The Value of Distributed Electricity Storage in Texas

Proposed Policy for Enabling Grid-Integrated Storage Investments

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Executive Summary

Electricity storage is attracting much attention as storage manufacturers begin to announce rapid reductions in the technology's costs, utilities publicize upcoming deployments, and states evaluate new policy initiatives.[1] Interest in electricity storage is driven by a range of potential applications that include avoiding power outages for customers, reinforcing the grid, reducing other transmission and distribution (T&D) costs, shifting power consumption away from costly peak-load periods, balancing intermittent renewable energy resources, and providing ancillary services and emergency response service in the wholesale power markets. While the potential value of these and other storage applications have long been recognized, electricity storage costs have not been competitive with alternative technologies and resources that can provide comparable services. Therefore, electricity storage investments to date have been deployed primarily as demonstration projects.

Due to recent development, electricity storage appears to be on the verge of becoming quite economically attractive. Most importantly, several battery storage manufacturers have indicated that their costs will decrease substantially over the next few years. Public reports now forecast cost declines from the current $700–$3,000 per kWh of installed electricity storage in 2014 to less than half of that over the next three years.[2] Some analyst projections and vendor quotes point to even more significant cost reductions, forecasting that the installed costs of battery systems will drop to approximately $350/kWh by 2020.[3] At these much lower system costs, many innovative applications of electricity storage could be cost effective.

In this context of declining battery costs, Oncor Electric Delivery Company, a Transmission and Distribution Service Provider (TDSP) in Texas, has engaged us to explore the economics of grid-integrated storage deployment in Texas. We evaluate this question first by estimating whether storage could be cost-effectively deployed on the distribution systems in the state from the perspectives of retail customers, wholesale electricity market participants, and the combined system or "society as a whole." We then evaluate whether new public policies supporting electricity storage in Texas would be needed, given the Electric Reliability Council of Texas's (ERCOT's) deregulated market structure, and if so, what policies might be necessary for Texas to

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1 For example, see Public Utility Commission of the State of California (2013), p. 2.

2 Navigant notes that current storage costs for a four-hour battery are $720–$2,800/kWh depending on the scale of the battery. According to Sam Jaffe of Navigant Research, battery-only costs are currently around $500–700/kWh with the remaining installation costs due to system costs. Also see Dumoulin-Smith, *et al.* (2014) p. 1.

3 The $350/kWh installed cost projection is based on Oncor's discussions with vendors, consistent with industry sources. For example, Morgan Stanley predicts that battery-only costs may reach $125–$150/kWh in the near future, down from the $500/kWh currently. See Byrd, *et al.* (2014), p. 40. If battery costs are capable of reaching the low costs projected by Tesla Motors Inc., this would imply a battery-only cost of only $110/kWh. See Jaffe (2014) p. 30.

realize the full economic and reliability benefits of grid-integrated, distributed electrical energy storage.

Our analysis shows that deploying electricity storage on distribution systems across Texas could provide substantial net benefits to the state. We estimate that up to 5,000 MW (15,000 MWh, assuming a three-to-one ratio of storage to discharge capability) of grid-integrated, distributed electricity storage would be cost effective from an ERCOT system-wide societal perspective based on a forecast of installed cost of storage of approximately $350/kWh. Our analysis assumes that the storage deployment plan will be developed to capture as much benefits as possible by integrating value from increasing customer reliability, improving the T&D systems, and transacting in the wholesale power markets. Our analysis accounts for the net impact that deploying storage would have on generation investments in ERCOT's "energy-only" wholesale electricity market. The resulting generation investment response sustains market prices sufficient to support the development of the generating capacity necessary to maintain ERCOT's resource adequacy.

We also evaluate the benefits of grid-integrated storage deployed by TDSPs from an average electricity customer's perspective. Our analysis shows that deploying 3,000 MW (9,000 MWh) of storage across ERCOT (with 1,000 MW on Oncor's system) would reduce residential customer bills slightly and provide additional reliability benefits in the form of reduced power outages for customers located in areas where storage is installed. **Considering both the impact on electricity bills and improved reliability of grid-integrated storage, total customer benefits would significantly exceed costs.** However, while beneficial from an integrated, system-wide perspective, an efficient scale of storage deployment would not be reached if deployed solely by merchant developers in the wholesale market, by retail customers, or only for capturing T&D benefits.

Storage investments could not be undertaken at an efficient scale solely by merchant developers in the Texas restructured electricity market because the value that a merchant storage developer can capture and monetize through transacting in the wholesale power market alone is too low compared to costs. For instance, we find that approximately 30–40% of the total system-wide benefits of storage investments are associated with reliability, transmission, and distribution functions that are not reflected in wholesale market prices and, therefore, cannot be captured by merchant storage investors. Even at the low projected storage costs, the opportunity to arbitrage wholesale power market prices and sell ancillary services would not likely attract merchant storage investments at a significant scale. This means that relying only on merchant investors to develop storage in ERCOT would result in under-investment in storage from a state-wide perspective. Moreover, without being integrated in T&D planning and operations, merchant electricity storage would be under-utilized and unable to capture the high additional value offered by targeted deployment within the state's transmission and distribution systems.

Similarly, while individual customers would be able to capture backup-power benefits of storage, they are not likely to directly monetize the larger grid-wide and wholesale power market benefits. Finally, developing storage to capture only the T&D system benefits would likely result

in under-investment and under-utilization of electricity storage for wholesale power applications.

In contrast, deploying storage in a manner that can capture wholesale market benefits but is also integrated into the distribution system would allow TDSPs to capture high-value applications such as providing backup power and voltage support on distribution feeders with below-average reliability or high-value end uses, reducing wear on critical distribution assets, and deferring some T&D investments. Given that deploying storage on specific locations on the distribution system is important for capturing the full value that storage can provide, a grid-based deployment strategy will be most effective if it is integrated with: (a) the planning of transmission and distribution system investments; and (b) targeted efforts to use electricity storage backup to reduce customers' distribution-system-related power outages. In addition, to capture the full value of distributed storage assets would require that they be dispatched into the wholesale power markets.

Given the significant benefits that storage can bring to the system as a whole, enabling cost-effective investments in electricity storage will require a regulatory framework that helps investors capture both the wholesale market and the T&D system values associated with the storage devices. We envision that such a policy would involve: (1) enabling electricity storage investments to be deployed by TDSPs on their systems as part of T&D planning that seeks to capture T&D and reliability-related values; and (2) allowing independent wholesale market participants to offer the storage devices into the wholesale power market. Specifically, we propose that an effective regulatory framework would involve allowing the transmission and distribution companies to "auction off" to independent third parties the wholesale market dispatch of the electricity storage deployed on the T&D system. This approach would maintain the clear delineation between: (1) the TDSP's role as a T&D service provider and (2) wholesale market participants who transact in the market. The auction proceeds would be used as an offset to retail customers' T&D costs, which include paying for the storage facilities. Such a regulatory framework would facilitate an economically-efficient level of storage investments in Texas, and reduce investment barriers by allowing the storage technology to be deployed when the combined benefits from the wholesale market, transmission, and distribution systems exceed the expected costs by a sufficient margin.