The Benefits of Energy Efficiency Participation in Capacity Markets

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Executive Summary

US capacity markets have evolved substantially since their inception. The earliest capacity markets were aimed at attracting and retaining conventional, dispatchable "steel in the ground" resources like coal-, gas-, and oil-fired thermal generation. Later, the participation of demand response resources in these markets proved to be an unexpected success. Today, as capacity markets prepare for a clean energy future, they will need to evolve and reposition themselves to rely on an increasing share of emerging resources like utility-scale wind, solar, battery storage, and distributed energy resources (DERs). These include demand response (DR) and energy efficiency (EE) resources, which reduce demand for electricity. Evolving capacity markets must maintain reliability while coordinating entry and exit decisions, sending technology-neutral price signals to conventional and distributed resources alike to mobilize efficient, cost-effective investments. In support of this goal, FERC's Order 2222 requires full accommodation of DER participation and competition in wholesale capacity markets.

The EE resources that fall under the umbrella of Order 2222 play a vital role in the US energy sector, providing a low-cost way to meet customers' electricity needs and meet environmental policy goals. The reduction in load that EE delivers provides a range of economic and social benefits, such as improved air and water quality, greater grid resilience, a lessening of inequitable energy burdens, and improved health and comfort. As a result, EE plays a central role as an increasing number of cities, states, and regions set ambitious clean energy and decarbonization goals.[1]

Policy requirements for greater EE are amplified by the fact that the transition to clean energy for heating and transportation will have a significant impact to increase total demand for electricity across the United States. By one estimate, even accounting for increases in EE and other technological improvements, electrification could lead to a 5% to 15% increase in demand by 2030, and an increase of 25% to 85% by 2050.[2] Consequently, reductions in demand achieved through verified, measurable EE deployments represent a fundamental component of the successful, economy-wide transition to clean energy. The challenge currently facing policymakers and market operators is how to most effectively enable EE for maximum participation and impact.

Theoretically, EE, DR, and other DERs can be accounted for either on the supply or the demand side of capacity markets. In practice, however, there are numerous frictions and barriers to demand-side accounting that reduce entry of these resources even at the lowest costs, and under-counts DERs that are

1 Sergici, Sanem and Irwin, Nicole, The Brattle Group for Uplight. "Energy Efficiency Administrator Models: Relative Strengths and Impacts on Energy Efficiency Program Success," November 19, 2019.

2 Weiss, Jürgen, Hagerty, J. Michael, and Castañer, María, The Brattle Group for WIRES. "The Coming Electrification of the North American Economy: Why We need a Robust Transmission Grid," March 2019.

on the system. Good wholesale market design allows these resources, including EE, to participate on the supply side and can reduce barriers, thereby improving outcomes and reducing costs.

Enabling efficient deployment of EE requires effort and cost. The EE aggregator makes a large investment in aggregating and delivering the EE measures but only the customer sees the benefit on their electric bill. Like a developer of any resource, there must be a return on the investment involved to make the effort feasible and worthwhile. This business model is not possible without supply-side participation.

After first describing the business model for EE providers in this paper, we identify several interrelated reasons for why supply-side participation of EE will yield more predictable and efficient outcomes. These include supply-side participation's ability to:

- **Yield Binding Capacity-Market Commitments:** Supply-side participation of EE requires binding forward contract commitments, which enable the market operator to have more confidence in the quantity and delivery of EE measures relative to demand-side participation, which does not require any binding supplier commitments. This improves reliability by increasing the incentives for EE performance and enabling penalties for non-performance.
- **Improve Load Forecasts:** Accounting for EE entirely on the demand side understates the volume of EE measures forecasted by the ISO due to the inherent conservatism in the load forecasting process. More specifically, this process often underestimates the pace of technology advancement, the lack of binding commitments behind the implementation of future EE measures, and the time it takes before realized EE impacts are reflected in the historical data used for forecasting. Moving EE to the supply side reduces EE uncertainty as a contributor to demand forecast uncertainty, further improving reliability and lowering costs.
- **Reduce Barriers to EE:** Allowing supply-side participation of EE reduces market barriers for merchant EE providers, which means certain cost-effective EE resources targeted by merchant providers would not be developed without supply-side treatment. Supply-side participation of EE also ensures that all resources are able to compete to provide capacity service in the same time horizon. Procuring generation resources on a one-month to three-year forward basis, but accounting for EE approximately 10 years after it is installed (the length of time most load forecasting methodologies take to fully account for reductions in any one year) cannot yield efficient results. Such mismatched time horizons lead to higher-cost market outcomes and no corresponding market benefit.
- **Yield More Cost-Effective Capacity Market:** The combination of the above factors results in: more cost-effective market outcomes under supply-side participation by avoiding over-forecasting loads and the over-procurement of unnecessary capacity resources; a lower price for all capacity because of less expensive capacity procured on the margin; and the deferral of transmission investments that would have been needed under too-high load forecasts that did not properly account for the effects of EE.

I. Energy Efficiency Participation in Capacity Markets

In contrast to generation resources, which increase the energy and ancillary services provided in the market during scarcity conditions, EE contributes to resource adequacy by reducing end-user load. Even though the mechanism is different, the resource adequacy value of these resources is real, just as it is for other demand-side resources like demand response and rooftop solar. In other words, EE makes the system more reliable.

Enabling efficient deployment of EE requires effort, cost, and risk. This is the role of the EE aggregator. Building a resource comprised of EE takes years of effort to build and maintain a program of thousands of individual EE measures. Furthermore, the EE aggregator must work with vendors to enable the plan, continually gather data on installed measures, conduct measurement and verification studies to demonstrate savings, and report these data to the relevant RTO for inclusion in the capacity market. Finally, EE aggregators must offer their resources into the wholesale markets, incurring participation and collateral costs, and take on the financial risk that the EE resources may face.

This substantial effort and investment to enable a cost-effective resource should be able to earn a return on investment, like any other developer and owner of a capacity resource. Unlike the customer, the EE aggregator (either merchant or utility) does not save money on a bill as a benefit of their investment in EE. Instead, their compensation must come from the value of the newly enabled EE through energy and/or capacity cost savings.

The resource adequacy value of EE needs to be accounted for in the capacity markets. There are two possible competing frameworks for doing so:

- **Under a demand-side model,** EE investments are interpreted as reducing the end-use electric load in the applicable years of historic load used to develop the forecasts, thereby reducing the need for capacity procurement in the capacity markets. Under this model, end customers can capture the capacity value of the EE only insofar as the EE measure reduces their peak load contribution, thereby reducing the share of capacity charges allocated to them; there is no direct mechanism for compensating aggregators who enable the EE.
- **Under a supply-side model,** EE investments are interpreted as providing discrete, verifiable capacity supply commitments that EE providers can qualify for and then offer as supply into the capacity markets. This requires rigorous measurement and verification of savings to baseline provided by EE

commitments,[3] and setting the capacity procurement target based on the (higher) demand that excluded the committed EE measures. Under this model, aggregators selling EE into the capacity market are directly compensated through capacity revenues, while end customers enjoy cost savings from reduced electric load.

Allowing only demand-side participation, to the exclusion of supply-side participation, represents an overly narrow view of the participation of demand-side resources based on the idea that either supply or demand side accounting would result in the same efficient outcomes. These approaches could be equivalent under certain idealized assumptions but are not equivalent because of barriers to entry, load forecast challenges, and other practical limitations that are further discussed in the following section.[4] The result is that under demand side-only participation, EE would be under-counted and underutilized relative to the efficient market outcome. By unlocking the capacity value of EE and selling it in the capacity market, EE aggregators earn capacity revenues, which bridge the gap between the low marginal price that consumers face for capacity and the higher marginal value of that capacity on the system.

EE PARTICIPATION PATTERNS

Today most US jurisdictions with capacity markets enable EE to participate as supply-side resources. However, there are substantial differences in the rules governing EE participation, as well in other areas of market design. These invariably have led to differences in the rates of supply-side participation. For example, the high penetration of EE in ISO-NE is due in part to the fact that EE resources there are allowed to participate in the capacity market up to their full measure life, in contrast to PJM and MISO, which impose limitations of four years each.[5] The average measure life in ISO-NE is approximately seven years, but resources can participate for a maximum of 30 years (pending annual M&V).[6] EE benefits only accrue to the EE aggregator for the maximum allowed measure life, after which time the EE is accounted for in the load forecast and reduces capacity purchases system-wide.

[3] Savings produced through investment in EE are generally measured against a "baseline," which represents the amount of energy or capacity that would have been used in the absence of the specified EE resources.

[4] Enabling EE aggregators to choose either accounting approach would be theoretically possible but we assume few or no entities would use that option given the practical disadvantages we outline.

[5] PJM, "Manual 18: PJM Capacity Market," May 28, 2020.
MISO, "MISO Resource Adequacy Business Practices Manual BPM-011-r22 - Resource Adequacy," October 1, 2019.

[6] See ISO-NE, "Energy Efficiency Measure Database (EEM) User Guide," Version 3.0, 2017, p. 66, and "Motion for Leave to File Answer and Answer of ISO New England Inc.," December 7, 2017, ISO New England Inc., United States of America Before the Federal Energy Regulatory Commission, Docket No. ER18-264-000, p. 10.

TABLE 1: EE PARTICIPATION IN US CAPACITY MARKETS

	ISO-NE	PJM	MISO
Forward Timeframe of Capacity Market	3 years	3 year	Prompt
EE Measure-Life Maximum Supply-side Participation	30 years	4 years	4 years
Supply-Side EE Portion of Total Capacity	9.8%	1.7%	0.5%
Number of Historical Years Included in Peak Demand Forecast	15 years	10 years	Up to 29 years

Sources:

- ISO-NE: "Forward Capacity Auction #14 Results Summary," 2020; "Long-Term Load Forecast Methodology Overview," September 27, 2019.
- PJM: "2021/2022 RPM Base Residual Auction Results," 2019; "PJM Load Forecast Report," January 2020
- MISO, "2020/2021 Planning Resource Auction (PRA) Results," April 14, 2020; "2020 MISO Energy and Peak Demand Forecasting for System Planning," November 2020. Note: We report the number of historical years used to prepare the MISO independent load forecast by the Purdue University State Utility Forecasting Group. However, LSEs' and MISO's PRA requirement is based on forecasts of coincident peak demand submitted by LSEs and EDCs; those forecasts are prepared using a range of different methodologies and historical years.

Regardless of market differences, trends in all three markets point to the growing penetration of EE. Cleared EE supply has increased by 170% in ISO-NE and by more than 300% in PJM in the last ten years. In MISO, it has increased from zero supply in the 2016-17 planning year to its present level.

II. Why Energy Efficiency Should Participate on the Supply Side of Capacity Markets

We have identified how EE measures could theoretically be accounted for on either the supply side or the demand side of the market. To attract cost-effective EE requires good wholesale market design, with EE on the supply side. This removes barriers prevent participation of capable EE resources or that result in unduly discriminatory treatment of EE, as required by FERC Order 2222, with the goal of achieving efficient market outcomes and reducing overall costs. Supply-side participation of EE will yield more predictable and efficient outcomes thanks to this and several other reasons. As described below, these include the ability of supply-side accounting to:

- Yield binding commitments
- Improve load forecasts

- Reduce barriers to EE adoption and participation
- Yield a more cost-effective capacity market

A. Supply-Side Accounting Yields Binding Commitments to Provide EE Capacity

Supply-side participation offers a number of advantages by virtue of its binding commitment to reliably deliver on EE capacity commitments in capacity markets, especially in jurisdictions with a forward capacity market. In the event that an EE provider fails to aggregate, measure, verify, and deliver the load reductions to cover their capacity market commitments, they are financially responsible to cover the shortfall or be subject to fees and penalties for underperformance like any other capacity market supplier. This ensures that the ISO can count on the delivery of committed future EE measures, making those resources known and verifiable in a way. This would not be possible through demand-side participation which requires no commitments. The commitment that EE providers deliver in a particular time and place removes uncertainty created by demand-side treatment. The baseline accounting used for supply-side participation also makes it possible to develop more accurate load forecasting processes that reflect the impact of EE resources in both historical and forecasted load data. In combination with improved load forecasts, these binding commitments increase system reliability.

Furthermore, supply-side EE shifts the risks from loads (consumers) to EE providers. When EE is on the demand side, customers face the risk of under-performance of EE relative to the expected level: if less than the anticipated amount of EE is available in the delivery year, reliability risks are increased. With EE on the supply side, the risk of under-performance of EE (relative to the quantity sold forward in the auction) is transferred to the under-performing suppliers directly, who face significant financial penalties. This improves the alignment of incentives to the parties best suited to mitigate risks.

Supply-side EE providers have a demonstrated and proven track record of delivering on their commitments. Data from ISO-NE and PJM show that EE resources have been as reliable in meeting capacity market commitments, if not more so, than generation and demand response resources. In ISO-NE, EE resources have consistently exceeded commitments. This was documented as early as the summer of 2012, when EE delivered 120% of what was bid into the capacity market.[7] This pattern continues through the current delivery year, when EE resources in ISO-NE had an audited performance of 3.5% above their capacity supply obligation in 2020.[8] In PJM, specific data on excess capacity delivery by EE resources is not available, but data does indicate that there were only minor commitment shortages (failure to satisfy capacity commitments) for EE resources (averaging less than 0.25% since EE resources

[7] Neme, C., Energy Futures Group, and Cowart, R., Regulatory Assistance Project. "Energy Efficiency Participation in Electricity Capacity Markets – The U.S. Experience," 2014.

[8] ISO-NE, "Demand Resources Working Group Monthly Statistics Report," October 2020.

were first allowed to provide capacity in 2011).[9] It is also important to note that commitment shortages do not necessarily lead to decreased reliability, but are generally resolved through financial transactions in adjustment auctions designed to allow resources to adjust their market positions.

B. Supply-Side Accounting Improves Load Forecasts by Reducing Uncertainty and Statistical Bias

When allowing for EE participation only on the demand side, accurately forecasting peak load is significantly more challenging, especially in jurisdictions with a *forward* capacity market that procures capacity three years before the delivery period. If EE participation was only accounted for on the demand side, there would be no binding forward commitments to implement measurable and verifiable EE programs. The ISO's ability to forecast peak load, net of estimated EE activity, would be impaired

In contrast, supply-side aggregation of EE measures creates the supply side resource that has helpful attributes: more specific measurement and verification; binding commitments with financial assurance; and bottom-up accounting. This improves load forecast in two main ways. First, it reduces the overall uncertainty (variance) of the load forecast estimate. Second, it reduces the systematic bias (consistent error) of the load forecast that results from systematic undercounting of EE when it is on the demand side. We explore these two drivers separately below.

REDUCING UNCERTAINTY

Having EE on the supply side of the capacity market reduces its contribution to demand forecast uncertainty: identifying the amount of non-EE capacity that is needed to meet reliability targets under uncertain load is much easier when the amount of EE is knowable and verifiable (as it is when on the supply side) than when the amount of EE is uncertain. A simple analogy is that it would be easier to forecast the average return of the S&P 500 ("total load") if you could know with certainty the return of some of the individual component stocks ("EE supply").

This effect is primarily a result of the structure of the econometric load forecasting models used in all jurisdictions with capacity markets in North America. These models rely on historical data about load and the various drivers of load (including population, GDP, weather, etc.) to statistically infer the relationship between each driver and the resulting system load. However, these models are never perfect. The overall uncertainty of the model increases when the relationship between the individual drivers and the resulting

[9] Monitoring Analytics, "Analysis of Replacement Capacity for RPM Commitments: June 1, 2007 to June 1, 2019," September 13, 2019, Table 8.

historical load is weaker, and there is more "unexplained variation" in the historical load—that is, increases or decreases in the historical load that are not well explained by changes in the drivers.

Demand-side statistical forecasting models generally struggle with unexpected, idiosyncratic decreases in demand due to outside events such as natural disasters, economic shocks, and rapid adoption of new behind-the-meter technologies such as generation, storage, or electrified appliances. Without quantified EE resources in the market that have commitments to deliver on the supply side, there are little means to separate the distinct load reduction effects of EE from other drivers of load changes. For example, COVID produced a precipitous drop in load but coincident EE load reductions are unaffected by the pandemic. Peak load will likely rebound when the impact of COVID is eliminated, but absent EE on the supply side, demand reductions from increased EE installations cannot be disaggregated from the significant load reductions in 2020–2021.

In summary, the impact of EE measures can be difficult to measure on the demand side, because they can become lost among many other fluctuations in load. Enabling EE to participate on the supply side, and enforcing measurement and verification for that EE, reduces the overall uncertainty in the demand forecasting models and yields better forecasts.

REDUCING SYSTEMATIC BIAS

Beyond the uncertainty effect described above, load and peak demand forecasts that account for EE on the demand side will tend to undercount EE, yielding load forecasts that are systematically biased. Moving to supply-side accounting resolves this issue.

Without an accurate adjustment for EE impacts in the load forecast, the demand-side entry of incremental EE would not be reflected in ISO load forecasts for a long time, which results in more forward procurement of other capacity resources. This is especially true in PJM and ISO-NE, which have a three-year forward capacity market and consequently must forecast load around four years before the delivery year. Because load is charged the full cost of the capacity procured on a three-year forward basis, any added EE measures that were not reflected in the load forecast would thus not provide any capacity market savings to load for several years—not until the actually realized EE measures are fully incorporated into historical load data and fully reflected in load forecasts. The capacity markets we reviewed use at least 10 years of historical data in the econometric load forecast models. This leads to a 10-plus year delay between EE measure installation and the point that the full amount of load reduction is reflected in the historical dataset. With new EE measures being installed every month, the load forecast would always lag reality by the timeframe of the historical data period.

Further, another four years (the capacity market forward period) would be needed to realize the savings associated with reduced ISO capacity procurement. This adds even more time to fully account for EE measures. All the while, the market would continue to procure excess capacity at extra expense to customers. Although adjustments to the load forecast for expected demand-side EE impacts can be made proactively, such adjustments would rest on judgment and be subject to greater uncertainty compared to the binding forward commitments made when EE participates on the supply side.

Developing a reliable four-year forward load forecast net of likely demand-side EE deployments is more challenging than relying on EE commitments that have been cleared as supply in the capacity market. It would require the ISO to have an accurate accounting of total installed EE capability, account for historical load with and without these EE deployments, and adjust forecast load based on the rate at which EE growth may change. Because over-forecasting future EE growth would result in under-procuring capacity and potential resource adequacy challenges, ISOs would try to avoid such outcomes. The result of not having firm forward EE commitments through supply-side capacity market participation would be an under-forecasting of EE to avoid resource adequacy risks.

The ISOs are rightly cautious about making speculative assumptions about how much EE might materialize if there are no binding obligations to implement the measures. However sensible it is to be conservative in forecasting demand-side EE impacts, the outcome is an over-forecast of capacity needs. Even though some public information on EE measures installed is available from EE providers, there is no guarantee that it would capture all installed EE. To obtain a more accurate forecast with demand side accounting, the ISO would need to invest in expensive measures such as surveys and EE adoption studies to attempt to support more realistic assumptions and modeling.

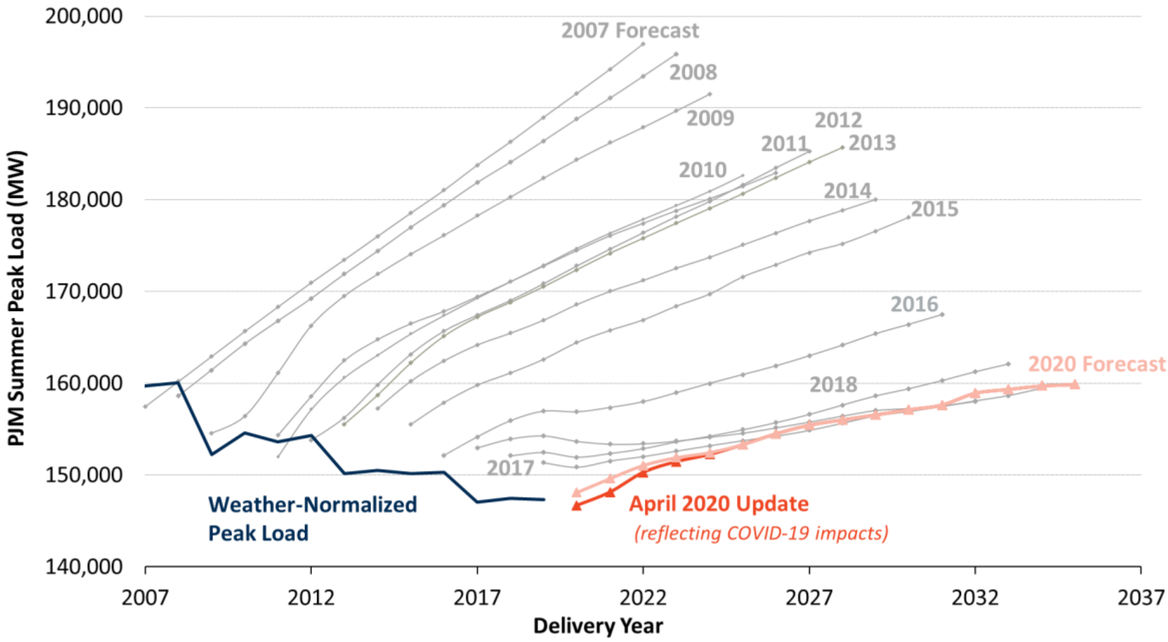
A multi-year delay in fully reflecting demand-side EE participation in the load forecast and ISO capacity procurement makes it difficult for load serving entities (LSEs), their customers, and third-party EE providers to capture capacity market savings associated with peak load reductions in a timeframe that is feasible from a business perspective. Enabling supply-side participation addresses these issues by requiring forward commitments from qualified EE resources, ensuring a robust system of accounting for measurable investments, holding sellers accountable for performance, and accelerating the return on investment for both the EE investor and end user.

The difficulties of accurately forecasting EE on the demand side are illustrated by PJM's example. PJM over-forecasted load consistently and repeatedly over more than ten years, as illustrated in Figure 1. The pattern of over-forecasting can be partially attributed to the effect of the Great Recession beginning in 2008, underestimating the decoupling between GDP growth and energy consumption, and other modeling issues; however, issues with accounting for EE also contributed. Even though PJM enables supply-side EE in the capacity market for a duration of four years, the load forecasts did not capture the existing EE that was not bid into the market, nor any new EE programs predicted beyond the capacity market's three year forward period. An earlier Brattle Group report on the cost of "missing EE" in PJM estimated additional capacity procurement costs of $200–$500M per year.[10] While the load forecast has been slowly improved over time, and now the forecasts attempt to more directly account for future EE,

[10] Ahmad Faruqui, Sanem Sergici, and Kathleen Spees, "Quantifying the Amount and Economic Impacts of Missing Energy Efficiency in PJM's Load Forecast," prepared for The Sustainable FERC Project, September 2014.

the pace of load forecast reductions was not fast enough to eliminate over-forecasting, as demonstrated by the following figure.

FIGURE 1: UNDERCOUNTING EE IN PJM CONTRIBUTED TO SYSTEMATIC OVER-FORECASTING



Sources and Notes:

- Based on data collected from PJM's annual Load Forecast Reports.
- In 2016, PJM changed its weather-normalization procedure, which increased historical peaks prior to 2009. PJM forecasts prior to the additions of ATSI, Cleveland Public Power, and DEOK in 2011–12, EKPC in 2013, and OVEC in 2018 were adjusted upwards to be comparable with forecasts from later years.

The difficulties in forecasting demand-side EE are exacerbated in ISOs such as MISO, where the overall capacity requirement is based on decentralized load forecasts provided to MISO by each individual LSE. There is considerable variation in the load forecasting procedures used across LSEs, including how EE is accounted for on the demand side. Supply-side participation removes this additional layer of uncertainty and variability across LSE load forecasts by standardizing the treatment of EE resources.

Finally, even outside of the context of the capacity market, improving load forecasts through supply-side participation of EE is valuable. More accurate supply/demand accounting can, for example, also enable improved planning of the transmission and distribution systems and other utility planning.

C. Supply-Side Accounting Reduces Barriers to Merchant Energy Efficiency Providers

Supply-side participation of EE yields reduced market barriers to EE participation and aggregation, increasing the amount of cost-effective EE that can be mobilized in the region. This reduction in market barriers occurs because supply-side participation in capacity markets provides EE aggregators with a revenue stream from the wholesale capacity market that monetizes the value of the delivered load reductions on a delivery year basis. In contrast, allowing only demand-side participation creates a barrier to market-based EE providers by both delaying and reducing compensation for EE measures' capacity value. Further, misalignment of rates with marginal system costs of capacity systematically undervalues reductions in peak load enabled by EE. This results in lower EE implementation and higher customer costs under a demand-side participation model.

For merchant (non-utility) EE providers who do not receive any state EE program funding, supply-side participation is particularly important because these providers use capacity market revenues as part of their business model. Under these business models, customers keep their retail bill savings and aggregators receive the capacity market revenues, which they can use to implement their programs. Given the competitive nature of their business models, these providers can cost-effectively expand the pool of EE savings. If merchant EE did not receive supply-side treatment, the EE providers would have little incentive to present the market operator with accurate estimates—and certainly not with financially binding forward commitments—for their anticipated peak load reductions.

If merchant EE providers are not enabled in the capacity market, there is no incentive to fully inform and commit to the ISO on a forward basis about EE activity they may pursue. This leads to the procurement of unnecessary and more costly other capacity. Thus, while the demand-side model may work for some state-funded EE programs to the extent that EE impacts are predictable and the broader social benefits of avoided capacity procurement can be seen from a statewide perspective, demand side–only participation essentially excludes merchant EE as a viable business model in the capacity market.

Finally, given the intent of the capacity markets to facilitate and enable innovative market participants and business models to find low-cost solutions to meet system resource adequacy needs, the markets should offer opportunities to obtain full capacity value via market mechanisms. Even if demand side participation works for some, mostly state-funded programs, the merchant EE sector would largely be left out. Enabling additional competition by merchant EE in the capacity market facilitates competition and innovation.

D. Supply-Side Accounting Reduces Capacity Costs to Customers

The combination of the factors discussed above will mean that supply-side participation mobilizes more cost-effective resources and, thus, tends to create more efficient capacity-market clearing prices. Reducing the likelihood of over-procurement will further add to achieving a more cost-effective overall outcome under supply-side EE participation. The main drivers of the cost advantage of supply-side participation are:

- The individual customers participating save by paying lower electricity costs;
- Those customers and others benefit through more cost-effective EE as a result of reduced barriers to entry;
- All customers (including non-participating customers) benefit by having more cost-effective EE in the market because it will only clear if it is cheaper than other capacity resources; this yields lower prices and lower costs for all customers;
- All customers benefit from an improved load forecast by avoiding over-procurement of capacity resources. Avoiding over-procurement also reduces the need for transmission investments associated with excess capacity resources.

Further, EE benefits are only privately captured by the participating customer or EE aggregator for a limited time. After that, the EE will still exist and be built in to load forecasts and properly be accounted for as reduced capacity purchases for all customers. The sum total of the benefits of accounting for all EE and unlocking new EE potential are large—and enabling supply-side participation for EE is the only way to maximize that opportunity.