Congressional Research Service
Informing the legislative debate since 1914

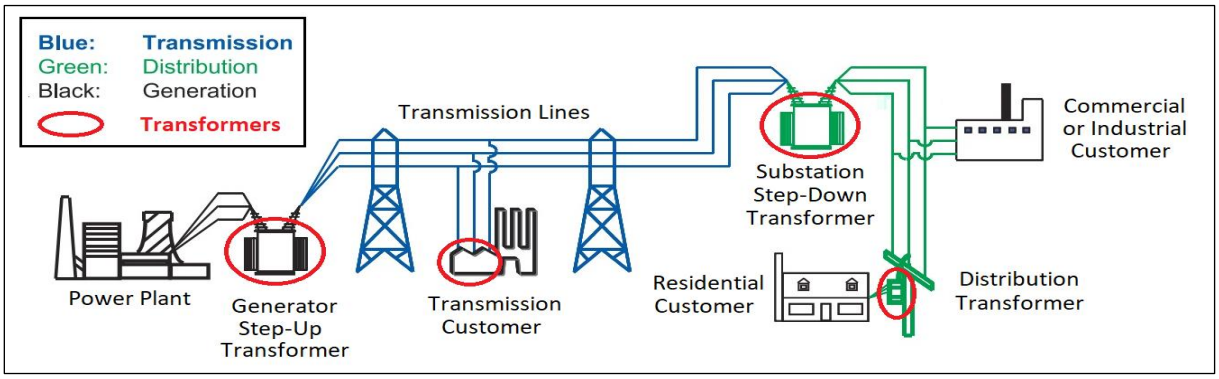
INSIGHT

Electric Power Transformers: Supply Issues

November 16, 2022

Electric power transformers are fundamental components of the U.S. electric grid. They control the voltage of electricity so that it can be synchronized with other power supplies, transmitted long distances, and distributed to customers (**Figure 1**). Some utilities assert that they face transformer shortages due to a combination of historical supply constraints, the impacts of the COVID-19 pandemic, and severe weather events. Industry analysts warn that shortages may jeopardize electric service reliability, storm recovery, and grid expansion to accommodate anticipated growth in renewable electricity supplies. The Biden Administration and some Members of Congress have likewise expressed concern about transformer shortages and have taken actions to address them. Transformer supply challenges include access to emergency transformer reserves, domestic manufacturing capacity, and the availability of specialty steel.

Figure 1. Transformers in the Electric Power Grid



Source: Adapted by CRS from *U.S.-Canada Power System Outage Task Force, Final Report on the August 14, 2003 Blackout in the United States and Canada: Causes and Recommendations*, April 2004, Figure 2.1.

Transformer Supply Constraints

Power transformers range in size from small, pole-mounted units that may serve a dozen homes to large substation units that may serve an entire city. In the past, interest among policymakers focused mostly on

Congressional Research Service
https://crsreports.congress.gov
IN12048

large power transformers (LPTs), high-voltage units used in bulk power transmission. A 2014 Department of Energy (DOE) study found that the United States had "limited production capability to manufacture LPTs" and that "if several LPTs were to fail at the same time, it could be challenging to quickly replace them." DOE's 2015 *Quadrennial Energy Review (QER)* concluded that, for LPTs, "the lack of off-the-shelf transformer options and industry practice of as-needed manufacturing is an ongoing concern" and recommended that DOE develop a critical LPT reserve of emergency spares.

Following the QER's recommendations, Congress included provisions in the Fixing America's Surface Transportation (FAST) Act (P.L. 114-94) requiring DOE to develop a plan for a "Strategic Transformer Reserve" of spare LPTs to temporarily replace critical units damaged due to intentional attack or destructive natural events. In its subsequent report to Congress, DOE concluded that an industry-led solution, including the formation of private consortia and companies for transformer sharing in the event of major grid disruptions, was "best positioned" to meet the needs of transmission companies.

Over the past few years, concerns about transformer supplies have extended to smaller units used in local distribution networks. For example, an August 2022 survey by the American Public Power Association found that "production of distribution transformers is not meeting current demand" and that "many public power utilities are at a high risk of stocking out on transformers." An Edison Electric Institute official stated at the time that supply constraints were even greater for smaller, distribution-level transformers than for LPTs. Some smaller utilities have reported that lead times for orders of distribution transformers grew from a few months in 2020 to well over a year in 2022, and that unit prices have increased by up to 400% or more.

A key factor limiting domestic transformer production is the availability of transformer component materials, particularly grain-oriented electrical steel (GOES), a specialty metal required for transformer cores. A 2020 Department of Commerce investigation found "insufficient or no domestic production capability for certain grades and qualities of GOES ... for distribution transformers." A 2022 DOE report found that there is just one U.S. GOES manufacturer and that the company could not meet domestic demand for the highest quality steel at prices comparable to imported GOES. Some analysts suggest that delays in transformer manufacturing and shipping and labor shortages exacerbated by the COVID-19 pandemic, as well as tariffs on specialty steel imports, also have affected U.S. transformer manufacturing. The need to replace a large number of transformers due to damage from recent storms, like Hurricanes Ida and Ian, may put additional strain on U.S. transformer inventories.

Administration and Congressional Initiatives

In June 2022, President Biden issued a memorandum allowing DOE to use Defense Production Act (50 U.S.C. §§4501 et seq.) authority to increase domestic production of transformers, among other electrical equipment. DOE states it subsequently has held listening sessions with stakeholders and has published an associated Request for Information. DOE also has joined with the Electricity Subsector Coordinating Council to establish a "Supply Chain Tiger Team" to identify supply chain challenges and potential solutions for grid components, including transformers. Some stakeholders and Members of Congress have called for additional agency actions to increase transformer supplies. These actions include:

- temporarily waiving DOE's energy efficiency standards for distribution transformers to reduce their required steel content (which DOE reportedly has declined to do);
- having the Federal Emergency Management Agency identify existing transformer stockpiles among suppliers and utilities available for emergencies; and
- allocating funds in P.L. 117-169, commonly called the Inflation Reduction Act, for wage subsidies to transformer manufacturing workers to increase domestic production.

The Infrastructure Investment and Jobs Act (IIJA; P.L. 117-58) requires DOE to assess the potential development and storage of an inventory of high-voltage transformers and to provide an update of related industry efforts. (CRS has been unable to determine the status of this assessment.) Some Members of the 117th Congress have introduced additional legislation intended to address transformer supplies. Proposals include the GRID Act of 2022 (H.R. 6779), the LIFT America Act (H.R. 1848), the CLEAN Future Act (H.R. 1512), and the America COMPETES Act of 2022 (H.R. 4521, as passed in the House), which would authorize funds for a federally-owned strategic LPT reserve. House-passed H.R. 4521 and the House-passed National Defense Authorization Act for Fiscal Year 2023 (H.R. 7900) would direct the Secretary of Energy to "facilitate the domestic manufacturing of large power transformers, generator step-up transformers ... and other critical electric grid equipment," through grants, loans, and technical support. The Facilitating the Reshoring of Energy Grid Component Manufacturing Act of 2022 (S. 4626) would establish a DOE loan program to expand domestic manufacturing of GOES, LPTs, distribution transformers, and other electric grid components.

Author Information

Paul W. Parfomak
Specialist in Energy Policy

Disclaimer