MIT CEEPR
Center for Energy and Environmental Policy Research

Research Commentary

A Roadmap for Advanced Transmission Technology Adoption

Brian Deese, Rob Gramlich, and Anna Pasnau

SEPTEMBER 2024
CEEPR RC 2024-06

Research Commentary Series.

Since 1977, the Center for Energy and Environmental Policy Research (CEEPR) has been a focal point for research on energy and environmental policy at MIT. CEEPR promotes rigorous, objective research for improved decision making in government and the private sector, and secures the relevance of its work through close cooperation with industry partners from around the globe. Drawing on the unparalleled resources available at MIT, affiliated faculty and research staff as well as international research associates contribute to the empirical study of a wide range of policy issues related to energy supply, energy demand, and the environment.

As a Research Commentary, views expressed within are solely those of the authors. Interested parties may contact the authors directly for further feedback on their Commentaries.

MIT CEEPR
Center for Energy and Environmental Policy Research

RC-2024-06
Commentary

A Roadmap for Advanced Transmission Technology Adoption

Brian Deese, Rob Gramlich, and Anna Pasnau

U.S. electricity deployment is falling behind the pace necessary to meet projected demand growth—posing risks for the United States' ability to meet its clean energy deployment goals and raising costs for ratepayers. In recent months, this challenge has become more urgent as the gradual shift of electrification has collided with a near-term increase in electricity demand brought on by the electrification of buildings and transportation, renewed domestic manufacturing, cryptocurrency mining, and data centers.

Increased use of advanced transmission technologies (ATTs) can play a major role in meeting this demand growth quickly and cost-effectively. However, electricity market structures—which disincentivize investment in innovation—are impeding progress towards modernizing the electric grid. Policies that overcome these obstacles to incentivize ATT adoption can expand grid capacity, lower costs for ratepayers, and help the U.S. meet its energy deployment and energy security goals. This paper lays out a five-part framework for unlocking the potential of ATTs.

I. The Need for Advanced Transmission Technologies

The recent increase in demand for electricity after two decades of flat, low demand growth has generated alarming assessments from a range of utilities, regulators, and industry analysts.

We are already seeing a surge of investment in clean energy to meet this demand, with over $79 billion in investments in clean energy and industry in 2023. However, system bottlenecks are preventing this investment from translating into increased electricity generation resources. Over the course of 2023, the backlog of generator and storage capacity actively seeking interconnection to the electric grid increased by 27 percent—by December 2023, nearly 2,600 GW of generator and storage capacity were in the "queue," 95 percent of which was solar, storage, and wind.

Beyond connection to the grid, the U.S. also lacks the necessary transmission infrastructure to deliver more power. The Department of Energy (DOE) has estimated that by 2035, transmission infrastructure will need to grow by 57 percent. Despite this, high-voltage transmission construction has slowed from an average of 1,700 miles built per year between 2010 and 2014 to only 55 miles built in 2023.

Unlocking these system constraints is crucial to meeting the country's growing electricity demand without undermining our clean energy goals or shifting significant new costs to consumers. Grid capacity constraints are already driving up costs for ratepayers; in 2022, congestion costs rose by more than 50 percent to $21 billion.

However, fixing our grid challenges is complex and multifaceted. It will require reforming the process by which interconnection requests are evaluated and approved.[1] It will also require building new long distance transmission lines to move electricity more efficiently from the location where it is generated to where it is needed.[2]

In the near-term, perhaps the most powerful opportunity for progress involves increasing the capacity of the electricity grid without building entirely new lines or systems. With so-called advanced transmission technologies (ATTs), we can expand transmission capacity quickly by improving utilization of existing grid infrastructure. According to a recent DOE report, wider implementation of these solutions could meet our expected 10-year peak demand growth if deployed rapidly. The technologies are particularly useful in the context of widespread permitting and siting constraints, which are especially challenging for high-voltage interstate transmission—they avoid such obstacles by using existing right of ways.

ATTs are also cost-effective. One estimate looking at Illinois, Indiana, Ohio, Pennsylvania, and Virginia found that adoption of three ATTs would cost about $100 million and yield about $1 billion in annual production cost savings. Another report found that GETs (a subset of ATTs, as described in the below box) could deliver $5 billion in yearly energy production cost savings, with upfront investment paid back in just 6 months. In effect, supporting their adoption may be the closest energy policy analog we have today to finding a $20 bill on the table.

WHAT ARE ADVANCED TRANSMISSION TECHNOLOGIES?

Advanced transmission technologies refer to a set of technologies that can increase physical line capacity. This box summarizes a few of the most widely used technologies.

Dynamic line ratings (DLRs): DLRs increase capacity by an average of 10-30 percent, take less than three to six months to deploy, and cost less than 5 percent of the price of building new transmission. As air temperatures rise, the carrying capacity of electric power cables decreases. Accordingly, grid transmission lines are given static line ratings that determine the amount of power that can be transmitted on the line, with conservative assumptions for weather conditions (high temperatures, full sun exposure, little wind cooling) at all times. When the weather is better than these conditions, transmission lines can safely transmit additional power; when the weather is worse, it risks damage to the line. DLRs involve the real-time calculation of a transmission line's thermal capacity based on local conditions, typically using a device installed on or near the line to collect this information. In most conditions, DLRs allow operators to increase the amount of power the line can safely carry. Occasionally in extremely bad weather, they report reduced power transfer capacity on the line, thereby protecting the system's reliability.

[1] FERC's Order 2023, released in July of 2023, adopted a series of reforms intended to reduce these backlogs.

[2] Conversations around accelerating the rapid buildout of new transmission often, and correctly, lead to calls for permitting reform. Permitting challenges are an important factor slowing the construction of new transmission, especially interstate transmission, and reform will be essential to building new transmission lines necessary for the U.S. electric grid.

Advanced power flow control devices (APFCs): APFCs increase capacity by 10-25 percent or more and take less than fifteen months to deploy. These power-electronics-based devices enable the dynamic adjustment of network power flow by changing line reactance. This can enable the redistribution of power from lines that are overcapacity to lines with available capacity, significantly increasing firm system capacity, reducing congestion, and accelerating grid modernization.

Topology optimization: Topology optimization can increase capacity by about 5-50 percent and takes less than three to six months to deploy. Topology optimization software models the grid's network and conditions to identify and address congestion by switching transmission branch elements, including transmission lines and transformers, using pre-existing high voltage circuit breakers to efficiently distribute power flow across the grid.

High-performance conductors (HPCs): HPCs generally double capacity (but can increase capacity by as much as 10 times in some cases) and reduce transmission line losses by roughly 30 percent. They can take one to three years to deploy (when reconductoring existing lines). HPCs are conductors made with carbon, composite cores, or other advanced materials like high-temperature superconducting tape instead of steel. Transmission providers can replace the traditional conductors on existing lines ("reconductoring") or use HPCs in the construction of new transmission lines. While HPCs can be almost three times as expensive as conventional conductors, reconductoring costs less than half the price of building new transmission lines.

Many of the leading companies manufacturing these technologies are headquartered in the United States, including LineVision, Lindsey Systems, and Atecnum (DLR); Smart Wires (DLR and APFC); NewGrid (topology optimization); CTC Global and TS Conductor (advanced conductors); VEIR (superconductors); and MetOx (superconducting tape).

Dynamic line ratings, advanced power flow control devices, and transmission switching are all classified as "grid-enhancing technologies" (GETs), a subcategory of ATTs that enable the optimization and control of a dynamic grid. The underlying obstacles to—and solutions for—adoption, described in detail below, vary slightly for GETs as opposed to high-performance conductors.

The potential of these technologies is well-understood. Advanced conductors have been in the market since the early 2000s, topology optimization has been studied since the early 1980s, and power flow controllers were introduced in the 1970s. Moreover, in some places their use is widespread. Countries including Belgium, the Netherlands, Italy, India, and China have pursued large-scale reconductoring projects to quickly expand transmission capacity. In 2021, the U.K. transmission operator National Grid deployed 48 advanced power flow control devices across its grid, unlocking 1.5 GW of electric capacity and saving the operator an estimated $500 million over seven years. And in the United States, AES deployed dynamic line rating (DLR) sensors across five transmission lines in Indiana and Ohio—the upgrade took only 9 months, cost $45,000 per mile, and increased capacity by more than 50 percent. Another DLR upgrade in Syracuse, New York is estimated to increase capacity by 20-30 percent across four transmission lines.

II. Obstacles to ATT Adoption

The incentives for transmission providers, information provided to regulators, and features of electricity markets slow the adoption of these technologies in the United States.

First, the profit structure of electricity markets fails to incentivize transmission providers to adopt many forms of ATTs, despite their benefits to ratepayers and capacity. Under the current electricity industry regulatory structure, utilities earn profits from capital expenditures, meaning that they are incentivized to make more costly capital investments (e.g. building a new power plant) over changing their operating expenses or lowering and smoothing demand for electricity—even when those capital expenditures ultimately increase costs for consumers. This "capex bias," which has become an accepted and well-known feature of cost-of-service regulation for over 50 years,[3] ultimately means that transmission providers lack a positive incentive to use GETs or can be disincentivized from using GETs.[4] Because GETs can obviate the need for more costly construction of new transmission lines, thereby reducing utility capital expenditures, they can lower utilities' profits. Even high-performance conductors, which are more expensive than regular conductors, can lower profits when they are installed in lieu of building new transmission – reconductoring transmission lines costs less than half as much as building new transmission.

Second, current regulatory practices limit ATT adoption. Regulators are tasked with preventing utilities from taking advantage of capex bias and with ensuring utilities make investments that are in the best interest of their consumers. However, both transmission providers and regulators can struggle to identify the best way to expand capacity against a backdrop of multiple options, and for some technologies, they need new modeling practices to assess benefits. Transmission providers and their regulators have historically focused their cost-benefit analyses on a narrow set of risks and thus are slow to scale innovations, preferring the status quo. The possibility of regulators blocking utilities' proposals may discourage utilities from including ATTs in their plans.

In the case of high-performance conductors, specifically, even as the "opportunity cost" of installing high-performance conductors (instead of building new transmission) may disincentivize transmission providers from using them, high-performance conductors can also be blocked by regulators for being more expensive than regular conductors. Regulators have a mandate to monitor and prevent so-called "gold-plating" (the practice of excessive spending on capital expenditures in order to increase utilities' profits). They may mistakenly see high-performance conductors as gold-plating due to their initial high cost because they lack the necessary information to see the savings enabled by high-performance conductors.

Third, in some cases, transmission investment of all kinds (including in ATTs) may be limited by a chicken-and-egg problem, where transmission developments are not economical until they connect to generation facilities, but generation facilities cannot be built until transmission is in place.

III. Policy Solutions

Overcoming these barriers to adoption requires modernizing the practices of and incentives facing transmission providers. Some states are taking action: in May 2024, Minnesota's state legislature passed a law requiring the consideration of ATTs in transmission planning. In 2023, Montana's state legislature unanimously passed a law allowing utilities that use high-

[3] Known as the Averch-Johnson effect after their 1962 article.

[4] In time, in a load growth environment, capex needs may become so large that transmission providers will be limited in their ability to make large investments and will be more inclined to use ATTs. Until then, actions that ensure transmission providers are incentivized to adopt ATTs where they can provide net benefits will be necessary.

performance conductors to receive additional profits (legislators were encouraged by CTC Global, a leading manufacturer of high-performance conductors). Nine states have implemented performance-based regulation to align utility incentives with key performance metrics. And on a national level, the Federal Energy Regulatory Commission's (FERC) Order 1920, finalized in May 2024, requires transmission providers to consider the use of ATTs.

These steps are positive but not sufficient to drive more rapid widespread adoption of ATTs across our electricity system. This paper lays out reforms in five categories that can drive adoption of ATTs.

1. Requiring transmission providers to use ATTs in certain contexts;

2. Requiring transmission providers and regulators to conduct robust analyses of the value of ATTs for their current footprint;

3. Creating financial incentives for transmission providers to adopt ATTs where they can provide significant net benefits;

4. Requiring transmission providers to release additional data on the grid and building digital tools to inform ATTs adoption;

5. Requiring transmission providers to release data to a third-party entity that takes on the responsibility of planning ATT adoption.

Recommendation #1: Require transmission providers to adopt ATTs in certain contexts.

There are some circumstances in which ATTs have no major downside ("no regrets" upgrades), such as in the deployment of DLRs on congested lines. In these cases, requiring the use of efficient tech is the most effective way to drive rapid adoption.

FERC should require DLRs – which are a cost-effective way to increase the capacity and resilience of grids—for highly congested lines. This would increase capacity for certain lines, lowering congestion costs for ratepayers. Installing DLRs costs roughly one-tenth as much as reconductoring with high-performance conductors (one-twentieth the price of building new transmission) and can increase capacity by 10-30 percent. Accordingly, PJM Interconnection, the country's largest grid operator, has proposed that thermally limited lines with high historical ($2 million or more per year on average) and projected ($1 million or more per year on average) congestion should be required to deploy DLRs. Very few lines—likely less than two dozen—would meet this threshold, but even a high threshold would be a good start to address some extremely congested lines. FERC currently has an open DLR Advance Notice of Proposed Rulemaking (ANOPR), which proposes requiring DLRs on certain lines based on ambient weather conditions, solar conditions, wind speed, and congestion. The ANOPR includes certain fairly conservative provisions designed to slow implementation, such as a limit on the number of lines to which transmission providers can be required to add DLRs (a proposed 0.25 percent of the transmission providers' lines per year—even if additional lines meet the requisite congestion and weather condition thresholds).[5]

[5] The ANOPR explains: "For example, for a transmission provider with 1,130 transmission lines in a given year, 0.25% of its lines would be (0.0025)*(1,130) = 2.825 lines. As such, that transmission provider would not be required to implement the wind requirement on more than 3 of its transmission lines in that year, even if more than 3 of its transmission lines meet both a wind speed threshold and a congestion threshold. Transmission providers could, of course, voluntarily implement the wind requirement on additional transmission lines in any given year, but under this preliminary proposal they would not be required to do so."

Additionally, **DOE should adopt a national conductor efficiency standard**. This would ensure that transmission providers install more efficient transmission lines, which can reduce line electricity losses by 30 percent. Between 2018 and 2022, annual electricity transmission and distribution losses averaged about 5 percent of all electricity transmitted and distributed in the United States. Approximately one third of those losses occur in the transmission of electricity. While increased capacity may not always be necessary, increased efficiency has no downsides. Congress's 2023 appropriations included funding for a conductor efficiency study regarding the environmental, economic, and clean energy deployment benefits of establishing an energy conservation standard for overhead electricity conductors. When that study is released, DOE should use its results to support an efficiency standard for conductors, which would require transmission providers to reconductor inefficient transmission lines.

DOE has the authority to promulgate efficiency standards for industrial equipment, but Congress could further clarify DOE's authority to promulgate standards for transmission conductors, as it did in 1992 for distribution transformers. While the design of the standard should be shaped by DOE's findings from the conductor efficiency study, the efficiency standard could operate similarly to distribution transformer efficiency standards, which are updated every six years and provide a compliance timeframe of five years.

Recommendation #2: Require transmission providers and regulators to conduct robust analyses of the value of ATTs for their electric grid.

ATT adoption requires thorough analysis of where the technologies have benefits for grid capacity that exceed their costs. Today, regulators and transmission providers are often not transparent about how they evaluate the use of ATTs. Because transmission providers are less accustomed to ATTs and may have incomplete information about their benefits and disadvantages, they may be reluctant to consider them in planning. Similarly, if transmission providers suspect regulators will reject the use of ATTs, they are likely to be conservative about proposing ATTs.

FERC Order No. 1920, finalized in May 2024 has the potential to help address these problems by requiring the consideration of ATTs (DLRs, advanced power flow control devices, advanced conductors, and transmission switching) in long-term regional transmission planning, building new facilities, and upgrading existing facilities. However, the impact of the order will depend on how in-depth transmission providers' consideration actually is. Order 1920 currently lacks the necessary specificity—or enforcement mechanisms—to ensure that transmission providers actually adopt ATTs where they are beneficial. An effort to ensure transmission providers meaningfully include ATTs in their planning in the initial implementation phase of this order will be essential to ensuring that consideration is more than just cursory box-checking.

Moreover, some aspects of Order 1920 currently limit its efficacy with respect to ATTs adoption. The order requires that transmission providers engage in proactive, forward-looking (at least 20 years into the future) regional planning at least every five years. This timing is out of sync with the timing of ATTs deployment, as ATTs can be deployed in months or a few years. The need for increased capacity could arise and be met by ATTs all within the five years between transmission plans.

In their implementation of these orders, regions should plan to put a good faith effort into evaluating ATTs—and regulators to effectively enforcing compliance with the order. This would help the order produce its intended effect by encouraging regions to comprehensively evaluate ATTs. In response to Order 1920, each region must file a compliance plan within 12 months for FERC to adjudicate. In the adjudication process, FERC has discretion over how strictly to enforce its provisions, but once the commission approves compliance plans, industry will take the lead on implementing the order. The opportunity for ensuring maximum impact of Order 1920, therefore, is during the compliance plan process.

Regions should include in their compliance plans detailed descriptions of how they will make good faith efforts at evaluating ATTs—including describing the data and assumptions they will use. They should also volunteer to conduct planning on a more regular cadence than every five years, perhaps every two years or similar. And in its adjudication process, FERC should enforce compliance with the intentions of the order by holding these plans to a high standard. The attention of third-party watchdog organizations on this compliance plan process is critical to ensuring all regions engage seriously with the order.

To supplement FERC Order 1920, states should adopt legislation that requires transmission providers to comprehensively assess the potential use of ATTs in their transmission planning, since both states and FERC have jurisdiction over transmission. This would act as a backstop for FERC Order 1920 and further encourage transmission providers to seriously consider ATTs. These requirements were recently enacted in Minnesota's HF 5247, which adds GETs to the state's transmission planning process and requires utilities owning more than 750 miles of transmission lines to evaluate GETs on highly congested lines. Similarly, this year Virginia passed a law requiring utilities to consider GETs in their long-term planning process, although the law limited this requirement to planning for distribution lines, making it less effective. Both laws target existing state-jurisdictional issues and processes, which makes them more legally durable, as they act at the fuzzy intersection of state and federal oversight of the electricity system. It may be helpful for DOE to put forth a set of model regulations or legislation—or a series of best practices—that states could use to develop these requirements.

DOE should provide funding to regional state committees for staff or consulting expertise to identify opportunities for ATTs. This would allow regional state committees to serve as a check on transmission plans and to propose alternatives where necessary. Regional state committees—such as the Organization of MISO States (OMS), the Organization of PJM States Inc (OPSI), or the New England States Committee on Electricity (NESCOE)—were formed by states in part to coordinate and provide policy input to RTOs on issues including transmission design. They could serve as a second perspective on opportunities for ATTs adoption and could coordinate recommendations within regions. NESCOE has already called on New England transmission owners to develop an Asset Condition Guidance Document that provides transparency into the process and criteria by which transmission owners identify transmission needs and determine how to meet those needs (including with advanced transmission technologies).

Recommendation #3: Creating financial incentives for transmission providers to adopt ATTs where they can provide high net benefits.

Even if utilities and regulators conduct analyses on where ATTs can lower costs and expand capacity, the industry structure still disincentivizes ATT adoption. Targeted policy actions can help increase the incentives for adopting ATTs to offset these obstacles. Ideally, insofar as they meet the same capacity need, developers should be indifferent on a profitability basis between ATT projects and a new transmission line build. While perfect parity may be difficult to achieve in practice, greater incentives for ATT use would increase adoption.

FERC should adopt a "shared savings" incentive nationally. This would allow utilities that use GETs to earn a profit for saving ratepayers money, shifting incentives towards performance and not just investment, and could have a significant effect on GETs adoption. On the whole, it could lead to billions in consumer savings each year. A shared savings proposal, developed by the WATT Coalition and Advanced Energy United (and based on similar incentives in the UK and Australia), was vetted by FERC in 2021. Under the proposal, the planning authority would evaluate projects using standard cost and benefits calculations, which usually include production cost and capacity cost savings. For projects that use GETs, cost under $25 million, and have a benefit-cost ratio of at least 4:1, the utility would receive a portion of the net savings (taken out of the savings to ratepayers). The WATT Coalition has proposed that smaller projects (projects costing less than $2.5 million) receive a standard percentage of the benefits, perhaps 25 percent. Larger projects could undergo a competitive proposal process in which project developers propose a share of savings and the planning authority awards the project to the developer who proposed the lowest cost option overall. Project developers would only be eligible for shared savings for the first three years of the project's operation unless those projects continued to show a cost-benefit ratio higher than 4:1. This incentive was recently included in the Advancing GETs Act proposed by Senator Peter Welch.

Where possible, **state legislatures should authorize an additional return on equity for projects that use cost-effective ATTs**. This would increase the profits utilities earn when they use ATTs, suppressing the effects of capex bias. While an adder may have limited benefits for GETs adoption on existing lines (which have tiny upfront capital investments and would be better supported by a shared savings incentive), it would be helpful for high-performance conductors (which are not supported by the WATT Coalition's shared savings incentive). This has already been enacted in Montana, where HB 729 allows the state's public service commission to develop cost-effectiveness criteria for advanced conductor projects, ensuring that utilities and regulators know how proposed advanced conductor projects will be evaluated, and allows the state's regulator to determine an appropriate return-on-investment adder (up to 2 percent) for projects that use advanced conductors, financially incentivizing utilities to install advanced conductors.[6]

DOE should expand its Grid Deployment Office (GDO) to facilitate financing for ATTs. This would provide capital to help overcome the chicken-and-egg challenge. Joshua Macey and Rob Gramlich have advocated for the GDO to take an enhanced role in providing financial assurances to developers who build lines in new transmission corridors. DOE is already authorized to borrow up to $2.5 billion under the Transmission Facilitation Program and $2 billion under the Transmission Facility Financing Program. GDO could help make better use of these funds by purchasing up to half of planned line capacity, providing loans directly, and participating in public-private partnerships within designated National Interest Electric Transmission Corridors. GDO could then recover those costs from utilities through direct cost allocation, enabling them to reuse the funding.

Recommendation #4: Build digital tools that inform ATTs adoption.

In many cases, transmission providers lack detailed, accurate information about expected demand, planned transmission, and the potential advantages or disadvantages of ATTs. At the same time, regulators, consumer advocates, environmental policy groups, and other stakeholders lack the necessary information to hold providers accountable when they fail to act in the best interest of their ratepayers. Even when that information is available, it is often siloed, making it difficult to grasp a full picture of the U.S. electric grid, to identify high-priority needs, and to promote connectivity across regions.

FERC should require transmission providers to share additional information publicly. This would allow third-party groups to evaluate utilities' adoption of ATTs and to hold utilities accountable when they fail to make the necessary investments in transmission. The WATT Coalition has recommended that FERC require utilities (where permissible under Critical Energy/Electric Infrastructure Information Regulations) to release information about transmission capacity and planned upgrades and expansions; a list of transmission constraints that caused, or are projected to cause, $500,000 of yearly congestion—

[6] The ROI adder may be only feasible in states with bundled electricity rates (non-ISO/RTO utilities), where the state still has some jurisdiction over transmission rates.

along with the cause of that constraint; and a list of GETs and other non-wires alternatives that transmission providers might use to resolve constraints and conditions under which each would be applied. Among grid operators, there is already some understanding of the need for increased data sharing; PJM has said it would be willing to share with FERC historical and projected congestion levels on an annual basis. And FERC is already moving in that direction; its DLR ANOPR proposes additional reporting requirements for transmission providers in non-RTO regions, including requiring providers to maintain a database with information on instances of congestion and the limiting elements causing it.

Researchers, likely at a national lab, should develop a "digital twin" of the current transmission system that can support evaluation of the impact of various ATTs on grid capacity. The digital twin model would allow more accurate analysis of where ATTs may be advantageous and could be used by transmission providers to inform their analyses, by regulators to evaluate providers' plans, or by environmental groups to enforce smart transmission expansion. This modeling exercise has been attempted in the past and failed due to a lack of data sharing—successful development would necessitate transmission providers sharing detailed data (on electricity demand and supply, line efficiency, use of ATTs, age, and quality of equipment) to facilitate more advanced modeling of transmission needs. To ensure compliance with CEII Regulations, the model and relevant data would likely need to be maintained by a national lab.

"Hyperscaler" organizations that are operating large-scale data centers and driving up electricity demand could support the capacity of national labs to develop these modeling capabilities. Some hyperscalers are having difficulty meeting their own climate goals; financial or technical support for grid modeling could help them meet their electricity demand with clean energy, thereby lowering their emissions.

Recommendation #5: Shift the responsibility of planning ATTs to a third party.

While our proposed reforms could substantially increase ATTs adoption, they do not eliminate the underlying challenges that limit adoption: namely the industry structure where transmission providers do not profit from the adoption of ATTs and thus are disincentivized to adopt them, and where regulators are limited in their ability to pressure-test providers' decisions by a lack of resources and data. In the context of FERC Order 1920, while grid operators are now required to consider grid-enhancing technologies, regulators will have few ways of determining whether adequate consideration has taken place. At the same time, without systemic change to the transmission planning process or utility incentives, transmission providers will continue to adopt ATTs at suboptimal rates—with negative consequences for their ratepayers and for their ability to build out sufficient capacity to meet our climate goals.

Our first four proposed reforms could significantly increase ATTs adoption and would be considerably better than failing to act altogether. However, truly addressing the obstacles to adoption would require a more transformative reform, namely shifting the responsibility of planning ATTs away from transmission providers altogether. **FERC could require transmission providers to release relevant data on an annual basis to NREL or a different uninterested nonprofit entity with the capacity to house and process sensitive data securely**. These data would include information about transmission capacity and planned upgrades and expansions, current ATTs use, age and condition of equipment, electricity demand, and line congestion. CEII would be respected with appropriate constraints in place to make sure that all data are secure and there is no sharing of sensitive information.

The third party would develop a plan for each grid operators' optimal adoption of ATTs based on these data and publish it on a regular basis (akin to the 5-year FERC Order 1920 cycle—transmission providers would still be able to adopt additional ATTs in the intervening years). The utility would be required to either take the third party's recommendations or to provide an explanation for why the proposed approach is inappropriate and offer a counterproposal.[7]

Transmission providers may be reluctant to release their data or to delegate planning responsibilities to another organization. Without substantial data sharing, no third party would have the necessary information to evaluate opportunities for ATT adoption. Despite this, the recommendation could lead to significant benefits by more fully addressing the structural factors that disincentivize ATT adoption. Tasking one entity with coordinating ATT adoption across the entire grid could also promote complementary ATT adoption and eliminate redundancies.

Conclusion

The United States has reached a pivotal moment for its electric grid. After decades of low growth in electricity demand, demand growth has begun to increase due to new data centers, increased domestic manufacturing, and electrification. However, long-standing barriers are set to limit the generation and transmission of affordable clean energy to meet this demand growth, raising costs for consumers and hampering the clean energy transition. While it is too soon to evaluate the precise pace of electricity demand growth, it is not too soon to begin identifying—and enacting—solutions.

Increased adoption of advanced transmission technologies – including dynamic line ratings, high-performance conductors, advanced power flow control devices, and topology optimization—can help expand the capacity of the electric grid quickly and cost-effectively. These technologies may not be appropriate in every setting, but researchers, regulators, and policymakers increasingly recognize that they are widely under-adopted.

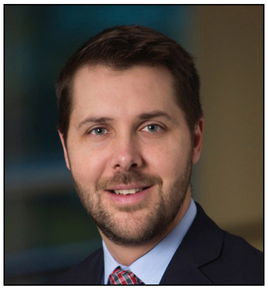
A range of solutions could help support adoption *within* the current electricity system. These include policies to:

- Require transmission providers to use ATTs in certain contexts
- Require transmission providers and regulators to conduct robust analyses of the value of ATTs
- Create financial incentives for transmission providers to adopt ATTs where they can provide high net benefits
- Require transmission providers to release additional data on the grid and build digital tools to inform ATTs adoption

Although these solutions will support increased adoption, they will not eliminate the underlying incentives that discourage ATTs adoption. More transformative change, such as by shifting the responsibility of ATT planning altogether to a third party, could. This would enable the rapid buildout of transmission and the connection of new clean energy generation sources to the grid—lowering electricity prices, reducing U.S. emissions, and facilitating continued innovation in energy-intensive industries.

[7] In theory, if this independent entity successfully coordinates widespread, cost-effective ATT adoption, it could make sense to expand its planning responsibilities to other aspects of transmission planning. In the near-term, however, it would be best to constrain its planning responsibilities to ATTs (a relatively low-cost aspect of the planning process), to determine whether this solution is effective at scale.

About the Author



Brian Deese is the current Institute Innovation Fellow at MIT and CEEPR, where he is focused on researching and developing strategies to address climate change and promote sustainable economic growth. As the former Director of the White House National Economic Council, Deese advised President Biden on domestic and international economic policy and coordinated the economic agenda of the Biden-Harris Administration. A former senior advisor to President Obama, Deese was instrumental in engineering the rescue of the U.S. auto industry and negotiating the landmark Paris Climate Agreement. Deese is a crisis-tested advisor with broad experience in accelerating economic prosperity, empowering working Americans, and harnessing the economic opportunities that come from building a clean energy economy and combating the climate crisis. Deese received his B.A. from Middlebury College and his JD from Yale Law School.

Rob Gramlich is President of Grid Strategies LLC, a Washington DC-based consultancy focused on transmission and power markets for a reliable, affordable, and sustainable power system. He co-founded Americans for a Clean Energy Grid, Working for Advanced Transmission Technologies (WATT Coalition), Advancing Modern Powerlines, the Macro Grid Initiative, and the Future Power Markets Forum. Rob has been invited to testify by both parties before Congress, FERC, and state agencies. Rob previously oversaw transmission and power market policy for the American Wind Energy Association as SVP and Interim CEO, served as Economic Advisor to FERC Chairman Pat Wood III, and was Senior Economist at PJM Interconnection. Rob has a Master of Public Policy (MPP) degree from UC Berkeley and a B.A. with Honors in Economics from Colby College.

Anna Pasnau is a Research Associate working with MIT Innovation Fellow Brian Deese. Before joining MIT, Anna worked for three years at the White House Council of Economic Advisors on a range of issue areas including care, labor, industrial strategy, and climate change. She has also worked at the U.S. Congress Joint Economic Committee researching topics related to labor and infrastructure. Anna received her B.A. in economics from Brown University.

Contact.

The MIT CEEPR Research Commentary Series
is published by the MIT Center for Energy and Environmental Policy Research from submissions by affiliated researchers.

For inquiries and/or for permission to reproduce material in this commentary, please contact:

General inquiries: ceepr@mit.edu

Media inquiries: ceepr-media@mit.edu

MIT CEEPR
Center for Energy and Environmental Policy Research

MIT Center for Energy and Environmental Policy Research
Massachusetts Institute of Technology
77 Massachusetts Avenue, E19-411
Cambridge, MA 02139-4307
USA

ceepr.mit.edu

MASSACHUSETTS INSTITUTE OF TECHNOLOGY