Bottling Electricity: Storage as a Strategic Tool for Managing Variability and Capacity Concerns in the Modern Grid

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Chapter 3
Regulatory Issues and Potential Barriers to Deploying Energy Storage Technologies

3.1 Regulatory Uncertainty

Energy storage technologies face regulatory barriers to their implementation in the electric power industry. Like any new or emerging technology, energy storage has a lack of regulatory history to guide regulators on its use. In addition, there is no overall strategy or policy on how energy storage technologies can be incorporated into existing components of the electric power industry. In fact, there are very few regulations that explicitly address energy storage. The lack of any specific regulations leaves utilities uncertain regarding how investment in energy storage technologies will be treated, how costs will be recovered, or whether energy storage technologies will be allowed in a particular regulatory environment. The primary reason for the lack of regulation is that energy storage on a utility-scale basis is very uncommon and, except for pumped hydroelectric storage, is relegated to pilot projects or one-time deployments. Utilities have not used energy storage to address capacity issues and are perhaps not accustomed to considering the use of a nontraditional technology, such as energy storage, to address issues in ways different from those used in the past.

An additional reason for the uncertainty regarding the treatment of energy storage technology stems from whether energy storage technology is seen as being related to generation or transmission. The problem, from a regulatory perspective, is that energy storage applications can provide functions related to both, as discussed in Chapter 2. The bulk storage of electricity, for example, if used by a utility to shift the generation of electricity from a time of low-cost generation, such as in the middle of the night, to a time of high-cost generation, such as during peak use, would be seen as similar to generation. On the other hand, in addition to reducing or eliminating the need for peaking facilities, this type of action could also reduce transmission congestion, provide voltage support at a time of peak use, and provide other ancillary services that support transmission functions. The ability of energy storage technology to fill multiple roles in both transmission and generation leads to confusion and uncertainty about how energy storage should be regulated.

3.2 Utility Reluctance

The multiple applications of energy storage spread out the transmission and generation benefits that energy storage provides as well as the income streams provided by these benefits. Regulated investor-owned utilities generally need to be assured of cost recovery before proceeding with major investments, and a new technology such as storage may present challenges in obtaining regulatory approval. Such reluctance results in a barrier to deploying widespread energy storage technology due to the indeterminate state of the technology and the costs of implementation. This confusion affects the cost recovery status of energy storage projects because these utilities are uncertain that a basis can be made for the cost recovery of this new, innovative technology. If an energy storage project is compared directly to a peaking generation facility or to developing a new transmission line, without taking into account the system benefits of energy storage, the cost of the energy storage project may not seem justified if the problem can be addressed through a less-expensive solution. However, it may be difficult to quantify or compare the costs and benefits of all of the different functions provided by an energy storage project to those of a single generation or transmission project.

Because multiple benefits can be provided by energy storage applications, the potential income streams from energy storage are also diverse. For example, an energy storage project may provide the benefits of improved reliability and deferral of transmission improvements. An owner of storage may also attempt to arbitrage the price of electricity by storing when the price of electricity is low and selling back to the grid at peak demand when the price is higher or by providing other ancillary services. However, these benefits would not provide sufficient income if they were considered individually, but combining multiple income streams would allow for full cost recovery of the energy storage project.

However, because these benefits address different functions (generation vs. transmission), it may be difficult to measure the different benefits and allow for full cost recovery based on these benefits. Energy storage provides benefits that can transcend narrowly focused applications categories; for example, energy storage that increases the effective capacity factor of a renewable energy resource improves the economics of that resource and also reduces overall emissions. In addition, the deployment of energy storage technology may allow deferral of transmission expansion (or more realistically, allow higher-priority transmission expansion to take precedence). Application of energy storage avoids a need to carry higher-spinning or short-term generation reserves on a renewable energy project and frees up generation capacity, thus allowing deferral of traditional generation expansion. The challenge for public policymakers is to design incentive structures that fully recognize all of the potential benefits without creating an incentive-driven competition between energy storage and other desirable investments.

Generators, or residential consumers with small-scale renewable energy generation, may deploy energy storage technology for arbitrage purposes; however, the revenue from arbitrage may not be sufficient to cover the costs of an energy storage project and may present another potential barrier to adding more energy storage to the electric power delivery system infrastructure.

A utility that is guaranteed to receive cost recovery of either a transmission or generation project, or both, may have little incentive to put an energy storage project in place. Rather than invest in energy storage technology, a utility may simply opt to construct a transmission and/or generation facility, the costs of which are more likely to be approved and recovered. In addition, state utility regulators may be reluctant to allow cost recovery for an innovative energy storage technology. State utility regulators may instruct the utility to rely on proven technology to address issues that could be solved through energy storage technology.

3.3 Electricity Pricing and Energy Storage Technologies

The current typical pricing structure of flat rates does not provide consumers with any incentive to invest in energy storage applications. Consumers that are exposed to time-of-use or real-time prices will have an incentive to invest in storage if the price differentials are significant, but today relatively few residential or small commercial customers are under such pricing schemes. However, energy storage applications for larger consumers may provide other benefits, such as reducing or eliminating demand charges. Energy storage for all consumers could also be used for demand-side resource programs, if there is an incentive associated with this benefit for the consumer.

To successfully overcome regulatory obstacles to deploying energy storage technologies, a definition of such technologies must be adopted by regulators as a class of assets within the generation, transmission, distribution, or distributed/end-user sectors according to their ownership and application. Furthermore, regulators must then provide appropriate regulations on the use of energy storage in each case. Incentives or allowances for cost recovery should be made by either allowing the energy storage technology owner to obtain multiple income streams to offset the costs or allowing cost recovery through rates. By explicitly addressing the issue of implementation of energy storage technology and indicating that the technology is a cost-effective option that is available to address market issues, the largest barrier to successful development and deployment of energy storage technologies will be overcome.

Chapter 6 Recommendations

Achieving the nation's goals of reducing dependence on fossil fuels and deploying a clean energy economy are enormous tasks that will require major technological innovation. Energy storage technologies will be major contributors in the transportation sector and will play a vital role in the electric power industry to help achieve those goals. Widespread deployment of energy storage technologies will require a three-pronged approach: (1) improved technologies that provide direct cost benefits to consumers and market opportunities for service providers; (2) financial incentives such as tax credits, and (3) mandated, time-based targets for the penetration of energy storage technologies, through mechanisms such as building codes.

To assist the U.S. Department of Energy (DOE) in accomplishing its goals to promote and develop cost-effective, innovative energy storage technologies, the Electricity Advisory Committee (EAC) provides the following recommendations:

1. Provide leadership in coordinating the completion of the mandates of the Energy Independence and Security Act of 2007 as defined in Chapter 5 of this report, particularly with respect to the research and development (R&D) and demonstration recommendations.
2. Create financial incentives, including ones applicable to non-profit utility entities, to help launch new storage applications for economics and reliability.
3. Guide the development of using energy storage as a primary source of frequency regulation control and possibly other ancillary services to replace the use of coal and natural gas-fired generation assets currently used in this application.
4. Establish a requirement that all long-term planning, including generation, transmission and distribution (T&D), demand-side resources, and renewable portfolio standards, specifically consider and address the deployment of energy storage technology as potential components of an integrated plan, considering the potential benefits identified in this report.
5. Commission an authoritative study to guide federal and state policymakers that quantifies the potential societal benefits of energy storage technologies. Such benefits include augmenting the usefulness and value of renewable energy resources and demand-side resources / load management, improving the capacity of the existing electric delivery system infrastructure, improving capacity factors of traditional generating resources, flattening electricity demand, and improving power quality and reliability. This effort should include the reuse of PHEV battery systems as storage devices in the grid after primary service in vehicles. It also should address the end-of-life disposal of storage media and "do-no-harm" policies with respect to environmental, public health, and safety considerations.
6. Promote public communications to raise awareness of the benefits of energy storage technologies to a level that is similar to public awareness of wind and solar power technologies. Such public education efforts should include the benefits of electric and hybrid vehicles

7. Encourage federal legislation to support applications of energy storage technologies by residential, commercial, and industrial consumers of electricity. For example, encourage the use of energy storage in the construction of new homes and commercial or industrial buildings, which would provide benefits such as reduced environmental impacts, improved energy independence, and improved reliability.
8. Carry out a focused education campaign. The DOE campaign should focus on educating power engineers and other stakeholders on the value and applications of electricity storage. DOE should approach land-grant universities for assistance in disseminating information about energy storage technologies and their application.