ISO new england

memo

To: NEPOOL Participants Committee Working Session

From: Market Development

Date: March 11, 2021

Subject: Evaluation of an Integrated Forward Clean Energy Market

Introduction

As part of the Future Pathways project, stakeholders have requested feedback on the feasibility of a forward clean energy market (FCEM) that is integrated with the forward capacity market, also known as an integrated clean capacity market (ICCM). This memo describes, at a high level, the ISO's current assessment of a potential conceptual approach for an ICCM construct for purposes of the pathways analysis. The ISO welcomes feedback on the approach and looks forward to continued discussion of a forward clean energy framework that will be modeled in these pathways efforts.

Conceptually, an ICCM would jointly procure both conventional capacity and clean energy on a forward basis to satisfy both sets of demand bids at least cost. Under such an approach, "clean" resources would be able to sell forward both capacity and clean energy, where the states would submit demand bids for clean energy.[1] More specifically, as part of their capacity offers, "clean" resource owners would include an offer parameter indicating how many MWh of forward clean energy they wish to sell for each unit of capacity awarded. As a result, capacity and clean energy awards would be bound together in a single procurement. The next section provides a more in-depth review of the formulation, including a numerical example.

While there are still many outstanding questions, this memo provides a high-level discussion of a possible conceptual approach for an integrated design. As such, stakeholders should not consider the details included in this memo as ISO recommendations or implicit confirmation that the ISO could implement such an approach. Rather, as is typical with the development of novel auction constructs, significant additional work would be necessary to evaluate critical design details, potential pricing rules (given there are multiple products and non-rationable offers), and potential implementation challenges.

[1] The ISO presumes that the forward positions would settle against a "spot" position that is determined by the resource's actual clean energy production during the delivery period. Further discussion of how this may work is included in the FCEM scoping memo.

Design Details

In an ICCM that procures clean energy forward, the FCM would be expanded to include clean energy bids determined by the states. In the following subsections, the memo details the ISO's current thinking on i) how participants might formulate and submit offers under this ICCM construct, ii) how the integrated auction clearing process would assign awards, and iii) how prices would be determined (when the marginal offer for each product is rationable). The memo concludes with a numerical example to illustrate these points.

Offer Structure

With the FCM as currently structured, resources submit offers that reflect the minimum amount of payment needed for the resource to take on a Capacity Supply Obligation (CSO). Such an offer includes, at a minimum, any "missing money" that the resource would need to recover its capital costs as well as any forgone revenues associated with selling capacity forward under pay-for-performance. With this $/unit of capacity offer, resources also have a qualified capacity value that represents the maximum capacity award that they can receive. The capacity offers can be rationable, where the CSO awarded can be less than the resource's qualified capacity, or non-rationable, where the resource's CSO award is all-or-nothing.

The ISO anticipates that a conceptual ICCM framework could build off this structure: participants would still submit a $/unit of capacity offer, their capacity awards would still be capped by their qualified capacity, and the resources would still be able to submit rationable or non-rationable offers. New to the FCM through an ICCM construct, however, is that resources would also submit a clean energy parameter that reflects the MWh quantity of clean energy they would sell on a forward basis per unit of capacity awarded. This clean energy parameter would bind the resource's CSO award with their clean energy award, so that, for each MW of CSO awarded, they are also awarded a forward clean energy position equal to their offered clean energy parameter.

Note that allowing non-rationable offers, as under the current FCM construct, may raise additional questions and challenges with current rules, including numerous questions about the pricing rules and the possibility of make-whole payments in the primary forward capacity auction.

Integrated Auction Clearing

The ICCM would clear resources based on their offers and their contribution to both the capacity and the clean energy bids. The capacity demand bids would be set in a manner consistent with the current FCM rules, but the clean energy demand bids would be set by the states. The auction would then clear bundles of capacity and clean energy to maximize social surplus, where the social surplus considers the benefits of both products. Holding a resource's offer constant, resources that are willing to take on larger forward clean energy positions would have a higher chance of receiving forward positions in the auction because their award would contribute more to meeting the region's clean energy demand.

Numerical Example

Three tables below outline a numerical example. Table 1 below contains key parameters for the example.[2]

[2] Note that, to simplify the incorporation of clean energy awards in these examples, offers and CSO awards are measured in MW-Year rather than the typical kW-Month.

Table 1. Resource Parameters			
Generator	Max Capacity	Clean Energy Parameter	Offer
Non-Clean 1	500 MW-Year	-	$60,000/MW-Year
Non-Clean 2	500 MW-Year	-	$70,000/MW-Year
Clean 1	300 MW-Year	6000 MWh/MW-Year	$150,000/MW-Year
Clean 2	300 MW-Year	7000 MWh/MW-Year	$200,000/MW-Year

In the example, there are two resources that can sell clean energy forward (Clean 1 and Clean 2) and two resources that cannot (Non-Clean 1 and Non-Clean 2). Each resource submits offers that are fully rationable, meaning the auction can award it forward positions that are less than its maximum capacity capability.[3]

Non-Clean 1 and Non-Clean 2 are each qualified to sell 500 MW-Year of capacity and Clean 1 and Clean 2 are each qualified to sell 300 MW-Year of capacity. Non-Clean 1 and Non-Clean 2 submit offers to sell capacity of $60,000/MW-Year and $70,000/MW-Year, respectively. These offers reflect the minimum payment per MW-Year that Non-Clean 1 and Non-Clean 2 must receive to sell capacity. Clean 1 and Clean 2 offer to sell both capacity and clean energy forward. For every MW-Year of capacity that Clean 1 sells, it would also sell a quantity of clean energy forward. More specifically, for each MW-Year of capacity that Clean 1 sells, it would sell 6,000 MWhs of clean energy. Clean 1's offer of $150,000/MW-Year indicates that to sell both one MW-Year of capacity and 6,000 MWhs of clean energy, Clean 1 would need to be paid at least $150,000. Similarly, for every MW-Year of capacity that Clean 2 sells, it would sell 7,000 MWh of clean energy forward. Clean 2's offer of $200,000/MW-Year indicates that Clean 2 would need to be paid at least that price per MW-year of capacity to sell its capacity and clean energy.[4] Note that the offers from Clean 1 and Clean 2 of $150,000 and $200,000 per MW-Year, respectively, represent an offer to sell a bundled product of capacity and clean energy on a forward basis. As such, their offers include both costs associated with capacity and costs associated with taking on a forward clean energy position. See Appendix A for a more detailed examination of how participants might submit offers in an ICCM.

For simplicity, this example assumes vertical demand curves for capacity and clean energy set at 850 MW and 2,500,000 MWh, respectively.[5] Given the offers and clean energy parameters in Table 1 above, Table 2 below contains the awards and clearing prices for this simple ICCM.

[3] This assumption allows prices for each product to be set based on the marginal supply offer. If these offers were instead assumed to be non-rationable, it is less clear how prices for each product would be established.
[4] The difference between the two resources' clean energy parameters could reflect differences in expected production or risk preferences.
[5] This ICCM concept can be applied similarly to instances where sloped demand curves are employed.

Table 2. ICCM Clearing and Awards			
Generator	Offer	Capacity Award	Clean Energy Award
Non-Clean 1	$60,000/MW-Year	450 MW	0 MWh
Non-Clean 2	$70,000/MW-Year	0 MW	0 MWh
Clean 1	$150,000/MW-Year	300 MW	1,800,000 MWh
Clean 2	$200,000/MW-Year	100 MW	700,000 MWh

Non-Clean 1 is the marginal resource for capacity and sets the capacity price at $60,000/MW-Year. This is the price Non-Clean 1 is paid per MW-Year. To see how this price is determined, consider an incremental increase in the installed capacity requirement of one MW-Year without a corresponding increase in the clean energy bids. To meet this additional MW-Year of capacity demanded, Non-Clean 1 would receive an additional one MW-Year of capacity award, at a cost to the system of $60,000/MW-Year. Note that, absent the clean energy requirement, Non-Clean 2 would be marginal for capacity and would set the capacity price at $70,000/MW-Year.

Clean 2 is the marginal resource for the forward clean energy positions and so sets the forward clean energy price at $20/MWh. To see how this price is determined, consider an incremental increase in the forward clean energy demand bids of one MWh. To meet this additional one MWh bid, Clean 2 must be awarded an additional $\frac{1}{7000}$ MW-Year of CSO,[6] costing the system $\frac{1}{7000} * \$200{,}000 = \$28.57$. Because Clean 2 clears for an additional $\frac{1}{7000}$ MW-Years of CSO, however, Non-Clean 1's CSO award can be decreased by $\frac{1}{7000}$ MW-Years, saving the system $\frac{1}{7000} * \$60{,}000 = \$8.57$. The total change in system costs is thus $28.57 - $8.57 = $20, and so the forward clean energy price is $20/MWh.

The total price paid to each resource per unit of capacity awarded is the capacity clearing price ($60,000/MW-Year) plus their clean energy parameter times the forward clean energy price ($20/MWh). That is, resources can be paid different prices per unit of capacity sold if their clean energy parameters differ. Table 3 below details price formation for the three resources that receive capacity awards.

Table 3. Resource Specific Clearing Prices					
			Non-Clean 1	Clean 1	Clean 2
[1]	CSO Clearing Price		$60,000/MW-Year	$60,000/MW-Year	$60,000/MW-Year
[2]	Clean Energy Parameter		0 MWh/MW-Year	6000 MWh/MW-Year	7000 MWh/MW-Year
[3]	Forward Clean Energy Price		$20/MWh	$20/MWh	$20/MWh
[4]	Resource Price Per MW-Year	=[1]+[2]*[3]	$60,000/MW-Year	$180,000/MW-Year	$200,000/MW-Year

Note that Clean 2 is paid more per MW-Year than Clean 1 because Clean 2 sells an additional 1,000 MWh of clean energy forward each awarded MW-Year of capacity.

[6] From Table 1, Clean 2 provides 7000 MWh of clean energy/MW-Year of capacity, so one additional MWh of clean energy from Clean 2 requires 1/7000 MW-Year of additional capacity from Clean 2.

Key Observations

- This formulation effectively yields two prices for the procured products – one for capacity in $/MW-Year and one for forward clean energy in $/MWh. This is necessary to account for the fact that the optimization procures two distinct products, and there are different costs associated with each.

- Some stakeholder presentations have discussed an ICCM with fully non-rationable offers for both capacity and clean energy. The concept proposed in this memo allows for participants to offer the products in a more flexible manner, as their offers can be either non-rationable or rationable. This is consistent with the current capacity market rules. However, allowing participants to submit non-rationable offers for both capacity and clean energy may raise additional challenges that need to be investigated further.

- At present, the ISO has not evaluated the work or implementation challenges that may arise when considering whether this conceptual framework could be sensibly translated into a more fully developed market design. We expect it would likely add significant complexity to the FCM process, and there would require a number of substantial changes to the FCM rules, schedule, and processes to implement such an approach. Further consideration of these challenges is outside the scope of these pathway efforts.

Conclusion

Based on preliminary analysis, the ISO believes that the joint procurement of capacity and clean energy in an integrated forward market is conceptually feasible as illustrated above and thus can be considered in the pathways analysis. However, additional work would be necessary to fully evaluate if this conceptual approach can be sensibly translated into a more concrete market design, and such work is outside the scope of these efforts. The ISO welcomes observations and feedback from stakeholders on this approach.

Appendix A

Table A1 below displays the offer components for "Clean 2", a resource that features prominently in the numerical example above.

Table A1. Clean 2's Optimal Offer, $/MW of CSO

	Offer Components		Capacity Only	Capacity + Clean Energy
[1]	Expected PFP Settlement		$60,000/MW-Year	$60,000/MW-Year
[2]	Clean Energy Parameter		N/A	7000 MWh/MW-Year
[3]	Expected Spot Clean Energy Price		N/A	$20/MWh
[4]	Clean 2's Offer	=[1] + [2]*[3]	$60,000/MW-Year	$200,000/MW-Year

In the FCM as it currently exists (capacity only), Clean 2's offer for capacity is simply the expected PFP settlement. (For simplicity, we are assuming that the resource has no missing money.) With an ICCM, however, the resource would also submit a clean energy parameter, given in Row [2]. Because Clean 2 could opt not to sell their clean energy forward and instead sell it in the delivery year, they must be paid at least the expected clean energy price in the delivery year per MWh of clean energy they sell forward. As such, their ICCM offer is the sum of the expected PFP settlement (Row [1]) plus their offered clean energy parameter (Row [2]) times the expected clean energy price in the delivery year (Row [3]). Note that Clean 2's offer is substantially larger in an ICCM than in a "capacity only" market. This reflects the additional costs of the forward clean energy position Clean 2 would take if they receive an award.