Making Sense of Energy Storage

How Storage Technologies Can Support a Renewable Energy Future

Energy storage can be an important part of the electric grid of the future, providing reliable access to electricity while supporting America's transition to 100 percent renewable energy. Getting the most out of energy storage, however, requires understanding how it works, where and when it is necessary, and how it can be supported by public policy.

Why Store Energy?

America and the world need to shift our energy system away from fossil fuels and towards clean, renewable sources. This change requires modernizing our electric grid, including building new capacity to store energy for later use. Doing so could offer a variety of benefits:

- Energy storage can capture renewable energy produced in excess of the grid's immediate needs for later use. In California, solar and wind energy plants were forced to halt production more than one-fifth of the time during 2016 because the power they produced was not needed at that moment.
- Energy storage can help utilities to meet peak demand, potentially replacing expensive peaking plants.
- Energy storage can extend the service lifetime of existing transmission and distribution infrastructure and reduce congestion in these systems by providing power locally at times of high demand.
- Energy storage can improve community resilience, providing backup power in case of emergency, or even allowing individuals or communities to live "off the grid," relying on clean energy they produce themselves.
- Energy storage can provide needed ancillary services that help the grid function more efficiently and reliably.

Other Strategies to Integrate Clean Energy

Energy storage is likely to be most effective when used as part of a suite of tools and strategies to address the variability of renewable energy. Other strategies include:

- **Widespread integration** of renewable energy into the grid: Increasing the number and geographic spread of renewable generators significantly reduces their collective variability.
- **Weather forecasting**: Having advance knowledge of when wind and solar availability is likely to rise or fall allows energy providers to plan effectively.
- **Energy efficiency**: The American Council for an Energy-Efficient Economy has found that reducing utility electricity consumption by 15 percent will reduce peak demand by approximately 10 percent.
- **Demand response**: Systems that allow utilities to temporarily cut power demand from heaters, industrial machinery and other sources when demand peaks – and pay consumers who volunteer to have their power curtailed – can reduce the challenges posed by variability.
- **Building excess capacity**: A University of Delaware study found that the most affordable way to meet 99.9 percent of regional demand with renewable sources involved generating 2.9 times more electricity than average demand, while building just enough storage to run the grid for nine to 72 hours.

Current Energy Storage Technologies

Various energy storage technologies can help integrate renewable energy into America's energy system.

Thermal storage stores energy in very hot or very cold materials. This stored energy can be used directly for heating or cooling, or can be used to power a generator and produce electricity.

Utility-scale batteries can be located along the electricity distribution or transmission system, providing power during times of peak demand, aiding with frequency regulation, and absorbing excess renewable energy for later use.

Residential and commercial batteries located "behind the meter" can provide backup power and have the potential to be aggregated and controlled by a utility to support grid reliability. Electric vehicle batteries could also someday be integrated into the grid, charging when renewables are available and powering homes and businesses at times when demand is high.

Pumped-storage hydropower, currently the most common form of grid-connected energy storage, works by pumping water from a lower reservoir, such as a river, to a higher reservoir. When electricity is needed, the water in the higher reservoir is released to spin turbines and generate electricity.

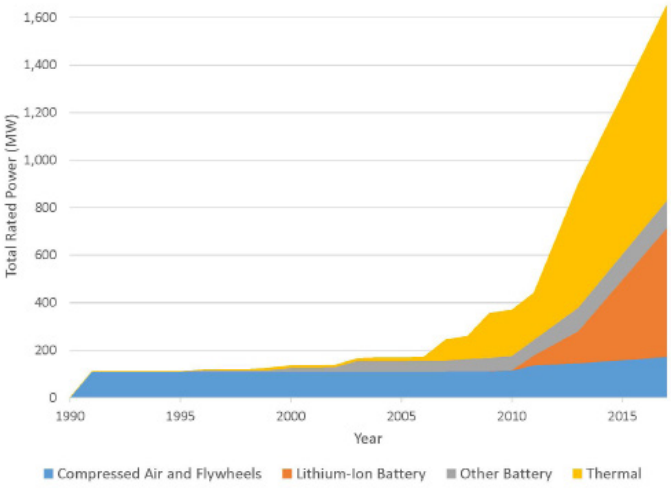
Compressed air energy storage works by compressing air and storing it in underground reservoirs, such as salt caverns. When electricity is needed, the air is released into an expansion turbine, which drives a generator.

Flywheels use excess electricity to spin a rotor in a very low-friction environment and then use the spinning rotor to power a generator and produce electricity when needed. These systems require little maintenance, last for a long time and have little impact on the environment, but have limited power capacity.

Energy Storage Is Taking Off

Energy storage has been spreading rapidly, and this growth is projected to continue. There was six times more energy storage capacity (excluding pumped-storage hydropower) in 2017 than in 2007. GTM Research, an electricity industry analysis firm, predicts that the energy storage market will be 11 times larger in 2022 than it was in 2016.

Capacity of Operational U.S. Energy Storage Projects over Time, Excluding Pumped-Storage Hydropower (Department of Energy)



Supporting the Growth of Energy Storage

Energy storage is likely to become increasingly important and valuable in the years ahead, due to:

- **Falling costs**: The cost of energy storage has been declining rapidly. Over the next five years, average battery costs are projected to fall 19 to 49 percent.
- **Increasing renewable energy adoption**: The U.S. Energy Information Agency expects that solar and wind capacity will increase by almost 20 percent from 2016 to 2018.
- **Public policies**: Statewide policies supporting energy storage have been adopted in California, Oregon, Massachusetts, New York, and Nevada in recent years.

To ensure that energy storage is adopted alongside a transition toward a 100 percent renewable energy system, policymakers should:

- Clarify existing grid connection and permitting policies to remove barriers to installation and deployment of energy storage;
- Design energy markets to capture the full value of energy storage and all the services these technologies can provide;
- Incentivize homes and businesses to adopt storage;
- Set storage benchmarks and encourage utilities to build and utilize energy storage throughout their systems.

For more information and the full report, please visit www.environmentamericacenter.org

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