To: Peter Lake, White House National Energy Dominance Council
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Date: November 17, 2025
Subject: Advanced Reconductoring to Accelerate U.S. Grid Capacity

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Executive Summary

Domestic electricity demand is rising rapidly for many reasons, including economic growth, increased industrial activity, and concentrated large loads from facilities such as data centers.[1] In addition, many existing transmission corridors are congested and lead times for new transmission lines are much longer than for new power plants. This mismatch in timelines inhibits the power sector's ability to serve that load growth. Peer-reviewed and third-party analyses finds that reconductoring—replacing wires on existing structures—can add large amounts of capacity faster, at far lower total cost, and with fewer permitting hurdles than building new transmission lines.[2,3] As such, **reconductoring should be one of the first actions considered for congested corridors and as a way to accelerate grid expansion**.

Key Facts and Figures

Most of America's existing transmission infrastructure uses ACSR (Aluminum Conductor Steel Reinforced). ACSR is a mature technology that wraps aluminum conductors around a steel core to provide structural support. Though its long history of deployment and high level of industry experience are advantageous, it is unsuitable for high temperature operations as it weakens structurally at temperatures above ~ 200 °F (temperatures regularly experienced by congested lines).[3] As such, the wires often become a thermally-limited bottleneck to moving more power. Advanced conductors can help address this limitation.

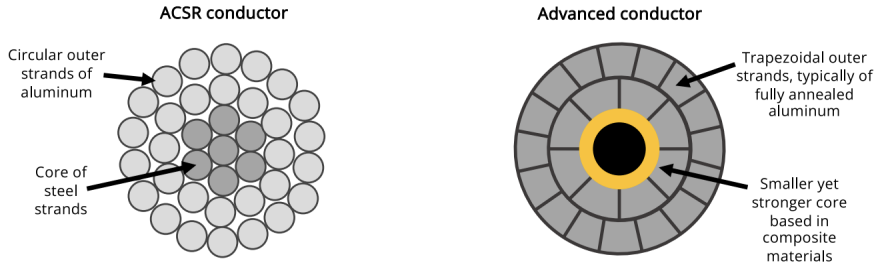


Figure 1: Standard ACSR conductor compared to a typical advanced, composite core conductor.[2]

Advanced conductors generally include any type of composite-core conductors, ultra-high strength steel-core conductors, and conductors with heat dissipating coatings. They can improve grid operations by at least one of three ways:

1. Raising the thermal ceiling of the line so it can carry more current before hitting its temperature limit, which creates headroom for peaks and contingencies.
2. Lowering line resistance at normal operating temperatures, which means lower losses.
3. Cooling lines more effectively from high-emissivity coatings to achieve more capacity at the same temperatures or same capacity at a cooler temperature (decreasing losses).

There are several different types of relevant advanced conductor technologies available from suppliers in the USA and Europe.

Table 1: Selected advanced conductors and coatings.

	Technology	Manufacturer	Note
Conductors	ACSS	Reynolds, General Cable (USA)	Mature HTLS; high capacity uplift and broad utility familiarity, but high-temperature sag must be managed.
	ACCR	3M (USA)	Aluminum-matrix HTLS; good high-temperature sag behavior, but relies on more specialized hardware and practice.
	ACCC	CTC Global (USA), Lamifil (BELGIUM)	Composite-core HTLS with very low sag and lower losses; suitable for long spans but needs specialized fittings and installation.
	TS Conductor	TS Conductor (USA)	Advanced HTLS with low sag and efficient conductor design; more standard installation practices but a shorter field record.
	C7 Conductor	Southwire (USA)	HTLS similar in concept to TS; low sag and efficient operation, also with a relatively short field record.
Coatings	E3X	Prysmian (ITALY)	High-emissivity coating; factory-applied or robotic retrofit that can deliver roughly 15–25% ampacity uplift and reduced losses.
	Asset Cool	AssetCool (UK)	Spectrally selective nanocoating with line-robot application; cools existing conductors and can add about 30% static ampacity without reconductoring.

HTLS = High Temperature Low Sag; ACSS = Aluminum Conductor Steel Supported; ACCR = Aluminum Conductor Composite Reinforced; ACCC = Aluminum Conductor Composite Core; TS Conductor = carbon-fiber composite core with thermoset resin matrix; C7 Conductor = high-strength aluminum alloy core instead of steel

Advanced conductors have been successfully deployed in multiple locations, including the USA, Europe, Middle East, and New Zealand. However, the USA lags behind other nations in terms of deployment.[2] Though this track record shows advanced conductors can be very effective, for very long transmission lines the voltage drop due to reactive power can be the main limiting factor, so novel tower designs have been used to reduce that drop (for example, for a 500 kV line in Brazil).

Dynamic Line Rating (DLR) increases the operational ratings during certain favorable conditions (like a cool, windy day) providing an operational alternative – and complement – to reconductoring.[4] Some advanced conductors, such as CTC Global's Infocore and TS Conductor, embed fiber optics, making them highly suitable candidates for reconductoring paired with DLR.[3] These capabilities, paired with the ability of data centers to operate in a flexible manner, can relieve bottlenecks and accelerate new interconnections.

Key Findings

Reconductoring avoids most of the greenfield siting and ROW (right-of-way) barriers of new traditional transmission projects and can be delivered in months to years, rather than years to decades. Furthermore, conductor materials are a small fraction of all-in greenfield cost; even if the advanced conductor material is 2–4× the price of ACSR, the total project cost for reconductoring often remains far below the cost of new construction. Additional benefits include reduced corrosion and lower line losses during most hours.

According to the Idaho National Laboratory,[3] advanced conductors (e.g. ACSS/TW, ACCC, TS,

C7) and high-emissivity coatings (e.g., E3X) can unlock ∼25–100%+ rating increases and reduce losses, often without tower replacements or new ROW. Success depends on matching technology to corridor constraints (clearances, spans, wind/ice, etc.), the actual capacity shortfall, crew familiarity, and outage windows.

Peer-reviewed analysis published in the *Proceedings of the National Academy of Sciences* (PNAS)[2] concludes that "large-scale reconductoring with advanced composite-core conductors can effectively double transmission capacity within existing right-of-way, with limited additional permitting." That research found that reconductoring can provide $180B in system cost savings by 2050 because of reduced grid congestion and increased resilience through interregional energy trade.

Cost & Schedule Snapshot (Illustrative)

There is limited third-party validation of various reconductoring claims. But, our team at UT Austin has built a rigorous cost calculator for comparing transmission options (including reconductoring and new builds) that considers capital requirements, time delays, ROW requirements, etc. The calculator can be used to quantitatively compare traditional transmission construction with reconductoring. An illustrative comparison is below, and we can provide additional analysis if it is of interest.

- **Greenfield parallel 161-kV line (50-yr life):** Large life-cycle spend dominated by ROW and structures; ∼5 years permitting + ∼9 months build and a total project cost of $200M+.
- **Reconductoring same corridor:** Conductor material costs <$10M; schedule measured in months to ∼2 years depending on outage windows; avoids most ROW/structure costs.

Needs and Opportunities

Though there are papers and reports on this topic, it would be useful to have updated third-party meta-analysis of the tradeoffs in cost and speed of reconductoring versus traditional new-build transmission in the USA. There is also room for policy initiatives to accelerate deployment of reconductoring or other grid enhancing technologies (GETs) on critical corridors. Example policy levers include the Loan Program Office (LPO) authority, direct-funded pilot demonstrations with national labs or universities, and SBIR program support. If useful, we can prepare a more thorough report for you on the risks and benefits, potential tradeoffs in cost and speed, and recommendations for a policy approach or decision framework.

References

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Appendix A: Additional References That Are Relevant

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Appendix B: More Details for Advanced Conductors and Coatings

ACSS (Aluminum Conductor Steel Supported) ACSS is a high-temperature version of ACSR introduced in the 1970s. A larger steel core allows for more aluminum to be stranded, allowing current to be carried up to ~ 482 °F. The steel supports more mechanical load and the aluminum carries more current. ACSS can nearly double the ampacity of the same-size ACSR conductor. However, the steel still expands significantly when hot and ACSS experiences high thermal sag at maximum capacity. This can be troublesome in wildfire-prone or clearance-constrained areas; utilities may need to raise tower heights or reduce spans if reconductoring with ACSS. ACSS/TW (trapezoidal wire) is a newer variant of ACSS that uses trapezoidal-shaped aluminum strands, doubling ampacity with improved sag and efficiency. ACSS and ACSS/TW are attractive for their familiarity (they are similar to ACSR), but their sag at high load is a key trade-off. There are multiple manufacturers of ACSS.[3,5]

ACCR (Aluminum Conductor Composite Reinforced) ACCR replaces the steel core with a composite aluminum-oxide fiber core. This core is lighter and expands less with heat. ACCR can operate at temperatures upwards of 392 °F with less sag than ACSS and with good strength. ACCR has been used in projects, offers high capacity and good sag characteristics, but it is more expensive and less widely adopted. ACCR is manufactured by 3M.[2,3]

ACCC (Aluminum Conductor Composite Core) ACCC is the most widely deployed advanced conductor. It uses a lightweight carbon-fiber composite core instead of steel. The core is about 70% lighter than an equivalent steel core, allowing for roughly 30% more aluminum strands for the same overall diameter. The carbon-fiber composite core has low sag and allows current to be carried up to $\sim$ 410 °F. At normal temperatures it loses $\sim$ 20% less energy to resistance compared to ACSR. ACCC is a mature and widely deployed technology—over 1,000 ACCC projects have been deployed worldwide across more than 60 countries. Its main drawbacks are cost and installation difficulties. ACCC is around 2–4× more expensive than ACSR. Additionally, installation requires special dead-ends and trained crews, as the brittle carbon-fiber core can break if bent too much during installation. Even so, its use continues to grow, and it has proven its ability to nearly double capacity with no major changes to structures necessary. ACCC is manufactured by CTC Global and Lamifil.[3,6,7]

"TS" Composite Conductor TS Conductor is the product of a California startup that uses a carbon-fiber composite core with a proprietary thermoset resin matrix for greater flexibility. TS conductors claim they can deliver 2–3× the capacity of the same-size ACSR with lower resistance and sag. In practice, TS offers similar performance to ACCC but aims to simplify installation. Adoption in the United States is nascent, as utilities await more field experience.[3,8]

C7 C7 uses a high-strength aluminum alloy core instead of steel. This gives C7 low thermal expansion and high stiffness, improving its sag performance under extreme conditions. It can operate at temperatures of $\sim$ 410°C and is comparable to ACCR or ACCC in capacity. Its adoption is currently limited, as it is a relatively new technology and utilities are still gaining operational experience with it.[3,5]

E3X While not an advanced conductor on its own, E3X is a thin ceramic coating that can be applied to conductors to increase their heat-radiating ability. It helps a hot line shed heat more effectively to the air, lowering the operating temperature for a given current, or allowing higher currents for the same temperature limit. Adding E3X can raise ampacity by roughly 25% beyond the base conductor rating. Coatings like this are relatively low cost and help improve new and existing wires. E3X can be applied in the factory for new wires and, with dedicated robotic systems, can also be retrofitted on existing lines. These coatings do not substitute the major capacity leaps of the advanced conductors above but are useful complements to increase thermal limits without sacrificing other characteristics. E3X is manufactured by Prysmian.[3,9]

AssetCool Spectrally Selective Coatings and Robotics AssetCool is developing spectrally selective "photonic" nanocoatings for overhead lines, combined with dedicated power-line coating robots for in-situ application. The coating is designed to reflect most incoming solar radiation while increasing infrared emissivity, passively cooling the conductor. Field trials and vendor claims suggest that treated lines can run significantly cooler and gain up to $\sim$ 30% additional static ampacity, with reduced losses, without replacing the underlying conductor. AssetCool positions this as a grid-enhancing technology that can be deployed over existing spans (potentially several spans per day) as an alternative or complement to reconductoring, and as a competing option to proprietary coatings such as Prysmian's E3X.[10]