FCM-C Mechanics

Robert Stoddard
Senior Consultant
Charles River Associates

Jerry Elmer
Senior Attorney
Conservation Law Foundation

Kathleen Spees
Principal
Brattle Group

October 6, 2016

clf
conservation law foundation

CLF's overall proposal has two components

1. Price on Carbon in Energy Markets -- Not discussed today.

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

Why Do Both CO_2 Pricing *and* FCM-C?

CLF does not argue that this combination is the only approach, nor necessarily the best option in all regions, but does see reasons to pursue this combination in New England

Component	Rationale
CO_2 Pricing	• Most critical element of the design proposal • Internalizes the externality; directly supports the design objective of decarbonizing • Will immediately introduce incentives to avoid CO_2 emissions in operations, retain existing clean resources, and attract new clean energy investments

FCM-C	• Indirectly supports the design objective of decarbonizing by supporting clean energy investments (indirect nature comes with some disadvantages)
	• May not be needed in every market, but reasons to adopt in New England:
	  ◦ Many stakeholders supported a clean energy procurement in some form
	  ◦ Introduces a more predictable quantity component to decarbonization (i.e. CO_2 pricing alone has less certainty on the timeframe and magnitude of reductions)
	  ◦ Option to pursue differentiated quantity goals over time among states (CO_2 pricing would reflect a single combined objective and willingness to pay for reductions)
	  ◦ Some stakeholders and states believe that forward certainty is needed to support clean energy investments, and FCM-C provides some with up to 7-year lock-in
	  ◦ Opportunities to reconcile with state RPS, procurements, and ORTP
	  ◦ Opportunities to reconcile magnitude, forward period, and delivery period of investment signals provided to clean energy and traditional capacity resources
	  ◦ Technology-neutral and FCM-integrated approach provides opportunities to reduce costs of decarbonizing compared to status quo
	• Complements CO_2 pricing, with ZEC prices clearing lower given expected CO_2 price effect on energy

Review of FCM-C

- Two supply curves for two separate products in a single auction:
  - Capacity Product: Current definition of capacity megawatts; cleared resources acquire a CSO
  - New Product: Zero Emission Credits (ZECs) for producing megawatt-hours from non-emitting resources
- ZEC-eligible resources offer a single price (for both commodities) sufficient to meet their revenue requirement*
- Single price approach analogous to single energy market price that is applied to both energy and reserves markets
- ISO clears these offers using least-cost combination of the two products
- ISO clears both products simultaneously in the single auction

*Design will need to consider the most appropriate offer structure, e.g. to ensure that resources clearing for ZECs earn a sufficient additional capacity payment for taking on the pay-for-performance obligation, see subsequent slides on this topic.

Review of FCM-C (cont.)

- Each year the ISO develops two demand curves for the auction:
  - Capacity demand curve continues to be denominated in MW
  - New ZEC curve is denominated in MWh
- Denominating the ZEC obligation in MWh allows the ZEC generator to satisfy its delivery obligation at any time during the delivery year
- Clearing price for new ZEC resources comes with the same clearing-price lock-in provided to new resources clearing for traditional capacity (currently 7 years)
- Incumbent resources are not eligible for clearing price lock-in, but are eligible for ZECs

Review of FCM-C (cont.)

CLF's two-part proposal (carbon adder in the energy market + new ZEC market integrated with the forward capacity market) is technology-neutral

- ZEC market is open to both new and existing resources, e.g. existing nuclear plants are eligible
- Imported resources are eligible
- ZECs are a system-wide product, no locational differentiation
- Determining responsibility for and criteria for resource qualification will be a substantial area of refinement, ideally leveraging existing state REC qualification approaches and tracking systems for internal and imported resources (but need to acknowledge the substantial effort since approaches differ across states)

Please provide additional examples to illustrate how the co-optimized capacity and ZEC auction would clear

- We report a series of examples here in a narrative form, and provide detailed offer price and clearing results as an appendix in each case
  - Example 1: ZECs and ICR
  - Example 2: Wind is Marginal for ZECs; Gas is Marginal for Capacity (Same Example as in Previous Presentation)
  - Example 3:Nuclear Plant is Marginal for Both Products

Example 1: ZECs and the ICR

The Clean Green Wind Farm

Nameplate: 150 MW
Capacity Factor: 22%
Offers into FCA: 33 MW plus 262,800 MW**h** of ZECs
Unit clears: 33 MW plus 240,000 MW**h** of ZECs

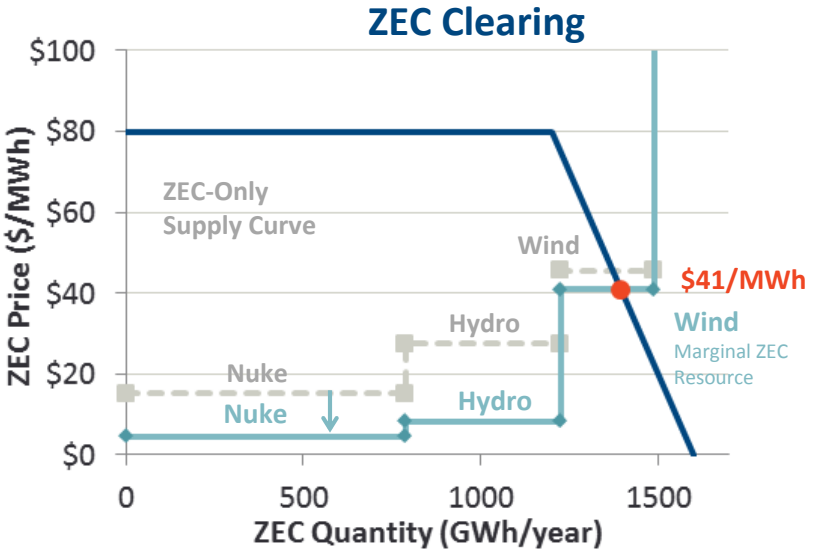
- The 33 MW does count toward satisfying the ICR (just as all cleared MW that acquire a CSO count)
- The 240,000 MW**h** of ZECs to not count toward satisfying the ICR

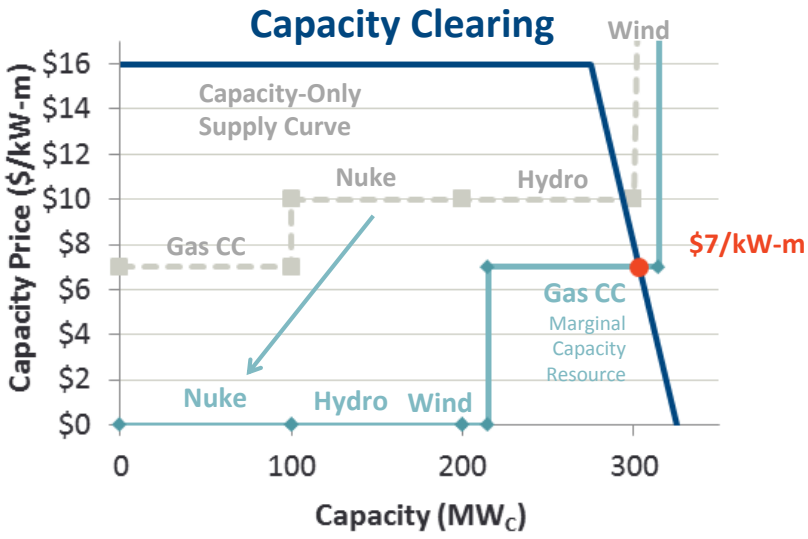
Example 2: Wind is Marginal for ZECs
Gas CC is Marginal for Capacity

- Same example as prior presentation
- Different resources are marginal for each product:
  - Wind is price-setting for ZECs (ZEC price clears below ZEC-only offer price based on capacity revenue earned)
  - Gas CC is price-setting for capacity
- Adding ZEC product changes merit order for capacity, some non-emitting resources displace some fossil resources

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	$10
Cleared Quantity					
Percent Offered	(%)	100%	100%	93%	64%
Revenues					
Total	($/kW-m_N$)	$34	$22	$7	$10





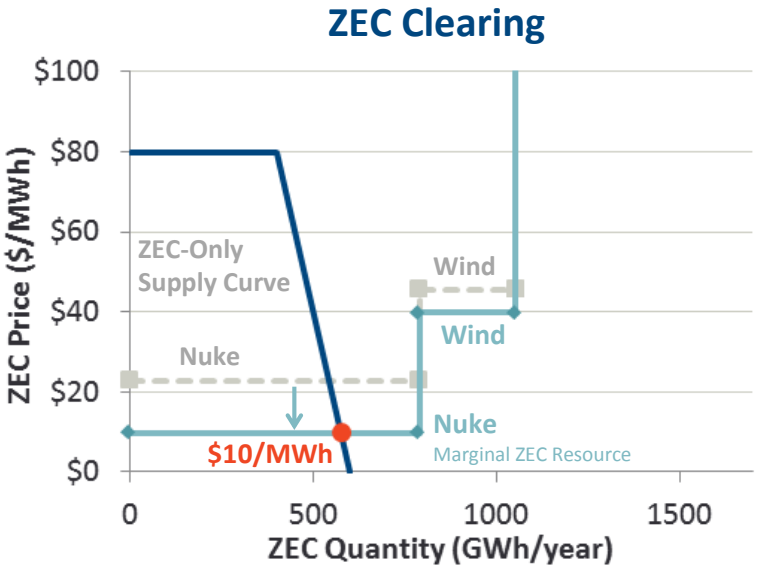
Notes: Supply curve for ZECs reflects minimum ZEC price that each resource is willing to accept, given the capacity clearing price. Similarly, supply curve for capacity reflects minimum capacity price each seller will accept once the ZEC price is known.

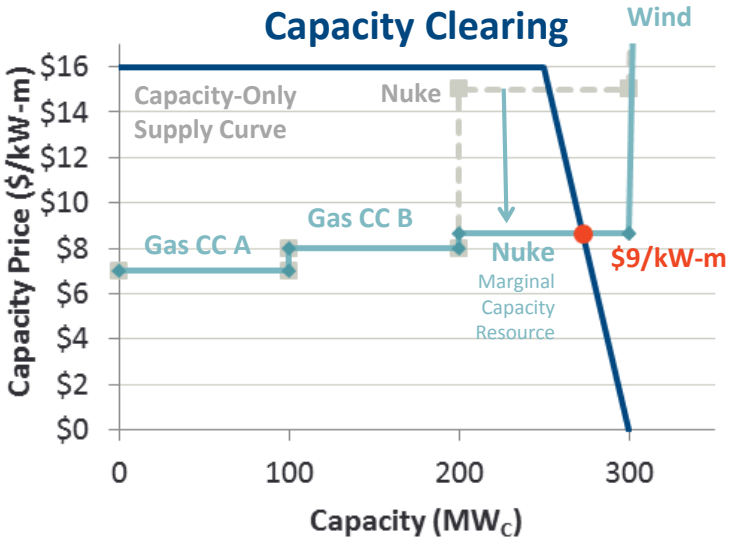
Example 3: Nuclear Plant is Marginal for Both Products

- Same resource can be price setting in both products
- Nuke offer price of $15/kW-m would have been price-setting for capacity without ZEC product
- Nuke plant's effective capacity offer price drops to $9/kW-m as price-setting for capacity once accounting for ZEC revenues

Resource Offers and Clearing Results

		Nuke	Gas CC A	Gas CC B	Wind
Resource Ratings					
Nameplate	(MW_N)	100	100	100	100
Capacity	(MW_C)	100	100	100	15
ZECs	(GWh/year)	788	0	0	263
Offer Price	($/kW-m$_N$)	$15	$7	$8	$10
Cleared Quantity					
Percent Cleared	(%)	73%	100%	100%	0%
Revenues					
Total	($/kW-m$_N$)	$15	$9	$9	$0





Is there a secondary market for ZECs?

Answer: Yes

- Reconfiguration auctions and bilateral trades.
  → Reason: Both ISO-NE and public policy are presumed to be indifferent as to who satisfies the ZEC obligation

- Bilateral trades can continue even into the delivery year.
  → Reason: Delivery requirement of MWh can be any time during the delivery year; both ISO and public policy continue to be indifferent as to who satisfies the obligation, even during the delivery year

Are there performance obligations for ZECs?

Answer: Yes (but not like pay-for-performance)

- Obligation is to produce clean energy MWh during the delivery year, with financial implications for under-delivery (and likely incremental payments for over-delivery)
- Need to work out details to fully specify the product definition, ensure appropriate interactions with energy market, and ensure settlement incentives align with the policy objective of reducing carbon (all FCEM and ZEC proposals will face these same questions)

Performance obligation for ZECs? (cont.)

- In-Year Settlement Options:
  - Resource does not get paid absent delivery
  - Deficiencies and over-delivery could be settled against a final reconfiguration auction at the end of the delivery year, using the same demand curve as in the original FCM-C auction
  - Another option is to allow some banking/borrowing between delivery years
  - A final option is to explore whether settlements should be tied to the CO_2 component of LMP during delivery hours (which would be more complicated and not consistent with REC definition, but could recognize that some resources' output profiles are superior to others in terms of achieving the decarbonization objective)
  - Financial penalty for failure to achieve benchmark set by ISO-NE (e.g. 90% of MWh promised)

Performance obligation for ZECs? (cont.)

- In-Year Settlement Options (cont.):
  - Need to carefully examine the implications of deficiency settlements on offer and dispatch during minimum generation conditions in the energy market. For example, to avoid very negative prices when there is overgen from only non-emitting resources such as intermittent and nuclear (but negative pricing is not necessarily problematic if it induces less unit commitment from fossil plants); has implications for whether resources can produce a ZEC in hours when they were involuntarily curtailed
- Adjustments to Future Resource Ratings:
  - Generators that under-deliver in Year 1 will have resource qualification to offer in Year 2 (and subsequent years) reduced. Similarly, resources that over-deliver can have increased qualification in subsequent years

How does ISO create the demand curve for ZECs?

Answer: Details have to be worked out by stakeholders. CLF suggests the following criteria:

- Curve should be created by ISO based on demand specified by the states and their respective carbon goals
- Curve should start with carbon goals and work back to annual ZEC demand curve
- Curve should avoid year-over-year price volatility by increasing procurements annually
- Option for ZEC price and quantity points to come from each state (recognizing differentiated procurement goals), but likely would need some durability to the states' commitment to avoid regulatory uncertainty (e.g. each state submits a demand for ZECs, but that quantity cannot be reduced for 10 years)

Should ZEC-eligible resources be able to withhold supply from the capacity market and offer only in the ZEC market (to avoid PFP exposure)?

Answer: Need to adapt offer structure and mitigation procedures appropriately

- Apply current monitoring and mitigation principles to this new construct
- Incumbent capacity resources continue to have a must-offer obligation for capacity; ZEC-eligible resource may have a must-offer obligation if the auction is deemed structurally uncompetitive
- Appropriate formulas for offer caps will be developed, and may differ for ZEC-only, capacity-only, and ZEC+capacity clearing outcomes
- For example, a resource clearing for ZECs must still earn a sufficient additional payment to take on a capacity obligation and the associated PFP exposure (or lost bonus payments that would be available to a resource without a CSO)

Will ZECs that clear in the auction have any effect on NICR?

Answer: No

- Ex ante, the number of ZECs that ISO seeks to procure in an auction will not affect the ISO's NICR calculation
- When the auction is cleared, the ZECs that the ISO actually procures also will not count toward satisfying the NICR (however, the underlying resource that is selling ZECs will also have some capacity value, and so that capacity value will contribute toward meeting the NICR requirement)

Reason: Two different commodities (CSO and ZECs), calibrated in different units (MW for CSO; MWh for ZECs), with two different demand curves

Can ZEC-eligible resources offer into only the FCM-C market?

Answer: Yes, but subject to monitoring and mitigation provisions

- Typically, resources will want to sell both products to earn maximum revenues unless there are technical limitations
- But the products are decoupled and so need not be sold together (e.g. capacity can be sold into another market, while ZECs are sold into ISO New England)
- Monitoring and mitigation provisions will determine procedures for when and whether one of the products have a “must offer” requirement, likely the must offer requirement will be applicable to all existing resources qualified for each product unless they show a technical inability to deliver the product or an off-system commitment

Do states retain their ability to use PPAs?

Answer: Yes (but a functional FCM-C could limit the need)

- We anticipate that states may continue to use PPAs, for technology and location-specific procurements and as a supplement to FCM-C to pursue some policy objectives, e.g. if states desire that a subset of the total system ZECs come from a higher-cost resource type that would not otherwise clear the FCM-C, but that is desired for other reasons
- Revenues from any PPAs that are not broadly available might continue to be considered “out-of-market” but could be exempted from ORTP up to a renewables exemption limit

How do ZECs interact with RECs?

Answer: Two additive products

- There are several options for accounting, but we suggest one as a starting point
- ZECs reflect all non-emitting resources, RECs reflect a subset of the ZECs that also meet the additional requirements imposed under a state's RPS
- Thus, the ZEC reflects the "non-emitting" attribute, while the REC reflects any additional "state policy value" placed on a subset of these resources such as Class I renewables
- REC prices would drop to zero and be over-supplied if the least-cost resource for meeting ZECs is also qualified to produce RECs

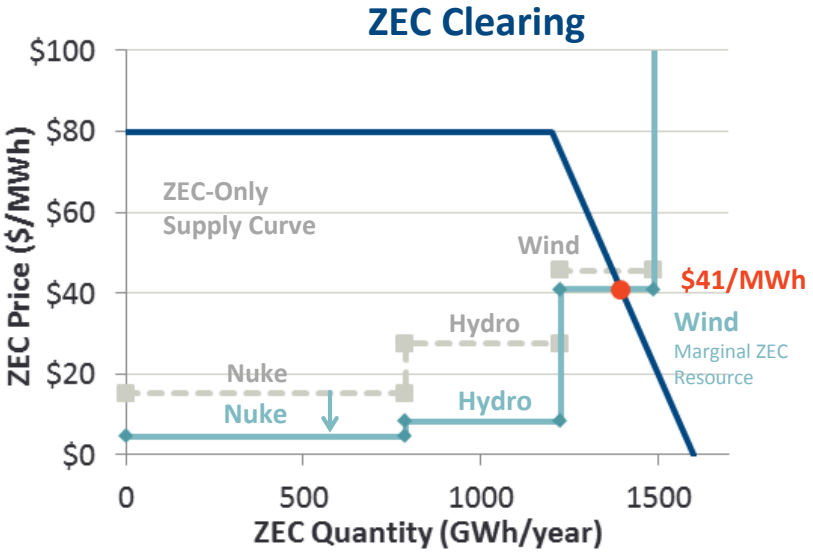
APPENDIX

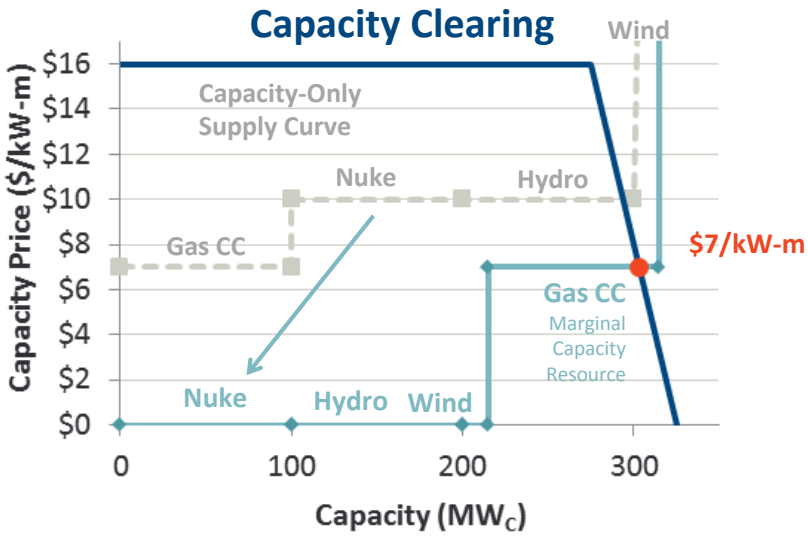
Details on Auction Clearing Examples

Example 2 Detail: Wind is Marginal for ZECs
Gas CC is Marginal for Capacity

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	$10
Cleared Quantity					
Nameplate	(MW_N)	100	100	93	64
Capacity	(MW_C)	100	100	93	10
ZECs	(GWh/year)	788	438	0	169
Percent Cleared	(%)	100%	100%	93%	64%
Revenues					
ZECs	($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.

Example 3 Detail: Nuclear Plant is Marginal for Both Products

Resource Offers and Clearing Results

		Nuke	Gas CC A	Gas CC B	Wind
Resource Ratings					
Nameplate	(MW_N)	100	100	100	100
Capacity	(MW_C)	100	100	100	15
ZECs	(GWh/year)	788	0	0	263
Offer Price	($/kW-m$_N$)	$15	$7	$8	$10
Cleared Quantity					
Nameplate	(MW_N)	73	100	100	0
Capacity	(MW_C)	73	100	100	0
ZECs	(GWh/year)	576	0	0	0
Percent Cleared	(%)	73%	100%	100%	0%
Revenues					
ZECs	($M/year)	$6	$0	$0	$0
Capacity	($M/year)	$8	$10	$10	$0
Total	($M/year)	$13	$10	$10	$0
Total	($/kW-m$_N$)	$15	$9	$9	$0