

Why GAO Did This Study

Power plants' electricity output must be matched continuously with demand, which varies depending on the time of day and year. To maintain a reliable supply of electricity, operators of the electricity grid—a complex network of power plants and power lines managed by utility companies and other operators—take steps to ensure power plants are available to generate electricity when needed. Increasingly, renewable sources of energy, such as solar and wind, are being integrated into the grid.

Energy storage allows for electricity to be stored and used later when it is needed and could change the operating capabilities of the electricity grid. Batteries and other energy storage technologies can store energy in one form—such as chemical, mechanical, or thermal energy—and transform that energy to generate electrical power at a later time.

GAO was asked to provide information on the role of energy storage in grid operations. This report describes (1) how energy storage can be used to enhance grid operations and performance; (2) factors that affect the deployment of energy storage for grid operations; and (3) federal and state policies and other efforts that address the deployment of energy storage. GAO reviewed studies published from 2012 through 2017; and interviewed 41 stakeholders, including officials from government agencies and representatives of industry and other groups based on their knowledge of energy storage and grid operations.

View [GAO-18-402](#). For more information, contact Frank Rusco at (202) 512-3841 or ruscof@gao.gov.

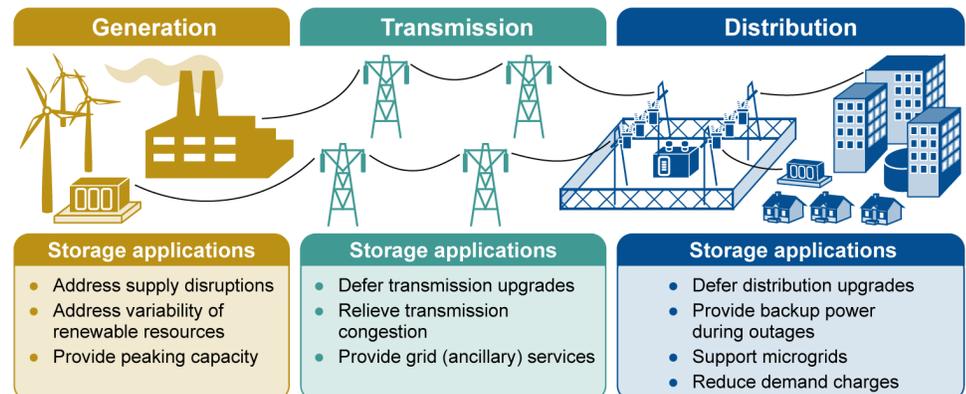
ENERGY STORAGE

Information on Challenges to Deployment for Electricity Grid Operations and Efforts to Address Them

What GAO Found

Energy storage can be used in various ways to enhance the reliability, resilience, and efficiency of grid operations, according to studies GAO reviewed and stakeholders GAO interviewed. Such storage can be deployed throughout the electricity system and act as a generation, transmission, distribution, or customer-sited asset to provide various services, address operational challenges and needs, and potentially reduce costs, as shown in the figure below. For example, storage can help grid operators address supply disruptions and the variability of renewable energy resources, such as solar and wind; relieve transmission congestion; defer the need for transmission or distribution system upgrades; and provide backup power during a power outage.

Examples of Potential Storage Applications on the Electricity Grid



Source: GAO illustration based on studies and documents. | GAO-18-402

Various factors affect energy storage deployment. These include industry and technology readiness, safety concerns and stringency of siting requirements, increasing use of renewable resources, cost-competitiveness of storage and challenges with quantifying the value of storage, and the regulatory environment, according to studies GAO reviewed and stakeholders GAO interviewed. For example, industry and technical challenges include uncertainty about the performance of certain technologies over time and in various operating conditions.

Federal and state policymakers have used various policies and other efforts to encourage the deployment of storage and address market barriers. For example, the Department of Energy has undertaken various efforts, including research and development focused on improving factors that affect the cost and capacity of certain storage technologies. In addition, the Federal Energy Regulatory Commission has issued proposed and final rules to address market barriers to storage deployment in wholesale markets. Lastly, state policies and other efforts that aim to encourage the deployment of storage or to address market barriers include establishing mandates and targets for storage adoption, revising planning requirements, and offering financial incentives and funding.