UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

Interconnection of Large Loads to the	)	
Interstate Transmission System	)	Docket No. RM26-4-000

JOINT REPLY COMMENTS OF THE INDUSTRIAL CUSTOMER ORGANIZATIONS

The Industrial Energy Consumers of America ("IECA"), the American Forest & Paper Association ("AF&PA"), the PJM Industrial Customer Coalition ("PJMICC"), and the Coalition of MISO Transmission Customers ("CMTC") (collectively, "Industrial Customer Organizations"), welcome the opportunity to submit these Reply Comments in response to other parties' comments on the Federal Energy Regulatory Commission's ("FERC" or "Commission") October 27, 2025 Notice Inviting Comments on Interconnection of Large Loads to the Interstate Transmission System ("Notice"), in the above referenced docket. The Notice was prompted by the Secretary of Energy's proposed Advanced Notice of Proposed Rulemaking ("ANOPR"), which was issued on October 23, 2025.[1] The Industrial Customer Organizations appreciate the ANOPR's objective for the Commission to exercise its jurisdiction over the interstate, bulk electric system to streamline and standardize large load transmission-level interconnection. While standardization of studies impacting the bulk electric system ("BES") is within FERC's jurisdiction, the comments affirm the importance of maintaining state jurisdiction over retail services provided to an end-use customer.[2] Therefore, any ensuing Notice of Proposed Rulemaking ("NOPR") should focus only

[1] On October 23, 2025, pursuant to section 403 of the Department of Energy ("DOE") Organization Act, 42 U.S.C. § 7173, the Secretary of Energy released a proposed ANOPR for consideration and final action by the Commission.

[2] *See, e.g.*, The Comments of the Organization of MISO States at 9 ("the Commission should limit its authority over large-load interconnection requests to the study process itself, with clear guardrails ensuring no effect on retail service obligations").

on large load interconnection impacts to the FERC-jurisdictional transmission grid and FERC-jurisdictional electricity markets.

Paramount to these Reply Comments is our request that the Commission require evaluation and use of Grid Enhancing Technologies ("GETs") technologies in transmission studies where cost-effective. The time has come and gone for voluntary or incentivized consideration of GETs. It is well documented that use of GETs delivers cost reductions and cost avoidance to the benefit of consumers nationwide. Despite this, relatively few projects have been implemented. To strengthen the grid and protect consumers, the Commission must take a more aggressive posture, fully exercise its regulatory authority over the transmission of electricity in interstate commerce, and require GETs and advanced transmission technologies where cost-effective.

I. REQURING THE EVALUATION AND USE OF GRID ENHANCING TECHNOLOGIES IN TRANSMISSION STUDIES – AND DEPLOYING SUCH TECHNOLOGIES WHERE COST-EFFECTIVE – IS NECESSARY TO ENSURE BOTH SPEED TO POWER AND JUST AND REASONABLE RATES

To unleash the ANOPR's speed-to-power objectives, the Commission should narrowly focus its near-term efforts on optimizing existing system capacity (or transfer capability) via reconductoring and deployment of GETs and require the transparency of load forecasting and assumptions underlying transmission system studies. As recognized by the Data Center Coalition, the Commission must ensure that transmission planning reflects real and foreseeable load growth and that "[r]equiring grid enhancing technologies…would improve system capacity and accelerate interconnection timelines."[3] The Working for Advanced Transmission Technologies Coalition ("WATT") and the Advancing Modern Powerlines ("AMP") Coalition demonstrate that GETs and

[3] Data Center Coalition Comments at 10-11.

advanced transmission technologies are "**the fastest way to increase transmission capacity** and provide additional benefits to large loads and consumers through lower upgrade and system costs, as well as improved reliability."[4]

The Industrial Customer Organizations agree with the Data Center Coalition that the Commission should proceed to move forward with finalizing the pending rulemaking on Dynamic Line Ratings ("DLRs"), requiring the evaluation of DLRs and require its use so long as the deployment of DLRs is cost-effective and the benefits outweigh the costs.[5] We also agree with WATT/AMP that the Commission should require the evaluation of GETs and advanced transmission technologies alongside traditional upgrades in the interconnection process for large loads. Other commenters to the ANOPR highlighted the importance of GETs, system efficiencies,[6] and grid technology solutions, including the Distributed Capacity Parties,[7] Spight, Inc.,[8] AES Corporation,[9] Advanced Energy United,[10] Eolian, L.P.,[11] Google Energy,[12] and DTE Electric.[13] Edison Electric Institute ("EEI") emphasized the importance of efficient system planning.[14]

[4] WATT/AMP Comments at 2 (emphasis in original); *see also generally* Comments of CTC

[5] *See* Data Center Coalition Comments fn. 10 (citing *Implementation of Dynamic Line Ratings*, *Advance Notice of Proposed Rulemaking*, Docket No. RM24-6-000, 89 Fed. Reg. 57,690 (July 15, 2024)).

[6] Several comments stressed the importance of an efficient system buildout, such as through studying load and generation together. *See* ISO-New England Comments at 7 (Principle 5).

[7] *See* Distributed Capacity Parties Comments at 2 (advocating for distributed capacity technologies and GETs).

[8] *See* Spight, Inc. Comments at 2 (highlighting Demand Congestion Management software).

[9] AES Corporation Comments at 7 (asking FERC to expedite several solutions, including GETs, batteries, and demand response).

[10] Advanced Energy United Comments at 2 (seeking advanced grid management and customer-sited technologies).

[11] Eolian L.P. Comments at 2-3 (advocating for unlocking existing system capacity through load flexibility commitments and associated technologies).

[12] Google Energy Comments at 6-7.

[13] *See* DTE Electric Comments at 4 (suggesting pathways to "facilitate efficient use of existing infrastructure").

[14] EEI Comments at 17-18 (arguing for efficient planning in the context of co-located loads).

Notably, several organizations are actively working on deploying GETs:

- Grid Strategies through their WATT Coalition[15] project partnered with the Brattle Group on a report in 2023. https://www.brattle.com/wp-content/uploads/2023/04/Building-a-Better-Grid-How-Grid-Enhancing-Technologies-Complement-Transmission-Buildouts.pdf

- CTC Global is working with Google on an advanced transmission partnership. https://www.utilitydive.com/news/google-ctc-global-advanced-conductors-transmission/750878/

- CTC Global presented in June 2025 to the Independent System Operator – New England ("ISO-NE") on GETs and advanced conductors. https://nhconservation.org/lib/exe/fetch.php?media=x178:2025_06_18_gets_ctc_global_material.pdf

- On November 17, 2025, representatives from Pew, Grid Strategies / WATT Coalition, and CTC Global presented at the Pennsylvania State Capitol on the ability of advanced transmission technologies to cost-effectively meet growing electricity needs and demands. *See* **Attachment A** to these Reply Comments (compilation of presentations by Pew, Grid Strategies/WATT Coalition, and CTC Global) (Nov. 17, 2025).
    - In 2019, GETs reduced congestion costs by 50% in PJM. Attachment A, Grid Strategies Presentation at 7.
    - A 2021 deployment by Alliant in the Midcontinent Independent System Operator, Inc. ("MISO") footprint saved $24 million in congestion costs over two years. *Id.*
    - Advanced Power Flow Controls in a 2024 deployment in New York unlocked 185 MW to accommodate new generation
    - Advanced Conductors (using carbon) can result in up to 40% in lower line losses. Attachment A, CTC Global Presentation at 5-6.

Prior studies and analyses have been conducted on GETs, including:

- January 2024 Summary of Case Studies and Modeling on the Value of Grid Enhancing Technologies: https://watt-transmission.org/wp-content/uploads/2024/01/Case-Studies-and-Modeling-on-the-Value-of-Grid-Enhancing-Technologies-%E2%80%93-January-2024-.pdf
- Grid Lab 2035 Report: Reconductoring With Advanced Conductors Can Accelerate the Rapid Transmission Expansion Required for a Clean Grid: https://www.2035report.com/wp-content/uploads/2024/04/GridLab_2035-Reconductoring-Technical-Report.pdf
- Accelerating transmission capacity expansion by using advanced conductors in existing right-of-way," Proceedings of the National Academy of Sciences (E. Chojkiewicz et al.): https://www.pnas.org/doi/10.1073/pnas.2411207121

[15] More information and studies is available on the WATT Coalition's website here: https://watt-transmission.org/resource-library/#FilingsAndKeyReports

Requiring an evaluation of GETs for transmission studies and load studies impacting the transmission system is a consensus-based solution that has the support of the states. Through a November 13, 2025 resolution, the National Association of Regulatory Utility Commissioners ("NARUC") supported further deployment of GETs to address issues raised by accelerated large load interconnections.[16]

To fully optimize the system and unleash GETs, the Commission must address head-on the underlying financial incentive for transmission owners to understate system capability to overbuild and expand rate base, including through transmission owner-conducted load studies and transmission studies generated in response to requests for new large load interconnections. To that end, the Commission could – to protect existing customers and promote an efficient electric system – require the relevant transmission owner or regional grid operator to evaluate the use of advanced conductor deployment and the use of GETs, and other efficiency and optimization measures for any new large load, transmission-level interconnection applications. Importantly, the Commission must refrain from establishing incentives for GETs, but instead require that transmission owners and transmission providers routinely and systematically evaluate GETs as a means for optimizing existing transmission facilities to accommodate new large load interconnections and other load growth. If a traditional upgrade or new line or facility is necessary and more cost-effective than GET deployment, then documentation and analysis supporting the traditional upgrade should be provided publicly so that the parties to the interconnection process, customers, and state and federal regulators have full visibility into the decision.

[16] *See Resolution Supporting the Integration of Advanced Transmission Technologies in the Electricity Transmission System* (passed Nov. 13, 2025) (hereinafter "NARUC GETs Resolution"), *available at* https://pubs.naruc.org/pub/812873F4-E348-B77F-4D75-E513FF13A86D (last accessed Dec. 5, 2025).

Importantly, some utilities have successfully deployed GETs. By deploying DLRs, PPL Electric Utilities reduced congestion by over $60 million year-over-year on a single line when the alternative – rebuilding the line – would have cost $50 million and required an extended outage.[17] However, the PPL success story is an industry anomaly, as not all transmission owners in all instances (likely in most instances) are optimizing existing transmission facilities to the best of their ability. The current financial incentive, and arguably even the fiduciary obligation of each publicly traded transmission owner, is to provide shareholder value. Both of these factors, combined with the current regulatory design, favor the construction of new facilities over the optimization of existing facilities because only new construction offers an opportunity to earn a "return on" the new investment when it is added to a transmission owner's rate base.

Given the current generation supply-demand dynamics and ever-escalating transmission rates, the Industrial Customer Organizations respectfully submit that requiring an evaluation of GETs for all transmission planning and load studies impacting the transmission system is necessary to ensure just and reasonable FERC-jurisdictional rates for the transmission of electricity in interstate commerce. Accordingly, all transmission planners and jurisdictional utilities should be required to independently evaluate, as part of transmission planning and especially in the context of new large load additions, whether GETs can serve as an alternative to more expensive capital investment in towers, lines, transformers, and other equipment. If the transmission planners make such a determination, then the GETs should be included in the transmission plan. Investment in GETs, where cost-effective for consumers, is consistent with good utility practice. We recognize that regionally planned, backbone transmission can provide benefits that outweigh the

[17] *See* https://watt-transmission.org/about-dynamic-line-ratings/; *see also* https://insidelines.pjm.com/dynamic-line-rating-activated-by-ppl-electric-utilities/ (explaining PPL's estimate that its DLR project will save customers $23 million annually in congestion costs).

costs of the investment; however, given rapidly increasing transmission rates throughout the country, we ask the Commission to require an evaluation of GETs to fully optimize existing transmission facilities to reduce investment in new transmission lines, towers, substations, and associated equipment.

A utility's obligation to provide reliable service at just and reasonable rates must be a utility's first obligation. Obtaining the desired return on new capital investments for shareholders is a secondary obligation. GETs must be required and should no longer be voluntary or simply encouraged or incentivized. To ensure transmission owners evaluate GETs, the Commission could establish a risk of non-recovery of the costs of new transmission facilities that are placed into service if transmission owner fails to consider GETs or advanced technology alternatives to the new construction. Additionally, the Commission should create a new office or staff that independently evaluates any proposed transmission solutions associated with a large load interconnection request. This is necessary because RTOs and ISOs are not regulators with a duty to ensure just and reasonable rates. Commission staff, with multidisciplinary skillsets, could evaluate the proposed solution from an engineering, cost, and reliability perspective. Commission staff could also evaluate any cost shifts associated with any upgrades flowing out of the large load interconnection request.

II. THE COMMISSION SHOULD REQUIRE INCREASED COORDINATION AND TRANSPARENCY FOR LOAD FORECASTING, INCREASED PUBLIC REPORTING ON TRANSMISSION AND RELIABILITY IMPACTS ASSOCIATED WITH LARGE LOAD INTERCONNECTION REQUESTS, AND INCREASED TRANSPARENCY INTO ASSUMPTIONS USED IN STUDIES IMPACTING THE TRANSMISSION SYSTEM.

The initial comments overwhelmingly support increased transparency into load forecasting practices and into assumptions and methods used in transmission system studies necessitated by large load interconnection requests. Shell Energy emphasizes that "[i]ncreased

scrutiny and transparency will strengthen market confidence in [load] projections, allowing forward markets to more accurately reflect actual loads and enabling participants to make informed investment decisions."[18] PSE&G emphasized the need to improve the accuracy of the regional load forecast through enhanced transparency.[19] Calibrant Energy Holdings ("Calibrant") explained that any FERC rule must ensure a transparent interconnection process that clearly identifies "specific constraints, system conditions, and/or the hours that are driving the need for new system upgrades and investment," as such visibility into system conditions can help customers and stakeholders develop cost-effective, alternative solutions that can help avoid "an overbuilt, unnecessarily expensive electric system."[20] The Office of the Ohio Consumers Council ("OCC") requests publication of implementation schedules for large load interconnection requests and periodic public reporting on queue progress, study completion, and cost impacts.[21]

The Industrial Customer Organizations wholeheartedly agree with these comments. Increased transparency and visibility into the impacts of large load requests is an area where the Commission should focus its efforts in developing any NOPR. Further, as noted by OCC, RTOs and transmission providers must coordinate closely with state commissions and consumer advocates as to reliability and cost impacts associated with large load additions.[22] Given that the ANOPR has asserted Commission jurisdiction over transmission system impacts associated with large load additions, the Commission could track all new pending projects on its web site.

[18] Shell Energy Comments at 6.

[19] PSE&G Comments at 10, 27.

[20] Calibrant Comments at 1-2

[21] OCC Comments at 12.

[22] *See* OCC Comments at 12.

Without transparency, the risk of over-building, under-building, and inefficiently building remains very high, with consumers on the risk of paying for stranded costs or, conversely, not receiving reliable electric service. FERC is best situated to collect and facilitate the sharing of data impacting jurisdictional transmission systems, and to provide such national transparency.

III. THE INITIAL COMMENTS AFFIRM THE IMPORTANCE OF MAINTAINING THE COST CAUSATION PRINCIPLE AND ENSURING LARGE LOADS PAY THEIR FAIR SHARE OF SYSTEM COSTS.

EEI, Shell Energy, Google Energy, and several other commenters emphasize the importance of the cost causation principle and the assignment of costs based on the load's use of the transmission system.[23] Consistent with the Industrial Customer Organizations' initial comments in this proceeding, the Commission must protect customers by upholding the cost causation principle, and as necessary, refine the application of that principle to account for instances where existing customers may be more vulnerable to cost shifts associated with a large new load in a smaller utility zone that has little headroom on the transmission facilities in that zone and a small denominator over which to spread new transmission upgrade costs.[24]

IV. EXISTING STATE PROCESSES, ESPECIALLY THE ONES THAT ARE WORKING, SHOULD BE PROTECTED.

States and utilities in their initial comments emphasized the need to protect existing state processes.[25] Because a new federal mandate could trigger uncertainty and ongoing litigation

[23] *See, e.g.*, EEI Comments at 3, 10-11; Google Energy Comments at 12; Shell Energy Comments at 7-8; ELCON Comments at 12; Comments of the Organization of MISO States at 9 ("Careful consideration will be needed to ensure that cost causation principles are maintained"); *see also* Geronimo Power Comments at 17-21.

[24] *See* Industrial Customer Organizations Comments at 8 (recognizing the need for a more precises and nuanced cost causation analysis when benefits accrue primarily to new large load and where existing customer base may be disproportionately small compared to the size of the new large load).

[25] *See* EEI Comments at 35-36; NARUC Comments at 6 (emphasizing the importance of a state role in the large load interconnection process); *see also* Comments of the Organization of MISO States at 2 ("load interconnection study processes have been working well within the MISO footprint and there are no bottlenecks for interconnecting and energizing large loads that need attention in MISO").

and discourage a manufacturing renaissance in the United States, the Commission should consider implementing an optional and elective, fast lane, federal interconnection process, consistent with the framework in the initial comments of the Industrial Customer Organizations.[26] Further, any NOPR should focus on large load interconnection impacts to the FERC-jurisdictional transmission grid and FERC-jurisdictional electricity markets.

V. IF THE COMMISSION SELECTS A MW-BASED THRESHOLD, IT SHOULD BE SUBSTANTIALLY HIGHER THAN 20 MW AND APPLICABLE ONLY TO NEW LOADS

Several commenters caution FERC against implementing a Megawatt ("MW") threshold for large load interconnections.[27] Geronimo Power emphasizes that a more reasonable threshold may be 100 MW or higher given that the larger loads are driving the unprecedented load growth.[28] New England municipal entities emphasized that newer data centers routinely exceed 500 MW of demand and are thus significantly larger and more impactful projects than the projects that informed the ANOPR's suggested 20 MW threshold used in generation interconnection procedures.[29] If FERC implements a standardized large load interconnection process and load queue, then the Commission should consider using FERC's Seven Factor Test to evaluate the jurisdictional nature of the interconnection, in lieu of any arbitrary MW threshold.

[26] *See* Industrial Customer Organizations Comments at 16-19.

[27] *See, e.g.*, Tri-State Generation and Transmission Association, Inc. Comments at 5 ("it would be harmful for FERC to establish a nationwide threshold" but FERC should allow for higher thresholds if it proceeds).

[28] Geronimo Power Comments at 15.

[29] Comments of New England Consumer-Owned Systems and Energy New England, LLC at 19.

VI. THE COMMISSION SHOULD NOT RUSH TO DEVELOP A LOAD INTERCONNECTION QUEUE; HOWEVER, IF THE COMMISSION PURSUES A LOAD QUEUE, THEN CONSIDERATION SHOULD BE GIVEN TO DEVELOPING LOAD INTERCONNECTION RIGHTS, IN CONJUNCTION WITH STATE INPUT.

PJM Interconnection, L.L.C. ("PJM") asks the Commission to continue gathering information and assessing the pros and cons of creating large load interconnection queues.[30] The Industrial Customer Organizations agree that mandating a load interconnection queue process in the near term is not advised at this time. However, if the Commission were to seriously explore development of a load interconnection queue, then large loads should enjoy load interconnection rights, similar to Capacity Interconnection Rights that are granted to generation resources.

VII. THE COMMISSION MUST FACILITATE AND PROTECT MARKET-BASED SOLUTIONS, INCLUDING COMPETITIVE BIDDING FOR TRANSMISSION FACILITIES AND IN GENERATION DEVELOPMENT.

Although the ANOPR does not propose any changes to the principles in Order No. 1000, ATC Transmission Company LLC ("ATC") takes an opportunity to argue – without any evidence – that competitive bidding for new transmission does not reduce consumer rates and will only cause delays for infrastructure deployment.[31] ATC further suggests – again, without evidence – that incumbent monopolies with long histories provide the best value for consumers and the highest capability to build the grid out as fast as possible.[32] However, for larger scale transmission projects that are holistically and regionally planned, ATC fails to demonstrate that incumbent preferences and cost-of-service regulation are as effective as competition – where innovative solutions, cost caps, cost containment mechanisms, and accountability commitments

[30] *See* PJM Comments at 2-3.

[31] ATC Comments at 4-5

[32] ACT Comments at 5. While an incumbent transmission utility may be well-positioned to address emergency repairs to an existing line,

flow out of competitive solicitations – in establishing FERC-jurisdictional transmission rates. While an incumbent transmission utility may be well-positioned to address emergency repairs to its existing line, open and vibrant competition and market mechanisms should be embraced in most circumstances, especially given the escalation in transmission rates and planned investments for the future. Ample evidence, as previously highlighted by the Electricity Transmission Competition Coalition and reports by the Brattle Group demonstrate that competition is still the best way to ensure that the electric grid is built out in a way that lowers rates and fosters innovation.[33] As recognized by non-incumbent developers of generation and transmission:

> The Commission should continue to rely on competitive markets – both in generation and transmission planning and development – to incentivize efficient generation and transmission investment, to ensure cost discipline and schedule accountability, and to unleash innovation going forward. Competition remains a necessary and important component of solving complex energy problems.[34]

Accordingly, the Commission should exercise its regulatory authority, as needed, to ensure reliability and to protect consumers, including the protection of market mechanisms that lower prices and provide enduring value to both the grid and consumers.

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[33] *See* "Motion For Leave To Answer And Answer Of The Electricity Transmission Competition Coalition To The Unauthorized Supplemental Reply Comments Of Certain Anti-Competition Incumbent Utilities," Docket Nos. RM2-17-000, AD22-8-000, and AD21-15-000 (filed Feb. 1, 2024), *available at* https://elibrary.ferc.gov/eLibrary/filelist?accession_number=20240201-5046&optimized=false&sid=a958ce01-247a-4186-8dd3-3b216e24329d (last accessed Dec. 5, 2025); *see also* "Competitive Transmission Myths Dispelled," The Electricity Transmission Competition Coalition (Nov. 6, 2025), *available at* https://www.ieca-us.org/wp-content/uploads/ETCC-Competitive-Transmission-Myths-Dispelled-11_6_25-FINAL.pdf (last accessed Dec. 5, 2025).

[34] Comments of LS Power Development, LLC at 4; *see also* Comments of Electric Power Supply Association at 4 (independent power producers utilize competitive market mechanisms tailored to meet a customer's specific needs).

VIII. CONCLUSION

WHEREFORE, the Industrial Customer Organizations respectfully request that the Commission afford due consideration to these Reply Comments.

Respectfully submitted,

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Dated: December 5, 2025

CERTIFICATE OF SERVICE

I hereby certify that I have this day served, via first-class mail, electronic transmission, or hand-delivery the foregoing upon each person designated on the official service list compiled by the Secretary in this proceeding.

Dated at this 5th day of December, 2025.

By: */s/ Kenneth R. Stark*

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ATTACHMENT A

(compilation of presentations by Pew, Grid Strategies/WATT Coalition, and CTC Global) (Nov. 17, 2025)

How Advanced Transmission Technologies Can Meet Growing Electricity Needs

Pennsylvania Energy Roundtable

Jenny Netherton | Officer
jnetherton@pewtrusts.org

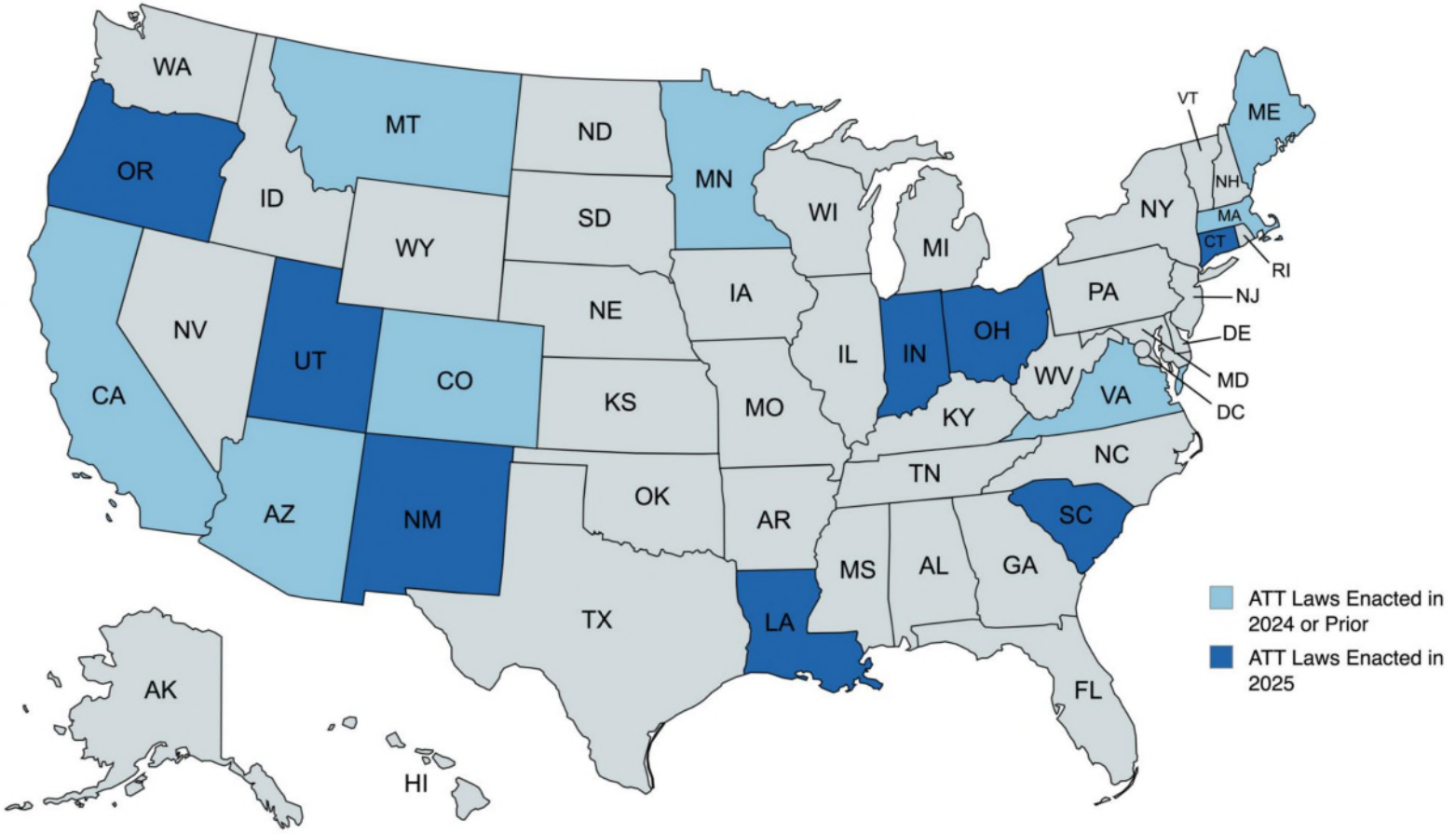
November 17, 2025

Pew

Advanced Transmission Technologies (ATTs)

- **Unlock more capacity** out of our existing grid
- **Upgrade the grid faster and for less cost** than traditional transmission infrastructure
- **Reduce congestion costs** for consumers

National ATTs Policy Landscape



Thank You!

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Advanced Transmission Technologies (ATTs)

Kelt Wilska, Senior Manager of State Policy for Advanced Transmission Technologies

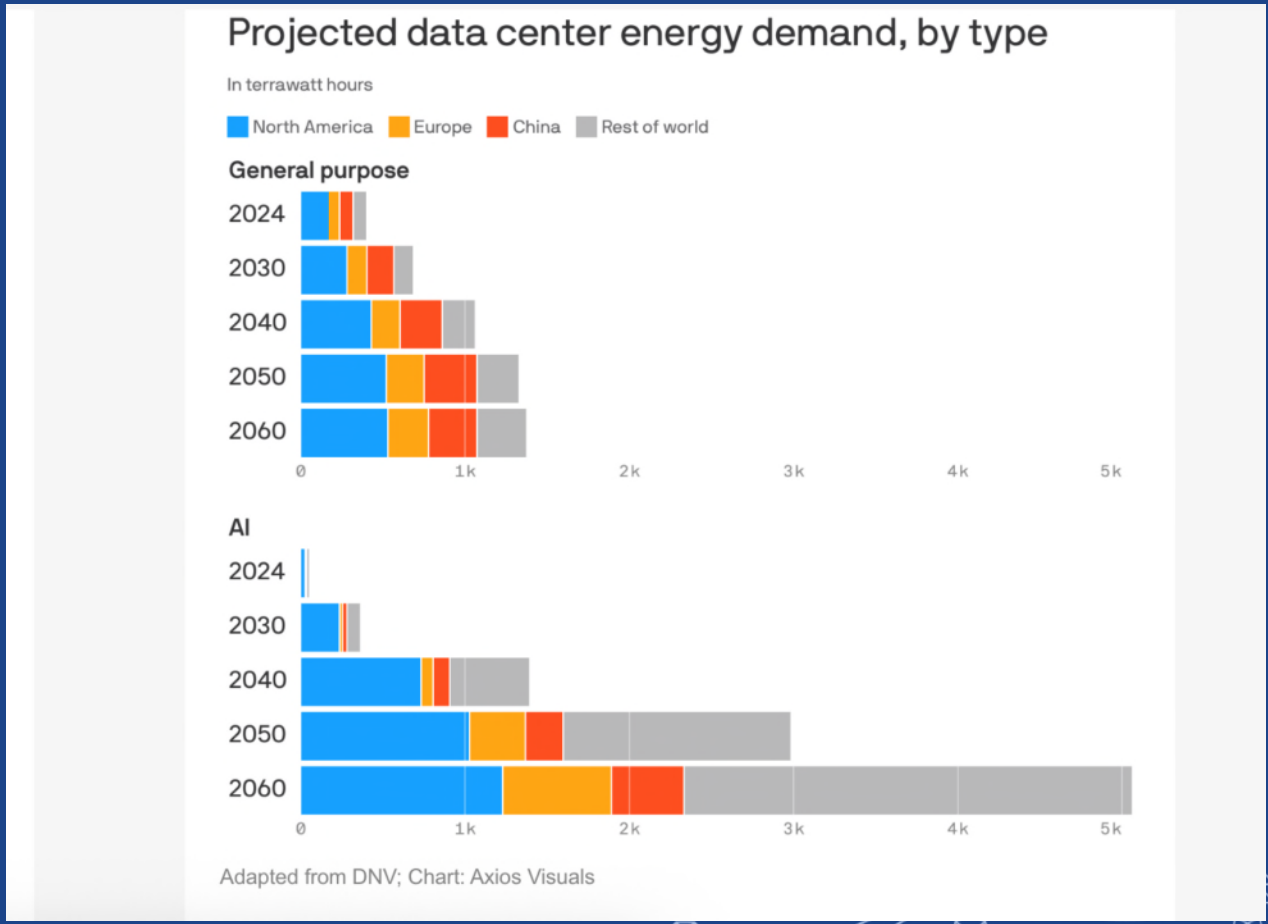
Why learn about ATTs today?

Today's grid is *inefficient*

because it is *underutilized*.

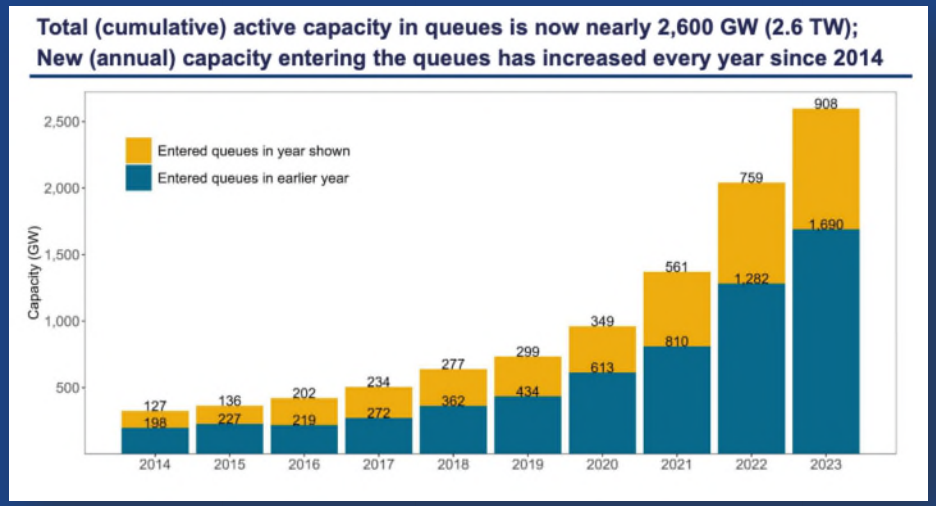
Bubble?

Where?

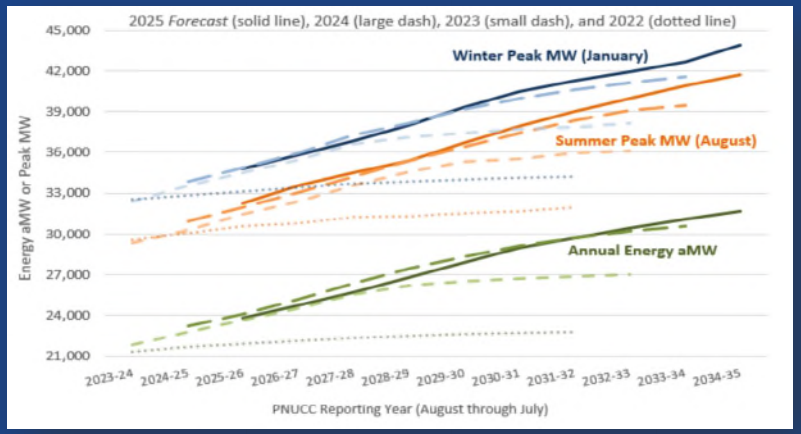


Urgent need for transmission capacity

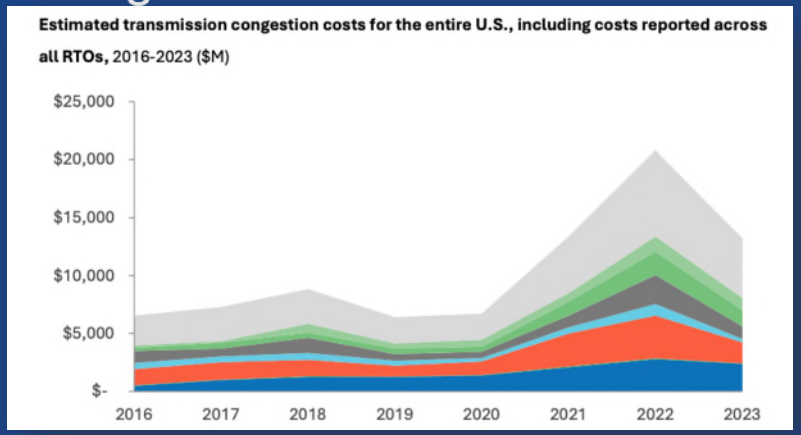
Interconnection



Load growth



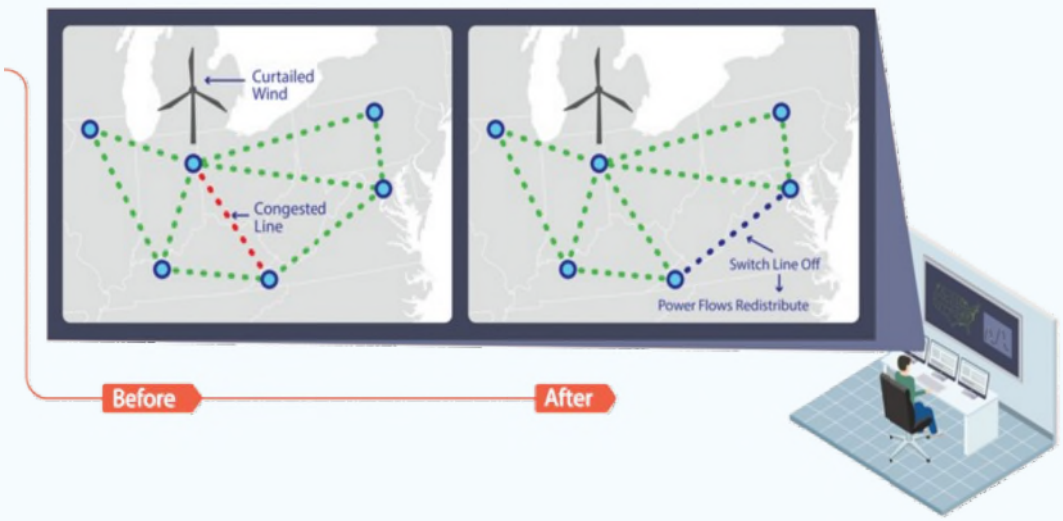
Congestion



Grid Enhancing Technologies (GETs)

Transmission Topology Optimization

Technology that identifies reconfigurations of the transmission grid to most efficiently deliver power



Results from 2019 study in PJM

Topology optimization could reduce congestion costs by 50% in PJM, in ex-post study.

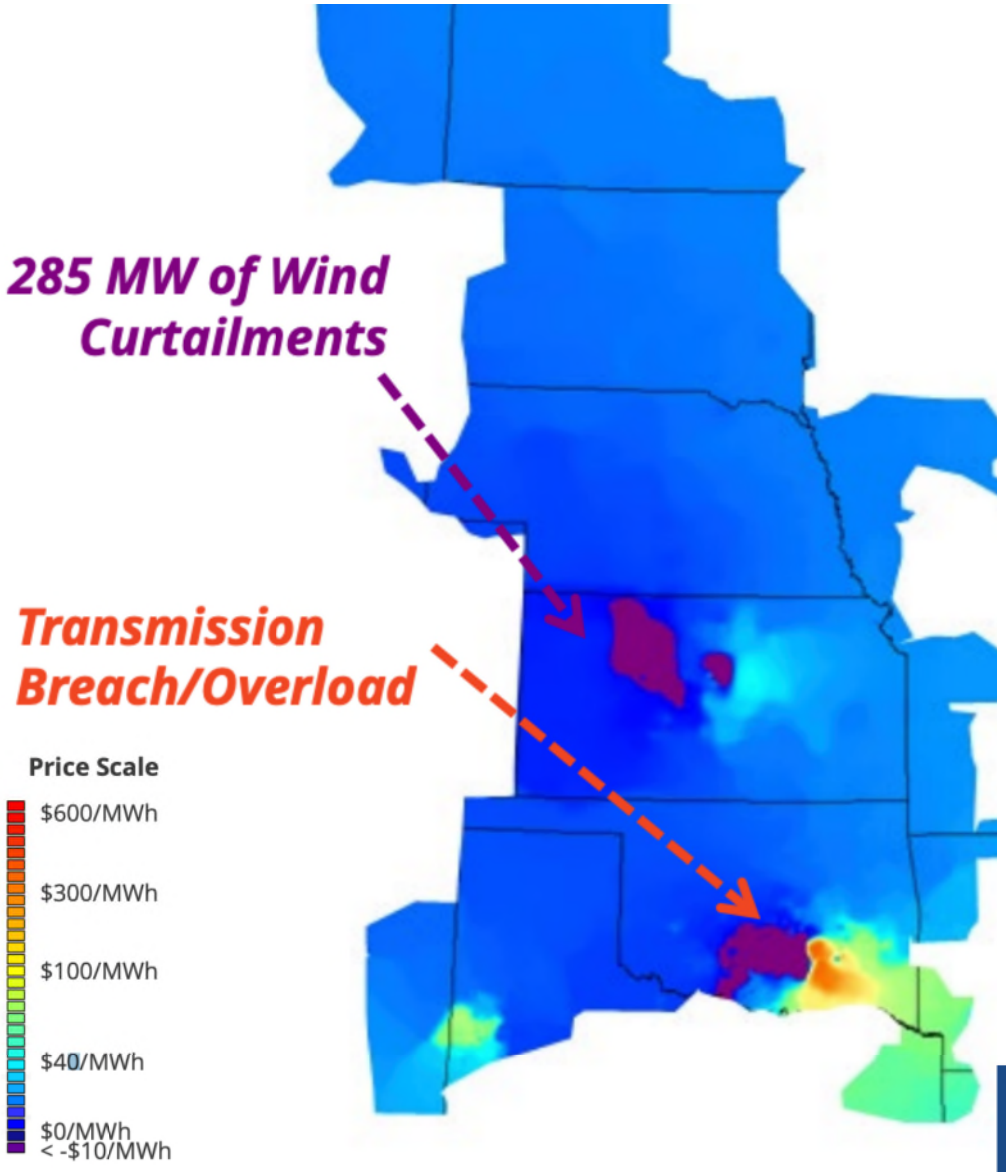
Results from 2021 Alliant deployment in MISO

Alliant customers saved 49% in congestion costs ($24 million) over 2 years.

Case study examples

ISO-NE and SPP
Used for outage planning

ERCOT and MISO
Allowed reconfigurations for congestion mitigation



Reduce grid congestion by 40%

2x capacity for new generation

Advanced Power Flow Control

Hardware and software used to reroute electricity from overloaded transmission lines to underutilized transmission corridors by adjusting circuit impedance

Results from 2024 deployment in New York

APFC unlocked 185 MW of capacity to accommodate new generation

APFC offered advantages over legacy solutions, such as lower cost and smaller footprint

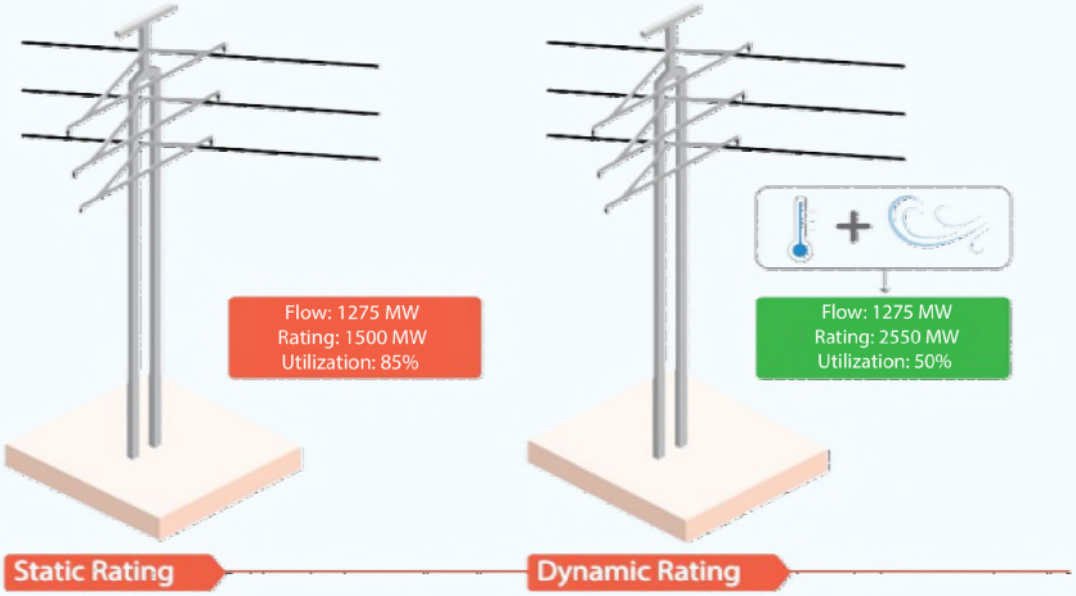
Case study examples

2024 California
Utilities identified reliability applications

2023 Vermont
Increased VT—NY transmission capacity

Dynamic Line Ratings

Hardware or software used to calculate the true capacity of transmission lines using real-time and forecasted weather conditions



Results from 2021 deployments across 3 states

DLR exceeded static reference ratings by 9-33% in winter, and 26-36% in summer

DLR exceeded static ratings over 85% of the time

Case study examples

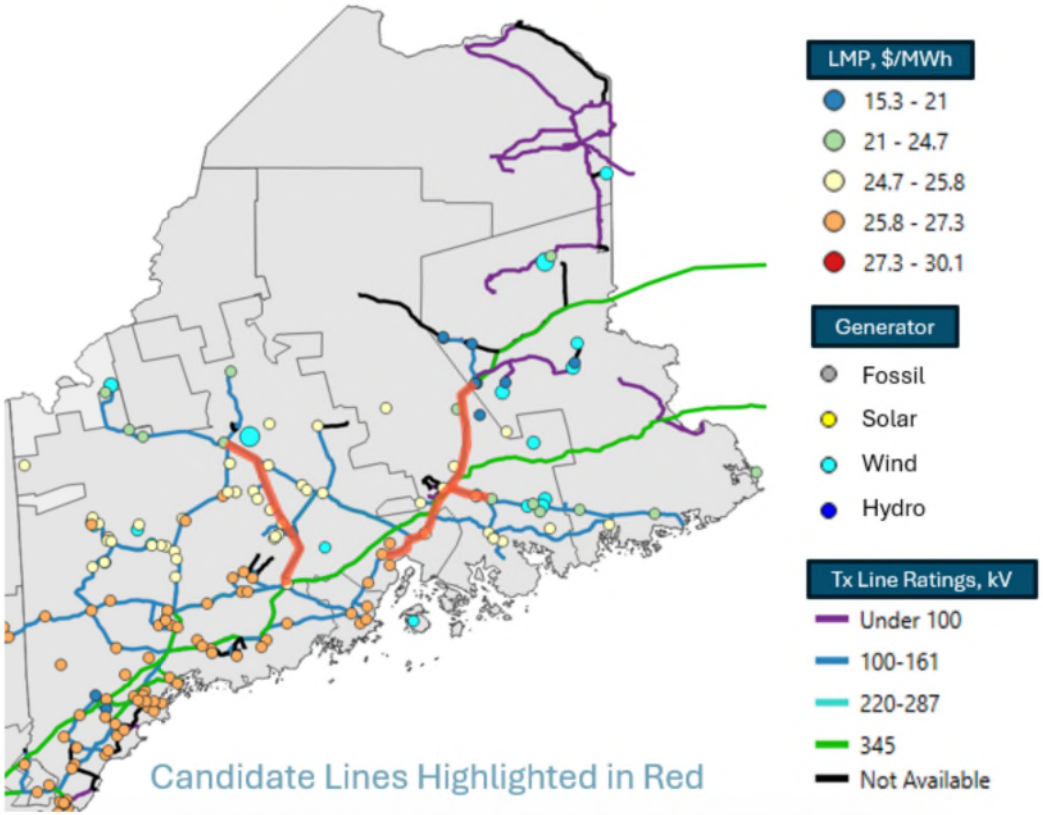
2022 Pennsylvania
Increased line capacity by 25% on average

2012 Belgium
Increased capacity by >20%, 90% of the time.

2025 Maine DLR Analysis

- Authors conducted a simulation of DLR deployment in Maine
  - 155 miles of 115 kV transmission lines
  - NE/NW Maine where the wind industry is growing
- Significant congestion is occurring in SW Maine, leading to curtailment of low-LMP wind
- Option 1: Conventional rebuild
  - $930 million
  - Increased transfer capacity
  - Would eliminate wind curtailment through 2050

Figure 12: *Selected corridors for illustrative analysis*



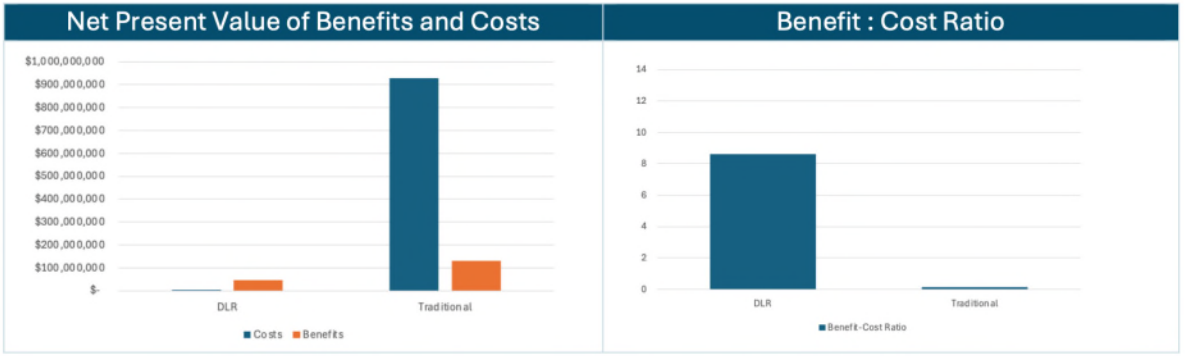
Option 2: DLR

- $1.3 million up-front
- Annual operating costs of $277,000
- 1/3 of transfer capacity benefits of Option 1
- $1.35-2.5 million in avoided curtailments annually through 2050

The Money: Benefit-Cost Analysis

- Option 1: Conventional Rebuild
  - X4 total ratepayer benefits of Option 2
  - .14 benefit-cost ratio
- Option 2: DLR
  - Nearly 9-1 benefit-cost ratio
  - Demonstrates much higher returns for Maine ratepayers

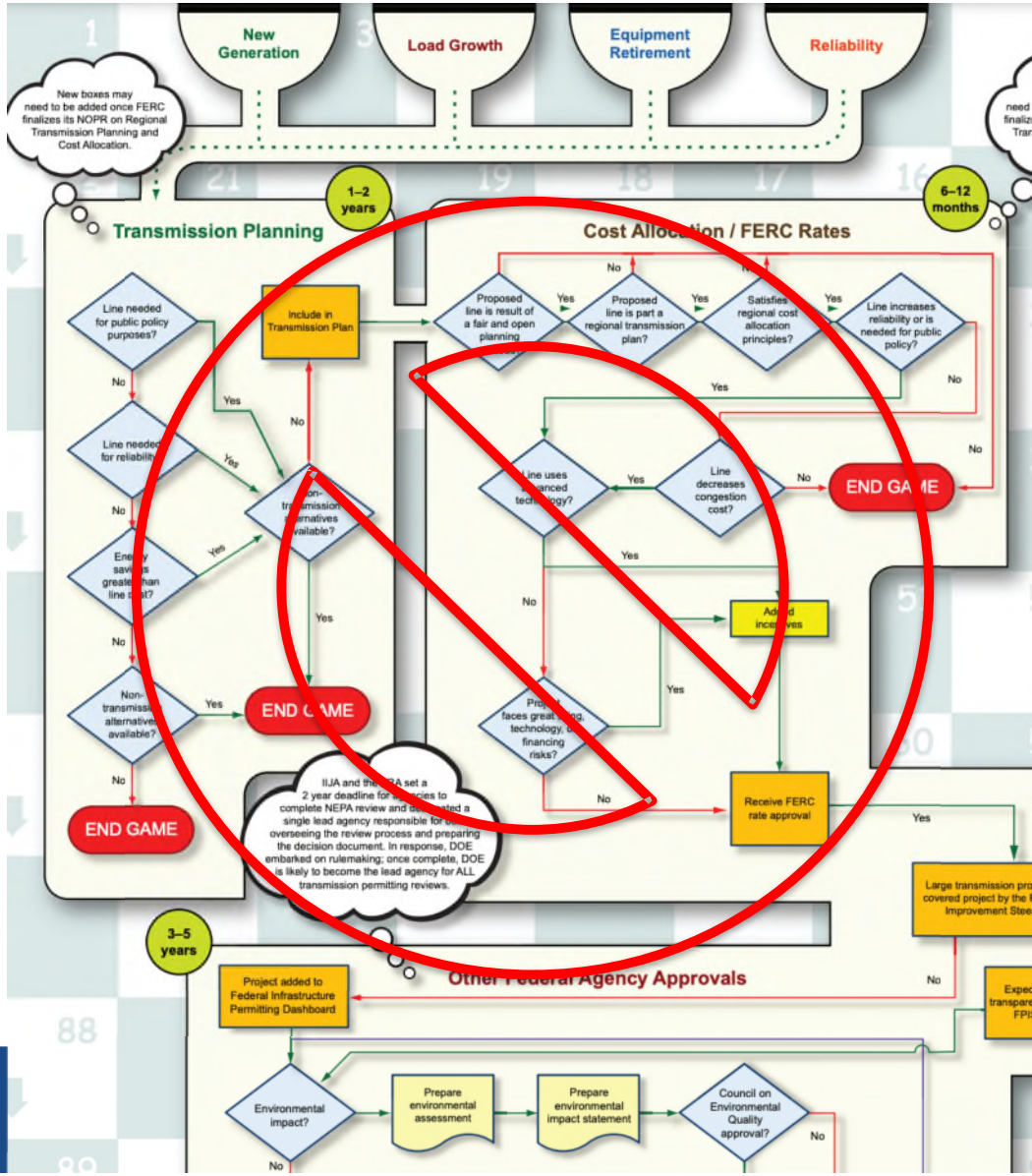
***Figure 15:** NPV of Benefits and Costs*



GETs deploy in *months*

For cheap!

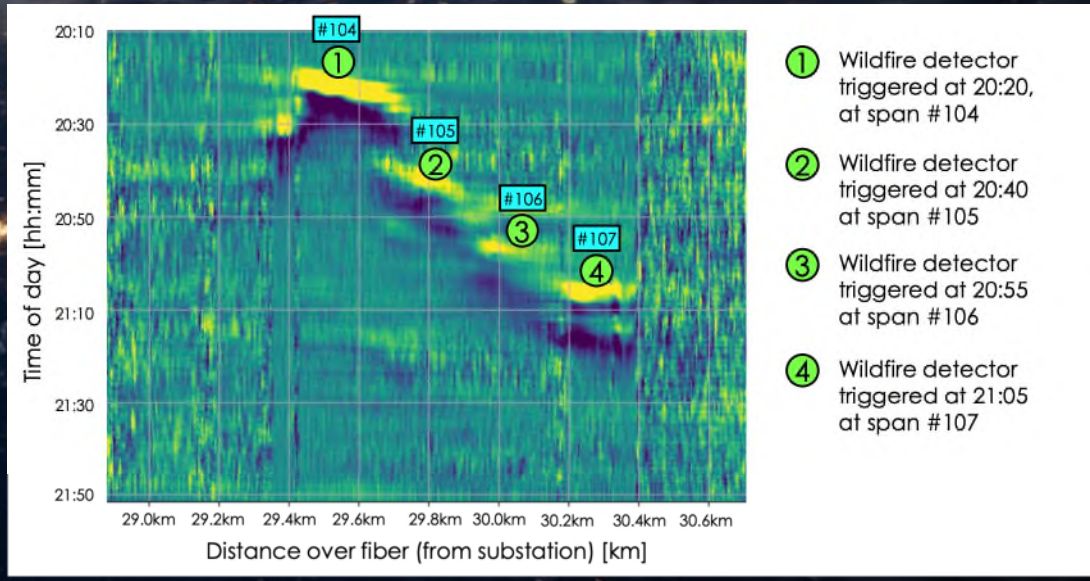
1/20-1/200th the cost



 NEMA 2024, continues for 2 more pages

Benefits of GETs:

Monitoring and control supp0rt resilience and reliability.



ADVANCED POWER FLOW CONTROL

Power flow control technologies actively balance the flow on transmission lines.

DYNAMIC LINE RATING (DLR)

DLR monitors ambient conditions which heat or cool transmission lines to calculate the true capacity of transmission lines, based on their thermal limits.

TOPOLOGY OPTIMIZATION

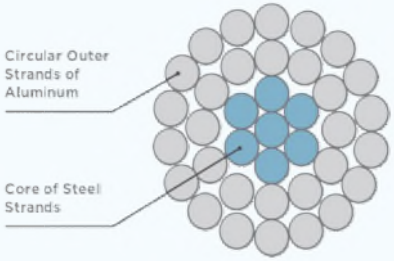
Software identifies options to increase transfer capacity by redirecting flows.

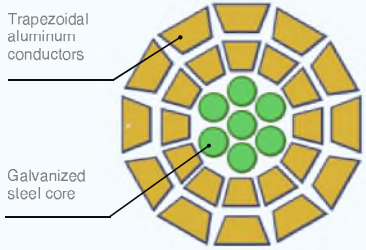
High Performance Conductors (HPCs)

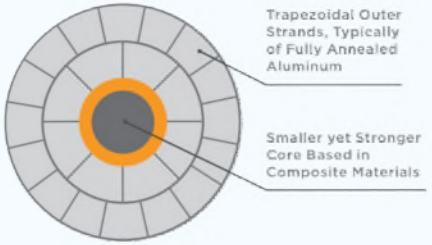
Conductor technology has evolved beyond traditional ACSR/ACSS to “High Performance Conductors” (HPCs)

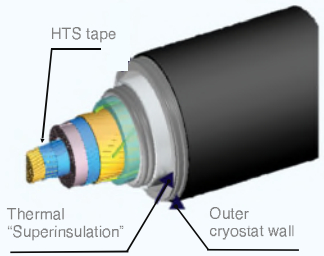
Evolution of conductors

ACSR → **ACSS (RW/TW)** → **HPCs (Carbon/composite core and superconductors)**









Additional Capacity *(Compared to ACSR)*		**150-200%**	**150-300%**	**500-1,000%**
Efficiency *(Compared to ACSR)*		**2-20%**	**20-40%**	**50-80%**
Line sag	**Thermal sag**	**Thermal sag**	**10% thermal sag**	**No thermal sag**

High Performance Conductor Benefits

Increased Capacity

- 2x for composite core conductors
- 5x for superconductors

Greater Efficiency

- Composite core conductors can reduce energy losses by 20% +
- Superconductors can reduce losses by 50-80%.

Additional Resilience

- Composite core conductors are stronger and have less thermal sag
- Superconductors are actively cooled and do not vary with ambient temperatures

Reduced Land Impacts

- Reconductoring/rebuilds utilize existing ROWs
- New builds reduce the number of transmission towers and size of ROW

Reconductoring Potential: National Studies

Reconductoring reuses original tower and right-of-way.

- Takes 1-3 years
- Doubles capacity on an existing corridor
- ~ ½ the cost of a new transmission line

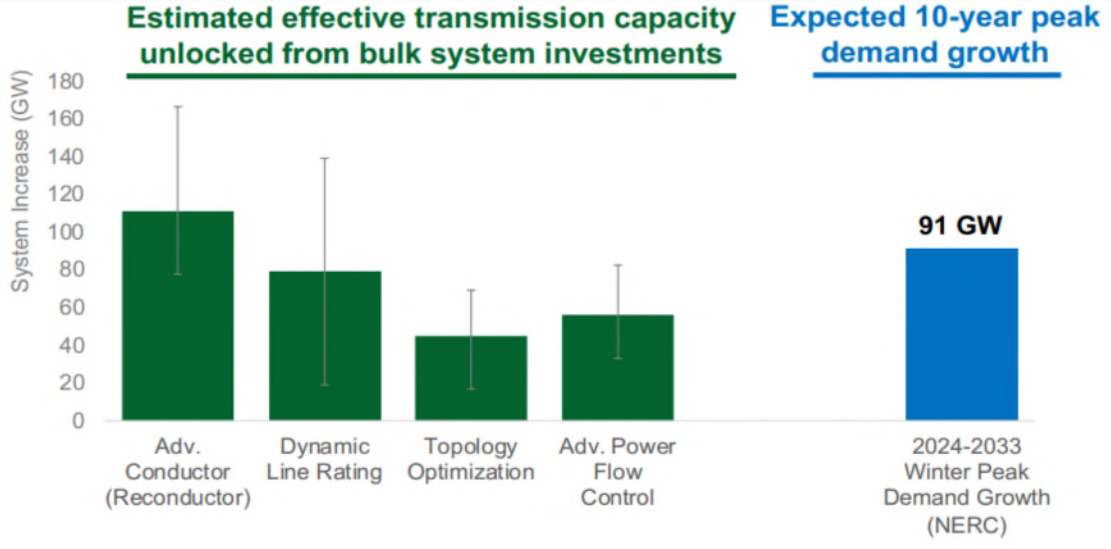
Rebuilds requires replacement of towers to accommodate larger conductors

- Longer process and more expensive
- Up to 10x the capacity

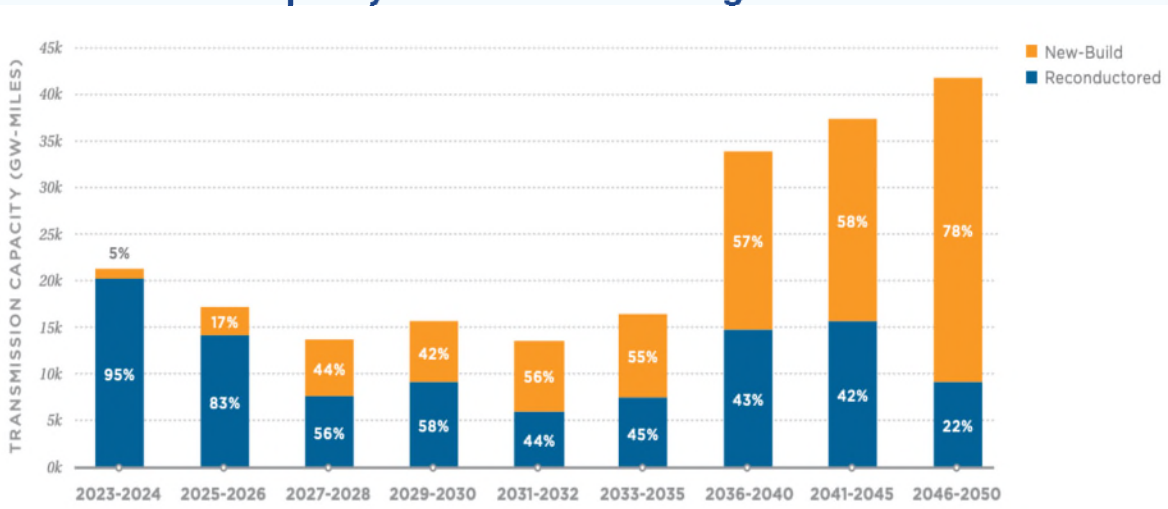
GridStrategies

SOURCE | GridLab, Reconductoring Technical Report (April 2024); DOE, Pathways to Commercial Liftoff: Innovative Grid Deployment, (April 2024).

DOE Grid Modernization Report



Transmission Capacity from reconductoring and new-builds



Barriers to adoption

Barriers to adoption: Education, inertia, incentives, culture

Experience and expertise

New technologies need to get out of utility R&D groups and into many other teams – planning, operations, standards and asset management, etc.

Misaligned incentives

Grid efficiency is not rewarded in cost-of-service business model.

Understanding costs & benefits

HPCs or GETs could add incremental cost to a project, while unlocking transformative benefits.

Thank you!

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We offer research and advising on

Founded in 2017, Grid Strategies works on policy to enable decarbonization and an affordable, reliable electricity system.

AFFORDABLY INCREASE CAPACITY WITH ADVANCED CONDUCTORS

Paige Rodrigues
Senior Manager, Policy & Grid Strategy

CTC GLOBAL

CTC GLOBAL

Leaders in Modern Power Grid Solutions

Company Snapshot

20 years of Experience with 500+ Employees Globally

1,250 Projects Spanning 125,000 mi in over 65 Countries.

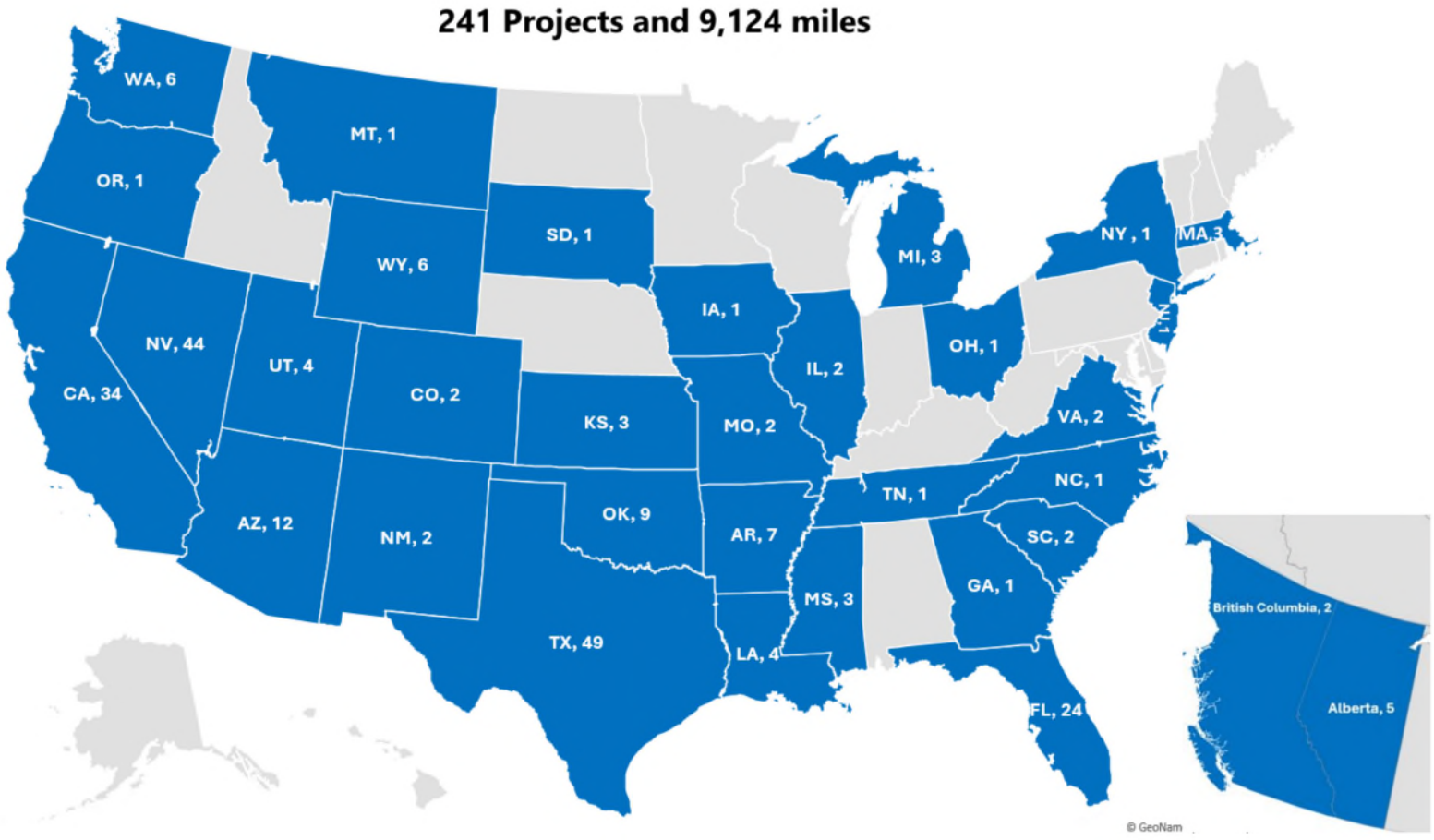
5 ACCC® Core Production Facilities and 35 Licensed ACCC® Manufacturing Partners Worldwide

Proudly Serving 300+ Customers

PLN nationalgrid NVEnergy icepco AMERICAN ELECTRIC POWER SOUTHERN CALIFORNIA EDISON

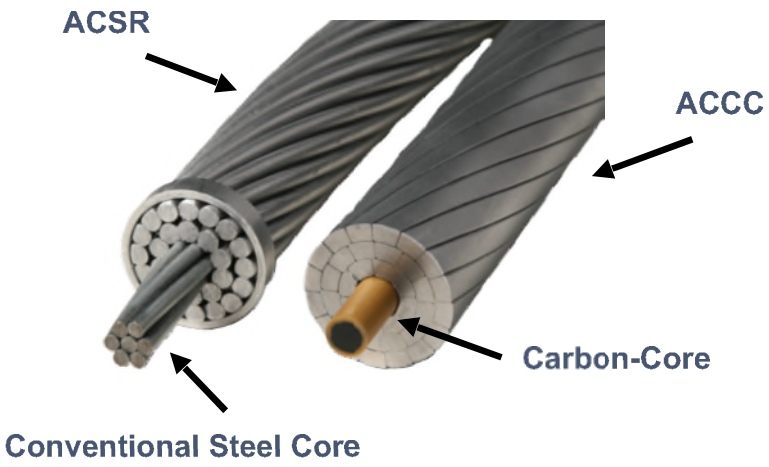
CTC GLOBAL

ACCC® Conductor Installations- North America



CTC GLOBAL

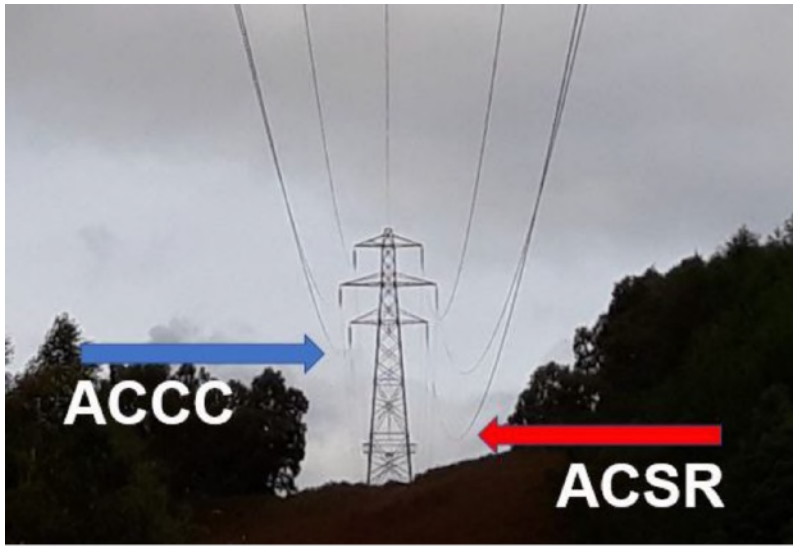
101: What are Advanced Conductors?



Advanced vs. Conventional

Replace steel and hard aluminum with carbon and annealed aluminum. Carbon is lighter and stronger, so more aluminum can be used.

Even after more aluminum is added, **the carbon-core Advanced Conductor weighs about the same** as the conventional ACSR of the same diameter. That means the Advanced Conductor can be installed on the **same tower/structure** that was designed for the conventional ACSR (same diameter & weight).



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Benefits of ACCC Conductors

Higher Capacity

2X the capacity of conventional conductors mitigates bottlenecks and provides a “no-regrets” path to future-proof the grid

Up to 40% Lower Line Losses

Reduces line losses under any load condition, lowers utility and consumer costs, and decreases GHG/CO2 emissions

Reduced Project Costs & Time-frames

Heading new lines or reconductor projects, the ACCC® Conductor quickly delivers the greatest amount of electricity at the lowest capital cost

Enhanced Reliability & Resilience

The ACCC® Conductor’s high strength, low-sag and superior core technology offers long term performance

CTC GLOBAL

Much Faster Capacity I Lower Project Costs

Reconductoring	**2X capacity with ACCC® and up to 40% reduced losses** on existing structures with **minimal retrofitting – 75% less cost than doubling capacity with a new line**	Similar capacity upgrade with traditional conductors like ACSR and ACSS requires more structure replacements or full rebuilds with significantly higher total project costs and much longer timelines
New & Rebuilds	**Substantially lower** structure & construction **costs when using ACCC® - 40 – 50% cost less than rebuilds with traditional conductor like ACSS**	Lower sag allows for longer span (fewer structures) and/ or shorter structures requiring less right of way
Adding capacity	**Faster & lower cost project completion** when replacing ACSR with ACCC®	Avoid rebuilds to quickly increase line capacity

CTC GLOBAL

AEP Saved $43M & Increased Line Capacity

Utility:	American Electric Power
Line configuration:	345kV 120-mile double circuit line
ACCC® install base:	1,440 miles
Project objective:	Increase capacity to accommodate load growth. N-1 line could not take the outage and a rebuild require high capex with 3-4 year timeline

Project details with traditional vs ACCC® Conductor

	ACSR	ACCC®
Rebuild/retrofit required:	Yes	No
De-energizing required:	Yes	No
Conductor type:	ACSR Drake	ACCC® Drake
Project cost:	$418M	$375M
Time to completion:	36 – 48 months	33 months

ACCC® Solution

AMERICAN ELECTRIC POWER

1 **Increased line capacity faster & at lower cost**

Increased the line's capacity by 80% (1751 amps to 3099 amps) while saving $43M and ~9 months on the project

2 **Upgrade completed with uninterrupted service**

Temporary single-phase line designed to the replace 240 mi while energized – largest of the type in the world

3 **Reduced line losses**

Reduced line loss by 30% enabling energy conservation by freeing up 34 MW of generation capacity

> *"These benefits, and the savings realized by completing the project while the line remained energized, have saved consumers tens of millions of dollars.*
>
> James Berger, (former) Director of Transmission

CTC GLOBAL

SCE Saved $87M & Increased Line Capacity

Utility:	Southern California Edison
Line configuration:	230 kV 137-mile single circuit line
ACCC® conductor installed:	411 conductor miles
Project objective:	SCE needed to rebuild 137 miles of the Big Creek transmission corridor to mitigate sag violations

Project details with traditional vs ACCC® conductor

	ACSR	ACCC®
Rebuild/retrofit required:	Yes	No
Conductor type:	ACSR Dove	ACCC® Dove
Project cost:	$135M	$48M
Time to completion:	48 months	18 months

ACCC® Solution

1 Increased line capacity

Increased the line's rating from 936 amps to 1520 amps, adding **60%+ more capacity**

2 Sag violation mitigation

Realized **40% improvement in line sag**, mitigating all violations and increasing overall line safety

3 Reduced line losses

Reduced line loss by 30% enabling conservation of generation capacity and saving $85M in customer costs

> *Reconductoring with ACCC® vs rebuilding saved years of time in permitting and construction, provided significant environmental advantages, and saved tens of millions of dollars in project costs.*
>
> SCE

Google + CTC Global Partnership

- Announced first-of-its-kind partnership to address the grid of the equation
- June 2025: Launched an **RFI to states, utilities & transmission developers** to identify high-impact lines for partnership.
- **Selected partners/projects** will receive: cost assistance, workforce training, and technical analysis to accelerate deployment.

CTC GLOBAL

Advanced Conductor Benefits for PA

- **Affordability**: Up 2x transmission capacity at ¼ the cost of new build & reduced transmission congestion costs
- **Speed to Power**: New capacity in a matter of months, not years
- **Grid Reliability**: Peak load in PJM growing 32 GW from 2024 – 2030
- **Unlock Generation**: ~38 GW of generation sitting in PJM interconnection queues

Thank you

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