Constellation Energy Group's Acquisition of Calpine Corporation

A review of market power impacts

Prepared for Public Citizen, PennFuture, and Clean Air Council

March 25, 2025

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1. INTRODUCTION

On January 24, 2025, Constellation Energy Corporation and Constellation Energy Generation, LLC (together the "Constellation Applicants"), together with Calpine Corporation and its public utility subsidiaries (together the "Calpine Applicants"), jointly "the Applicants", filed an application before the Federal Energy Regulatory Commission for authorization for the Constellation Applicants to acquire the Calpine Applicants (the "Transaction"). Synapse Energy Economics, Inc. was retained by Earthjustice on behalf of Public Citizen, PennFuture, and Clean Air Council to assess the potential impacts of the Transaction on market power and market prices in PJM Interconnection, L.L.C. ("PJM").

2. APPLICANTS' EVALUATION OF MARKET IMPACTS

The Applicants engaged consultants to evaluate the competitive effects of the Transaction and determine whether it results in market power concerns. The Applicants' consultants performed a Competitive Analysis Screen to examine the horizontal market power effects of the Transaction. As part of the competitive analysis, the Applicants' consultants calculated the Herfindahl-Hirschman Index (HHI) to determine whether the post-transaction market in various regions would become more concentrated. According to the analysis, an increase in HHI above 100 in a moderately concentrated market or above 50 in a highly concentrated market would result in a "screen violation" and require further analysis, and potential mitigation, of market power concerns. However, as discussed below, this analysis is inadequate and obscures the fact that market power is already a concern in PJM and that it would be further exacerbated by the Transaction.

2.1. The HHI Metric is Not Sufficient to Determine whether the Transaction is Consistent with the Public Interest

Based on changes in the HHI for each market, the Applicants argue that the Transaction has no adverse effect on competition, as it would not result in any screen violations following the proposed divestiture of certain generating units in eastern PJM.[1] However, the HHI is a simplistic metric and is inadequate to determine whether a transaction is consistent with the public interest, in part because it does not account for the structure and complexities in regional energy markets, nor does it account for ownership of generation along the supply stack.

[1] The Applicants note that screen violations do occur under certain operating conditions in certain markets that the Commission has, in the past, recognized as submarkets. Application. Page 11.

The HHI has been widely criticized as misleading or inadequate because a market participant with a relatively small market share may still be able to exercise market power.[2] This is largely because HHI is a static measure of market concentration, while actual market conditions—such as demand, generation availability, and transmission constraints—can change rapidly. As a result, when demand approaches system capacity, a supplier can become pivotal and exert market power, even if their overall market share is relatively small.[3]

As noted by an economist at the U.S. Department of Justice, "[w]hat matters for figuring out whether a firm can exercise market power is not necessarily its overall market share, but a firm's ownership share of the various types of units along the industry supply curve at any instant."[4] In particular, the "combination through merger of inframarginal plus marginal capacity can lead to a post-merger price increase."[5]

Because market power can be exercised even when the HHI in that market has been calculated to be unconcentrated, additional analysis is required to determine whether the Transaction is consistent with the public interest.

3. FACTORS CONTRIBUTING TO THE ABILITY AND INCENTIVE TO EXERCISE MARKET POWER

In electricity markets, generating units are generally dispatched in merit order from the lowest to the highest marginal cost. The most expensive unit dispatched to meet demand—known as the *marginal unit*—sets the market clearing price for electricity in that hour. A merger or acquisition can increase market power if it enhances a supplier's ability and incentive to withhold generation from the market, thereby raising market clearing prices.

Withholding can take two forms: physical or economic.

[2] U.S. Department of Justice and the Federal Trade Commission. Comments in Docket No. RM16-21-000. Modifications to Commission Requirements for Review of Transactions Under Section 203 of the Federal Power Act and Market-Based Rate Applications Under Section 205 of the Federal Power Act. November 28, 2016, at 3. Available at: https://www.justice.gov/atr/page/file/913741/dl?inline.

[3] Twomey, P.; Green, R.; Neuhoff, K.; and Newbery, D. A Review of the Monitoring of Market Power: The Possible Roles of TSOs in Monitoring for Market Power Issues in Congested Transmission Systems. MIT Center for Energy and Environmental Policy Research. March 2005, at 17. Available at: https://ceepr.mit.edu/wp-content/uploads/2023/02/2005-002.pdf

[4] Carlton, Dennis. Mergers in Regulated Industries: Electricity. Economic Analysis Group Discussion Paper. December 2007, at 2. Available at https://www.justice.gov/atr/public/eag/228709.pdf.

[5] *Id.,* at 5.

- Physical withholding occurs when a generation owner chooses not to offer all of its available capacity to the market, reducing supply and potentially increasing prices.
- Economic withholding occurs when a generation owner submits an offer price significantly above its true marginal cost, reducing the likelihood of dispatch and potentially increasing market clearing prices.

Several key factors must be considered in evaluating whether a merger or acquisition increases the ability and incentive for generation owners to withhold capacity: the supplier's resource portfolio, the location of those assets and the context of the market in which they operate, and (of increasing importance in present times) the potential co-location of assets with load.

3.1. Resource Profile

The first factor to consider is the supplier's pre- and post-transaction resource profile—the type and quantity of generation units the supplier owns. Generators are typically classified as baseload, intermediate, or peaking units. Usually:

- Baseload generators run almost continuously, serving the minimum level of demand on the electricity grid.
- Intermediate generators ramp up and down over the course of the day to meet fluctuating demand.
- Peaking generators are dispatched during periods of high electricity demand.

The composition of a supplier's portfolio determines both its ability to raise the market clearing price through physical or economic withholding and the extent to which it benefits from higher prices.

- Marginal units set the market clearing price in any given hour. Peaking units typically operate on the margin during periods of high demand, while intermediate units are often on the margin during periods of moderate demand.
- Inframarginal units do not set the market clearing price but benefit when prices rise. Baseload units are typically inframarginal, and intermediate units frequently are as well.

Critically, when a supplier owns substantial generation across the entire supply stack—both marginal and inframarginal units—it may have both a greater ability and incentive to exercise market power. In other words, a diverse resource portfolio spanning the full dispatch curve can pose a particularly significant risk to competition. A transaction that adds resources along the supply stack to a utility's resource portfolio, therefore, requires close inspection, as it may heighten the utility's ability and incentive to exercise market power.

As a result, changes in the type and number of generators in a supplier's portfolio can significantly affect its ability to exercise market power. The more marginal generation a supplier controls, the greater its

ability to influence market prices. The more inframarginal generation it owns, the more it stands to gain from elevated prices. And, to be sure, a utility can withhold inframarginal generation and affect the market-clearing price.

Applicants' Resource Profile

A list of the units that are affected by the merger are shown in Table 1 and Table 2, for Constellation and Energy Capital Partners/Calpine, respectively. Synapse has classified each of these units according to their position in the supply stack. Nuclear, coal, and hydro power units are classified as "Baseload" given their near continuous operations. Natural gas combined cycle units are classified as "Intermediate." Gas turbines and internal combustion engines are classified as "Peaking." Wind and solar are "Intermittent," while batteries and pumped storage hydro are classified as "Storage." The tables also list the submarkets that the Commission has historically considered as separate relevant markets due to transmission constraints.[6]

[6] As identified in Application Exhibit J Solomon-Opgrand Affidavit, at 16.

Table 1. Units owned by Constellation Energy

Market	Plant Name	Summer MW	State	Capacity Zone	Supply Position
PJM	Braidwood Generation Station	2,337.0	IL	COMED	Baseload
PJM	Byron Generating Station	2,300.0	IL	COMED	Baseload
5004/5005	Calvert Cliffs	1,707.8	MD	SWMAAC	Baseload
East	Conowingo	527.5	MD	EMAAC	Baseload
PJM	Dresden	1,778.5	IL	COMED	Baseload
PJM	LaSalle	2,264.4	IL	COMED	Baseload
East	Limerick	2,241.8	PA	EMAAC	Baseload
5004/5005	Peach Bottom	1,254.2	PA	EMAAC	Baseload
East	PSEG Salem Generating Station	1,007.9	NJ	EMAAC	Baseload
PJM	Quad Cities	1,364.3	IL	COMED	Baseload
PJM	Criterion Wind	70.0	MD	RTO	Intermittent
PJM	Fair Wind	30.0	MD		Intermittent
PJM	Fourmile Ridge Wind	40.0	MD	RTO	Intermittent
East	Chester Generating Station	39.0	PA	EMAAC	Peaking
East	Croydon CT	391.0	PA	EMAAC	Peaking
East	Delaware Generating Station	56.0	PA	EMAAC	Peaking
East	Eddystone Generating Station	60.0	PA	EMAAC	Peaking
East	Falls	51.0	PA	EMAAC	Peaking
PJM	Handsome Lake Energy	267.5	PA	MAAC	Peaking
East	Moser Generating Station	51.0	PA	EMAAC	Peaking
5004/5005	Perryman	294.0	MD	BGE	Peaking
5004/5005	Philadelphia Road	59.7	MD	BGE	Peaking
East	Richmond Generating Station	98.0	PA	EMAAC	Peaking
East	Schuylkill Generating Station	30.0	PA	EMAAC	Peaking
East	Southwark Generating Station	52.0	PA	EMAAC	Peaking
PJM	Clinton Battery	5.0	OH		Storage
East	Muddy Run	1,063.3	PA	EMAAC	Storage
Total		**19,440.9**			

Source: Merger Application. Exhibit SEC-3.

Table 2. Units owned by Calpine

Market	Plant Name	Summer MW	State	Capacity Zone	Supply Position
East	Bethlehem Units 1-7*	939.0	PA	PPL/MAAC	Intermediate
5004/5005	Bethlehem Unit 8*	195.0	PA	PPL/MAAC	Intermediate
East	Hay Road*	1,136.0	DE	EMAAC	Intermediate
5004/5005	York Energy Center 1*	569.0	PA	EMAAC	Intermediate
5004/5005	York Energy Center 2	835.0	PA	EMAAC	Intermediate
East	Calpine Vineland Solar	4.1	NJ	NA	Intermittent
East	Bayview	12.6	VA	DPL-SOUTH	Peaking
East	Christiana	50.0	DE	EMAAC	Peaking
East	Crisfield	10.4	MD	DPL-SOUTH	Peaking
East	Cumberland	186.9	NJ	EMAAC	Peaking
East	Delaware City 10	18.0	DE	EMAAC	Peaking
East	Edge Moor*	707.0	DE	EMAAC	Peaking
East	Sherman Avenue	86.9	NJ	EMAAC	Peaking
East	Tasley	29.9	VA	DPL-SOUTH	Peaking
East	West Station	15.0	DE	EMAAC	Peaking
PJM	Zion Energy Center	546.0	IL	COMED	Peaking
Total		**5,340.8**			

**Units included in the proposed divestiture.*

Source: Merger Application at 24 and Exhibit SEC-4

As shown in Table 2, the Transaction would add to Constellation's portfolio a sizable volume of peaking capacity spread across a number of units in eastern PJM states and one in Illinois, as well as a large intermediate gas-burning generator in Pennsylvania. This warrants an evaluation as to whether or not the acquisition likely increases the ability and/or incentive to withhold generation from the market.

3.2. Market Characteristics

The second factor that should be considered is the location in which the supplier sells power and the characteristics of that market.

Locational Constraints

Transmission constraints restrict the flow of electricity imports, which can create submarkets that are particularly prone to market power issues, absent mitigation measures. Transmission constraints and local reliability issues have concentrated the supply in local markets, creating the potential for the exercise of market power. Indeed, the PJM IMM observed that "local market structure was evaluated as not competitive due to the highly concentrated ownership of supply in local markets created by transmission

constraints and local reliability issues."[7] Given that local markets have already been deemed "not competitive" in PJM, the Transaction should be closely scrutinized.

Withdrawal of units from PJM (such as the withdrawal of a nuclear unit to serve data center load) may also create new transmission constraints (or exacerbate existing ones), resulting in higher locational marginal prices (LMPs) in certain transmission zones. Such transmission constraints could occur because additional generation from outside the transmission zone will be required to replace any nuclear generation withdrawn to serve data center load. Thus, acquisition of additional generation within a zone may strengthen the incentive for the Applicants to withdraw nuclear units, as it increases the extent to which the Applicants would benefit from higher LMPs. For example:

- In the ComEd transmission zone, Constellation currently owns five nuclear power plants and would acquire Calpine's gas-fired peaking unit, Zion Energy Center (546 MW). The withdrawal of one or more nuclear power plants in the ComEd zone could increase congestion and LMPs, resulting in higher revenue for the remaining nuclear units and the newly-acquired Zion Energy Center.
- Similarly, in the PECO zone, Constellation currently owns Limerick nuclear plant and would acquire Calpine's gas-fired intermediate unit, York Energy Center 2 (835 MW). Withdrawal of Limerick could result in higher LMPs for the PECO zone, benefiting the Applicants through ownership of York Unit 2.

In this way, the Transaction may strengthen incentives for the Applicants to withdraw nuclear generators from PJM to serve data center load, as Applicants' remaining projects in PJM would benefit from higher LMPs resulting from local transmission bottlenecks caused by the removal of the generators. Such impacts should be studied to determine the Transaction's likely impact on competition and rates prior to deciding whether to approve or block the Transaction. We are unable to perform this study because we do not have access to non-public information required for the study.

Elasticity of Supply and Demand

The elasticity of supply refers to the extent to which output changes relative to a change in price. If supply is inelastic, then a large change in price will induce a smaller change in output. And it works the other way too, i.e., if the supply is inelastic, then a small reduction in output will induce a larger change in price. The steeper (more inelastic) the supply curve, the more likely that withholding will lead to market price increases.

The baseload portion (bottom) of the supply curve tends to be more elastic, while the peaking portion of the supply curve (top) tends to be inelastic. If baseload generation (e.g., a nuclear unit) is physically withdrawn from the market, then the supply curve will shift left, and the demand curve will intersect with a more inelastic portion of the supply curve, resulting in higher prices and greater price volatility.

[7] Monitoring Analytics, LLC. 2024 PJM State of the Market Report. March 13, 2025, at 9.

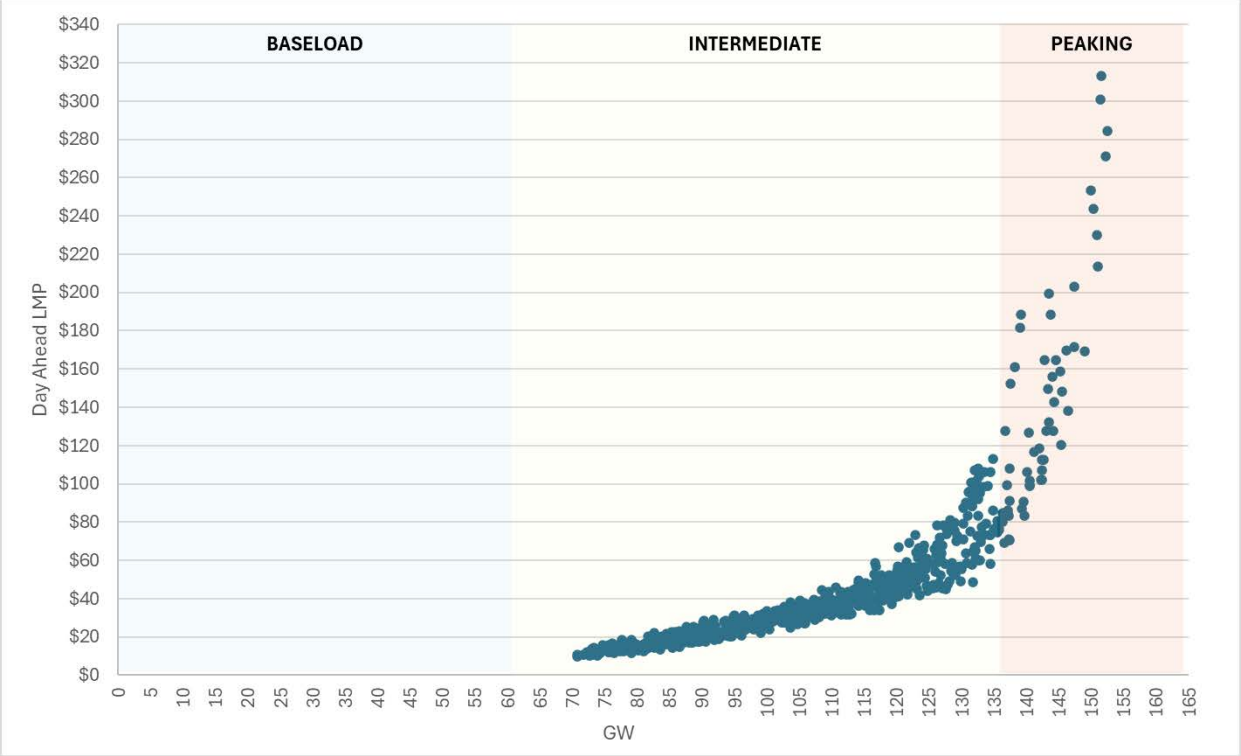
In the short-run, the elasticity of the supply curve is impacted by generation flexibility. Although there may technically be capacity available, if supply is inflexible, generators cannot respond quickly to changes in demand. This can contribute to higher prices when generation is withheld.

Long-run elasticity is characterized by the extent to which additional suppliers can enter the market. If there are significant barriers to entry, competition is restricted and suppliers have greater ability to exercise and maintain market power.

The inelasticity of demand is another contributing factor to the potential to exercise market power. Few customers are exposed to real-time prices,[8] thus attenuating price signals that would otherwise encourage customers to reduce demand during high prices.

When demand is high, the PJM energy market's supply curve is inelastic.[9] This means that a small change in generation availability can result in price spikes, as illustrated in the day-ahead prices for July 2024 displayed in Figure 1 below.

Figure 1. PJM RTO day-ahead prices, July 2024



[8] Twomey, P.; Green, R.; Neuhoff, K.; and Newbery, D. A Review of the Monitoring of Market Power: The Possible Roles of TSOs in Monitoring for Market Power Issues in Congested Transmission Systems. MIT Center for Energy and Environmental Policy Research. March 2005, at 11. Available at: https://ceepr.mit.edu/wp-content/uploads/2023/02/2005-002.pdf

[9] Monitoring Analytics, LLC. 2024 PJM State of the Market Report. March 13, 2025, at 141.

Source: PJM. Data Miner 2. Day-Ahead Hourly LMPs (RTO) and Hourly Load: Metered (RTO). Available at https://dataminer2.pjm.com/feed/da_hrl_lmps and https://dataminer2.pjm.com/feed/hrl_load_metered.

Each point on the graph represents the day-ahead hourly market clearing price, as set by the marginal generator at a certain level of demand. Because baseload generation is inframarginal, it does not set the market clearing price and is therefore not represented by any points on the graph. For the purposes of illustration, we classify any generation operating below the July 2024 minimum level of demand in PJM as "baseload," and marginal generators above 90 percent of peak demand as "peaking." The remaining generation is classified as "intermediate" in the graph.[10]

The inelasticity of the peaking portion of the supply curve at times results in prices more than 10 times higher than the average price of $31/MWh. To illustrate, for the afternoon of July 15, 2024, demand in PJM was projected to rise by 6%, from 143 GW at 1 pm to 152 GW at 5 pm. The corresponding day-ahead market clearing price for those hours rose from $150/MWh to $313/MWh, an increase of nearly 110 percent. This inelasticity of the supply curve underscores the ability and incentive for the exercise of market power in PJM.

In the longer-term, supply is likely to remain inelastic. In contrast to Ms. Solomon and Dr. Opgrand's assertions that "entry is not constrained,"[11] barriers to entry in PJM have been widely noted. Just last month, Commissioner Rosner and Commissioner Phillips' concurrence noted that PJM has not yet implemented the additional interconnection reforms required in the Commission's Order No. 2023 to further speed the process of connecting new resources to the grid. As a result, PJM's "interconnection process is overwhelmed by the volume of requests to connect new generation and storage, causing the typical wait time in PJM's queue to exceed five years."[12]

Market Power Mitigations

The existence of market mitigations that deprive suppliers of either the ability or the incentive to physically or economically withhold generation is another characteristic that should be considered. In PJM, the IMM has repeatedly noted that there are issues with existing market power mitigations, which "can result in the exercise of local market power even when market power mitigation rules are applied."[13] To illustrate the presence of market power, the IMM observed that "a significant proportion of units were offered with high markups, consistent with the exercise of market power."[14]

In 2023, Commissioner Clements identified her concerns with PJM's offer cap rules, stating "I believe the Independent Market Monitor for PJM (Market Monitor) has presented evidence that these rules may not

[10] This is a rough approximation. A more detailed analysis of the supply stack would take into account the physical and economic characteristics of each generator. However, this data was not available to us for this analysis.

[11] Application Exhibit J, Solomon-Opgrand Affidavit, at 44.

[12] Concurrence Regarding PJM's Reliability Resource Initiative (RRI) Proposal (ER25-712-000). February 10, 2025.

[13] Monitoring Analytics, LLC. 2024 PJM State of the Market Report. March 13, 2025, at 10.

[14] Monitoring Analytics, LLC. 2024 PJM State of the Market Report. March 13, 2025, at 24.

be working as intended and may be permitting the exercise of market power in PJM's day-ahead and real-time energy markets."[15]

3.3. Persistence of Issues

The concerns around competition described in the preceding sections are likely to persist in the PJM market for the foreseeable future. As described by PJM in recent filings, PJM faces "an extreme and rapid tightening of supply and demand"[16] in the near term and needs "additional resources . . . to rapidly address PJM's near-term reliability challenge."[17] On December 9, 2024, PJM Board Chair Mark Takahashi wrote that, "Taking the anticipated 2025 Long-Term Load Forecast into account, the PJM system could see a capacity shortage as soon as the 2026/2027 Delivery Year."[18]

Although sufficient volumes of installed storage capacity would help alleviate some of the supply constraints and provide additional flexibility to the system, storage deployment in PJM remains limited. According to recent reports, battery storage makes up only a small fraction of PJM's total installed capacity and has yet to meaningfully impact system reliability or mitigate price spikes.[19] Ongoing challenges, including regulatory uncertainty, interconnection delays, and market design limitations, continue to slow the pace of storage development.

Finally, existing system-wide mitigation measures, as discussed above, are inadequate to address these concerns. Current market rules do not sufficiently prevent the exercise of market power, particularly in an environment where barriers to entry are high and new supply is slow to come online.

All of this points to the fact that competition in PJM remains vulnerable, and without significant improvements in entry processes, interconnection reforms, and mitigation measures, the risk of market power and its adverse effects on market outcomes will likely continue.

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[15] Commissioner Clements's Partial Dissent in PJM Interconnection, L.L.C. Docket No. EL21-78-000. November 30, 2023. Available at: https://www.ferc.gov/news-events/news/commissioner-clementss-partial-dissent-pjm-interconnection-llc-docket-no-el21-78

[16] PJM Interconnection, L.L.C.. Revisions to Reliability Pricing Model of PJM Interconnection, L.L.C.. Docket No. ER25-682-000. Dec. 9, 2024, at 5.

[17] PJM Interconnection, L.L.C.. Tariff Revisions for Reliability Resource Initiative of PJM Interconnection, L.L.C., Docket No. ER25-712-000, Dec. 13, 2024, at 1.

[18] Takahashi, Mark. Letter from the PJM Board of Managers. December 9, 2024, page 1. Available at: https://www.pjm.com/-/media/DotCom/about-pjm/who-we-are/public-disclosures/2024/20241209-board-letter-outlining-action-on-capacity-market-adjustments-rri-and-sis.pdf

[19] Of the 145,883 MW of generation (UCAP MW, reflecting ELCC accreditation and excluding energy efficiency) that cleared in the 2025/2026 Base Residual Auction, 14 MW (UCAP, reflecting ELCC accreditation) were battery storage. See PJM. 2024. 2025/2026 Base Residual Auction Report.

4. THE TRANSACTION WOULD LIKELY EXACERBATE MARKET POWER ISSUES

Constellation's acquisition of Calpine leads to market power concerns. This is because (1) the Applicants' post-transaction resource mix increases ownership of resources along the supply stack, and (2) the market context allows for and multiplies the ability and incentive to exercise market power.

4.1. Resource Mix

Constellation is currently the largest nuclear plant owner in the United States and in PJM. Nuclear generation is baseload generation, which benefits from increases in market prices, but does not set market prices in the majority of hours. The Transaction will allow Constellation to add intermediate generators and fossil-fired peaking units, which can be withheld to increase prices, while benefitting Constellation's substantial quantity of baseload generation.

4.2. Market Context Permits Exercise of Market Power

As shown above, the inelasticity of the supply curve and existing concentration of peaking resources already results in high price markups during periods of high demand. Further, most of Calpine's PJM units are located in eastern PJM, where transmission constraints already frequently lead to increased prices. A small amount of physical or economic withholding anywhere along the supply curve can therefore result in substantial price increases in PJM. For example, were Constellation to withdraw nuclear generation from the PJM market to serve data center load, it would likely have a large impact on market prices. As noted by the IMM, "Removal of even a relatively small amount of capacity from the market would have a significant impact on reliability and capacity market prices."[20]

[20] PJM IMM. Comments to the Maryland PSC Senate Bill 1 Co-location Study. Administrative Docket PC 61. September 24, 2024, p. 1.