A Competitive Markets Design to Achieve New England's Energy Decarbonization Goals

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September 14, 2016

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The CLF Market Design Team

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Issues For Consideration

- Consensus Statement of the Goal of this Process
- Recommendation for Pre-design Modeling
- Revised CLF Market Design Proposal

Consensus Statement of IMAPP Goal

- Proposals, positions and comments to date suggest a diverse and divergent understanding of the primary goal of this process
- Achieving consensus on final market adjustments requires an initial consensus on the overarching goal sought to be achieved by those changes
- The Consensus Goal Statement should be simple, clear and broadly encompassing
- To date, the ISO-NE wholesale markets and planning processes have been designed to achieve two overarching objectives: reliability and economic efficiency
- The IMAPP Consensus Goal Statement must incorporate a third core objective: achieving the collective state greenhouse gas reduction targets

CLF Proposed Goal Statement

“ISO-NE electricity markets that are consistent in design and function with the New England states' shared goal of achieving an 80% reduction in greenhouse gas emissions by 2050 and that maintain reliability and cost-efficiency”

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Essential Pre-design Modeling

- States' have shared goal of 80% reduction in greenhouse gas emissions by 2050
- Electrification of transportation and buildings (heating) sectors is critical to achieving 80% by 2050
- If markets are to facilitate timely decarbonization of the electric sector, they must be designed in accordance with some understanding of what decarbonization over 34 years will look like
- It is essential that we inform proper final design by answering, in advance, critical questions around the necessary trajectory for electric sector decarbonization to achieve the economy-wide goal as well as essential attributes of a decarbonized electric system

Revised CLF Market Design Proposal

Two Components:

1) Price on Carbon in Energy Markets
   - Recognizing the true societal cost of the GHG emissions externality will send the proper signal for investment in clean forms of energy while reducing carbon in dispatch
   - Provides price signal to ensure efficient use of distributed resources and storage

2) Carbon Integrated Forward Capacity Market (FCM-C)
   - Provides an investment signal for the development of clean energy resources on a schedule consistent with the goal of 80% GHG reduction by 2050

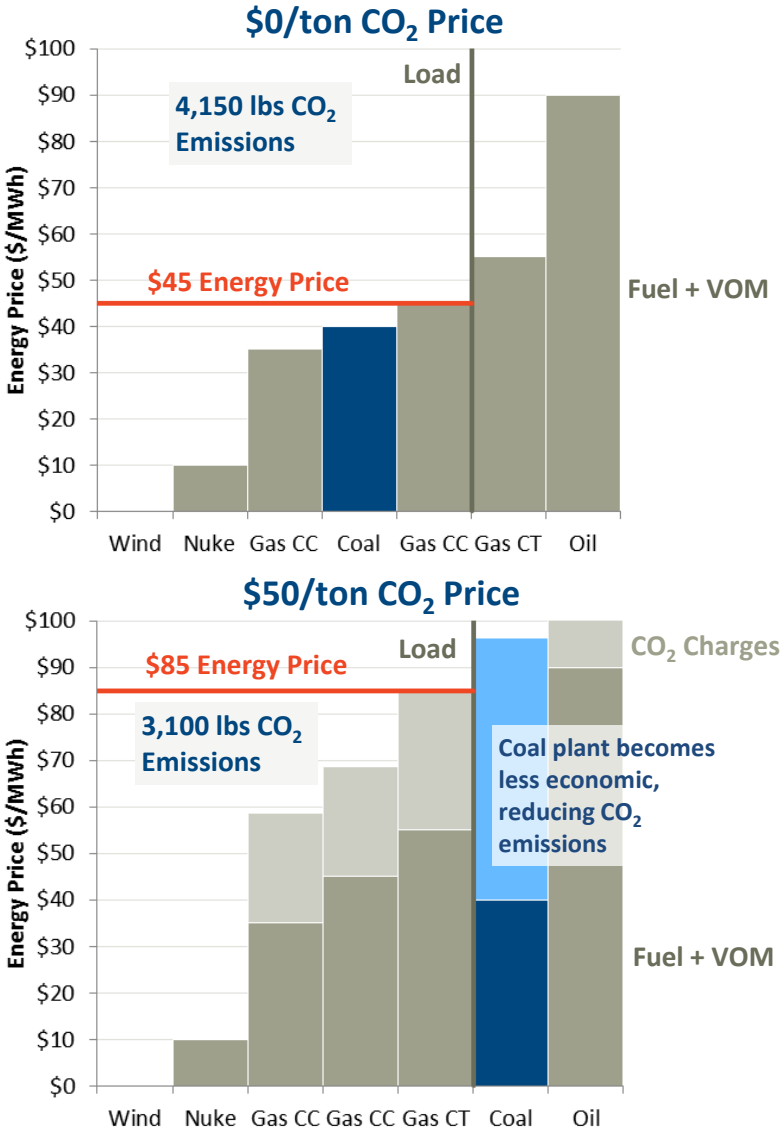
Price on Carbon in Energy Markets

- Real carbon price, not just shadow price on carbon
- Carbon price applied to generator offers will be reduced by the most recent RGGI auction price
- Approach designed to be technology neutral, rewarding low and zero carbon emitting resources
- While wholesale energy prices will reflect the carbon adder, customer cost increases will be offset by the ISO returning the carbon charges collected proportionally to state-regulated EDCs, muni/coop entities and direct wholesale customers on a monthly lump sum basis
- Seams issues will be addressed with a CO_2 price adder at the border (reflecting the difference in CO_2 prices in each market, with many details to be part of the design phase)

CO_2 Pricing Furthers State Decarbonization Goals in the Short- and Long-Term

- Short-term dispatch effect from higher-emitting resources incurring higher CO_2 charges and becoming more costly on a per MWh basis

- Will avoid dispatch of CO_2 emissions in the short-term by, for example, avoiding increased emissions from cycling; peaking DR may also be more economic than some high-emitting gas/oil peakers; and remaining coal/oil left in market dispatched less frequently



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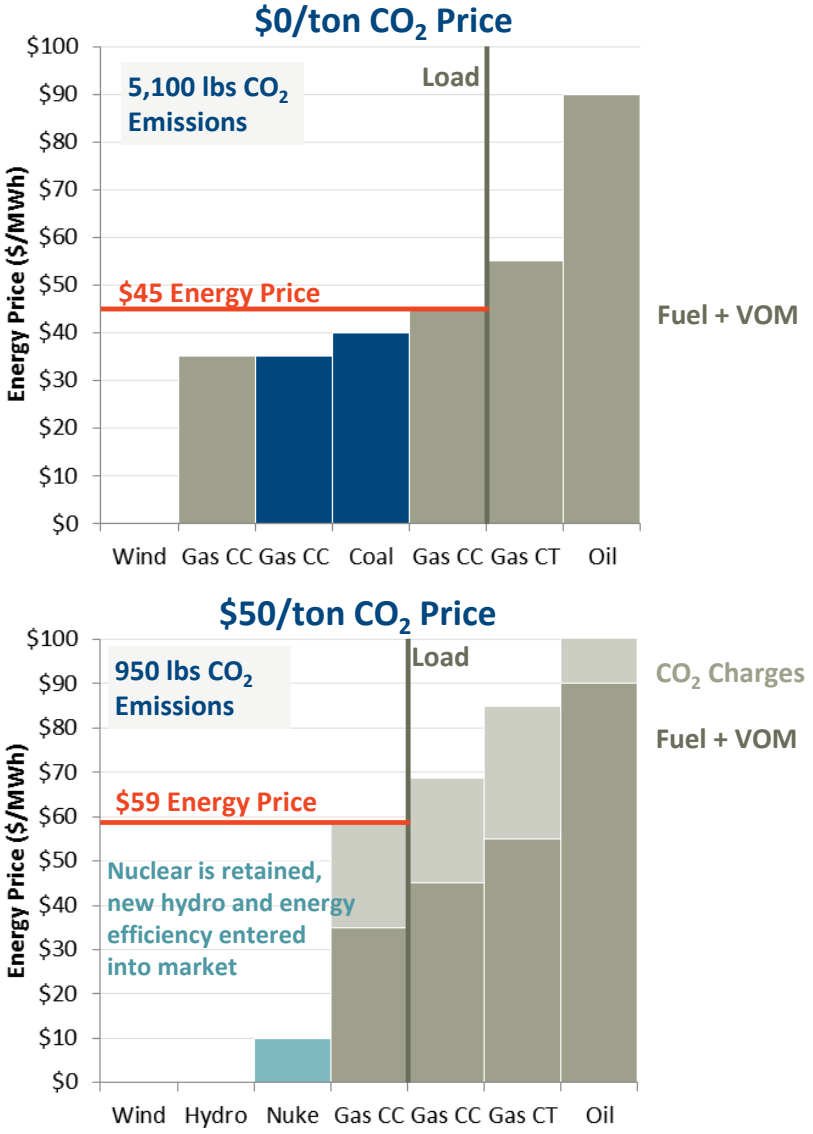
Notes: Adapted from Exelon slide 4. Each plant is 1 MW in size, with typical fuel+ VOM costs and CO_2 emissions rates.

Long-Term: Price Signal Creates Incentive for Clean Energy Resource Development

- Lower-emitting and non-emitting resources will be more profitable and more attractive to investors than without a CO_2 price
- Will induce investments toward a lower-emitting resources over time
- Expected long-term effects:
  - Higher energy margins will help retain existing clean energy resources that may otherwise retire
  - Existing coal and high-emitting steam plants will face more financial pressure to retire
  - New wind, hydro, and energy efficiency will become more attractive investments (and reduce the amount of gas CCs as new entrants)
- Long-run prices and costs:
  - Energy prices can increase (due to higher CO_2 prices) or decrease (due to more entry of non-emitting resources with no fuel costs)
  - Total energy + capacity + ZEC (see later slide) prices will be high enough to support the policy objective of attracting investments in new non-emitting generation



Notes: Adapted from Exelon slide 4. Each plant is 1 MW in size, with typical fuel+ VOM costs and CO_2 emissions rates. Fleet effects are directional, but realized energy prices

Defining Price on Carbon

Based Upon:

1) **Social Cost and Willingness to Pay**: Stakeholders will determine a reasonable range of prices that could be adopted based on the social cost and willingness to pay for avoiding CO_2 emissions.
   - Starting Price: at federal government's Social Cost of Carbon (SCC): $61/ton.
   - Maximum Price: Highest CO_2 price reflecting the maximum willingness to pay to avoid CO_2 emissions (updated with inflation)
   - Minimum/Reservation Price: Lowest CO_2 price reflecting a situation where it is a relatively low cost to achieve even greater levels of CO_2 emissions earlier (updated with inflation)
2) **Quantity**:
   - ISO-NE will develop a CO_2 emission reduction trajectory consistent with the states' policy mandates of 80% reductions by 2050, in consultation with state regulators
   - CO_2 price may be adjusted upward or downward regularly (every 1-3 years?) based on whether the prior years' emissions were above or below the target, with price adjustments in increments not to exceed a pre-specified level
   - Price will adjust to meet quantity targets, but will stay within the price collar

Revenues from Pricing Carbon

- Price on carbon is designed to be revenue-neutral with respect to ISO-NE with 100% of surplus returned to load
- Money is returned proportionally to state-regulated EDCs, muni/coop entities, and direct wholesale customers
- State Regulators will oversee how these funds are used by the EDCs
  - PUCs can decide whether to use the funds for programs that benefit electricity consumers such as energy efficiency investments, provide direct customer rebates, or elect other uses
  - Energy efficiency programs should not be negatively impacted:
    1) Rebates to customers should maintain incentives for EE
    2) this has additional possibilities for states with LCP mandates, including MA, ME, VT, RI, because ambit of “Least Cost” is enlarged

CLF Carbon Integrated Forward Capacity Market (FCM-C)

- Complementary to carbon price in energy market
  - The carbon price will help reduce carbon emissions (as described in previous slides)
  - FCM-C creates additional market-based incentives for clean energy resources to be developed on a schedule consistent with 80% by 2050 goal
- Operates as a component of and simultaneous with FCA
- All suppliers bid in two quantities at a single combined price: (a) zero-emissions credits (ZECs) for zero-emitting resources (in MWh) and (b) traditional FCA capacity (in MW).
- ZEC is the “green” attribute of non-emitting resources:
  - Not bundled with energy value (additive to energy price payments)
  - Technology neutral, all non-emitting existing and new resources can produce ZECs

FCM-C Mechanics: Offer Structure

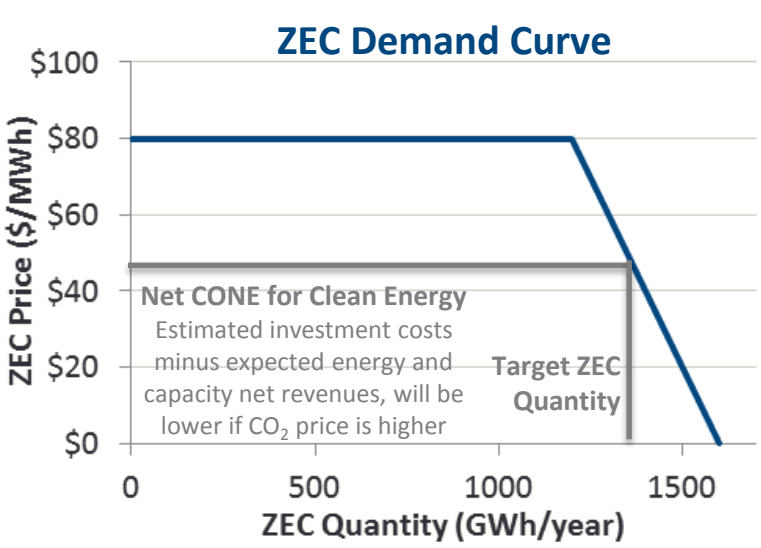
- **Offer Structure:**
  - Just as in today's FCM, resources bid a single price into the FCM-C in accordance with their revenue requirements. Offer price is in $ per nameplate MW.
  - The FCM-C recognizes this single-price bid as reflecting willingness to sell both: (1) a particular quantity of ZECs (offered in MWh) and (2) a particular quantity of traditional capacity (offered in MW). The seller should be indifferent to whether the payment comes from ZEC or capacity, as long as the total payment is equal or greater than the offer price

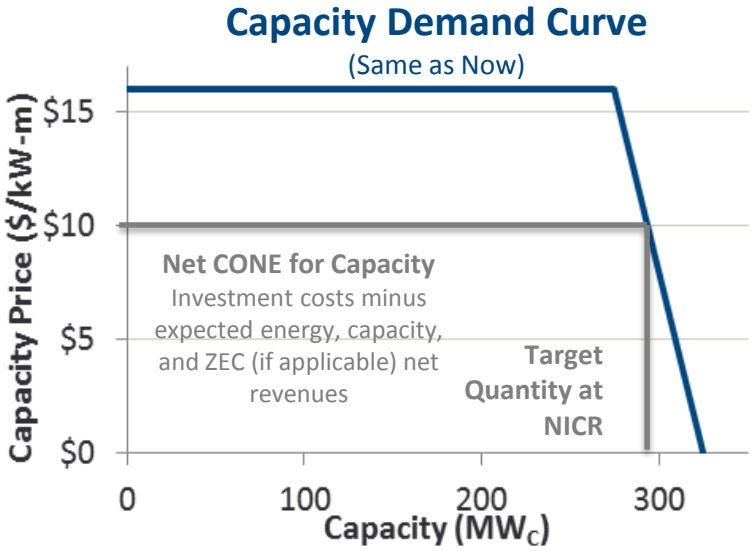
Example: Offers for Different Resource Types

		Nuke	Hydro	Gas CC	Wind
Resource Ratings					
Nameplate	*(MW_N)*	100	100	100	100
Capacity	*(MW_C)*	100	100	100	15
ZECs	*(GWh/year)*	788	438	0	263
Offer Price	*($/kW-$m_N$)*	$10	$10	$7	$10

FCM-C Mechanics: Demand Curves

- **Two Demand Curves:** (1) one for zero-emitting energy; (b) one for capacity, per current tariff
- **Capacity Demand Curve:** Same as now
- **ZEC Demand Curve:**
  - Quantity points on the ZEC demand curve are developed by ISO based on a projection developed in the CELT that determines the quantity of clean energy MWh needed, consistent with the CO_2 emissions trajectory determined by ISO-NE in consultation with state regulators
  - Price points on the ZEC demand curve are based on the "Net CONE" for the anticipated marginal non-emitting resource type. Price can fall to zero if clean energy resources are built based on the energy plus capacity prices, or can rise up to the price cap (e.g. at 1.6x the Marginal Clean Energy Resource's Net CONE) if the quantity is short





Notes: Straight-line curves shown for simplicity. No change is proposed to the current capacity demand curve shape.

FCM-C Mechanics

- **New Entry Price Lock-in:**
  - Same term of price guarantee (in both $/MWh for ZECs and $/kW-m for capacity) is offered to any new resources that clear in the auction (the same applies to traditional resources and non-emitting resources)

- **Impact on meeting NICR:**
  - Capacity value of non-emitting resources that clear in the FCM-C contribute toward meeting the NICR

FCM-C Mechanics: Joint Auction Clearing

- Capacity and clean energy needs will be jointly procured in a co-optimized fashion
- Benefits of joint procurement:
  - Minimize total capacity + ZEC procurement costs, reducing system and customer costs compared to non-integrated procurement
  - Enable suppliers to avoid risk of selling capacity without knowing ZEC price (and avoid selling ZECs without knowing capacity price)
- Using same optimization framework as in current capacity auctions (with one more constraint)

Co-Optimized Procurement

- **Objective Function:** Minimize capacity + ZEC procurement costs (or more accurately, "maximize social surplus")
- **Constraints:** Same as in current optimization, no additional locational constraints applied for ZECs
- **Prices:** Marginal cost of procuring additional ZECs and/or capacity (same as now)

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Notes: *In the context of downward-sloping demand curves, the actual objective function is "maximize social surplus" or area under the demand curves for ZEC and capacity minus .

FCM-C Example: ZEC Price Formation

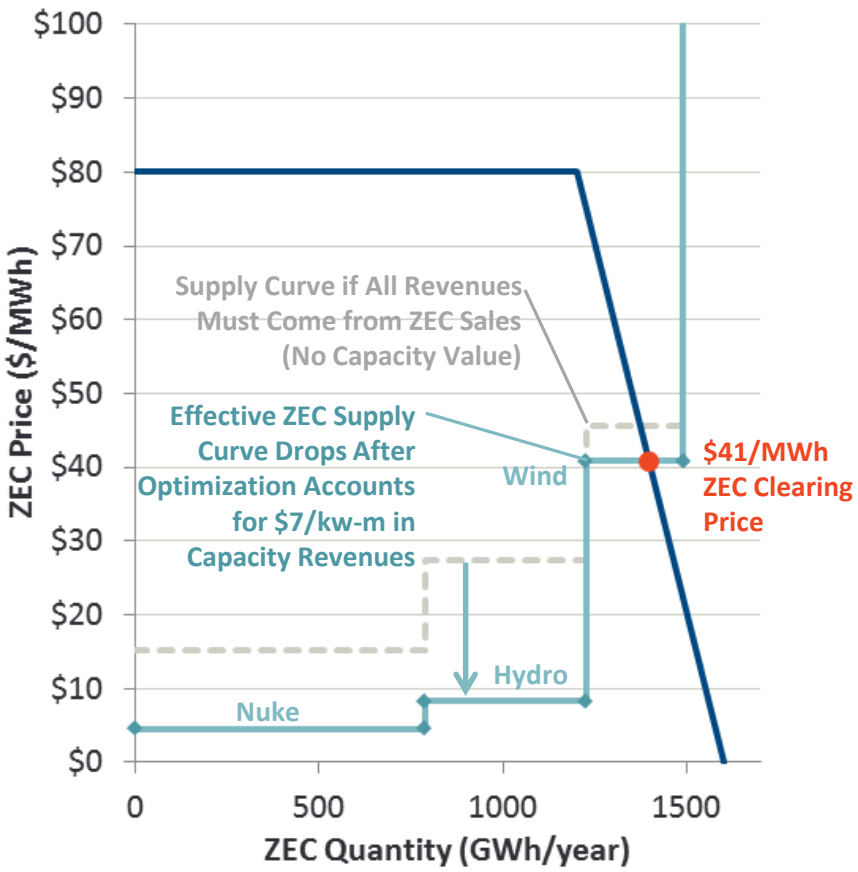
- If procuring ZECs independent of capacity, suppliers would need to take a risk on expected capacity revenues
- Joint procurement will account for capacity revenues by resource type, resulting in lower ZEC prices if capacity prices are higher

Resource Offers

		Nuke	Hydro	Gas CC	Wind
Resource Ratings					
Nameplate	*(MW_N)*	100	100	100	100
Capacity	*(MW_C)*	100	100	100	15
ZECs	*(GWh/year)*	788	438	0	263
Offer Price	*($/kW-m$_N$)*	$10	$10	$7	$10

ZEC Price Formation

ZEC Supply Curve Before and After Accounting for and Without Joint Clearing



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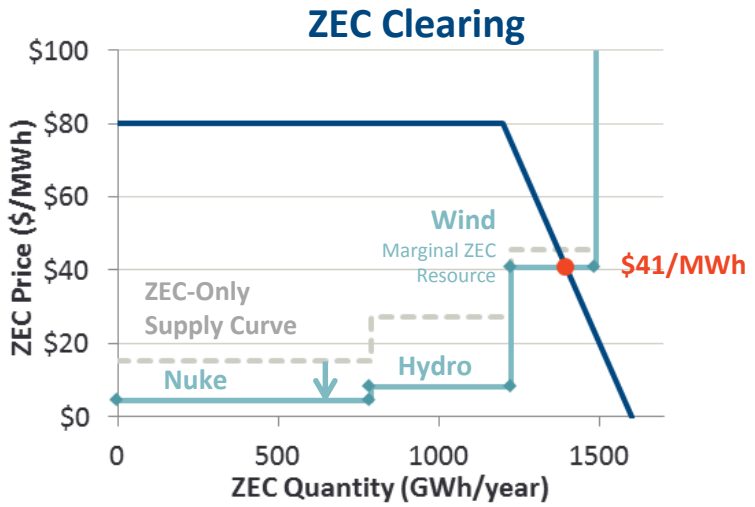
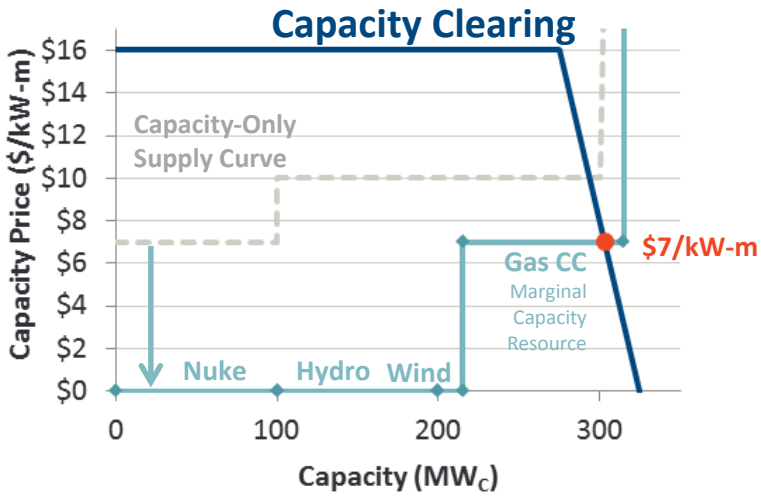
FCM-C Example: ZEC & Capacity Price Interactions

- Interaction between ZEC and capacity prices is offsetting: high ZEC prices translate to low capacity prices (and vice versa)
- ZEC + capacity payments are expected to be high enough to cover the investment costs for all cleared resources
- Results in cost-minimizing procurement between the two products

Resource Offers and Clearing Results

		Nuke	Hydro	Gas CC	Wind
Resource Ratings					
Nameplate	*(MW_N)*	100	100	100	100
Capacity	*(MW_C)*	100	100	100	15
ZECs	*(GWh/year)*	788	438	0	263
Offer Price	*($/kW-m$_N$)*	$10	$10	$7	$10
Revenues					
ZECs	*($M/year)*	$32	$18	$0	$7
Capacity	*($M/year)*	$8	$8	$8	$1
Total	*($M/year)*	$41	$26	$8	$8
Total	*($/kW-m$_N$)*	$34	$22	$7	$10





Notes: Supply curve for ZECs reflects minimum ZEC price that each resource is willing to accept, given the capacity clearing price. Similarly, supply curve for capacity reflects minimum capacity price each seller will accept once the ZEC price is known.

CO_2 Price and FCM-C Interactions

- CO_2 pricing and FCM-C markets will work together to decarbonize the electricity system
- Should not be viewed as additive to customer costs, since prices will be offsetting. Together, these markets will pay the variable and fixed costs needed to attract new clean energy resources, but no more
- For example, higher CO_2 prices will translate to:
  - Lower ZEC prices needed to attract clean energy (and more clean energy entering in the ZEC demand curve)
  - More clean energy entering will result in lower capacity prices
- Combined effects will create both short-term and long-term decarbonization incentives, as required under state policy

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FCM-C Mechanics: Offer Review Trigger Price Modifications

- **ORTP Modified**:
  - CLF recommends returning the ORTP to its original purpose, to prevent artificial price suppression from those with a net negative position in the market
  - ORTP will be reformed to only apply to entities that have an incentive to suppress capacity and/or ZEC prices (such as net short entities, agents of the state, or their contractual counterparties). Developers that would enter the market on a merchant basis, without a net short position, and/or without a contractual counterparty will not be subject to the ORTP
  - The 200 MW (600 MW cumulative) renewables exemption will continue to apply for resources procured under any state-mandated PPAs or specialized procurements under payment mechanisms that are not broadly available to all non-emitting resource types

Advantages of FCM-C over other proposals

- Integrated clearing with FCA
  - No guess-work for renewable developers
  - Lowest cost *joint* solution to meet reliability & GHG goals
  - No distortion of capacity prices
  - Reduces tariff development
  - Minimal need for additional market monitoring
  - Aligns price lock-in period for new clean resources
- ZECs vs. CFD
  - Consumers hedge only the zero-carbon attribute value of the product
  - Suppliers retain commodity energy price risk

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Next Steps towards FCM-C Implementation

- Process for setting ZEC demand curve
- ZEC imbalance market or mechanism
- ZEC unit qualification standards
- Seams issues
  - Qualification of imports to offer ZECs in FCM-C
  - Proof of delivery of imported ZECs
  - Attribute stripping on exports

All FCEM proposals need to address these points

Questions?