



Advanced Transmission Technologies (ATTs)

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Est. 2017

- **Trade association for Grid Enhancing Technologies**
 - Dynamic Line Ratings
 - Advanced Power Flow Control
 - Topology Optimization
- **Vendors, generators, investors, utilities**
- **www.watt-transmission.org**

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Est. 2023

- **Trade association for High Performance Conductors**
 - Composite-Core
 - Superconductors
- **Vendors and suppliers**
- **www.ampcoalition.org**

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Why learn about ATTs today?

Today's grid is
inefficient

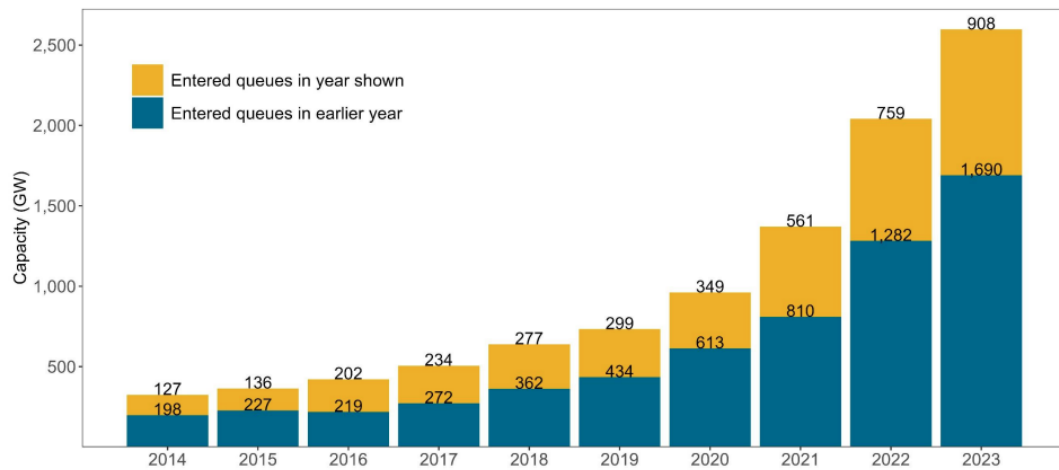
because it has
untapped capacity



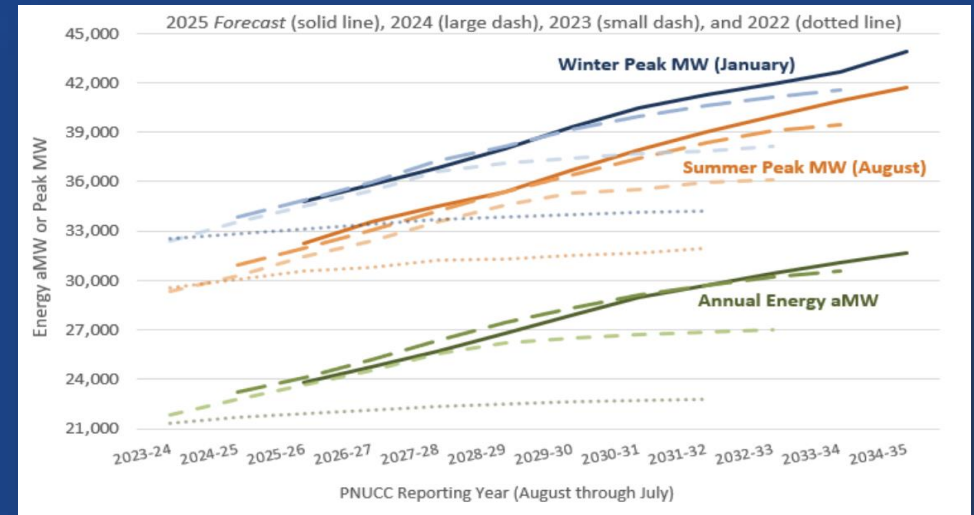
Urgent need for transmission capacity

Interconnection

Total (cumulative) active capacity in queues is now nearly 2,600 GW (2.6 TW); New (annual) capacity entering the queues has increased every year since 2014

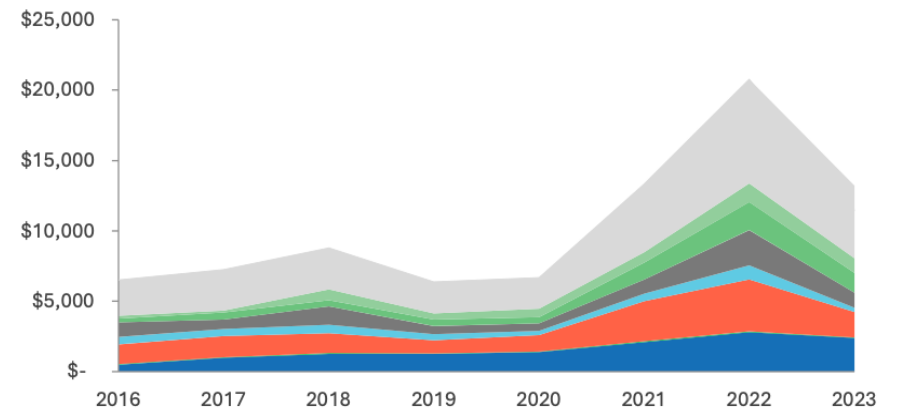


Load growth



PJM Congestion: \$1.8B in 2024 to **\$3.2B in 2025**

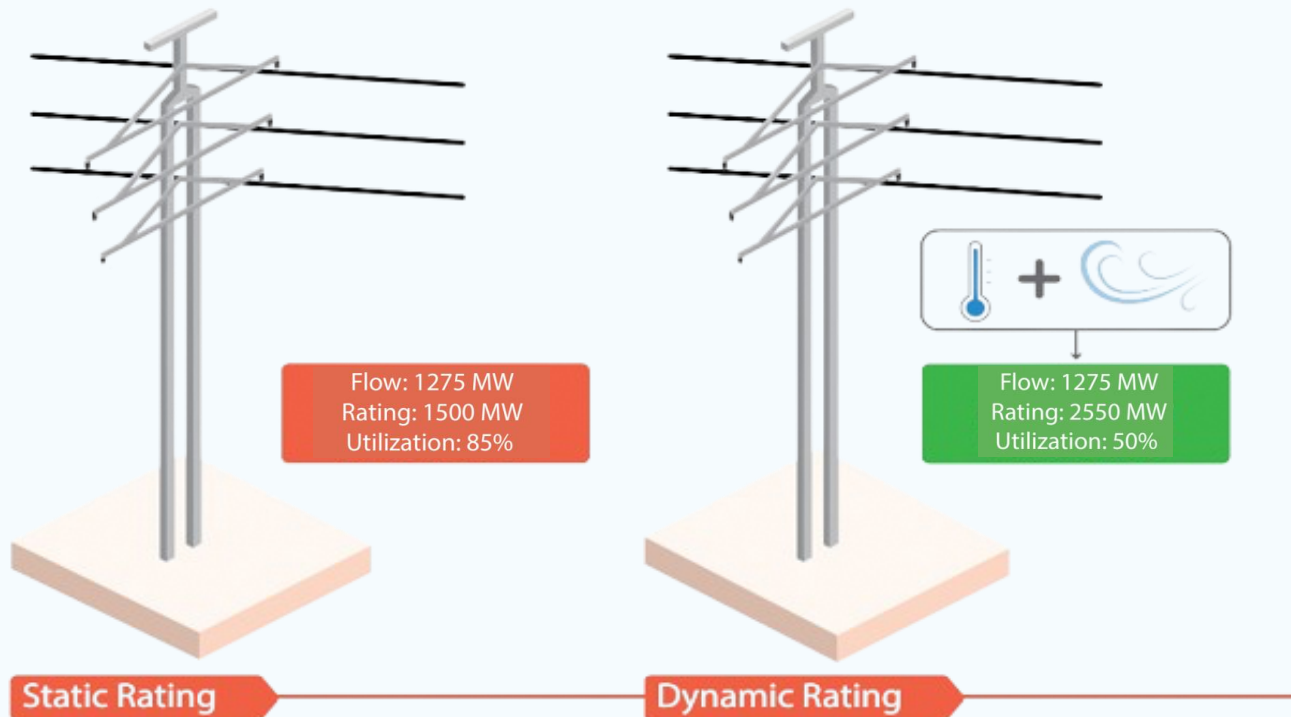
Estimated transmission congestion costs for the entire U.S., including costs reported across all RTOs, 2016-2023 (\$M)



Grid Enhancing Technologies (GETs)

Dynamic Line Ratings

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



Case study examples



2022 Pennsylvania

Increased line capacity by 25% on average



2012 Belgium

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

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

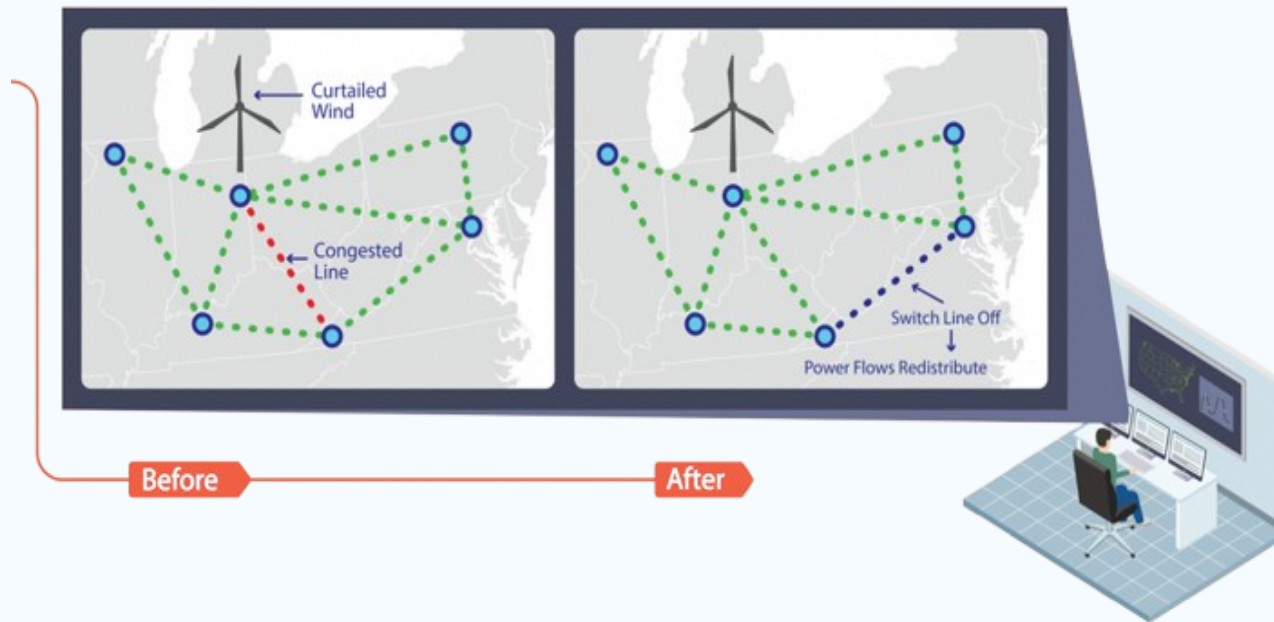


2023 Vermont

Increased VT—NY transmission capacity

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

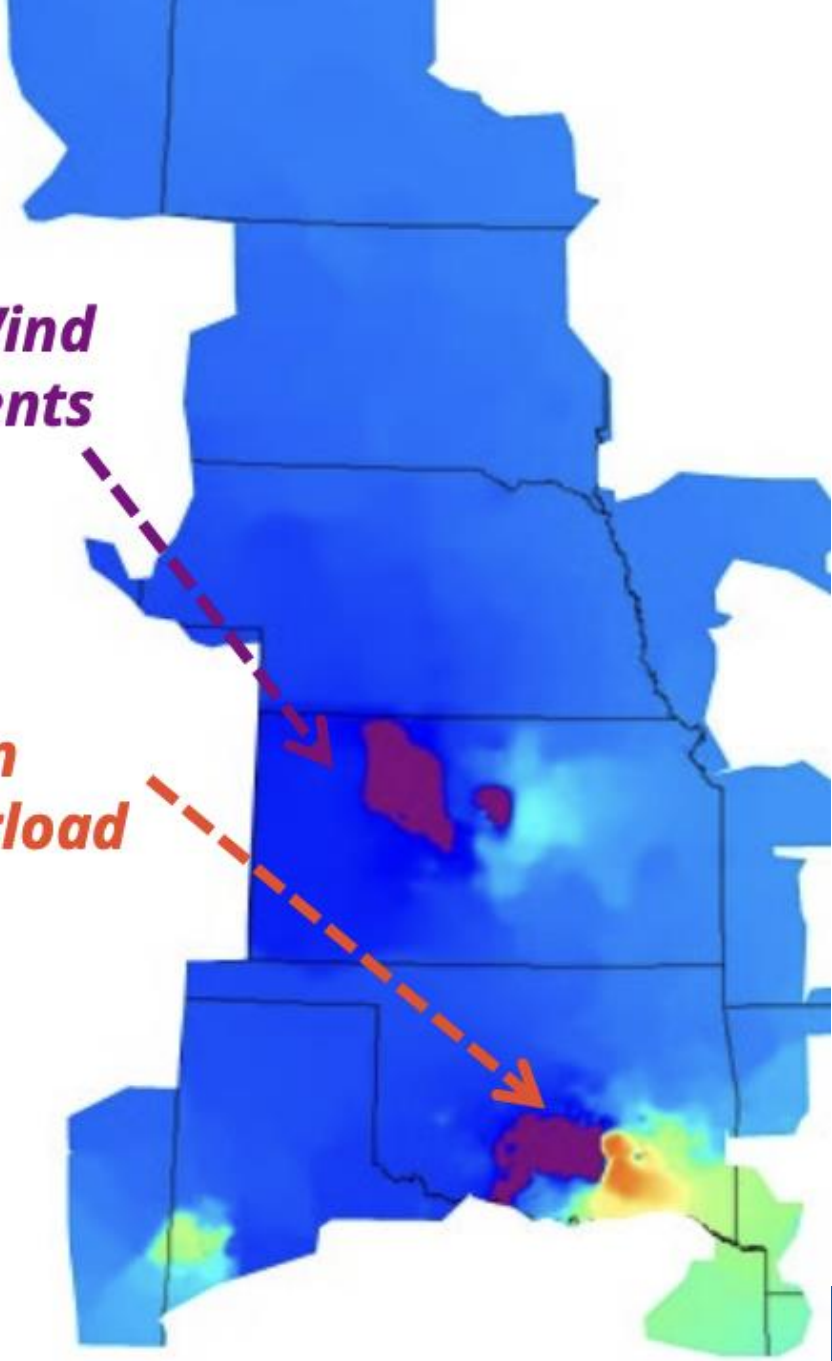


ERCOT and MISO

Allow reconfigurations for congestion mitigation

**285 MW of Wind
Curtailments**

**Transmission
Breach/Overload**



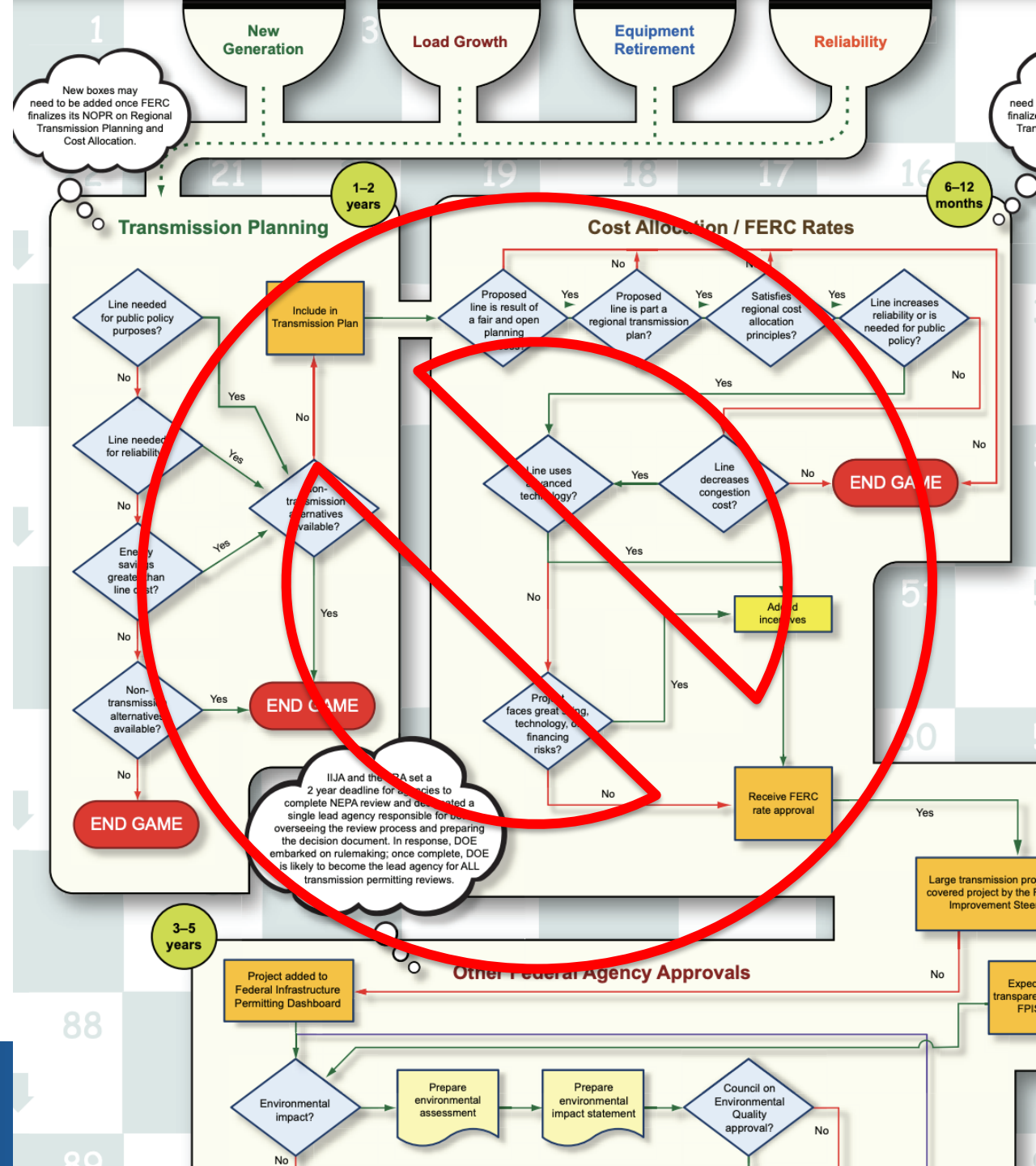
**Reduce grid
congestion by 40%+
2x interconnection**



GETs deploy in months

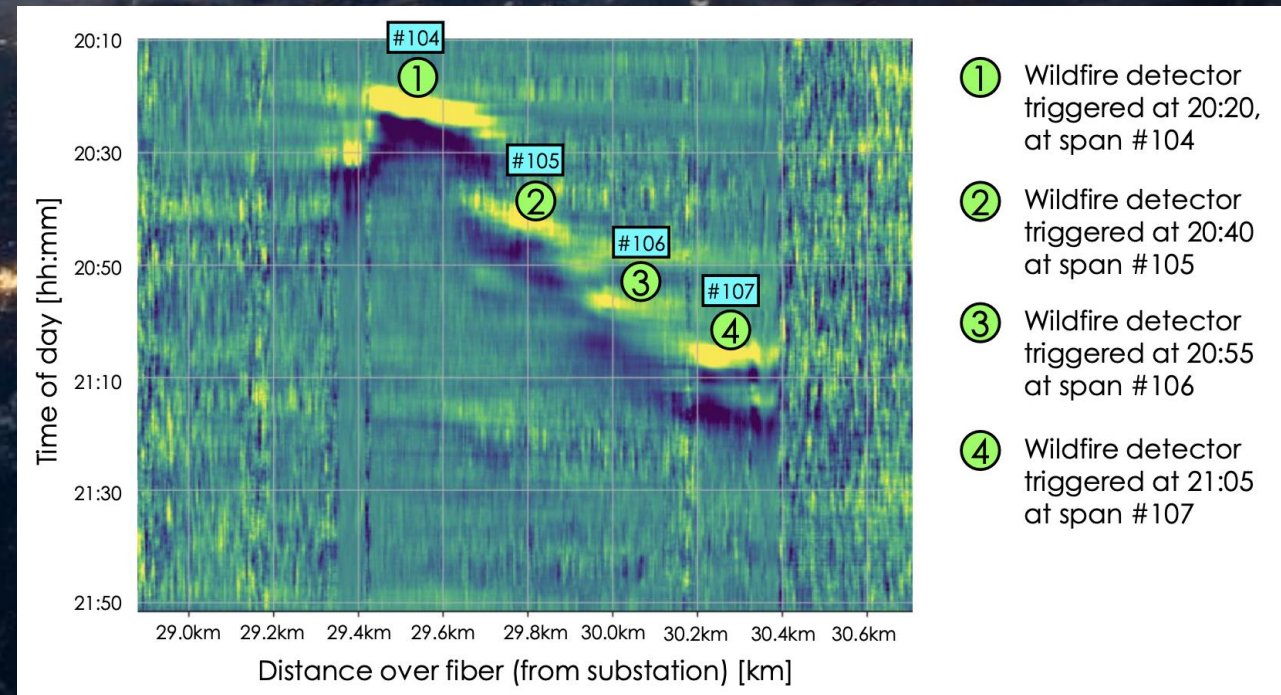
For cheap!

1/20-1/200th the cost



Benefits of GETs:

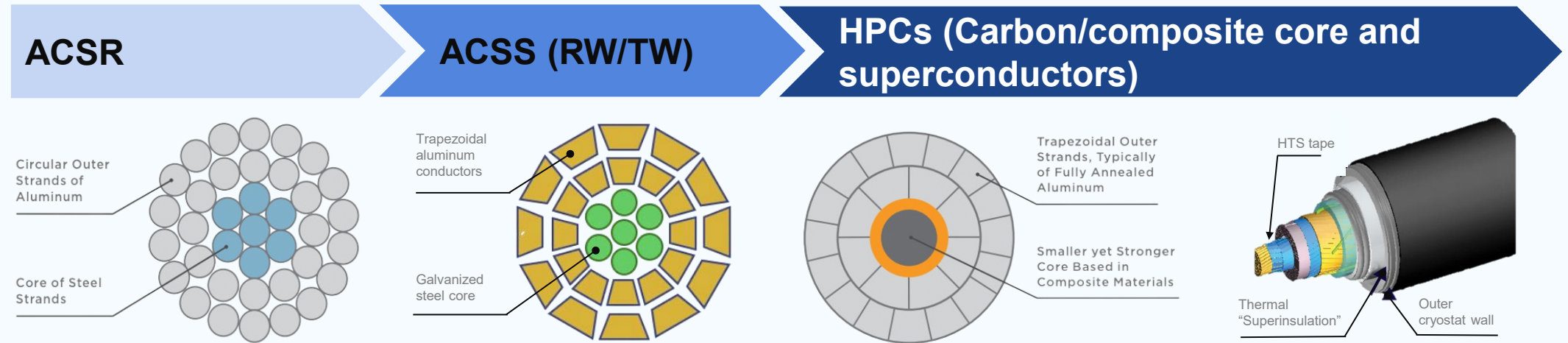
Monitoring and control support resilience and reliability.



High Performance Conductors (HPCs)

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

Evolution of conductors



Additional capacity

(Compared to ACSR)

0.75-2x

1.5-3x

5-10x

Efficiency gain

(Compared to ACSR)

2-20%

20-40%

50-80%

Line sag

(Compared to ACSR)

Thermal sag

Thermal sag

10% thermal sag

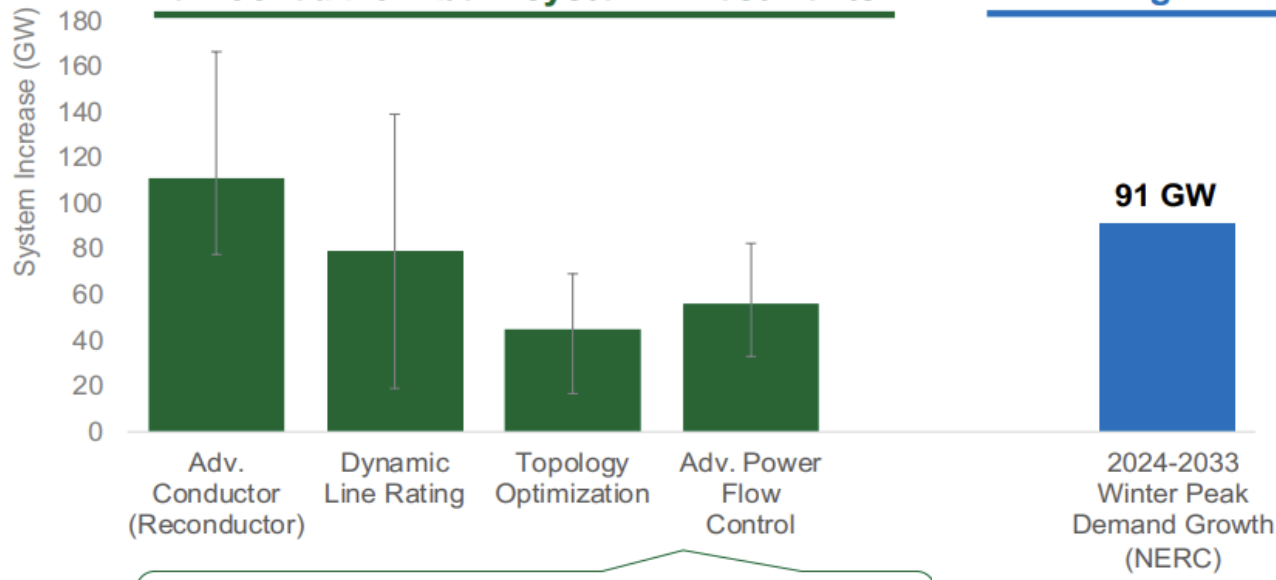
No thermal sag

High Performance Conductor Case Studies

DOE Grid Modernization Report

Estimated effective transmission capacity unlocked from bulk system investments

Expected 10-year peak demand growth



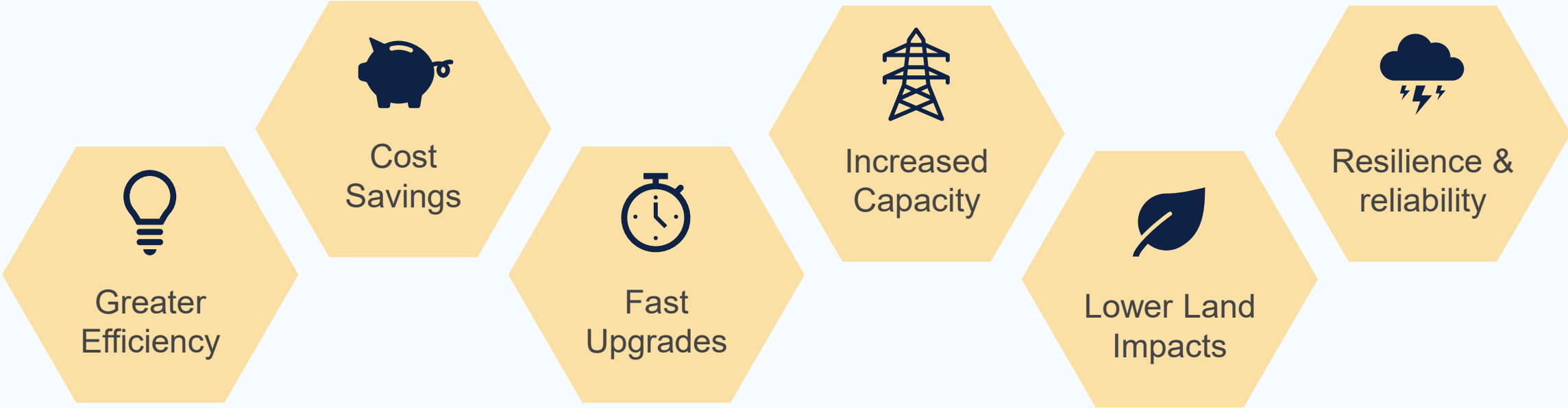
AEP Reconductoring in Lower Rio Grand Valley (2011)

- 240-miles on 345 kV circuit
- Doubled capacity
- 30% reduction in line losses
- Saved customers ~\$15 million annually

Montana-Dakota Utilities Reconductoring (2021)

- 11 miles on 230 kV circuit
- 80% capacity increase
- 20% reduction in line losses
- \$1.8 million in avoided upgrade costs and construction time and \$21 million in lifetime line loss savings

Benefits of Grid Enhancing Technologies (GETs) and High Performance Conductors (HPCs)

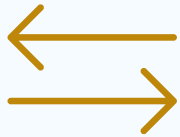


Barriers to adoption

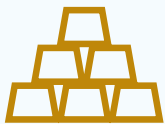
Barriers to adoption of GETs and HPCs sustain inertia



Utility lack of experience and prioritization/workload



Misaligned incentives



Understanding benefits & costs

Limited deployments in Maryland


DLR

Exelon has deployed DLR on two lines in Maryland to validate the use of Ampacimon's system for further expansion.

Reconductoring with HPCs






Exelon used HPCs to reconnector a 54-year-old 500 kV line connecting PECO and BG&E.

Federal policies: Advanced Transmission Technologies

Organization	Federal action	ATTs impact	Date
 FERC	Order No. 679	Transmission Rate Incentives: Allows a transmission owner to seek incentive rate treatment for ATTs on a case-by-case basis when the project benefits consumers and the requested incentive is justified by the project’s risks or challenges.	Jul 2006
	Order No. 881	Line ratings: Mandates that RTOs accept dynamic line ratings, and utilities use Ambient Adjusted Ratings. RTOs have asked for extensions to July 2025 deadline .	Dec 2021
	Order No. 2023	Generator interconnection: Requires the consideration of APFC and HPCs in generator interconnection processes; TTO and DLR as optional. All RTOs submitted compliance filings in May 2024; FERC has not ruled on any compliance filings yet.	Jul 2023
	Order No. 1920	Transmission planning: Requires APFC, DLR, HPCs and transmission switching to be studied in regional plans and deployed if it would make transmission assets more cost effective; also includes a “right-sizing” requirement.	May 2024
	DLR ANOPR	DLR Ruling: Proposes requirements that transmission owners must deploy dynamic line ratings on highly constrained lines.	Jun 2024

Adjusting Utility Incentives

Comparing regulatory models and their results

	Country and model				
					
Dimension	Cost-of-Service	RIT-T & NCIPAP	RIIO	Least cost planning	EU injection charges
Core model	Capex-based	Cost-benefit + incentive	Totex + performance	Least-cost requirement	Throughput-based
Incentive calculation	Project-based	Portfolio/system-wide	Scenario-based	Project-based	Nonprofit TSO + generators pay for system utilization
Bias towards GETs	Low <i>Disincentivized</i>	Moderate <i>High oversight with limited incentive</i>	Very High <i>Shared savings based on total avoided costs</i>	Low <i>Still capital driven but with high oversight</i>	High <i>Profit correlated with throughput</i>
Consumer benefit from GETs	Low <i>Utilities lack incentive to deploy</i>	High <i>Utilities maximize investment value</i>	High <i>Utilities deploy based on generation and infrastructure savings</i>	Low-Moderate <i>Utilities lack incentive to deploy</i>	Moderate <i>Customers save based on lower generation costs</i>

All Regulation is Incentive Regulation – Alfred Kahn

Carrots

- Allow utilities to propose performance incentive mechanisms to their PUCs (e.g. MT, MA)
- Affirm PUC's ability to approve projects based on highest net-benefit
- Washington's PUC approved an incentive for utilities seeking federal funding - 50 basis points for the required matching funds
- Option: Encourage PJM to develop a shared savings incentive in transmission tariff (through OPSI)

Sticks

- Require reporting on ATTs deployments (e.g. VA, OH)
- Require studies of ATTs for cost-effectiveness to alleviate congestion, accelerate interconnection, etc (e.g. CA, MN)
- Require consideration of ATTs (FERC Orders 1920, 2023)
- Require capabilities to use ATTs (FERC Order 881)

Orange Sticks

- Affirm cost-recovery for projects that use ATTs (e.g. UT)
- Ask PJM to study ATTs deployment potential across the region, with the utilities required to create implementation plans to deploy cost-effective technologies.

Congressional incentive proposals

More information in appendix

Bill	ATTs impact
Shared Savings (Advancing GETs Act)	FERC to implement Section 219(b)(3) of FPA by creating shared savings incentive, thereby allowing utilities to retain a share of customer savings from deploying cost-effective ATTs.
SURGE Act	Amends Section 219 of FPA: Adds “improving efficiency” and directs FERC to establish shared savings where utilities may recover 10–60% of line loss reductions from ATTs
REWIRE Act	Directs DOE to develop clearinghouse, tech. assistance, and planning/resource adequacy/etc. models inclusive of ATTs. Directs FERC to improve ROE treatment for HPCs.

Stay tuned: near-term efficiency planning requirement



Goal: Create formal framework for near-term grid optimization, with focus on ATTs.



Mechanism: Require FERC to initiate a rulemaking on near-term grid capacity expansion and economic efficiency of grid operations and assets by EOY 2026 (compliance due EOY 2027)

Considerations:

- Focuses on operational planning gap (between day-ahead and 5+ year planning) that is not in O.1920
- Utilities are constantly working on managing outages, scheduling generators, but there isn't a mandate for efficiency in these processes.
- Includes deployment triggers, outage mitigation, efficiency audits, and benefit-cost thresholds

Federal legislation in development.

States can apply for \$1.9 billion in federal funding for ATT deployment through the SPARK program

There are three funding topic areas...

1. Topic Area 1: Grid Resilience
2. Topic Area 2: Smart Grid (states can apply)
3. Topic Area 3: Grid Innovation Program (2 or more states can apply)



...for which DOE is prioritizing projects that...

1. Reconductor with advanced conductors;
2. Use ATTs that can increase the usable capacity of existing assets in real time; and
3. Involve large-scale, cross-regional transmission upgrades and coordinated planning.

Timelines are fast! Concept papers are due April 2, 2026, and full applications are due May 20, 2026

But concept papers are nonbinding – just an opportunity for feedback from DOE before a full application.

Learn more About SPARK Funding

WATT/AMP Webinar (free)

Thursday, March 26, 11AM - 12 PM ET (and recorded)

Why attend:

Hear from ATTs vendors about how they can support your applications, and what deployments best fit the SPARK framework.

Registration

link: https://us06web.zoom.us/webinar/register/WN_8N6bghHhRTWvENHjcCo9jg



ACORE webinar (\$100 to attend)

Tuesday, March 31, 2026, 2 - 3 PM ET

Why attend:

The former manager of the GRIP programs (precursor to SPARK) will discuss strategies for "Positioning Your Application for Success."

Registration link: <https://acore.swoogo.com/sparkgrants>



GETs can decrease congestion costs by up to 50%, at relatively low cost.

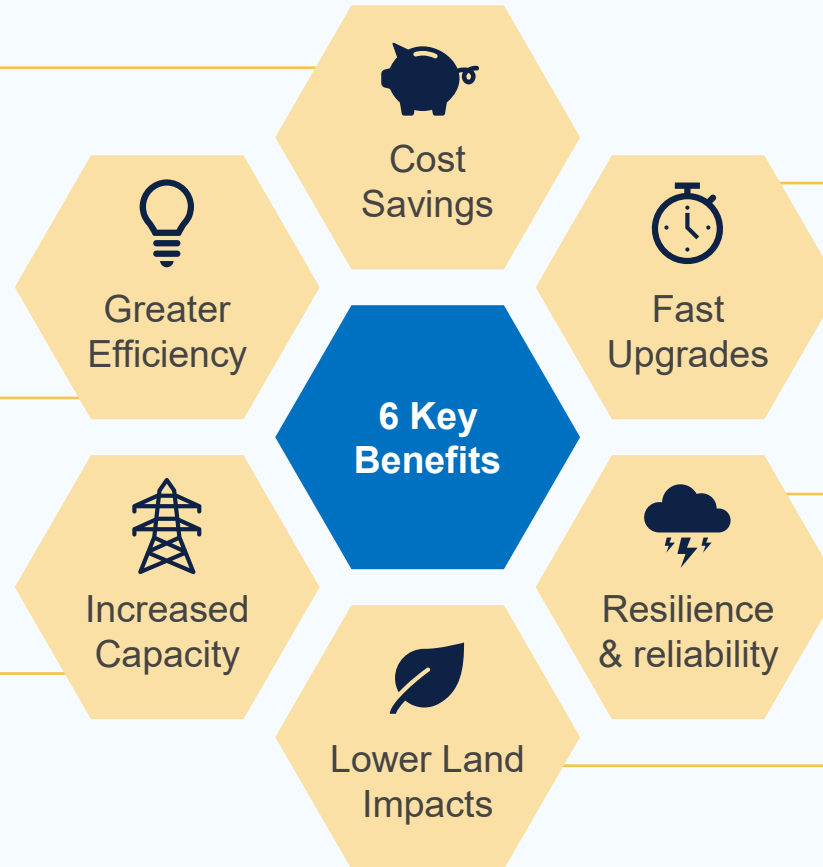
HPCs can double transmission capacity at approximately half the cost of building a new line.

GETs can increase the utilization of high-voltage 345kV lines by 15-22%.

HPCs reduce energy losses by at least 20% for Composite / Carbon Core Conductors, and up to 80% for superconductors

GETs can increase the power transfer capacity of existing transmission lines by 20%+ on average.

HPCs such as Composite / Carbon Core Conductors double transmission capacity, while superconductors can quintuple capacity.



GETs can double the capacity of new generation integrated into the existing transmission grid in months.

HPCs can use existing rights-of-ways, reducing permitting and construction times.

GETs can give operators new tools to manage reliability by unlocking the grid's dynamic capabilities.

HPCs can decrease wildfire risk by reducing line sagging compared to traditional conductors.

GETs can defer the need for construction of new transmission infrastructure.

HPCs can expand transmission capacity using existing rights-of-way.



Thank you!

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We offer research and advising on



Clean Energy
Integration



Business & Policy
Solutions



Regulatory
Engagement

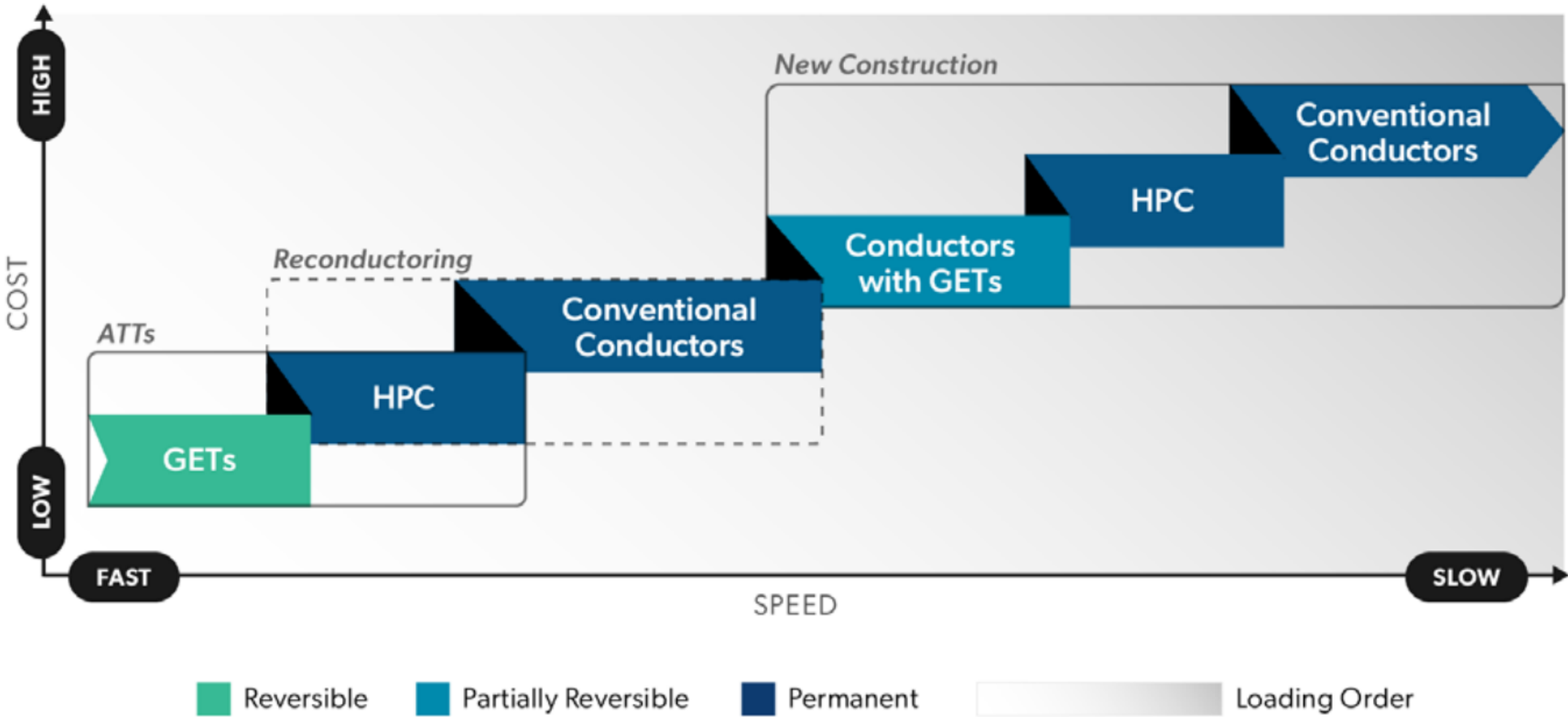
Founded in 2017, Grid Strategies works on policy to enable decarbonization and an affordable, reliable electricity system.

Appendix!

Checklist to confirm with transmission owners

- Train field personnel on installation and maintenance of ATTs
- Build internal modeling expertise for HPCs, DLR, APFC, and TTO
- Train operators on new data streams and operational procedures
- Update EMS systems to accept DLR
- Incorporate GETs in outage mitigation workflow
- Pre-study topology reconfigurations to enable faster restoration after events.

Transmission Loading Order



Appendix: Case studies



Proposed GETs Solutions for Interconnection

For wind generation facilities in the Eastern Interconnection



Dynamic Line Ratings Could Avoid 100 Miles of Line Rebuild

Problem: Thermal line overloads in summer high-wind case.

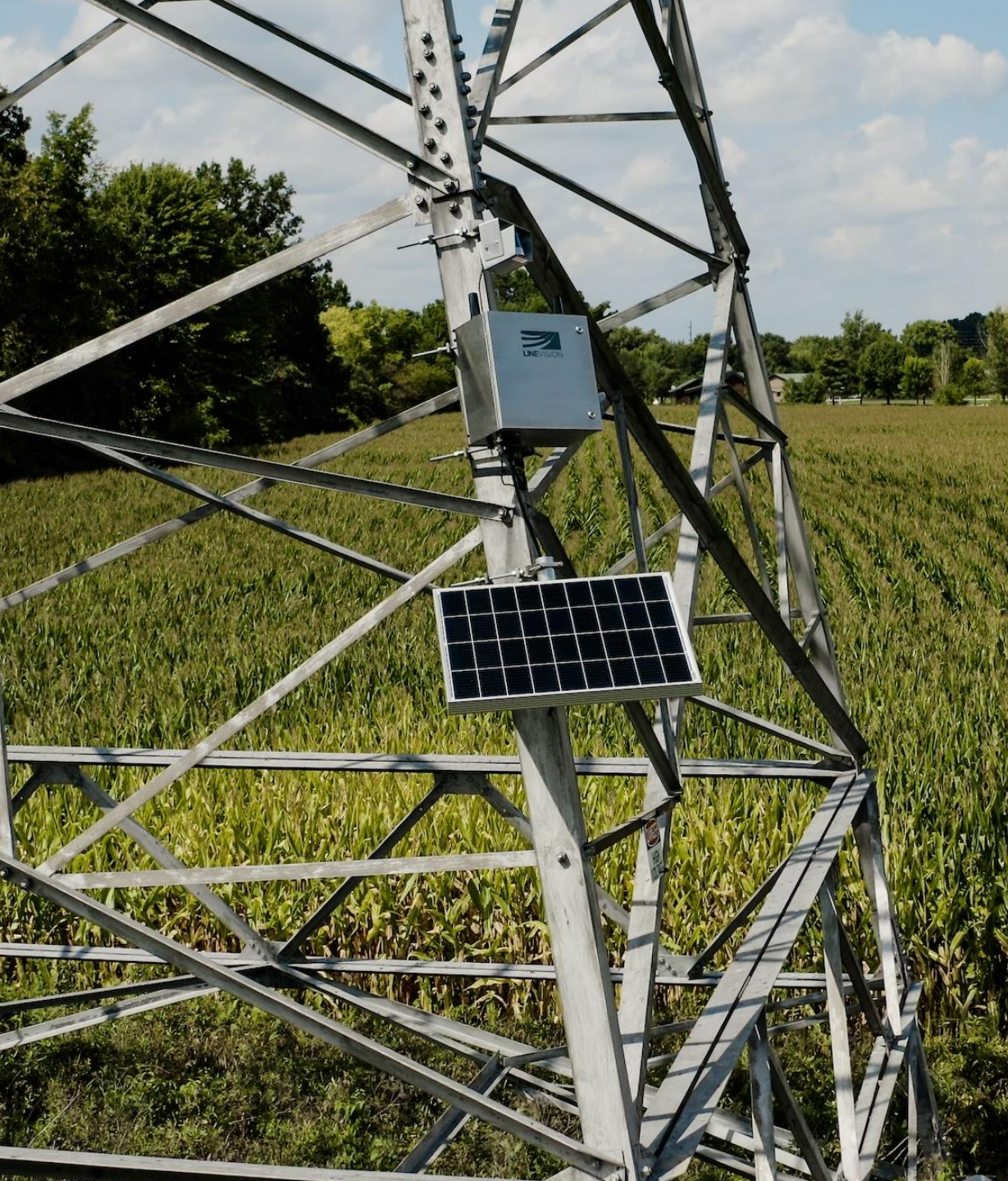
TO solution: rebuilding more than 100 miles of 115kV lines. Interconnection study assumed wind at 2 meters per second to calculate the line ratings.

Developer solution: DLR could likely increase the line capacity by up to 30% in the conditions that triggered the overload.

TO response: Would not consider DLR.

Photo from Heimdall Power





Dynamic Line Ratings Could Avoid \$50 Million Line Rebuild

Problem: 3% modeled thermal overload in high-wind scenarios in summer and winter.

TO solution: \$50 million line rebuild

Developer solution: DLR

TO response: Would not consider DLR.





A 1% Line Overload Could Cost \$400 Million

Problem: 1% thermal overload in high-wind scenarios

TO solution: \$400 million upgrade between RTO seams.

Developer solution: DLR

TO response: Would not consider DLR.





APFC could save \$150M in congestion costs

Problem: High congestion costs driven by flow imbalance across lower-rated lines.

TO Solution: Reconductoring to increase thermal capacity.

Developer Solution: Deploy APFC to redistribute power flow and relieve constraints.

TO response: APFC perceived as complex to model and integrate into planning studies.



Appendix: State Policy

Appendix: Regional Policy

All regions are seeing progress, but piecemeal

ISO/RTO	ISO-NE	Uses TTO software to support their transmission outage coordination process; Is adding a position to evaluate ATTs for asset condition projects
	MISO	Allows grid users to propose TTO reconfigurations
	PJM	Accepts DLR into both real-time and day-ahead market operations
	SPP	Will allow grid users to propose TTO reconfigurations
	ERCOT	Will allow grid users to propose TTO reconfigurations
	CAISO	Calls out ATTs in transmission plan, with utilities each doing studies per 2024 legislation
Non - ISO/RTO	Southeast	Southern Company has APFC, DLR and HPC projects announced; originates GETs projects from planning, real-time operations, and maintenance teams
	Southwest	Limited HPC adoption
	Northwest	PSE, BPA, PGE beginning DLR deployments; PacifiCorp and NV Energy deploying HPCs

FERC: DLR Advance Notice of Proposed Rulemaking

The [DLR Advance Notice of Proposed Rulemaking](#) (ANOPR) explores requiring transmission providers to evaluate and adopt DLR on highly constrained lines. The process stalled after collecting comments in Fall 2024, but the next step would be a Notice of Proposed Rulemaking and then a final rule.



Appendix: Reports

The Brattle Group 2021: Unlocking the Queue

The Benefits of GETs in Kansas and Oklahoma



2x the renewable energy capacity



Paid for in **6 MONTHS**



3 MILLION TONS carbon emissions avoided annually



\$175 MILLION annual production cost savings



11,300 direct short-term jobs
650 direct long-term jobs

Potential Nationwide Benefits



20 MILLION carbon emissions cuts equal to 20 million cars off the road



OVER \$5 BILLION production cost savings



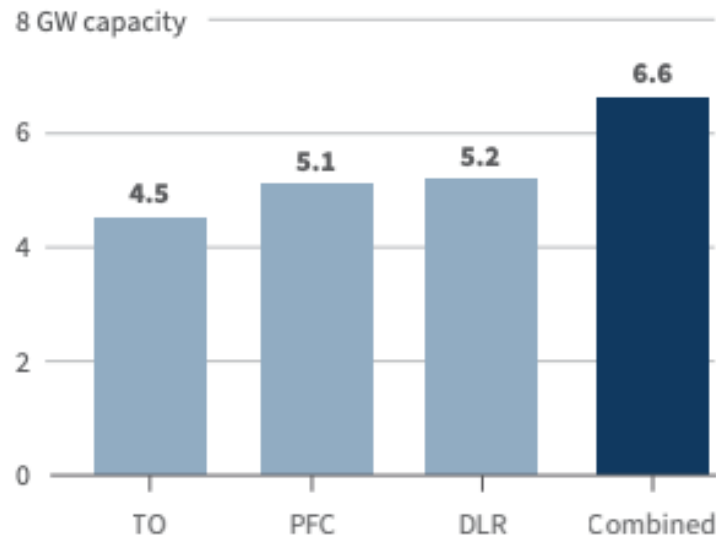
TENS OF THOUSANDS of local construction jobs, and thousands of long-term, high-paying jobs



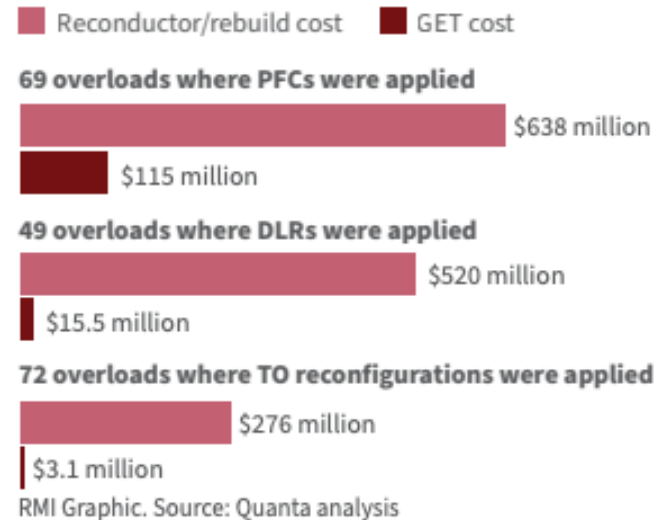
IMMEDIATE PROGRESS towards a decarbonized grid

Quanta/RMI 2024: GETting Interconnected in PJM

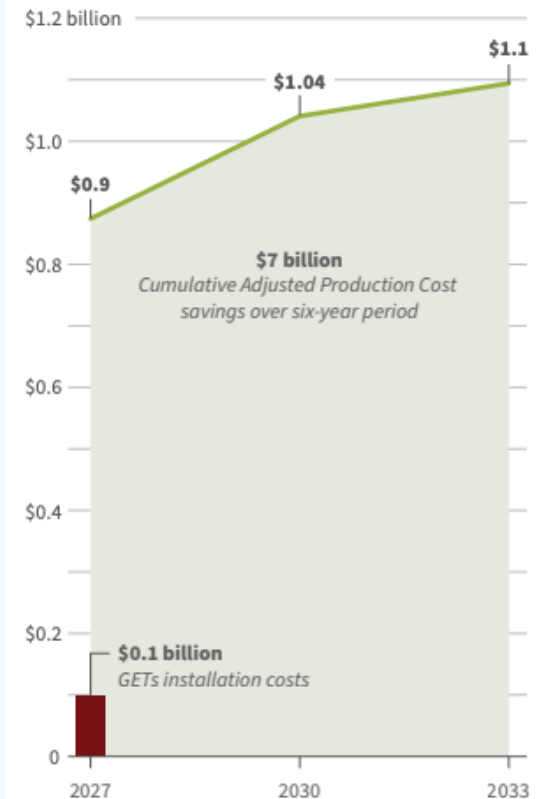
Capacity of queued generation (in GW) enabled to interconnect by each GET, as well as GETs in combination



Comparison of the typical network upgrade costs that would have been used to address an overload versus the cost of the GETs alternatives



Annual adjusted production cost savings from 2027–33, driven by GETs and the new generation enabled to interconnect



Appendix: Federal Legislative Proposals

Casten Bill (SURGE Act)



Goal: Incentivize HPC deployment by sharing savings from reduced line losses.



Mechanism: Amends Section 219 of FPA: Adds “improving efficiency” and directs FERC to establish shared savings where utilities may recover 10–60% of line loss reductions from ATTs

Considerations:

- Focused narrowly on reductions in transmission physical losses (e.g., not congestion relief)
- Creates financial upside, but does not mandate evaluation or deployment of ATTs
- Contains DOE guidance and state grant support for non-jurisdictional utilities to craft own incentive



Welch-McCormick Bill (REWIRE Act)



Goal: Create models, set up supportive infrastructure, and strengthen financial incentives for ATTs



Mechanism: Directs DOE to develop clearinghouse, tech. assistance, and planning/resource adequacy/etc. models inclusive of ATTs. Directs FERC to improve ROE treatment for HPCs.

Considerations:

- Directs FERC to create financial incentive only for HPCs, not GETs; GET benefits primarily planning integration rather than earnings mechanisms.
- Focuses on reconductoring and ATTs deployment within existing corridors, not new projects.



Shared Savings (Advancing GETs Act)

Goal: Align utility incentives with ATT deployment via financial upside for utility.



Mechanism: FERC to implement Section 219(b)(3) of FPA by creating shared savings incentive, thereby allowing utilities to retain a share of customer savings from deploying cost-effective ATTs.



Considerations:

- Developed by WATT in 2020; introduced in multiple Congresses
- Introduced in current Congress by both Sen. Welch and Rep. Castor
- Endorsed by ACEG, WATT, and others; no public utility support to date

