Forward Capacity Auction Formats

Questions and Answers

ISO Discussion Paper
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At the Forward Capacity Market (FCM) Descending Clock Auction forum held December 2, 2015 (the "December Forum"), stakeholders posed a range of questions to the ISO concerning the format of the Forward Capacity Auction (FCA) and its implications. This document is intended to be an informational guide on many of the topics broached during the last forum, in order to facilitate productive discussions with stakeholders about the future format of the FCA.

In general, the broad range of questions posed at the December Forum can be usefully arranged in two groups: (1) **Direct consequences** of the FCA format, such as questions about bidding strategies during the auction or the role of the FCA's market clearing engine; and (2) **Indirect consequences** of the FCA format, such as its effects on pre-auction activities such as bid/offer reviews by the IMM, the timing of reliability studies, various process-related deadlines leading up to the auction, and so on. This discussion is similarly organized in two parts. One part addresses questions concerning the direct consequences of the auction format, and the second part addresses questions concerning indirect consequences of the auction format.

As a summary matter, the ISO is not opposed to a change in the future format of the FCA from a Descending Clock Auction (DCA) to a Sealed Bid Auction (SBA). As discussed in greater detail below, the ISO does not view such a format change as likely to have a significant direct impact on future FCA results, though changes in the format could have indirect consequences for pre-auction processes. The ISO would need to perform a more detailed assessment of the potential impacts on other project priorities and the scope of work involved before it would be in a position to address the timing of a possible formal stakeholder process for FCA format-related changes.

We look forward to stakeholder feedback and further discussion on these issues.

I. Preliminaries: Pros and Cons of Alternative Auction Formats

A. Key Features of Auction Formats

Before turning to details, it is useful to summarize the key features of three auction formats central to the present discussion: pure Descending Clock Auction (DCA), pure Sealed Bid Auction (SBA), and the ISO's current "hybrid DCA" format. After explaining the key features, we compare and contrast the main pros and cons of these formats.

Pure DCA format. In a pure DCA format, auction participants observe the exact price levels at which their competitors exit the auction. As the clock ticks down continuously from the starting price to lower price levels, the auction continues until the total supply that remains in the auction equals (or falls immediately below) total demand. All participants therefore observe the supply 'curve' above the market-clearing price during the course of the auction and can react to others' exit decisions as the auction proceeds.

Generally, pure DCA format auctions are preferred in settings where (a) the auction participants face considerable uncertainty over their future cost of delivering the goods they sell at auction (or, if the auctioneer is a seller, the bidders face uncertainty over the value of goods they are buying); and (b) there are a large number of potential bidders, relative the quantity to be awarded, at auction. Outside of electricity markets, DCAs are used in various financial auctions when there are many bidders but the value of the assets being auctioned is highly uncertain. For examples, the US Treasury has used the DCA format for some of its multi-billion dollar bond auctions, and corporations use similarly-structured clock auctions for share repurchases (stock buybacks) and, on occasion, initial public offerings (IPOs).[1]

Pure SBA format. In a pure SBA format, all participants submit irrevocable "final and best offer" (or FABO) bids/offers to the auctioneer by a common deadline. The auctioneer then uses a mathematical algorithm, consistent with the auction's formal objective function, to determine the market-clearing price and to determine which bids/offers are cleared. When auctions are designed to promote market efficiency, the formal objective function is to maximize social surplus (this objective is already consistent with the ISO's current Tariff rules for clearing the FCA).

Generally, pure SBA format auctions are preferred in settings where (a) the auction participants accurately know their future cost of delivering the goods they offer today at auction (so bidders rarely make 'mistakes' by selling at a price below their cost to deliver the goods, as occurs when their future costs are uncertain), and (b) there are few potential bidders, relative to the quantity to be awarded at auction. Outside of electricity markets, government procurement auctions for highly specialized goods (e.g., satellites, bridges) are usually sealed-bid auctions, as there may be only a few firms that are qualified do this specialized work.

FCA's Current "Hybrid DCA" Format. The ISO uses a hybrid auction format that seeks to capture certain beneficial features of both the DCA and the SBA formats. In simple terms, this hybrid DCA format is

[1] DCAs are sometimes called "Dutch Auctions," as this format has been used successfully in Holland's longstanding Aalsmeer flower market auctions for more than a century.

conducted in two stages: the DCA stage and the market-clearing stage. To help explain the pros and cons of this format (relative to a pure SBA or pure DCA format) it is useful to summarize each of these two stages briefly.

Stage 1: A DCA in Rounds. The DCA stage is essentially a bid collection process. The DCA stage is conducted in a sequence of rounds, delineated by specific price levels (*i.e.*, each round has a starting and ending price point). The first round's starting point is the FCA Starting Price. Capacity suppliers wishing exit at a price within the current round submit their withdrawal price to the auctioneer without observing withdrawal prices (if any) of other possible capacity suppliers. Capacity suppliers that do not wish to exit at a price within the current round (or are not permitted to do so) wait until a later round.

The auctioneer closes the FCA when it is determined that enough rounds have concluded (and enough bids/offers have withdrawn) to clear the auction. This occurs when the auctioneer can ensure that the market clearing price (which will be determined in the second stage) will be higher than the current end-of-round price. (Roughly speaking, this means supply is short at the end-of-round price). If this is not the case, the DCA stage does not close and continues to another round, with price at the end of the round becoming the starting price of the next round. And so on.

After each round, if the auction continues to a new round, the auctioneer provides information (consistent with specific Tariff rules) about the excess supply still in the auction at the end-of-round closing price. This publication feature during the auction differentiates the hybrid DCA format from a pure SBA format, where no information about excess supply is published during the auction clearing process. In effect, this publication feature makes the hybrid DCA essentially a "sealed bid within rounds" auction.

Stage 2: The Market-Clearing Stage. After the DCA stage of the auction closes, all of the withdrawal prices and quantities, along with other auction inputs (including, *e.g.,* the demand curves, resource types, constraints, and so on), are used in a specialized software algorithm known as the Market Clearing Engine (MCE) to finalize clearing prices and actual capacity awards (*i.e*., the Capacity Supply Obligation MW of each Capacity Resource). The MCE determines, mathematically, the specific combination of resource bids/offers needed in order to maximize social surplus while honoring the various Tariff-specified rules governing the clearing process.

The principal reason a MCE is needed – as opposed to relying simply on where "supply intersects demand" from the DCA stage – is due to the lumpiness of capacity bids/offers. [2] In the ISO Tariff, bids/offers that are lumpy, or indivisible, are called "non-rationable." With lumpy bids/offers, skipping a lower-priced but larger MW supply bid/offer in favor of a higher-priced, but smaller MW supply bid/offer can increase total social surplus. In fact, an outcome consistent with this possibility was observed in FCA 9.

Altogether, the two-stage hybrid DCA format captures two beneficial aspects of the pure DCA and pure SBA formats, respectively. First, because it is conducted in sealed-bid form *within* each round, participants cannot directly observe their competitors' bid prices during the current round. This affords much of a pure

[2] In addition, various complex Tariff pricing and capacity award rules are coded into the MCE (such as wheeled export bid treatment rules, tie-breaking rules when there are equal offer prices in different zones, etc.). Thus, using the MCE ensures that the outcome is consistent with ISO's Tariff.

sealed-bid auction's benefit in attenuating market power if the total number of bidders (or total offered MW) turns out to be small *relative* to total demand. (The ability of the auctioneer to adjust the round sizes based on this information in conducting the FCA's hybrid DCA rounds helps to further capture this benefit a sealed-bid auction; we discuss this further in the next section).

The second desirable aspect of the hybrid DCA is that information about the aggregate supply withdrawn during the *previous* rounds is communicated by the auctioneer publicly during the auction. Communicating this information can help minimize the possibility of bidder pricing mistakes during the auction (*e.g.,* a bidder that leaves the auction too early and, after observing the clearing price *ex post*, regrets not offering at a lower price). This affords some of the benefits of a pure DCA. It can promote more aggressive bidding (lower prices) than pure SBAs, in settings where there is a high level of competition but bidders nonetheless face uncertainty about their future cost of delivering the goods they sell at auction today. (More on this below.)

Different Activity Rules: New versus Existing Resources. There is another major difference between the current FCA rules and a pure DCA or pure SBA. The current FCA differs from pure DCA and pure SBA formats in that it features different participation rules (also called "activity rules") for different participants – namely, new versus existing capacity resources.

Existing resource owners are generally subject to maximum bid price limits. An existing resource that wishes to exit at a price above the Dynamic Delist Bid Threshold (currently set at $5.50/kW-month) must receive the IMM's approval of its bid. This review and approval occurs several months in advance of the auction. If an existing resource's bid price above the threshold price is approved, its final bid is entered into the auction at the approved price.[3] It remains passively in the auction and cannot be raised or lowered in response to information revealed during the auction.

New resources, in contrast, are potentially subject to minimum offer prices. Their offer prices are subject to review by the IMM several months in advance of the auction, which may result in a resource-specific minimum offer price. A new resource must actively participate in the auction, by withdrawing its capacity at its preferred exit price (down to its minimum offer price). It may do so without disclosing the lowest price at which it is willing to stay in the auction, down to the price level where its minimum offer price is reached; at that point it must withdraw from the auction.

These activity rules are designed to limit the exercise of market power in the FCM: Seller-side market power by existing resources, and buyer-side market power by new resources. However, these rules also limit the potential benefits of a DCA (the benefits being less likelihood of (gross) bid pricing errors by participants, and potentially more aggressive bidding by existing resource owners). Importantly, this means the current hybrid DCA format is not able to achieve the same degree of benefits that pure DCA auction formats ideally achieve.

[3] An existing resource with an IMM-approved bid price above the threshold has the opportunity to lower its bid price, or to elect to bid below the threshold, during an administrative "static delist bid finalization window" period prior to the auction.

B. Direct Consequences of the Auction Format: Key Pros and Cons

At a conceptual level, the pros and cons of these different auction formats can be grouped into the following central categories:

- Potential exercise of market power;
- Potential for mis-pricing errors by bidders (due to uncertainty over future costs);
- Confidentiality of bid prices; and
- Administrative simplicity.

We elaborate briefly on each of these four considerations next. Note there are also various potential *indirect* consequences of the auction format (such as the timing of reliability reviews, *e.g.*); these indirect consequences are addressed in Section II.B further below.

Potential Exercise of Market Power. A pure DCA and a pure SBA differ in the ability they provide to an auction participant to act on an incentive to raise its bid/offer price above its true cost of supplying capacity.

In general, pure "open" auctions (*i.e.,* pure descending and ascending clock auctions) are potentially more susceptible to this kind of market power. This is because in addition to the information available before the auction about the potential number of bidders competing to meet demand, a pure DCA format allows a bidder to observe exactly when its close competitors exit, and therefore when its bid may be pivotal and set the price. Further, if the total supply in the auction is tighter than expected, bidders can observe this as the pure DCA proceeds and adjust their bidding strategies, potentially setting price above their true cost (in the absence of other mitigation rules, that is).

These observations are not specific to the capacity market, but rather are considerations in auction design generally.[4] Largely for these reasons, the ISO does not use a pure DCA but instead employs the hybrid DCA format, which is far less susceptible to market power than a pure DCA.

Indeed, because of the extensive market power protections incorporated in the current FCA rules – including both the bid reviews by the IMM prior to the auction, and the auction elements adjustable by the auctioneer during the auction – it is unclear that switching from the current hybrid DCA format to a SBA format (if the same mitigation rules apply) would make a material difference with respect to the potential exercise of either supply-side market power by existing resources, or buyer-side market power by new resources.

Potential for Bid/Offer Mis-pricing by Auction Participants. Proper pricing of capacity is central to a well-functioning capacity market. As noted above, one of the beneficial features of a pure DCA format is that it

[4] For more information, see Paul Klemperer, "What Really Matters in Auction Design," *J. Economic Perspectives* 2002, 16: 169-189 (available at http://people.hss.caltech.edu/~jkg/what-matters.pdf), or Paul Klemperer, *Auctions: Theory and Practice* (Princeton University Press, 2004).

can help reduce the likelihood that (one or more) bidders may make (gross) errors in pricing their capacity offers due to mis-estimating their future costs of delivering capacity three years hence. Mis-pricing errors by bidders can result in inefficient price formation in the capacity market, may unnecessarily raise the cost of capacity for consumers, and can increase the likelihood of a de facto default (*i.e.*, a new entrant that clears but fails to commence commercial operations).

The logic behind how different auction formats impact bidders' mis-pricing errors takes a little explanation, as it depends on the uncertainties bidders face – not just about their competitors, but about their own (future) costs. A pure DCA reduces the likelihood of mis-pricing errors because some important but uncertain future cost components tend to similarly affect many (if not most) competing capacity suppliers. For example, think of future natural gas prices (which help determine a gas-fired resource's future net energy revenue), or the future number of capacity scarcity hours (which affect all resources' performance revenue risk). Both of these factors are uncertain three years forward, and are determined by market conditions that are common to most capacity suppliers.

Going into a SBA, if an auction participant's expectation of future energy revenues is significantly below the market's expectation, or the number of capacity scarcity hours is significantly above the market's expectation, the bidder may submit a higher price than other market participants (other things equal). As a result of that higher bid price, it might not clear in the FCA because it (erroneously) expected to have higher costs three years forward than everyone else's expectations. However, in a pure DCA, in this scenario the bidder may observe a large amount of excess supply – much of which is from resources with similar technologies – continuing to remain in the auction. As that supply approaches the bidder's initial high bid price, the bidder may (appropriately) infer that the other bidders expect the competitive cost of supplying capacity to be lower in future years than it initially anticipated. This can lead the bidder to adjust its bidding strategy during the auction, and (in this case) induce more aggressive bidding than would occur with a SBA format.

It must be noted that the opposite can also occur – for reasons having nothing to do with market power. For instance, consider if an auction participant's initial expectation of future energy revenues is significantly above the other bidders' expectations, or the number of capacity scarcity hours is significantly below the other bidders' expectations. In a SBA, this bidder might submit a lower bid price than other market participants would (all other things equal). In a pure DCA, however, the bidder may observe the competition withdrawing from the market at higher prices than it anticipated, and then infer that the market expects the competitive cost of supplying capacity to be much higher in the future than it initially anticipated. This can lead the bidder to decide to exit at a higher withdrawal price than it planned at the start of the auction.

A considerable body of research has studied this informational effect of auctions when bidders face common uncertainties over their future costs.[5] This research examines what should happen *on average* in a pure open auction (such as a pure DCA) versus a pure SBA when participants face considerable uncertainty (from a common source) about their future costs of delivering the good. The general conclusion is that if the total number of bidders (and total offered MW) is large, relative to total demand,

[5] A thorough, if technical, discussion of this research is Paul Milgrom, *Putting Auction Theory to Work* (Cambridge University Press, 2004).

pure DCAs will tend to promote more aggressive bidding (that is, lower prices) than pure SBAs in this context. In simple terms, the explanation is that because bidders can adjust planned bid prices during a pure DCA if excess supply (in the aggregate) withdraws quite differently than a bidder expects, a pure DCA reduces a bidder's risk of making a (gross) mis-pricing error during the auction. This reduces bidders' overall risk of participating in the auction, and lower levels of risk – again, on average – tends to result in lower overall required returns and, accordingly, lower clearing prices.

How does the hybrid DCA format fare with respect to these considerations? By itself, publishing excess supply information after each round will tend to preserve much of the benefit of a pure DCA format in reducing the likelihood of (gross) mis-pricing errors. On the other hand, however, the FCA's activity rules on bidding by existing resources that serve to limit market power tend to reduce, if not largely eliminate, this benefit of a pure DCA. This is because existing resources that wish to withdraw above the Dynamic Delist Bid Threshold must finalize their withdrawal prices several months before the auction. Thus, most capacity in the FCA (possibly nearly all, depending on the final clearing price) has no ability to adjust their bids in response to information revealed during the auction – muting the potential benefits of the DCA stage of the FCA's current hybrid format. This is a fundamental tradeoff between minimizing the risk of bid pricing errors (which promotes more aggressive bidding) and minimizing the risk of market power in auction design.

Clearing Price Transparency and Bid Price Confidentiality. Auction information can be used for both competitive and anticompetitive purposes. Clearing prices signal the scarcity of capacity and guide investment decisions, both critical market functions. And as just discussed, information about common components of future costs can serve to help prevent mis-pricing errors by capacity suppliers. On the other hand, specific information about competitors' bid/offer prices can be used for anticompetitive purposes (*i.e.,* facilitating unilateral market power or, in extreme cases, facilitating collusive behavior among participants). For that reason, professional market designers consider publishing individual bid/offer prices after the auction a potentially perilous practice.

In general, the transparency of an auction is determined by the post-auction publication rules as much as (if not more than) the auction's format. To promote competition and facilitate efficient price signals for investment, the auction's clearing prices must be transparent – that is, publicly available when the auction is complete for both auction participants and its non-participants (who may be future entrants). To promote competition and minimize anti-competitive behavior, however, participants' individual bids and the infra-marginal supply curve should remain non-public. With a sealed-bid auction, somewhat less information about the losing bids becomes available than under the ISO's hybrid DCA design (provided the auction rules ensure losing bids are not published after the fact under a SBA). That can help reduce the potential for anticompetitive conduct in auctions when there are few bidders (or low excess supply, relative to demand).

Administrative Simplicity. Generally, SBAs are simpler to implement than DCAs. The DCA stage requires its own software, "live" two-way secure communications systems with participants during the auction, additional testing, and so on. *Some* of these costs could be avoided if the ISO switched from its current hybrid DCA format to a SBA format (though any auction format will continue to entail significant costs for the ISO related to software systems, testing, validation, and so on). Overall, any change in auction formats

would entail some up-front software work to implement, and the ISO does not anticipate the potential longer-term cost differential to be a pertinent issue in considering the choice of auction formats.

Summary. We summarize the foregoing considerations in the table below. A gold star indicates the best expected performance on that dimension, and a silver star the second best expected performance. As the table shows, there is no 'single best' auction format; it depends on the circumstances and what considerations figure most prominently in the context of the auction. Note these are qualitative observations, and it is difficult to quantify the relative importance of the different formats with respect to these considerations.

Issue	Descending Clock Auction	Hybrid DCA	Sealed Bid Auction
Minimizing exercise of market power		☆	★
Minimizing bid/offer mis-pricing errors by participants	★	☆	
Maintaining confidentiality of resources' bid/offer prices		☆	★
Administrative simplicity	☆		★

Significance of the Auction Format. All things considered, on the basis of these observations we find no compelling reason to expect that average FCA prices would be higher or lower under the current hybrid DCA versus SBA format. Nor do we anticipate there would be materially significant differences in other FCA outcomes as a direct result of the auction's format.

In summary, this conclusion is based on three considerations. First, in general, the competitiveness of any auction is dominated by how many participants there are competing to clear in the auction (that is, how much excess supply there is relative to demand). The auction format, by itself, plays a comparatively limited role.

Second, given the auctioneer's ability to adjust auction round sizes based on the (non-public) bids submitted each round of the current hybrid DCA, and the extensive review and mitigation of bids and offers in the FCA, using either the current hybrid DCA or a SBA is unlikely to materially affect the potential exercise of market power during the auction.

Third, the extensive limitations on the bidding latitude of existing resources during the auction (when above the Dynamic Delist Bid Threshold price) means the hybrid DCA is similar to a SBA already with respect to impacts on bid/offer mispricing errors by participants.

II. Stakeholder Questions

A. Direct Consequences of the Auction Format

Many of the questions posed in the December Forum asked, in varying ways, issues noted in the preceding section. Here we summarize the main questions posed on the direct consequences of the choice of auction format, and the ISO's perspectives.

Promoting Competition. A number of questions asked about whether one format or another is more likely to promote more competitive bidding by participants. These include:

- *When facing conditions of limited competition, which format works better?*
- *Does one auction design encourage bidders to focus more on their individual cost recovery needs versus trying to discover the actions/behavior of other bidders?*

As noted in Section I, sealed bid auctions fare better with respect to reducing the ability to act on incentives to exercise market power, and are generally preferred when the number of competitors (or total excess supply, relative to demand), is low. This is because in addition to the information bidders have about total supply before the auction, DCAs allow bidders to observe the condition of the market during the auction. If the supply during the auction is tighter than expected, bidders can potentially observe as much during a pure DCA and adjust their bids up, setting the price higher.

The FCA's hybrid DCA format is far less susceptible to this form of market power than a pure DCA, however. The round structure in the hybrid DCA hampers the ability of the bidders to determine when exiting the auction will set price. In addition, the current FCA's activity rules and the IMM's review of both existing and new resources' bid/offer prices greatly limit the ability of participants to act on any incentives to exercise market power.

With regard to the second question above, the issue is complex. Under the FCA's current pricing rules used in the MCE (and specified in the ISO Tariff), any of the three alternatives discussed in this paper – a SBA, DCA, or the hybrid DCA – all create unavoidable incentives for bidders to focus on the expected bid prices of the other bidders they compete with. This is a general characteristic of so-called "first-price" auctions, in which the clearing price is set by the (marginal) winning bid. In other words, from the standpoint of economic theory, there is no solid basis to conclude that any one of these formats would lead bidders to ignore the expected bid prices of their competitors.

Entry. Several questions at the December Forum asked about the longer-term implications of the auction format for entry into the market, and for producing useful information about the cost of new entry:

- *Does one format better attract new entry?*
- *Would either auction format provide more information about lower cost resources; and would that information provide value to the marketplace (after the auction)?*

The extent to which the auction format plays a role in attracting new entry into the capacity market is limited. In theory, a pure DCA might allow participants to gather more information (albeit noisy) about other bidders' expectations of future cost conditions, and such information may be more valuable to a new entrants with little or no experience in capacity market (inasmuch as it lowers their likelihood of a making a significant bid mis-pricing error). In practice, the FCA's current hybrid DCA provides these informational opportunities in a fairly diluted form, so this likely has rather limited benefit.

More generally, the principal signal that will tend to attract new entry is a high price (and the expectation that this price will persist in the future). As mentioned earlier, there's no compelling basis to expect that one format or another will tend to produce higher or lower clearing prices overall, all things considered.

With regard to providing information about lower cost resources, a SBA is likely to provide more information about lower cost resources to the *auctioneer* (and the ISO) than the hybrid DCA (or a pure DCA). This is because DCAs stop when the auctioneer collects enough information to calculate awards and clearing prices. In the FCA, this means that no information about resources with costs below the end-of-round price in the hybrid DCA's final round is revealed to the auctioneer (typically).[6] When supply is limited and the DCA stops when the price is high, little information is revealed to the auctioneer about the costs of resources below the stopping price.

A SBA that requires final and best offers to be submitted by all resources prior to the auction, therefore, provides more information about otherwise unobservable segments of the supply curve to the auctioneer (and the ISO). This does not mean, however, that it would be prudent for the auctioneer (or the ISO) to reveal any of these infra-marginal bid prices publicly after the auction. As mentioned above, doing so can facilitate coordinated bidding or collusive anticompetitive conduct.

Activity Rules and Bid Timing. Several questions asked, in various ways, how the activity rules (see Section I.B) and the bid submission deadlines affect bidding behavior and auction outcomes. Representative questions on these issues, and the ISO's perspectives, follow next.

- *Is the DCA beneficial when there are limited suppliers and offers are submitted nearly a year before the auction?*

As noted earlier (see Section I.B), when the number of suppliers (or total offered supply in MW) is limited relative to total demand, the potential benefits of a pure DCA tend to dissipate and are replaced by concerns about the exercise of market power. In such conditions, an SBA may be preferable to a pure DCA. However, when the bids/offers are submitted well in advance of the auction and subject to IMM review (per current Tariff rules), both the benefits of a DCA (whether pure or hybrid) and the potential concerns over market power are muted significantly. We address the practical constraints on when bids/offers must be submitted to the ISO further below, in response to the questions in Section II.B(2).

[6] The IMM will have additional information about the delist bid prices for some existing resources, and costs for new resources that seek to offer below the Offer Review Trigger Price, but will not have a complete picture of the final and best offer for all resources.

- *Does one mechanism provide more comparable treatment of resources in the clearing of the auction?*

With regard to the auction *clearing* process, the answer is no – both the hybrid DCA and a SBA would provide a similar treatment of resources in the auction award stage. As noted earlier in this paper, the DCA stage of the current FCA is a means to collect information about bids and offers. Once enough information is collected, the auction is cleared by the Market Clearing Engine (*i.e.* the MCE awards CSOs and calculates capacity prices), with the objective of maximizing social surplus subject to various constraints. The MCE extends identical treatment to bids and offers from new and existing capacity resources, and we do not anticipate that would be any different under the current hybrid DCA format or a SBA format.

With regard to new entry and the FCM qualification process, the ISO Tariff provides somewhat different rules governing the resource qualification process for different resource types. The comparability of different resource types' treatment in that process is not implicated by the format of the FCA.

- *Would a more competitive auction allow all resources to enter bids at the same time, and be held to the submitted prices?*

This question is more involved. Would an auction be more competitive auction if the format required all bids due at the same time? The answer is theoretically unclear, as there are two competing effects at play.

On the one hand, having bids due from permanently exiting (retiring) resources early is potentially beneficial, by providing additional time and information that may lead new resources to "show up" and participate in the auction to replace them. As noted earlier in Section I, the primary determinant of the competitiveness of an auction is the number of competitors that bid in the auction (that is, having excess supply from many different firms, relative to total demand). This retirement-related consideration is one reason the ISO recently accelerated the timeframe for participants to submit resource retirement information prior to each FCA.

On the other hand, for new and existing (non-retiring) resources, asymmetric bid submission deadlines and activity rules may have some adverse efficiency consequences. Specifically, they can contribute to the "winner's curse" problem for resources facing the earlier bid submission deadline. In this context, the winner's curse is a phenomenon where a bidder with slightly inferior (*e.g.*, stale) information about future costs is underpaid for the capacity obligation it assumes. The bidders who have to lock-in their capacity bid prices many months before the auction are, by construction, more exposed to this winner's curse problem. They cannot update their bids to account for any information about future costs (such as forward-looking natural gas futures prices) that may change after they submit their bids. New resources tend to have a greater ability to incorporate information learned just prior to the FCA into their offer behavior.

If an existing resource owner is fully cognizant of the possibility that its (slightly) inferior information might lead to obtaining a CSO below the price it would submit if it could incorporate additional information (closer to the FCA), it may have an incentive to try and account for this risk in the form of a higher bid/offer price – even though doing so may render it less likely to clear (*i.e.*, to obtain a CSO) at all. In general, this consideration suggests that a uniform bid submission deadline may tend to produce more

competitive outcomes, and a deadline that is long before the auction may potentially result in less efficient outcomes. However, we note again that this is not the only consideration at play with respect to bid submission timing. Ensuring that resources that seek to exit the market (*i.e.*, retire) can be readily replaced by competing new supply remains a paramount consideration with regard to submission timing rules.

Informational Issues and Auction Rounds. Various questions inquired about the mechanics of the hybrid DCA auction, focusing on information-related issues about bidders' incentives or the auction round structure. Representative questions on this topic are addressed next.

- *Are bidders' incentives to provide true/best offers different with and without post-round information?*

Yes, bidders' pricing incentives vary with and without the post-round information. As discussed earlier, the information revealed after each round can be used in two ways: (a) it can be used to facilitate the exercise of unilateral market power or, in extreme cases, to coordinate collusive conduct (both greater concerns when supply is limited relative to demand); and (b) it can be used beneficially to help reduce the magnitude of (gross) bidder mis-pricing errors during the auction (more of a benefit when there are a lot of suppliers relative to demand). As noted earlier, because of these competing considerations there is no 'single best' auction format; it depends on the circumstances and what considerations figure most prominently in the context of each particular auction.

- *The price-quantity pairs of bids/offers within a round are not revealed to other suppliers [during the round]. If information sharing is a benefit of an open auction, why have that structure?*

This question might be interpreted to ask why the FCA employs the hybrid DCA format (sealed bid within rounds), rather than a pure DCA format (where participants can observe the price-quantity pairs at which other suppliers withdraw). Here, the competing considerations noted in the prior response highlight that while some information can help the competitiveness of auctions, other information can facilitate the exercise of market power. The current FCA format strives to strike a balanced approach through the hybrid DCA, where some information about the general status of excess supply is released at the end of each round – but nothing is released during each round, to reduce the ability of any supplier to know when it may be able to set price by abruptly withdrawing its capacity during a round.

- *Can the DCA format be changed to share more information during the auction? Participants can't see the information used by the auctioneer to make decisions about rounds (such as the bid/cover ratio or size of rounds).*

For the DCA stage of the FCA, the auctioneer does not share any detailed information about the bid-to-cover ratio or any advance information about the anticipated round sizes. (Each round's size is announced during the auction, prior to the start of each round). Using the excess supply information released at the end of the each round of the hybrid DCA, participants can calculate a (rough) indication of the system-wide bid-to-cover ratio – that is, the ratio of excess supply to total demand at the end-of-round price. The information the auctioneer uses to determine the size of the rounds includes various data about zonal and rest-of-system supply, the sizes of resources with the flexibility to withdraw during the upcoming round, and supply that will withdraw at prices below the end-of-round price. It would be unwise for this type of

non-public information to be made public, because it could reveal sensitivity of supply to changes in price (*i.e.*, the immediate elasticity of supply) and thereby signal conditions favorable to exercise of market power during upcoming rounds. The auctioneer tends to select round sizes precisely to reduce the possibility of participants being able to infer conditions favorable to the exercise of market power.

- *What are the implications of using a single-round DCA that includes the cap down to the floor (all else being equal)?*

Viewed from a purely mechanical standpoint, using the hybrid DCA format with a single round that ranges from the FCA Starting Price all the way down to zero is identical to clearing the auction as a SBA. However, in practice, using the hybrid DCA format with a single round could produce different outcomes than if the ISO committed to run a SBA each year in the Tariff, for a number of reasons. Most importantly, using a single round only on occasion (as occurred in FCA8) could be interpreted as an unintentional signal to auction participants at the start of the auction that supply is tight. No such signal will be sent to the marketplace if the ISO commits to using a SBA format for all future capacity auctions, and minimizes the information publicly provided about supply conditions prior to each FCA.[7]

As a practical matter, if the region switched permanently to use a SBA format in the FCA, then it would be advisable to revise the Tariff accordingly to stipulate that auction format and make associated conforming changes (e.g., removing references to the DCA), and the ISO would also undertake associated software changes to drop the DCA-related components of the auction process.

B. Indirect Consequences of Auction Formats

Many questions posed during the December Forum related to issues that are possible indirect consequences of the auction format. These include whether and how a change in the FCA format may alter (or enable changes to) the timing of various pre-auction deadlines and processes. Most of these indirect consequences questions concern either the ISO's planning-related functions, such as qualification processes, or the ISO's mitigation-related functions. We address questions related to these two functions in the following two subsections.

1) Questions regarding system planning-related activities, timing, and deadlines

A number of questions concerned the pre-auction system planning activities related to new resource qualification and overlapping impact tests, the timing of reliability reviews for existing resources under different auction formats, and modeling alternative capacity zone configurations. We address each in turn.

[7] The eighth capacity auction (for the 2017-2018 commitment period) concluded in a single round that ranged from the FCA Starting Price of $15.819/kW-month down to $3/kW-month.

- *Would or could the timing and implementation of overlapping impact tests be different with one format versus the other?*

As part of the qualification process for new resources, or to qualify additional capacity from an existing resource, an overlapping impact test is performed to evaluate whether the new or additional capacity is deliverable to the Load Zone in which it is electrically connected.[8] Generation, Active Demand Response, and Import/Elective Transmission Upgrade resource types are subject to this test.

It takes ISO staff just over three months to perform the overlapping impact analyses. During these analyses, ISO staff works with the interconnecting customer and Transmission Owner to identify the transmission upgrades needed. The results of this analysis are also applicable to ARA participation. In some cases, there can be efficiencies to performing the analysis at a single time during the year and applying the results to all relevant Capacity Commitment Periods.

The result of the overlapping impact test is provided in a resource's Qualification Determination Notification (QDN) letter in late September. This date is based on the time required for the ISO to perform its pre-auction processes (we address these timing issues more generally toward the end of section II.B.2 below). The format of the FCA has no direct bearing on the time required to conduct the overlapping impact analyses. Under the simplest changes necessary to switch to a SBA format, the overlapping impact tests would continue to be conducted in advance of the auction; a resource's position in the Interconnection Queue determines the order in which the overlapping impact analysis is performed.

- *Would one of the auction formats better facilitate a design where costs could determine overlapping impacts/queue positions?*

We interpret this question to be asking about a change in the interconnection analysis and qualification processes such that the overlapping impact test would be performed *after* the FCA is conducted, and (potentially) not be based on queue position but rather auction clearing.

The ISO has not assessed the feasibility or merits of this alternative timing. Such a change may have a number of significant implications for planning the system – including an increased potential for awarding a Capacity Supply Obligation (CSO) to a resource that cannot be built by the start of the Capacity Commitment Period, or could not be built at the cost the sponsor anticipated when bidding in the FCA.

With respect to the FCA format, however, we are not aware of any logical inter-dependency between the FCA format and this alternative timing. In other words, whether such an alternative process is viable would be determined by considerations other than the FCA's format.

- *Does one auction format better facilitate reliability reviews? Would that be more cost effective for the ISO?*

In the FCM, reliability reviews are performed if an existing resource seeks to exit the market (via a Static Delist Bid, Permanent Delist Bid or Retirement Delist Bid). Reliability reviews are conducted to ensure the

[8] ISO Tariff, § III.13.1.1.2.3 (Gen) and § III.13.1.4.1.2.2 (DR).

system satisfies NERC, NPCC, or ISO reliability planning criteria in the absence of the exiting resource. Reliability reviews are needed regardless of the auction's format. Presently, these reviews are performed in two stages. Initial review work is conducted prior to the auction, primarily to help minimize the scope and complexity of any reliability reviews that may need to be performed during the course of the DCA itself. In addition, the ISO may perform reliability reviews between rounds of the DCA, if necessary based on the information presented as the auction progresses.

If the FCA adopts a sealed-bid auction format, it may be possible for the FCA reliability reviews to be performed "simultaneously" with the auction clearing processes (or, technically speaking, iteratively with the auction clearing process). That would be similar to how reliability reviews are conducted for the Annual Reconfiguration Auctions. As the question suggests, that could be more cost effective for the ISO if a simultaneous review process results in fewer delist bids and retirement requests, but there is no obvious reason to expect that outcome. Based on past submittals, a more likely scenario might be that several iterations of reliability reviews and the market-clearing engine may be needed to find the auction awards that meet the FCA's objectives while satisfying the reliability requirements. In that case, the time and resources required for the ISO to perform those reliability reviews would likely be approximately the same.

As noted in response to the following question, however, a sealed bid format may have a benefit (relative to the existing hybrid DCA format) with respect to how new resources may be addressed in the reliability review and auction clearing process.

- *Which auction format better facilitates the inclusion and consideration of new resources in reliability reviews?*

A sealed bid auction format may enable new resources to replace existing resources that are exiting the market (via a Permanent Delist bid or Retirement Request) without triggering the need to retain an existing resource for reliability. More specifically, knowing which combination of new and existing resources would clear the auction may enable the ISO to perform reliability reviews in a manner that accounts for the contribution of cleared new resources to resolving any (sub-zonal) reliability issues that the delisting of existing resources may present. This could be beneficial in promoting overall market efficiency in the FCA by reducing the likelihood that an uneconomic resource would need to be retained for reliability.

However, during the first ten FCAs it has been an uncommon occurrence for the ISO to retain a resource for reliability, and even more uncommon that the retention could have been avoided by the consideration of a specific new resource. Thus, this potential benefit of a sealed-bid auction format is likely to be infrequent.

- *Does one format better model complex zonal configurations in the FCM?*

This question implicates two distinct issues: The Capacity Zone formation and evaluation process that is conducted well in advance of the FCA, and the zonal modeling in the auction-clearing process. With respect to each of these two distinct issues:

1. The Capacity Zone formation process is independent of the auction's format. Therefore, the zone formation process could remain unchanged if the format changes to a sealed bid auction from the hybrid DCA format.

2. A pure DCA format places limitations on the structure of the zonal configurations that could be used in the FCM. In principle, the Market Clearing Engine could be extended to handle some more complex zonal configurations, although this has not been assessed in detail.

More generally, the ISO's reliability planning system has been applied to model only capacity zones that are 'radial' to the Rest-of-Pool zone (i.e., a hub-and-spoke zonal configuration). In that context, certain mesh (non-radial) zone configurations do not lend themselves to transfer capability calculations that would be meaningful given the physical characteristics of the system. For example, no import transfer capability has been calculated for the Vermont or New Hampshire (or the Vermont/New Hampshire combined) zones and no such interfaces have been defined for the purposes of managing power flows in system operations or in system planning. These considerations can limit modeling more complex zonal structures, and are independent of the choice of auction format.

2) Questions regarding FCA mitigation-related procedures and timing

Several lines of questions concerned the IMM's mitigation procedures that are conducted prior to the auction. Several asked, in either general or specific ways, how a change in the auction format might alter mitigation of delist bids, supply offers, and various tests. Representative questions include:

- *Whether the ISO's mitigation measures would be different under one format or the other? (and if so, how?)*

- *Whether various tests done by the IMM, such as the pivotal supplier test, could or should be performed differently (such as including new resource offers) with a sealed-bid format instead of the DCA?*

The IMM will continue to review bids and offers and to mitigate the exercise of market power with either auction format. The need to review the bids of pivotal suppliers for seller-side market power, and to review the offers of new resources for buyer-side market power, is not materially diminished by a change in the auction format. As in auctions outside electricity markets, in the FCA there can be a significant financial incentive for pivotal suppliers to bid above their true cost of supplying capacity, particularly under conditions when aggregate supply is limited (relative to total demand).

In general, the reviews conducted by the IMM do not depend on the auction format. For example, the decision to not include new resources in IMM's pivotal supplier test does not depend on the auction format. The reasoning is simple: the price at which new resources may withdraw from the FCA is not subject to the IMM's review (other than a potential offer floor) and, unlike existing resources that are physically present, there is no guarantee that a new capacity resource will be built. As a result, including the new resource(s) of a supplier as part of the system's total available capacity in the pivotal supplier test increases the likelihood that another truly pivotal supplier would be incorrectly identified as non-pivotal.

This logic – and therefore the logic to not include new resources in pivotal supplier test – stands independently of the auction format.

Other mitigation-related questions focused on the impact of mitigation, and how it relates to the FCA format. These include:

- *If it is assumed that mitigated price is the exit price, does that effectively collapse the DCA into a sealed bid format?*

- *Which format better facilitates the inclusion and consideration of new resources in mitigation reviews?*

Under the current FCA rules, the bid price of an existing resource that is above the Dynamic Delist Bid Threshold must be finalized several months before the auction is conducted. For this resource, the capacity auction is very close to an SBA, except in that any new resources with which it competes can update their bids based on information obtained closer to the auction date. That is, new resources retain the possibility to exit based on their individual assessment as the DCA stage of the FCA proceeds (down to their mitigated offer floor price). This does not quite correspond to a SBA format. In addition, if the hybrid DCA proceeds to a round below the Dynamic Delist Bid Threshold price, then any existing capacity that remains in the auction has the latitude to withdraw based on its assessment of the remaining excess supply during such rounds. This does not correspond to an SBA format either. So, in brief, the answer to the first question is no.

With respect to the second question, concerning new resources inclusion in mitigation reviews: As noted above, a change in the auction format does not change the IMM's general mitigation framework. Reviews of new resource offer prices, which are conducted to reduce the potential for buyer-side market power, are neither facilitated nor hampered by a change in the FCA format.

Bid Submission Timing Questions. Finally, a number of questions concerned the timing of bid submissions. This involves both auction design questions and the practicalities of the ISO's mitigation and system planning processes. Typical questions on this include:

- *Whether the timing of submission of certain (e.g. static) existing resources' bids and new resources' offers could be aligned?*

- *Whether one of the auction formats better facilitate changes to, or more flexibility in, the current timelines? Ex: Can sealed bid allow all ISO functions to be concluded later?*

The timing of bid/offer submissions is a challenging issue because it implicates both the economic benefits of timing rules and the practical challenges of reviewing bids for both mitigation purposes and qualification processes.

In principle, there are economic efficiency benefits to having bid submission deadlines set as late as possible. This allows participants take as much information as possible into account in their submission, and – holding all else equal – will tend to produce more efficient auction prices and clearing outcomes.

Moreover, as noted previously (see Section II.A, "Activity Rules and Bid Timing"), a uniform submission deadline for all auction participants can help to reduce the incidence of winner's curse.

These potential benefits must be balanced against the practical considerations that the ISO's mitigation reviews and system planning qualification processes need to be carefully executed and can involve complex, time-consuming analyses. For example, the review of all static delist bids and new resource offer prices potentially subject to mitigation for each FCA presently takes the IMM staff approximately three months (from June into September). After participants are notified of the IMM's determinations, the bid submission timeline rules must allocate additional time in the event a participant seeks to contest an IMM determination before the FERC, so the FERC can (ideally) resolve the matter prior to the FCA. The time constraints faced by the IMM are also a challenge for system planning in conducting new resource qualification analyses. In sum, regardless of the auction's format, these practical process considerations limit the ISO's ability to implement a timeline in which bids are submitted close to the date the auction is conducted.

3) Miscellaneous Questions and Issues not Addressed Previously

The December Forum raised a wide range of questions, some of which do not fit neatly within the central lines of questions previously addressed in this paper. Here we respond to a number of questions posed by (one or more) stakeholders, sharing the ISO's current perspective on their materiality to the FCA format.

Since these questions do not have a unifying theme, we address them sequentially.

- *Is one mechanism more cost effective for the ISO to implement?*

As noted in Section I.B, there may be modestly lower costs for the ISO to operate a sealed-bid auction than the hybrid DCA-format, on an annual, ongoing basis. However, these costs of "conducting" the auction itself are not material enough to be an important consideration in the region's choice of auction format. In general, most of the ISO's total costs of running the FCA would be similar under either auction format, as they are expended on auction-related processes that would performed similarly either way (such as annual software updates and testing of the Market Clearing Engine).

- *With a format change, would or could the FCA compensation be pay-as-bid?*

The nature of compensation (namely, uniform-clearing prices versus pay-as-bid) is a different issue than the choice of a SBA or DCA format. A considerable body of economic research has studied the application of uniform clearing prices and pay-as-bid auctions, with the general conclusion that the latter will be less efficient, less transparent, and unnecessarily complicate market participation (that is, the bid pricing process for auction participants). These reasons are why commodity markets generally – from electricity to oil to metals to agricultural commodities – use uniform clearing price market designs.

In 2001, following the California energy crisis, a Blue Ribbon panel of independent market design experts was commissioned in California to examine this issue. The panel's main conclusion was direct: "In sum, […] the expectation behind the proposal to shift from uniform to as-bid pricing — that it would provide purchasers of electric power substantial relief from the soaring prices of electric power such

as they have recently experienced — is simply mistaken." They similarly concluded that there is no reason to expect switching compensation to pay-as-bid would improve other market outcomes generally, and that it would likely weaken competition, making outcomes materially less efficient. The panel's thoughtful and detailed explanations are quite general and remain applicable to the question today. Their report can be accessed through the free Research Papers in Economics (RePEc) website.[9]

In sum, quite independent of whether New England uses a DCA or SBA format, the economic research is unequivocal that it would be a poor market design to compensate resources using a pay-as-bid rule. This is just as true in the capacity market as it is in the energy market – as it is for all commodity markets.

- *Now that we have a Demand Curve, do we still need a DCA?*

This question seems to presume that a DCA was "needed" before we had a sloped demand curve in the capacity auction. If so, that presumption is not correct. The ISO can employ a sloped demand curve, or a vertical demand curve, in the FCA regardless of whether the FCA uses a SBA or the hybrid DCA format. Adopting a sloped demand curve (of any type) does not, by itself, imply a need to change the auction format.

That said, there are some technical interdependencies between sloped demand curves and the auction format. These technical interdependencies relate to the way that lumpy (that is, indivisible or non-rationable) capacity supply offers are cleared in the FCA. A pure DCA cannot handle that properly in all possible circumstances, so the Market Clearing Engine software is employed for this purpose. The ISO's hybrid DCA format, which uses the MCE in the second (post-DCA) stage, can accommodate this situation (and does, with the sloped demand curves used since FCA 9). With a sealed bid auction, only the Market Clearing Engine software would be needed.

- *Have other capacity markets moved from an open auction format to closed?*

In the US, only ISO New England has used the hybrid DCA format for a centralized capacity auction, to our knowledge. Outside of the US, both have occurred. The UK, after considering both, adopted an open (partially DCA-based) format for their capacity market. Colombia (the country) is in the process of switching from a hybrid DCA format that has been used in the past to a SBA format, primary to address increasing market power concerns. In general, the experience in other nations does not yield compelling implications for how the trade-offs between an open and closed format should be balanced in New England's FCA.

* * *

ISO hopes the information provided in this paper is informative, and that it will enable productive discussions with stakeholders about possible future changes in the FCA format.

[9] Available at https://ideas.repec.org/p/pcc/pccumd/01calpx.html.