



Comments on the PJM Capacity Performance Proposal

September 2014

Introduction

PJM issued a Capacity Performance Proposal (hereafter referred to as the “proposal”) on August 20th, 2014. The proposal defines a new capacity product, Capacity Performance, to address the reliability issues experienced during the winter of 2013/2014. PJM is requesting stakeholder written comments.

The Ohio Manufacturers’ Association Energy Group (OMAEG) is pleased to provide comments on the proposal. The OMA represents over 1,400 manufacturing businesses in the state of Ohio on matters of public policy, including energy policy. The OMAEG is a non-profit entity created by the OMA for the purpose of educating and providing information to energy consumers, regulatory boards and suppliers of energy; advancing energy policies to promote an adequate, reliable, and efficient supply of energy at reasonable prices; and, advocating on behalf of OMA in critical cases regarding energy regulatory matters. A core concern of the OMAEG is maximizing inclusion of lowest-cost energy resources in electricity planning. Unreliable energy is of highest-cost to a manufacturer and its workers, as the cost of a power outage is the cost of lost business. Therefore, reliable electricity is a critically important concern to the OMAEG. The OMAEG’s interests also include ensuring reliability needs with the lowest-cost mix of resources.

Executive Summary

PJM’s proposal highlights four distinct issues that contributed to the reliability issues in January 2014:

- Record cold-weather peak electric demand
- Limited natural gas availability due to coincident peaking electric and natural gas demand
- No availability of warm-weather demand response (DR) capacity
- Cold-weather related operations and maintenance (O&M) shortcomings at generation facilities

PJM’s proposed Capacity Performance product creates incentives and penalties designed to promote reliable *annual capacity resources* to meet *winter coincident peaks*. The mismatch of annual products to winter-time reliability ignores several root issues:

- Cold weather capacity resources are not organized by PJM - PJM capacity markets are organized with a focus on warm-weather, summer peaks in electric demand. For example, currently both capacity pricing and capacity products are geared towards meeting summer coincident peaks. As a result, the cost of cold-weather demand is not currently factored into capacity pricing. Additionally, there are no distinct cold-weather capacity products, as there are for summer peaks. In other words, there is currently no organized market at PJM for cold-weather reliability.

PJM states repeatedly that the Polar Vortex-induced reliability concerns are the impetus for the proposal. It follows that an organized market for cold-weather reliability would consist of both pricing on cold-weather peaks, and also cold-weather products. Capacity Performance may or may not create pricing based on cold weather peaks¹, as PJM has presented two cost allocation models. Moreover, Capacity Performance promotes high availability annual resources. While high annual availability is important, it is not the root cause of the reliability concern. PJM has suggested that generator investment in O&M is likely already sufficient for high probability events that would occur annually, but perhaps not sufficient for low-probability events such as extreme cold weather. However, capacity resources participating as Capacity Performance would be annual resources, excluding participation of cold-weather capacity resources.

Inclusion of cold-weather products is important, as it would allow least-cost resources such as cold-weather demand response and energy-efficiency to provide least-cost reliability. Consider that PJM's Independent Market Monitor found that eliminating DR and efficiency from the 2017/18 capacity auctions increases costs from approximately \$7 billion to \$16 billion. It is reasonable to conclude that eliminating winter DR and efficiency products could have a negative impact on the price of cold-weather reliability.

- Coincident electric and natural gas peaking – Considerable outages of natural gas plants occurred due to unavailability of natural gas. It is probable that natural gas fueled power plants will become even more prevalent in the future due to low natural gas prices and proposed EPA regulations on the electric generation sector. In fact, EIA estimates that 70% of all new generating capacity could be natural gas from 2020-2035². Thus, it is possible that coinciding winter electric and gas peaks will be common if not exacerbated over time, creating stress on both the electric grid and natural gas network, and thus potentially raising prices for both electricity and natural gas. Thus, capacity resources which reduce both electric demand and gas network demand are of critical importance. Combined heat and power (CHP), cold-weather demand response, and cold-weather energy-efficiency all have the potential to provide significant electric capacity and reduce natural gas network consumption. CHP alone has a technical potential of over 44,000 MW within PJM territory – more than the forced outages of Jan. 7.

Accordingly, OMAEG recommends that PJM consider the following:

- Pricing cold-weather coincident peaks into capacity markets
- Developing cold-weather capacity products, including cold-weather DR and energy-efficiency
- Allowing CHP as an eligible capacity resource

This would allow PJM to procure winter reliability at the least cost to consumers, while simultaneously reducing stress on the natural gas network.

¹ PJM Capacity Performance Proposal, Section iX

² http://www.eia.gov/forecasts/aeo/MT_electric.cfm#electricity_coal

Cold-Weather Capacity Pricing

Accurate costing of reliability is an important part of a well-functioning capacity market. For example, in practice there has been a noticeable increase in the number of manufacturers managing their peak load contribution (PLC) of summertime coincident peaks, and increasing sophistication of their management. This increase in sophisticated management is a likely response to proliferating retail products offered by commercial retail electric suppliers. Although having warm-weather specific capacity products is an important tool in meeting summer reliability at the lowest cost, so is accurate pricing of the cost of summer reliability.

Winter reliability now has a cost. As such, manufacturers and other businesses can best manage their contribution to this cost with accurate pricing that is based on winter-time coincident peaks. Capacity Performance, as proposed by PJM, is based on winter peak load requirements. PJM proposes allocating costs to winter peaks in Cost Allocation Option 2.

Cold-Weather Capacity Products

A major focus of PJM's Reliability Pricing Model (RPM) capacity market historically has been creating price signals and capacity products for when the electric grid has been historically most stressed, namely, warm-weather peaks. For example, the cost of reliability to many consumers is based on their electric demand during five coincident peak hours during the summer. Thus, one way in which reliability is managed by PJM is via a price signal to meet warm-weather capacity. A complimentary way in which PJM manages reliability is through several capacity products which are specific to warm-weather, including:

- Limited DR – Limited demand response is available for interruption June through September, 12 pm through 8 pm, for 6-hour durations. Limited DR is available for interruption at least 10 hours per year.
- Extended Summer Product – Extended Summer capacity is available May through October, 10 am to 10 pm, for 10 hour durations, with unlimited calls. Extended Summer includes demand response as well as energy-efficiency resources.

PJM allows generation, demand resources such as demand response and energy-efficiency, transmission upgrades, and storage to be bid to meet the forecast load in competitive auctions.

Numerous sources have concluded that the least-cost resource to meet capacity needs is cost-effective energy-efficiency and demand response. PJM's Independent Market Monitor (IMM) starkly illustrated this in a 2014 study which tested the sensitivity of eliminating demand response and energy-efficiency from the 2017/18 PJM Base Residual Auction. The IMM found that reliability was unchanged, though capacity costs increased from approximately \$7 billion to \$16 billion. These findings suggest that a strategy for meeting cold-weather reliability at the least-cost would maximize the use of demand response and energy-efficiency in cold-weather products.

Accordingly, OMAEG recommends that PJM consider developing products similar to what is offered for warm-weather peaks, such as "Cold-weather Limited DR" and/or "Extended Winter Product". Cold-

weather demand response and energy-efficiency could play major roles in these products. In addition to low-cost capacity, both of these demand resources would reduce peak consumption from the natural gas network, which while not in PJM's jurisdiction, is of critical interest to manufacturers.

Provided below are examples of these cold-weather DR and EE products, and reasons why they would be precluded from participation in PJM's proposed Capacity Performance product.

Cold-weather demand response

PJM notes in the Capacity Performance proposal that winter peak load days pose a unique operational challenge, with two peaks occurring, as opposed to one peak during summer days. According to Figure 2 of PJM's proposal, the winter peaks occur from approximately 7 am to Noon, and then from 6 pm to 10 pm. The unique shape of the winter peak is a function of diurnal heat gain from solar loads impacting heating requirements of buildings, ie, buildings require less space heat from Noon to 6 pm due to solar gain and higher daytime temperatures. Between the night-time hours of 10 pm and 7 am, space heating loads are typically higher, but for unoccupied commercial buildings can be easily trimmed. Additionally, appliance and lighting loads are lightly used, and offset the increased heating requirements.

Commercial buildings and heating systems are actually well suited to shift heating loads from the dual day-time peaks to the mid-day and night-time troughs. Commercial buildings have a fair amount of thermal mass which creates a lagged response time of space temperature to energy consumption. In other words, many commercial buildings could be fully heated prior to 7 am, and adequately "float" through noon with no impact to occupant comfort but with considerable reduction to electric and natural gas uses. Similarly, thermal mass could be used to float through the evening peak, effectively flattening the dual winter-day peaks. This type of cold-weather demand response is widely available, and at low cost, considering that little additional capital equipment is needed.

This is but one example of cold-weather demand response that could have significant, low-cost contributions to meeting reliability for cold-weather peaks. However, no product utilizing this type of demand response has been included in PJM's proposal. Capacity Performance, as well as Base Capacity-Annual Demand Resources, requires year-round availability. DR which trims cold-weather peaks from cold-weather uses (e.g. space heating) is not available year round. Also, the warm-weather Limited DR and Extended Summer products would preclude cold-weather DR from participating.

Cold-weather energy-efficiency

Similarly, a fair amount of permanent demand reduction from energy-efficiency that reduces cold-weather peaks is not currently bid into PJM's capacity auctions. Specifically, upgrades in efficiency to heat-pumps and ancillary heating equipment such as fans and pumps would not be eligible in current or proposed PJM products. These efficiency upgrades would result in permanent demand reductions during cold-weather peaks, as they impact space heating equipment. However, efficiency that trims cold-weather peaks is not available year round, as required by Capacity Performance and Base Capacity products. The warm-weather Limited DR and Extended Summer products would also preclude such cold-weather efficiency from participating.

Combined Heat and Power

While combined heat and power (CHP) is never explicitly mentioned in the proposal, it is clear that CHP offers one of the best solutions to the challenges specific to the PJM area and this proposal. CHP systems can operate as highly flexible capacity resources, as well as reliable and consistent efficiency resources. By greatly improving the efficiency of natural gas consumption, and by producing thermal energy that could actually replace the need for additional natural gas boilers and furnaces, CHP systems could cost-effectively meet the requirements of PJM's proposal's identified performance product.

For over a century, CHP systems, which generate both electric and thermal energy from a single fuel input, have been reliably providing individual facilities, cities, and utilities with heating, cooling, and power. These systems can be found at over 4,000 locations around the U.S., and currently account for about 12% of all power generated in the U.S. [1], [2]. Today CHP is found primarily in the industrial sector, though it is increasingly being deployed in the commercial and multi-family sectors [3]. CHP systems have helped stabilize area grids, fostered fuel flexibility, and offered facilities additional resilience during times of disaster, such as Superstorm Sandy and Hurricane Katrina [4].

CHP systems generate much more useful "work" with a single fuel input compared to a typical power generating unit. The average fuel efficiency of a power plant in the U.S. is just over 34%, and the combined efficiency of power from these plants, paired with an average boiler, is about 45% [2]. In contrast, today's CHP systems can easily offer a combined electric and thermal efficiency of 65%-75%, and many regularly operate at or above 80% [2]. CHP systems make much more efficient use of fuel than traditional generators and boilers, and that fuel is most often natural gas, which powers 72% of the country's in-place CHP systems [3]. The current U.S. fleet of CHP systems operating today avoids the additional consumption of over 1.9 quadrillion BTUs of fuel [2].

CHP systems are highly reliable. These systems proved fundamental to the sustained performance of critical facilities such as hospitals and water treatment facilities during Superstorm Sandy. As a result, the U.S. Department of Energy commissioned a report reviewing these CHP success stories in order to encourage cities and states to view CHP as an integral component of any resiliency plan for critical infrastructure [5]. While other types of backup generation have failed during major disasters, CHP has proven itself so reliable that states such as New Jersey and New York have developed specifically targeted programs to deploy CHP that can provide "continuous power and heat during power outages" [5]. Similarly, in response to grid power failures during Hurricanes Katrina, Rita, and Ike, the hurricane-prone states of Texas and Louisiana both adopted legislation that calls for all state and city buildings deemed "critical facilities" to conduct feasibility assessments for CHP when under initial construction or major renovation [4], [6]. Both efforts recognized that CHP was more reliable than diesel-powered backup generation, and that CHP systems were well-positioned to mitigate stress on the grid during times of disaster.

While CHP capacity is present within PJM's footprint, the potential CHP capacity within PJM states is substantial, as demonstrated below. Table 1 identifies the existing CHP capacity installed in PJM states, as well as the current technical potential for CHP. This table reflects a fairly conservative estimate of technical potential, looking only at existing facilities, and considering CHP systems sized only to meet the

on-site thermal needs. These estimates do not include assessments of larger CHP systems that might meet the power or thermal needs of multiple sites.

Table 1: Existing and Potential CHP Capacity, PJM States

State	Existing (MW)	Current Technical Potential (MW)
Delaware	53	398
Illinois	1,276	5,354
Indiana	2,262	2,705
Kentucky	123	2,539
Maryland	714	1,756
Michigan	3,064	4,408
New Jersey	3,055	3,801
North Carolina	1,541	4,358
Ohio	521	5,951
Pennsylvania	3,307	6,115
Tennessee	495	2,737
Virginia	1,731	3,060
Washington, DC	15	321
West Virginia	382	789
Total	18,539	44,292

Data source: [2]

Both existing CHP and new CHP could play important roles as capacity performance products. Depending on business decision-making criteria, state-level policies and incentives, and a variety of other factors, only some portion of the above technical potential is likely to be deployed. However, the availability of additional revenue streams, such as those resulting from selling performance capacity and other capacity products, would likely hasten the deployment of some portion of this identified technical potential.

CHP as Flexible Capacity Resource

Areas of the country with constrained grids have increasingly looked to CHP to alleviate congestion and avoid costly system upgrades. In New York, Con Edison views strategically-sited CHP systems as an important capacity resource. In fact, by deploying CHP to reduce strain on its distribution system and shaving the peak demands of some of its largest customers, Con Edison has found that it is often able to avoid economically unattractive peak-time capacity market purchases. Many of the CHP systems providing these services allow Con Edison access to telemetry-enabled real time data, and the utility views these systems as true capacity assets on its system [1].

CHP systems are much more flexible grid assets than traditional generation plants. This is due to the fact that CHP systems are sited at facilities that require thermal energy for processes or comfort. CHP systems can and do oscillate between generating more power and less heat, or vice-versa. In many cases CHP systems are combined with thermal storage, such as hot water tanks or chilled water tanks that

allow them to generate and store thermal energy when electricity is not in high demand. They can also rely on thermal storage to provide needed on-site thermal energy when it makes economic sense to generate more power.

In a number of European countries, the peak-time capacity services offered by CHP are well known and thoroughly integrated into transmission system operations and planning. Distributed CHP systems bid into capacity markets, and are able to quickly ramp up or down and take advantage of the storage capabilities of connected district heating systems or onsite heat storage [7], [8]. In Denmark fuel-to-power arbitrage is achieved via a coordinated system of natural gas-fired CHP plants, heat storage, and large-scale heat pumps. Denmark experiences both its peak electric and natural gas demands in the winter, and it relies substantially on natural gas-fueled CHP systems to balance its electric system and squeeze the most useful energy from its natural gas resources during these times.

There are already places in the U.S. where facilities are taking advantage of CHP's flexibility. Princeton University, in the PJM footprint, offers an excellent example of how CHP systems can leverage their thermal storage for the benefit of the grid. A cold-water storage tank allows the university to generate and store chilled water during the night, taking cooling-related strain off the grid in the day. Princeton uses its 14.6 MW CHP and its thermal storage assets to optimize its production of power, steam, and chilled water throughout the day, explicitly structuring its production to avoid peak-time purchases of grid power from PJM [9].

CHP systems can provide short time period capacity services, such as frequency regulation service, as well as long-term capacity resources, such as those sought in the proposal. In fact, CHP systems are perhaps better suited than other types of traditional generation to provide these services, since certain prime movers used frequently in CHP configurations, such as reciprocating engines, "are more amenable to ramping than large turbines" [10]. According to one company that helps CHP owners participate in ancillary services markets, CHP systems do not need any additional special equipment to participate in ancillary services markets, except perhaps additional control systems [1].

CHP participates as a demand response resource in several ISOs around the country, including PJM. In the ISO-NE, a 2MW CHP system at a lumber mill regularly participates in the demand response market, as does a CHP system at the Massachusetts Institute of Technology. Princeton University also uses its aforementioned flexibility to participate in PJM's demand response market [1].

CHP systems can also be geographically targeted to provide the greatest possible capacity relief. As systems near their peaks, line losses increase exponentially, making strategically sited CHP even more valuable during the peak periods discussed in the proposal. Though average lines losses range somewhere between 6 and 10%, marginal losses are much more pronounced as the system nears full capacity, reaching upwards of 20% at full system load [11]. Multiple analyses have found that geographically targeted distributed generation, such as CHP, could avoid major line losses, with one study finding that 80GW of new distributed generation sited at the more vulnerable areas of the grid "could cut U.S. line losses in half" [12]. In addition to line losses, other components of the grid, such as transformers, are more stressed as a system nears peak demand, failing at a rate also exponentially linked to rising load [1].

CHP as an Energy Efficiency Resource

Because most existing CHP systems are serving industrial facilities, the heat demand they meet is most often process-related, rather than for comfort or space heating. As an energy efficiency resource, then, their performance during the winter should be as efficient as the summer. Additionally, in situations where CHP is providing space heating or domestic hot water, its efficiency benefits will likely be more pronounced in the winter than the summer.

Several states are successfully relying on CHP as an energy efficiency resource capable of delivering reductions all year. CHP systems are subject to extensive measurement and verification requirements in these states. Massachusetts, which has aggressive efficiency goals and has extensively encouraged CHP within its energy efficiency programming, has found that CHP plays a critical role in meeting efficiency needs. In one recent program year, CHP savings alone accounted for 30% of the state's commercial and industrial efficiency savings. Massachusetts has also found CHP to be the most cost-effective efficiency resource available in certain program years [1]. Recognizing the efficiency benefits of CHP, Massachusetts has set an official goal for its utilities that CHP will provide 5% of their system loads by 2020. [1]

Many of the states within PJM's territory have specifically included CHP systems in their energy efficiency programs because they offer such reliable year-round efficiency benefits. New Jersey and Maryland both have recently launched new, aggressive CHP incentives and targets, identifying CHP systems as critical and cost-effective efficiency resource that had heretofore been relatively untapped [14]. Baltimore Gas and Electric (BG&E) has pre-approved nine new CHP projects totaling 8.6 MW, and its initial round of funding saw all accepted projects fall within an impressive combined fuel efficiency range of 68% to 82%. While projects funded in the first round are to be implemented, BG&E felt strongly enough that the program was yielding important and reliable efficiency resources that it sought and received approval for a second round of CHP project funding, for projects that will be built by 2016 [14].

CHP offers ratepayers a low-cost energy resource. Multiple analyses have found the levelized cost of CHP-provided power to be less than that from more traditional centralized generation [1], [3]. As pure energy resources, CHP systems can meet or beat the economics of a wide variety of alternative generation resources that are more typically considered during resource planning activities.

Critically, CHP systems are typically high load factor customers, requiring substantial but constant demand for natural gas. Their consumption patterns are quite different from typical natural gas-using customers, and they are attractive to natural gas utilities for these exact reasons. Indeed, several natural gas utilities around the country, such as Philadelphia Gas Works, have designed CHP-specific programs due to the fact that they view CHP as having a calming effect on their daily system fluctuations. Additionally, states such as Connecticut and New York and utilities such as New Jersey Natural Gas offer CHP-using facilities reduced gas rates or freedom from gas delivery charges entirely. These programs recognize the increased efficiency of CHP and the many benefits of having a greater number of high load factor customers, including improved planning and forecasting accuracy [13].

Additional Considerations for CHP

As PJM considers its long-term transmission system planning to comply with FERC Order 1000, it is important to note the key role CHP can play as a non-transmission alternative. CHP has proven itself to be an effective way to avoid major transmission and distribution infrastructure investments [3]. Utilities such as Con Edison in New York now specifically deploy CHP in areas with challenged distribution infrastructure. Relieving local distribution bottlenecks reduces the maximum capacity that transmission systems must be built to meet [11]. While CHP can play an important role as a performance capacity resource, it could also offer cost-effective transmission solutions that could benefit the entire PJM region.

Finally, the states in PJM's footprint will soon be facing new federal goals for power-related CO₂ emissions. Certain resources that would be well-suited to meeting the reliability needs identified in this proposal, such as CHP and energy efficiency, are also viewed favorably as tools to help states comply with their new federal CO₂ targets [15], [16]. As states consider the design of their compliance plans, PJM could benefit from coordinated efforts to both mitigate winter reliability concerns and reduce CO₂ emissions. Assets such as CHP and energy efficiency would reduce the need for more costly transmission and generation infrastructure and improve winter reliability, all while helping states meet their CO₂ goals in the most cost-effective way possible [15].

Conclusion

In conclusion the OMAEG has interest in ensuring cold-weather reliability at the lowest-cost to consumers. Accordingly, OMAEG recommends that PJM thoroughly consider the reliability and cost impacts of the following:

- Pricing cold-weather coincident peaks into capacity markets
- Developing cold-weather capacity products, including cold-weather DR and energy-efficiency
- Allowing CHP as an eligible capacity resource

Moreover, OMAEG recommends that PJM take into consideration the impact of capacity products on the natural gas network, since several types of generation and demand-side resources impact both electricity and natural gas markets.

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