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Indiana Utility Regulatory Commission
101 West Washington Street, Suite 1500 East
Indianapolis, IN 46204

RE: Request for Stakeholder Comments for the IURC's Advanced Transmission Technologies Study

Introduction

The WATT Coalition ("WATT") and AMP Coalition ("AMP"), collectively representing the Advanced Transmission Technologies ("ATTs") industry, appreciate the opportunity to provide comments in this proceeding regarding the Request for Stakeholder Comments for the IURC's Advanced Transmission Technologies Study.

This proceeding comes at an important time for Indiana. Indiana's annual energy demand is projected to more than double by 2035.[1] At the same time, consumers are increasingly focused on maintaining reliability and affordability as our existing transmission infrastructure needs continue to grow to accommodate rising demand. Meeting this moment will require both continued investment in new transmission infrastructure and more effective optimization of the transmission system already in place.

ATTs offer utilities cost-effective and proven tools to increase transmission capacity, improve operational flexibility, reduce congestion, and enhance the performance of existing infrastructure. ATTs can be deployed more quickly and at lower cost than traditional transmission expansion projects, making them particularly valuable for

[1] Synapse Energy Economics, *How Increased Clean Energy Deployment in Indiana Can Pave the Way for Lower Bills* (Feb. 2026), https://advancedenergyunited.org/press-releases/study-offers-way-to-lower-indiana-bills/.

addressing near-term reliability, affordability, and load growth challenges while longer-term infrastructure investments are planned and constructed.

The Commission's inquiry provides an important opportunity to evaluate the capabilities, limitations, costs, and benefits of these technologies and to consider how they may complement traditional transmission planning and investment strategies. This study is intended to serve as a building block for robust utility analysis. Per SB 422 passed in 2025,[2] the same legislation mandating this study, Indiana's utilities must evaluate ATTs as part of their Integrated Resource Planning (IRP) processes. One Indiana utility, Indiana Michigan Power (I&M), has already begun exploring the benefits of ATTs per the requirements of an ongoing settlement with the IURC.[3] Perplexingly, I&M reported little congestion on its system and thus said there would be little cost-effective opportunity to deploy ATTs.[4] This is puzzling given that the PJM Independent Market Monitor found over $493 million of zonal congestion in the PJM service territory of I&M's parent company, AEP.[5] While AEP's PJM service territory does extend into other states, this data is a useful indicator of congestion that could be more accurately represented in utility filings. Moreover, I&M's Twin Branch-Meridian line was one of the most congested facilities in PJM in 2025 according to the same Independent Market Monitor report.[6]

WATT and AMP respectfully submit the following comments in response to the Commission's prompts and encourage Indiana utilities to use this comprehensive study as a foundation for robust investigation, evaluation, and modeling of ATTs.

About the WATT Coalition and Grid Enhancing Technologies

The Working for Advanced Transmission Technologies ("WATT") Coalition is a trade association composed of technology providers, transmission experts, and industry stakeholders dedicated to advancing the deployment of Grid Enhancing Technologies ("GETs"), including Dynamic Line Rating ("DLR"), Advanced Power Flow Control ("APFC"), and Transmission Topology Optimization ("TTO"). WATT's members have worked with

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[2] Indiana General Assembly. "Senate Bill 422: Advanced Transmission Technologies." *Indiana General Assembly*, 124th General Assembly, Regular Session (Mar. 2025), https://iga.in.gov/pdf-documents/124/2025/senate/bills/SB0422/SB0422.04.ENRH.pdf.

[3] *In the Matter of the Verified Petition of Indiana Michigan Power Company for Approval of Modifications to Its Industrial Power Tariff – Tariff I.P.* Cause No. 46097, Indiana Utility Regulatory Commission (Feb. 2025).

[4] Indiana Michigan Power (I&M). *I&M Grid Enhancing Technologies Study* (Feb. 2026), IURC Cause No. 46097.

[5] Monitoring Analytics, LLC. *2025 State of the Market Report for PJM*. Vol. 2, Independent Market Monitor for PJM (Mar. 2026) at 682, https://www.monitoringanalytics.com/reports/PJM_State_of_the_Market/2025/2025-som-pjm-vol2.pdf.

[6] Id. At 707.

utilities, RTOs, regulators, and policymakers across the country to evaluate and deploy technologies that improve the performance of the existing transmission system. Learn more at watt-transmission.org.

GETs are hardware and software that increase the capacity, efficiency, and reliability of the transmission system. These technologies are installed on existing transmission infrastructure to give operators more situational awareness and control over the grid. There are three types of GETs:

- **Advanced Power Flow Control** ("APFC") is hardware that actively balances the flow on transmission lines. It can intelligently raise or lower impedance, or the opposition to current, in real time to push power from overloaded circuits to lines that have the capacity to carry it.
- **Dynamic Line Rating** ("DLR") is hardware and software that monitors ambient conditions including temperature, wind speed, and wind direction that heat or cool transmission lines to calculate the true capacity of lines based on their thermal limits. DLR often allows significantly more power flow than a static rating over the course of the year, but it also detects when flows should be reduced to continue safe and reliable operation in extreme heat or other conditions.
- **Transmission Topology Optimization** ("TTO") is software that models the grid's network and power flow conditions to identify ways to reroute power flow around congested or overloaded transmission elements. These "reconfigurations" are implemented by switching on or off existing high-voltage circuit breakers. By more evenly distributing flow over the network, TTO increases the transfer capacity of the grid like Google maps redirects cars in traffic.

About the AMP Coalition and High Performance Conductors

The Advancing Modern Powerlines ("AMP") Coalition is an ad hoc group of High Performance Conductor ("HPC") technology manufacturers and vendors. AMP's goal is to further the use of HPCs as a tool for modernizing and increasing grid capacity, as well as improving the overall resilience, reliability, and energy efficiency of the grid. The coalition includes vendors and manufacturers of both types of HPC technologies: Carbon Core Conductors and Superconductors. Learn more at ampcoalition.org.

HPCs are modern conductor technologies that have greater performance characteristics when compared to traditional conductors, including increased capacity, higher efficiency, and less thermal sag. There are two types of HPCs:

- **Carbon Core Conductors**, also known as advanced conductors, are overhead, bare conductors that use a trapezoid-shaped wire of annealed aluminum to carry electrical current and that use a carbon core for support. Used commercially for 20 years, they have been deployed in over 60 countries across 5 continents.[7] Carbon Core Conductors have three key advantages over traditional conductors: 1) stronger and lighter-weight cores, which allows for more aluminum to be added to the conductor, doubling the capacity; 2) 20% or greater efficiency; and 3) half as much thermal sag.[8]
- **Superconductors** use a class of metallic compounds that exhibit negligible resistance when cooled using liquid nitrogen, enabling very low losses and very high power flow capacities. Developed in the 1980s, they have been deployed in Europe, Asia, and the U.S. over the past 20 years.[9] Superconductors have three key advantages over traditional conductors: 1) increased capacity by 5-10 times at lower voltages, reducing substation build and cost; 2) no thermal sag and lines do not vary with ambient weather conditions because there is no exposure to elements; and 3) at least 50% greater efficiency.[10]

Prompt 1: The potential use or deployment of ATTs by public utilities to enable those utilities to:

a) **safely, reliably, efficiently, and cost effectively meet electric system demand**

GETs can help meet electric system demand by identifying and using available transfer capacity on existing assets that would otherwise remain inaccessible under traditional operating practices. GETs usually unlock 5-40% additional grid capacity (see the appendix to these comments for case studies). HPCs can significantly increase transfer capability within existing rights-of-way (ROWs) through reconductoring—replacing the power line while reusing existing structures. Reconductoring with HPCs avoids the need for new corridors and reduces the permitting challenges that come with establishing new ROWs while doubling capacity.

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[7] *See appendix*. ACORE, Grid Strategies, *Unlocking the Grid: A Playbook on High Performance Conductors for State and Regional Regulators and Policymakers* (Oct. 2024), at 2, https://acore.org/wp-content/uploads/2024/10/Unlocking-the-Grid-A-Playbook-on-High-Performance-Conductors-for-Stateand-Regional-Regulators-and-Policymakers.pdf (hereinafter, "HPCs Playbook").
[8] Id.
[9] Id.
[10] ENTSO-E, *Technopedia: High Temperature Superconducting (HTS) Cables* (Mar. 2025), https://www.entsoe.eu//technopedia/techsheets/hightemperature-superconducting-cables/ (hereinafter, "Technopedia").

In addition to increasing transmission capacity to help meet electric system demand, ATTs provide utilities with operational flexibility and visibility, allowing operators to respond more effectively to changing weather conditions, equipment outages, maintenance activities, and shifting load patterns while maintaining reliability.[11] ATTs can also provide a cost-effective means of addressing near-term reliability and capacity needs, as many GETs can be deployed in months rather than years, and HPC reconductoring projects can often be completed substantially faster than greenfield transmission construction. As a result, ATTs can serve as practical "bridge solutions" that help utilities accommodate growing demand while larger transmission projects move through the development process.

Several recent deployments illustrate the ability of ATTs to support growing demand. Pacific Gas & Electric recently announced plans to deploy APFC technology at its Los Esteros substation in San Jose to support rapidly growing data center demand. The project is expected to unlock more than 100 MW of additional transmission capacity by mitigating thermal overloads and redirecting power flows across the network.[12] Similarly, Great River Energy deployed DLR in Minnesota and has found up to 63% more transmission capacity during periods of peak demand.[13] PPL Electric, AES, and other utilities have deployed GETs to increase capacity and improve the use of existing infrastructure. These examples are discussed further in the comments below.

b) provide safe, reliable, and affordable electric utility service to customers

In addition to helping utilities meet growing demand, ATTs can also provide direct benefits to customers through lower costs, improved reliability, and more efficient use of infrastructure that customers have already funded through transmission rates.

One of the primary ways ATTs benefit customers is through access to the lowest-cost generation resources. Grid congestion occurs when transmission constraints prevent lower-cost generation resources from serving demand, requiring system operators to dispatch more expensive resources instead. These congestion costs are ultimately borne by customers through wholesale electricity prices and transmission charges. By increasing

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[11] See appendix. ACORE, Grid Strategies, *Playbook: Grid Enhancing Technologies* (Oct. 2024), https://watt-transmission.org/playbook-grid-enhancing-technologies/ (hereinafter, "GETs Playbook").
[12] PG&E Corporation, *PG&E and Smart Wires Enhance Grid Reliability, Capacity for Data Centers in San Jose* (May 2025), https://investor.pgecorp.com/news-events/press-releases/press-release-details/2025/PGE-and-Smart-Wires-Enhance-Grid-Reliability-Capacity-for-Data-Centers-in-San-Jose/default.aspx.
[13] Heimdall Power, *[Whitepaper] Grid Optimization Gets Real: One Year Inside America's Largest DLR Deployment* (Aug. 2025), https://www.heimdallpower.com/news/whitepaper-one-year-gre.

the effective capacity and flexibility of the existing transmission network, ATTs can reduce grid congestion and enable lower-cost generation resources to serve more load.

Several operational GETs installations have demonstrated significant congestion reduction benefits. ISO New England has identified reconfigurations using TTO that mitigate high-constraint flows on most-limiting transmission constraints by 31% on average.[14] Similarly, MISO addressed several constraints in 2024 by using transmission reconfigurations from TTO software, realizing over $100 million in savings, with one reconfiguration providing $57 million in market benefits.[15]

ATTs can also improve reliability and resilience for customers by providing operators with additional flexibility during equipment outages, extreme weather events, and other system disruptions. During Winter Storm Elliott in December 2022, Southwest Power Pool (SPP) implemented transmission switching solutions that increased transfer capability into a major metropolitan area and released up to 845 MW of otherwise stranded generation. The resulting increase in available supply reduced the risk of load shedding and enabled approximately 14 GWh of additional energy delivery during emergency conditions.[16] Similarly, during the January 2018 "Bomb Cyclone" event in the Northeast, exceptionally cold temperatures increased the thermal capability of transmission lines. ISO New England utilized these favorable conditions to increase transmission transfer limits via DLR, allowing additional power imports and reducing congestion during a period of extreme system stress. DLR provides utilities with the tools necessary to identify and safely utilize these types of opportunities when they occur.[17]

HPCs have a broad suite of benefits that help provide safe, reliable, and affordable electric utility service to customers. These include congestion reduction, lifetime loss reductions, reliability improvements, avoided or deferred capital expenditures (e.g., rebuilds), and reduced outage hours.[18] Furthermore, Carbon Core Conductors can increase grid

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[14] NewGrid, *TRANSMISSION TOPOLOGY OPTIMIZATION: A SOFTWARE GRID-ENHANCING TECHNOLOGY* (Jun. 2025), https://www.iso-ne.com/static-assets/documents/100024/2025_06_18_gets_newgrid_materials.pdf.

[15] NewGrid, Ex-post Report 05/01-05/26: Rising – Bondville 138 kV flo Rising – Sidney 345 kV Congestion Mitigation (Sept. 2024), at 3, https://cdn.misoenergy.org/RSC%20Revisions%20to%20MISOs%20Screening%20Criteria%20for%20Evaluating%20Economic%20Reconfiguration%20Requests%20(202408)_Alliant%20Energy649115.pdf.

[16] *See appendix*. Brattle, Grid Strategies, Incorporating GETs and HPCs into Transmission Planning Under FERC Order 1920 (Apr. 2025), at 25, https://acore.org/wp-content/uploads/2025/04/Report__Incorporating-GETs-and-HPCs-Under-FERC-Order-1920__April-21-2025.pdf (hereinafter, "GETs and HPCs Under 1920").

[17] Id, at 19.

[18] *See appendix*. *HPCs Playbook*, at 5.

resilience against fire and major climatic events in areas of frequent grid failure, rural or urban, as they are stronger and sag about half as much as traditional conductors. This limits their exposure to vegetation and structures. Southern California Edison reconductored a transmission line using HPCs, and in 2020, the line avoided damage during a wildfire, likely due to the conductor's low-sag characteristics.[19]

Beyond reconductoring and rebuilding transmission lines, underground lines can also be upgraded using HPCs. This is particularly useful in urban areas where additional transmission and distribution system capacity will be needed to accommodate load growth from new data centers and advanced manufacturing facilities, as well as to replace aging assets. Replacing underground traditional conductors with Superconductors provides several benefits, particularly for corridors that are in urban areas where construction and access to the conductor are very challenging. These benefits include higher-capacity transfers at lower voltages and minimized impacts on surroundings, as Superconductors have almost no external magnetic fields and are actively cooled. This means there are no thermal restrictions on their placement underground, as well as no thermal requirements to allow spacing between phases.

Prompt 2: The attributes, functions, costs, and benefits of various ATTs, including grid enhancing technologies and advanced conductors

The principal categories of ATTs include GETs (i.e., DLR, APFC, TTO) and HPCs, as described in the introductory sections. The following definitions are adapted from "Assessment and Evaluation of Grid Enhancing Technologies" by engineering firm EPE.[20]

<u>Dynamic Line Rating</u>

DLR systems continuously calculate the thermal carrying capacity of transmission lines using real-time and forecasted environmental conditions, including wind speed and direction and/or line behavior. Different DLR technologies can utilize various line monitoring and measurement techniques, including line-mounted sensors, tower-mounted sensors, fiber-optic cables, tension/sag monitoring, and weather station data. Data from these sensors and forecasts are used in computational modeling to determine

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[19] Id, at 11.
[20] *See* Electric Power Engineers, *Assessment and Evaluation of Grid Enhancing Technologies (GETs)* (Feb. 2025), https://watt-transmission.org/wp-content/uploads/2025/05/Assesment-and-Evaluation-of-Grid-Enhancing-Technologies-GETs-Report-1.pdf.

the thermal carrying capacity of the transmission line that can then be used in planning and operational environments.

Traditional transmission line ratings are based on static, conservative assumptions regarding ambient temperature, wind speed, solar heating, and other environmental conditions. Because actual conditions are often more favorable than these assumptions, transmission lines using DLR frequently have additional capacity available that cannot be utilized under static ratings. This is particularly noticeable in areas with high winds, as the cooling effect of the wind has the greatest impact on the current-carrying capacity of conductors. Likewise, in colder temperatures, lines can also carry more current, which is advantageous for utilities facing transmission constraints during winter peaks. Beyond these specific situations, DLR generally identifies additional transmission capacity beyond ambient adjusted ratings and static ratings. Even when DLR does not physically increase capacity, it offers insights into operating assets based on their true capacity while maintaining safety and reliability.

DLR is generally among the lowest-cost ATT options because it typically requires only sensors, communications equipment, and software rather than major physical modifications to transmission infrastructure.

Advanced Power Flow Control

APFCs are advanced devices used for voltage regulation and power flow control. APFC is a type of Modular Static Synchronous Series Compensator (M-SSSC) that is a new advancement within the flexible alternating current transmission systems (FACTS) technologies, which leverage power electronics to alter line impedance, phase angle, and voltage magnitude in transmission systems. Traditional FACTS devices, such as static synchronous compensators (STATCOMs) and static var compensators (SVCs), have been utilized in transmission systems for many years. APFC enhances these traditional devices by incorporating modular digital power flow control technology, allowing for rapid and precise control of power flow.

Through voltage injection using voltage-source converters, APFCs can effectively enhance or reduce the reactance of a specific circuit, enabling real-time control of power flow. This method is particularly effective in meshed electric grids for addressing loading violations by utilizing spare system capacity on alternative power pathways. APFCs operate at line potential without connecting to the ground and do not require an insertion/coupling transformer, unlike conventional SSSC solutions.

The modularity of APFC installations allows utilities to quickly and accurately respond to system demands and easily accommodate future needs by adding new modules. These devices are voltage-agnostic and can be redeployed to different lines with varying voltage levels. The rapid response time of the power electronics in APFCs allows operators to regularly adjust operational settings, enabling active management of power flows without compromising the devices' longevity. APFCs can operate in various control modes, adjusting the injected voltage based on the line current to maintain fixed reactance or keep the line current within operating limits.

The primary benefits of APFC include congestion reduction, increased transfer capability, improved utilization of existing infrastructure, enhanced operational flexibility, and deferral of more expensive transmission upgrades. APFC projects generally involve higher costs than software-based GETs like TTO, but are substantially less expensive and significantly faster to deploy than legacy power flow control devices, which can cost over $100 million and are so large that highways often need to be shut down to transport them.

Transmission Topology Optimization

TTO reconfigures the grid's layout to optimize power flow, reducing congestion and enhancing the grid's resilience using existing hardware. TTO uses complex algorithms to analyze the state of the grid and simulate various reconfigurations to find the optimal one. This approach involves strategically reconfiguring the power grid by changing the status of circuit breakers, switches, or other controllable devices. This process includes switching transmission lines in or out, splitting bus sections, and switching substation breakers.

Unlike many infrastructure investments, TTO often requires little or no new physical equipment. Instead, it leverages existing transmission assets by identifying alternative network configurations that can improve performance under specific operating conditions. Importantly, TTO software does not automatically change the configuration of the grid, but identifies potential switching options that operators may evaluate and implement consistent with existing reliability procedures and operational judgment.

The primary benefits of TTO include reduced congestion, improved reliability, improved outage management, enhanced operational flexibility, and reduced production costs. Because TTO often relies primarily on software and operational changes, it is frequently one of the lowest-cost ATT options available.

High Performance Conductors

HPCs are conductors designed to carry more electricity than traditional conductors while exhibiting lower sag, improved thermal performance, and reduced electrical losses. One type of HPC utilizes carbon cores rather than traditional steel cores, allowing them to operate at higher temperatures while maintaining acceptable clearances. Another type of HPC is a Superconductor, which uses a class of metallic compounds that exhibit negligible resistance when cooled using liquid nitrogen, enabling very low losses and very high power flow capacities.

Unlike GETs, which primarily improve the utilization of existing infrastructure, HPCs increase the physical capability of transmission facilities. This can be done through either (a) using HPCs in new builds, or (b) reconductoring existing facilities with HPCs. These HPC reconductoring projects replace existing conductors with higher-capacity HPCs, often using existing towers, structures, and ROWs. Reconductoring and rebuilding with HPCs enables faster deployment of new grid capacity compared to building new transmission lines. Reconductoring generally takes 1-3 years and can double the capacity of a transmission line at approximately half the cost of building a new one, while rebuilding with a Superconductor can add 5 times the capacity or more.[21] The time saved, reductions in congestion, lower generation curtailment, and faster interconnection to the grid are significant and often not considered in current decision-making frameworks.

While HPCs may have higher up-front costs than traditional conductors, calculating the total lifecycle cost savings from HPCs under a broad net benefit framework that captures these enumerated benefits reveals HPCs to be the highest-net-benefit option over the lifetime of an asset. For example, because transmission and distribution losses represent energy that must be generated but never reaches customers, reducing those losses through HPC deployment would improve overall system efficiency and drive affordability for customers.

Prompt 3: Whether each particular technology does the following:

a) Increases transmission capacity

Each of the different types of ATT can increase transmission capacity, although they do so through different mechanisms. DLR increases the usable capacity of existing lines by

[21] *HPCs Playbook*, at 3.

measuring real grid capacity rather than relying on conservative static assumptions. APFC increases transfer capability by redirecting power flows away from congested facilities and toward underutilized portions of the network. TTO increases throughput by identifying more efficient network configurations. HPCs increase the physical capability of transmission facilities through reconductoring or rebuilding existing facilities, or building new facilities.

Real-world ATTs deployments have demonstrated substantial capacity increases. Duquesne Light Company found approximately 25% additional capacity on transmission lines using DLR, while deployments in Xcel Energy's Minnesota, Wisconsin, and Colorado territories demonstrated increased transmission capacity 85% of the time. Similarly, an APFC deployment in Australia is expected to increase transfer capability into New South Wales by approximately 170 MW, while a transmission reconfiguration used during a major MISO outage in 2021 increased power transfers across a constrained corridor by 56%. Dominion increased capacity on a line by 90% using HPCs to complete a line near Dulles airport in Loudoun County, Virginia.[22]

b) Increases transmission efficiency

ATTs improve transmission efficiency both by reducing electrical losses and by allowing power to flow over more efficient paths across the transmission network.

HPCs provide the most direct efficiency benefits. Transmission and distribution losses average approximately 5% of electricity delivered in the United States, and HPCs can reduce these losses substantially.[23] Depending on operating conditions, HPCs can reduce losses by 20% to 40% or more compared to traditional conductors.[24] If deployed across the grid, this could represent approximately $2 billion saved annually in reduced line losses[25] A Hydro-Québec comparison found that HPCs operated 60-80°C cooler than comparable traditional conductors, reflecting significantly lower resistive losses.[26]

GETs can also improve efficiency by increasing utilization of the highest-capacity portions of the transmission network. A Brattle Group study found that deploying DLR, APFC, and

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[22] *See appendix for listed case studies.*
[23] *GETs and HPCs Under 1920,* at 22.
[24] Id.
[25] Pg 18, https://acore.org/wp-content/uploads/2022/03/Advanced_Conductors_to_Accelerate_Grid_Decarbonization.pdf
[26] *GETs and HPCs Under 1920,* at 22.

TTO across portions of SPP could increase utilization of existing 345 kV facilities by 15% to 22%, reducing losses associated with routing power through lower-voltage facilities.[27]

c) Reduces transmission congestion

Reducing congestion is one of the most well-established benefits of ATTs. DLR, APFC, TTO, and HPCs can all increase the effective capability of constrained transmission facilities, allowing lower-cost generation to reach customers more frequently. APFC and TTO are particularly effective because they actively redirect power flows away from congested facilities and toward underutilized portions of the network.

The first market-integrated DLR deployment in the United States, implemented by PPL Electric Utilities in Pennsylvania, reduced congestion by more than $60 million year-over-year on a single transmission line.[28] Similarly, a study of APFC deployment during a transmission rebuild project found that APFC devices could avoid more than $20 million per year in redispatch costs, generating net savings of approximately $62–70 million over the duration of the project.[29] In another example, a transmission switching solution identified through TTO would have completely eliminated congestion during a four-month outage at an electric cooperative, avoiding approximately $4 million in congestion costs.[30]

d) Reduces the curtailment of generation resources

ATTs can significantly reduce generation curtailment by increasing the amount of power that can be transferred from generators to load centers. This benefit is particularly pronounced for DLR because wind and solar generation often perform best during the same weather conditions that increase transmission line capacity. Windy and cool conditions both increase wind generator output and improve conductor cooling, resulting in higher transmission ratings than assumed under traditional static ratings. DLR captures this additional capacity and allows operators to safely utilize it.

An MIT study of the ERCOT system found that DLR could enable approximately 360 MW of additional solar generation and substantially greater utilization of available wind

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[27] The Brattle Group, *Building a Better Grid: How Grid-Enhancing Technologies Complement Transmission Buildouts* (Apr. 2023), https://watt-transmission.org/wp-content/uploads/2024/11/Understanding-the-Benefits-of-GETs-Resources-Demonstrating-the-System-and-Consumer-Value-of-GETs.pdf (hereinafter, "Building a Better Grid").
[28] *GETs Playbook*, at 9.
[29] *GETs and HPCs Under 1920*, at 24.
[30] Id, at 24.

resources.[31] National Grid Electricity Transmission in England estimated that APFC deployment on portions of its network could avoid more than $500 million in generator curtailment costs.[32] In Kansas and Missouri, TTO identified a network reconfiguration that eliminated a major transmission constraint during high-wind periods and was projected to reduce congestion costs by approximately 85% for Evergy customers.[33]

e) Increases system reliability

ATTs can improve system reliability by increasing operational flexibility, improving visibility into available transmission capability, and enabling more efficient use of existing transmission infrastructure. By increasing the amount of power that can be delivered across the transmission system and providing operators with additional tools to manage power flows, ATTs can help reduce transmission constraints that might otherwise limit the reliable delivery of electricity to customers.

DLR improves reliability by providing operators with a more accurate understanding of available transmission capacity in real time. For example, PacifiCorp deployed DLR in eastern Wyoming in 2019 to address both congestion and reliability concerns on its transmission system. The system calculates transmission line ratings every ten seconds and continuously updates PacifiCorp's Energy Management System, providing operators with enhanced situational awareness and more accurate information regarding available transmission capability.[34]

APFC technologies improve reliability by allowing operators to actively manage power flows across the transmission network and reduce stress on constrained facilities. For example, Georgia Power recently partnered with Smart Wires to deploy 21 APFC modules across portions of its 230 kV system serving the rapidly growing Atlanta metropolitan area. The project was developed in response to growing electricity demand and is intended to improve the utility's ability to reliably serve customers by dynamically redirecting power flows and making more efficient use of existing transmission infrastructure.[35]

TTO similarly improves reliability by identifying network configurations that make more effective use of available transmission facilities. During a seven-month outage of a critical

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[31] Lee, Nair, Sun, Impacts of Dynamic Line Ratings on the ERCOT Transmission System (Oct. 2022), https://ieeexplore.ieee.org/document/10012241.
[32] *GETs Playbook*.
[33] Id.
[34] *See appendix for case studies.*
[35] Id.

345 kV transmission line in MISO in 2021, a transmission reconfiguration increased power transfers through the affected corridor by approximately 56%, helping maintain system performance while the facility remained out of service.[36]

f) Increases system resiliency

ATTs can improve resiliency by increasing operational flexibility, providing greater visibility into available transmission capability, and allowing operators to access additional transmission capacity during stressed system conditions.

The resiliency value of ATTs is often most apparent during extreme weather events and major system disturbances. As discussed in the response to Prompt 1(b) above, during the 2018 "Bomb Cyclone," ISO New England increased transfer limits via DLR on key interfaces because cold weather increased the actual thermal capability of transmission facilities. This additional transfer capability helped support system resiliency and reliability during a period of exceptionally high demand. Similarly, during Winter Storm Elliott in 2022, SPP implemented transmission switching solutions that increased transfer capability into a major metropolitan area, released up to 845 MW of otherwise stranded generation, and enabled approximately 14 GWh of additional energy delivery during emergency conditions. HPCs also provide resiliency benefits through their physical design. Many HPCs were developed in response to the 2003 Northeast Blackout, where excessive conductor sag contributed to the event. Modern low-sag conductors are specifically designed to maintain clearances under high loading conditions while carrying substantially more power than traditional conductors.[37]

g) Increases the capacity to connect new energy generation resources

ATTs can increase the amount of generation that can be interconnected to the grid by increasing the effective capability of existing transmission infrastructure and reducing transmission constraints that limit the delivery of power from new resources. GETs can be particularly valuable in areas where transmission constraints limit the ability of new generation resources to connect to the grid by increasing transmission capacity, improving power flows, and reducing congestion to create additional transfer capability. HPCs can provide similar benefits by increasing the firm, physical capability of existing transmission facilities through reconductoring.

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[36] *GETs Playbook*, at 12.
[37] *GETs and HPCs Under 1920,* at 21.

A 2021 study by The Brattle Group examined whether a portfolio of GETs could increase the amount of generation that could be interconnected in portions of Kansas and Oklahoma within SPP. The study found that planned transmission upgrades alone would enable approximately 2,600 MW of new generation by 2025. However, when DLR, TTO, and APFC were added, the amount of generation that could be integrated increased to approximately 5,200 MW—effectively doubling the amount of generation that could be accommodated. The study further found that the production cost savings associated with the additional generation would offset the approximately $90 million cost of the GET investments in less than six months.[38]

Prompt 4: What is the potential of each ATT to be used or be deployed by public utilities to provide safe, reliable, and affordable electric utility service to customers in Indiana, considering existing and planned transmission infrastructure and projected demand growth?

As referenced in the introduction, Indiana's annual energy demand is projected to more than double by 2035. This is leading to substantial grid congestion in the state. ATTs offer Indiana utilities near-term tools to expand grid capacity while larger transmission projects are planned and constructed. Utilities could deploy ATTs incrementally and strategically at high-value congestion points or constrained interfaces. Reconductoring with advanced conductors may be particularly valuable in constrained corridors where siting new transmission is difficult or time-consuming. Moreover, Indiana's central location within regional transmission systems makes congestion reduction and transfer capability improvements especially important.

Prompt 5: What potential reductions in project costs and project completion deadlines can be furthered by ATTs compared to traditional transmission infrastructure?

Deployment speed is one of the most significant advantages of ATTs. Many GETs can be deployed within months or a few years—a fraction of the time it takes to build new transmission. DLR often requires only the installation of sensors, communications systems, and software. TTO can frequently be implemented through software platforms and operational processes alone. APFC devices typically require substation-level

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[38] The Brattle Group, *Unlocking the Queue with Grid-Enhancing Technologies* (Feb. 2021), https://watt-transmission.org/wp-content/uploads/2021/02/Brattle__Unlocking-the-Queue-with-Grid-Enhancing-Technologies__Final-Report_Public-Version.pdf90.pdf.

installations that can be completed substantially faster than constructing an entirely new transmission corridor.

HPCs can similarly reduce costs and timelines by increasing capacity within existing transmission corridors. Because reconductoring projects often utilize existing structures and ROWs, they can avoid many of the permitting and land acquisition challenges associated with greenfield transmission development (which often drive the cost and schedule of traditional transmission projects) while still delivering substantial increases in transfer capability.

These shorter deployment timelines can provide substantial value by allowing utilities to address near-term reliability concerns, congestion issues, interconnection backlogs, and load growth while larger transmission projects are planned and constructed. ATTs are the best option for "speed-to-power" where there is a need to bridge the gap between immediate system needs and longer-term infrastructure expansion.

In addition to reducing direct capital costs and accelerating project completion deadlines, ATTs reduce opportunity costs associated with transmission constraints. Delayed transmission upgrades can increase congestion costs, delay new generation interconnections, constrain economic development, and increase system operating costs. By providing earlier access to transmission capacity, ATTs can help reduce these costs while enabling utilities to defer or optimize larger capital investments.

Finally, ATTs can help improve the efficiency of future transmission planning by allowing utilities to defer, resize, or sequence traditional transmission investments more effectively. In select cases, ATT deployments may eliminate the need for a larger transmission project altogether; in others, they may provide interim capacity that allows utilities to build larger projects on a more deliberate timeline. This flexibility can improve overall capital allocation and reduce costs for ratepayers.

Recent deployments demonstrate the scale of these potential savings. In Pennsylvania, PPL deployed DLR on three 230 kV transmission lines to address projected congestion costs of approximately $23.5 million annually. The DLR solution cost less than $1 million and was installed in less than one year without requiring outages. By comparison, reconductoring was estimated to cost approximately $20 million and require two to three years with extended outages, while rebuilding the transmission facilities was estimated to cost $40–60 million and require three to five years with extended outages. The DLR investment represented only 4–5% of the projected annual congestion costs it was intended to address, while providing approximately 20% additional transmission capacity for most operating hours.[39]

Similarly, in upstate New York, DLR was deployed on two double-circuit 115 kV transmission lines experiencing increasing generation growth. The project is expected to reduce generation curtailments by more than 350 MW and increase transfer capability by an additional 190 MW while avoiding the need to rebuild approximately 26 miles of transmission lines. The total project cost was approximately $3.2 million, less than the average cost of rebuilding a single mile of comparable 115 kV transmission infrastructure in the region.[40]

Prompt 6: What are potential ways to streamline the deployment of ATTs, including streamlined processes for permitting, maintenance, and upgrades?

Utilities, regulators, RTOs, and other stakeholders can accelerate ATTs adoption by

1. improving planning processes,
2. standardizing evaluation methodologies,
3. building operational readiness, and
4. facilitating knowledge transfer from existing deployments.

The recommendations below focus on practical steps that can help ensure cost-effective ATT opportunities are consistently identified, evaluated, and implemented.

1. <u>Integrate ATTs into utility planning and evaluation processes</u>

Many ATTs can be deployed more quickly than traditional transmission infrastructure, but their adoption is often limited by planning, evaluation, and implementation processes that were developed before these technologies became widely available. ATTs should be consistently considered alongside traditional transmission solutions when utilities evaluate reliability, congestion, interconnection, and load growth needs, but utilities need to upskill workers and ensure that modeling tools include ATTs. The Federal Energy Regulatory Commission has already set these requirements in Order Nos. 1920 and 2023, requiring ATTs evaluation in transmission planning and generator interconnection, respectively.

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[39] *GETs Playbook*, at 9.
[40] *GETs and HPCs Under 1920*, at 19.

One way that many states have tried to ensure that utilities are prepared to fully implement these requirements is through a required state study of ATTs against multiple benefits. This standalone study helps utilities build experience and identify projects that don't fit neatly into traditional long-range transmission planning. For example, California utilities submitted reports pursuant to SB 1006 that identified approximately 85 potential ATT deployment opportunities across utility systems. In Minnesota, the legislatively-mandated 2025 GETs study identified 12 cost-effective deployment opportunities and provided a detailed assessment of where these technologies could provide measurable system benefits.

Utilities should also be encouraged to evaluate ATTs as part of transmission planning studies, interconnection studies, and infrastructure upgrade assessments even before fully implementing FERC Order No. 1920. Where states have jurisdiction, requiring utilities to evaluate whether ATTs could provide a cost-effective solution in these proceedings can help ensure that all reasonable alternatives are considered before more costly infrastructure investments are pursued, helping ensure that planners identify the most cost-effective portfolio of solutions rather than defaulting exclusively to traditional infrastructure investments. Importantly, such evaluations need not mandate deployment of any particular technology, but rather ensure that utilities have assessed whether an ATT could provide equal or greater benefits at lower cost or on a faster timeline.

Several states have recently taken steps to formalize ATT consideration in utility planning and infrastructure proceedings. For example, Ohio enacted House Bill 15 in 2025, which requires electric utilities to evaluate ATTs as part of transmission planning and siting application activities. Similar requirements have been adopted in states including Utah, South Carolina, Virginia, and of course Indiana.[41]

2. **Improve modeling, forecasting, and evaluation methodologies**

A persistent barrier to deployment is inexperience with ATT modeling, performance forecasting, and benefit quantification. Many utilities do not have staff who have previously incorporated DLR, APFC, and TTO into planning studies and operational models. Industry organizations including ESIG have documented these challenges and identified opportunities to improve utility confidence through standardized modeling approaches,

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[41] WATT Coalition, *State Legislative Momentum Builds for Grid Enhancing Technologies* (Jul. 2025), https://watt-transmission.org/state-policy-momentum-builds-for-grid-enhancing-technologies-in-2025/.

improved data collection, and sharing of operational experience from existing deployments.[42]

One way to address these challenges is through the use of structured evaluation frameworks that can help utilities systematically assess potential ATTs applications. Utilities, regulators, and stakeholders often use different assumptions and metrics when assessing ATT benefits, making comparisons difficult. For example, WATT has developed a GETs Integration Checklist (see below) that outlines the initial questions and considerations for beginning to evaluate and deploy Grid Enhancing Technologies, including GETs in planning, operations, modeling, implementation, and stakeholder engagement. Such frameworks can help utilities move beyond ad hoc evaluations and establish more consistent processes for identifying, assessing, and implementing cost-effective ATT opportunities. The figure below notes the initial steps utilities should take to be ready to use GETs.[43]

Utilities and system operators need to evolve their processes and invest in capability building across teams to maximize the benefits of grid modernization with GETs.

Checklist: Are you ready to deploy GETs in operations?

- ✓ Train field personnel on installation and maintenance of GETs
- ✓ Build internal modeling expertise for DLR, APFC, and topology optimization.
- ✓ Train operators on new data streams and operational procedures
- ✓ Update EMS (if needed): Accept and display DLR, export node-breaker cases (if applicable)
- ✓ Incorporate GETs in outage impact mitigation workflows
- ✓ Develop topology reconfigurations to mitigate extreme and load shed events

Teams to engage: Operations, Operations Planning, Transmission Planning, Workforce, IT, R&D

Initial applications of GETs: Six proven ideas

- ✓ **Persistent congestion mitigation:** Study switching solutions to address frequent bottlenecks. Review lines for DLR use (e.g. with 50+ congested hours last year, or $500,000 in congestion costs). Allow generators to pay for GETs installation to mitigate curtailment.
- ✓ **Outage impact mitigation:** Model GETs to mitigate future planned outages and assess cost-effectiveness. Develop switching plans using topology optimization.
- ✓ **Load interconnection:** Increase capacity to expand headroom for new large loads.
- ✓ **Generator interconnection**: Include GETs in generator interconnection studies, per FERC Orders 2023 and 1920.
- ✓ **Asset health awareness:** Install DLR sensors to measure and monitor conductor performance and detect aging. Install APFC to extend asset and equipment life.
- ✓ **Transmission planning:** Study GETs for the seven benefits in FERC 1920-A.

3. Build experience and operational readiness

Successful deployment also depends on utility familiarity and operational integration. Training programs and knowledge sharing initiatives can help planners, engineers, and system operators develop experience with ATT applications and identify where particular technologies are most effective. As utilities gain operational experience, ATTs can more

[42] ESIG, Utility Perspectives on Making Grid-Enhancing Technologies Work (Jul. 2025), https://www.esig.energy/wp-content/uploads/2025/07/ESIG-Grid-Enhancing-Technologies-report-2025.pdf.
[43] Available for download at: https://watt-transmission.org/wp-content/uploads/2025/06/GETs-Integration-Checklist.pdf

readily become part of routine planning and operational processes rather than being considered only on a project-by-project basis. The WATT and AMP Coalition will be hosting utility training opportunities later this year, and the Energy Systems Integration Group[44] and Electric Power Research Institute[45] both have user-groups for utilities to share knowledge.

4. **Strengthen stakeholder coordination and information sharing**

Finally, regulators can play important convening and oversight roles. Regulators can initiate informational proceedings and hearings to promote exchanges among utilities, RTOs, consumer advocates, technology providers, and other stakeholders. Many of the benefits of ATTs are realized at the system level and may involve coordination across utility or RTO boundaries. Regular stakeholder engagement can help identify deployment opportunities, facilitate sharing of lessons learned from existing projects, and ensure that successful applications are replicated where appropriate. Regulators can also ask utilities to share examples of their ATTs analysis and explain their decision-making processes to ensure that ATTs are being appropriately considered.

Prompt 7: Are there any other aspects of ATTs that can assist the IURC to understand the potential role of ATTs in Indiana?

One important consideration is that ATTs should be viewed as complementary to traditional transmission expansion, not as a substitute for all new transmission infrastructure. Indiana will continue to require investment in new transmission facilities to support long-term reliability, economic development, and resource integration. However, ATTs can often help utilities maximize the value of existing infrastructure, address near-term constraints, and improve system performance while larger transmission projects are being planned and constructed. As a result, Indiana may benefit from a "both-and" approach that combines strategic transmission expansion with modernization of the existing grid.

As ATT deployment expands, the Commission may wish to consider establishing reporting and transparency mechanisms in the IRP process that allow regulators and stakeholders to better understand deployment opportunities and outcomes. Such reporting could include information on ATT evaluations performed, projects deployed, congestion reductions

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[44] ESIG, *Advanced Grid Solutions User Group*, accessed Jun. 3, 2026, https://www.esig.energy/user-groups/advanced-grid-solutions/.

[45] EPRI, *GET SET Affinity Group*, accessed Jun. 3, 2026, https://transmission.epri.com/getset/public/affinity_group/.

achieved, customer savings realized, reliability impacts, and lessons learned. Over time, this information can help build a stronger empirical foundation for future utility planning and regulatory decision-making.

Appendix: Example capacity gains and cost savings from domestic ATTs deployments

Dynamic Line Rating

- PPL Electric Utilities, PA: The first market-integrated deployment of DLR in the U.S. by PPL Electric Utilities in Pennsylvania reduced congestion by over $60 million year-over-year on a single line. The alternative upgrade, rebuilding the line, would have cost $50 million and required an extended outage. PPL was awarded the 95th Edison Award by the Edison Electric Institute in 2023 for this achievement in 2023.
- AES, OH / IN: Found 61% more capacity on a 345 kV line.
- Duquesne Light Company, PA: Found an average of 25% more capacity on transmission lines.
- National Grid, MA: DLR deployment created an average increase of 47% in line capacity.
- New York Power Authority, NY: DLR deployment found up to 60% more capacity.
- Great River Energy, MN: Found an average of 40% more capacity on a line through their first DLR demonstration in Minnesota.
- PacifiCorp, WY: PacifiCorp deployed DLR in eastern Wyoming in 2019 to alleviate congestion and address reliability issues. The system calculates line ratings every 10 seconds and updates the utility's Energy Management System.
- BPA, Pacific Northwest: BPA's Real Time Operations team deployed DLR to produce hourly line ratings, providing an accurate picture of real-time loading on transmission facilities.

Topology Optimization

- Alliant, IA: Has saved customers in Iowa $24 million in the 2-year period since Oct. 2021.
- ERCOT: Uses TTO software to support Constraint Management Plan review and development.
- ISO-NE: Uses TTO software to support their transmission outage coordination process. This software aids the ISO-NE Outage Coordination

staff during analysis of complex outage studies to minimize reliability risks and economic impacts caused by planned transmission outages. .
Has mitigated flow on most-limiting transmission constraints by 31% on average and resolved the need for flow mitigation in 12 out of 24 cases.)

- MISO: The MISO reconfiguration request process allows proposals for TTO reconfigurations. 2024 implemented economic reconfigurations resulted in $100M in market benefits.
- SPP: TTO vendor NewGrid provides congestion monitoring and mitigation services to SPP members. Reconfigurations analyzed as part of the services have mitigated overloads and delivered tens of millions in congestion cost savings.

Advanced Power Flow Control

- Georgia Power, GA: Installation of 21 APFCs on 2 circuits in 2025 delivered the required capacity within 18 months. Second set of deployments planned by 2028.
- Central Hudson, NY: Project has unlocked over 185 MW of capacity on the existing grid.
- PG&E, CA: Plans to deploy APFC to support new data centers in San Jose, aiming to increase capacity by more than 100MW.
- TVA, TN: Demonstration project – installed 99 Smart Wires units covering 17 tower spans on a 161-kV transmission line near Knoxville, Tenn.
- Duke Energy Florida, FL: Demonstration project – installed 3 APFCs on a 138 kV circuit at an Orlando substation.
- National Grid, MA: Demonstration project – installed 3 APFCs on a 115 kV circuit in a western Massachusetts substation.

Carbon Core Conductors: ~10,000 miles deployed in the U.S.

- SCE, CA: SCE reconductored 137 miles of a 230 kV line with HPCs in 2018 to mitigate sag, increase ROW capacity by 40%, and reduce line losses by 30%.
- Entergy, LA: saved $9.6 million by reconductoring a 230 kV transmission line using HPCs to increase line capacity.
- Montana-Dakota Utilities, ND: Unlocked 40% cost savings in a reconductoring project using HPCs when compared to rebuilding with ACSS conductor.
- AEP West, TX: Reconductoring project saved customers $15 million annually through a reduction in line losses.

- APS, AZ: Almost doubled the capacity of a line (~850 to 1600 amps) in Tempe, AZ without needing to modify or replace the existing structures.
- Dominion Energy, VA: Increased capacity on a line by 90% using HPCs to complete a line near Dulles Airport in Loudoun County, VA.
- South Texas Electric Cooperative, TX: reduced energy losses by just over 5,000 MWh in the first year after reconductoring a line using HPCs.

Superconductors

- Commonwealth Edison, IL: A 2021 Superconductor project in Chicago connected two substations in the city, increasing reliability and avoiding the need to acquire additional land and disturb existing infrastructure.
- Long Island Power Authority (LIPA), NY: Installed a superconducting AC transmission cable in 2008 with 574 MW of capacity in a ROW only one meter wide.