
Volume 23, Issue 9, November 2010
ISSN 1040–6190
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Forward Capacity Market CONEfusion

In ISO New England and PJM it was assumed that sponsors of new capacity projects would offer them into the newly established forward centralized capacity markets at prices based on their levelized net cost of new entry, or ''Net CONE.'' But the FCCMs have not operated in the way their proponents had expected. To clear up the CONEfusion, FCCM designs should be reconsidered to adapt them to the changing circumstances and to be grounded in realistic expectations of market conduct.

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I. The Rationale for Forward Centralized Capacity Markets

Policy changes beginning in the 1990s restructured the U.S. electric power industry and introduced elements of competition. In some areas regional transmission organizations (RTOs) were formed and electric distribution companies ceased to be responsible for planning and procuring adequate generating capacity for the customers in their service territories. However, there was concern that at least for the foreseeable future, the restructured wholesale markets might not provide sufficient generating capacity to maintain the desired high level of reliability or would do so only if prices were allowed to rise to very high levels at times. Some RTOs concluded that a centralized capacity market mechanism was desirable as a transitional provision[1] until wholesale market designs could be further developed and the demand side of the market could become more actively involved.[2] Under these mechanisms, the RTOs determine the amount of capacity needed for adequate reliability and hold auctions to procure commitments to provide the capacity to the extent load-serving entities do not self-provide or contract for sufficient capacity in advance of the auctions.

Centralized capacity market mechanisms involve many complex rules, combining market-like and administrative elements. Of the various issues faced in designing them, two fundamental choices are of special importance in this article: the choice of the duration of the capacity commitments determined through the mechanism (''commitment period'') and how far in advance to impose mandatory capacity obligations and hold the capacity auctions (''forward period''). While all of the RTO capacity mechanisms rely primarily on one-year commitments, two RTOs chose to impose obligations and hold the auctions three years in advance, hoping the additional lead time would allow proposed new power plants not yet under construction to compete in the auctions. ISO New England's Forward Capacity Market (FCM) and PJM Interconnection LLC's Reliability Pricing Model (RPM) are the two three-year forward centralized capacity markets (or FCCMs).[3] Other RTOs either lack centralized capacity markets (MISO, ERCOT, CA-ISO), or the centralized capacity market imposes capacity obligations one year or less in advance (NYISO).

II. FCCMs in Operation: Initial Expectations

ISO New England's FCM and PJM's RPM were conceived and designed in the 2003–05 period with the ultimate designs resulting from extensive multi-party settlement negotiations in 2006.[4] Their designs, and the expectations for how they would operate, reflect the circumstances of the time:

Centralized capacity market mechanisms involve many complex rules, combining market-like and administrative elements.

- Peak load growth had been and was expected to remain fairly steady. As a result, it was expected there would be a stable, consistent need to add new generating capacity.
- The vast majority of the new power plants built in the preceding years had been gas-fired, and gas-fired capacity was expected to continue to dominate capacity additions.
- It was expected that in the restructured markets, new power plants would be built under ''merchant'' circumstances – i.e., relying upon anticipated revenues in short-term wholesale markets rather than long-term contracts.

It was expected that developers would only build new power plants if they could anticipate earning revenues from wholesale markets over the life of a project that would cover the cost to build plus a return on the investment, and therefore, capacity prices would have to average over time the levelized cost of construction net of energy and ancillary services market earnings (the net cost of new entry, or ''Net CONE'').[5] Based on this expectation of revenue and price needs, there was a widely held view that under competitive circumstances the sponsors of new capacity projects would offer them into the forward capacity markets at prices based on their levelized net cost (Net CONE).[6]

The expectation that multiple, competing projects based on similar gas-fired technologies would be offered into the FCCMs at similar prices reflecting each project's Net CONE led to expectations that the FCCM auction supply curves would include a relatively ''flat'' segment reflecting multiple offers near a gas-fired combustion turbine's levelized Net CONE.[7] (Combustion turbines are considered to be the least expensive source of incremental capacity.) Such a supply curve

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would result in auctions that would generally clear at prices near Net CONE. Thus, FCCM capacity prices were expected to be stable near Net CONE, which would provide strong incentives for investment in new capacity while also largely eliminating any one seller's ability to raise capacity prices by withholding capacity.

The expectation that new capacity would and should be offered into FCCMs at prices based on Net CONE was and remains reflected in the FCCM designs in numerous ways.[8] For PJM's RPM, the Net CONE parameter is set based on an engineering study of the cost to build a combustion turbine net of a three-year average of historical energy and ancillary services earnings. Net CONE then serves as the price parameter of a sloped capacity ''demand curve'' used in the capacity auctions.

The FCCMs were designed to accommodate offers from existing and new generation and also offers from demand response providers and merchant transmission projects. Based on this structure and the expectations regarding offer prices, there was also an expectation that the forward capacity auctions, in selecting the lowest-cost offers, would be selecting the most attractive projects and lead to efficient capacity expansion, essentially accomplishing least-cost, integrated resource planning.[9] Both RPM and FCM also provided for capacity prices that could be higher in transmission-constrained zones. To date, prices have varied across several zones under RPM, but there has been no locational pricing under FCM.

These expectations regarding FCCM operation were reflected in and supported by modeling exercises to simulate their operation under alternative designs.[10]

III. FCCMs in Operation: Experience to Date

Three-year forward auctions have now been held for three delivery years under ISO New England's FCM and for three delivery years under PJM's RPM.[11] The FCCMs have not operated according to the expectations described above. Several aspects have differed.

- Auction clearing prices have not been stable around Net CONE[12] (or any other price level), as shown in **Figure 1** for PJM (FCM prices have been limited by an administratively set price floor in all three auctions held to date).
- In some years, auction clearing prices have been lower than what were considered the net ''going-forward'' cost of many existing power plants.[13] However, while many existing plants have failed to clear in the auctions, very little of the uncleared capacity has been retired.[14]
- The FCCM auction supply curves have not exhibited the anticipated ''flat'' segment, or any cluster of offers around Net CONE or any other price level, even where the evidence suggests the auctions were competitive (Figures 2 and 3). Instead, many new resources have been offered at much lower prices.
- Despite prices lower at times than many had expected, a substantial quantity of incremental

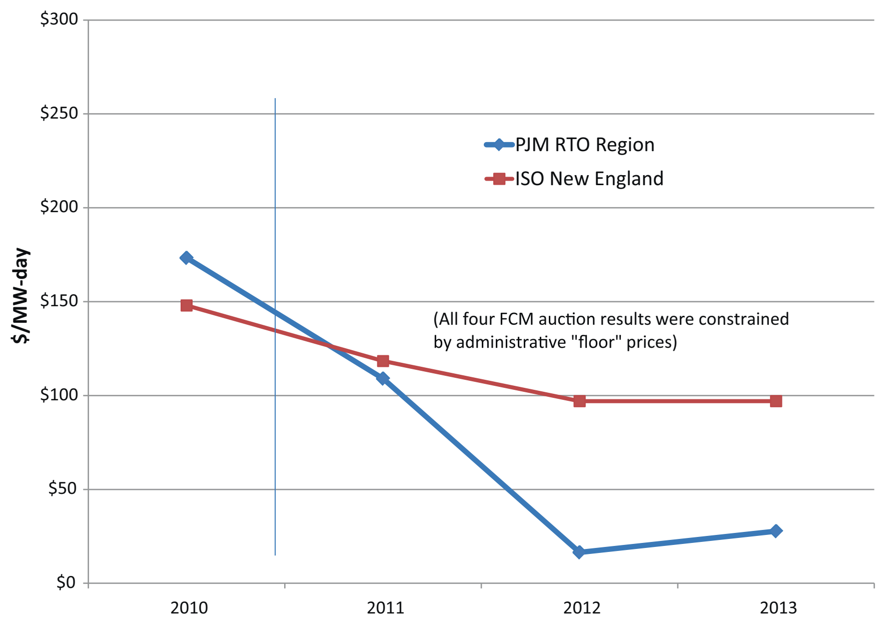

Figure 1: RPM and FCM Clearing Prices, 3 Year Forward Auctions (RTO Regions)

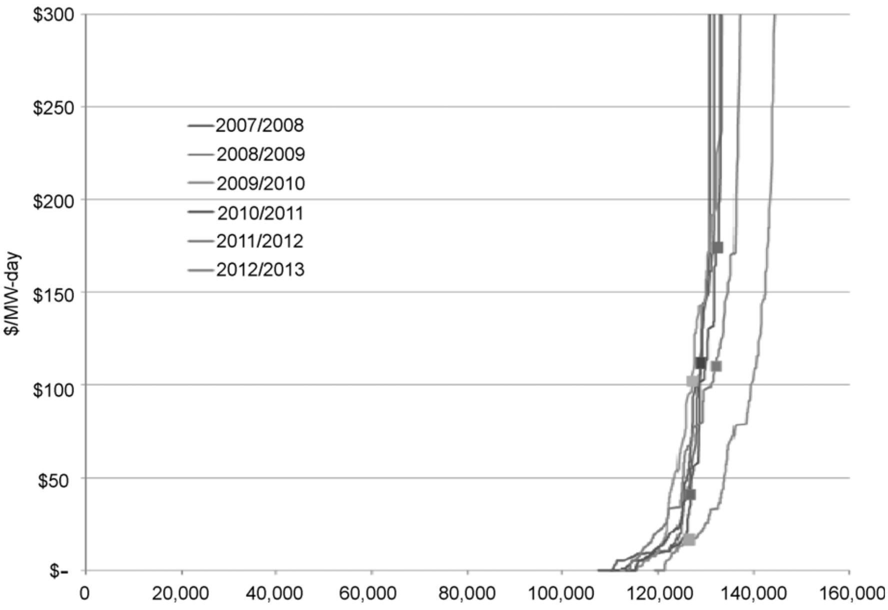

Figure 2: RPM Supply Curves – RTO Region

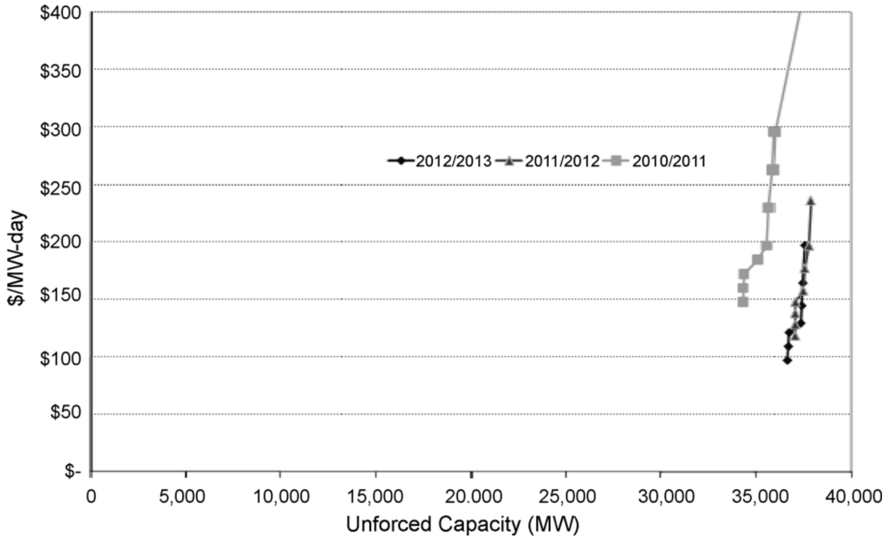

Figure 3: Total Supply By Round In FCM Auctions

capacity has become available, and both regions have excess capacity for several years into the future (as do neighboring systems MISO and NYISO).[15] Consequently, the fundamental goal of resource adequacy has been accomplished although some smaller zones anticipate incremental capacity needs sooner. However, very little of the incremental capacity has been gas-fired or built under merchant circumstances.

• While capacity prices have been substantially higher in constrained zones of PJM, this has not led to these zones attracting or retaining proportionately more capacity than the rest of the RTO region where capacity prices are much lower.[16]

IV. Changing Industry Circumstances that Have Affected FCCM Results

The gap between the expectations and the reality of FCCM operation has been due in part to industry circumstances quite different from those envisioned when the FCCMs were designed:

• It has become increasingly difficult to obtain financing for merchant power plants in recent years. At the present time a long-term contract or other highly reliable source of revenue is generally considered necessary to finance and build a new power plant. As a result, few new power plants have been built under merchant circumstances.

• State and federal policies have increasingly emphasized non-price attributes such as environmental characteristics, renewable sources, demand-side efficiency, and fuel diversity. Programs have created incentives and/or targets for demand-side resources, energy efficiency, renewable resources, and cleaner and more diversified sources of energy, and new resources are increasingly being selected and contracted based on such policies. This is a substantial change from the time when the FCCMs were designed, when the focus was on minimizing cost through

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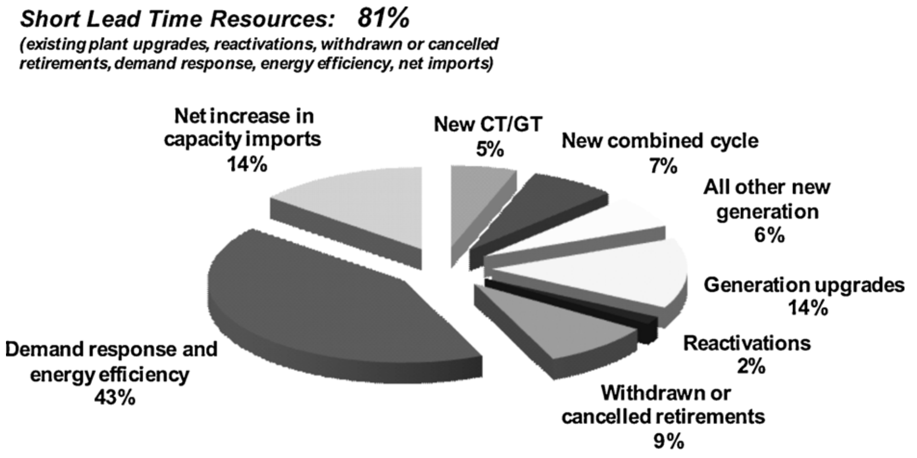


Source: PJM, *2013/2014 RPM Base Residual Auction Results*, Tables 7 and 9; based on offered capacity expressed in installed capacity terms (except Demand Response and Energy Efficiency).

Figure 4: Incremental Capacity Resources: First Seven PJM RPM Base Residual Auctions

price-only competition amongst similar, competing sources of gas-fired capacity.

- Demand response has become a major resource for satisfying incremental capacity needs. Upgrades to existing plants have also been a significant source of incremental capacity in some areas. Gas-fired power plants have represented a shrinking fraction of new capacity, as shown in **Figure 4** for PJM.
- Much of the new capacity that has been offered into the FCCMs has shorter construction lead times than the three years considered necessary for new gas-fired generation (Figure 4). Demand response capacity, in particular, can be added in much less than three years. Upgrades and uprates of existing plants, another source of incremental capacity, also typically take less than three years to implement.
- In addition, peak load growth has been slowing.[17] This reflects the recent recession, but it also likely reflects responses to higher fuel and energy prices and increasing efficiency of electricity use over the past several years. As a result, long-term expectations of peak load growth and incremental capacity needs have been lowered.

As a result of weakening load growth, the development of new sources of incremental capacity other than gas-fired power plants, few retirements, and difficulties in obtaining financing, fewer gas-fired power plants have been built, and very few have been built entirely under merchant circumstances.

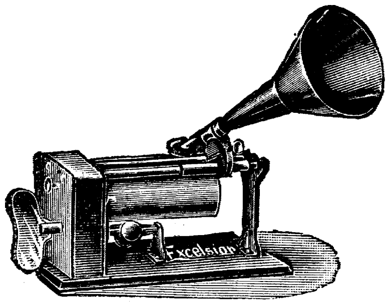
V. Another Reason FCCMs Are Not Operating as Expected: ''CONEfusion''

In addition to the changing circumstances described above, the FCCMs are not operating as some had anticipated due to a key misconception underlying their designs, which led to expectations that would not have been fulfilled even if conditions had remained largely unchanged.

FCCM designs, and expectations for their operation, were based on the notion that new capacity should and generally would be offered into the FCCMs at prices based on the resource's levelized cost of construction, net of anticipated market earnings (Net CONE). The notion that the sponsors of new capacity would offer their projects into the FCCM auctions at the prices they would need to earn, on average over the life of the project, to make them profitable has superficial appeal. However, it was never grounded in any sound economic or business logic (as this author pointed out in comments on the original RPM application[18]), and as shown in the preceding section, the FCCM auction results have now provided substantial evidence that new capacity is not priced on this basis in the FCCM auctions.

Only by coincidence would it be economically rational to offer a new resource into an FCCM auction at a price close to its levelized Net CONE. This is primarily because capacity resources are fixed assets that typically operate for 20 or more years, but the FCCM auctions provide a payment for only a single year (with rarely used exceptions[19]). If much longer commitments were being auctioned (as had been contemplated in early stages of FCCM design[20]), new, long-lived resources might rationally be offered at prices close to their levelized net cost, but this is not the case; the FCCMs offer one-year commitments and, therefore, are essentially spot markets for capacity. The economically rational offer price for a new resource into a one-year capacity auction will depend upon the resource's particular circumstances and its owner's expectations of future market conditions and could be much lower or higher than the levelized Net CONE value. The following paragraphs describe some of the circumstances owners may face and the implications for rational FCCM auction offer strategies and prices.

1. If the resource is under construction or under contract and, as a result, already largely committed to being in operation in the delivery year, the resource is in a similar situation to that of an existing resource from an economic perspective. Resources committed to being available by the delivery year would rationally offer into the auction based on their net going-forward cost or, if higher, opportunity cost.[21] For resources committed to being in operation by a delivery year, offering into the FCCM auction at a price higher than the net going-forward or opportunity cost (for instance, at Net CONE, or a price based on the resource's net long-run average cost) makes no economic sense, because this risks failing to receive a capacity supply obligation and capacity payment that would be attractive at a lower price level. For example, suppose the project's first-year net going-forward cost is \$100/MW-year. If it is offered into the auction at \$150/MW-year and the auction clears at \$120/MW-year, the sponsor has missed the opportunity to earn \$30/MW-year over its net going-forward cost toward fixed-cost recovery. If the sponsor has decided to go forward with the



project (for whatever reasons), it makes no sense to pass up this opportunity; the resource should have been offered at 100/MW-year (or a higher price based on the opportunity cost of an alternative to the capacity obligation).

2. A resource committed to being available in the delivery year might also be withheld from the auction, or offered at very high price. The owner might adopt this strategy if it is expected that prices might be higher in an incremental auction for the delivery year. If the owner believes offering the new resource will suppress the capacity price somewhat (this impact will be larger in zones) and owns a portfolio of other assets that will clear in the same auction, it may be rational to withhold the new capacity from the three-year forward auction and offer it into an incremental auction even if the price there is expected to be lower.

3. Resources not yet under construction or under contract, and, therefore, not committed to being available in the delivery year, face a ''go/no-go'' decision on whether to proceed with construction for the delivery year. For a long-lived asset, the decision depends upon the present value of the project's stream of anticipated net revenues over the life of the project compared to its construction cost, while also weighing in various uncertainties and risks. If the sponsor believes the project's net present value is positive (and delaying a year would not further increase anticipated profitability), the sponsor can be expected to decide to go forward with the project. The sponsor would then rationally offer the project into the first auction based on its net going-forward or opportunity cost (just as it would offer an existing resource or a new resource already largely committed to being available in the delivery year), or perhaps a somewhat higher price if the economics were so marginal that a higher price would be needed in the first year to decide to proceed.

4. The developer of a potential project who concludes that it is not expected to have a positive net present value, or the net present value might be greater if the

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construction were delayed, would tentatively plan to cancel or delay development of the project. However, it might be that a high enough price in the first auction could make building for the delivery year sufficiently profitable on a net present value basis. This threshold first-year capacity price would rationally be determined based on the project's expected net present value shortfall, not on its levelized cost or shortfall (see **Box 1** offering a numerical example based on this circumstance). It would be rational to offer into the FCCM auction at this threshold price, which could be much higher than the levelized Net CONE and might have little chance of clearing.

Box 1. The Economically Rational Offer Price is Not Net CONE (Illustrative Example)

Consider the sponsor of a project with a 20-year period of operation, who believes the project, if built, would have construction cost (expressed on a levelized basis) of $200/MW-year, earn $60/MW-year on average from energy and ancillary services markets, and earn capacity payments of $110/MW-year on average. Under these circumstances, the sponsor expects the project would lose $30/MW-year on a levelized or average basis. But if the project could average $140/MW-year (rather than the expected $110/MW-year) from capacity markets, it would break even.

Does this mean the sponsor should offer the resource into the first FCCM auction at $140/MW-year? No, that would not be economically rational and would lead to expected losses because if the first auction clears at $140/MW-year, it would only mean the project earns this payment in the first year of operation. The sponsor would need to believe it would earn at least $140/MW-year from the capacity market *on average over the life of the project* in order to break even.

Losing $30/MW-year on average over 20 years is a loss of $192/MW on a net present value basis (discounting at 15 percent). The project would break even if it could earn the extra $192/MW all in the first year. That is, if the sponsor's calculations reflected expectations of a $110/MW-year capacity price in the first year, the loss would be covered if the first auction cleared $192/MW-year higher, at $302/MW-year. Under these assumptions, it would be economically rational for the sponsor to offer the project into the FCCM auction at $302/MW-year, and if it clears, build it.

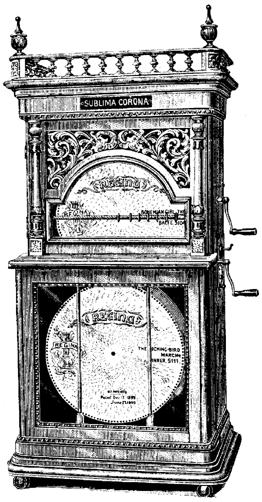
Note that if the sponsor offers the project at $140/MW-year (the amount that must be earned on average to break even), and clears, and if the sponsor's expectations of capacity prices and other revenues in future years prove accurate, the project will ultimately lose an amount of money equal to the difference between $302/MW-year and the clearing price in the first year.

5. The developer of a potential project who is mainly deciding whether to begin (or continue) construction or instead to delay the target commercial date would focus on the potential impacts of a delay on revenues and costs. The impacts of delay, in addition to the loss of the market revenues from the first year, could include additional costs to adjust contractual commitments pertaining to construction or future operation; the risk of rising construction costs; costs or risks associated with regulatory permits and requirements; and the risk that competing projects may go forward and commercial opportunities may be lost, among other considerations. The offer price into the FCCM auction for the first potential year of commercial operation would rationally be at the level required to make it worthwhile to target construction for that delivery year rather than delay, considering all of the potential costs, risks, and benefits of delay. This offer price could be much higher than the project's levelized Net CONE (if there are perceived net benefits to delay that only a high capacity price would overcome), or much lower than Net CONE (if the project is already largely committed to the first delivery year and/or there are substantial costs or risks to delay). This offer price could be near the project's levelized Net CONE if the various impacts of delay on costs and revenues happen to result in Net CONE being the value needed from the capacity market in the first year to make operation in the first year attractive compared to delay. However, this is unlikely to be the case, as price and revenue expectations for the first year are unlikely to be typical of expected long-run averages for a number of reasons, and there are likely to be other significant costs and risks of delay.

Note that even assuming there are multiple, competing new projects all based on similar combustion turbine (or some other) technology, and assuming all have similar construction costs, we should still expect a wide range of rational FCCM offer prices. This is because the various owners are likely to adopt different assumptions and approaches for financing the projects, and to have different expectations regarding future market conditions, energy prices, and net revenues from energy, ancillary services, and capacity markets over the life of the project.

The fact that new resources will not be offered at Net CONE but instead will rationally be offered at a range of prices reflecting project-specific circumstances and owner expectations helps explain why the FCCM supply curves have not exhibited a cluster of offers at Net CONE-based levels, and why the FCCM auctions have not cleared at prices close to Net CONE, as many had expected. Offer prices for new capacity will often reflect the net going-forward costs of the capacity (when sponsors have already decided to make the capacity available, perhaps due to contractual commitments or construction schedules), and, accordingly, FCCMs will often clear at price levels that accommodate some incremental sources of supply while also retaining all but the highest-cost existing generation. The supply curves may often be fairly elastic at such price levels, reflecting competition between new resources and the highest-cost existing resources, and prices may be stable at such price levels unless there are interventions to prevent the spot capacity markets from clearing supply and demand in this manner.

It is often stated that capacity market prices should reflect the market cost of new entry when new entry is needed. Of course, by ''cost of new entry'' is not meant the full cost of construction of a new power plant, because the full cost would not be recovered in a single auction, and some of the cost will be recovered through energy and ancillary services markets, not capacity markets. Therefore, ''cost of new entry'' could be interpreted as something



like levelized Net CONE, in which case, as explained above, there is little hope capacity market prices will reflect the ''cost of new entry'' so understood. Because the sponsors of new resources generally will not offer their new resources at prices based on Net CONE (and in any case, their Net CONE values may vary widely), FCCM supply curves will not include a significant amount of capacity at some ''cost of new entry'' level, and the auctions will not reveal and set price to a cost of new entry. However, the FCCMs are designed to allow prices to rise to the level necessary to clear sufficient capacity when new capacity is needed, so market prices will reflect the ''cost of new entry'' if that is understood to mean the price necessary to attract sufficient new capacity.

VI. Revising Expectations for FCCMs

In addition to the changes in industry circumstances described above, two new forces should be noted that will have an increasing impact on future capacity supply, demand, and markets:

- Many states have put in place aggressive targets for renewable resources. To meet these targets in some areas, renewable resources will have to be added at a rate that exceeds anticipated load growth.
- The Smart Grid, including advanced metering and smart devices, will result in loads that are increasingly price-responsive, reducing future peak loads and capacity requirements. Price-responsive demand may reduce and ultimately eliminate the need for centralized capacity markets, as discussed further below.

The changing industry circumstances and the revised understanding of the economics described in this article have several inter-related implications for how capacity markets should be designed and how they should be expected to operate.

A. New capacity should not be expected or required to offer at prices near Net CONE

As described above, the evidence from FCCM auctions is

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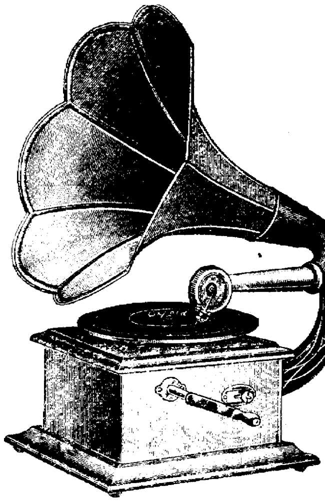
consistent with the economic analysis: We should not expect new capacity to be offered into the FCCM auctions at prices based on a resource's levelized net cost (Net CONE). Instead, new capacity will be offered at a range of prices reflecting each project's circumstances at the time the offer must be submitted and will often be much lower than estimates of the project's, or a reference resource's, Net CONE. Even pure ''merchant'' projects won't be offered at the project's levelized Net CONE as there is no economic rationale for offering at this price. Offer prices may also frequently reflect contractual commitments to provide service in the delivery year or regulatory incentives that reduce the amount that must be gained from capacity markets. The increasing diversity of new sources of capacity will also contribute to the range of offer prices. In many instances new capacity will be offered at low prices with the intention to clear in the auction. Accordingly, it is not appropriate to mitigate new capacity offers based on a comparison of the offer price to an estimate of the resource's levelized net cost or long-run average cost. Such mitigation imposes an inappropriate criterion and distorts auction results. As recognized in a recent Federal Energy Regulatory Commission order, mitigation should be imposed if an offer reflects an attempt by a buyer in a position to exercise market power to inappropriately suppress the auction price.[22]

B. FCCM rules should not discourage contractual or incentivized capacity additions

Much of the recent incremental capacity has become available



with regulatory incentives or under contracts, rather than entering the market on a purely merchant basis (relying solely on anticipated earnings in wholesale spot energy and ancillary services markets). This trend, which will only increase with the continuing emphasis on demand response and renewable resources, should be accepted and accommodated in FCCM rules. In industries such as electric power with costly, long-lived, fixed assets, capacity additions typically involve long-term contracts or some other strong assurance of revenue, such as could be provided through regulatory action, and the electric power industry historically worked this way. Contracts can provide both buyers and sellers assurance of price and/or quantity, hedging spot market prices, and lowering the cost of capital, and regulatory policies encourage long-term contracting.[23]

As noted earlier in this article, non-price attributes of energy sources such as environmental characteristics, fuel diversity, and fuel flexibility have become increasingly important in recent years. Contracting allows consideration of such non-price attributes, while the FCCM mechanisms, designed to procure a homogeneous capacity product, cannot. FCCM rules should accept new capacity offered at low prices that reflect incentives or contractual commitments; load-serving entities should be encouraged to be proactive in arranging for future capacity needs. This capacity contributes to meeting requirements and achieving desired levels of reliability at the lowest cost. Of course, if new resources are offered into an FCCM auction by a net buyer with the goal of suppressing the auction clearing prices, such offers should be mitigated.

C. FCCM auctions should not be expected to clear around Net CONE

Because new capacity will continue to be offered at a wide range of prices, and much of it will be offered at prices based on net going-forward cost with full intention to clear, we should not expect FCCM auction clearing prices to be stable at a level reflective of the Net CONE of a combustion turbine (or of any other type of resource that might be the most economical source of incremental capacity at some time), even when new capacity is needed. Instead, we should expect that in relatively large and competitive areas (such as the PJM RTO Region or the ISO New England Region), FCCM auction prices will continue to be considerably lower than Net CONE values, and instead will reflect the net going-forward costs of the highest-cost existing generation. At such levels, some new capacity will clear each year while some of the least efficient, highest-cost existing capacity will not clear.

Over time, FCCMs, as capacity spot markets, may exhibit price patterns typical of other spot markets: relatively low prices (compared to contract prices, and long-run incremental capacity costs) in most years, possibly rising to higher levels at times for short periods when needed to clear sufficient capacity.

In smaller zones where conditions are considerably less competitive, FCCM clearing prices are likely to be higher and more volatile, as has occurred to date in PJM's zones. High and volatile capacity prices in zones may be further exacerbated by overly conservative approaches to setting the capacity requirements for the zones since the resulting excessive requirements raise the clearing prices in the zones and depress the clearing prices in the surrounding RTO regions.

D. FCCM auction prices should be allowed to balance demand and supply

The FCCMs were designed based on the concept that clearing

prices should reflect the cost of new entry, when new entry is needed. This is a realistic expectation, with the ''cost of new entry'' understood to mean the price level at which sufficient existing and new capacity has been offered to meet reliability requirements. However, as explained earlier, there is no ''cost of new entry'' price at which most new capacity will be offered, so there is also no predictable or target price level to which prices should be expected to rise when new capacity is needed.

''Natural'' clearing of FCCM supply and demand leads to prices that reflect the true state of supply and demand at any time. It also supports efficient trading of capacity across RTO borders; capacity will naturally migrate to regions where capacity is more needed, as reflected in FCCM prices, leading to an efficient result.

E. FCCM auctions should not be expected to substantially influence new capacity decisions or to identify the new resources that should/should not be built

In every FCCM auction, some resources clear and others do not. However, it should not be hoped or expected that the fact that certain new resources clear indicates that they are the most economically attractive, while the rejected resources are less desirable and should not be built. That is, it should not be hoped that the FCCM auctions will constitute a market-based approach to determining the most cost-effective way to meet long-term incremental capacity needs, essentially determining a least-cost expansion plan, as some have imagined. The FCCMs will not accomplish this for at least two principal reasons. First, resources' offer prices generally will not be consistent with a ranking according to project value or net long-run average cost because offer prices will reflect many other considerations, as explained earlier. Second, offer prices will also not rank projects by their long-term economic value because they will generally not

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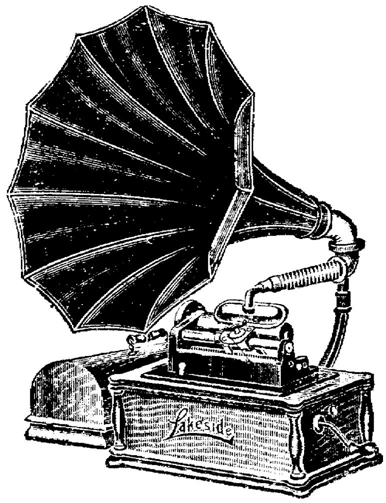
reflect increasingly important non-price attributes.

Furthermore, it should not be expected that whether or not a resource clears in the FCCM auction will be decisive for many resources. Decisions to bring forth new resources often will have been made by market participants before the FCCM auctions, with the results of such decisions reflected in the auctions – resources under contract or eligible for incentives offered at relatively low prices, and resources without contracts and not under construction offered at a range of prices, with some at very high prices. In addition, many existing plants that failed to clear in FCCM auctions to date have not been announced for retirement. This suggests that auction results are also not decisive for existing capacity in many instances.

FCCMs, as spot markets for capacity, will reflect the state of supply and demand rather than determine it. Hopes that FCCMs will play the larger role of a long-term market, determining the projects that will be built and those that will be retired, lead to misguided market design choices and should be dropped. Nor should FCCMs be modified to attempt to broaden the role beyond that of a capacity spot market, for instance, by offering long-term commitments or attempting to recognize non-price attributes. Such modifications would likely be complex and raise the cost to consumers while falling far short of accomplishing efficient resource planning.

F. FCCM zonal prices should not be expected to have much influence over where new capacity is built or existing capacity is retired

Where FCCMs have produced locational capacity prices, these prices have been volatile, and the available evidence suggests the higher locational capacity prices have not attracted relatively more capacity to the constrained areas. The evidence suggests that zonal capacity pricing results in unstable, unreliable price signals that do not have much direct influence on new capacity decision-making. In addition, the incentives to withhold existing and incremental capacity to further raise zonal capacity prices are strong for incumbents with substantial portfolios in the zone. Thus, locational capacity pricing may decrease rather than increase capacity market efficiency.



G. FCCM designs should anticipate increasing price-responsive demand and declining need for capacity mechanisms

As noted earlier, it has always been recognized that the centralized capacity market is a transitional mechanism whose role should diminish as wholesale markets further develop and the demand side becomes more actively involved. Utilities across the country are planning wide-scale implementation of advanced metering, and the implementation of the smart grid should greatly increase the extent to which peak demands are price-responsive. Revisions to wholesale and retail pricing mechanisms to more accurately reflect system conditions and capacity needs at all times (including scarcity pricing and critical peak pricing), together with the increasing availability of smart devices that can respond to such price signals, will lower peak loads and shift some peak demand to adjacent hours. As a result of this flattening of peak loads, price ''spikes'' may become less likely; however, there should also be many more hours with loads close to peak levels and somewhat elevated prices. Higher prices in a larger number of peak and near-peak hours should reduce and eventually eliminate the present disconnect between the amount of capacity that can economically operate relying on energy and ancillary services revenues and the amount of capacity considered required for reliability; and under such conditions, centralized capacity markets are no longer needed.[24]

FCCM designs should anticipate the declining need for substantial capacity payments as the Smart Grid and price-responsive demand develop. Provisions that attempt to stabilize prices or move them toward estimated long-term equilibrium levels, or that introduce lags in the capacity market's response to supply and demand conditions, will fail to clear short-term supply and demand and also delay the transition to the lower capacity payments consistent with a more active demand side in the markets.

H. Three-year forward mandatory obligations should be reconsidered

In proposing to impose capacity obligations and hold auctions three or four years in advance of each delivery year (rather than one year or less, the more common approach), PJM anticipated the following benefits from its RPM capacity construct in 2005[25]:

- Planned new resources not yet under construction would be able to compete with existing resources for capacity supply obligations, increasing supply and competitiveness;
- The auctions would provide ''relatively stable long-term price signals'' to incent investment and facilitate load hedging, and could be ''a deciding factor'' in decisions to construct new capacity;
- The forward capacity procurement mechanism would smooth out ''boom-bust'' cycles of construction activity, and
- Forward commitment would also eliminate short-notice announcement of retirements.

RTOs also value knowing, three years in advance, that there will be enough capacity, and the specific resources that are committed to provide the capacity.

These anticipated benefits reflected concerns at the time that not enough generation was being constructed and the existing capacity market construct did not produce stable long-term price signals. The benefits were anticipated to outweigh the potential drawbacks of the three-year forward approach, which included:[26]

- The risk that three-year forward load forecasts and the resulting capacity requirements could be inaccurate, leading to procurement of excess capacity and excess cost;
- The built-in bias in favor of three-year lead-time generation, such as gas-fired, as opposed to other types of generation and transmission that have longer or shorter lead times and to demand response providers, many of whom find it difficult to commit to load reductions so far in advance;
- The risk a three-year forward obligation imposed on some existing resources, such as older, inefficient plants that are uncertain of future operation and may retire, and
- The possibility that three-year forward procurement could discourage bilateral contracting.

Few of the anticipated advantages of the three-year forward approach have materialized. RPM prices have not been stable, and FCM prices have been stable only due to an administrative ''floor'' price. While there has been excess capacity and no evidence of a boom-bust cycle, adjacent markets that lack FCCMs (MISO, NYISO) also have excess capacity at this time. It is not clear the three-year forward capacity markets have accomplished anything that a one-year forward capacity market would not have, other than the advance identification (subject to later adjustment) of future capacity resources.

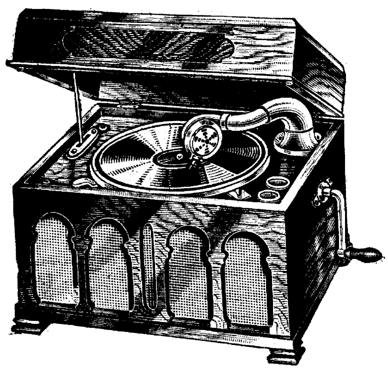
In contrast, disadvantages of the three-year forward approach have become reality, and the changing conditions have exacerbated their impacts. Forecasts of capacity

  doi:/10.1016/j.tej.2010.09.013

requirements for 2009 and 2010 were way too high, resulting in the acquisition of excessive amounts of capacity at excessive prices for these delivery years through the FCCM auctions held years in advance. As a result, the cost of capacity for these delivery years was billions of dollars higher than necessary for reliability. The risk that three-year forward forecasts of capacity requirements will be significantly wrong remains substantial at this time, due to the uncertain pace of economic growth, the potential impact of energy prices, increasing efficiency in energy use, and developing price-responsive demand.

The FCCMs also lead to excessive cost as a result of attempting to satisfy all (or nearly all[27]) of the forecast capacity requirement at a time when not all of the capacity that ultimately will be available for the delivery year is in a position to participate in the auction. This results in a mismatch between the auction's supply and demand that raises the clearing price. Many of the new resources that ultimately will be available for an upcoming delivery year have not been identified or are not prepared to offer into the FCCM auction three years in advance (most notably, demand resources), and some existing resources (such as older plants near retirement) find it risky to enter into a commitment three years in advance. In later, incremental auctions, where additional supply becomes available but generally not additional demand, prices are typically much lower.

While years-forward capacity procurement has become more costly and risky, the need for it has also declined. There is now much more flexibility to adjust capacity obligations closer to the delivery year than was anticipated when the three-year forward approach was evaluated



and selected, due to the new-found abundance of short-lead-time resources, including demand response, incremental upgrades to existing plants, energy efficiency, plant reactivations or delayed retirements, and imports from neighboring regions. This flexibility means that even if peak loads increase unexpectedly (contrary to state policies encouraging efficiency and peak-load reductions), it will likely be possible to acquire additional needed resources with short lead time.

Under these circumstances of high uncertainty and substantial flexibility, the need for and potential value of three-year forward mandatory procurement is lower and the associated risk is higher. Under present circumstances the costs and risks of the mandatory three-year forward approach may outweigh the potential benefits. While processes that reveal market supply, demand, and apparent adequacy years in advance are valuable, this can be accomplished to some extent through voluntary processes.

VII. Summary and Conclusions

The designs of the two centralized capacity markets that impose obligations years in advance, ISO New England's FCM and PJM's RPM, reflect the industry conditions at the time of their conception in the 2003 to 2005 period. The FCCMs have not operated in the way their proponents had expected. Changing industry circumstances contributed to the discrepancy; in addition, fundamental concepts upon which the designs were based have been disproven. It has now been seen that the expectation that new capacity would be offered at prices based on the levelized cost to build net of anticipated market earnings (Net CONE) was incorrect, and this also invalidates the expectations of stable prices and long-term price signals for investment.

This raises the issue of whether to allow the FCCMs' roles as capacity spot markets to evolve in response to the changing conditions and changing understanding of how they operate, or instead to attempt to force a stronger correspondence with the original, flawed theories and expectations. There would appear to be little need for or benefit to attempting to force such outcomes. With surplus capacity and slower load growth expected, demand response continuing to grow, plans to add substantial amounts of renewable capacity in the coming years to meet state goals, and the anticipated development of price-responsive demand, the need to attract new capacity under ''merchant'' circumstances, as assumed under the FCCM designs, is unclear. Instead, FCCM designs should be reconsidered to adapt them to the changing circumstances and to be grounded in realistic expectations of market conduct.■

Should we instead attempt to force a stronger correspondence with the original, flawed theories and expectations?

 1040-6190/$–see front matter , doi:/10.1016/j.tej.2010.09.013

Endnotes:

1. For further discussion of the rationale for capacity payments in wholesale electricity markets, see Paul Joskow, *Competitive Electricity Markets and Investment in New Generating Capacity*, MIT Center for Energy & Environmental Policy Working Paper No. 0609, June 12, 2006; Peter Cramton and Steven Stoft, *The Convergence of Market Designs for Adequate Generating Capacity*, Univ. of Maryland working paper, April 25, 2006; or William W. Hogan, *Acting in Time: Regulating Wholesale Electricity Markets*, FERC Conference on Competition in Wholesale Power Markets, May 8, 2007.

2. See, for instance, *PJM Interconnection LLC*, 115 FERC ¶ 61,079 (April 20, 2006) Para. 190–191.

3. The FCM rules are in ISO New England's Market Rule 1, section III.13, with information on auction results available at http://www.iso-ne.com/markets/othrmkts_data/fcm/index.html. The RPM rules are found in the PJM Tariff, Attachment DD, and information on auctions is available at http://www.pjm.com/markets-and-operations/rpm/rpm-auction-user-info.aspx.

4. The basic design for both FCM and RPM was described in a jointly funded report: NERA Economic Consulting, *Central Resource Adequacy Markets for PJM, NY-ISO and NE-ISO*, Feb. 2003. PJM proposed RPM in 2005, and a settlement process in 2006 resulted in the design that was submitted in Sept. 2006 and approved with few changes. FCM also resulted from a settlement filed in 2006.

5. The term ''Net CONE'' is used in RPM to refer to the levelized cost of construction net of a historical average of annual net revenue from sales of energy and ancillary services. Under FCM, capacity resources earn offsetting net revenues in energy and ancillary services markets as under RPM, however, the estimated amount of such revenue that a very-high-heat-rate peaking resource would earn is recaptured under the FCM rules as Peak Energy Rents (PER). Consequently, under FCM, very-high-heat-rate units retain no net revenues, and CONE and Net CONE are the same, while Net CONE will be less than CONE for other, more efficient resources. Under FCM, the term Net CONE is not used and the parameter called ''CONE'' is updated based on auction clearing prices year to year, so over time it has become unrelated to the CONE or Net CONE of a combustion turbine, or, for that matter, any other resource.

6. See, for instance, Affidavit of Joseph E. Bowring on Behalf of PJM

Interconnection LLC, submitted with PJM's Reliability Pricing Model Filing, FERC Docket Nos. ER05-1410-000 and EL05-148-000, Aug. 31, 2005, at 2 (''A competitive offer price in the RPM market for a new CT for its first year of operation equals the total annual fixed costs of the CT, less expected net revenues from all other sources.'').

7. See, for instance, CRA International, *Reliability at Stake: PJM's Reliability Pricing Model*, prepared for PJM Power Providers, May 5, 2008, at 32 (''Introducing new entry into the market adds a long, fairly flat segment to the supply curves, as shown in Figure 14A. . .'' and suggesting this results in clearing at Net CONE.) The report is available at http://www.p3powergroup.com/siteFiles/News/78216655F463A2810314AD68BD1BBCF9.pdf.

8. Under FCM, various price thresholds for market power mitigation are linked to the CONE parameter, and a ''Quantity Rule,'' calling for deferral of capacity purchases under certain circumstances, is also linked to the parameter. Under RPM, offer prices are compared to Net CONE for mitigation purposes, and Net CONE is also the price parameter of the sloped capacity demand curve, among other roles.

9. For instance, PJM's RPM Application stated (p. 14), ''Where transmission solutions are more cost-effective than installing generation, those transmission solutions will be selected in the auction.'' In support of the RPM Application, PJM witness Steven Herling stated (p. 15) that the RPM auction ''allows for direct comparison between the benefit offered by the transmission upgrade versus the benefits offered by competing generators.'' PJM Interconnection LLC, Reliability Pricing Model Filing, FERC Docket Nos. ER05-1410-000 and EL05-148-000, Aug. 31, 2005, and Affidavit of Steven J. Herling on Behalf of PJM Interconnection LLC, an attachment to the Application. The view that forward capacity markets can lead to optimal resource expansion has also been expressed more recently in support of implementation of forward capacity markets. In a California Public Utilities Commission proceeding to consider alternatives (such as a forward capacity market) for providing resource adequacy, the California Independent System Operator (CA-ISO) states (p. 1) that it believes the goal of the proceeding should be to design a program ''that will facilitate open and efficient competition to produce the optimal, cost-effective mix of infrastructure investments.'' CA-ISO favors a centralized capacity market with mandatory obligations three years in advance, stating (p. 8), ''As another benefit, a central capacity market would provide an explicit platform for evaluating whether investment in new supply and demand response resources could substitute for a transmission upgrade into a constrained local load area. . .. The central capacity market would provide the mechanism both for making the economic decision between transmission and non-wires alternatives and for committing the suppliers to deliver those non-wires resources that clear the market.'' Comments of California Independent System Operator on Revised Proposed Decision, California Public Utilities Commission Rulemaking 05-12-013, April 16, 2010.

10. See, for instance, Affidavit of Benjamin F. Hobbs on Behalf of PJM Interconnection LLC, Aug. 31, 2005, in Docket Nos. ER05-1410 and EL05-148. Prof. Hobbs' model assumed all entry would be by combustion turbines all having the same cost, and the model predicted stable prices.

11. Additional ''incremental auctions'' (RPM terminology; under FCM they are called ''reconfiguration'' auctions) have also been held for these delivery years. The purpose of these additional auctions is to allow market participants to adjust their capacity commitments from the primary, three-year forward auctions, and these auctions involve much smaller quantities. The primary, three-year-forward auctions are the most important element of the FCCM mechanisms and the main focus of the discussion in this article.

12. The most recent RPM auction used Net CONE values ranging from \$227.20/MW-day to \$317.95/MW-day. The original CONE value used in FCM was \$228.13/MW-day.

13. A power plant's net going-forward cost is the cost it must incur to operate in a year with a capacity obligation, net of anticipated market earnings, and could avoid if not operating with a capacity obligation. In principle, if a plant cannot receive this amount from the capacity market, the owner should find it more attractive to shut down for the year or to sell the plant's output into an adjacent region than to operate with the capacity supply obligation.

14. PJM's summaries of recent and planned retirements are available at http://www.pjm.com/planning/generation-retirements.aspx.

15. See, for instance, North American Electric Reliability Corporation, 2009 Long Term Reliability Assessment 2009–2018, Oct. 2009.

16. This evidence is presented in detail in *Direct Testimony of James F. Wilson in Support of First Brief of the Joint Filing Supporters*, filed July 1, 2010, in FERC Docket No. ER10-787, Section V.

17. PJM's weather-normalized, unrestricted peak load grew at a 2.7 percent/year rate from 1998 to 2005, and 0.7 percent/year from 2005 to 2008, before declining 1.9 percent in 2009. PJM's unrestricted peak load is now forecast to grow 1.1 percent per year from 2015 to 2020; three years ago growth during that period was expected to be 1.4 or 1.5 percent per year. PJM Load Forecast Report, Jan. 2010, Tables B-1 and F-1, and PJM Load Forecast Report, Jan. 2007, Table B-1. Similarly, ISO New England now forecasts 1.1 percent/year growth in unrestricted peak load after 2015, compared to somewhat higher rates in earlier forecasts. ISO New England, 2010–2019 Forecast Report of Capacity, Energy, Loads, And Transmission (CELT Report), April 2010.

18. I explained why new capacity would not be offered based on levelized cost in comments in response to PJM's original application to implement its RPM capacity mechanism and at various times since; and the explanation is equally applicable to FCM. See, for instance, Affidavit of James F. Wilson on Behalf of The Public Power Association of New Jersey, Docket Nos. ER05-1410 and EL05-148, filed Oct. 19, 2005, at 15–17; Affidavit of James F. Wilson on Proposed Changes to the Reliability Pricing Model in Support of Protest of RPM Load Group, filed Jan. 9, 2009, in Docket No. ER09-412-000, P. 194–201.

19. ISO New England's Market Rule 1 sections III.13.1.1.2.2.4 and III.13.1.4.2.2.5 provide new generation and demand response, respectively, the opportunity to elect up to four additional and consecutive capacity commitment periods at the price set in the first auction, adjusted for inflation. However, in the first two capacity auctions, only 15.5 percent of new demand response and 4.5 percent of new generating capacity took advantage of the multi-year option, according to auction results posted on the ISO New England website. PJM's Tariff, Attachment DD, section 5.14(c) provides a similar opportunity to lock in the first year auction price for additional years. However, the opportunity is quite restricted and has never been used.

20. NERA Economic Consulting, *Central Resource Adequacy Markets for PJM, NY-ISO and NE-ISO*, Feb. 2003 (at 22–29, discussing and evaluating commitment periods from one to 10 years in duration, and ultimately recommending a three-year commitment period).

21. A resource's opportunity cost reflects its other available opportunities for operation during the delivery year, such as selling its capacity and output into a neighboring region. In principle, the capacity price must be high enough to make accepting a capacity supply obligation attractive relative to other available opportunities.

22. 131 FERC ¶ 61,065, Order on Forward Capacity Market Revisions and Related Complaints, April 23, 2010, Para. 75–77.

23. *Wholesale Competition in Regions with Organized Electric Markets*, 125 FERC ¶ 61,071 (Order 719) at P. 151.

24. This is further explained in James F. Wilson, *Reconsidering Resource Adequacy*, Part 1, Pub. Util. Fortnightly, April, 2010, and Part 2, Pub. Util. Fortnightly, May 2010, primarily in Part 2 at 46–47. These articles are available at http://www.fortnightly.com/exclusive.cfm?o_id=310 and http://www.fortnightly.com/exclusive.cfm?o_id=355.

25. *PJM Interconnection, L.L.C.*, 115 FERC ¶ 61,079 (April 20, 2006) Para. 57.

26. *Id.*, Para. 60–66.

27. Under RPM, 2.5 percent of the Reliability Requirement is acquired through the incremental auctions. PJM Tariff, Attachment DD section 5.10 (a) (Variable Resource Requirement curve is determined taking into account the Short Term Resource Procurement Target).