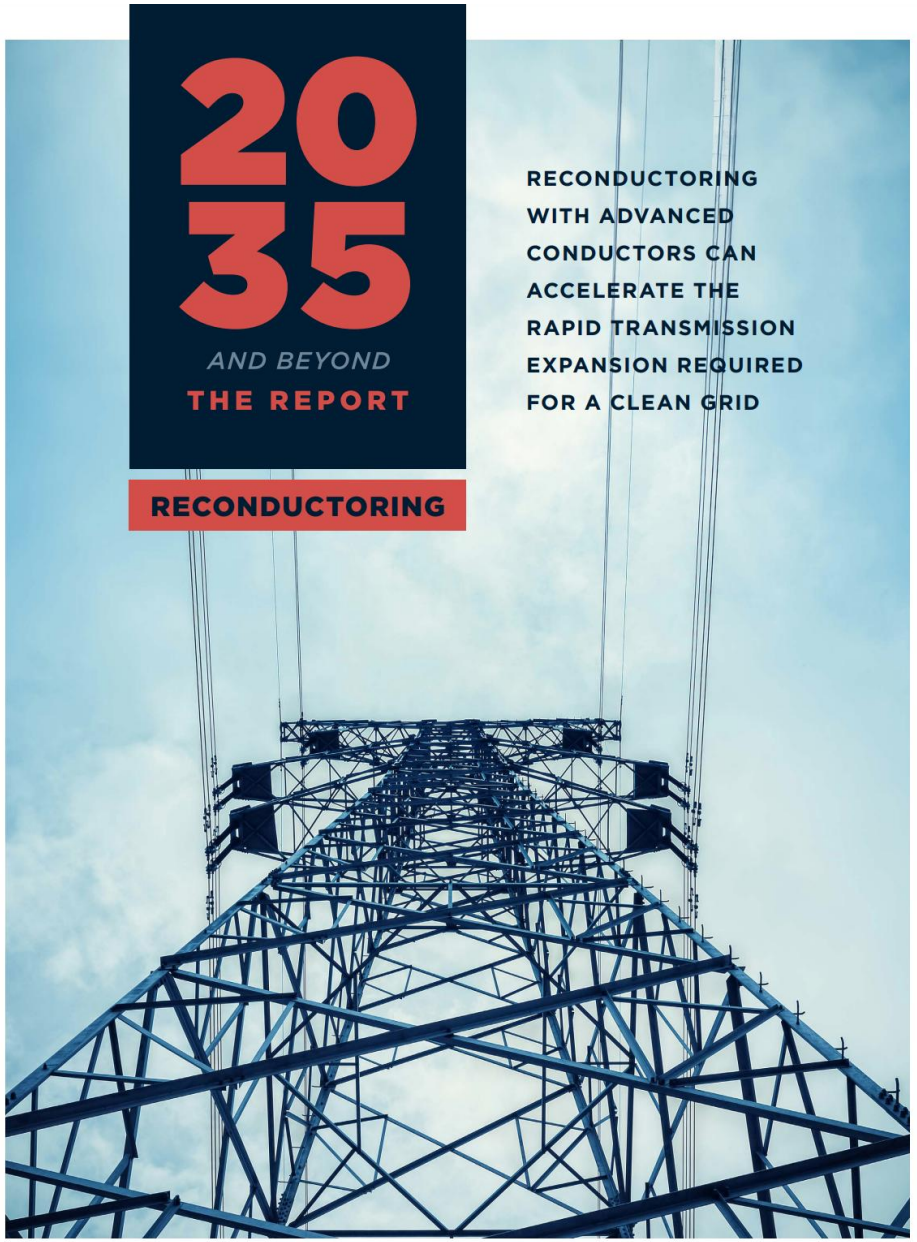
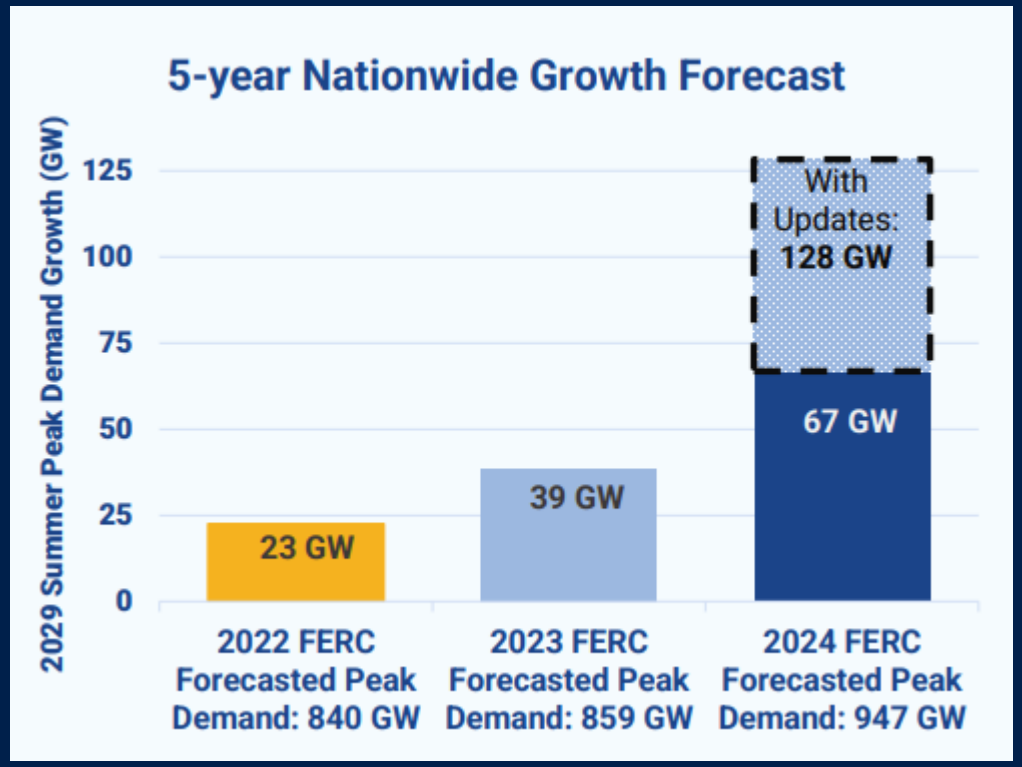
The Promise and Pitfalls of High-Performance Conductors

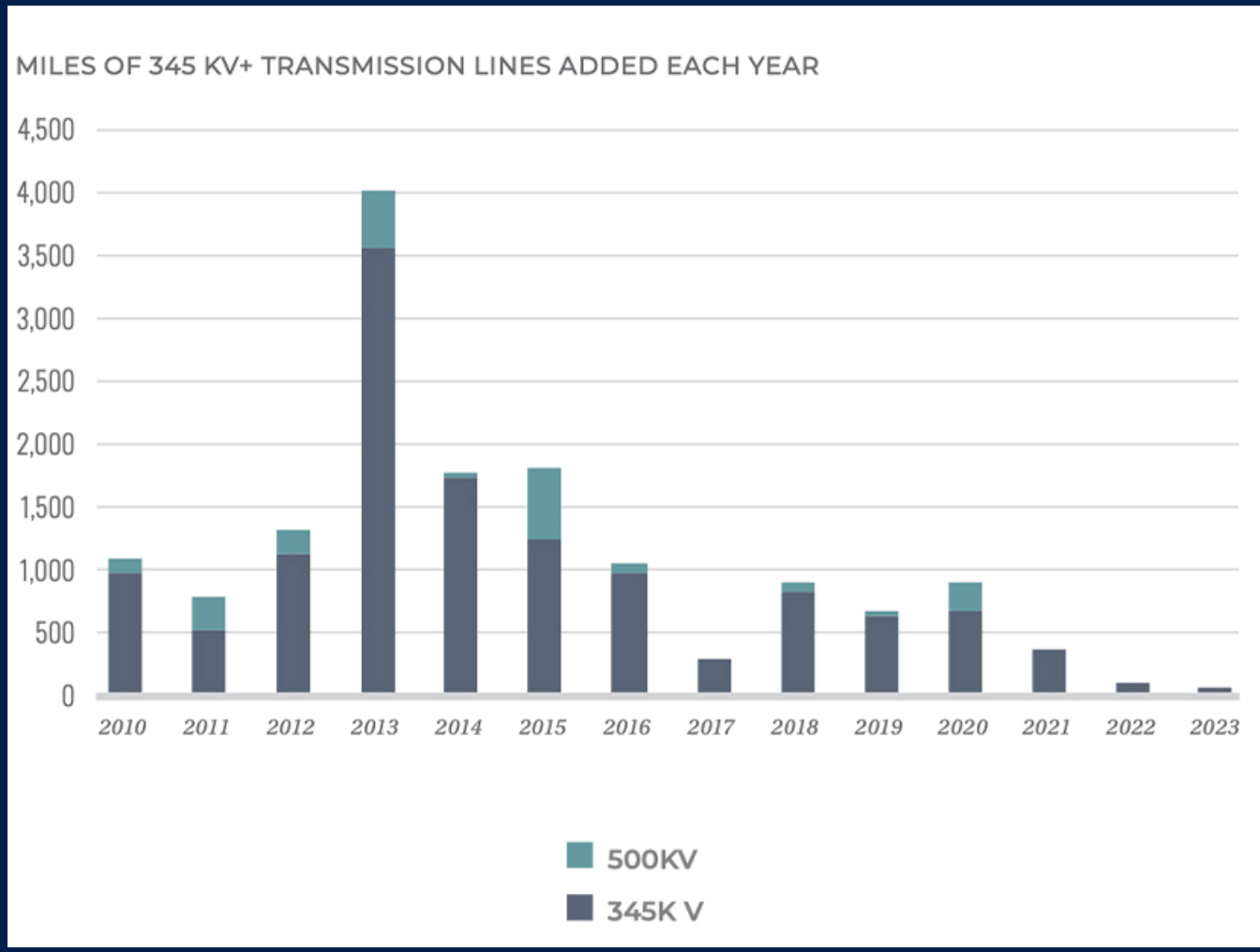
Casey Baker
Senior Program Manager
Casey@GridLab.org

GridLAB





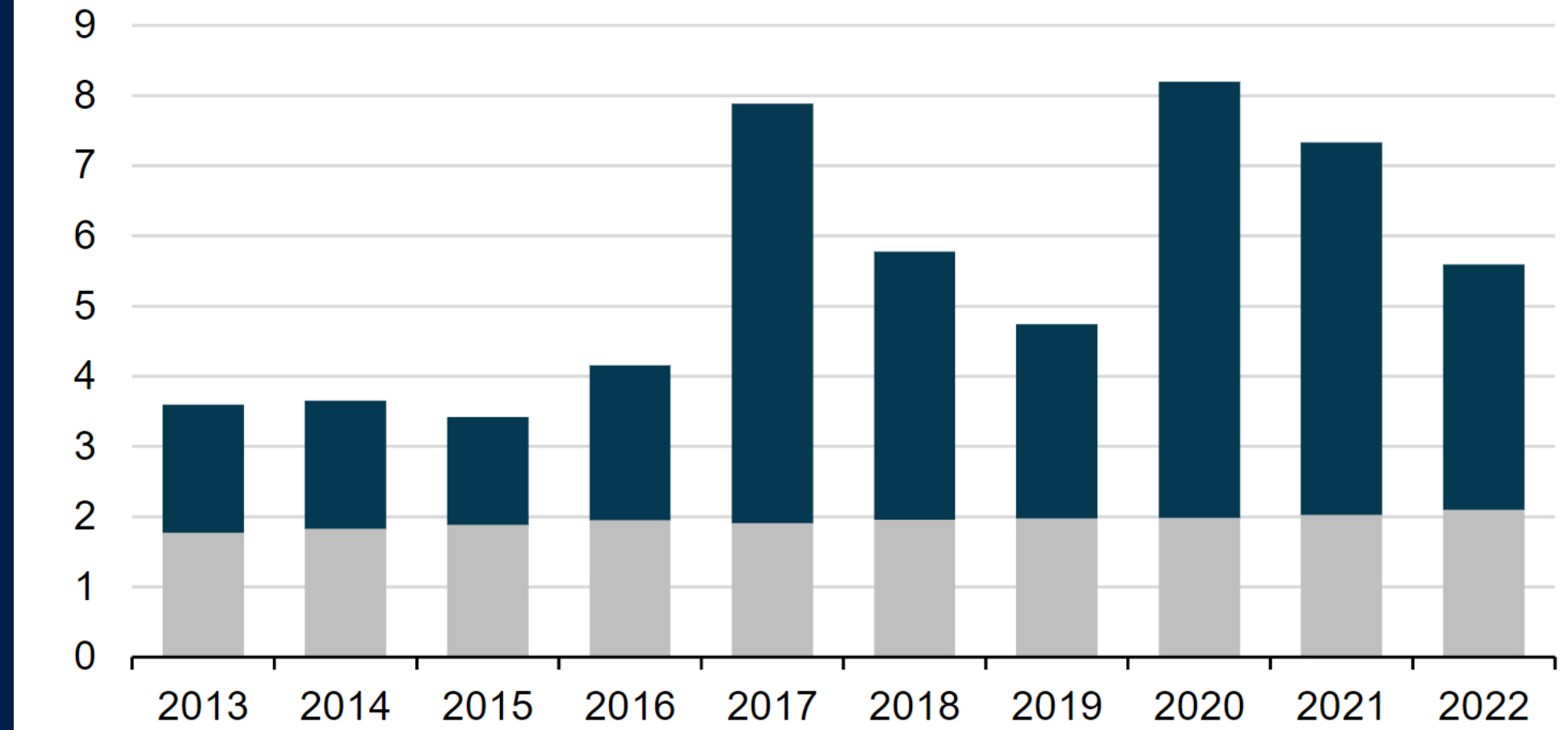
Source: GridStrategies
https://gridstrategiesllc.com/wp-content/uploads/National-Load-Growth-Report-2024.pdf



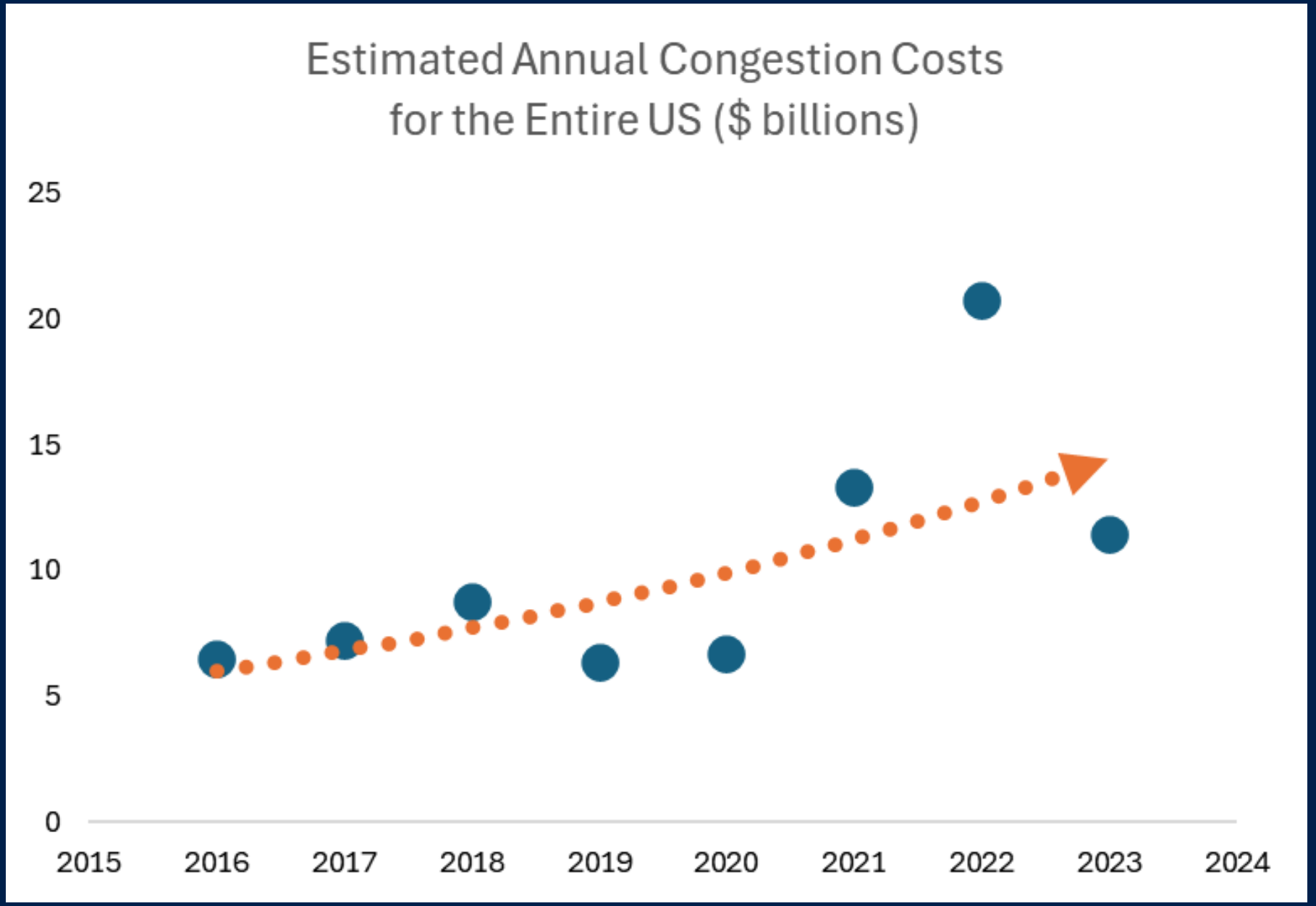
Source: ACEG
https://cleanenergygrid.org/portfolio/report-fewer-new-miles-the-u-s-transmission-grid-in-the-2020s/

Average annual total of electric power interruptions (2013–2022)

number of hours per customer



Source: U.S. Energy Information Administration
https://www.eia.gov/electricity/data/eia861/



Source: Grid Strategies
https://gridstrategiesllc.com/wp-content/uploads/Grid-Strategies_2023-Transmission-Congestion-Report.pdf

Addressing the Greenfield Challenge

Planning

- RTO/ISO Planning Processes (15-20 years)
- FERC Order 1920
- NERC Interregional Transfer Capability Study (ITCS)
- State Transmission Authorities

Permitting

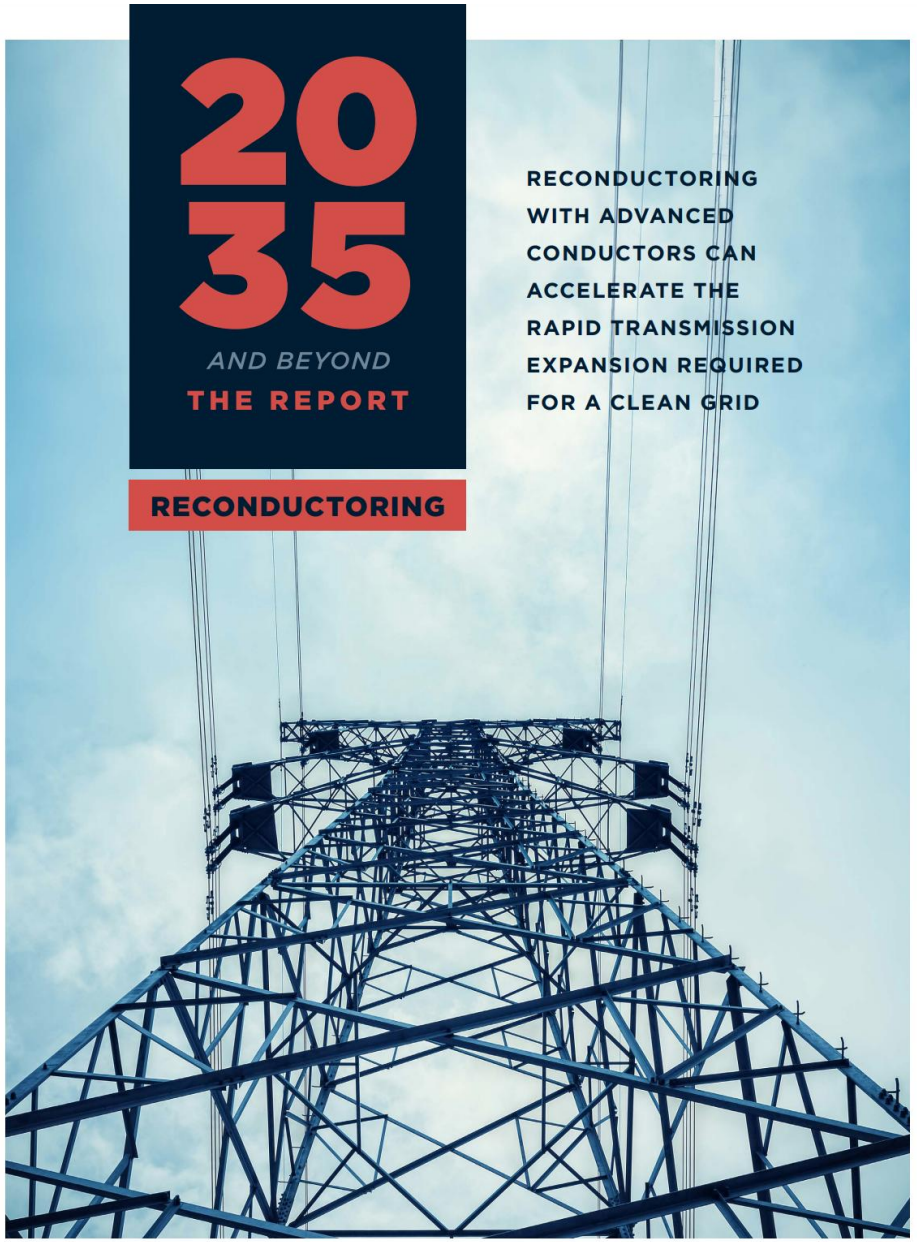
- Permitting along highways and railways

  (Seeing some success in MN, IL, and CO)
- National Interest Electric Transmission Corridors (NIETCs)
- DOE Coordinated Interagency Transmission Authorizations and Permits Program (CITAP)

Paying

- Cost allocation methodologies

The Promise


2035
AND BEYOND
THE REPORT
RECONDUCTORING
RECONDUCTORING WITH ADVANCED CONDUCTORS CAN ACCELERATE THE RAPID TRANSMISSION EXPANSION REQUIRED FOR A CLEAN GRID

High Performance Conductors
(a.k.a. “Advanced Conductors”)

Conventional Conductor

“Aluminum Conductor Steel Reinforced” (ACSR)

High Performance or Advanced Conductors

“ACSS” Trapezoidal Wire

3M “ACCR”

CTC Global “ACCC”

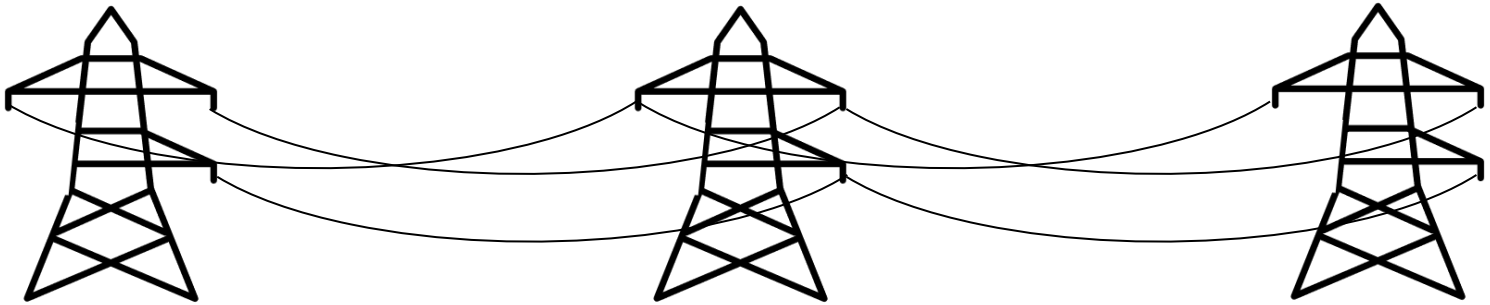
TS Conductor

- ☑ 2x Capacity
- ☑ Reduce Losses 10-40%
- ☑ Increase Resiliency

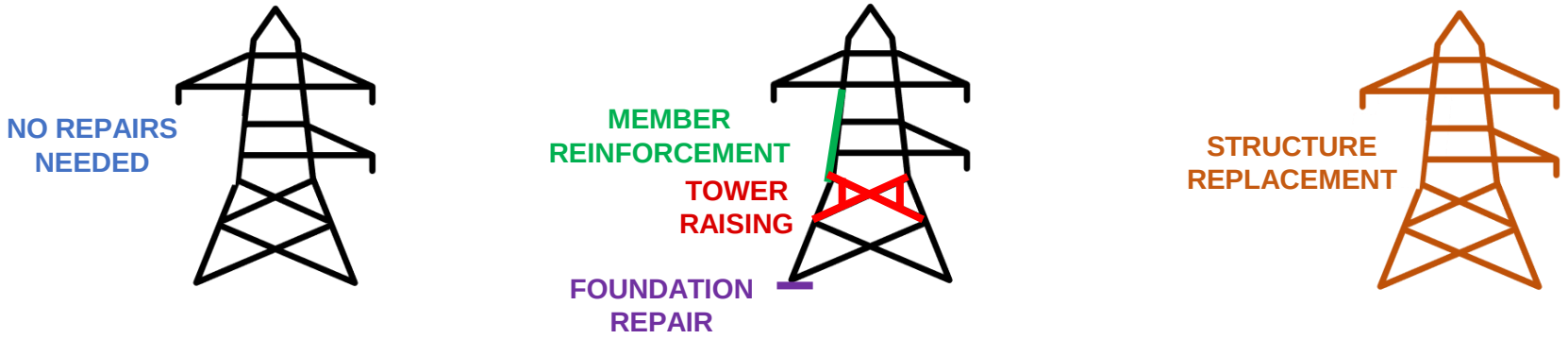
Source: Idaho National Labs
https://inl.gov/content/uploads/2024/02/23-50856_R8_-AdvConductorszScan-Report.pdf

“Advanced Reconductoring”

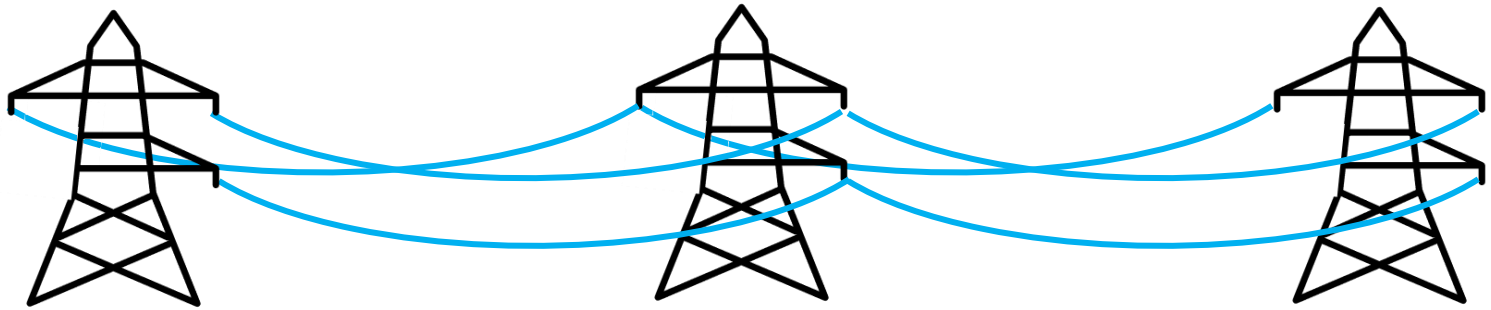
EXISTING LINE

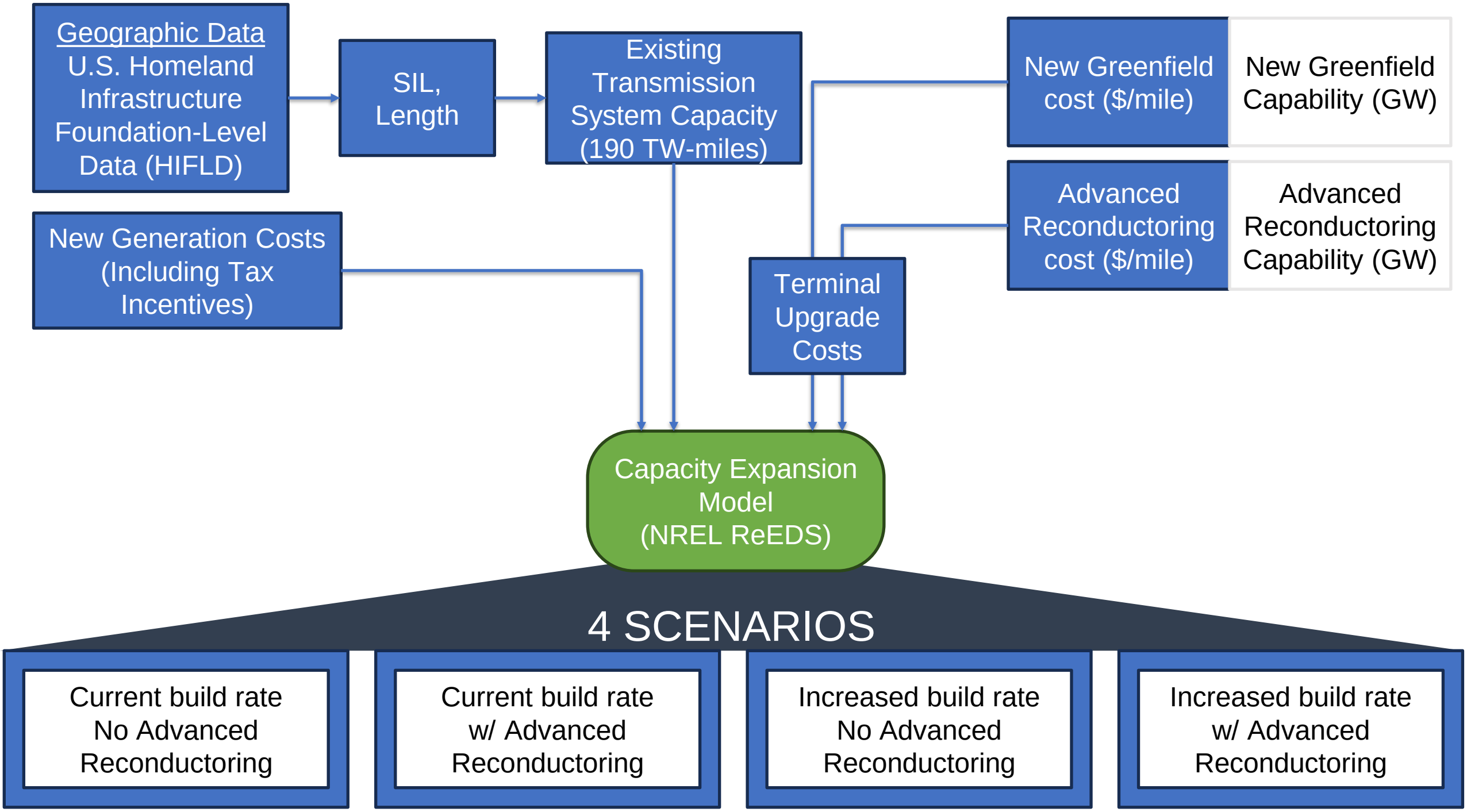


OLD CONDUCTOR REMOVED, STRUCTURES REHABILITATED/ REPLACED AS NEEDED

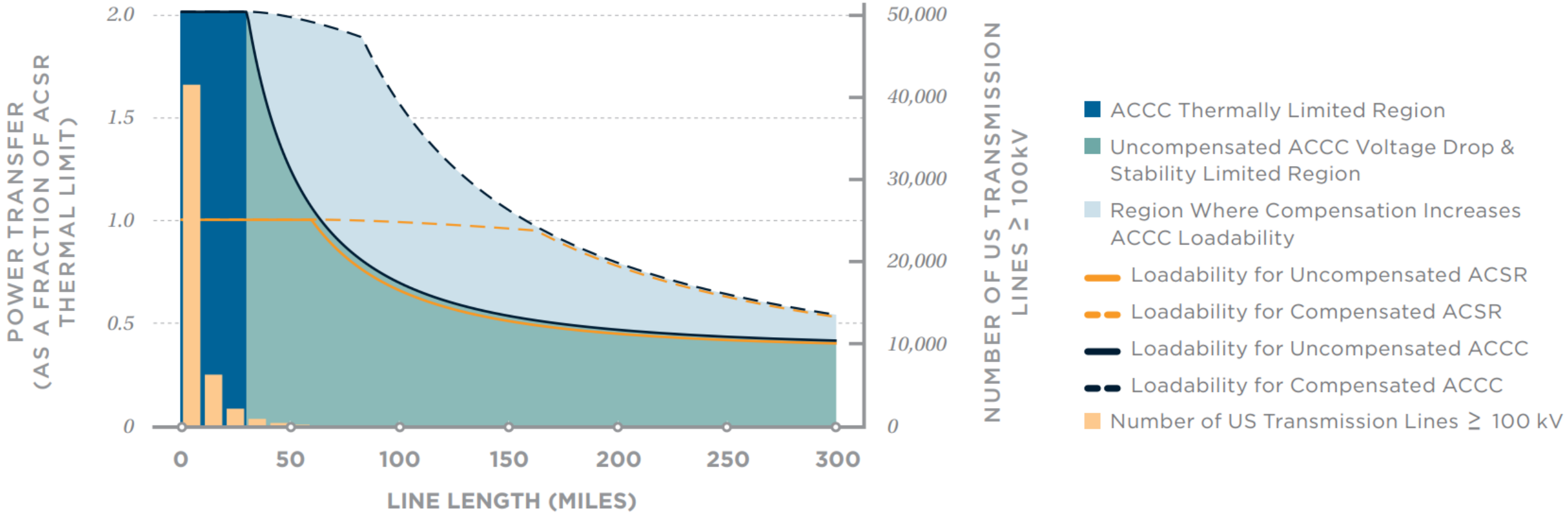


NEW CONDUCTOR STRUNG ON EXISTING STRUCTURES

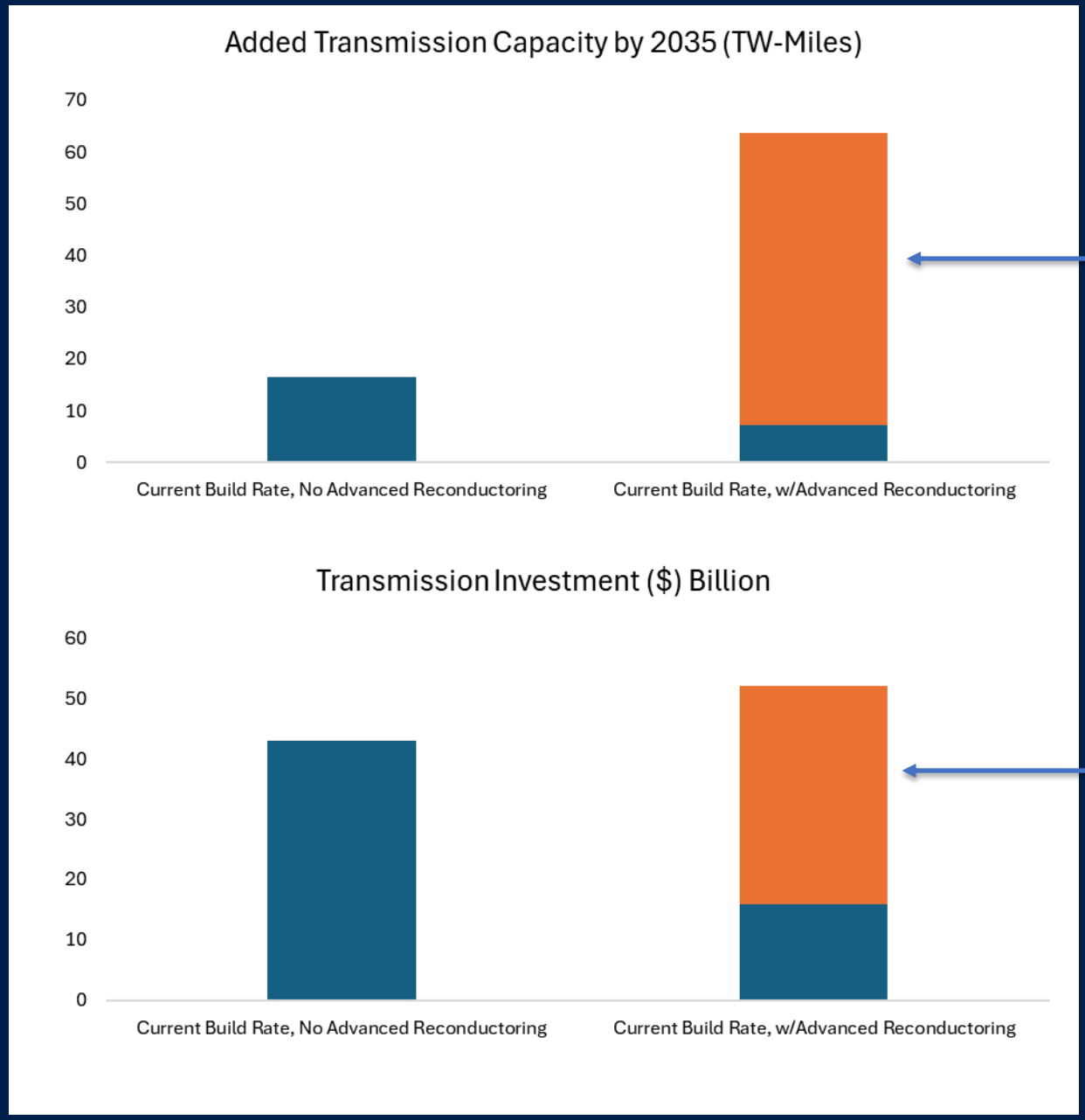



Geographic Data
U.S. Homeland Infrastructure Foundation-Level Data (HIFLD)
SIL, Length
Existing Transmission System Capacity (190 TW-miles)
New Greenfield cost ($/mile)
New Greenfield Capability (GW)
Advanced Reconductoring cost ($/mile)
Advanced Reconductoring Capability (GW)
New Generation Costs (Including Tax Incentives)
Terminal Upgrade Costs
Capacity Expansion Model (NREL ReEDS)
4 SCENARIOS
Current build rate No Advanced Reconductoring
Current build rate w/ Advanced Reconductoring
Increased build rate No Advanced Reconductoring
Increased build rate w/ Advanced Reconductoring

POWER TRANSFER CAPABILITY AS A FRACTION OF THERMAL LIMIT BASED ON ST. CLAIR'S CURVES FOR LINE LOADABILITY



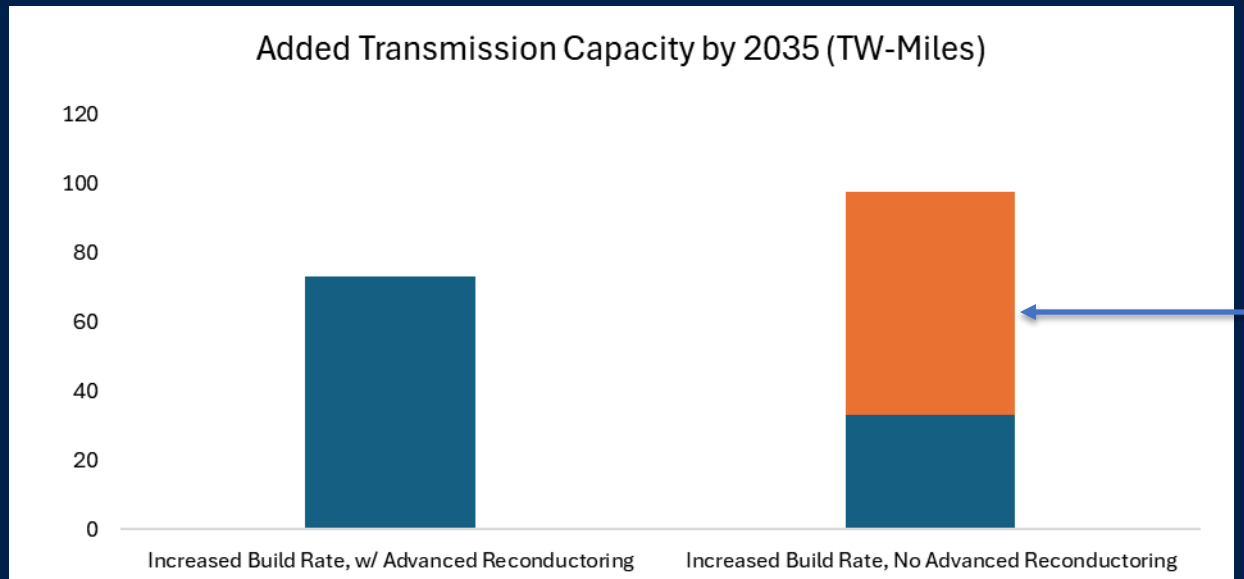
Current US Transmission Build Rate



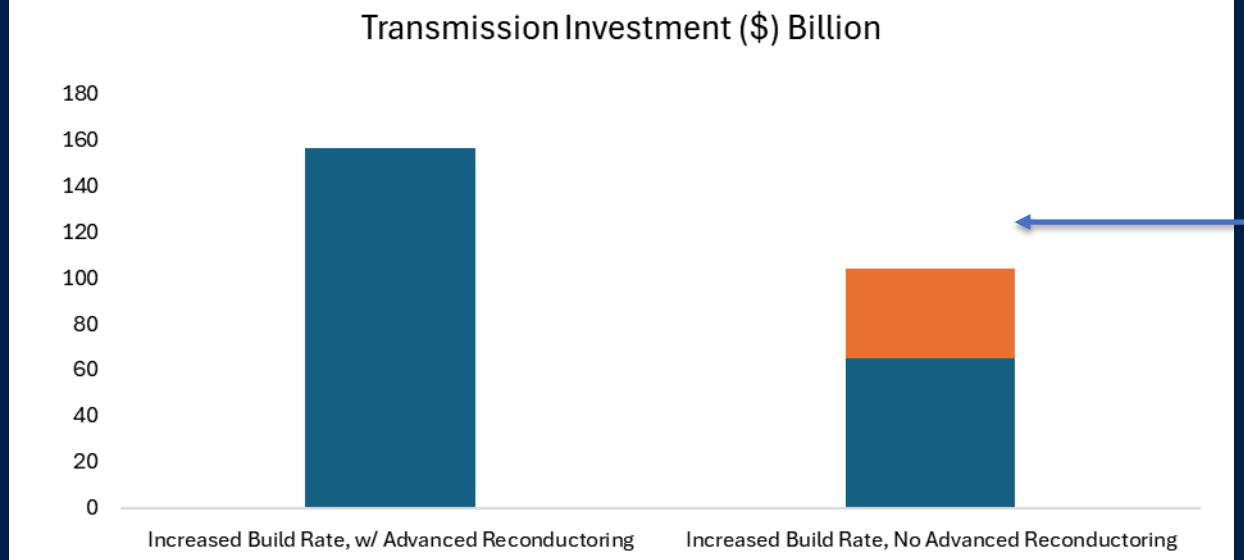
4x Transmission Capacity

20% Increased Cost

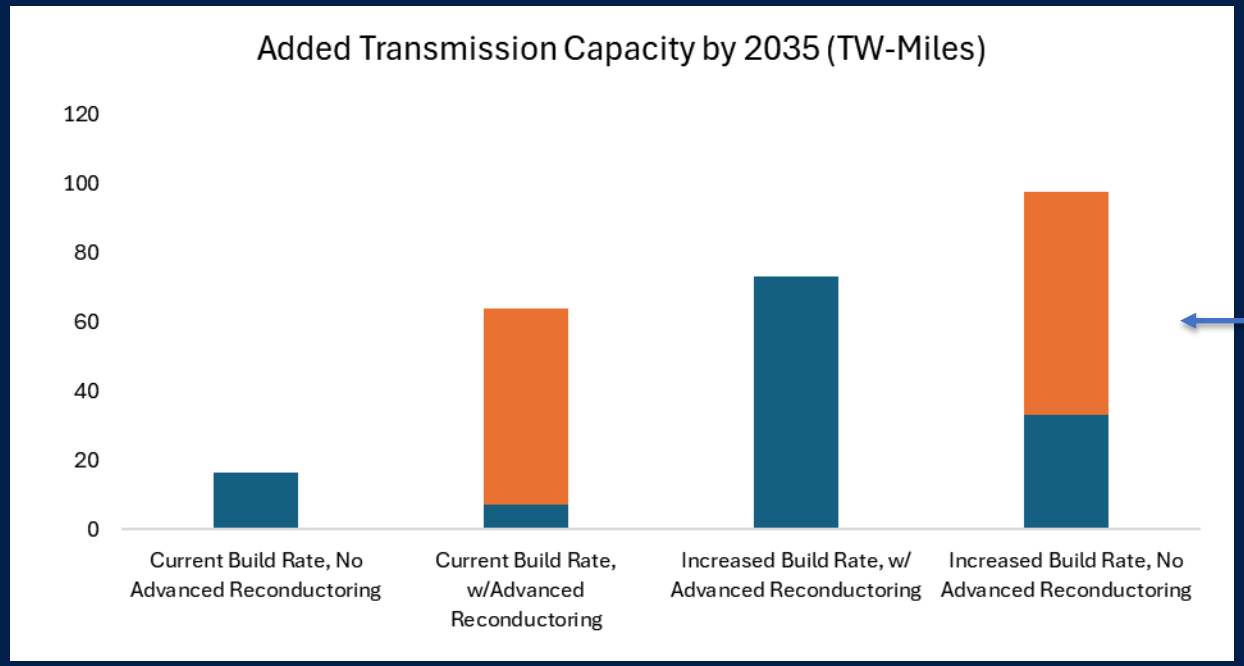
Increased US Transmission Build Rate



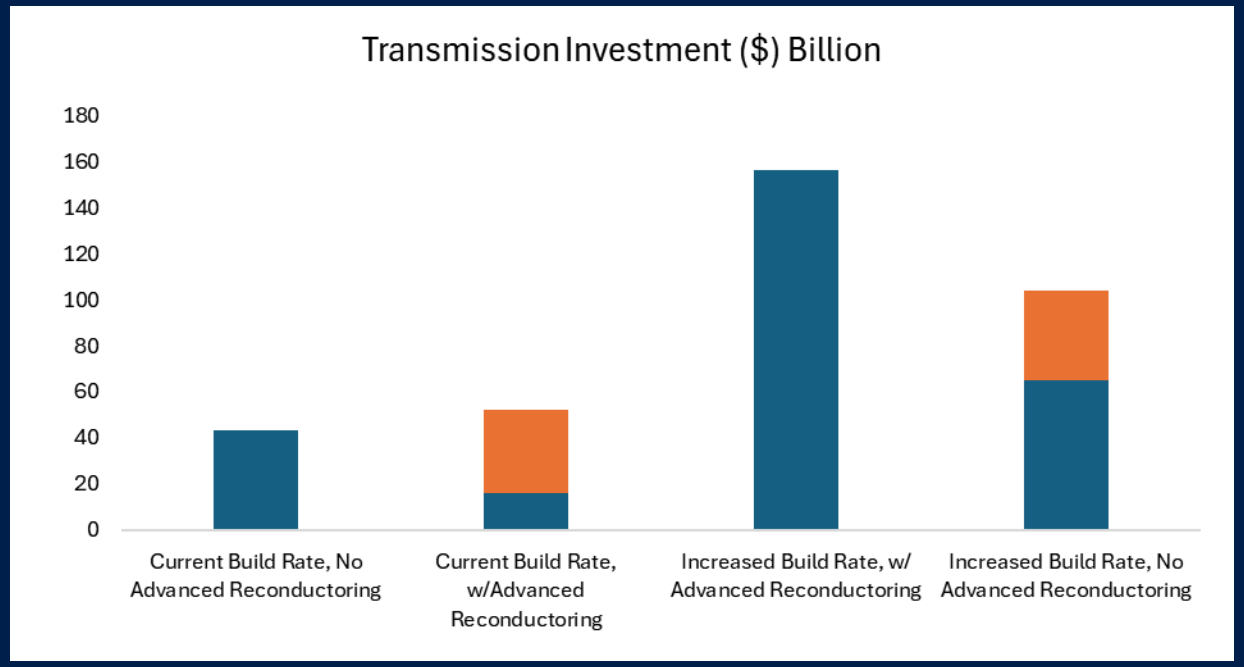
1.34x Transmission Capacity



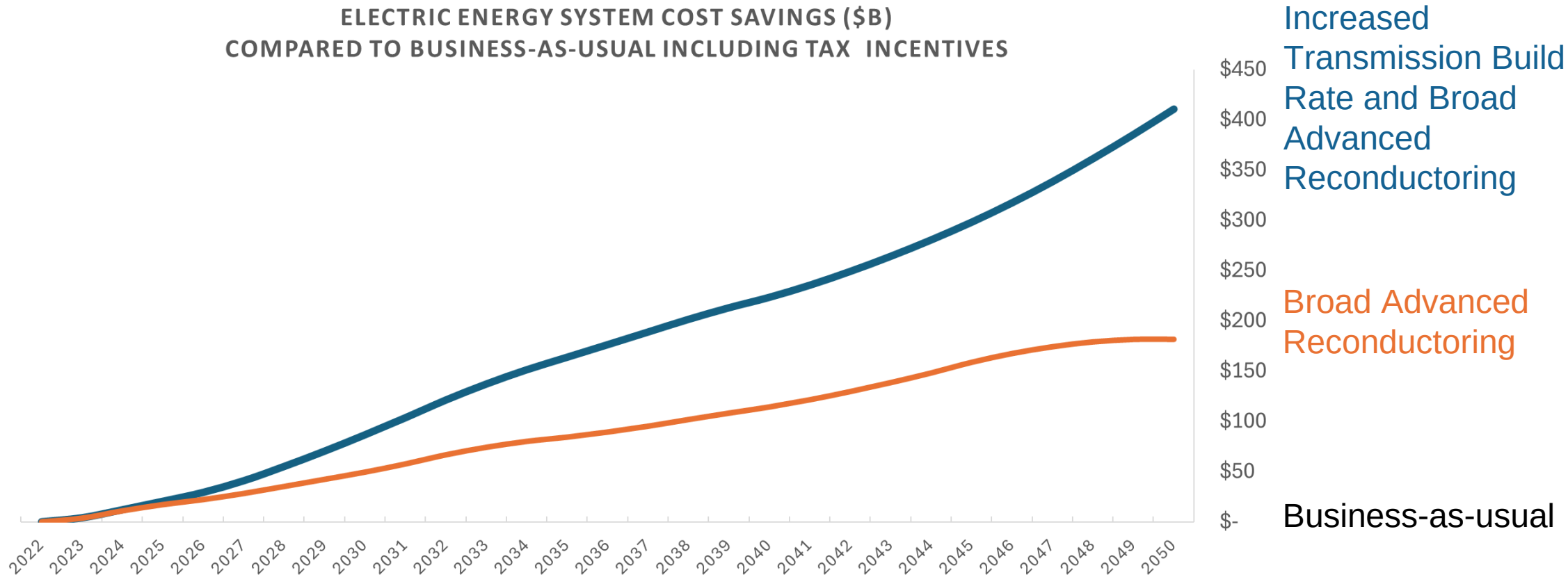
48% Lower Cost



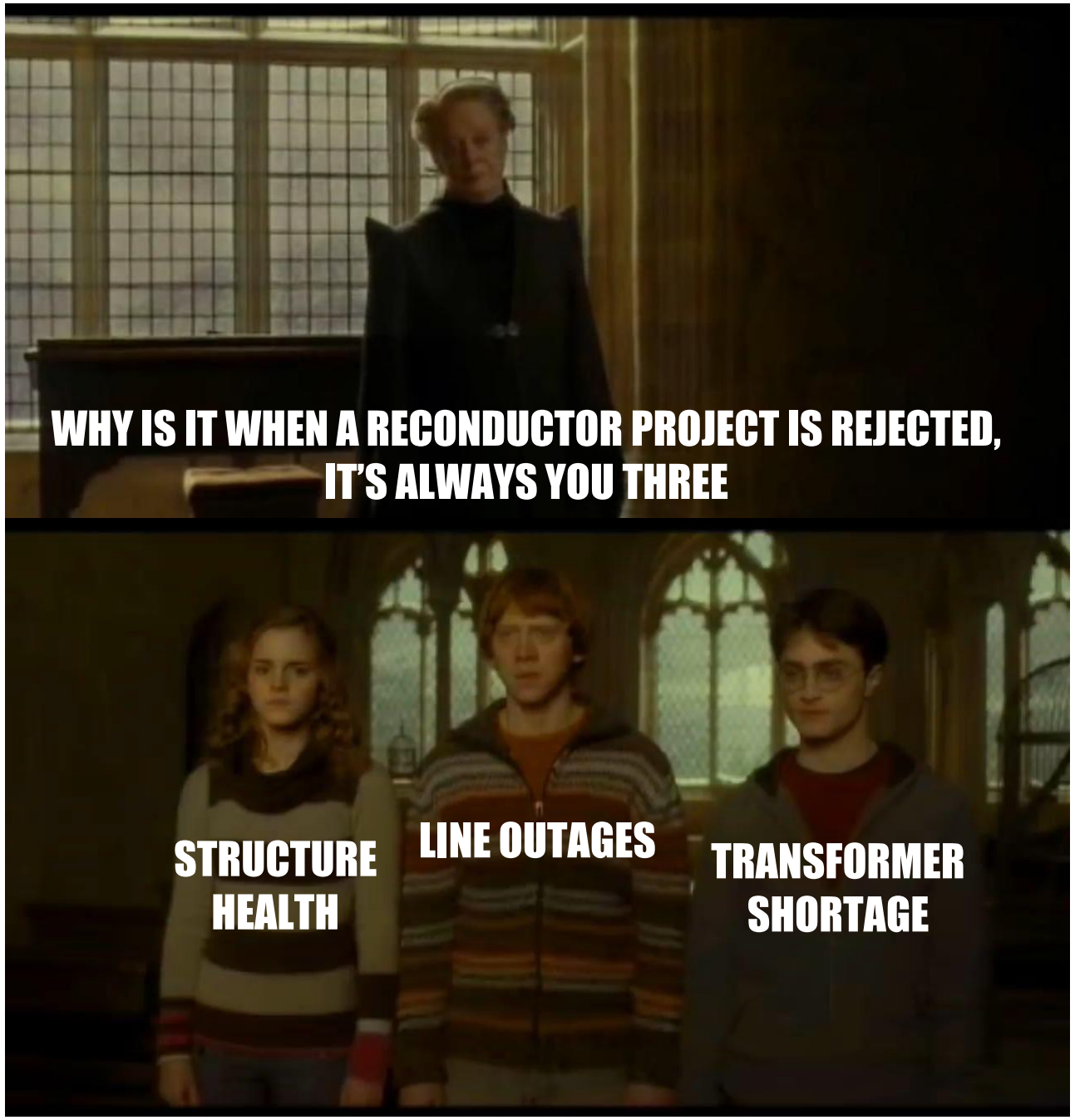
5.3x Transmission Capacity Compared to BAU



MORE TRANSMISSION = MORE ACCESS TO LOWER COST ENERGY



The Pitfalls (Barriers)


WHY IS IT WHEN A RECONDUCTOR PROJECT IS REJECTED,
IT'S ALWAYS YOU THREE
STRUCTURE HEALTH
LINE OUTAGES
TRANSFORMER SHORTAGE

Planning/ Technical

- Data gaps
- Long Lines
- Structure Health

Institutional

- Equipment Standards/ Procurement
- Workforce Shortages
- Training

Coordination

- Outages
- Lack of Standards
- Supply Chain Shortage

Permitting

- Limited Space for Construction
- Lack of permitting clarity
- Can trigger new permitting concerns

Cost

- “Gold Plating”
- High upfront cost
- Regulator education

Case Studies (Solutions)

NV Energy

NV Energy has **installed more than 125 miles of composite core conductors over 25 lines** in Nevada to increase the capacity of existing transmission corridors, reduce sag for public safety, and allow for rapid load growth.

NV Energy started using HPCs in 2009 on a 115 kV reconductor project to avoid replacing existing structures.

After using HPCs over the past 15 years, **NV Energy crews now prefer working with HPC to bundled ACSR**, and projects using HPCs have faster construction timelines.

Addressing the Barriers

- Equipment Standards/ Procurement
- Training

Wildfire burned the poles to the ground but HPC stayed intact

Source: CTC Global
https://ctcglobal.com/video-library/

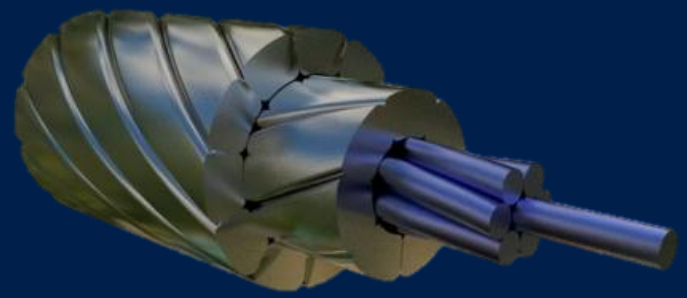
Evergy

In 2003, KCP&L (predecessor to Evergy) performed a **live line reconductoring** of the LaCygne to Stillwell line using ACSS/TW on a 345kV 32-mile line.

The cost savings of the added transmission capacity paid for the cost of the upgrade in 14 months.

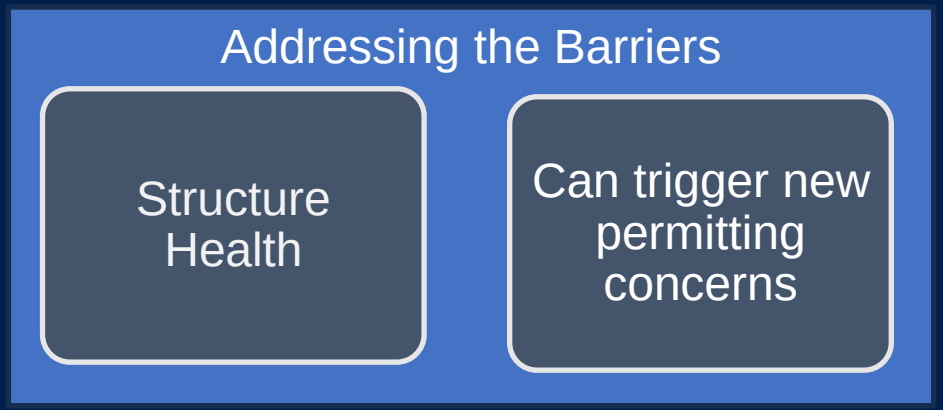
Addressing the Barriers

- Outages
- High upfront cost



Source: Idaho National Labs https://inl.gov/content/uploads/2024/02/23-50856_R4a_-Use-Case-Studies.pdf

National Grid



In 2018, NG rebuilt the Somerset-Fall River line which had originally been constructed in 1923. In addition to being 100 years old, the very large structures were occupying a large amount of valuable real estate on the Taunton River.

During the rebuild, smaller structures were used that not **only took up less space on the ground but were also considerably shorter**, which reduced the risk to aviation.

To enable the **shorter, smaller structures**, NG used a composite core conductor

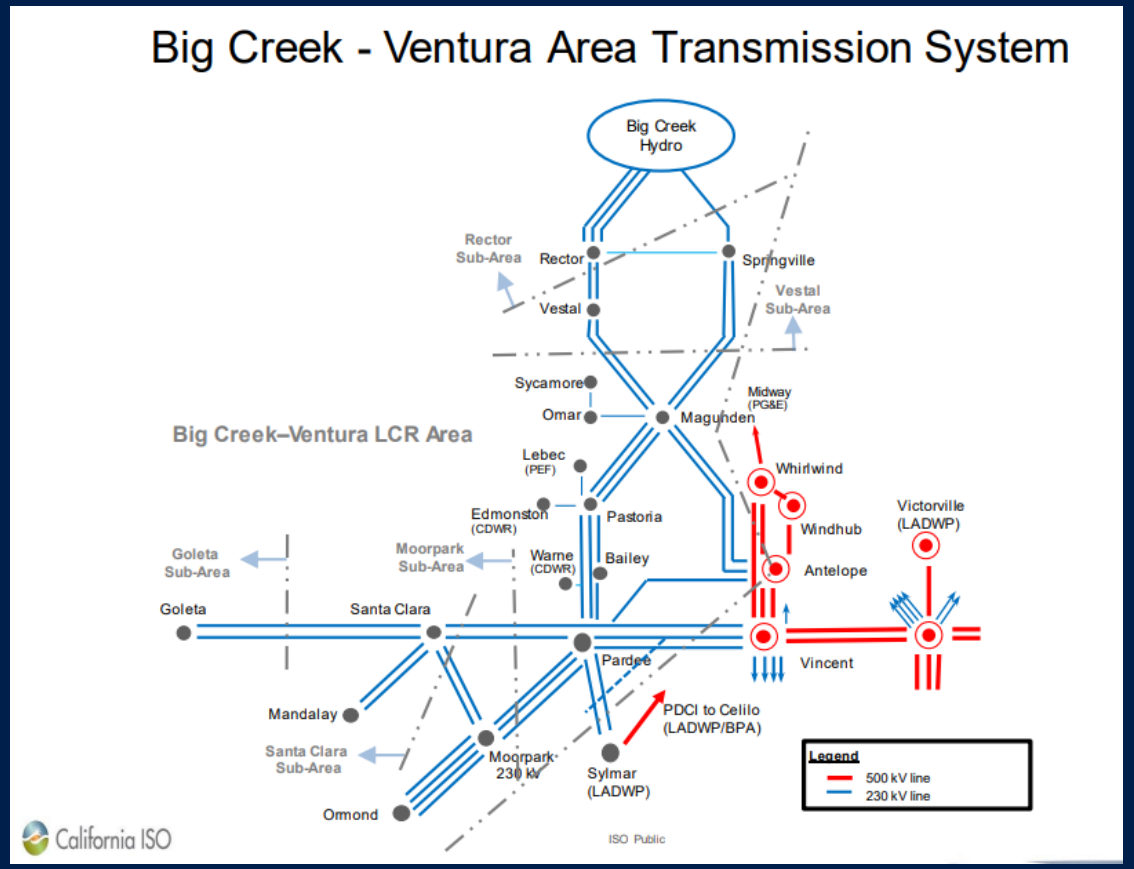
Big Creek Corridor Upgrade 220 kV (California)

Addressing the Barriers

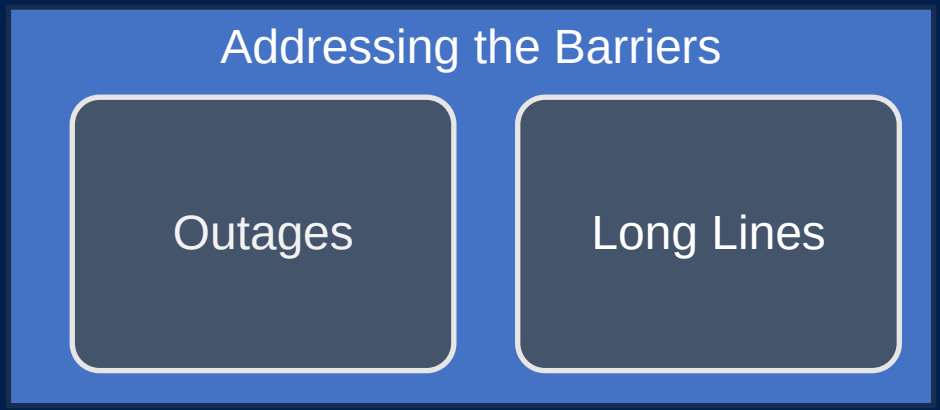
- Structure Health
- Lack of permitting clarity

Pursued to for wildfire risk and **instead of raising towers**, reconductored with composite core conductor

Installed under a capital maintenance program, and CAISO leveraged the increased capacity improvements at terminating substations to increase the corridor transmission capacity



Lower Rio Grande Valley Reconductoring Project (Texas)



The southeastern Texas Lower Rio Grande Valley reconductoring project 2016, involved reconductoring **two 120- mile transmission lines** while energized with composite core conductor. The **project increased the summer peak rating by 75 percent.**

Conventional solutions such as new lines were considered but were seen as too risky due to permitting delays.

Energized reconductoring of the line emerged as the only option, which did not require time-intensive permitting for new land acquisition

Northwestern Energy (Montana)

NorthWestern implemented two parallel composite core reconductoring jobs on their 100 kV Great Falls Project in Black Eagle, Montana.

The capacity of the lines is being doubled **without the need to modify or replace any of the existing steel monopoles or H-frame structures**.

The project includes roadway, railway and a 1,700 foot span crossing over the Missouri River.

Addressing the Barriers

- Structure Health
- Regulator education

Source: CTC Global

Sumatera Utara (Indonesia)

300 mile, 150kV line
Reconductored with composite core conductor
Did not require tower modifications
Doubled ampacity of existing line

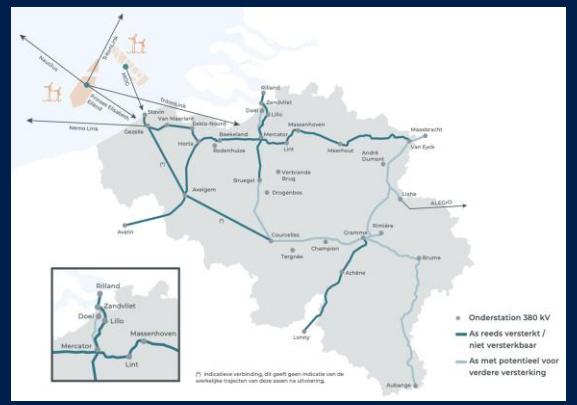
Addressing the Barriers

- Long Lines
- Structure Health

Source: Epsilon Cable

High performance Conductors are being deployed at scale around the world

Belgium

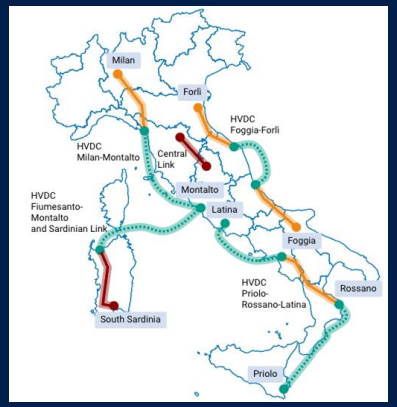


Belgium's Transmission System Operator (TSO) Elia is reconductoring most high voltage (380 kV) lines by 2035 in order to accommodate increasing offshore wind capacity and rapid electrification

Netherlands

The Dutch TSO TenneT is similarly reconductoring their high voltage grid, recognizing their value in faster project realization, avoiding permitting delays and much lower project Capex

Italy



In addition to reconductoring, Italy is building out a multi-terminal HVDC network, with new subsea HVDC lines and converting existing AC lines to DC

India

India's transmission planning philosophy encourages the optimization of existing ROW first, leading to the adoption of efficient HPCs and smart grid technologies

China

China, which sees $50 billion in transmission investment each year, is utilizing HPCs in both reconductoring as well as new-build projects to keep up with growing electricity demand

THANK YOU

Casey Baker
Senior Program Manager
Casey@GridLab.org

GridLAB