Harvard Kennedy School Energy Policy Seminar Series, Fall 2014
Energy storage: Its value to the grid and ongoing policy challenges to deployment and support of renewable energy

Monday, October 27, 2014

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Despite offering substantial benefits to the grid, "energy storage is uniquely exposed to price suppression effects in market environments," argued Paul Denholm of the National Renewable Energy Laboratory in Monday's energy policy seminar—causing a profitability dilemma that may threaten the real benefits storage can provide to energy markets.

At first glance, it seems like it should not be that hard to make money in the energy market with an efficient storage technology, Denholm explained. All electricity markets show significant demand variation across a twenty-four hour period, with usage (and wholesale prices) typically lowest in the middle of the night and peaking sometime in the day or early evening. So there is a daily opportunity for electricity storage providers to buy low and sell high. Adding renewable energy to the mix, especially in large quantities, can increase the opportunity, in some cases pushing energy prices not just low but into negative territory—so, in theory, an energy storage provider could get paid just for taking energy off the system, then paid again for selling it back to the system.

Denholm noted that storage offers, not just arbitrage opportunities, but the potential for real overall system cost savings. Using computer modeling of the Colorado electricity system, Denholm simulated the impact of adding 300 MW of eight-hour storage to the system, finding that the addition of storage allowed the system to operate more efficiently, saving almost $6 million in fuel costs (about ½ of 1%) and an additional $5.5 million in avoided plant start-up costs (about 1%). And the value to the system may increase as renewables penetration grows.

However, Denholm's modeling projected that, despite saving the market $10.5 million in costs in his modeling scenario, the storage itself would only be able to realize revenues of about $5.2 million. This gap between what storage can save the market and what storage providers can earn from the market can be traced to two main causes, Denholm said. First, wholesale electricity market pricing does not reflect start up costs for plants, so energy storage providers can't make money from avoiding these start up costs. The second cause is the exposure of energy storage to price suppression effects. Energy storage, Denholm explained, is "uniquely" exposed in that it erodes the prices that support its profitability both by making prices higher when it buys from the market to store energy and lower when it sells into the market. The more effective storage is at responding to market highs and lows, the more it smooths out the price differences that are its major source of revenue—eroding the "buy low and sell high" dynamic that allows storage to make money.

Additional revenues might be available to storage through payments for energy regulation services, Denholm acknowledged, but this is an inherently small market—not enough to support significant storage. Storage could realize significant revenues if it were found to be eligible for capacity payments, but it is not yet clear whether it will be eligible for these payments, which were developed to support the construction of generation capacity. Thus, the question of

how to incorporate efficient amounts of storage into electricity market remains a puzzle for energy policy that goes beyond the technical question of developing more efficient battery technologies.

Denholm's presentation was part of the Kennedy School's Energy Policy Seminar Series, which is jointly sponsored by the Energy Technology Innovation Policy research group of the Belfer Center for Science and International Affairs and by the Consortium for Energy Policy Research of the Mossavar-Rahmani Center on Business and Government.