CENTER FOR CLIMATE AND ENERGY SOLUTIONS

U.S. POLICY

Advanced Transmission Technologies:

Providing Near-term Energy System Benefits

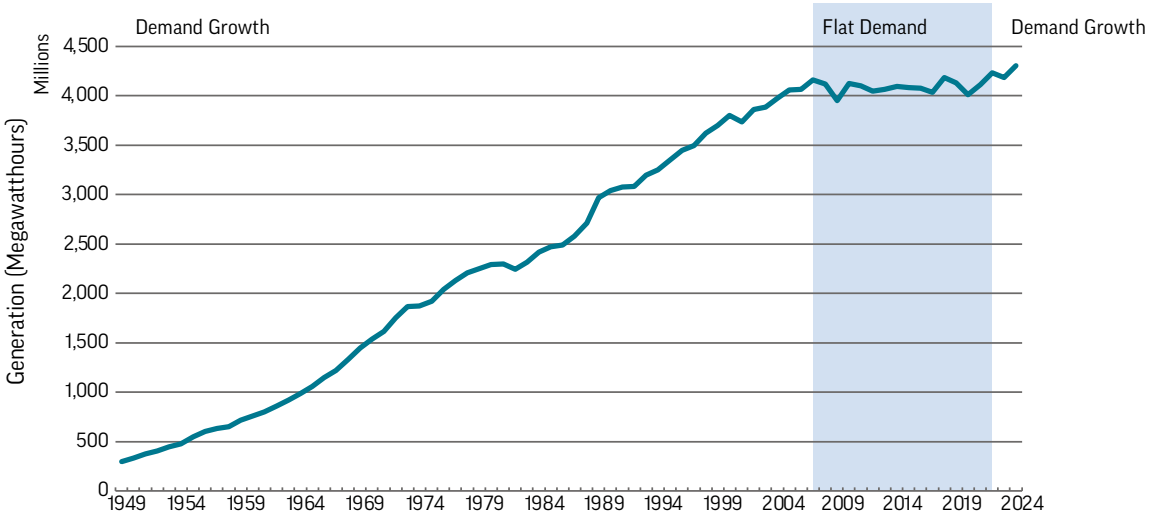
November 2025

After decades of flat growth, electricity demand is surging once again (see Figure 1). This rapid growth straining our nation's grid is presenting new challenges for ratepayers, energy system planners, and policymakers. A strong and reliable grid are crucial to ensuring the United States continues to be a global economic leader by revitalizing the U.S. manufacturing sector, advancing electrification, and remaining competitive in the AI race. Actions must be taken to modernize and optimize transmission infrastructure.

In the long term, building new transmission lines will be necessary to meet growing demand; however, the current permitting process to build new lines can take decades or more to complete. Fortunately, there are accessible and cost-effective advanced transmission technologies that can help us more-easily meet rising demand in the near term.

C2ES is a non-partisan, non-profit research organization. These policies were developed in consultation with leading businesses across the U.S. economy; however, as a fully independent organization C2ES is solely responsible for its positions, programs, and publications.

FIGURE 1: ELECTRICITY GENERATION (1949–2024)



U.S. Energy Information Administration, "Table 7.2a: Electricity Net Generation," Monthly Energy Review, Accessed November 2025, https://www.eia.gov/totalenergy/data/monthly.

To learn more about or engage with C2ES's permitting policy campaign, reach out to Director of Advocacy, Rose Luttenberger Caruso (luttenbergerr@c2es.org).

Grid Enhancing Technologies

System inefficiencies lead to lost electrons; grid enhancing technologies (GET) can quickly enhance the system's ability to avoid wasted electricity. GETs are advanced hardware and software tools that increase efficiency of existing infrastructure, delivering system benefits nearly immediately.

Types of GETs:

- **Dynamic line ratings** (DLR) increase power capacity by utilizing sensors that monitor real-time weather conditions (e.g., temperature, wind speed) and adjust thermal limits (which are typically set conservatively low), allowing for increased and optimized power flows matched to ambient conditions.
- **Advanced power flow control** (PFC) directs grid "traffic," preventing backups using hardware to reroute power from congested lines onto ones with available capacity.
- **Topology optimization** (TO) is similar to PFC technology, except software is used rather than hardware to analyze and identify optimal configurations to route power.

Benefits of GETs:

- GETs are lower cost, quickly deployed (i.e., less than two years) technologies that increase line carrying capacity, reduce congestion, improve efficiency, and enhance reliability by responding to rapidly changing conditions.
- Deployed together, advanced PFCs, DLR, and TO can further increase system utilization, unlocking an average of 10 to 50 percent of additional carrying capacity in existing infrastructure.
- GETs save ratepayers money. Studies in the PJM region (i.e., Eastern United States) show GETs deployment enabled grid operators to save around $500 million in infrastructure upgrades and save ratepayers $1 billion in annual production costs due to increased system efficiencies.

Reconductoring with High-Performance Conductors

Reconductoring involves replacing existing lines (i.e., the cable portion) on existing transmission infrastructure with new materials, namely high-performing or advanced conductors. Next-generation conductors are upgraded lines made from carbon fiber and other composite materials that result in near-immediate benefits like higher line capacity, less line sag due to their lighter weight, and enhanced reliability.

Benefits of Reconductoring:

- While more expensive and slightly longer to deploy than GETs (i.e., 18 – 36 months), reconductoring projects deliver larger benefits by increasing existing line capacity by 50 to 110 percent without requiring new rights-of-way or land takings, avoiding the lengthy delays encountered when building new lines.
- Replacing existing lines with advanced conductors typically costs less than half as much as building new lines for the same gained capacity, partly because it makes use of existing infrastructure (e.g., transmission towers).

Policy Solutions

- Currently, the Federal Energy Regulatory Commission (FERC) treats GETs and reconductoring with advanced conductors as a form of transmission expansion and includes them in regulations to modernize regional grids. FERC's recent rule, Order No. 1920, highlights reconductoring with high-performing conductors and GETs adoption as ways to cost-effectively and quickly increase grid capacity without acquiring new land. **Congress should further incentivize research and innovation by supporting, via funding, existing programs and offices at the U.S. Department of Energy (DOE) focused on the demonstration of next-generation grid technologies, namely the Grid Resilience and Innovation Partnerships (GRIP) Program.**

- **Congress should direct FERC to complete a study exploring the potential benefits of advanced grid technologies, including advanced conductors, GETs, and other emerging technologies.** This study should include potential structures to generate shared economic benefits for adopters (i.e., utilities) and ratepayers, and other recommendations for actions that can be taken to incentivize more widespread adoption.

Together, GETs and reconductoring can provide compounding benefits, each providing upwards of 100 GW of additional capacity to our existing grid infrastructure. Furthermore, they provide a cost-effective solution for energy abundance by enhancing grid reliability, reducing congestion, and integrating new sources of clean electricity, all while supporting economic growth.