Competitive Auctions with Subsidized Policy Resources

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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

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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

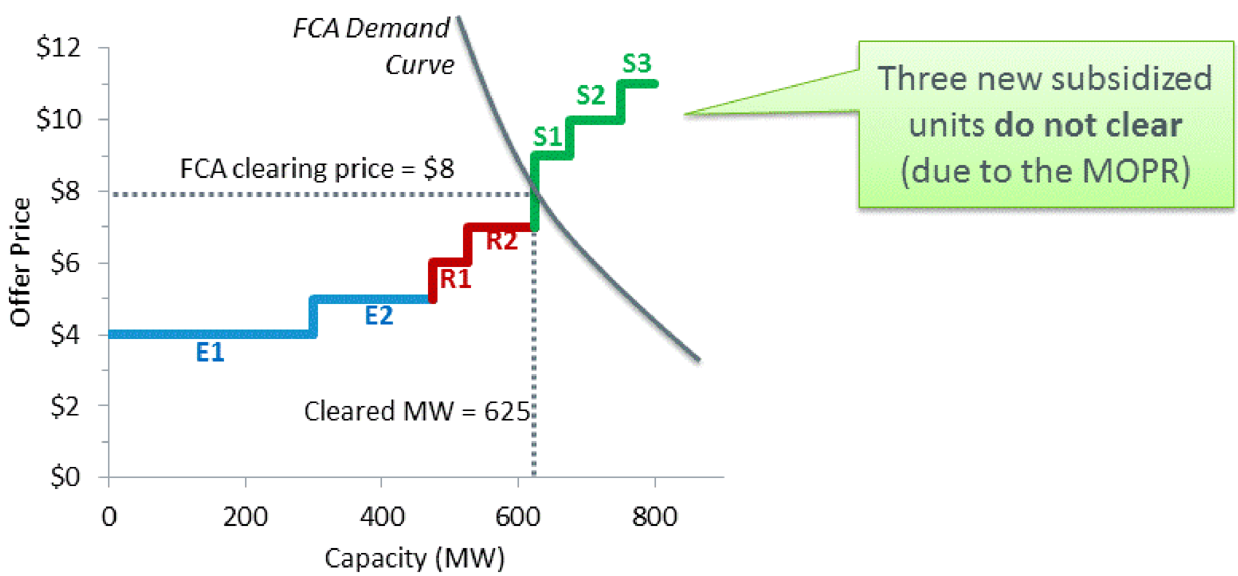


Table 2 summarizes the resource-level outcomes of the primary FCA. Note that, because the capacity clearing price exceeds the priced retirement bids of resources R1 and R2, both of these resources retain their existing capacity obligations in the primary FCA. All of the resources with cleared capacity 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

Awarded obligations

Do not clear primary FCA

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.

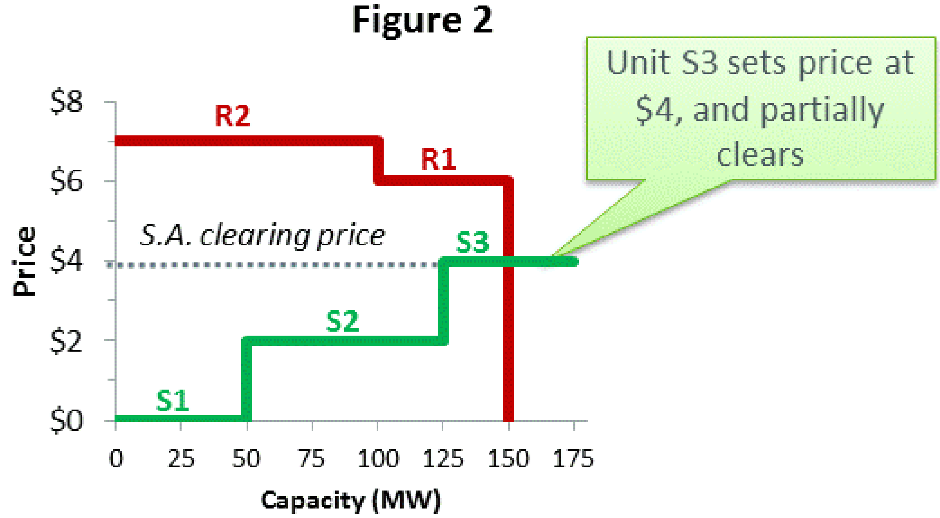
Table 4
STAGE 2 – DEMAND BIDS

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

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[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

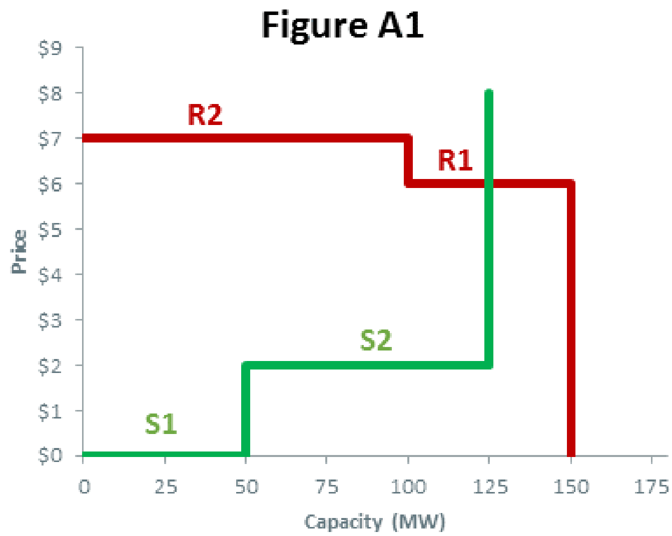
This section addresses how non-rationable offers from retirement resources will be cleared in the substitution auction, and the logic for this treatment. This issue does not affect the conceptual logic of the substitution auction or its primary features, but it is a technically important issue within 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.



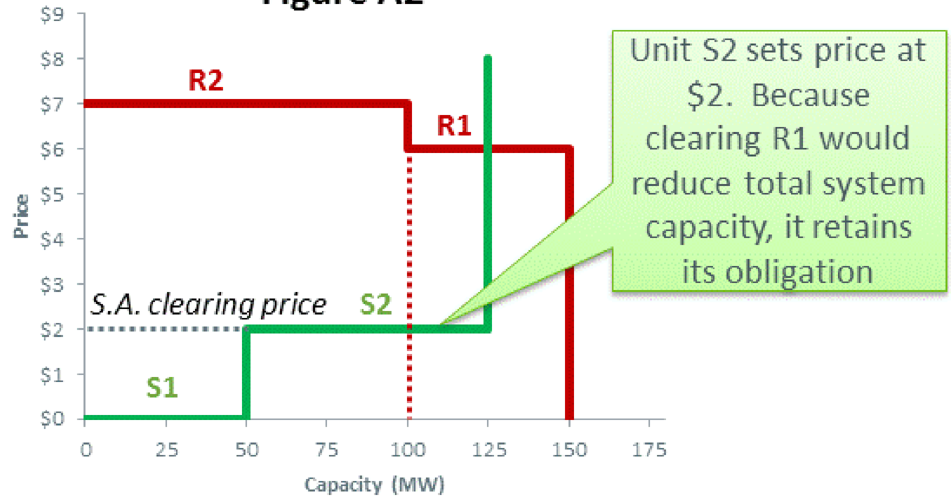
First, imagine that the substitution auction buys-out R1's entire bid. In this scenario, a total of 150 MW of capacity would permanently exit the market while only 125 MW of subsidized new capacity are available to enter. As a result, this would reduce the total obligated capacity in the system by 25 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

Awarded obligations

Do not clear primary FCA

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).

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[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