



**RESPONSE TO QUESTIONS FOR THE RECORD FROM KUSHAL PATEL
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**U.S. HOUSE OF REPRESENTATIVES
ENERGY AND COMMERCE COMMITTEE
ENERGY SUBCOMMITTEE**

**Hearing entitled “Powering America: The Role of Energy Storage in the Nation’s Electricity
System”**

November 19, 2018

Thank you again for the invitation to testify at the July 18th hearing entitled “Powering America: The Role of Energy Storage in the Nation’s Electricity System”. I would also like to thank Congressman Walden, Chairman Upon, and Congressman McNerney for their additional questions for the record. I have included each question and my responses below.

The Honorable Greg Walden

1. *FERC issued Order No. 841, earlier this year, and asked the RTOs/ISOs to ensure their market rules are not creating barriers to the participation of energy storage resources in their capacity, energy, and ancillary services markets. As these market operators are contemplating their responses.*
 - a. *From your perspectives, are the markets working? Are energy storage resources able to compete? If not, what are the barriers?*

In short, the markets are not currently working well. Many of the services that storage could provide lack viable market participation structures, and so storage assets are not adequately utilized or compensated.

Until the high (but declining) cost of storage can be offset by well-defined market structures that allow for monetization of the full value of storage, only the highest value storage use cases will be cost-effective and competitive.

The most substantial barrier to storage becoming competitive in markets is the limited ability for storage to earn revenues for the numerous services it can perform. Because of the versatility of energy storage, finding ways to monetize all these services requires addressing many challenges. Some of these challenges are hardware-related; for example, full valuation of distribution- and customer-sited storage requires telemetry and metering infrastructure that may be cost-prohibitive. More challenges stem from outdated market rules that do not value near-instantaneous response times or allow a resource to switch between consuming energy and supplying it. The newness of the technology creates other challenges as well: hardware and “soft costs” continue to decline but are still high, sufficient data on storage performance is not yet available, and financing remains nonstandard and thus increases transaction costs.

With FERC Order 841 and the ongoing development of rules for Distributed Energy Resource participation, markets are evolving. But the coming changes will not be implemented uniformly in each market, because product definitions and participations rules remain nonstandard. Consequently, some regions of the country will become more favorable to storage projects than others. Having more uniform market rules and definitions across the country would result in more standardized and steady value streams, which in turn would lead to well-formed financing structures and increase storage market participation.

The Honorable Fred Upton

1. *According to EIA, about 90% of large-scale battery storage capacity in the United States is installed in the regions covered by five of the seven organized markets (RTOs/ISOs). Nearly 40% of existing large-scale battery storage power capacity lies in the PJM footprint, the next being CAISO with 18% existing power capacity.*
 - a. *What circumstances led to the PJM market having this large share of large-scale battery storage capacity?*
 - b. *Could market rules in PJM be utilized in other competitive electricity markets?*

In response to FERC Order 755 in 2011, the PJM market created two different regulation products: Regulation A (“RegA”) and Regulation D (“RegD”). The RegA signal covers needs on a timescale of minutes, while the RegD signal covers near-instantaneous needs. Short duration energy storage was a perfect fit for the RegD product, and PJM saw over 250 MW of storage installed.

However, changes to the RegD market in 2015 and 2017 capped the procurement amount of RegD resources and decreased the advantage that batteries had over other technologies in the regulation market. These rule changes, along with saturation of the market for RegD, eliminated the revenue streams for short-duration storage in the PJM system. Accordingly, energy storage capacity in PJM has stagnated, with almost no new installed MW in 2017.¹

While the existence of a fast frequency response market does capture a product that energy storage can uniquely provide, applying the initial PJM rules universally would be imprudent. The initial RegD product promoted rapid growth of storage capacity in the PJM system, but PJM changed these initial rules because they adversely affected system operations. Also, the RegD product only encouraged installations of very short-duration energy storage.

A set of well-defined market rules would promote installations of a wider range of storage technologies and would unilaterally help the system to run more efficiently. We should take the rapid growth in PJM

¹ EIA report on U.S. Battery Storage Market Trends, Figure ES1.
https://www.eia.gov/analysis/studies/electricity/batterystorage/pdf/battery_storage.pdf

as evidence of two things: 1) storage developers are ready to build projects when market rules are favorable; and 2) long-term market design issues should be addressed proactively in the beginning to ensure a viable longer-term market vs. one that is more “boom and bust.”

The Honorable Jerry McNerney

1. How would each of you properly value storage?

E3 has conducted several analyses to assess the potential value of different types of storage – i.e., Li-ion batteries, compressed-air energy storage, and pumped hydro – for clients including utilities, commercial customers, and project developers. In these analyses, the actual value of storage depends on the underlying market and revenue streams available as well the dispatch behavior of the storage asset.

Potential revenue streams come from a wide variety of utility, customer, and grid services. Utility services may include Resource Adequacy, Transmission & Distribution Deferral, and Transmission Congestion Relief. Customer services may include Energy Bill Management, Demand Charge Reduction, Demand Response programs, Backup Power, and Increased PV Self-Consumption. Grid services may include Frequency Regulation, Spin/Non-spin Reserve, Energy Arbitrage, Load Following, Voltage Support, and Black Start.

The revenues available to a given storage asset depend on where the storage is sited (at the transmission, distribution, or customer level) and on the rules of the ISO/RTO or the specific state and utility to which the storage is connected. Given the presently evolving market rules, available revenue streams are still being developed, and the valuation process is filled with uncertainty. Indeed, many of these potential revenue streams are not currently realizable in most regions.

Thank you for your questions. If the Subcommittee has any additional questions after reading my response, I would be happy to provide more information. Once more, I applaud the Subcommittee's leadership in addressing this challenging topic.

Thank you.

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