding Director of New England Women in Energy and the Environment.

About The Brattle Group

The Brattle Group provides consulting and expert testimony in economics, finance, and regulation to corporations, law firms, and governmental agencies worldwide.

We combine in-depth industry experience and rigorous analyses to help clients answer complex economic and financial questions in litigation and regulation, develop strategies for changing markets, and make critical business decisions.

Our services to the electric power industry include:

- Climate Change Policy and Planning
- Cost of Capital
- Demand Forecasting Methodology
- Demand Response and Energy Efficiency
- Electricity Market Modeling
- Energy Asset Valuation
- Energy Contract Litigation
- Environmental Compliance
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