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PATHWAYS TO COMPETITION IN DEMAND RESPONSE

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INTRODUCTION

Demand response (DR) holds great promise to improve the competitiveness, reliability and environmental performance of the electricity system. DR refers to a system under which end-use customers earn compensation in exchange for an immediate reduction from their normal consumption patterns in the amount of electricity they use. Customers could reduce or shift their demand in response to an economic signal, such as a spike in wholesale prices, or an instruction from the grid operator, such as when grid reliability is threatened. DR comes in a variety of forms, including delaying the start of appliances or air conditioning, dimming lights or turning off factory machines.

DR helps to create healthier electricity markets by encouraging demand fluctuations to respond to grid conditions. Grid conditions can change significantly and rapidly – even in a matter minutes. Since grid operators must balance electric supply and demand instantaneously, a predictable or controllable reduction in demand can provide large market benefits, such as mitigating price spikes or the exercise of market power by power suppliers.[1] DR can provide reliability value to the grid by ensuring total demand does not exceed supply.

The greatest value of DR is in reducing the need for costly infrastructure investments. Power plants and transmission systems are capital-intensive and must be sized to meet peak demand. Peak demand rarely is realized,[2] so these large expenses support infrastructure that is used infrequently. DR can reduce peak demand and avoid those expenses. It also can help reduce the need for investments in backup generation that support the integration of renewable energy sources with variable output, like wind and solar.

EVOLUTION OF DEMAND RESPONSE

Historically, electricity grid operators only changed the output, or dispatch, of power plants to match changes in demand. The electric system must always be in balance, so when demand changed, power plants responded. This practice assumed that demand could not effectively respond to signals from the market or grid operator.

Occasionally, consumer demand results in surges in collective electricity consumption for small periods of time – for example, hot evenings when families return home and turn up the air conditioning all at once. Electric generators must be prepared for these instances of peak demand. There would be tremendous benefit to realize if these investments could be reduced, which ultimately prompted creative thinking about ways to reduce peak demand.

In the 1970s, vertically integrated monopoly utilities began developing basic DR programs to shift or reduce peak energy demand temporarily. These experiments typically involved allowing a utility to curtail a portion of electric service to a customer in exchange for financial compensation, such as a bill credit. These programs operated under a structured, regulated environment that did not expose consumers to real-time price signals. Utilities also compensated customers at a rate well below the real-time value it brought to the utility system.[3]

Restructuring in the electricity industry began to change these conditions in the 1990s, particularly with the introduction of competitive, organized wholesale electricity markets. These shifts broke up integrated utilities and shifted grid-operation responsibilities to regional grid operators known as regional transmission organizations (RTOs) or independent system operators (ISOs),[4] which were responsible for creating and managing these new markets. For the first time, the market would be responsive to a host of price signals, not just the administrative decisions of utilities.

Intermediaries that interface with the RTO/ISO and serve end-use customers have become a common business model in the restructured markets. These intermediaries serve to aggregate the demand of smaller customers and turn a profit by providing DR services in response to market signals from the RTO/ISO. [5] Restructuring, and the price signals it has enabled, widened the pool of potential DR participants and encouraged entrepreneurs to find innovative means to provide DR.[6]

The geographic footprints of RTOs and ISOs include many areas that retained regulated monopoly utilities. Some states within these regions permit third-party providers to subscribe customers to RTO/ISO DR programs. This competition with utilities to provide DR services has resulted in innovative offerings that reflect price signals. By contrast, utility programs have a poor record of creating DR programs aligned with market incentives.[7] Other states expressly prohibit third parties from providing DR services, generally as a result of utility concerns about appropriate integration of customer-demand impacts in their resource-planning processes.[8] Price signals in the RTO/ISO markets reflect the value of demand reduction far more accurately than the administratively determined legacy utility DR programs.

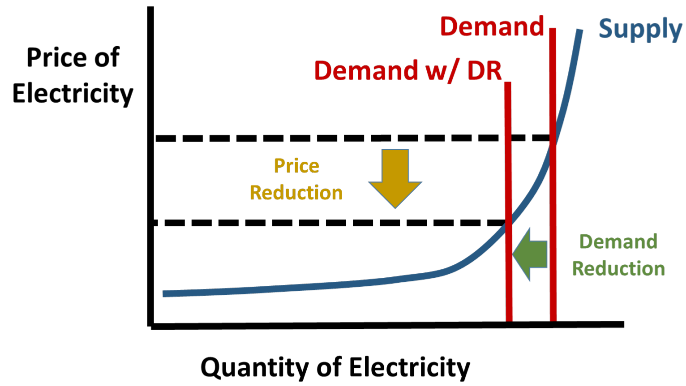
The transition to ISO/RTOs raised questions over how DR interfaces with organized wholesale markets to enhance market performance and what fair compensation for services should look like. Initially, this caused levels of DR to decrease until the RTO/ISOs developed. The Federal Energy Regulatory Commission approved rule changes that reduced barriers to DR participation and provided frameworks for compensation. The frameworks for wholesale DR participation have been premised primarily on treating DR as a supply-side resource.

DEMAND RESPONSE AS A SUPPLY-SIDE RESOURCE

Conventional supply-side resources, like fossil generators and nuclear power plants, submit offers to participate in RTO/ISO markets. If their offer clears the market, they receive the market-clearing price. RTO/ISO rules that enable supply-side DR treatment also allow DR providers to sell end-use customers' demand reductions as supply. In order to enhance market efficiency and grid reliability, DR must serve as a sufficient substitute for supply-side resources.

DR has enhanced competitive wholesale electricity markets and grid reliability when serving as an effective substitute for generation. It has avoided the need to build or retain rarely used power plants in several RTO/ISOs. DR has started to demonstrate value as a transmission alternative as well. The independent monitors of several RTO/ISOs note that DR has contributed to reliable system operations, lower costs, decreased price volatility and mitigated supplier market power.

FIGURE I: DEMAND RESPONSE DRIVES PRICE REDUCTIONS



DR has many opportunities to substitute for conventional supply-side resources, but this categorization is limited. Some forms of DR face seasonal restrictions on availability, strict limits on the length and number of deployments and no ability to dispatch at a highly specific geographic level.[9] By contrast, conventional supply-side resources can operate year-round. An RTO/ISO can also dispatch conventional resources at the most granular (nodal) level and turn them on and off far more frequently than most DR resources can be activated. These limitations can create problems for reliable grid operation and suppress market signals to generators.

In some cases, an RTO/ISO will activate DR to relieve a local transmission constraint, but find it has worsened transmission congestion, because the DR resources could not respond at a sufficiently granular level. By contrast, the RTO/ISO could dispatch a power generator at a known location to alleviate the constraint. Likewise, DR must be able to perform reliably if it displaces the retention or construction of power plants in long-term resource-planning markets. In some cases, summer-limited DR (for example, reduction of air-conditioning demand) may reduce conventional power supply that would otherwise be available to meet winter-demand surges.

To ensure reliable grid operation and appropriately compensate supply-side resources, we need an accurate measure of dispatch. RTO/ISOs can easily do this for conventional supply-side resources, but measuring DR dispatch requires a high-quality measurement and verification (M&V) methodology to determine the amount of demand that would have been present were DR not deployed. This presents some obvious challenges. Most notably, there can be no direct measurement of demand that does not exist, which has led to contentious debates and even cases of fraud. Major errors in M&V may compromise grid reliability and otherwise distort the market.

At the same time, some wholesale market rules and processes that treat DR as a supply resource undercompensate DR and constrain its innovative potential. Wholesale markets, for example, do not appropriately compensate resources, including DR, that displace transmission-investment needs. Making DR a supply-side resource proxy requires squeezing the heterogeneous types of DR into strict product definitions. This constrains the ability of DR to provide services that do not resemble conventional supply-side resources. For example, strict eligibility requirements create a barrier to entry for some valuable forms of DR to participate in RTO/ISO markets.

FERC ORDER 745

In 2011, FERC issued Order 745, which determined that supply-side DR resources would receive the market-clearing price in all jurisdictional RTO/ISOs.[10] The U.S. Court of Appeals for the D.C. Circuit vacated the order, finding that DR is a retail transaction that falls outside FERC's jurisdiction. The U.S. Supreme Court reversed that decision in the January 2016 opinion *FERC v. Electric Power Supply Association*, which affirmed FERC's authority over, and ordered compensation of, wholesale DR. The court's opinion does not prohibit FERC from altering Order 745.[11] The jurisdictional clarity offered by the decision has allowed FERC to begin moving on a backlog of DR cases.

FERC Order 745 engrained supply-side treatment in DR compensation. Generation resources receive compensation at the wholesale market price, which the order extended to DR. Consumers had an existing incentive to reduce demand to avoid paying the retail rate for electricity. Since the vast majority of retail rates do not reflect hourly wholesale market prices, consumers lacked a transparent price signal to respond to grid conditions. Order 745 correctly noted that the wholesale price should signal DR, but failed to acknowledge that DR is paid twice: the full wholesale price and the retail rate of the power consumption they avoid. This overcompensates DR resources compared to other supply-side resources that receive only the wholesale price. This double payment is akin to allowing a consumer to resell a product that he or she has not purchased.

Economists widely recognize that Order 745 results in DR procurement in excess of economically efficient levels. In effect, it serves as a subsidy that distorts the energy market and may create perverse incentives.[12] FERC may need to develop additional rules that correct these perverse incentives.[13] Many economists support DR compensation at the wholesale-market price, minus the retail rate. Others believe compensation must also account for DR administrative costs.[14] Either approach attempts to ensure DR resources receive an accurate price signal while avoiding overcompensation.

CONCLUSION

Continued treatment of DR as a supply-side resource must ensure its full market integration. This means ensuring DR resources can set the market-clearing price (not all DR products do) and that they do not face unnecessary barriers to entry. At the same time, RTO/ISO rules should not grant DR leniency that results in an inferior product displacing conventional supply resources. Accelerating the granularity of DR dispatch capabilities is an important step. Improved M&V techniques are also imperative to ensure competitive market outcomes and long-term grid reliability.

The Supreme Court decision correctly settled the jurisdictional debate over wholesale DR, as FERC should have jurisdiction over wholesale products offered into interstate electricity markets. Unfortunately, it left in place a flawed compensation scheme. The resolved jurisdictional uncertainty creates an opportunity to correct Order 745 and address other RTO/ISO rules that treat DR as a supply-side resource.

Some DR types cannot fully substitute for conventional supply resources but still provide some market value. Incorrectly treating DR as a supply-side resource has sometimes distorted markets, undermined reliable operations and constrained innovative applications of DR.[15] A preferable alternative may be to treat DR as a demand-side resource.

The demand side of RTO/ISO markets is generally underdeveloped. Ideally, customers or their designated intermediaries would see and react to market prices. This would require treating DR on the demand side, where customers would avoid paying for electricity at their own discretion. Some RTO/ISOs have embraced this idea by pursuing what's known as price-responsive demand (PRD) – the predictable change in electricity demand in response to wholesale electricity prices.[16] PRD allows customers to avoid electricity charges by reducing their demand. Some RTO/ISOs have begun phasing-in PRD, but it has seen minimal participation, likely because of the compensation advantages of supply-side DR.

PRD can increase grid operating certainty and improve market outcomes by enabling RTO/ISOs to forecast demand in response to price. PRD responds to price signals at a granular level, overcoming the locational constraints of supply-side DR. It also avoids the need for complicated and inaccurate M&V analysis, since it does not need to follow dispatch instructions from the RTO/ISO.

Advancing PRD, correcting DR supply-side treatment and enacting competition-enabling state reforms constitutes the ideal long-term vision for DR. Competitive markets have fueled growth and innovation in DR resources.[17] Competition will deliver next-generation DR that will play a critical role in the dynamic grid of the future.

ABOUT THE AUTHOR

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Devin previously worked at the Federal Energy Regulatory Commission (FERC), where he conducted economic analysis of wholesale electricity markets. His specialties included renewables integration, environmental regulation, coordination of natural gas and electric industries, and capacity-market performance and design evaluation.

ENDNOTES

1. Electricity systems are most vulnerable to market power when demand is highest relative to available supply. Such conditions can enable generators to increase the market price substantially by decreasing their output. DR reduces this ability by lowering demand relative to supply.

2. High peak demand commonly occurs several days per year in most electricity markets. Sometimes markets go multiple years without demand sufficiently enough to trigger DR activations.

3. Doug Hurley, Paul Peterson, Melissa Whited, "Demand Response as a Power System Resource," Regulatory Assistance Project and Synapse Energy Economics Inc., May 2013. https://www.raponline.org/document/download/id/6597

4. The domestic RTO/ISOs are ISO New England (ISO-NE), New York Independent System Operator (NYISO), PJM Interconnection (PJM), Midcontinent Independent System Operator (MISO), Southwest Power Pool (SPP), California Independent System Operator (CAISO) and Electric Reliability Council of Texas (ERCOT).

5. End-use electricity customers use an intermediary, commonly referred to as a curtailment service provider or aggregator of retail customers, to interface with the RTO/ISO. These intermediaries aggregate their customers' electricity demand and can provide DR services. Some large customers instead interface directly with the RTO/ISO.

6. Dan York and Martin Kushler, "Exploring the Relationship between Demand Response and Energy Efficiency: A Review of Experience and Discussion of Key Issues," American Council for an Energy Efficient Economy, Report Number U052, March 2005.

7. Strong evidence rests in the Midwest and mid-Atlantic wholesale electricity markets, which consist of a combination of restructured and traditionally regulated utilities. The market-monitoring units for these areas have noted a large discrepancy between the quality and extent of DR offers from monopoly utilities and competitive intermediaries, with competitive DR providers far more responsive to price signals.

8. An example is Indiana, where utilities are the sole providers of state DR resources brought into RTO/ISO markets. The visibility concerns expressed by some utilities can be rectified through information reporting from DR providers to utilities.

9. RTO/ISO energy markets are priced at the nodal level, which reflect localized transmission constraints. Nodal dispatch of DR would provide end-user customers with more accurate price signals and give the RTO/ISO the same ability to manage transmission constraints with DR as a conventional supply-side resource.

10. All RTO/ISOs are FERC-jurisdictional except ERCOT.

11. The court made a procedural finding that FERC's approach to determining compensation was carefully reasoned, not arbitrary and capricious. This was not a decision on the merits of the pricing analysis or compensation scheme.

12. For example, it artificially increases the value of behind-the-meter generation, which can appear as DR to the RTO/ISO. This creates an incentive to install generation that may not be profitable on the other side of the meter.

13. William W. Hogan, "Demand Response: Getting the Prices Right," February 2016. https://www.hks.harvard.edu/fs/whogan/Hogan_DR_pricing_021516.pdf

14. Steve Isser and Bob King, "The Price is Right? Demand Response on Appeal before the U.S. Supreme Court," *Public Utilities Fortnightly*, December 2015.

15. This highlights the importance of ensuring supply-side DR is given economically efficient, not preferential, treatment.

16. PJM Interconnection LLC Inc., "Price Responsive Demand," PJM staff white paper, March 2011.

17. DR products from competitive suppliers respond to price signals and have outperformed regulated-utility DR programs.