NEW ENGLAND POWER POOL

AGENDA

Integrating Markets and Public Policy (IMAPP)
Plenary Meeting #8
Wednesday, May 17, 2017
DoubleTree Hotel, Westborough, MA

Morning Session **9:30 a.m. - 12:00 p.m.**

- Introductory Remarks
- Review and Discuss ISO-NE's Conceptual Proposal:
  "*Competitive Auctions with Subsidized Policy Resources*"

Lunch Break **12:00 – 12:45 p.m.**

Afternoon Session **12:45 – end of day (estimated to be 4:00 p.m.)**

- Additional Feedback from State Officials on Long-Term Proposals
- Discussion on New, Updated or Refined Long-Term Proposals
- Concluding Remarks/Next Steps

M A Y 1 7 , 2 0 1 7 | W E S T B O R O U G H , M A

Competitive Auctions with Subsidized Policy Resources

The ISO's Proposed Approach to Balancing Wholesale Markets and States' Policies

Chris Geissler and Matthew White

E C O N O M I S T　　C H I E F E C O N O M I S T

Summary

- The ISO is offering a conceptual proposal for Forward Capacity Market (FCM) enhancements to:
  - Accommodate subsidized resources into the FCM over time, and
  - Preserve competitive capacity pricing for unsubsidized resources
- This presentation summarizes the objectives, key features, and benefits
- We seek stakeholder feedback, and plan to discuss design details at the NEPOOL Markets Committee beginning in June

ISO Discussion Paper Available


ISO new england

Competitive Auctions with Subsidized Policy Resources

ISO Discussion Paper
April 2017

Executive Summary

Noting a growing tension over the participation of state-subsidized new generation resources in the Forward Capacity Market (FCM), ISO New England's stakeholders initiated discussions in 2016 on Integrating Markets and Public Policy (IMAPP). Specifically, representatives of the New England states had expressed concern over the potential for electricity consumers to end up 'paying twice': once for the cost of capacity resources procured in the FCM, and a second time for the cost of subsidizing additional state-mandated new supply resources. Other stakeholders highlighted a different concern: the potential for capacity market prices to be depressed below competitive levels if substantial amounts of new subsidized resources entered the FCM without mitigation. That impact could undermine investors' willingness to maintain existing supply resources, and hamper the FCM's ability to attract competitive (i.e., unsubsidized) new investment cost-effectively when the power system requires it.

Following these stakeholder discussions, ISO New England agreed to develop a proposal to address both investors' and states' concerns about subsidized new resources' participation in the FCM. This paper explains ISO's proposal. Conceptually, the ISO's approach addresses these concerns by closely coordinating the entry of (subsidized) new resources with the exit of (unsubsidized) existing capacity resources. By doing so, the FCM can accommodate the entry of significant subsidized resources over time while maintaining competitively-based capacity prices for non-subsidized resources.

- Summarizes the challenges of integrating state policy resources into the FCM
- Presents the ISO's conceptual proposal and design principles in greater detail

Competitive Auctions with Subsidized Policy Resources

https://www.iso-ne.com/committees/participants/wholesale-markets-state-public-policy-initiative

States Are Subsidizing Clean Energy Resource Development to Meet Their Legislative Requirements

- Growing provision of out-of-market revenues through long-term contracts
- Legislative initiatives vary by state

States	Recent State Resource Procurement Initiatives	Expected Resources	Target MW (nameplate*)
MA, CT, RI	2016 Multi-State Clean Energy RFP	Solar, wind	460
MA	2016 Energy Diversity Act	Clean energy, incl. hydro import	Approx. 1200
MA	2016 Energy Diversity Act	Off-Shore Wind	Up to 1600

*Note: Nameplate MW may be higher than qualified FCM capacity MW

Concerns over Subsidized Resources

- **Status quo.** Under the Minimum Offer Price Rule (MOPR), resources may be built to meet state policies but cost too much to clear in the FCM
  - Limited MOPR exemption for some new renewables
- **Likely Results are Inefficient**. Region may end up overbuilt for Resource Adequacy needs
- **States concerned** that consumers would bear unnecessarily high costs if state policy resources do not participate as FCM resources:

FCM Costs + Additional retail charges to fund state subsidies

Competitively-Based Capacity Pricing Remains Essential

- Subsidized renewables can profitably sell in the capacity market for artificially low prices
- MOPR prevents capacity price suppression, helping to ensure competitive capacity prices
  - Even if unintentional, subsidized entry has a similar effect to buyer-side market power
- Competitive capacity pricing is essential to attract investment in (non-subsidized) new entry cost-effectively when needed

ISO's Proposed Path Forward

- The ISO is developing a capacity market design solution:
  - Accommodates subsidized resources into the Forward Capacity Market (FCM) over time, and
  - Preserves competitive capacity price signals for unsubsidized resources needed for regional Resource Adequacy

- It builds upon the existing capacity market framework in New England
- It is based on specific design principles and objectives discussed during the 2016 stakeholder-led discussions on Integrating Markets and Public Policy (IMAPP)

Four Design Objectives and Principles

1. **Competitive capacity pricing.** Maintain competitively-based capacity auction prices, by minimizing the price-suppressive effect of out-of-market subsidies on competitive (unsubsidized) resources

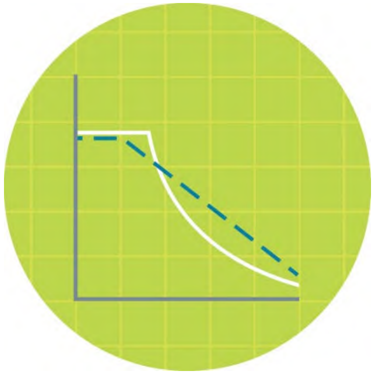
2. **Accommodate entry of subsidized resources into the FCM over time.** Minimize the potential for New England developing too many resources in the power system, an inefficient and costly outcome

3. **Avoid cost shifts.** To the extent possible, minimize the potential for one state's consumers to bear the costs of other states' subsidies

4. **A sustainable, market-based approach** that minimizes administrative mechanisms and extends, rather than upends, the existing capacity market framework

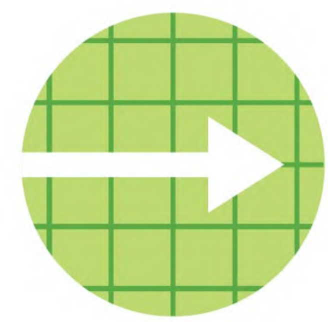
Key Concept: Coordinate Entry and Exit

- **Two forms.** Coordinate entry of (subsidized) **new** and:
  1. **Exit** of (unsubsidized) **existing** capacity [*New v. Existing*]
  2. **Entry** of (unsubsidized) **new** capacity [*New v. New*]
- Both forms help prevent the over-build problem *and* capacity price suppression with subsidized new entry
- **When there is no new subsidized supply to coordinate:** FCA's competitive price signals continue to guide entry and exit



Solution Approach: A Substitution Auction

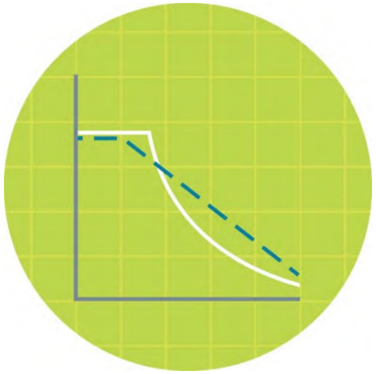
- After the FCA: Existing or new resources awarded capacity supply obligations (CSOs) may **transfer their obligations** to new, *subsidized* resources that do not have CSOs
- This is arranged using a two-settlement process known as a ***substitution auction***
  - Existing resources must then **permanently retire** (they have no CSOs)
  - New subsidized entrants may also **substitute for** unsubsidized new resources (which would then not enter)



- The substitution auction generally does not affect payments to existing (non-retiring) resources awarded CSOs, or to loads

Solution Stage 1 – The Primary FCA

- **The ISO would conduct the FCA in two stages**: The primary auction and the substitution auction
- **First stage:** ISO runs the FCA
  - Primary FCA determines the total supply to be procured, and resources' initial CSOs
  - MOPR applies to all new resource offers
  - Uses the current capacity demand curves



- The primary FCA sets the competitively-based capacity clearing price
  - This achieves Design Objective #1…
  - But subsidized new resources are still likely to be priced too high to clear the primary FCA

Solution Stage 2 – The Substitution Auction

- **Second stage:** Substitution auction runs promptly after the FCA
  - **Supply:** Subsidized resources are entered on the supply side, *without* a MOPR applied to their supply offer prices
  - **Demand:** Retirement bids and new offers awarded initial CSOs in first stage are entered *on demand side,* at same offer prices in primary FCA
  - No administrative demand curves are used in the substitution auction
- Through clearing this auction, resources that retained CSOs in the primary FCA **transfer their obligations** to subsidized new resources that did not clear in the FCA (due to the MOPR)
  - The subsidized supply is paid the substitution auction's clearing price
  - Subsidized supply that does not clear in either auction can participate as new (subsidized) supply in next year's auctions

SUBSTITUTION AUCTION: EXAMPLES

How the two-settlement substitution auction works

Next: Two Numerical Examples

- **Example A:** Coordinating subsidized new entry with exit of existing resources
- **Example B:** Coordinating subsidized new entry versus *un*subsidized new entry
- **Both examples will show:**
  1. How prices are set and the two-stage market settles
  2. No price suppression in the FCA for competitive capacity
  3. Accommodates entry of subsidized capacity into the FCM (over time)
  4. No impact on capacity payments by loads (generally)
- **The market clearing process is the same in both examples, but the settlements are different in the two cases**

Example A: The Setting

- Assume the FCA has a range of offers from seven resources

Low-cost existing supply

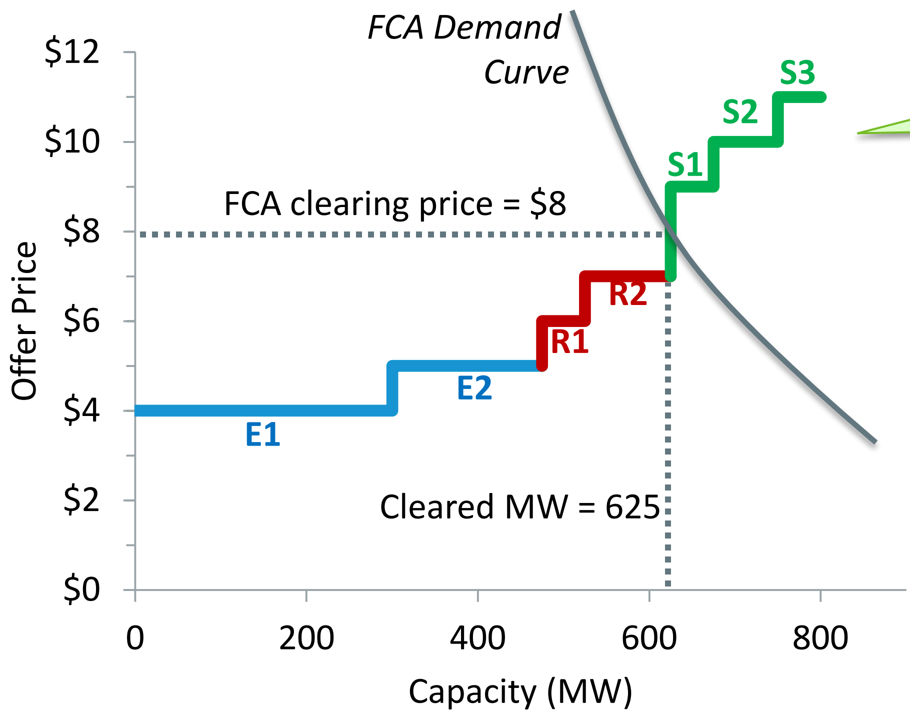
Two old, high-cost units that would retire without capacity revenue

Three new subsidized units have high offer prices due to MOPR

Resource Name	Offer Type	Offer Price with MOPR ($/kw-mo)	Preferred (Subsidized) Offer Price ($/kw-mo)	Offer Capacity (MW)
E1	Existing Supply Offer	$4	-	300
E2	Existing Supply Offer	$5	-	175
R1	Retirement Offer	$6	-	50
R2	Retirement Offer	$7	-	100
S1	New Supply Offer	$9	$0	50
S2	New Supply Offer	$10	$2	75
S3	New Supply Offer	$11	$4	50

Example A. Stage 1 – The Primary FCA

- Existing and retirement offers are awarded capacity obligations



Three new subsidized units **do not clear** (due to the MOPR)

- $8 / kw-mo. clearing price
- 625 MW total supply

Example A. Stage 1: Primary FCA – Full Results

- Total cost to load for the primary FCA: **$5M** / mo.

Resource Name	Offer Type	Clearing Price ($/kw-mo)	Cleared Capacity (MW)	Resource Payment ($/mo.)
E1	Existing Supply Offer	$8	300	$2.4M
E2	Existing Supply Offer	$8	175	$1.4M
R1	Retirement Offer	$8	50	$400K
R2	Retirement Offer	$8	100	$800K
S1	New Supply Offer	$8	-	-
S2	New Supply Offer	$8	-	-
S3	New Supply Offer	$8	-	-
Auction Totals			**625**	**$5.0 M**

Awarded obligations

Awarded obligations

Do not clear primary FCA

Example A. Stage 2 – The Substitution Auction

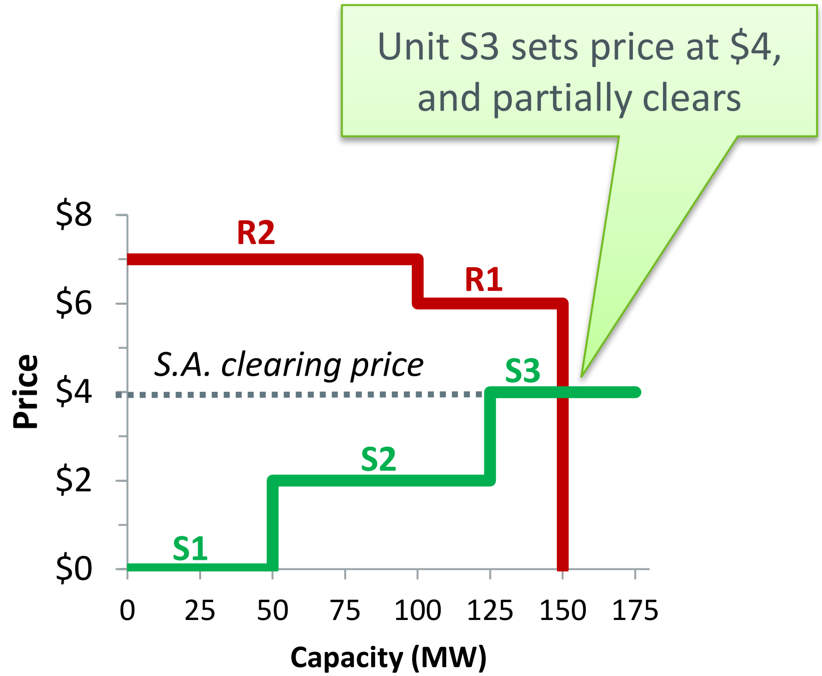
- No MOPR for new supply. Retirement bids enter as *demand.*

STAGE 2 – SUPPLY OFFERS

Resource Name	Offer Price without MOPR ($/kw-mo)	Offer Capacity (MW)
S1	$0	50
S2	$2	75
S3	$4	50

STAGE 2 – DEMAND BIDS

Resource Name	Bid Price ($/kw-mo)	Bid Capacity (MW)
R1	$6	50
R2	$7	100



- S1, S2, clear, and S3 partially, *acquiring* CSOs
- R1, R2 *shed* their CSOs

Example A. The "Severance" Payment

- In effect, R1 receives a "severance" payment of $200K/month, in exchange for a final obligation: to retire from the FCM

	Auction	Cleared (MW)	Price ($/kw-mo.)	Payment ($/mo.)
R1 sells capacity	FCA	50	$8	$400K
R1 "buys out" obligation	S.A.	–50	$4	($200K)
Final Outcome (Net)		**0 MW CSO**		**$200K**

- **Subsidized units** (S1, S2, S3) are paid the substitution auction price of $4/kw-mo., by the retiring resources "buying out" their CSOs
  - Analogous to the two-settlement process that occurs between the Day-Ahead and Real-Time energy markets

Example A. Total Capacity Payments, All Resources

Resource Name	FCA Clearing Price ($/kw-mo.)	FCA Cleared (MW)	FCA Credit ($/mo.)	S.A. Clearing Price ($/kw-mo.)	S.A. Cleared (MW) (deviation from FCA)	S.A. Credit (Charge) ($/mo.)	Final Capacity Obligation (MW)	Final Auctions Payment ($/mo.)
E1	$8	300	$2.4M	$4	-	-	300	$2.4M
E2	$8	175	$1.4M	$4	-	-	175	$1.4M
R1	$8	50	$400K	$4	–50	($200K)	-	$200K
R2	$8	100	$800K	$4	–100	($400K)	-	$400K
S1	$8	-	-	$4	50	$200K	50	$200K
S2	$8	-	-	$4	75	$300K	75	$300K
S3	$8	-	-	$4	25	$100K	25	$100K
Auction Totals		**625**	**$5.0 M**		**0**	**$0**	**625**	**$5.0 M**

- Subsidized resources S1, S2, S3 (combined) receive 150 MW of supply obligations, and total capacity payments of $600K/mo.

Payment Logic: Who is Paying What and Why?

- **The states' subsidies** enable high-cost, existing resources to receive a **net payment to retire** and be replaced by states' preferred new (e.g., higher-cost clean energy) resources
  - **Load entities** still pay the same total capacity cost, with or without the substitution auction: $5M/mo., in this example
- **In this two-settlement design, the payments' logic is:**
  - Subsidies enable the new units to offer capacity *below* their true costs
  - That, in turn, provides an opportunity for potentially retiring units to transfer ("buy out") their obligations at less than *their* true cost
  - The retiring units transfer their supply obligations to the subsidized units, and transfer part (but not all) of their primary FCA payments
  - The retiring units keep a portion of their primary FCA payment, in consideration for a final obligation to retire

Accommodating Subsidized New Entry Addresses Concerns over Consumers' Total Costs

- New (subsidized) supply clearing in the substitution auction **becomes existing** supply in subsequent FCAs
- In subsequent auctions, it would receive the ***primary*** **FCA clearing price** (until it eventually retires…)
- This capacity market revenue stream should be expected to reduce the out-of-market costs incurred by consumers to subsidize the development of state-preferred policy resources
- **Addresses states' concerns** over consumers' total costs if the state policy resources were unable to participate in the FCM

Example A: Summary

- Preserves **competitive capacity pricing** in the primary FCA (Design Objective #1)
- Accommodates **entry of subsidized new resources** into the FCM, minimizing potential for inefficient over-build (Design Objective #2)
- Increases financial incentives for existing, high-cost resources **to retire earlier** (relative to current FCM rules)
- Loads continue to **pay only the costs of the primary FCA**, like today
  - Consumers in non-subsidizing states do not bear higher costs because subsidized resources are accommodated (Design Objective #3)
- Transparent, competitive-market approach to balancing wholesale markets and public policies (Design Objective #4)

New Case: Treatment of *Un*subsidized New Supply in the Substitution Auction

- Coordinating 'new v. new' requires balancing three issues:
    1. **Deterring new supply by "fictitious entrants"** that only seek to substitute out for a payment, undermining the primary FCA price
    2. **Minimizing potential for an inefficient over-build** of the system when new entry is *not* needed
    3. **Preserving entry incentives** for competitive new entry *when needed*
- There is a tension (no 'perfect' solution) to these three issues
- Proposed treatment for 'new v. new' cases is similar to the prior example, with a modified settlement rule (*next*)

Example B: An *Un*subsidized New Supply Offer

- Assume competitive new supply N1 offers 100 MW at $7 / kw-mo. (*no retirement bid R2*). All other assumptions are unchanged.

Low-cost existing supply

Old, high-cost unit that would retire without capacity revenue

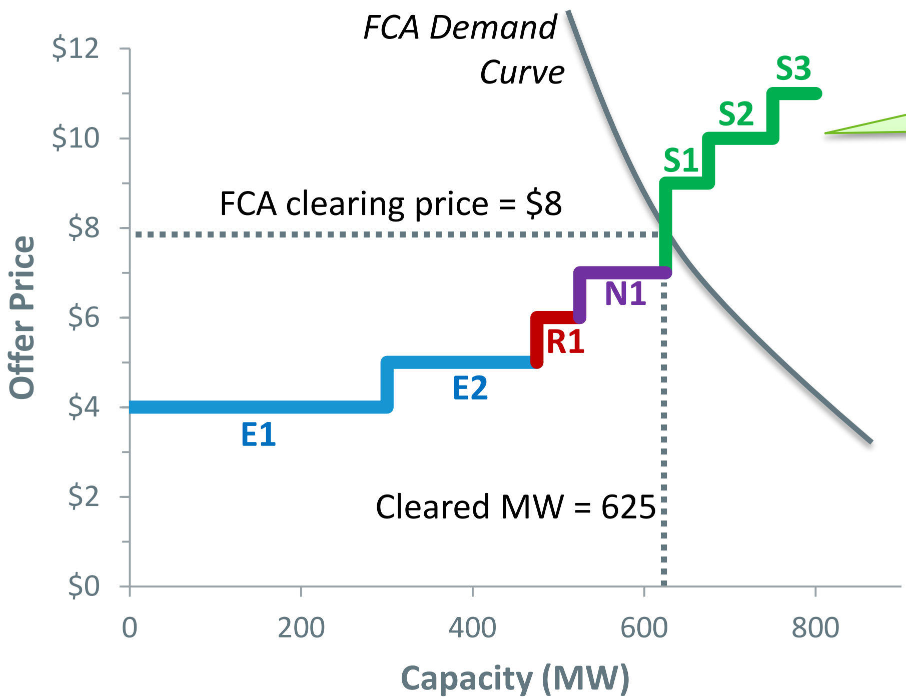
Competitive new unit that requires capacity revenue to enter market

Three new subsidized units have high offer prices due to MOPR

Resource Name	Offer Type	Offer Price with MOPR ($/kw-mo)	Preferred (Subsidized) Offer Price ($/kw-mo)	Offer Capacity (MW)
E1	Existing Supply Offer	$4	-	300
E2	Existing Supply Offer	$5	-	175
R1	Retirement Offer	$6	-	50
N1	New Supply Offer	$7	-	100
S1	New Supply Offer	$9	$0	50
S2	New Supply Offer	$10	$2	75
S3	New Supply Offer	$11	$4	50

Example B. Stage 1 – Primary FCA

- All existing resources’ bids, and the competitive new resource N1, are awarded initial capacity obligations



Three new subsidized units **do not clear** (due to the MOPR)

Same pricing as Example A:

- $8 / kw-mo. clearing price
- 625 MW total supply
- $5 M / mo. total payments

Example B. Stage 2 – The Substitution Auction

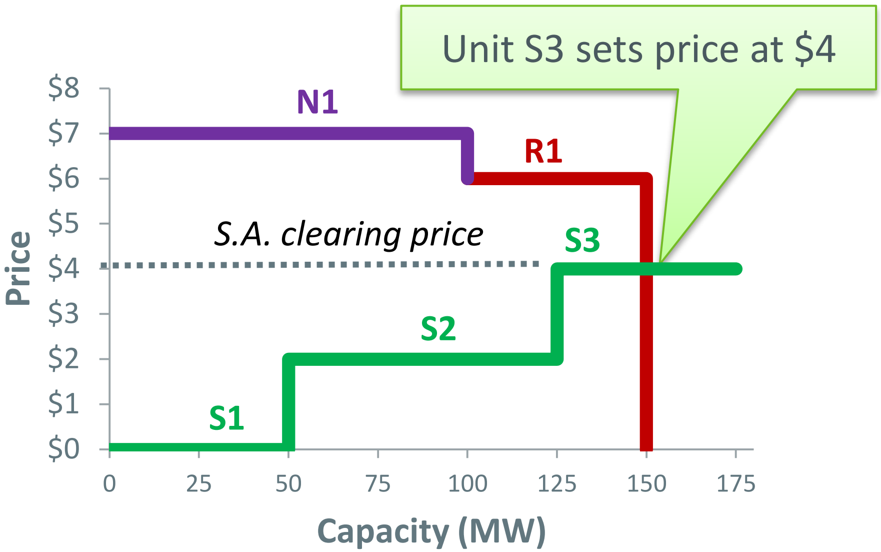
- Retirement bids and new supply offers (awarded obligations in primary FCA) enter as *demand* in the substitution auction

STAGE 2 – SUPPLY OFFERS

Resource Name	Offer Price without MOPR ($/kw-mo)	Offer Capacity (MW)
S1	$0	50
S2	$2	75
S3	$4	50

STAGE 2 – DEMAND BIDS

Resource Name	Bid Price ($/kw-mo)	Bid Capacity (MW)
R1	$6	50
N1	$7	100



- S1, S2, clear, and S3 partially, *acquiring* CSOs
- R1, N1 *shed* their CSOs

Example B. Total Capacity Payments

- **Modified settlement rule.** Resource N1 does not receive a CSO, and incurs no credit or charge:

Resource Name	FCA Clearing Price ($/kw-mo.)	FCA Cleared (MW)	FCA Credit ($/mo.)	S.A. Clearing Price ($/kw-mo.)	S.A. Cleared (MW) (deviation from FCA)	S.A. Credit (Charge) ($/mo.)	Final Capacity Obligation (MW)	Final Auctions Payment ($/mo.)
E1	$8	300	$2.4M	$4	-	-	300	$2.4M
E2	$8	175	$1.4M	$4	-	-	175	$1.4M
R1	$8	50	$400K	$4	–50	($200K)	-	$200K
N1	$8	100	**$0**	$4	–100	**$0**	-	**$0**
S1	$8	-	-	$4	50	$200K	50	$200K
S2	$8	-	-	$4	75	$300K	75	$300K
S3	$8	-	-	$4	25	$100K	25	$100K
Auction Totals		**625**	**$4.2 M**		**0**	**$400K**	**625**	**$4.6 M**

– *Note:* Reduces total payments from $5.0 M to $4.6 M: resource N1 is replaced by lower-cost subsidized supply that is paid the lower S.A. price

Proposed Treatment Balances the Three Issues

1. **The zero net payment** to "substituted out" competitive new supply **solves Issue 1**
   – "Fictitious entry" is unprofitable, preserving primary FCA pricing
2. **Substituting-out** competitive new for subsidized new **solves Issue 2**
   – Minimizes inefficient over-build when new entry is *not* needed
3. **Primary FCA clearing price** is paid to competitive new supply if not substituted out (e.g., if no subsidized supply)
   – Provides incentive for competitive new entry when there is no subsidized new supply (thus no substitution auction)

Examining Key Insights

- The substitution auction does not change the total MW with capacity supply obligations
  - Avoids both excess supply and FCM price deterioration over time
  - Maintains same total cost to load as primary FCA (generally)
- Provides **entry incentives** if there is no subsidized supply
- Sound design framework that can accommodate **entry and exit across constrained capacity zones** in the substitution auction (*see* ISO Discussion Paper appendix)

Notable Properties of the Substitution Auction

- It is likely to help New England states **achieve their GHG policy goals** (e.g., older, high-emitting units will retire sooner)
- The substitution auction accommodates new subsidized supply resources in a **technology-neutral** way
  - Accommodates future state subsidies to non-renewable resources (e.g., storage, fuel cells, large-scale hydro, and so on)
- It provides a mechanism to replace the (200 MW annual) existing MOPR renewables exemption by:
  - Accommodating greater amounts of subsidized capacity into the FCM over time, and
  - Replacing an administrative rule with a sustainable, market-based solution

Risks, Limitations, and Caveats

- **No perfect solution.** Some design objectives are in fundamental tension, and there is no truly perfect solution
- **No guarantees regarding retirements’ pace.** If no new offers or retirement bids are submitted, subsidized resources must await following year to seek obligations
  - Seeking to *coordinate* entry and exit over time
- **Some retirements may impact winter fuel security.** This is a complex issue to be addressed in a separate process
- **MOPR does not apply to existing resources in New England**, and we are not proposing to extend it

Next Steps

- The ISO seeks stakeholder input, and will discuss this proposal in the NEPOOL technical committee process beginning in June
- **Anticipated timeline** for 2017:
  - May 17: IMAPP Meeting
  - June – November: Discussions at NEPOOL Markets Committee
  - December/January: Participants Committee Vote and FERC Filing
- **Implementation**:
  - Targeting FCA 13, to be conducted in February 2019
  - Retirement bids are due March 2018

Questions

New England States Committee on Electricity

To: NEPOOL
From: NESCOE
Date: April 7, 2017
Subject: Feedback to NEPOOL on Long-Term "Achieve"-style IMAPP proposals

---

Summary

NESCOE considers NEPOOL's Integrating Markets and Public Policies (IMAPP) a success in that it has identified mechanisms that have the potential to advance state-level clean energy mandates through regional competitive wholesale markets. The states appreciate NEPOOL's time and effort and the work of market participants that have contributed to this important dialogue.

As noted at the outset of the IMAPP process, the New England states have a variety of mechanisms available to them through which to execute the requirements of state laws. The states have not, however, had a viable option in the form of a pricing mechanism directly connected to the wholesale competitive markets and appreciate the opportunity to explore that potential.

This memo provides NESCOE's feedback at this juncture on the long-term "achieve"-style proposals that market participants have proposed in NEPOOL's IMAPP process. These generally fall into two categories, a Forward Market Design (FMD) and a form of carbon pricing.

With respect to an FMD, states with forward-looking needs to satisfy the requirements of their respective state laws are interested in further analysis of these potential mechanisms. NESCOE believes market participants have developed potential frameworks to a sufficient level of detail such that NESCOE is able to conduct further analysis of these mechanisms and their interactions with the existing market structure in the context of its *Renewable and Clean Energy Mechanisms 2.0 Study* (Mechanisms 2.0 Study).

Further, NESCOE confirms that it does not support an additional[1] carbon pricing-style mechanism in furtherance of state laws, which would be administered by ISO New England (ISO-NE) and regulated by the Federal Energy Regulatory Commission (FERC).

---

[1] The New England states have a carbon pricing mechanism available to them in the form of the Regional Greenhouse Gas Initiative (RGGI), in which states have participated pursuant to the authority of each state's laws since 2009.

By way of next steps, NESCOE's Phase II of the Mechanisms 2.0 Study will provide analysis of a variety of mechanisms that states could employ to meet the requirements of their clean energy mandates. This analysis will assist the New England states' understanding of the potential consumer and other implications of various options, including state-jurisdictional mechanisms and a form of FMD. NESCOE also plans to assess ISO-NE's recommended approach to a short-term, "accommodate"-style proposal when ISO-NE makes it available along with other mechanisms.

Given the very small level of procurements completed to date pursuant to state laws – a few hundred (nameplate) megawatts – and the lengthy processes required before any such further procurements are concluded,[2] New England has the benefit of time to sort through market and/or other changes that may be required over the long-term in a way that is thorough and holistic. This includes, but is not limited to, policies and/or programs related to carbon reduction, storage, and distributed generation. NESCOE looks forward to discussion about the design of the future grid and associated market rules. This includes, for example, the relative size and proper form of the ancillary service markets, ISO-NE's examination of ramp pricing in the context of a wholesale market with a higher level of variable resources, and understanding the effect of the recently implemented fast start pricing and sub-hourly real-time settlement market rules that the states supported. NESCOE looks forward to continued collaboration with NEPOOL and ISO-NE on these important matters.

Context

Historically, when competitive markets have not produced the resources to meet state objectives, states have had a variety of mechanisms available to execute the requirements of state laws, such as Renewable Portfolio Standards and power purchase agreements. There has not until now, however, been a pathway tied directly to the wholesale competitive markets.

Beginning in the summer of 2016, market participants have worked diligently in the IMAPP process to develop potential mechanisms that might better integrate the requirements of state laws and wholesale competitive market design. Since the first IMAPP "pause" in late 2016, market participants have worked constructively to try to understand and address the issues states identified in a memo to NEPOOL dated September 30, 2016 (NESCOE Memo).[3] Proposal proponents have also spent time with states collectively through NESCOE and individually to ensure a clear understanding of concerns and proposals. NESCOE appreciates proposal proponents' efforts and responsiveness.

Over the course of 2016, and since the January 25, 2017 IMAPP meeting, states have dedicated time to assess and discuss the long-term "accomplish"-type proposals.

---

[2] *See* https://macleanenergy.com/83d/83d-timeline/ for an example of procurement timelines.

[3] *See* http://nepool.com/uploads/IMAPP_20161006_IMAPP_Objectives_to_NEPOOL_9_30_16.pdf.

Concurrently, as noted at the outset of the IMAPP process, NESCOE has been conducting its Mechanisms 2.0 Study.[4] This study followed a related mechanisms whitepaper NESCOE published in December 2015.[5] The purpose of the Mechanisms 2.0 Study is to: 1) examine energy and capacity markets under various hypothetical future market conditions (Phase I), and 2) assess various mechanisms, such as renewable portfolio and clean energy standards, power purchase agreements, strategic transmission investments, and centralized auction-based procurement (Phase II). Of course, producing information about a variety of mechanisms is not intended to, and should not be interpreted to, suggest a preference for any mechanism. NESCOE has completed Phase I, the scenario analysis, and is working on Phase II, the mechanisms analysis.

ISO-NE and long-term FMD proposal proponents have provided states with a solid understanding of the myriad issues associated with a centralized auction-based procurement approach and with practical information about how it could be implemented. NESCOE has sufficient information to enable its further comparative analysis in the Phase II of the Mechanisms 2.0 Study.

Interest in Continued Exploration of Long-Term Forward Market Designs

States continue to assess FMDs and the circumstances in which an FMD would make sense in the context of state laws and for consumers. States that foresee further clean and renewable energy needs remain interested in continuing to explore the advantages and disadvantages to an FMD, and should the former outweigh the latter, to explore work-arounds to any impediments.

As a threshold matter, the states continue to focus on the basic questions identified early in the IMAPP process, the answers to which help inform whether the potential benefits of an FMD outweigh any shortcomings. Those questions include:

1. On a going forward basis (after current procurements are concluded), what level of expected procurement activity would make development of an FMD worthwhile?

2. What would a procurement cycle look like? (e.g., 200 MW every year, 500 MW every three years, 1,000 MW every five years)?

3. Whether there is demand potential for a homogenous resource type in order to create a larger procurement level so that, for example, 70% of the expected purchases could be procured under a forward, centralized design with a remaining state-specific 30% procurement by individual states?

[4] *See* http://nescoe.com/resource-center/mechanisms-study-jun2016/.

[5] *See Mechanisms to Support Public Policy Resources in the New England States* at http://nescoe.com/resource-center/mechanisms-dec2015/4/. That paper identified a range of mechanisms available to states to support resources required by state laws, such as clean energy standards, contracting, and cap and trade programs. It described each mechanism's mechanics, as well their interaction with the competitive wholesale markets and some legal and regulatory issues.

4. Whether state specific evaluation criteria can be factored into a FMD?

The states understand the potential benefits of a longer-term centralized auction platform design. Most of these benefits align with the benefits of the transition to competitive wholesale markets.[6] In particular, the states see value in seeking to design a competitive market mechanism that can achieve state policy objectives while appropriately allocating resource investment risk to investors. The states are interested in continuing to explore market designs that allow the states to achieve the requirements of state laws while retaining competitive wholesale markets. Phase II of the Mechanisms 2.0 Study discussed above provides NESCOE an opportunity to consider some of the key design elements of an FMD. The states hope to use the study results and stakeholder outreach to inform potential design considerations of a market-based solution. The states looking forward to sharing those results with market participants, NEPOOL, and ISO-NE.

Feedback on an ISO-NE Administered and FERC Regulated Carbon Pricing Proposal

The New England states have for a decade collectively supported carbon pricing in the form of RGGI, a cooperative multi-state effort to reduce greenhouse gas emissions.[7]

The states have carefully reviewed the current carbon pricing-style proposals. The states recognize and appreciate that IMAPP proposal proponents have modified various carbon pricing-style proposals to address the consumer cost and cost allocation concerns that NESCOE first identified in the fall of 2016. The states at this time do not, however, support an additional, separate carbon pricing-style mechanism that would be administered by ISO-NE and subject to FERC jurisdiction to execute the requirements of various states' laws.

The states' rationale, informed by conversations and revised proposals as the IMAPP process progressed, is similar to those NESCOE identified in the fall of 2016. The states' continuing concerns about a FERC-jurisdictional tariff reflecting carbon pricing to execute the requirements of some states' laws include:

1. The imperative that states determine the specifics associated with the execution of state laws. The importance of state self-determination in connection with the implementation of its carbon-reduction laws, which have consumer cost and other policy implications, is self-evident.

   NESCOE offers two examples to illustrate the concern. First, recall that ISO-NE, NESCOE and NEPOOL agreed on core aspects, including roles and responsibilities, of New England's compliance filing on FERC's Order 1000

[6] For restructuring background and other information, see http://nescoe.com/wp-content/uploads/2015/12/RestructuringHistory_December2015.pdf.

[7] The RGGI states' Memorandum of Understanding was signed by all states in 2007. The first compliance period began in 2009.

public policy provision. Despite that agreement, FERC's New England order shifted decision-making about the specific means by which to implement state laws away from state officials and to ISO-NE. Mindful of this recent example, even if the region hypothetically could reach agreement about a carbon pricing-style mechanism structured and governed in a way that satisfied state officials, the states have no risk tolerance for a FERC order, whether initially or in response to a later complaint (see second example below), that seeks to shift responsibility to ISO-NE or any other entity over the form and/or level of a carbon price to satisfy state laws.

Another related example that gives states considerable pause is the risk that one or more market participants would seek changes, after-the-fact, to any regionally supported outcome they would have preferred had gone another way. A few years ago, ISO-NE, NEPOOL and NESCOE collectively supported the Renewable Technology Resource Exemption in the Forward Capacity Market as part of a package of reforms. Certain generators have continued to litigate the exemption. This creates uncertainty regarding an important component of an overall package of changes that NESCOE considered. Generating entities' after-the-fact challenge to the Peak Energy Rent mechanism has similar echoes. In the context of a wholesale market mechanism to implement state laws, the states have no tolerance for the risk, borne out in recent years, that a few market participants with an appetite and budget to litigate matters will seek to disrupt a design over which ISO-NE, NESCOE and NEPOOL had found agreement.

2. Continuing concerns over increasing energy costs that would be related to any carbon pricing-style mechanism proposal.

3. Continuing threshold legal questions about FERC's and/or ISO-NE's legal authority to establish and set the level of a specific carbon price in the locational marginal price of energy.

4. Continuing legal questions about state officials' authority to support the form or level of a carbon pricing-style mechanism in the context of an ISO-NE tariff.

5. Interaction with New England states' existing carbon-related support mechanism, RGGI.

6. The risk of providing certain existing resources that already receive economic support through other state programs incremental support through an ISO-NE administered carbon pricing-style mechanism. Consumers would pay for both.

7. The consumer cost risk associated with creating an increased revenue stream, whether needed or not, applicable to all non-carbon emitting resources without identifying the conditions under which such need would be determined. The states are concerned about the potential to increase consumer costs without any corresponding consumer benefit. Such result would be especially concerning if

the actual need for this revenue increase is limited to a single resource type (for example, nuclear resources that may be needed for reliability and that have sufficiently established financial distress).

8. Allocation of any over-collection of emission fees.[8]

We look forward to reviewing ISO-NE's proposal this spring and participating with ISO-NE and market participants in discussions about the way forward in the near-term. We believe that continuing to work together with ISO-NE and NEPOOL on potential near- and longer-term approaches is the best way to sort through the complex challenge of preserving the benefits of competitive wholesale markets while the states execute the requirements of state laws. We commit to continuing active engagement and timely feedback as we all consider the grid of the future and associated market rules.

[8] *See* Rebate Allocation, page 4, at http://nepool.com/uploads/IMAPP_20170125_ISO-NE_Discussion_Paper_Rev.pdf.

Monster in the Closet!

Integrating Markets and Public Policies

May 17, 2017

Doug Hurley, Synapse Energy Economics,
for Vermont Energy Investment Corporation

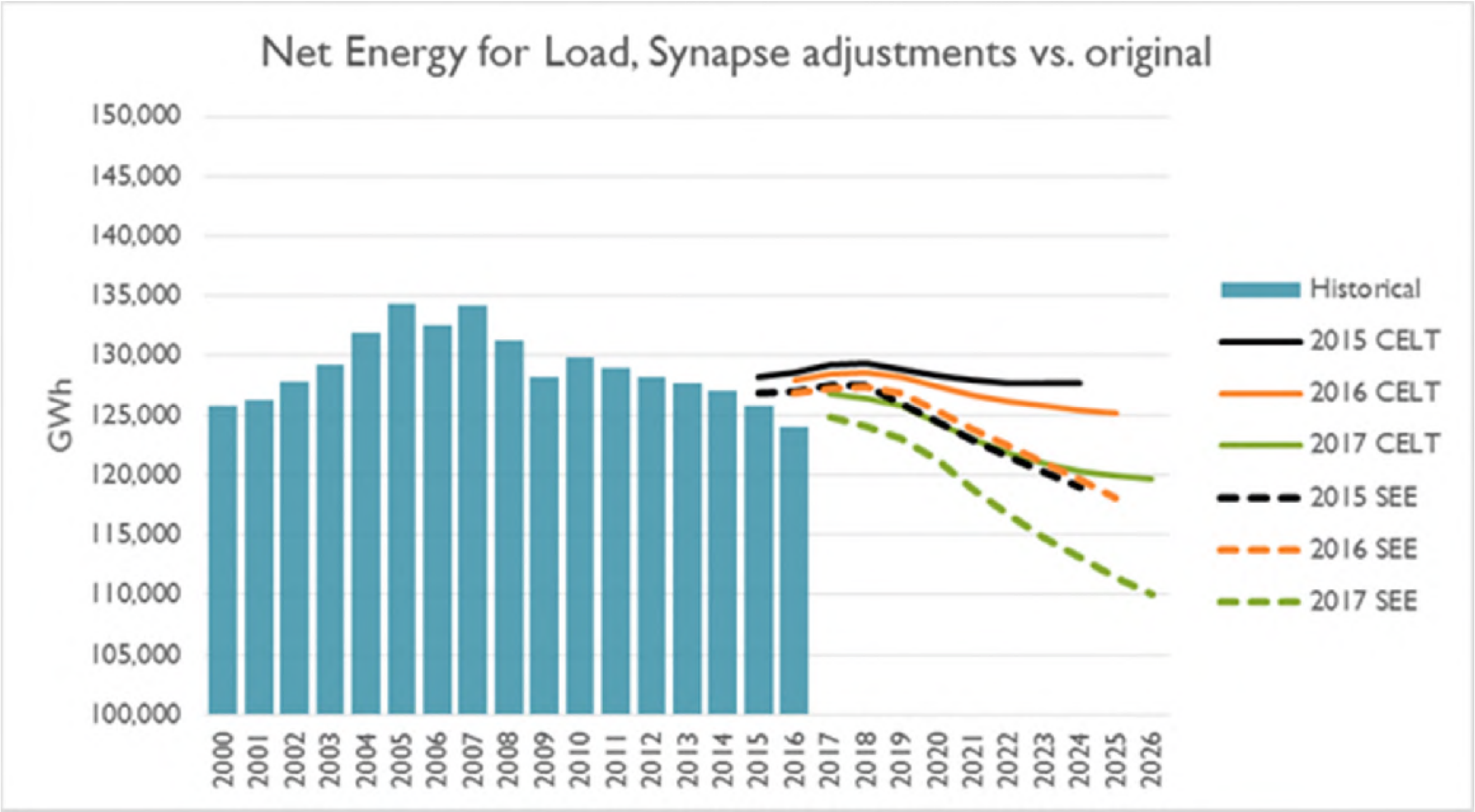
Synapse Energy Economics

- Founded in 1996 by CEO Bruce Biewald
- Leader for public interest and government clients in providing rigorous analysis of the electric power sector
- Staff of 30 includes experts in energy and environmental economics and environmental compliance
- Represent NEPOOL participants in the Alternative Resources and End User sectors.

Background

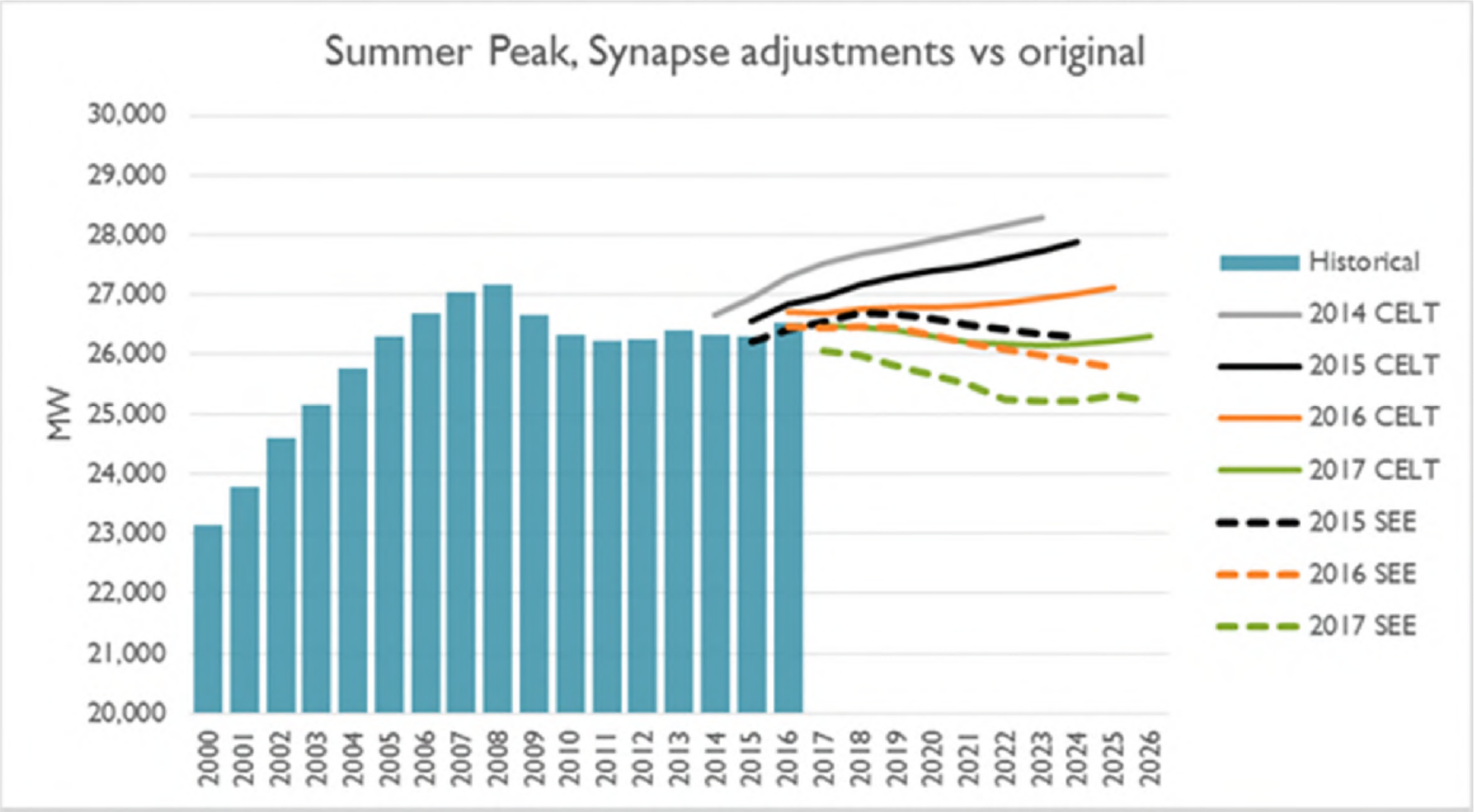
- System peak loads have been flat for a decade; declining in recent years (winter and summer)
- Net energy for load has been declining steadily for a decade
- New England system has had excess capacity resources for two decades
- Over 5,000 MW of new resources in the past 5 FCAs
- “Subsidized” renewables are being singled out as the problem, not just a small component of a bigger “problem”: too many supply resources for a shrinking demand

Net Energy for Load



Source: Historical values are weather normalized. From Table 5 of CELT.

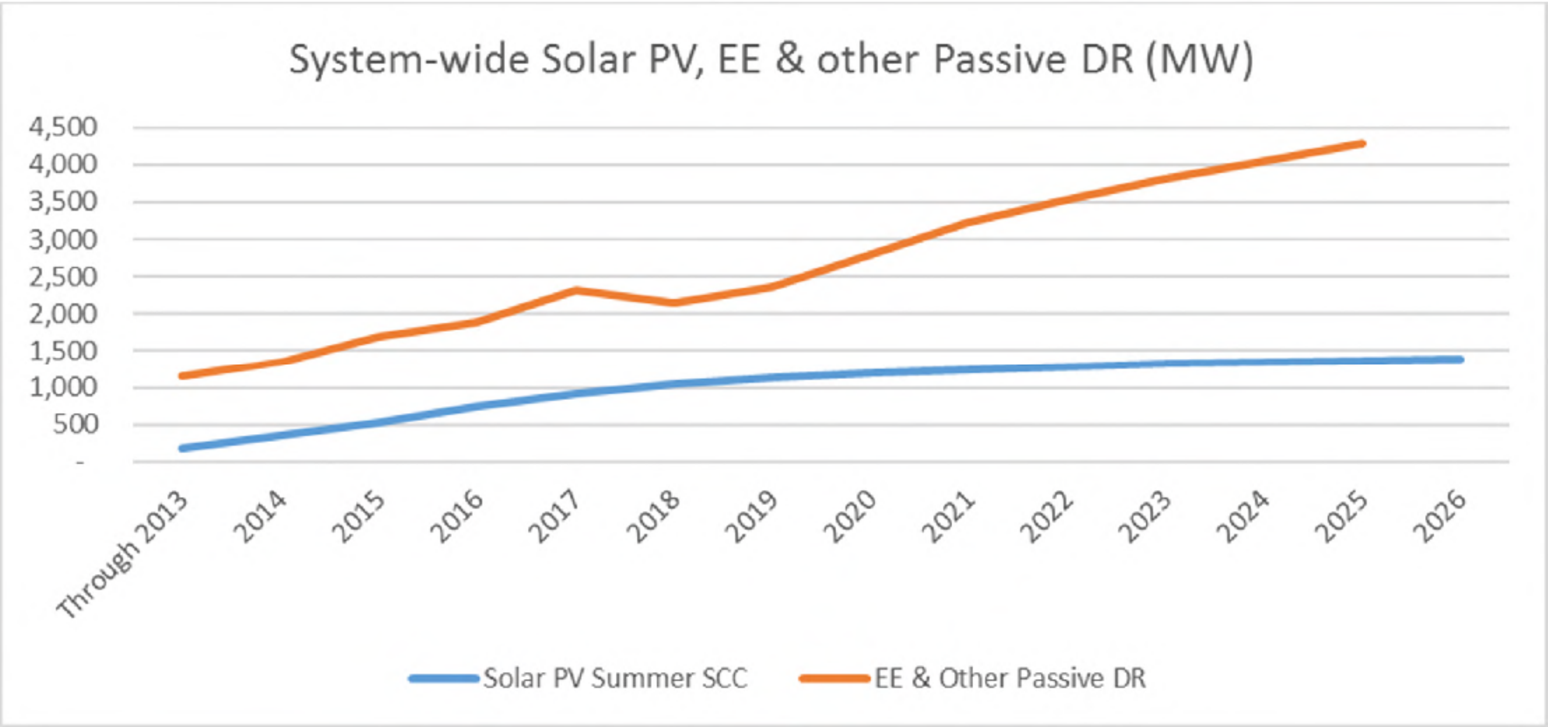
Summer Peak



Source: Historical values are weather normalized. From Table 5 of CELT.

EE and PV

- The region has made steady and substantial investments in energy efficiency and solar PV for more than a decade, because they are low-cost clean energy resources.



Source: Data from most recently available CELT for applicable year.
PV from Tables 3.1 and 3.1.2. EE & Other Passive DR from Table 4.1 through 2020, Table 1.1 through 2026.

Investment Signal?

- Numerous attributes of recent and current market design protect new and existing investments
  - Floor price for the first 7 auctions.
  - Demand Curve dampens downside risk when region is over-supplied
  - New development 7-year price lock
  - FCM PI will reward available resources
- The press releases after each auction appear to be correct. The FCM as it stands is attracting new capacity when needed

New Resources per FCA

Auction	New Resources (a)	RTR Amount (b)	New Gas Units >100 MW
FCA-7	1,045 MW	n/a	Footprint Power
FCA-8	382 MW	n/a	none
FCA-9	1,427 MW	16 MW	Towantic, Medway
FCA-10	1,380 MW	56 MW	Bridgeport, Burrillville, Canal
FCA-11	903 MW	31 MW	None

(a) New resources cleared per auction results filing, excluding imports.
(b) CELT 2017 table 4.2

As recently as FCA-11, several other new units were qualified, but didn't clear. Presumably would build if needed (512 MW Burrillville, 531 MW Killingly, 238 MW Ocean State).

ISO Problem Statement

- Despite this track record of success, the ISO-NE believes that there is a problem.
- "growing tension over the participation of state-subsidized new generation resources in the FCM"
- "Potential for electricity consumer to end up 'paying twice'", and
- "capacity market prices to be depressed below competitive levels" that would "undermine investors' willingness to maintain existing supply and … attract competitive (i.e., unsubsidized) new investment .. When the power system requires it."
  - *Source: ISO Discussion Paper entitled Competitive Auctions with **Subsidized** Policy Resource. April 2017. Page 1 of Executive Summary. (emphasis added)*

It is inappropriate and inaccurate to label upcoming contracts as "subsidized" with no recognition of subsidies to other power resources.

Subsidized resources

- Most resources used for energy production receive assistance (subsidies)
- Fossil resources
  - Accelerated cost recovery (depreciation)
  - Preferential tax rates
  - Tax exemptions
  - Tax benefits for compliance with labor and environmental laws
  - Corporate tax exemptions for some partnerships
  - Tax credits
- Renewable resources
  - Accelerated cost recovery (depreciation)
  - Residential tax credit
  - Production tax credit
  - Investment tax credit

Subsidized resources (con't.)

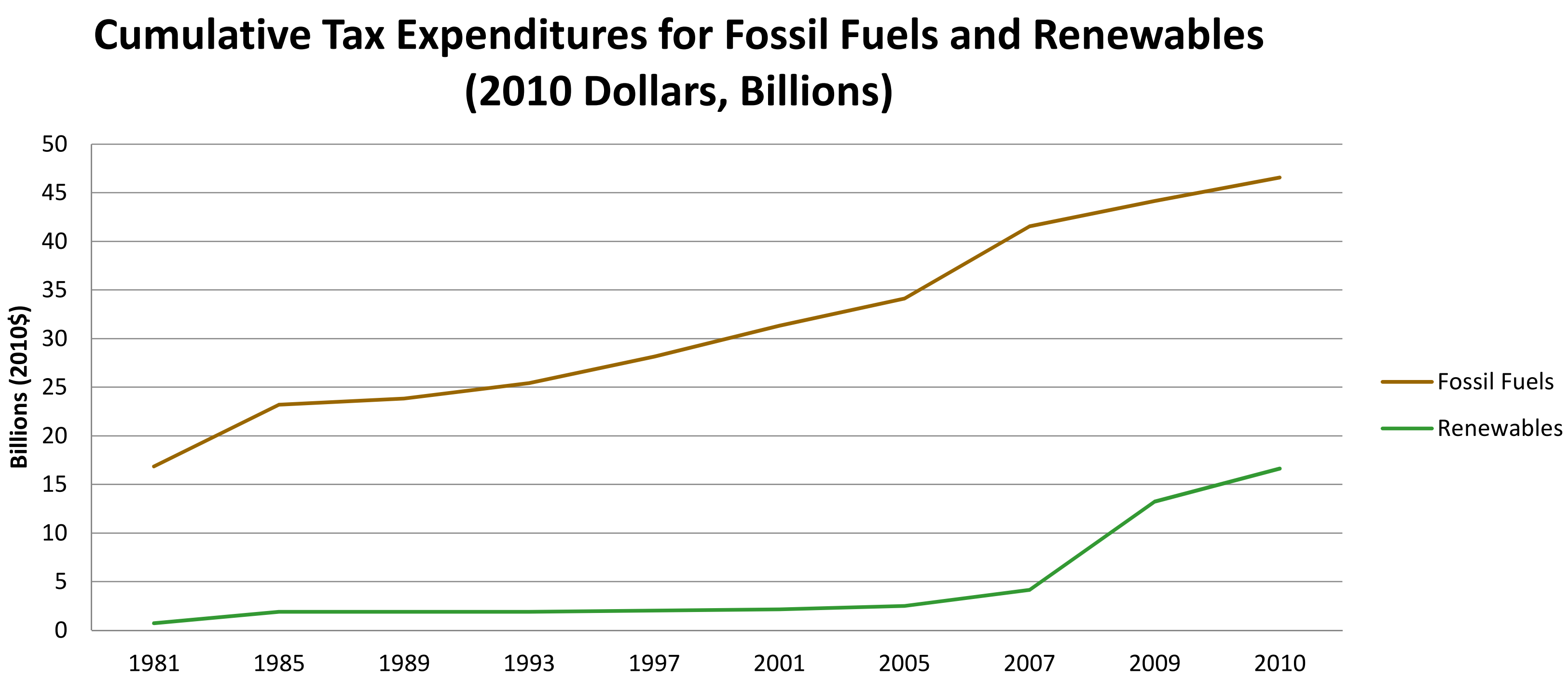
- Nuclear resources
  - Reactor design and safety
  - Insurance (Price-Anderson)
  - Federal (taxpayer) liability for high-level waste
  - Ultimate taxpayer liability for decommissioning
  - ZECs
- Traditional Resources
  - Market design
- Power Engineering April 2016 Headline:

  "U.S. Senate Votes to Restore Funding for Wind Power Research & Development"
  - First line: "The U.S. Senate on Tuesday voted 54-42 to approve a bipartisan amendment providing $95 million in federal funding to wind power research and development."
  - Later in the article: "In addition to $95 million for wind power research, the appropriations bill also gives the Department of Energy **$632 million for fossil fuel research and $1 billion for nuclear power research.**"

Starting Bibliography

- "Estimating U.S. Government Subsidies to Energy Sources: 2002 – 2008." Environmental Law Institute. September 2009.
- "60 Years of Energy Incentives. Analysis of Federal Expenditures for Energy Development." Management Information Services for the Nuclear Energy Institute. October 2011.
- "The Great Giveaway. An analysis of the costly failure of federal coal leasing in the Powder River Basin." Tom Sanzillo. Institute for Energy Economics and Financial Analysis. June 2012.
- "Effect of government subsidies for upstream oil infrastructure on U.S. oil production and global CO2 emissions." Working Paper from Stockholm Environment Institute. February 2017.
- "Picking Winners and Losers: A Structural Examination of Tax Subsidies to the Energy Industry." Tracey M. Roberts. Columbia Journal of Environmental Law. Vol 41:1. April 2016.

Not New Information



Source: [Congressional Research Service 2011]

From "Subsidies for Fossil Fuels in the Electric Generation Industry." Ann Berwick. Presentation to Restructuring Roundtable. June 2011.

Recognition of Subsidies by FERC

- “The premise of the MOPR appears to be based on an idealized vision of markets free from the influence of public policies. But such a world does not exist, and it is impossible to mitigate our way to its creation. The fact of the matter is that all energy resources receive federal subsidies, and some resources have received subsidies for decades. Yet the MOPR is only concerned with state subsidies, not federal ones, though both can have a similar impact on markets. … Nor does the MOPR examine whether existing resources have previously benefited from a state subsidy. In short, the MOPR suffers from a troubling lack of coherence that calls into question the soundness of its underlying rationale.

- *Source: Chairman Bay, concurring, EL16-92 (2017)*

Chairman Bay, con't

- "Given the pervasiveness of public policies that support resources, I believe the MOPR has proven to be unworkable in practice. … A prompt siting decision or a favorable zoning exemption may provide more economic benefit than a subsidy but only the subsidy is likely to result in application of the MOPR. While these state actions may be more significant than the subsidies subject to the MOPR, they are lawful. The Supreme Court has now made clear that states are permitted to enact a wide range of policy choices that can affect the wholesale market."

Unwind all subsidies?

- Extraordinary task
  - Federal tax code
  - Congressional legislation
  - Executive branch support
  - Vested, entrenched industries
- Failure to address all subsidies
  - “Undue discrimination” under the Federal Power Act?
  - FERC complaints and court appeals

- Do we need to search for a path to achieve new resources with state contracts?

Monster in the Closet?

Year	Addition	Estimated Nameplate (MW)	Estimated Capacity (MW)
2020	Clean Energy RFP	460 MW	100 MW?
2022	MA RE and Hydro	~1,200 MW	1,000 MW?
2023	MA Offshore Wind	400 MW	160 MW?
2025	MA Offshore Wind	400 MW	160 MW?
2027	MA Offshore Wind	400 MW	160 MW?
2029	MA Offshore Wind	400 MW	160 MW?

These amounts are well within the range of what the FCA has already been clearing, when new additions are needed. The monster doesn't seem so scary any more.

Approach

- Potomac Economics FERC statement suggests that 300 MW annually (with roll over) will allow almost all state mandated renewables to fit over next ten years

- Current FCM design includes an RTR cap of 200 MW annually (with roll over), that has been underutilized to date.

- Would an adjustment to the current FCM design be a reasonable approach that would achieve broad support?
- Focus on encouraging entry of clean energy.

Questions?

A Dynamic Clean Energy Market

Straw Proposal for a Long-Term IMAPP Design

PRESENTED AT

NEPOOL Integrating Markets and Public Policy Forum

PREPARED BY

The Brattle Group

Kathleen Spees   Judy Chang

Coalition Partners

Conservation Law Foundation

Brookfield Renewable

NextEra Energy Resources

Robert Stoddard

May 17, 2017

THE Brattle GROUP

Contents

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:

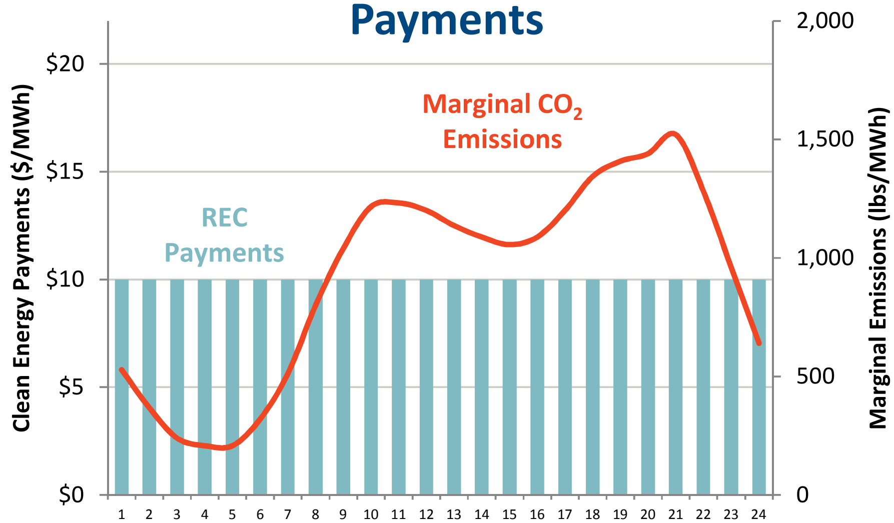
- Auction procures the **clean energy attribute only** (not bundled with energy)
- Purchases via this market **fulfill majority of states needs,** but possibly less than 100%
- Enable **competition among *all* clean energy resources** to yield least cost portfolio to meet the states' policy goals
- **Auction 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

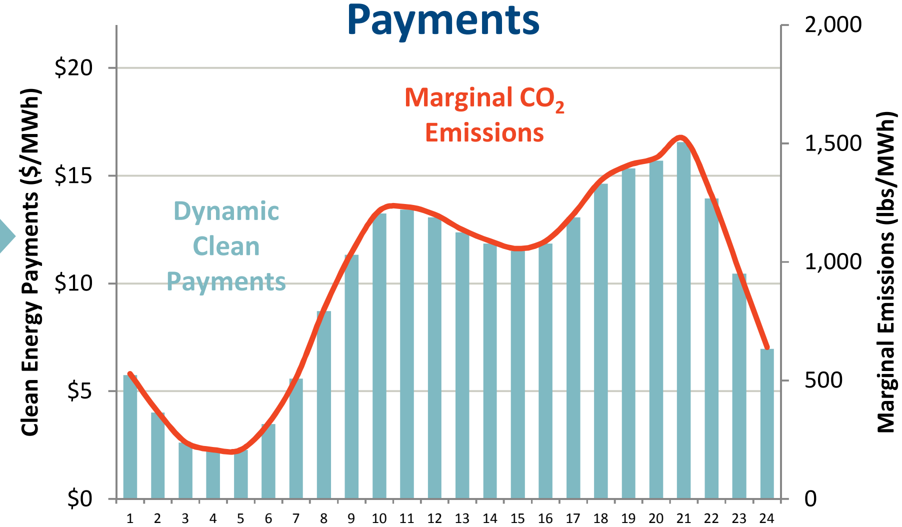
The centerpiece of this design proposal is a new "carbon-linked" dynamic clean energy payment

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:

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

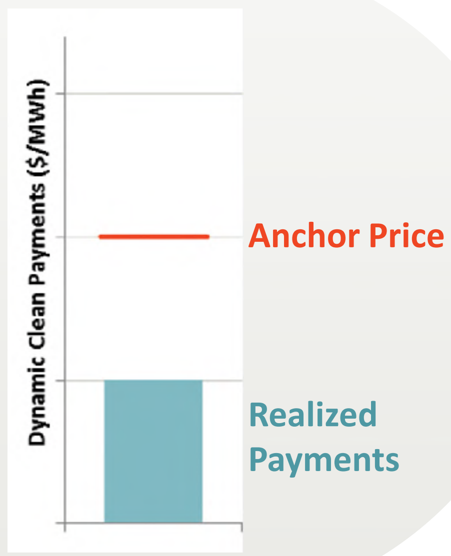
Design Concept

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

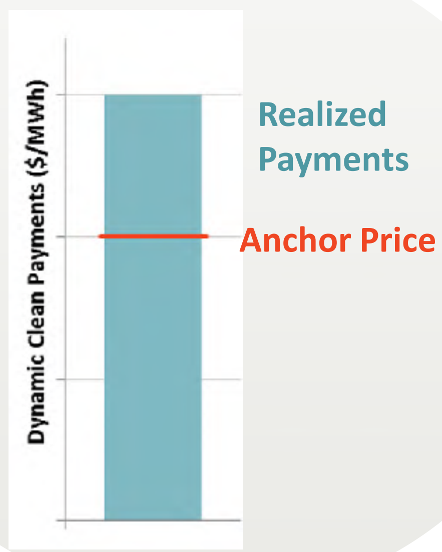
Low-Emitting Location

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

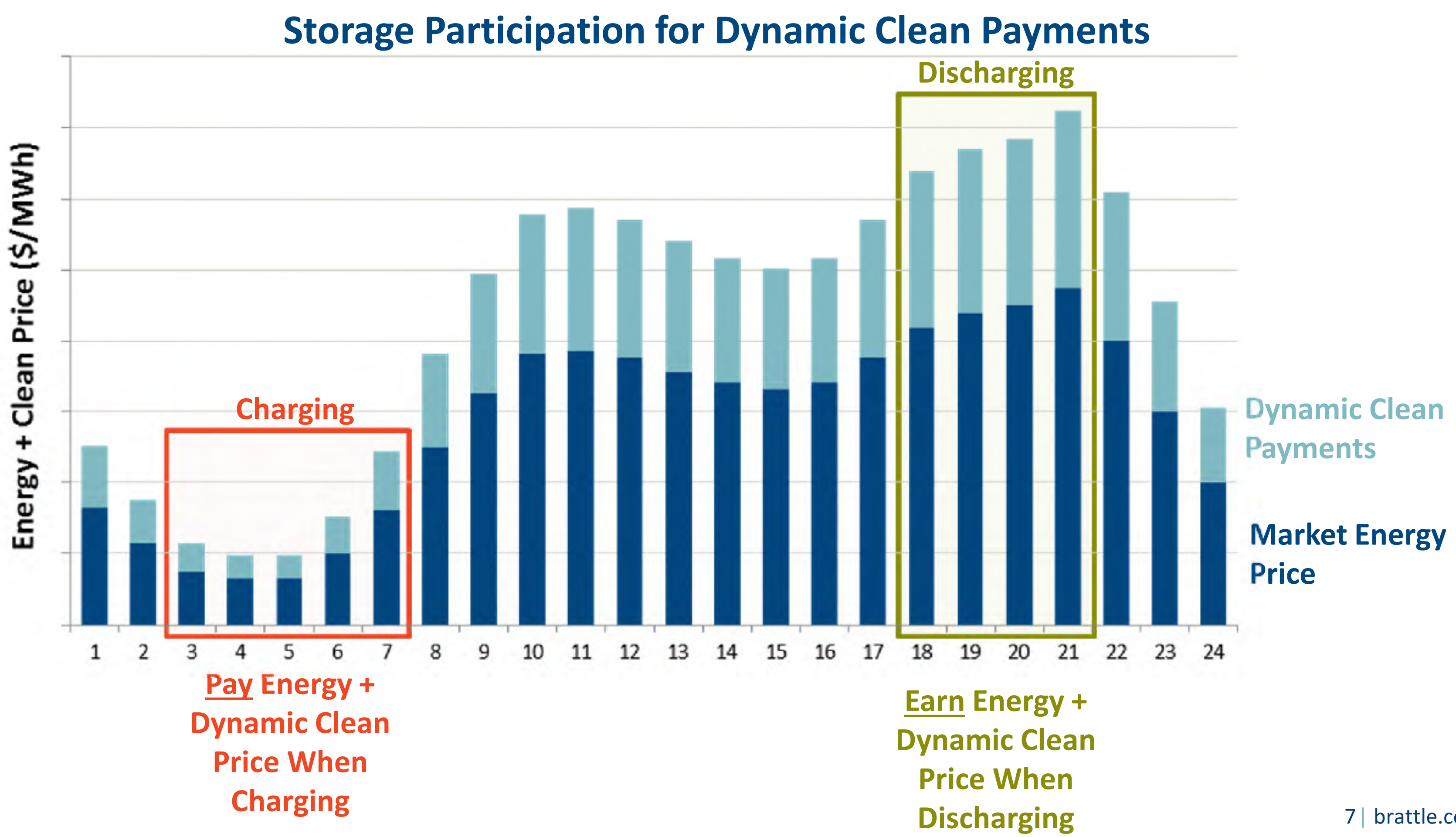
Load pocket where high-emitting steam oil units are often called on. Clean energy will displace more emissions (and earn more payments)



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 new or existing
- 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

- New 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

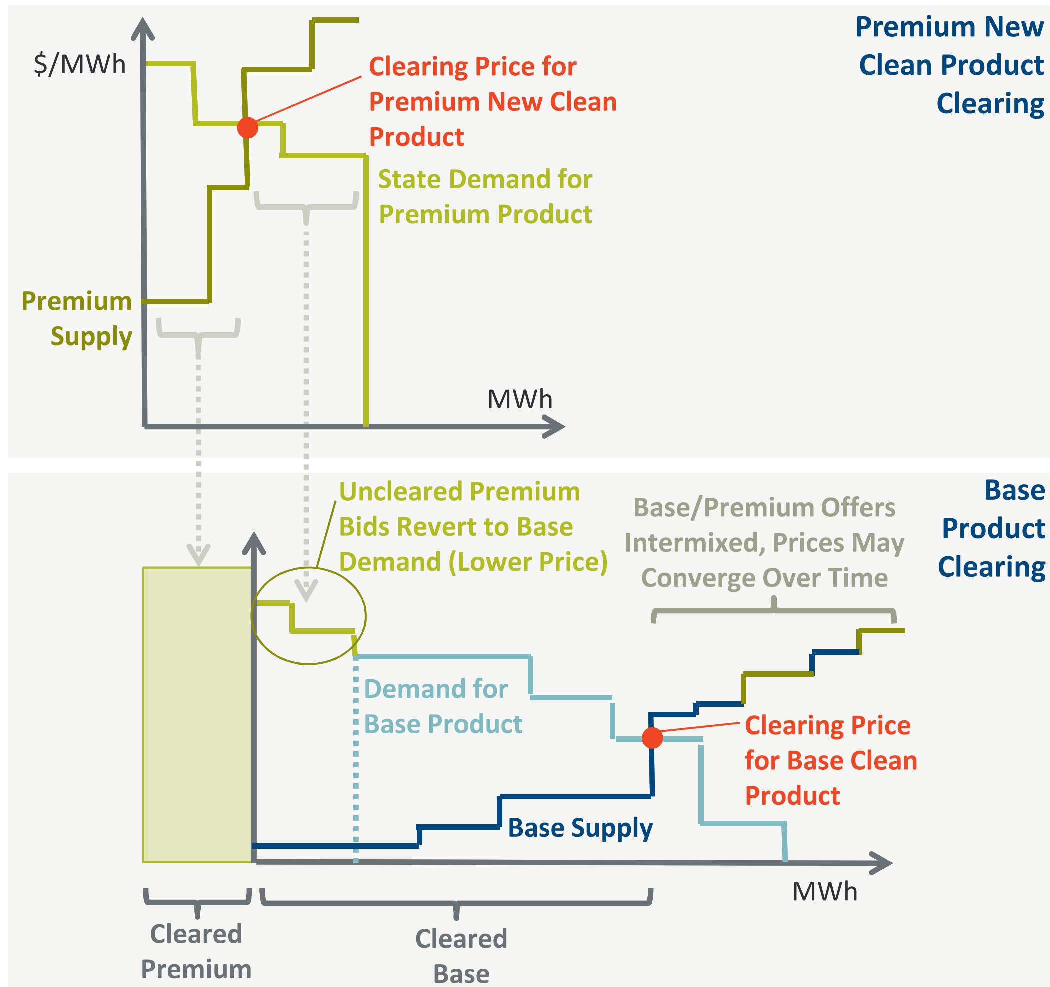
- Co-optimized clearing for all states' demand
- Conducted immediately prior to the FCM
- Uncleared clean resources have the option for a separate capacity-only offer in FCM

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

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

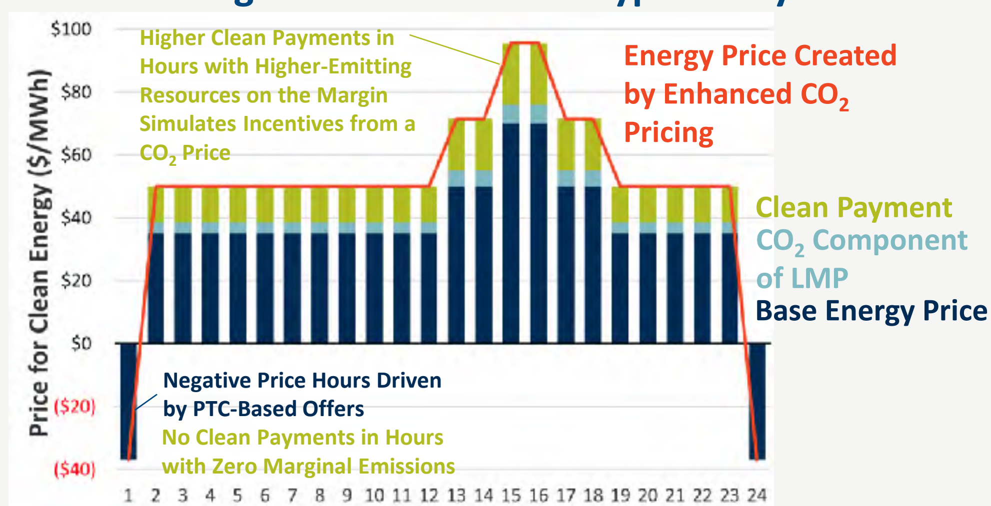
Market and Product Parameters

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

KATHLEEN SPEES
Principal | Cambridge
Kathleen.Spees@brattle.com
+1.617.234.5783

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.

Biography and Contact Information

JUDY W CHANG
Principal, Director | Cambridge
Judy.Chang@brattle.com
617.864.7900 office
617.234.5630 direct

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
- Fuel and Power Procurement
- Incentive Regulation
- Rate Design and Cost Allocation
- Regulatory Strategy and Litigation Support
- Renewables
- Resource Planning
- Retail Access and Restructuring
- Risk Management
- Market-Based Rates
- Market Design and Competitive Analysis
- Mergers and Acquisitions
- Transmission

Offices

CAMBRIDGE

NEW YORK

SAN FRANCISCO

WASHINGTON, DC

TORONTO

LONDON

MADRID

ROME

SYDNEY

Competitive Auctions with Subsidized Policy Resources

April 2017

Highlights

Noting a growing tension over the participation of state-subsidized new generation resources in the Forward Capacity Market (FCM), ISO New England's stakeholders initiated discussions in 2016 on Integrating Markets and Public Policy (IMAPP). Specifically, representatives of the New England states had expressed concern over the potential for electricity consumers to end up 'paying twice': once for the cost of capacity resources procured in the FCM, and a second time for the cost of subsidizing additional state-mandated new supply resources. Other stakeholders highlighted a different concern: the potential for capacity market prices to be depressed below competitive levels if substantial amounts of new subsidized resources entered the FCM without mitigation. That impact could undermine investors' willingness to maintain existing supply resources, and hamper the FCM's ability to attract competitive (i.e., unsubsidized) new investment cost-effectively when the power system requires it.

Following these stakeholder discussions, ISO New England agreed to develop a proposal to address both investors' and states' concerns about subsidized new resources' participation in the FCM. This paper explains ISO's proposal. Conceptually, the ISO's approach addresses these concerns by closely coordinating the entry of (subsidized) new resources with the exit of (unsubsidized) existing capacity resources. By doing so, the FCM can accommodate the entry of significant subsidized resources over time while maintaining competitively-based capacity prices for non-subsidized resources.

To achieve these objectives, the ISO's proposal provides financial incentives for existing, high-cost capacity resources to transfer their capacity obligations to subsidized new resources and to permanently exit the capacity market. This exchange of obligations is coordinated by conducting the annual Forward Capacity Auction (FCA) using a two-stage, two-settlement process. In the first stage, the ISO clears the FCA as it does today, including application of the current Minimum Offer Price Rule (MOPR) to new capacity offers. This first (or 'primary') stage of the FCA uses the existing capacity demand curves, establishes the competitively-based capacity clearing price, and determines all resources' initial capacity awards.

In the ISO's proposal, a new second stage would be added to the annual FCA. The second stage is designed to accommodate subsidized resources that participated in the primary FCA but did not clear (that is, did not acquire an obligation) due to the MOPR.[1] Specifically, promptly after conducting the primary FCA, the ISO would administer a secondary market known as a *substitution auction*. In the substitution auction, existing capacity resources with retirement bids that retained capacity obligations in the primary FCA may then transfer their obligations (in their entirety) to subsidized new resources that did not clear in that first stage. The transferring resources must pay the subsidized new resources for accepting the capacity obligations, and the transferring existing resources must then permanently retire from the FCM.

Importantly, no MOPR is applied in the substitution auction. That enables new subsidized resources to offer at a lower price than in the primary FCA. Because of this, the substitution auction will generally produce a different (lower) clearing price than the primary FCA. That, in turn, enables existing capacity resources that retained capacity obligations in the primary FCA to shed (or 'buy out') their obligations for a lower cost than if they retained their obligations. In effect, existing resources that transfer their obligations in the substitution auction receive a net payment for voluntarily retiring – akin to a 'severance payment.'

Through this exchange of obligations, the substitution auction serves as a market-based mechanism to coordinate the entry (of subsidized) and exit of (existing) capacity resources. It allows subsidized new resources to obtain capacity supply obligations, which aligns with the states' goal that new state-mandated resources contribute toward the region's resource adequacy requirements.

The quantity of subsidized new resources that enter (acquire obligations) through the substitution auction must be aligned with the quantity that exit (after transferring their obligations), to ensure that system reliability is preserved and that consumers are not adversely impacted. The substitution auction's outcomes therefore do not affect the capacity payments to other existing resources that obtained capacity obligations, as their payment rate continues to be determined by the competitive capacity clearing price established in the primary FCA. This proposal thereby preserves competitively-based capacity prices for new and existing competitive resources that acquire capacity obligations in the FCM.

A key feature of this two-stage auction process is its settlement. Although the clearing prices and (some) resources' capacity supply obligations may differ between the primary auction and the secondary (substitution) auction, each resource's final payment would be determined by a familiar, well-established process – the two-settlement system for sequential auctions. Specifically, capacity payments and supply obligations would be combined across the two auction stages in a manner that is analogous to the two-settlement process in the ISO's day-ahead and real-time energy markets. That is, all resources that clear in the primary FCA are credited at the first-stage FCA clearing price, and then each resource that sheds or acquires an obligation in the second-stage substitution auction

[1] In this document, we use the term 'clear' to mean 'awarded a Capacity Supply Obligation (CSO)' for both new supply offers and existing resource de-list bids. That interpretation differs from how 'clear' is sometimes applied to de-list bids in the FCA (where certain 'cleared bids' connote resources not awarded CSOs). The convention in this paper of using 'clear' to mean 'awarded a CSO' provides a consistent interpretation and consistent terminology for all resource types and auctions.

is credited or charged for the change (or deviation) in its obligation at the substitution auction clearing price.

In order for the coordination of entry and exit to be most effective, it is valuable if the states provide their best estimates of the timing and amount of new subsidized resources that will seek to acquire capacity obligations in the FCM. This will facilitate existing resource owners' evaluations of whether (and at what price) they would be willing to transfer their obligations and permanently exit, thereby accommodating the new subsidized supply. Furthermore, the FCM will operate more smoothly if the potential developers of competitive (that is, unsubsidized) new capacity are well-informed when only limited subsidized supply is forthcoming, so they can advance new projects when the capacity market requires them.

In addition to providing an opportunity to accommodate new subsidized resources into the FCM over time while preserving competitively-based capacity prices for (non-retiring) existing resources, the substitution auction has a number of additional benefits, including:

- This proposed approach builds upon the existing FCM design and should be technically straightforward for the ISO to implement. That should enable it to be implementable in the near-term (namely, for FCA 13 in February 2019).

- Although this approach to accommodating subsidized new capacity resources into the FCM is not designed to achieve states' carbon emission reduction goals directly (which is a separate, longer-term IMAPP discussion), it will likely help that cause indirectly. As new subsidized (non-emitting) resources enter the market, the resources that elect to retire sooner are likely to be among the older, less-efficient, and higher-emitting units in New England's power system. For this reason, the substitution auction might reasonably be viewed as an auction-based "cash for clunkers" secondary market.

- Because the substitution auction involves transfer payments among capacity suppliers, this approach may help to avoid one state's consumers inadvertently bearing the costs of other states' subsidies. As a general rule, the total cost of capacity to consumers would continue to be established in the primary FCA – as it is today – and it would be allocated among the New England states' consumers in the same way as today.

- By design, the substitution auction rules are technology neutral. No rules are envisioned, or necessary, governing which (current or possible future) technologies are eligible to participate in the substitution auction.

- This proposal avoids the complications associated with so-called 'in-between' resources that create difficulties in other ('two-tiered') capacity market design approaches discussed in the IMAPP sessions.[2] Because a substitution auction implements a two-settlement transfer of

[2] See the ISO's Discussion Paper *2016 NEPOOL IMAPP Proposals* (January 25, 2017), pp. 15-18, available at https://www.iso-ne.com/static-assets/documents/2017/03/iso-ne_jan_2017_imapp_memo_vtransmit2.pdf, and NESCOE's memorandum *Some Analysis on Two-Tiered Pricing Proposals* (October 2018, 2016), available at http://nepool.com/uploads/IMAPP_20161021_NESCOE_2Tiered_Pricing_Analysis.pdf.

supply obligations, it creates no ‘in-between’ resources and no need for various specialized rules (i.e., pro-rationing) to address such complications.

- The proposed design can be extended to enable new competitive resources to participate alongside retiring resources as demand in the substitution auction.
- The substitution auction design may help market participants that self-supply in the FCM, if they were to subsidize new self-supply resources that do not clear in the FCM due to the MOPR.[3] Stated differently, supply participation in the substitution auction would not be limited to resources subsidized through state-directed mechanisms, but would accommodate on equal terms a resource subsidized by another subsidy provider (such as a municipality, for example).

In the ISO’s proposal, the substitution auction would replace the existing Renewable Technology Resource (RTR) administrative exemption. This replacement accommodates a broader range of new technology resources than are allowed under the current RTR exemption. Specifically, because the substitution auction is technology neutral, it accommodates the entry of many current and future subsidized technologies that may not meet the existing renewable technology criteria (such as large scale hydro, battery storage technologies, or other future innovations that state policy makers may seek to develop).

In addition, the substitution auction can accommodate the entry of more new subsidized resources than the existing RTR exemption (which is limited to 200 MW annually, with a 600 MW cumulative catch-up provision). That said, the actual number of MW of new subsidized resources that may acquire capacity obligations each year in the substitution auction will depend on their (unmitigated) offer prices, as well as the number of MW of existing resources that clear in the primary FCA and are willing to retire (given the new incentives to do so). These market-based uncertainties are not shortcomings, however – they are appropriate determinants of the pace of capacity replacement in New England. Stated differently, in developing the substitution auction proposal, the ISO is striving to create a market-based solution to accommodate increasing amounts of new subsidized resources in the FCM – and not to create (or perpetuate) indefinite, technology-based exceptions to the market rules. Because the substitution auction is technology neutral and has no pre-set administrative limit, this market-based approach can achieve its principal goals as market conditions and state policies continue to evolve over time.

We look forward to stakeholder feedback and further regional discussion of these challenges.

[3] Under FCM rules, acquiring a CSO is a requisite for a load-serving entity to have its capacity load obligation charges offset by capacity supply obligation credits, i.e., to self-supply.

Competitive Auctions with Subsidized Policy Resources

ISO Discussion Paper
April 2017

Executive Summary

Noting a growing tension over the participation of state-subsidized new generation resources in the Forward Capacity Market (FCM), ISO New England's stakeholders initiated discussions in 2016 on Integrating Markets and Public Policy (IMAPP). Specifically, representatives of the New England states had expressed concern over the potential for electricity consumers to end up 'paying twice': once for the cost of capacity resources procured in the FCM, and a second time for the cost of subsidizing additional state-mandated new supply resources. Other stakeholders highlighted a different concern: the potential for capacity market prices to be depressed below competitive levels if substantial amounts of new subsidized resources entered the FCM without mitigation. That impact could undermine investors' willingness to maintain existing supply resources, and hamper the FCM's ability to attract competitive (i.e., unsubsidized) new investment cost-effectively when the power system requires it.

Following these stakeholder discussions, ISO New England agreed to develop a proposal to address both investors' and states' concerns about subsidized new resources' participation in the FCM. This paper explains ISO's proposal. Conceptually, the ISO's approach addresses these concerns by closely coordinating the entry of (subsidized) new resources with the exit of (unsubsidized) existing capacity resources. By doing so, the FCM can accommodate the entry of significant subsidized resources over time while maintaining competitively-based capacity prices for non-subsidized resources.

To achieve these objectives, the ISO's proposal provides financial incentives for existing, high-cost capacity resources to transfer their capacity obligations to subsidized new resources and to permanently exit the capacity market. This exchange of obligations is coordinated by conducting the annual Forward Capacity Auction (FCA) using a two-stage, two-settlement process. In the first stage, the ISO clears the FCA as it does today, including application of the current Minimum Offer Price Rule (MOPR) to new capacity offers. This first (or 'primary') stage of the FCA uses the existing capacity demand curves, establishes the competitively-based capacity clearing price, and determines all resources' initial capacity awards.

As part of the proposal, a new second stage would be added to the annual FCA. The second stage is designed to accommodate subsidized resources that participated in the primary FCA but did not clear (that is, did not acquire an obligation) due to the MOPR.[1] Specifically, promptly after conducting the primary FCA, the ISO would administer a secondary market known as a *substitution auction*. In the substitution auction, existing capacity resources with retirement bids that retained capacity obligations in the primary FCA may then transfer their obligations (in their entirety) to subsidized new resources that did not clear in that first stage. The transferring resources must pay the subsidized new resources for accepting the capacity obligations, and the transferring existing resources must then permanently retire from the FCM.

Importantly, no MOPR is applied in the substitution auction. That enables new subsidized resources to offer at a lower price than in the primary FCA. Because of this, the substitution auction will generally produce a different (lower) clearing price than the primary FCA. That, in turn, enables existing capacity resources that retained capacity obligations in the primary FCA to shed (or 'buy out') their obligations for a lower cost than if they retained their obligations. In effect, existing resources that transfer their obligations in the substitution auction receive a net payment for voluntarily retiring – akin to a 'severance payment.'

Through this exchange of obligations, the substitution auction serves as a market-based mechanism to coordinate the entry (of subsidized) and exit of (existing) capacity resources. It allows subsidized new resources to obtain capacity supply obligations, which aligns with the states' goal that new state-mandated resources contribute toward the region's resource adequacy requirements.

The quantity of subsidized new resources that enter (acquire obligations) through the substitution auction must be aligned with the quantity that exit (after transferring their obligations), to ensure that system reliability is preserved and that consumers are not adversely impacted. The substitution auction's outcomes therefore do not affect the capacity payments to other existing resources that obtained capacity obligations, as their payment rate continues to be determined by the competitive capacity clearing price established in the primary FCA. This proposal thereby preserves competitively-based capacity prices for new and existing competitive resources that acquire capacity obligations in the FCM.

A key feature of this two-stage auction process is its settlement. Although the clearing prices and (some) resources' capacity supply obligations may differ between the primary auction and the secondary (substitution) auction, each resource's final payment would be determined by a familiar, well-established process – the two-settlement system for sequential auctions. Specifically, capacity payments and supply obligations would be combined across the two auction stages in a manner that is analogous to the two-settlement process in the ISO's day-ahead and real-time energy markets. That is, all resources that clear in the primary FCA are credited at the first-stage FCA clearing price,

[1] In this paper, we use the term 'clear' to mean 'awarded a Capacity Supply Obligation (CSO)' for both new supply offers and existing resource de-list bids. That interpretation differs from how 'clear' is sometimes applied to de-list bids in the FCA (where certain 'cleared bids' connote resources not awarded CSOs). The convention in this paper of using 'clear' to mean 'awarded a CSO' provides a consistent interpretation and consistent terminology for all resource types and auctions.

and then each resource that sheds or acquires an obligation in the second-stage substitution auction is credited or charged for the change (or deviation) in its obligation at the substitution auction clearing price. We explain this familiar settlement logic, applied to the substitution auction context, using numerical examples further below.

In order for the coordination of entry and exit to be most effective, it is valuable if the states provide their best estimates of the timing and amount of new subsidized resources that will seek to acquire capacity obligations in the FCM. This will facilitate existing resource owners' evaluations of whether (and at what price) they would be willing to transfer their obligations and permanently exit, thereby accommodating the new subsidized supply. Furthermore, the FCM will operate more smoothly if the potential developers of competitive (that is, unsubsidized) new capacity are well-informed when only limited subsidized supply is forthcoming, so they can advance new projects when the capacity market requires them.

In addition to providing an opportunity to accommodate new subsidized resources into the FCM over time while preserving competitively-based capacity prices for (non-retiring) existing resources, the substitution auction has a number of additional benefits, including:

- This proposed approach builds upon the existing FCM design and should be technically straightforward for the ISO to implement. That should enable it to be implementable in the near-term (namely, for FCA 13 in February 2019).

- Although this approach to accommodating subsidized new capacity resources into the FCM is not designed to achieve states' carbon emission reduction goals directly (which is a separate, longer-term IMAPP discussion), it will likely help that cause indirectly. As new subsidized (non-emitting) resources enter the market, the resources that elect to retire sooner are likely to be among the older, less-efficient, and higher-emitting units in New England's power system. For this reason, the substitution auction might reasonably be viewed as an auction-based "cash for clunkers" secondary market.

- Because the substitution auction involves transfer payments among capacity suppliers, this approach may help to avoid one state's consumers inadvertently bearing the costs of other states' subsidies. As a general rule, the total cost of capacity to consumers would continue to be established in the primary FCA – as it is today – and it would be allocated among the New England states' consumers in the same way as today.

- By design, the substitution auction rules are technology neutral. No rules are envisioned, or necessary, governing which (current or possible future) technologies are eligible to participate in the substitution auction.

- This proposal avoids the complications associated with so-called 'in-between' resources that create difficulties in other ('two-tiered') capacity market design approaches discussed in the IMAPP sessions.[2] Because a substitution auction implements a two-settlement transfer of

[2] See the ISO's Discussion Paper *2016 NEPOOL IMAPP Proposals* (January 25, 2017), pp. 15-18, available at https://www.iso-ne.com/static-assets/documents/2017/03/iso-ne_jan_2017_imapp_memo_vtransmit2.pdf,

supply obligations, it creates no 'in-between' resources and no need for various specialized rules (i.e., pro-rationing) to address such complications.

- The proposed design can be extended to enable new competitive resources to participate alongside retiring resources as demand in the substitution auction.

- The substitution auction proposal may help market participants that self-supply in the FCM, if they were to subsidize new self-supply resources that do not clear in the FCM due to the MOPR.[3] Stated differently, supply participation in the substitution auction would not be limited to resources subsidized through state-directed mechanisms, but would accommodate on equal terms a resource subsidized by another subsidy provider (such as a municipality, for example).

In the proposed approach, the substitution auction would replace the existing Renewable Technology Resource (RTR) administrative exemption. This replacement accommodates a broader range of new technology resources than are allowed under the current RTR exemption. Specifically, because the substitution auction is technology neutral, it accommodates the entry of many current and future subsidized technologies that may not meet the existing renewable technology criteria (such as large scale hydro, battery storage technologies, or other future innovations that state policy makers may seek to develop).

In addition, the substitution auction can accommodate the entry of more new subsidized resources than the existing RTR exemption (which is limited to 200 MW annually, with a 600 MW cumulative catch-up provision). That said, the actual number of MW of new subsidized resources that may acquire capacity obligations each year in the substitution auction will depend on their (unmitigated) offer prices, as well as the number of MW of existing resources that clear in the primary FCA and are willing to retire (given the new incentives to do so). These market-based uncertainties are not shortcomings, however – they are appropriate determinants of the pace of capacity replacement in New England. Stated differently, with the substitution auction, the ISO is striving to create a market-based solution to accommodate increasing amounts of new subsidized resources in the FCM – and not to create (or perpetuate) indefinite, technology-based exceptions to the market rules. Because the substitution auction is technology neutral and has no pre-set administrative limit, this market-based approach can achieve its principal goals as market conditions and state policies continue to evolve over time.

The balance of this paper provides further perspective on the specific goals of this proposal, and explains in greater detail how the substitution auction would work. In Section 1, we discuss the design objectives and principles that this conceptual approach satisfies. In Section 2, we explain the mechanics of a substitution auction and who pays what. Section 3 provides a numerical example that will help convey the core concepts concretely. Section 4 describes several key properties of this

---

and NESCOE's memorandum *Some Analysis on Two-Tiered Pricing Proposals* (October 2018, 2016), available at http://nepool.com/uploads/IMAPP_20161021_NESCOE_2Tiered_Pricing_Analysis.pdf.

[3] Under FCM rules, acquiring a CSO is a requisite for a load-serving entity to have its capacity load obligation charges offset by capacity supply obligation credits, i.e., to self-supply.

approach, and Section 5 identifies a number of important issues for further consideration. Several technical aspects of the proposal, including clearing indivisible (or 'non-rationable') retirement bids in the substitution auction and handling substitution across constrained capacity zones, are addressed in the Appendix.

1. Problems and Objectives

Before turning to details, it is useful to summarize the problems with the status quo, and to provide the ISO's perspective on appropriate design objectives to solve these problems. We address each in turn.

Background: The Problem in Context

Over the past 15 years, the New England states have sought to reduce greenhouse gas (GHG) emissions and to meet climate goals through various mechanisms. More recently, some states have enacted legislation to promote the development of specific state-preferred new generation resources, including various types of non-emitting (or 'clean') electricity generation technologies. Many of these new resources are expected to be supported, in significant part, by mandates that state-regulated retail utilities enter into long-term contracts with the resources' developers. These contracts are often termed 'out-of-market contracts' because they are arranged outside the ISO-administered competitive wholesale markets, and because they may provide greater compensation to the preferred resources' developers than the region's competitive markets would otherwise tender. A modest quantity of new subsidized resources have acquired Capacity Supply Obligations (CSOs) using the Renewable Technology Resource exemption.[4]

Concerns about out-of-market contracting have grown over the last several years as some of the New England states pursue contracts for the development of significant new resources under the Multi-State Clean Energy request for proposals, and the clean energy procurements required by the 2016 Massachusetts Energy Diversity Act. The approximate size, type, and target delivery year for the new resources procured by these efforts are shown in the table below.

States	State Resource Procurement Initiative	Expected Resources	Target MW (nameplate)	Target Delivery Year
MA, CT, RI	2015/16 Multi-State Clean Energy RFP	Solar, wind	460	2020 (+/-)
MA	2016 Energy Diversity Act	Non-emitting generation (including hydro import)	Approx. 1200	2022 (+/-)
MA	2016 Energy Diversity Act	Off-Shore Wind	Up to 1600	By 2025-2027

[4] For example, 30.9 MW acquired CSOs using the RTR Exemption in the eleventh Forward Capacity Auction.

These types of state-initiated new resource procurements are likely to continue into the future – albeit at a pace that is difficult to predict with certainty. All six New England states have aggressive long-term GHG emissions reduction goals by 2050, and in three states (CT, MA and RI) these targets are state law. Achieving these long-term goals for the electric power sector is likely to require the development of many more non-emitting electric generation resources than presently supply the region's power system.

► **Forward Capacity Market Implications.** A tension has emerged surrounding the treatment of these potential new resources in the region's FCM. Under the current market rules, new resources are subject to a Minimum Offer Price Rule (MOPR) that, in effect, would preclude many of these resources from obtaining capacity supply obligations in the annual Forward Capacity Auctions – and consequently prevent these resources from receiving FCM payments. As noted at the outset, the New England states have expressed a legitimate concern that the FCM's current rules may therefore require electricity consumers to 'pay twice': once for the cost of the capacity procured in the FCM, and a second time for the additional generation capacity obtained through the out-of-market contracts with preferred resource developers.[5] Stated differently, the status quo could result in the region ultimately developing far more generation resources on the power system than the ISO requires to operate it – a costly and inefficient use of society's resources.

The tension arises because, in the absence of the FCM's MOPR, the participation of resources with out-of-market contract revenue in the FCM can depress capacity prices for all other capacity resources for many years. Further, this potential may impair the market's ability to attract new, competitively-compensated resources when they are needed.[6] The MOPR was instituted, at the direction of the Federal Energy Regulatory Commission (FERC), for a sound purpose: it largely prevents the exercise of buyer-side market power in the Forward Capacity Auction (FCA), thereby foreclosing a deleterious outcome that could distort capacity price signals and undermine competitive investment.[7] Even when pursued for different objectives, out-of-market contracts that

---

[5] See NESCOE's memorandum *Policies and Markets Problem Statement,* (May 17, 2016), p. 2, at http://nepool.com/uploads/IMAP_20160517_Problem_Statement.pdf ("At best, additional consumer costs occur when the capacity market does not consider such resources, so that consumers purchase a public policy resource and are then forced to purchase some redundant capacity in the market").

[6] Stated more explicitly: If current investors, after incurring the sunk costs of entry, face state-subsidized competition that depresses their capacity market revenue, then future investors may logically hesitate to develop new capacity, require greater risk premiums, or only offer to develop new capacity at such a high price as to recover their total costs and return on equity within the initial capacity price lock period (of seven years). This risk could raise the net cost of new entry substantially over time, and inefficiently undermine the cost-effectiveness of competitive markets to the detriment of society overall. In the economics literature, this type of regulatory risk is called the 'ratchet effect': In context, each time new capacity must be procured, the offered price ratchets higher due to successive investors' expectations that their future returns (after an initial contract expires) will be foreclosed by subsequent state action. See J.J. Laffont and J. Tirole, *A Theory of Incentives in Procurement and Regulation,* Chapter 9 (MIT Press, 1993).

[7] See *Order on Paper Hearing and Order on Rehearing (ISO New England Inc.),* 135 FERC 61,029 at P. 170 (2011) ("Our concern, however, is where pursuit of [states'] policy interests allows uneconomic entry of OOM capacity into the capacity market that is subject to our jurisdiction, with the effect of suppressing capacity prices in those markets. … We agree with arguments contending that OOM capacity suppresses prices

provide selected new resources with long-term revenue in excess of competitive levels can have a similar, if unintended, side-effect of suppressing the market's competitive price signals in the near-term and potentially deterring competitive investment in the future.

The magnitude of these potential impacts, and the timing of their realization, are difficult to quantify prospectively. Much depends on the pace and scale of new out-of-market contracts, in conjunction with other market fundamentals (such as resource retirements or demand forecasts) that can amplify or attenuate such impacts. Nonetheless, both the states' concerns about excess resource procurements and their excessive costs to consumers, as well as investors' concerns about depressed capacity prices due to subsidized new resource development, pose legitimate and realistic concerns involving – in part – the FCM's current market rules. Accordingly, it is appropriate to consider revisions to these rules that may address these stakeholder concerns and achieve better outcomes than continuation of the status quo.

Design Objectives and Principles

To make tangible progress and develop effective market enhancements, it is important to proceed from a clear statement of design objectives and principles. Although the set of possible design objectives is large, and stakeholders may have varying perspectives on their relative importance, the ISO developed a proposal based on the following four principal design objectives.

1. **Competitive capacity pricing**. Maintain competitively-based capacity auction prices by minimizing the price-suppressive effect of out-of-market subsidies on competitive (i.e., unsubsidized) resources in the FCA.

2. **Accommodate the entry of subsidized new resources into the FCM over time**. In doing so, the ISO's market rules should help to minimize the potential for New England to develop far more resources on the power system than the ISO requires to reliably operate it.

3. **Avoid cost shifts**. To the extent possible, minimize the potential for one state's consumers to bear the costs of other states' subsidies.

4. **A transparent, market-based approach**. Seek a practical solution approach that extends, rather than upends, the region's existing capacity market framework.

Each of these four objectives has a sensible rationale. As the ISO has explained previously, in New England's restructured electric system the capacity market's central purpose is to ensure there are sufficient resources to meet the region's reliability objectives in a cost-effective manner. Consistent with that central purpose, the first objective above helps to ensure the FCM can continue to attract new resource investment competitively and thereby cost-effectively.

The second objective is important because under the status quo, the pace and extent of possible procurements of new state-subsidized resources could result, in the near-term, in the development

regardless of intent and that ... uneconomic entry can produce unjust and unreasonable prices by artificially depressing capacity prices … " (citations omitted)).

of substantially more total electric generation resources on the power system than the ISO requires to reliably operate it. A market distorted by excess and unnecessary supply would be a costly outcome.

The third objective addresses an additional concern emphasized by the New England states during the IMAPP process.[8] Their concern over inadvertent cost shifts among states' consumers is understandable, and as such the ISO has focused on solution approaches that may help minimize this concern.

The fourth design objective is rooted more in practicality than market philosophy. By a transparent solution, we mean one that is robust and will continue to function properly as market fundamentals change over time; as the economic environment evolves, a good solution will not need to be continually revisited, and its market rules will not need to be adjusted. This objective requires that the solution approach employ sound economic principles where possible, and that it minimize administrative parameters whose appropriateness may not persist as the system evolves.

In considering these central design objectives, it is important to acknowledge that the first two are fundamentally in tension. It is difficult to ensure that markets will produce capacity prices at competitively-based levels while also allowing subsidized new resources to enter the FCM, because their entry tends to increase total capacity levels, thereby depressing prices. Because of this fundamental tension, there is no perfect solution to the region's objectives; or, stated in other terms, it is likely that not all of these design objectives can be simultaneously achieved to all stakeholders' satisfaction. Rather, developing a productive, workable solution that is better than continuing under the status quo necessarily involves some balancing of these different objectives – and, perhaps most importantly, avoiding a design direction that largely fails to achieve one objective or another.

These objectives do not encompass some of the longer-term goals that have been articulated in the IMAPP process. Most prominently, they do not directly include the reduction of the power sector's GHG emissions as an objective. As the ISO explained in its January discussion paper in the IMAPP process, there are a number of ways to pursue such goals through market-based mechanisms, but doing so – as a practical matter – would be a lengthy, multi-year effort and require substantial resources from both stakeholders and the ISO.[9] While acknowledging that much interest remains in discussing such longer-term goals, we note that such goals are not precluded by the region's near-term efforts to identify a solution to the concerns over subsidized new resources' participation in the FCM.

Accordingly, this discussion paper focuses narrowly on a near-term capacity market design enhancement intended to achieve the principal design objectives summarized above. Ultimately, the approach we discuss next seeks to balance the tension that has emerged over these issues, achieve a workable solution that the ISO can implement in the near-term, and provide a sustainable

---

[8] See NESCOE's memorandum *Policy and Markets: Goal Posts* (June 21, 2016), available at http://nepool.com/uploads/IMAP_20160621_Goal_Posts_States.pdf.

[9] See the ISO's Discussion Paper on *2016 NEPOOL IMAPP Proposals*, *op cit.,* pp. 2-3, 5.

resolution to today's challenges by adhering to sound principles and good market design.

2. Conceptual Approach

To satisfy the articulated objectives, the ISO's proposed solution is to conduct the FCA in two stages. Although the details are complex, the idea is simple. In the first (or primary) stage, the ISO administers the FCA similarly to today, including application of the current MOPR to new capacity offers. Then, promptly after conducting the primary FCA, the ISO would administer a secondary market known as a *substitution auction.* In the substitution auction, existing capacity resources that retained CSOs in the primary FCA may transfer their capacity obligations (in their entirety) to subsidized new resources that do not have capacity obligations. The transferring resources must pay the subsidized resources for accepting the capacity obligations, and the transferring resources must then permanently retire from the FCM.

We summarize the mechanics of this solution approach first, and then discuss its implications. For concreteness, we also provide a detailed numerical example further below.

► **A Two-Stage FCA.** In the primary FCA stage, the ISO clears the FCA similarly to today. New resources are subject to the existing MOPR. The primary auction employs the ISO's sloped system and zonal capacity demand curves, and the auction awards capacity obligations to the set of capacity bids and offers that maximize social surplus. This outcome is consistent with Design Objective 1 (competitive capacity market prices) – although, without the enhancements in the second stage, it would not provide a means to achieve Design Objective 2 (accommodate entry of subsidized new resources). Note that, like today, capacity obligations are awarded to existing resources that submit priced retirement offers below the FCA clearing price.

In the second stage – which is indeed a "secondary" market – the ISO runs the substitution auction. No MOPR is applied in the substitution auction and supply is comprised of only the (now unmitigated) offers from subsidized new resources that did not receive a CSO in the primary auction. This allows subsidized new resources to acquire obligations at a price that reflects their subsidized cost of new entry. Any subsidized new resources with supply offers that do not clear in the substitution auction are not awarded a CSO, and those qualified but uncleared MW are free to participate (as subsidized new resources) in the primary and substitution auctions the following year.

Unlike in the primary FCA, the substitution auction does not use an administratively-determined capacity demand curve. Rather, demand is represented by specific resources' offers that were initially awarded CSOs in the primary auction. The specific resources entered on the demand side in the substitution auction are those with offer types indicating a willingness to exit the FCM permanently if not awarded a CSO.[10] These resources' bids will be entered into the substitution auction – on the demand side – at the same offer price, and in the same quantity as in the primary

[10] Specifically, priced retirement bids and permanent de-list bids.

FCA.[11] The substitution auction's clearing price and quantity are determined, as usual, at the point where that auction's supply and demand curves meet.

► **Interpretation.** Effectively, the substitution auction's design allows existing resources that are considering retirement to exchange, or 'buy out', the obligations they were awarded in the primary FCA. Because no MOPR is applied in the substitution auction, new subsidized resources seeking CSOs can offer at a lower price than in the primary FCA, and the substitution auction will generally produce a lower clearing price than the primary FCA. That enables each existing resource that participates (as demand) in the substitution auction to shed its obligation at a lower price than it receives in the primary FCA.

Because of this structure, existing resources that transfer their obligations in the substitution auction will receive a net payment for permanently exiting the market (much like a severance payment), equal to the difference between the (higher) FCA clearing price and the (lower) substitution auction clearing price. In principle, relative to the current FCM design, this net payment increases the incentive for higher-cost existing resources to exit the capacity market.

► **Retirement Bids and Option Values**. In the ISO's proposal, the retirement bid price of any existing resource that acquires a CSO in the primary FCA is automatically entered into the *demand* side of the substitution auction, and at that resource's same bid price. Would a potentially retiring resource be willing to buy out of its CSO in the substitution auction at its primary auction bid price? This question is not as simple as it may initially seem, because a resource will also forgo any future capacity revenue if it retires. That is, imagine a resource whose owner might be willing to maintain a CSO for, say, between zero and five years, if expected capacity prices were sufficiently high. Does using the primary auction retirement bid price in the substitution auction properly reflect its foregone option value if it transfers its obligation away in the substitution auction, and must now permanently exit?

The short answer to both of these questions is yes. Today, a resource owner submitting a retirement bid in the FCA is giving up a stream of (possibly higher) future capacity revenues if its retirement bid fails to clear (i.e., if it does not retain its CSO). Accordingly, it should (and is allowed to, subject to IMM review) submit a higher retirement bid price in the FCA to reflect this potentially foregone option value (relative to, specifically, the de-list bid price of an otherwise identical existing resource submitting a competitive FCA de-list bid without the compulsory retirement consequence).

In theory, a competitive resource submitting a retirement bid should offer at its *indifference price* between clearing and not, accounting for the option value of retaining its CSO. That option value is the same option value it foregoes if it is bought out in the substitution auction, however.[12] Nothing changes a competitive resource's underlying valuation (i.e., its indifference price) between the primary and substitution auctions; if the owner of a potentially-retiring resource properly assessed

---

[11] This is conceptually analogous to a priced demand bid submitted by a resource with obligated capacity in a reconfiguration auction – that is, if the reconfiguration auctions had no administrative demand curves.

[12] This fact rests on a subtle point: In conducting the two-stage auction, the primary FCA results are not published prior to the execution of the substitution auction.

its foregone opportunity cost of retiring in its retirement bid in the primary FCA, its assessment will also be properly accounted for in the substitution auction.

A corollary of this economic logic is that it is not necessary (or desirable) to allow resources with retirement bids to revise their bid prices between the primary and substitution auctions. Because the substitution auction clearing price is less than (or equal to) the bid prices of all cleared demand bids in the substitution auction, the cost to a retiring resource of 'buying out' its obligation – i.e., the substitution auction price – is less than the retiring resource's indifference price. This produces, in effect, a form of inframarginal rent – on the demand side – that accrues to resources that shed their obligations in the substitution auction. For that reason, any resource owner with a retirement bid (that incorporates its potentially foregone option value) that sheds its obligation in the substitution auction should be financially much better off, and certainly no worse off, than if it retained its capacity obligation and did not participate in the substitution auction.

► **Impact on the FCA Clearing Prices Over Time**. Because the substitution auction does not use an administrative demand curve, each MW of demand that transfers its obligation represents an existing resource that will permanently exit the market. As a result, the substitution auction serves as a market-based mechanism to coordinate the entry (of subsidized) and exit (of retiring) capacity resources, generally on a 1-MW for 1-MW basis.[13] This design will therefore fix the system's total obligated capacity supply at (or very close to) the quantity determined in the primary FCA at the competitively-based capacity clearing price – preventing systematic increases in aggregate obligated capacity over time as new subsidized resources enter the market. If such a gradual increase in aggregate obligated capacity over time were to occur, the FCA would gradually 'walk down the demand curve' to a persistently low primary FCA clearing price – undermining Design Objective 1.

Furthermore, because an existing resource that sheds its obligation in the substitution auction must permanently exit the market, the design will not allow these resources to re-enter the capacity market through a later reconfiguration auction or in a subsequent commitment period. This restriction also helps to prevent the system's aggregate obligated capacity level from increasing above the competitive level over time – and, therefore, helps prevents the primary FCA's clearing price from decreasing below the competitive level.

► **Consumers and Existing (Non-Retiring) Resources**. There are two other implications of using a substitution auction design that closely coordinates the entry (of subsidized) and exit (of retiring) capacity resources in this way. The substitution auction's settlements involve transfers of obligations, and transfers of capacity payments, between exiting resources and the new subsidized resources that clear in the substitution auction. Because of this, the substitution auction does not affect the capacity payments to other existing (non-retiring) resources: their payment rate and supply obligations continue to be determined by the competitive capacity clearing price established in the primary FCA.

[13] The transfers may be slightly different that 1 MW-for-1 MW if they occur across a constrained capacity zone (i.e., one with price separation), based on zonal marginal reliability impact (MRI) values. See the Appendix for examples and further discussion.

Similarly, because the quantity of subsidized new resources that enter (acquire CSOs) through the substitution auction is aligned with the quantity that voluntarily agree to exit (after transferring CSOs), system reliability is preserved and the total capacity cost allocated to consumers (or their load-serving entities, more precisely) is generally not impacted. We show why these properties hold using a detailed numerical example, next.

3. An Illustrative Example

Many of the key ideas and properties of the substitution auction design can be shown by means of simple example. This example will illustrate both the mechanics of the two-stage FCA, and help to provide a more transparent understanding of a central question: who ultimately pays what, and why? We start with a simplified representation of the first stage, the FCA today.

Capacity Supply Offers

For purposes of this example, assume that there are three types of resources participating in the FCA: de-list bids from several existing resources (whether static or dynamic is unimportant here), priced retirement offers from existing resources, and new supply offers from several subsidized new resources with qualified capacity.

We will assume there are seven resources in total in this example, with the offer prices and qualified capacity (in MW) shown in Table 1. Existing resources in the FCM are not subject to the MOPR, and therefore each existing resource has one offer price in the FCA in this example. Each subsidized new resource has two offer prices: One (higher) offer price that is used in the primary FCA when the MOPR is applied (possibly after IMM review), and a second (lower) offer price that the new subsidized resource prefers to submit for the substitution auction, where the MOPR is not applied.

Table 1

Resource Name	Offer Type	Offer Price with MOPR ($/kw-mo)	Preferred (Subsidized) Offer Price ($/kw-mo)	Offer Capacity (MW)
E1	Existing Supply Offer	$4	-	300
E2	Existing Supply Offer	$5	-	175
R1	Retirement Offer	$6	-	50
R2	Retirement Offer	$7	-	100
S1	New Supply Offer	$9	$0	50
S2	New Supply Offer	$10	$2	75
S3	New Supply Offer	$11	$4	50

Low-cost existing supply

Two old, high-cost units that would retire without capacity revenue

Three new subsidized units have high offer prices due to MOPR

The Primary FCA Results

The process for clearing the first stage of the FCA is equivalent to how this auction is run today. In this example we will set aside the mechanics of the Descending Clock Auction bid-collection process, and assume that bid-collection process has completed and produced the final resource offer prices shown in Table 1 above. (The DCA is not important to this example.) This allows us to depict the primary FCA's clearing price using a familiar FCA supply and demand diagram.

Figure 1 shows the supply offer prices for all the resources in Table 1, stacked in ascending price order to form the market-level supply curve. Similarly, we show an (illustrative) convex system capacity demand curve for the FCA. The FCA clearing price in this example is $8/kW-month, and the total cleared capacity supply is 625 MW.

In this example, all resources submitting de-list bids (shown in blue) or priced retirement bids (shown in red) acquire CSOs in the primary FCA. However, the new subsidized resources (shown in green) that have high offer prices due to the application of the MOPR in the primary FCA come in above the market clearing price, and are therefore not awarded CSOs in the primary FCA.

Figure 1

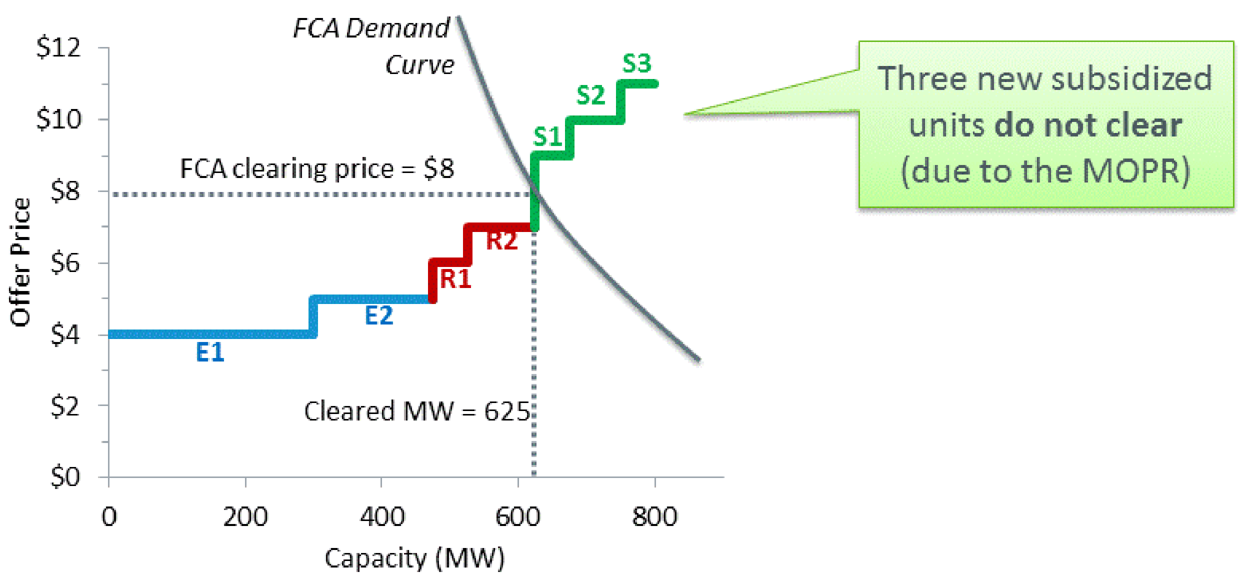


Table 2 summarizes the resource-level outcomes of the primary FCA. Note that, because the capacity clearing price exceeds the priced retirement bids of resources R1 and R2, both of these resources retain their existing capacity obligations in the primary FCA. All of the resources with cleared capacity offers (viz., E1, E2, R1, and R2) are credited at the primary FCA clearing price of $8 for each kW-month of capacity obligation awarded. The monthly primary FCA capacity payments shown in the last column in Table 2 are equal to the product of the cleared capacity MW and capacity clearing price (note this value is multiplied by 1000 to convert the cleared capacity from MW to kW). Because subsidized resources S1, S2, and S3 do not acquire CSOs in the primary FCA, they receive no capacity market revenue in the primary FCA stage.

For later purposes, it is worth noting that Table 2 shows that the total capacity payments (i.e., the charges to load) for the primary FCA are $5 million per month.

Table 2

Resource Name	Offer Type	Clearing Price ($/kw-mo)	Cleared Capacity (MW)	Resource Payment ($/mo.)
E1	Existing Supply Offer	$8	300	$2.4M
E2	Existing Supply Offer	$8	175	$1.4M
R1	Retirement Offer	$8	50	$400K
R2	Retirement Offer	$8	100	$800K
S1	New Supply Offer	$8	-	-
S2	New Supply Offer	$8	-	-
S3	New Supply Offer	$8	-	-
Auction Totals			625	$5.0 M

Awarded obligations (E1, E2)

Awarded obligations (R1, R2)

Do not clear primary FCA (S1, S2, S3)

The Substitution Auction Results

The substitution auction is run immediately after the primary auction, and allows capacity to be transferred from existing resources with retirement offers that retained an obligation in the primary FCA to new subsidized resources that did not receive an obligation. Existing resources without retirement bids are not eligible to participate in the substitution auction, because their capacity could re-enter the FCM in future auctions if they do not retain a CSO at the conclusion of the FCA's second stage.

Table 3 shows the supply offers from the new subsidized resources in the substitution auction. Here, no MOPR applies. Thus, the supply offer prices shown in Table 3 match the 'preferred' offer prices, without a MOPR, originally shown for the new subsidized resources in Table 1. Because the subsidized new resources did not clear in the primary FCA, they are able to offer the same unobligated capacity MW into the substitution auction.

Table 3

STAGE 2 – SUPPLY OFFERS

Resource Name	Offer Price without MOPR ($/kw-mo)	Offer Capacity (MW)
S1	$0	50
S2	$2	75
S3	$4	50

Table 4 shows the demand bids for the substitution auction, for resources R1 and R2. Each of these two resources, which submitted priced retirement bids, obtained a capacity supply obligation in the first stage. These resources do not have any unobligated capacity and therefore cannot sell additional capacity in the substitution auction. However, they can shed (transfer) the obligations retained in the primary FCA in the substitution auction.

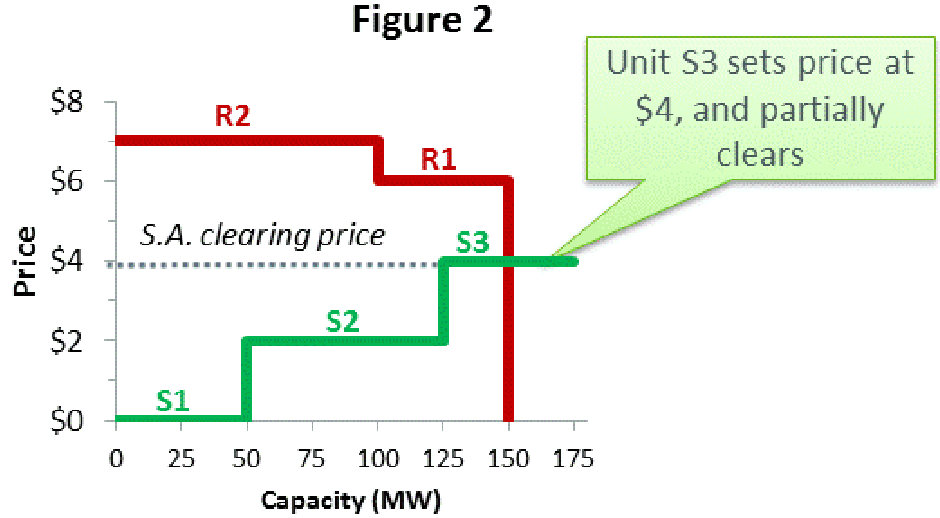
Table 4
STAGE 2 – DEMAND BIDS

Resource Name	Bid Price ($/kw-mo)	Bid Capacity (MW)
R1	$6	50
R2	$7	100

The bid price entered for each of these resources in the substitution auction is the same as the offer price entered for each resource in the primary FCA; in a competitive market, that now represents the highest price at which the resource can (profitably) 'buy out' its obligation in the substitution auction. Each resource's bid capacity on the demand side of the substitution auction is the CSO MW it retained in the primary auction.

The substitution auction clearing price and awards are shown in the supply and demand graph in Figure 2 below. The supply stack (in green) shows the offers from Table 3, in ascending price order, for the new subsidized resources (when no MOPR applies). The demand curve (in red) shows the retirement bid prices from Table 4, in descending price order, for the existing resources eligible to participate in the substitution action on the demand side.

Figure 2



As usual, the substitution auction clearing price and quantity are set where the supply and demand curves intersect. In this example, the substitution auction clearing price is set by new subsidized resource S3, at $4/kW-month. Total cleared capacity in the substitution auction is 150 MW.

The subsidized new resource supply offers below $4 are cleared (acquire CSOs), as these resources (S1 and S2) have indicated they are willing to take on an obligation for a capacity payment at less than this clearing price. Importantly, resource S3 is the marginal offer and only clears 25 MW of its 50 MW of qualified capacity. That is the proper clearing outcome to ensure that aggregate cleared supply and demand are equal, leaving the total system capacity unchanged from the primary FCA (and system reliability unchanged from the primary FCA).[14] The uncleared (that is, unobligated) remaining 25 MW of S3's qualified capacity will continue to be eligible to participate, as new subsidized capacity, in the primary and substitution auctions the following year (and until it finally clears as new, or elects to no longer offer into the FCA).

The $4/kW-month clearing price applies to all capacity bought and sold in the substitution auction. This means that all demand bids priced above $4 (which is all of R1 and R2's capacity) shed their obligations at a price that is less than their true cost of retaining their obligations (i.e., their indifference prices). This results in a net payment to each retiring resource, as shown next.

Substitution Auction Awards and Payments

Table 5 summarizes the resource-specific substitution auction payments for the newly-acquired capacity obligation of the three new subsidized resources in the substitution auction. For example, because resource S1 acquired a 50 MW capacity obligation at the substitution auction clearing price of $4/kW-month, it will receive a payment of 50 MW × $4,000/MW-month = $200,000/month.

Table 5

SUPPLY

Resource Name	Offer Price without MOPR ($/kw-mo)	Offer Capacity (MW)	Cleared Capacity (MW)	S.A. Clearing Price ($/kw-mo)	Credit (Charge) ($/mo.)	Comment
S1	$0	50	50	$4	$200K	Fully clears
S2	$2	75	75	$4	$300K	Fully clears
S3	$4	50	25	$4	$100K	Partially clears
Auction Totals			150		$600K	

[14] By holding aggregate quantity fixed in the substitution auction in this one-zone example, system reliability is not impacted. However, when the design is generalized to include multiple capacity zones, an incremental MW may not provide the same reliability value across all zones. In such cases, the substitution auction may allow the total system capacity level to change slightly to reflect these different reliability values. An example showing how the substitution auction is cleared when there are multiple zones is provided in the Appendix.

Similarly, Table 6 shows the substitution auction settlement for the two retiring resources that shed their obligations in the second stage.

Table 6

DEMAND

Resource Name	Bid Price ($/kw-mo)	Bid Capacity (MW)	Cleared Capacity (MW)	S.A. Clearing Price ($/kw-mo)	Credit (Charge) ($/mo.)	Comment
R1	$6	50	–50	$4	($200K)	Fully clears
R2	$7	100	–100	$4	($400K)	Fully clears
Auction Totals			–150		($600K)	

Tables 5 and 6 directly reveal three important properties of the substitution auction design. First, the total capacity supply acquired by the new subsidized resources in Table 5 is 150 MW, and is equal to the total capacity shed (transferred) by the now-retiring resources in Table 6. Second, because the substitution auction is settled at a uniform clearing price, the total payments to the resources acquiring obligations are covered by the total payments from the retiring resources that shed their obligations.[15]

Importantly, there is no substitution auction settlement for the existing resources that did not modify their positions (i.e., CSO MW) in the substitution auction.

Total Capacity Market Settlements

At noted at the outset of this paper, the total settlements for the two-stage auction process follow the well-established logic of a two-settlement market design for sequential markets. Under a two-settlement structure, resources that first take on an obligation in a forward market are credited at that market's forward price. They are then further paid (or charged) for any deviations from their initial forward market positions (i.e., obligations) in the balancing, or secondary market, at that secondary market's clearing price. In this context, the primary FCA represents the forward market, and the substitution auction represents the secondary market.

Table 7 summarizes sequential and final settlements and capacity awards after both the primary FCA and the substitution auction. Stepping through the results in this settlement table for resource R1 is informative. Resource R1 clears (acquires an obligation of) 50 MW in the primary FCA, at a capacity clearing price of $8/kW-month. It is therefore paid (credited) the product of this forward obligation MW and the applicable market clearing price of $8/kW-month, or $400,000/month (note the factor of 1000 to convert from kW to MW in calculating payments). In the substitution auction, resource R1 sheds (transfers, or 'buys out') its capacity obligation, producing a deviation of –50 MW in the secondary market from its initial obligation (note the negative sign convention when

[15] As noted earlier, the net cleared supply and shed demand in the substitution auction are equal when there is no price separation between zones in the primary FCA. However, when capacity's marginal reliability impact differs across zones, these values may differ because the substitution auction will clear supply offer and demand bids to ensure that total system reliability is not adversely impacted.

obligations are shed). It therefore is charged, in the substitution auction settlement, an amount equal to the product of its –50 MW deviation and the substitution auction clearing price of $4/kW-month, or –$200,000/month.

Table 7

Resource Name	FCA Clearing Price ($/kw-mo.)	FCA Cleared (MW)	FCA Credit ($/mo.)	S.A. Clearing Price ($/kw-mo.)	S.A. Cleared (MW) (deviation from FCA)	S.A. Credit (Charge) ($/mo.)	Final Capacity Obligation (MW)	Final Auctions Payment ($/mo.)
E1	$8	300	$2.4M	$4	-	-	300	$2.4M
E2	$8	175	$1.4M	$4	-	-	175	$1.4M
R1	$8	50	$400K	$4	–50	($200K)	-	$200K
R2	$8	100	$800K	$4	–100	($400K)	-	$400K
S1	$8	-	-	$4	50	$200K	50	$200K
S2	$8	-	-	$4	75	$300K	75	$300K
S3	$8	-	-	$4	25	$100K	25	$100K
Auction Totals		625	$5.0 M		0	$0	625	$5.0 M

Taken together, the total capacity payment to retiring resource R1 is the sum of its primary auction and secondary auction credits and charges. This adds up to a net payment of $400,000 – $200,000 = $200,000/month for resource R1. Resource R1 exits the two-stage FCA with no capacity supply obligation, and as such has one final obligation: to retire. However, it receives a net payment – akin to a severance plan payment – for exiting and creating 'space' for 50 MW of new subsidized capacity resources to take its place in the FCM going forward.

► **Discussion.** Who actually pays what, in the end, to enable these transfers and the net payment to the retiring resources? The logic of these settlements involves several simple steps. First, the provider of the subsidy enables the new subsidized resources to take on capacity obligations at less than the subsidized resources' true cost. That, in turn, enables a high-cost existing resource like R1 to transfer its capacity obligation to a subsidized resource for a price ($4/kW-month, in this example) that is less than the existing resource's cost of retaining it (a cost of $6/kW-month for R1, in this example). The retiring resource transfers its entire CSO MW to the new subsidized resource, but – and here's the important part – it does *not* transfer its entire FCA revenue to the new subsidized resource. Instead, it only transfers a portion of the revenue it was awarded in the primary FCA. The portion it transfers is determined by supply and demand in the substitution auction – in this example, it is determined by the unmitigated $4/kW-month offer price submitted by marginal resource S3 that sets price in the substitution auction. Retiring resource R1 therefore transfers $4 for each kW-month of obligation it sheds to the new subsidized resource(s) that acquires its obligation, and keeps the other $4/kW-month ($8 – $4) of its primary auction revenue as its net payment for voluntarily agreeing to permanently retire.

► **Interpretation.** On first blush, this settlement outcome may strike some as slightly *un*settling. That is, why should a retiring resource earn a net payment for a future delivery year in which it will have no remaining capacity obligation? Like all good settlement systems, the answer lies in the incentives it provides. Specifically, it provides properly-aligned incentives for the initially-awarded resources to subsequently transfer their positions to lower-cost suppliers in the second of two sequential markets.[16] If resources R1 and R2 did not earn a net payment for permanently exiting the capacity market, they would instead prefer to retain their obligations and receive the primary FCA clearing price even though the capacity can be provided at lower cost by subsidized new resources.

An analogy to the ISO's energy markets is useful here. One can think of the foregoing numerical example as analogous to the day-ahead and real-time energy markets. The relevant analogy is the case where one set of resources (think of S1-S3) has high costs in the day-ahead forward market, but is able to re-offer at a much lower cost in the real-time energy market. In the energy markets this is usually due to fuel cost factors rather than buyer-side mitigation as in the FCM, but the settlement logic is the same despite that market-driver difference. Imagine, for a moment, that there are seven suppliers that offer energy into the day-ahead energy market, with the same market clearing outcomes as in Figure 1. Resources S1-S3 have high costs and do not clear in this day-ahead market analogy, because (say) they have high expected operating costs day ahead.

In real-time, however, resources S1-S3 face lower operating costs than they anticipated day-ahead, and so reoffer in the real-time energy market at lower offer prices than some other suppliers that cleared in the day-ahead market. In this situation in the energy market, the now lowest-cost units S1-S3 would be dispatched up, and the higher-cost units R1 and R2 would be dispatched down, relative to their day-ahead positions – effectively, transferring planned production *from* R1 and R2 (which were paid the day-ahead price, and now buy-out at the real-time price) and *to* production by S1, S2, and part of S3 (which are now paid the real-time price – the market in which they first clear). Reflecting the availability of lower cost suppliers S1-S3, the real time energy price would also be lower than the day-ahead price, yielding a net payout to the resources that sold energy in the forward market before buying out in the secondary market (or R1 and R2).

Now, back to the 'who-pays-what' question posed earlier: It is useful to note that, much like in the energy market, the ultimate consumer is generally indifferent to this reallocation of obligations in the secondary market. Its total costs are established in the forward market, where it buys capacity (in the primary FCA) or most energy (in the day-ahead energy market). To see this directly, return to the example in Table 7, and note that the total cost of all payments incurred by consumers remains only $5 million in the final settlement column. That is, there are no additional charges or credits to loads resulting from the substitution auction in this example; loads' payments are (generally) the same as initially established when the primary FCA clears.[17]

[16] Stated more precisely, this allows the most cost-effective set of transfers of capacity supply obligations from existing resources that permanently exit the market to subsidized new resources.

[17] This conclusion can vary slightly in more general cases with constrained capacity zones. When there is congestion across two different capacity zones, and the reallocation in the substitution auction occurs across a congested interface, there will generally be a slight change in the total MW of capacity in the system and therefore a possible change in the total payments by loads. This occurs in the FCM under the new MRI-based congestion-pricing zonal demand curves if the substitution auction's transfers are at not executed at a strict 1 MW for 1 MW basis (which may be necessary to leave overall reliability unchanged). Conceptually, this is

4. Important Properties

Because the substitution auction design is based on sound economic principles and the familiar logic of two-settlement markets for sequential auctions, it has a number of beneficial properties. We first review how this solution approach achieves its principal design objectives, and then discuss a number of additional important properties.

► **Principal Design Objectives.** Although it is straightforward, it is nonetheless useful to note how and why the substitution auction satisfies the four principal design objectives set out in Section 2 of this paper.

1. **Competitive capacity pricing**. The design produces a competitive capacity market price in the first stage of the FCA that is not undermined by subsidized new resources. This price is paid to all competitive suppliers that receive capacity obligations. Importantly, the substitution auction design closely coordinates the MW of (subsidized) new resources that enter the market over time with the exit of (unsubsidized) resources. That is essential to prevent the primary FCA from suffering progressive price declines over time as new subsidized resources acquire capacity obligations and then become existing capacity resources (which are not subject to the MOPR) in subsequent primary auctions.

2. **Accommodate the entry of subsidized new resources into the FCM over time**. The substitution auction allows subsidized new resources to obtain capacity supply obligations in a transparent auction venue without application of the MOPR. Entry occurs over time, since subsidized new resources may not acquire capacity obligations in years with insufficient demand (retirement bids) or if the subsidized resources' offer prices are too high. Nonetheless, their coordinated entry – by virtue of being matched with the permanent exit of existing resources – helps reduce the potential for the power system to have (and consumers to pay for) more total resources than the ISO requires to reliably operate it.

3. **Avoid cost shifts**. The substitution auction transfers obligations from retiring resources to subsidized new resources. As shown in the numerical example, it is the subsidy provider's out-of-market revenue that ultimately permits retiring resources to receive net payments for voluntarily agreeing to exit and enabling new subsidized resources to acquire their obligation. In this way, consumers in one state are not directly bearing the costs of another state's public policy to subsidize its preferred new generation resources.

4. **A transparent, market-based approach**. The substitution auction employs sound economic concepts and extends, rather than upends, the region's existing capacity market framework. It avoids relying upon administrative parameters whose appropriateness may not persist as

---

broadly analogous to the energy market outcomes when real-time re-dispatch across a congested interface can produce a change in total congestion revenue from day-ahead that cannot be balanced strictly among the generators party to the real-time redispatch (in the energy markets, this real-time settlement imbalance currently flows to FTR holders). Although such situations should be conceptually familiar, the details can quickly become complex; we address this in more detail in the Appendix.

the system evolves, and therefore can be expected to continue to function properly even as state policies and market fundamentals evolve over time.

In addition to its core design principles, the substitution auction approach provides a number of other positive attributes.

► **Feasibility.** Because the substitution auction approach builds upon the existing FCM design, it should be technically straightforward for the ISO to implement. That should enable it to be implementable in the near-term (namely, for FCA 13 in February 2019).

► **Technology Neutral.** The substitution auction rules are technology neutral: there are no limits to the resources that can participate as based on technology types. No rules are envisioned, or necessary, governing which (current or possible future) technologies should be eligible to participate in the substitution auction.

► **Carbon Emissions Implications.** Although this approach to accommodating subsidized new capacity resources into the FCM is not designed to achieve states' carbon emission reduction goals directly (which is a separate, longer-term IMAPP discussion), it will likely help that cause indirectly. As new subsidized (non-emitting) resources enter the market, the resources that elect to retire sooner are likely to be among the older, less-efficient, and higher-emitting units in New England's power system. For this reason, this substitution design might reasonably be viewed as an auction-based "cash for clunkers" market design.

► **Solves Problematic Issues in Prior Proposals.** Unlike several solution concepts discussed during the IMAPP sessions in 2016, this proposed design avoids the complications of how to handle so-called 'in-between' resources that arise in other ('two-tiered') capacity market design approaches. Because a substitution auction implements a two-settlement transfer of supply obligations, it creates no 'in-between' resources and no need for various specialized (pro-rationing) rules that can give rise to inefficient bid inflation and complications in subsequent reconfiguration auctions.[18]

► **Facilitates Self-Supply.** The substitution auction design may help market participants that self-supply in the FCM, if those participants subsidize new self-supply resources that do not clear in the FCM due to the MOPR.[19] Stated differently, supply participation in the substitution auction would not be limited to resources subsidized through state-directed mechanisms, but would accommodate on equal terms a resource subsidized by another subsidy provider (such as a municipality, for example).

[18] For further explanation and analyses of the 'two-tier' pricing approaches discussed in the 2016 IMAPP sessions, see the ISO's Discussion Paper *2016 NEPOOL IMAPP Proposals* (January 25, 2017), pp. 15-18, available at https://www.iso-ne.com/static-assets/documents/2017/03/iso-ne_jan_2017_imapp_memo_vtransmit2.pdf.

[19] Under FCM rules, acquiring a CSO is a requisite for a load-serving entity to have its capacity load obligation charges offset by capacity supply obligation credits, i.e., to self-supply.

5. Additional Elements of the Proposal

Two important elements of the substitution auction design merit further discussion and explanation: the Renewable Technology Resource exemption from the MOPR, and the treatment of competitive (i.e., unsubsidized) new supply within the substation auction framework. We address each in turn.

Renewable Technology Resource Exemption

The proposed design serves as a replacement for the existing Renewable Technology Resource (RTR) administrative exemption from the MOPR, which was introduced in FCA 9 (conducted in 2015). Instead, the substitution auction would serve as the primary vehicle by which new renewable resources receiving out-of-market subsidies would enter the capacity market. This replacement improves the existing rules in two ways. First, the substitution auction can accommodate a broader range of new technology resources than are allowed under the current RTR exemption. Specifically, because the substitution auction is technology neutral, it accommodates the entry of many current and future subsidized technologies that may not meet the existing renewable technology criteria (such as large scale hydro, battery storage technologies, or other future innovations that state policy makers may seek to develop).

Second, unlike the existing RTR exemption, the substitution auction is a market-based approach that will accommodate greater subsidized new entry whenever doing so will not depress capacity market prices – the same supposition that underlay the ISO's original rationale for the RTR exemption.[20] More specifically, if numerous resources submit retirement bids or permanent de-list bids, the substitution auction can accommodate the entry of more new subsidized resources than the existing RTR exemption (which is limited to 200 MW annually, with a 600 MW cumulative catch-up provision). The actual number of MW of new subsidized resources that may acquire capacity obligations each year in the substitution auction will depend on their (unmitigated) offer prices, as well as the number of MW of existing resources that clear in the primary FCA and are willing to retire (given the new incentives to do so). This is an appropriate outcome, as it preserves competitively-based capacity prices in the primary FCA by matching the pace at which subsidized new resources enter the capacity market to the rate at which existing resources exit.

At a broader level, in developing the substitution auction design, the ISO is striving to create a market-based solution to accommodate increasing amounts of new subsidized resources in the FCM – and not to create (or perpetuate) inflexible and indefinite exceptions to the market rules. Because the substitution auction is technology neutral and has no pre-set administrative limit, this market-based approach can achieve its principal goals as market conditions and state policies continue to evolve over time.

[20] "As ISO-NE explains, while exemptions in general can lower prices, the exemption proposed here is coupled with a sloped demand curve that will limit the impact of price suppression as compared to the existing vertical demand curve." *Order Accepting Tariff Revisions,* 147 FERC ¶ 61,173 at P. 83 (2014).

The Substitution Auction and Unsubsidized New Capacity

The substitution auction is designed to coordinate entry and exit in the FCM among two specific sets of resources: subsidized new resources (entering), and existing capacity resources (exiting). The exchange of obligations among these resources (in consideration of payment at the substitution auction clearing price) gives rise to a natural interpretation of the design as a 'cash for clunkers' secondary market.

There is another set of resources that could potentially participate in the substitution auction, however: competitively-offered (that is, *unsubsidized*) new capacity supply. Since these resources have no subsidy, the pertinent design question is whether new unsubsidized resources that acquire capacity obligations in the primary FCA should then participate on the *demand* side of the substitution auction. Incorporating new unsubsidized capacity supply offers that clear in the primary FCA into the demand side of the substitution auction might seem a straightforward process (at least mechanically), but on closer review presents a number of significant issues. We explain our proposed treatment, and rationale, of these issues next.

► **The Fictitious Entry Problem.** A significant concern with allowing new unsubsidized capacity resources (that clear in the primary FCA) to participate as demand in the substitution auction is that it may spur low-priced new supply offers from participants that have no intention of fulfilling their obligations. For example, consider the situation when a significant amount of new *subsidized* resources are known or expected to participate on the supply side of the substitution auction. An *unsubsidized* new capacity resource that remains in the descending-clock auction just long enough to clear in the primary FCA has a new profit potential, even if it never intends to deliver capacity: by entering the demand-side of the substitution auction, it can earn a profit equal to the difference between the (higher) primary FCA and the (lower) substitution auction clearing prices. Moreover, it could continue to profitably do so year after year, as long as states continue to create new subsidized supply.[21]

We call this the 'fictitious entry' problem, because it creates an entry incentive (into the FCA) for supply offers by participants that never intend to, and may not be capable of, fulfilling their obligations during the capacity commitment period. The fundamental problem with fictitious entry is that, when it occurs, it will be attractive to many. The injection of new supply offers from fictitious entrants effectively shifts the primary FCA's supply curve down, lowers the primary FCA's clearing price, and may significantly undercut Design Objective 1.[22]

In addition, there are less-disconcerting behaviors that can hamper Design Objective 1 if new unsubsidized resources participate in the substitution auction. For example, if a competitive new

[21] This potential is more pronounced for some new resource types than for others, given differing FCM qualification requirements and Offer Review Trigger Prices.

[22] In equilibrium, it can be shown that this behavior will lead the market to 'unravel' to the point where the clearing price and quantity in the primary FCA are the same as would occur if no MOPR provision was in place and all subsidized new capacity was able to participate in the FCA as price takers (thus Design Objective 1 fails).

resource clears in the primary FCA before being bought-out in the substitution auction, its capability does not, in any tangible sense, 'permanently exit' the capacity market. Rather, the competitive new resource may treat the buy-out as a one year (paid) deferral, and submit a similarly-priced new capacity supply offer in the following year's FCA (or, alternatively, in a reconfiguration auction for the original commitment period). This may lead total cleared capacity to increase, clearing slightly lower on the capacity demand curve in the primary FCA and undermining Design Objective 1.

► **Caveats and Further Considerations.** The most effective means to avoid these problems is to limit demand-side participation in the substitution auction to existing capacity resources. That is consistent with the 'cash for clunkers' simplicity of the substitution auction design overall.

Nonetheless, precluding new unsubsidized resources from participating in the substitution auction (on the demand side) also introduces design issues. Imagine, as before, that a significant amount of new *subsidized* resources will participate on the supply side of the substitution auction, and imagine that these resources are already under development (so much of their fixed costs are sunk). Further, assume that few or no retirement bids are submitted by existing capacity resources in the FCA. If a new competitive (unsubsidized) capacity resource clears in the primary FCA, but is not entered into the demand-side of the substitution auction, then the market procures a new yet-to-be-developed competitive capacity resource in addition to the subsidized resources in development. Stated in terms of design objectives, including new unsubsidized supply offers (that clear in the primary FCA) in the demand side of the substitution auction can help meet Design Objective 2 – and, in certain situations, help avoid inefficiently duplicating the sunk costs of developing new generation resources.

► **Settlement Rule Solutions.** It is far from certain how likely or often such situations may occur. Nonetheless, after careful consideration of this issue, our conclusion is that if new unsubsidized capacity that clears in the primary FCA is entered into the demand side of the substitution auction, a modified settlement rule would be required to prevent the fictitious entry problem.

The simplest, and likely highly effective, modified settlement rule is that new unsubsidized capacity resources would not receive a net payment if they acquire an obligation in the primary FCA that is transferred to a subsidized new resource in the substitution auction. Under this treatment, a new unsubsidized capacity resource that acquires an initial capacity obligation in the primary FCA would be entered into the substitution auction on the demand side, also at its offer price – like existing resources with retirement bids that retain their obligations – but, if the obligation is transferred in the substitution auction, the new unsubsidized capacity would not be awarded the 'severance payment' in the FCA's settlement.

In effect, a new unsubsidized resource that is 'substituted out' in the substitution auction simply finishes the two-stage FCA with no capacity obligation, and no net payment. This modified settlement rule has a simple interpretation. In effect, it means that, if there is sufficient subsidized new capacity to 'cover' the MW initially cleared in the primary FCA by a competitive new resource, the competitive new resource will retain the capacity obligation after the substitution auction only if its offer price is below the *substitution auction's* clearing price.

This modified settlement rule has several benefits. First, it completely resolves the fictitious entry problem, since it eliminates a new unsubsidized resource's profit if it finishes the two-stage FCA without a capacity obligation. Second, entering the offers of new unsubsidized capacity into the substitution auction would effectively shift the substitution auction's demand curve to the right, which would allow subsidized new supply to acquire capacity obligations at a faster rate (that is, acquire obligations in an earlier commitment period than if they must await sufficient retirement bids). This helps to minimize the possible inefficiency (of duplicating sunk costs) noted previously.

Third, while existing resources with retirement bids and new competitive resources with supply offers that clear in the primary FCA and then shed their obligations in the substitution auction would receive different final payments, they are situated in a fundamentally differently way. The existing resource that sheds its capacity supply obligation in a substitution auction does have a final obligation, to permanently exit the FCM (thereby foregoing the option value of supplying capacity again in the market). A new unsubsidized resource that sheds its obligation in a substitution auction is effectively deferred for a year, as nothing precludes it from again offering its supply in a subsequent FCA (especially if there is no remaining subsidized capacity available in the substitution auction). The new unsubsidized resource is not permanently foregoing a potential stream of future forward capacity payments and, accordingly, does not receive a net 'severance payment' like the permanently retiring capacity resource.

►**Preserving Competitive Entry Incentives**. Finally, it is important to observe that the substitution auction design, including the modified settlement rule for new competitive (unsubsidized) supply offers, preserves the FCM's price signals and competitive entry incentives when new subsidized resources are limited or not available. In that situation, competitive new supply that clears in the primary FCA is not substituted out. Because the primary FCA continues to apply the MOPR like today, competitive new supply would receive a competitively-based clearing price both when it initially clears, and after its initial rate-lock expires; neither price is depressed by the (periodic) entry of new subsidized resources through the substitution auction. Under the current MOPR, the FCA's competitively-determined capacity price signals have successfully attracted considerable competitive new supply in several recent auctions when new supply was needed. Because the two-stage FCA design proposed here preserves these competitive price signals in the primary auction, it should be expected to continue to attract new supply resources cost-effectively whenever the system requires it and new subsidized supply is insufficient.

6. Continuing Efforts

The purpose of this paper is to propose a market design to address ISO and stakeholder concerns surrounding the future participation of new subsidized resources in the FCM. This proposal aims to enhance the existing capacity auction process, providing a productive path to maintain competitively-based capacity price signals in the FCM while accommodating the entry of new resources with out-of-market contract revenue into the FCM over time.

The ISO looks forward to discussing this design with stakeholders with the objective of modifying the capacity market rules to address these goals. We recognize that these changes will require a significant amount of time and effort from the region, and that these efforts are important to ensure the continued competitiveness of the capacity market structure that the region has adopted. We hope this paper is informative, and look forward to the opportunity to discuss these changes with stakeholders.

Appendix

Non-Rationable Demand Bids in the Substitution Auction

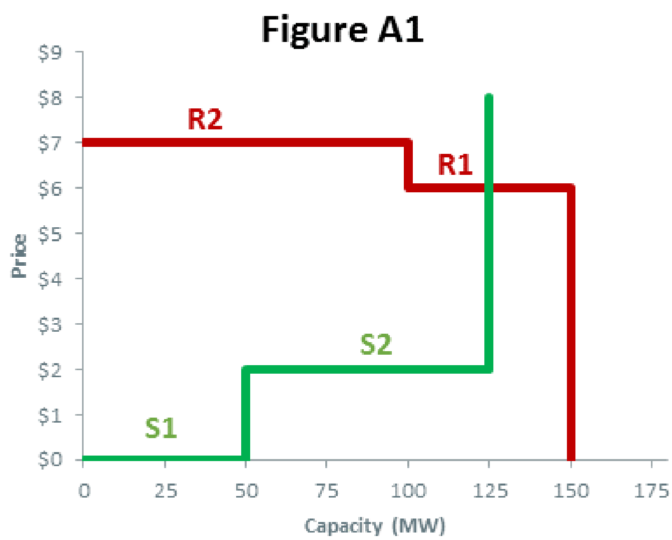
This section addresses how non-rationable offers from retirement resources will be cleared in the substitution auction, and the logic for this treatment. This issue does not affect the conceptual logic of the substitution auction or its primary features, but it is a technically important issue within the substitution auction clearing algorithm. We present it here using an extension of the numerical example discussed earlier in Section 3 of this paper.

In the earlier example, the substitution auction supply and demand curves intersect at a quantity of 150 MW along a horizontal segment of the supply curve and a vertical portion of the demand curve. Supplier S3 is the marginal unit and sets the substitution auction price at $4/kW-month. Because the proposal treats all capacity supply as fully rationable in the second stage, the substitution auction clears only a portion of S3's offer in that example to ensure that total cleared supply and demand are equal.

We now explore the clearing outcome when the substitution auction supply and demand curves cross at a MW quantity that corresponds to a vertical segment of the supply curve and a horizontal segment of the demand curve. Clearing is more complicated in such cases because if the 'marginal' demand bid is a retirement bid, it would typically be non-rationable (i.e., an all-or-none bid, as it may be impractical to partially shut down a generation facility). In such cases, the substitution auction cannot partially clear only a portion of the demand bid. We consider such a case now.

Imagine the same set of existing resource bids and priced-retirement bids as in the earlier example of Section 3. Furthermore, subsidized new suppliers S1 and S2 are assumed to have the same offers and parameters as in the earlier example. However, we will now assume that resource S3 no longer exists and therefore does not participate in the FCA or substitution auction. In this example, there is no change to the primary FCA awards or settlements, as the clearing price remains at $8/kW-month and resources E1, E2, R1, and R2 each clear capacity supply obligations for their entire qualified capacity.

However, this equivalence to the earlier example does not hold when we move to the substitution auction without S3. Figure A1 shows the new substitution auction supply and demand curves. Observe that the supply and demand curves now intersect at a quantity that would only partially clear R1's demand bid. Unlike in the earlier example, we cannot partially clear this demand bid if we assume (as we do here) that R1's retirement bid is non-rationable. As a result, we must determine whether the substitution auction should buy out R1's entire bid, or allow the resource to retain its entire obligation.



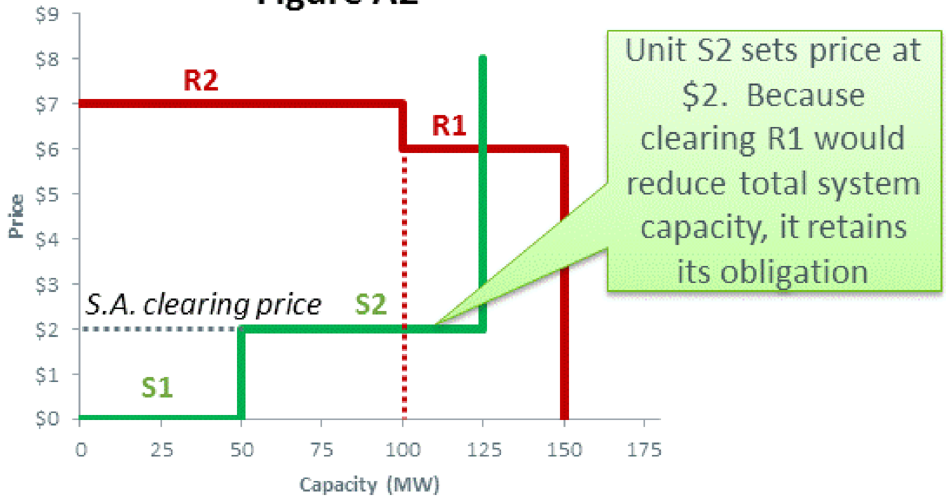
First, imagine that the substitution auction buys-out R1's entire bid. In this scenario, a total of 150 MW of capacity would permanently exit the market while only 125 MW of subsidized new capacity are available to enter. As a result, this would reduce the total obligated capacity in the system by 25 MW, adversely impacting system reliability. Such an outcome is problematic because it could allow existing resources to retire when a portion of that resource is needed to reliably operate the system (and ensure that aggregate capacity supply obligations, at the primary FCA clearing price, continue to lie on the marginal-reliability impact capacity demand curves).

Under the substitution auction, R1 would therefore retain its entire obligation to prevent the degradation of system reliability.[23] As a result, only R2 buys out of its obligation and a total of 100 MW permanently exit the market. The substitution auction would clear an equal quantity of subsidized supply to offset these 100 MW that are retired. In this case, S1 would clear its entire 50 supply offer and S2 would only clear 50 MW from its 75 MW supply offer (recall that its offer is treated as rationable). This would result in a total of 100 MW of subsidized new resources clearing to replace R2, and total system reliability would be unchanged.

When R1 is not cleared, S2 remains the marginal supplier, and therefore sets the substitution auction clearing price at $2 as shown in Figure A2.

[23] While not considered here, it is also important that the clearing rules account for a third scenario where there is a third subsidized supply resource, S3, which offers at a price that is greater than R1's demand bid. In such instances, the methodology must determine if the total change in social surplus associated with buying out R1 and clearing enough of S3 to keep system reliability constant would be positive (in which case R1 transfers its obligation and S2 clears all 75 MW while S3 also clears 25 MW) or negative (R1 keeps its obligation, S2 clears 50 MW and S3 does not clear). This is analogous to how non-rationable offers are cleared in the primary FCA currently.

Figure A2



Substitution Auction Clearing with Multiple Zones

This section addresses how the substitution auction clearing algorithm would account for multiple capacity zones that specify different capacity prices in the primary FCA. This issue adds complexity to the substitution auction clearing process, but it does not fundamentally change its core logic. We present a numerical example here that builds upon the numerical example discussed earlier in Section 3 of this paper, where there are now multiple capacity zones.

Imagine that we have the same set of supply offers, existing resource delist bids, and retirement bids as shown in Section 3's example earlier. However, we will now assume that some of these offers occur in the Rest-of-Pool (ROP) capacity zone, and others occur in an import constrained zone (ICZ). These offers are shown in Table A1 below, and specify each resource's capacity zone.

Table A1

Low-cost existing supply

Two old, high-cost units that would retire without capacity revenue

Three new subsidized units have high offer prices due to MOPR

Resource Name	Offer Type	Zone	Offer Price with MOPR ($/kw-mo)	Preferred (Subsidized) Offer Price ($/kw-mo)	Offer Capacity (MW)
E1	Existing Supply Offer	ROP	$4	-	300
E2	Existing Supply Offer	ICZ	$5	-	175
R1	Retirement Offer	ROP	$6	-	50
R2	Retirement Offer	ICZ	$7	-	100
S1	New Supply Offer	ROP	$9	$0	50
S2	New Supply Offer	ROP	$10	$2	75
S3	New Supply Offer	ICZ	$11	$4	50

As in the previous example, we assume that the all of the existing supply offers and retirement offers are awarded a capacity supply obligation in the primary FCA, and the new supply offers do not clear because their offer prices with the MOPR exceed the auction's clearing price in their zone. While the clearing price for the system is again assumed to be $8/kW-month, the sloped demand curves are assumed to produce a $2/kW-month congestion price in the ICZ to reflect that an increment of capacity in the import zone provides 25 percent more expected reliability than an increment of capacity in the ROP.[24] The total FCA price in ICZ is therefore $10/kW-month. These primary FCA settlements are summarized in Table A2 below.

Table A2

Resource Name	Offer Type	Zone	Clearing Price ($/kw-mo)	Cleared Capacity (MW)	Resource Payment ($/mo.)
E1	Existing Supply Offer	ROP	$8	300	$2.4M
E2	Existing Supply Offer	ICZ	$10	175	$1.75M
R1	Retirement Offer	ROP	$8	50	$400K
R2	Retirement Offer	ICZ	$10	100	$1M
S1	New Supply Offer	ROP	$8	-	-
S2	New Supply Offer	ROP	$8	-	-
S3	New Supply Offer	ICZ	$10	-	-
Auction Totals				625	$5.55 M

Awarded obligations (E1, E2)

Awarded obligations (R1, R2)

Do not clear primary FCA (S1, S2, S3)

While the primary FCA clears the same total capacity quantity of 625 MW, the total payments increase because E2 and R2 receive the higher $10/kW-month clearing price in the ICZ. This increases total costs by $550,000 per month, to $5.5 million per month.

The substitution auction follows the same general framework as previous examples, where resources R1 and R2 have demand bids submitted at their bid prices of $6 and $7, respectively. Furthermore, each of the three subsidized new resources submits a supply offer at its preferred offer price without a MOPR.

With multiple zones, clearing the substitution auction can no longer be illustrated using a supply and demand graph. Rather, the auction will clear the set of bids and offers that minimizes total production costs while holding system reliability fixed. In order to hold system reliability fixed, total capacity may need to change from its primary FCA quantity if the substitution auction transfers capacity between zones where its marginal reliability impact differs (that is, across a congested capacity interface).

[24] With the sloped demand curves introduced in FCA 11, a 25 percent price premium for an import zone will tend to correspond to capacity quantities where an incremental MW of capacity in the zone will also provide 25 percent more reliability than that in ROP. For a more detailed formulation of how reliability is measured and how the curves satisfy this property, see the ISO's December 7th, 2015 technical memo on the topic at https://www.iso-ne.com/static-assets/documents/2015/12/a09_iso_memo_12_07_15.pdf.

Tables A3 and A4 specify the results from the substitution auction, where we assume that, much like in the primary FCA, an incremental unit of capacity in the ICZ also provides 125 percent of the reliability of an incremental unit of capacity in the ROP.[25]

Table A3

SUPPLY

Resource Name	Zone	Offer Price without MOPR ($/kw-mo)	Offer Capacity (MW)	Cleared Capacity (MW)	Reliability Impact (MWh)	S.A. Clearing Price ($/kw-mo)	Credit (Charge) ($/mo.)	Comment
S1	ROP	$0	50	50	50	$3.20	$160K	Fully clears
S2	ROP	$2	75	75	75	$3.20	$300K	Fully clears
S3	ICZ	$4	50	40	50	$4.00	$160K	Partially clears
	Auction Totals			165	175		$560K	

Table A4

DEMAND

Resource Name	Zone	Bid Price ($/kw-mo)	Bid Capacity (MW)	Cleared Capacity (MW)	Reliability Impact (MWh)	S.A. Clearing Price ($/kw-mo)	Credit (Charge) ($/mo.)	Comment
R1	ROP	$6	50	–50	-50	$3.20	($160K)	Fully clears
R2	ICZ	$7	100	–100	-125	$4.00	($400K)	Fully clears
	Auction Totals			–150	-175		($560K)	

Observe that, unlike in the earlier examples, the total subsidized new capacity (165 MW) that clears in the substitution auction exceeds the capacity that permanently exits the market (150 MW). This increase in total system capacity is necessary to hold reliability constant because the substitution auction transfers capacity from the zone where it provides more reliability at the margin (ICZ) to the zone where it provides less reliability at the margin (ROP).

To get the specific new zonal substitution auction clearing prices, we need to evaluate if this 15 MW increase in total system capacity offsets the reliability impact associated with transferring the cleared capacity from ICZ to ROP. This is done with the reliability impact variable, shown in the sixth column of Tables A3 and A4. This variable indicates the decrease in expected unserved energy (measured in MWh, where a positive value improves reliability) associated with each resource's newly acquired capacity supply obligation or its retirement. For purposes of this example, we assume that an incremental MW of capacity in ROP decreases expected unserved energy by 1 hour (the actual values are determined by the ISO's published marginal reliability impact values for each FCA). Because capacity in the ICZ provides 125 percent more marginal reliability impact, an

[25] In reality, we may expect this relative value to change slightly when capacity is transferred between ROP and ICZ in the substitution auction. However, this modest change would not conceptually impact how the substitution auction determines the cleared supply offers and demand bids.

incremental MW in the import zone therefore decreases expected unserved energy by 1.25 hours.[26] The 'Reliability Impact' for each resource is equal to the product of its cleared capacity and the marginal reliability impact in its zone (1 hour in ROP, 1.25 hours in ICZ).

As shown at an aggregate level, the total decrease in expected unserved energy associated with adding the 165 MW of subsidized new capacity is 175 MWh annually. Similarly, the total increase in expected unserved energy that corresponds to the 150 MW of capacity retired in the substitution auction is 175 MWh annually. As a result, this exchange of capacity obligations in the substitution auction does not change system reliability.[27]

As in the previous example, resource S3 is partially cleared and therefore sets the substitution auction clearing price in the ICZ zone where it is located. Because all supply that is offered in ROP is cleared, and all demand bids in this zone shed their obligation, there is not an equivalent marginal resource in this zone that partially clears and sets price. However, recall that in the FCA, to ensure cost-effective outcomes, clearing prices between zones are proportional to capacity's marginal reliability impact between these zones.[28] That same property is applied here to ensure that the substitution auction clearing properly reflects the relative reliability value of capacity in different locations.[29] As a result, the ROP price is set to $3.20 to reflect that capacity in this zone provides 80 percent of that in ICZ (where 80% = 1 hour / 1.25 hours).

As with the earlier examples, consumers' total costs are not impacted by the substitution auction even though total cleared capacity increases. The majority of the subsidized resources taking on capacity obligations in the substitution auction are in the ROP, and therefore are paid the lower ROP clearing price of $3.20/kW-month; however, the majority of the MW that 'buy out' their obligations are in the ICZ and must pay the higher ICZ price of $4/kW-month to shed these obligations. This price difference causes the substitution auction's settlements to balance, and this balancing market simply transfers payments from the resources buying out of their obligation to the subsidized new resources that acquire obligations.

[26] The substitution auction's results would be unchanged if an incremental MW of capacity in the ROP instead reduced expected unserved energy by a different quantity of hours, as long as capacity in the ICZ continues to deliver 125 percent of the marginal reliability impact of capacity in ROP.

[27] This result can also be demonstrated by evaluating how the substitution auction changes the net capacity levels in each zone, and its relative marginal reliability impact between ROP and ICZ. More specifically, the total cleared capacity decreases by 60 MW in ICZ (adding 40 MW from S3, retiring 100 MW from R2) which increases the system's expected lost load by 75 MWh (= 60 MW × 1.25 hours). The 75 MW net increase of capacity in ROP (adding 50 MW from S1 and 75 MW from S2, retiring 50 MW from R1) reduces lost load by an equivalent 75 MWh (= 75 MW × 1 hour). This capacity transfer from ICZ to ROP therefore produces a net reliability effect of zero.

[28] See the derivation of equation (10) in the ISO's December 7th, 2015 memo at https://www.iso-ne.com/static-assets/documents/2015/12/a09_iso_memo_12_07_15.pdf.

[29] Applying this principle to the substitution auction ensures that it clears resources in a cost-effective manner.

Table A5 summarizes the two-settlement structure used to determine final capacity obligations and payments. As this table highlights, while total cleared system capacity increases by 15 MW, final payments are unchanged from those in the primary FCA, as shown in Table A2.

Table A5

Resource Name	Zone	FCA Clearing Price ($/kw-mo.)	FCA Cleared (MW)	FCA Credit ($/mo.)	S.A. Clearing Price ($/kw-mo.)	S.A. Cleared (MW) (deviation from FCA)	S.A. Credit (Charge) ($/mo.)	Final Capacity Obligation (MW)	Final Auctions Payment ($/mo.)
E1	ROP	$8	300	$2.4M	$3.20	-	-	300	$2.4M
E2	ICZ	$10	175	$1.75M	$4.00	-	-	175	$1.75M
R1	ROP	$8	50	$400K	$3.20	–50	($160K)	-	$240K
R2	ICZ	$10	100	$1M	$4.00	–100	($400K)	-	$600K
S1	ROP	$8	-	-	$3.20	50	$160K	50	$160K
S2	ROP	$8	-	-	$3.20	75	$240K	75	$240K
S3	ICZ	$10	-	-	$4.00	40	$160K	40	$160K
Auction Totals			**625**	**$5.55 M**		**15**	**$0**	**640**	**$5.55 M**