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Energy Storage

Highlights

- Grid energy storage may improve the **reliability, resiliency, and flexibility** of the grid, and can **reduce the potential for future rate increases**.
- Because of the increasing demand for clean, reliable, and low-cost electricity, **the value of grid storage is greater than it has ever been before**.
- Grid storage still faces significant technical, economic, and regulatory challenges, which may be surmounted by **a coordinated effort** between industry, government, and other stakeholders.

Why energy storage is important

- Energy storage may act as **inventory of electric energy** on the grid, adding a buffer to what is otherwise a just-in-time delivery system.
- Energy storage may make the overall grid **more flexible**, allowing for the accommodation of **more variable generation such as renewables**, and **reducing the strain on conventional generators**.
- Energy storage may **provide fast response to second-to-second ramps** in the supply or demand of electricity, as well as shifting larger amounts of energy through time to **balance generation and load**.
- Energy storage may **increase the reliability and resiliency of the grid** by providing temporary local sources of electricity, augmenting the transmission and distribution network.
- Energy storage may also **reduce the potential for future rate increases** by allowing deferral of grid upgrades and increasing asset utilization on the grid.

Storage is a greater opportunity than ever before

- The grid today operates without a substantial amount of energy storage:
  - **Worldwide**, about **2.4%** of generated electricity is stored.
  - In the **United States**, about **2.1%** of generated electricity is stored.
  - In **Europe**, about **4.5%** of generated electricity is stored.
  - In **Japan**, about **8.8%** of generated electricity is stored.

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- The grid is changing in ways that expand the value of storage:
    - **Increasing demand** for clean, highly reliable electric power.
    - Rapid expansion in the **deployment of variable renewable generation.**
    - Opportunities for increased reliability and resiliency through **smart grid technologies.**

- The performance of storage technologies is improving, and costs are falling.
    - Power systems researchers have applied **technological advances in materials, control systems, and power conversion** to improve all storage technologies.
    - The **consumer electronics and automobile industries have invested significant capital and effort** into developing and manufacturing better batteries for their products.

Storage still faces significant challenges

- Technical challenges:
    - While storage technologies are mature, **turn-key storage solutions are still nascent.**
    - Many storage technologies have relatively short useful life.
        - Batteries have lifetimes measured in **years.**
        - Grid equipment is expected to have lifetimes measured in **decades.**
    - Storage technologies have **inherent losses**, which can hurt economics.
    - Many of today's **grid analysis tools are not well-suited** to analyze storage.

- Economic challenges:
    - Storage is still **an expensive solution** compared to alternatives.
    - Monetizing storage can be difficult, as **benefits accrue to many entities** and not just the owner.

- Regulatory challenges:
    - Existing regulations are built around the just-in-time delivery framework and **do not account for many of the values of storage.**
    - Storage **does not fit neatly into the existing categories** of generation, transmission, distribution, or load asset.

The key research questions

- **How can we create better, longer-lasting and more cost-effective storage technologies?**
    - Technology research, funded by the DOE Office of Electricity and programs such as ARPA-E and conducted through universities and national labs, is addressing these issues.
    - Commercialization strategies for these technologies are important: At present, most commercialization is being done overseas.

- **Can we develop a more accurate understanding of when and how storage can best bring value?**
    - Storage is still an expensive technology and must be used wisely.
    - Better grid analysis tools can determine sizing, deployment, and use of storage for maximum value.
    - Tools are in development by a number of organizations, and results are now being observed with interest by regulators.

- **What are the best practices for installing and operating storage on the grid?**
    - Improvement in storage hardware is possible only through more experience with deployment and operation of storage systems.
    - State and federal agencies are funding many initial deployments, which are highly leveraged through investment from utilities, storage developers, and research organizations such as EPRI.
    - EPRI is coordinating a cross-industry forum called the Energy Storage Integration Council, a technical working group which brings together utilities, storage developers, analysts, and government agencies to facilitate the development of safe, reliable, and cost-effective storage solutions.

About EPRI

The Electric Power Research Institute, Inc. (EPRI, www.epri.com) conducts research and development relating to the generation, delivery and use of electricity for the benefit of the public. An independent, nonprofit organization, EPRI brings together its scientists and engineers as well as experts from academia and industry to help address challenges in electricity, including reliability, efficiency, health, safety and the environment. EPRI's members represent more than 90 percent of the electricity generated and delivered in the United States, and international participation extends to 30 countries. EPRI's principal offices and laboratories are located in Palo Alto, Calif.; Charlotte, N.C.; Knoxville, Tenn.; and Lenox, Mass.

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