
Tom Williams/CQ-Roll Call Inc. via Getty Images

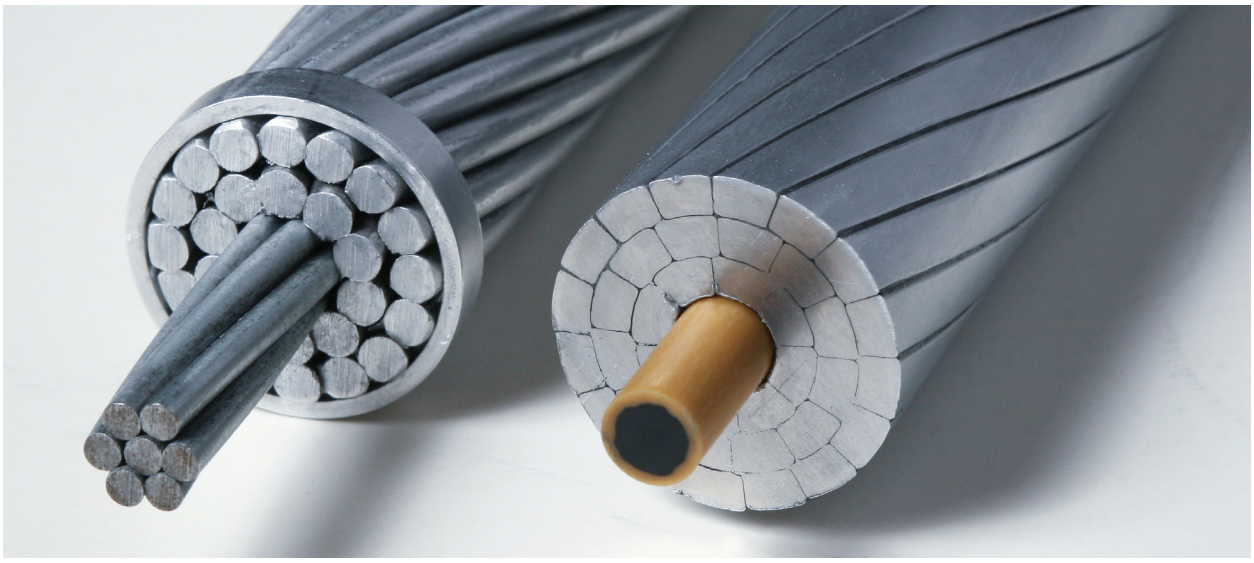
Advanced Transmission Technologies Can Help States Meet Growing Energy Demand

Policymakers look to hardware and software solutions to modernize the grid, boost capacity, and lower consumer costs

Overview

The U.S. energy grid is under growing pressure from the boom in data centers, rising use of artificial intelligence, expansion of domestic manufacturing, and extreme weather, among other factors. Further, U.S. grid planners have increased their forecasts for electricity load growth through 2029 fivefold from expectations of just two years ago.[1] At the same time, the nation is contending with an estimated 2,600 gigawatt backlog of generation projects waiting to connect to the grid.[2]

To meet these growing energy challenges, the U.S. must expand the transmission grid's capacity. Investing in new high-voltage transmission lines is a critical part of that effort, but projects can take 10 years to complete, on average.[3] Advanced transmission technologies (ATTs) offer a cost-effective near-term solution, requiring far less time—between three months and three years—to install.[4] Throughout the country, state policymakers are working to accelerate the deployment of ATTs to efficiently unlock additional capacity from existing grid infrastructure, reduce system congestion, improve reliability, and meet rising demand.



Two types of electric transmission lines. Advanced conductors (right) use more efficient and resilient materials to boost carrying capacity compared with conventional wires (left). If deployed nationwide, advanced conductors could quadruple energy transmission capacity in the U.S. and save $85 billion in systems costs by 2035, according to GridLab, a nonprofit energy use research organization. *Courtesy of CTC Global*

ATTs and their benefits

ATTs are a suite of software and hardware technologies that boost the capacity of transmission lines to carry more electricity.

One type of ATT is grid-enhancing technologies. These systems allow grid operators to make real-time adjustments to the maximum limits and flow of electricity, increasing transmission capacity by 10% to 30%.[5] One example is dynamic line rating systems, which use sensors to calculate the available transmission wire throughput based on actual weather conditions—such as temperature and wind speed—enabling operators to safely boost the amount of power on the line rather than relying on inefficient fixed assumptions, as the current system does.

Another ATT is advanced conductors—high performance transmission wires that can carry 50% to 110% more power than conventional lines thanks to more efficient materials.[6] Advanced conductors can be deployed on existing towers and rights of way to replace older transmission wires.

In addition to enhancing transmission line capacity, ATTs provide several significant benefits to the grid and ratepayers. They:

- **Reduce costs** to consumers by alleviating grid congestion. The bottlenecked electric grid lacks adequate transmission capacity to deliver energy in the most cost-effective and efficient manner when demand rises. Instead, grid operators must rely on expensive generation resources, costing consumers an estimated $20.8 billion in 2022.[7]
- **Modernize grid infrastructure** faster and for less cost than traditional transmission projects.
- **Boost energy generation** by allowing more resources to connect to the grid from the backlog of projects.
- **Optimize land use** by using ATTs to boost the capacity of transmission infrastructure within existing rights of way.[8]
- **Decrease wildfire risk** by deploying advanced conductors, which are more resilient to high temperatures and are far less likely to sag than traditional lines.[9]

Dynamic line rating systems like this one collect critical transmission line information in real time to detect risks, assess conductor health, and enhance line capacity. *LineVision*

State policy approaches

State lawmakers are considering different policy approaches to evaluate and promote ATT use. (See Table 1.) Legislators in Colorado and Maine have tasked state agencies or regulatory authorities with investigating the use of ATTs, and Virginia now requires utilities to evaluate ATTs within their integrated resource plans, in which they outline new investments in energy infrastructure, generation, and transmission. Other state policies have included incentives for cost-effective deployment and streamlined permitting.

Table 1

States Employ Various Policies to Support ATTs

Selected approaches

Policies	Description	States
Study bills	Tasks state agencies or regulatory agencies to investigate the use of ATTs.	Maine (L.D. 2205), Colorado (S.B. 23-016)
Utility planning requirements	Requires utilities to evaluate ATTs in their planning and gives them a path to recovering costs.	Minnesota (S.F. 4942), Virginia (H.B. 862)
Rate recovery and incentives	Allows utilities to recover ATT costs from their rate bases or provides them incentives if ATTs are shown to create grid infrastructure cost savings.	Montana (H.B. 729), Minnesota (S.F. 4942)
Streamlining permits	Simplifies replacement of conductors (wires on transmission lines) by expediting applications or reducing permitting requirements.	Arizona (H.B. 2003), Colorado (S.B. 23-016)

Source: Pew's analysis of state documents

Conclusion

Although not a replacement for much-needed investment in new high-voltage transmission wires, ATTs can play an important role in meeting near-term transmission needs and creating a modern, reliable grid that saves consumers money while utilities and governments work to build out new long-term infrastructure. State decision-makers can help support these solutions through policy that encourages the use of ATTs to squeeze more capacity out of the nation's existing grid infrastructure.

Endnotes

1 John D. Wilson, Zach Zimmerman, and Rob Gramlich, "Strategic Industries Surging: Driving U.S. Power Demand," December 2024, https://gridstrategiesllc.com/wp-content/uploads/National-Load-Growth-Report-2024.pdf.

2 Berkeley Lab Energy Technologies Area, "Grid Connection Backlog Grows by 30% in 2023, Dominated by Requests for Solar, Wind, and Energy Storage," news release, April 10, 2024, https://emp.lbl.gov/news/grid-connection-backlog-grows-30-2023-dominated-requests-solar-wind-and-energy-storage.

3 Michelle Solomon, "DOE Study Highlights America's Transmission Needs, but How Do We Accelerate Buildout?," *Utility Dive*, March 31, 2023, https://www.utilitydive.com/news/doe-study-transmission-clean-energy/646589/.

4 Louise White et al., "Pathways to Commercial Liftoff: Innovative Grid Deployment," U.S. Department of Energy, 2024, https://liftoff.energy.gov/wp-content/uploads/2024/04/Liftoff_Innovative-Grid-Deployment_Final_4.15.pdf.

5 Emilia Chojkiewicz et al., "2035 and Beyond: Reconductoring With Advanced Conductors Can Accelerate the Rapid Transmission Expansion Required for a Clean Grid," GridLab, 2024, https://www.2035report.com/wp-content/uploads/2024/06/GridLab_2035-Reconductoring-Technical-Report.pdf.

6 Emilia Chojkiewicz et al., "2035 and Beyond: Reconductoring With Advanced Conductors."

7 Richard Doying, Michael Goggin, and Abby Sherman, "Transmission Congestion Costs Rise Again in U.S. RTOs," Grid Strategies LLC, 2023, https://gridstrategiesllc.com/wp-content/uploads/2023/07/GS_Transmission-Congestion-Costs-in-the-U.S.-RTOs1.pdf.

8 U.S. Department of Energy, "Biden-Harris Administration Invests $2.2 Billion in the Nation's Grid to Protect Against Extreme Weather, Lower Costs, and Prepare for Growing Demand," news release, Aug. 6, 2024, https://www.energy.gov/articles/biden-harris-administration-invests-22-billion-nations-grid-protect-against-extreme.

9 Mike O'Boyle, Casey Baker, and Michelle Solomon, "Supporting Advanced Conductor Deployment: Barriers and Policy Solutions," Energy Innovation, GridLab, 2024, https://www.2035report.com/wp-content/uploads/2024/04/Supporting-Advanced-Conductor-Deployment-Barriers-and-Policy-Solutions.pdf.

For more information, please visit: pewtrusts.org

The Pew Charitable Trusts

Contact: Yaron Miller, senior manager, energy modernization project
Email: ymiller@pewtrusts.org
Project website: pewtrusts.org/energymodernization