ACCC® Advanced Conductor

Cost-effective Transmission Expansion

ISO-NE PAC Forum

June 18, 2025

CTC GLOBAL

CTC Global Overview

World's Largest Manufacturer / Supplier of Advanced Conductor Core

10X Larger than all current Advanced Conductor Competitors Combined

Headquartered in Irvine, California

500+ Employees Worldwide (300+ in Irvine)

Five Manufacturing Facilities Worldwide

Largest Facility is Irvine - Over 50% of CTC's Worldwide Capacity & Well over 50% of Irvine's Production is Exported

125,000+ Miles of ACCC® Conductor in the Air

>1,450+ ACCC Projects Completed w/ 100+ Active Projects

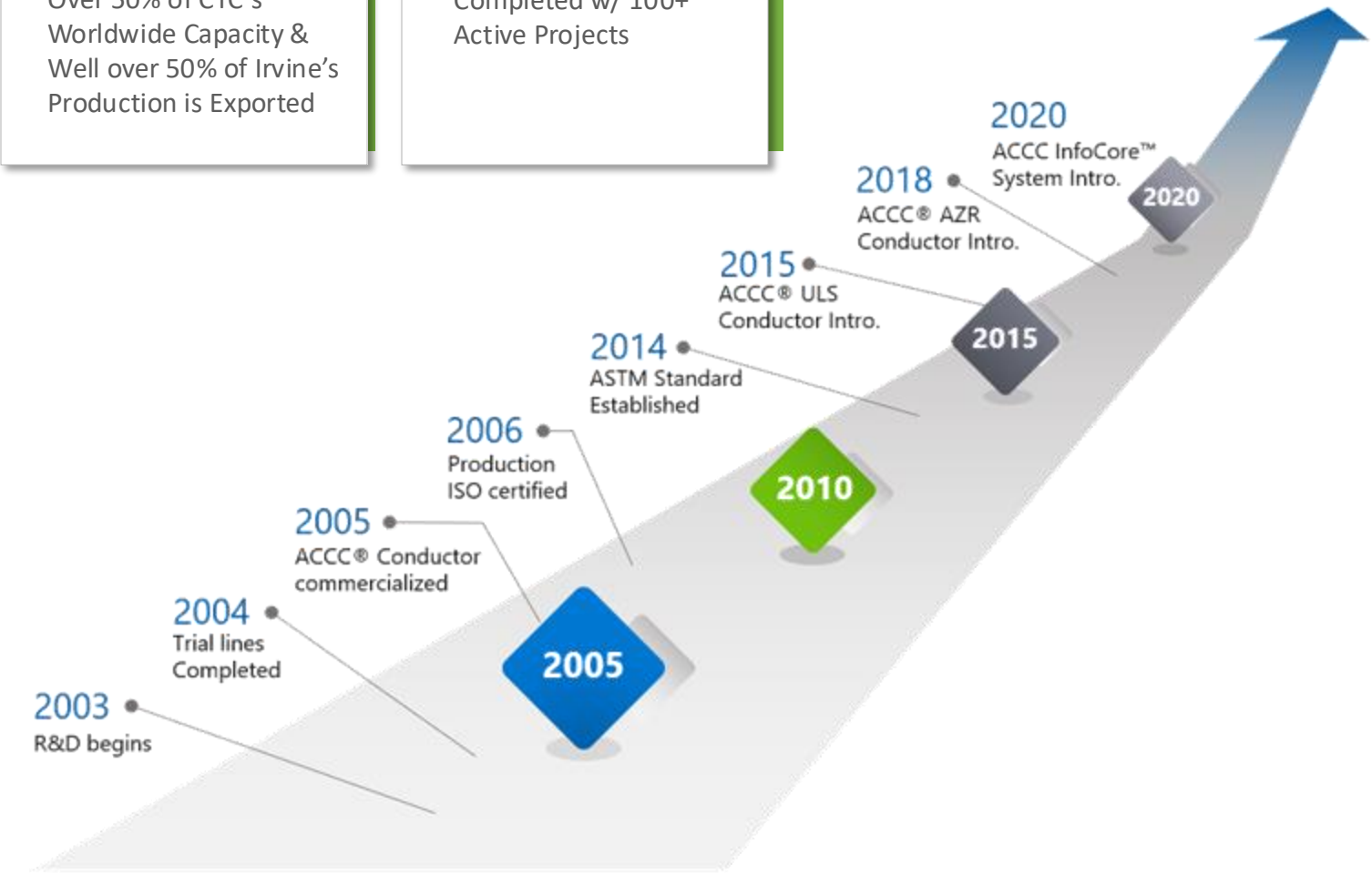
300+ Utilities served in 65+ Countries 30+ States

35+ ACCC Conductor Stranding Partners

10+ Hardware Manufacturing Partners

ACCC® is the only Advanced Conductor Manufactured in USA that **conforms to ASTM B987-20**

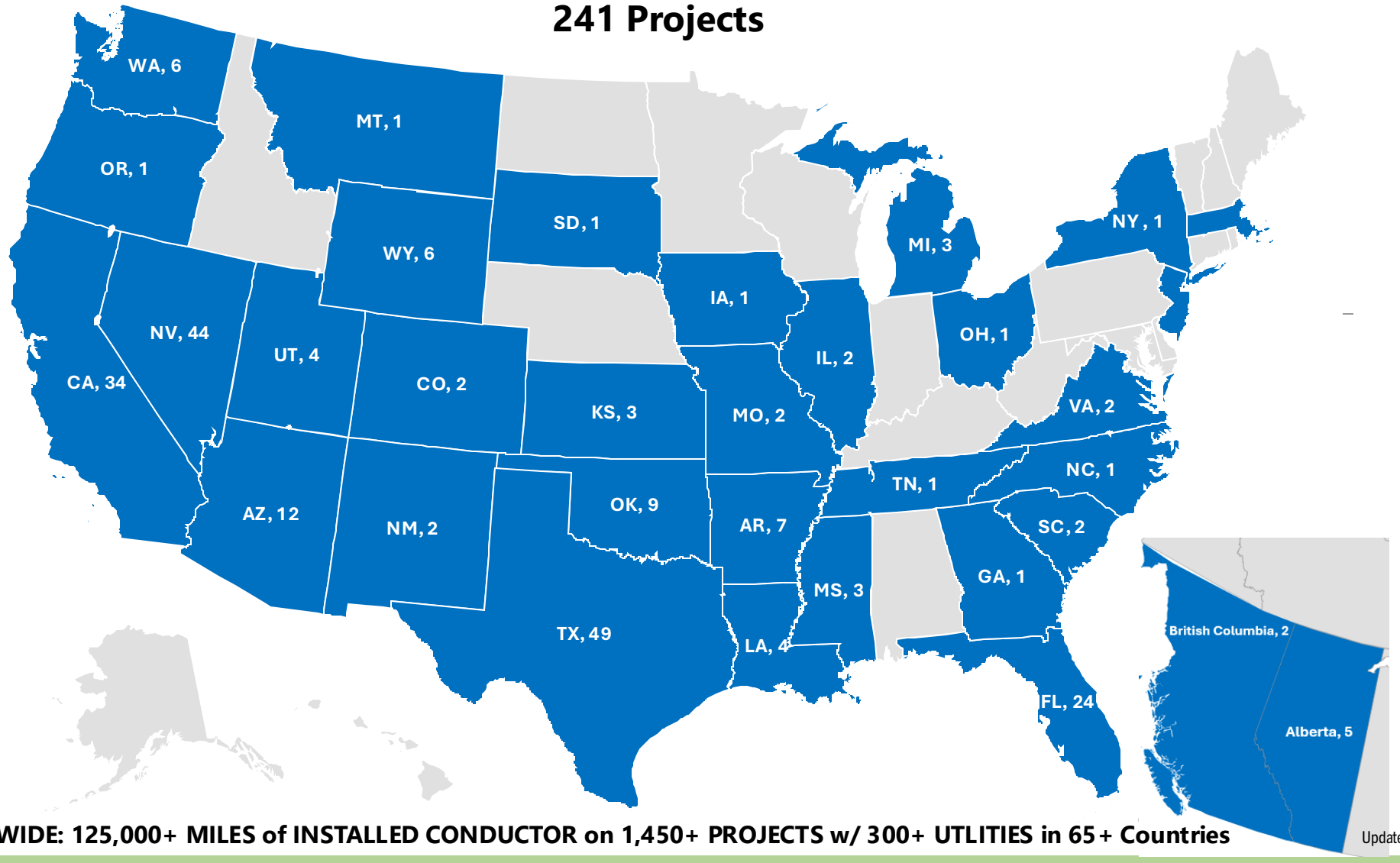
ISO 9001:2015, 14001:2015, & ISO/IEC 17025 certified



ACCC® Conductor Installations- North America

Alcan
AltaLink, L.P.
American Electric Power Company (AEP)
Arizona Public Service (APS)
ATCO Electric
Atlantic City Electric
Austin Energy
Black Hills Energy
Brookfield Renewables
Central Iowa Power Cooperative (CIPCO)
Cheyenne Fuel Light and Power (division of Black Hills Energy)
City of Alexandria, LA
City of Gillette, WY
City of Holland
City of Kingman
City of Riverside
ComEd / Exelon
Dominion
Douglas County PUD
Duke Energy Florida
Duke Entergy Alliance
ENMAX Power Corporation
Entergy Corporation
Flour Alliance - Tapoco APGI
Fortis BC
Holland Board of Public Works
KAMO
KBS Electric
Keys Energy
Kingman (FEMA)
Leesville Gas
Mohave Electric
National Grid USA
NorthWestern Energy
NV Energy
OG&E
Oncor Electric Delivery Company LLC
Orlando Utilities Commission (OUC)
Ormat Technologies, Inc.
Ozark Electric Cooperative
PacifiCorp
PEC
Progress Energy
Rappahannock Electric Cooperative
SCANA - South Carolina Gas & Electric
South Texas Electric Cooperative, Inc.
Southern California Edison
Southern California Edison (SCE)
SRP (Salt River Project)
Summit Line Construction
Tampa Electric Company (TECO)
Texas-New Mexico Power Company (TNMP)
WAPA
Xcel Energy

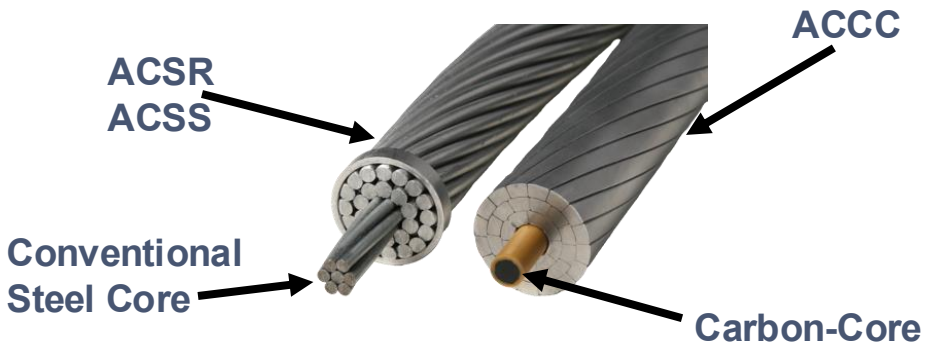
241 Projects

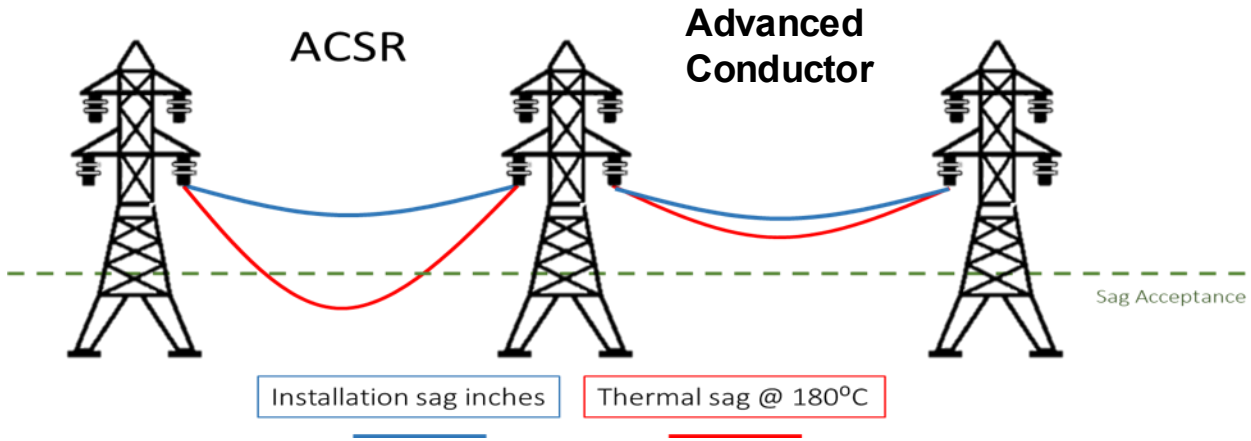


WORLDWIDE: 125,000+ MILES of INSTALLED CONDUCTOR on 1,450+ PROJECTS w/ 300+ UTLITIES in 65+ Countries

Updated FEB 2025

Advanced Conductors – Designed for Performance





Advanced vs. Conventional

- Replace steel and hard aluminum with carbon and annealed aluminum
- More aluminum that is more efficient equals:
  - 2x capacity capability
  - More efficient (~30% lower resistance)
- Much lower thermal expansion means 50% less thermal sag
- Corrosion resistant

Less Sag

- Less sag means smaller towers or fewer towers
- Less sag means wildfire risk mitigation

The Department of Energy defines Advanced Conductors* as:

"Conductors that increase line capacity by >1.5x (at a similar weight per foot); advanced conductors use composite core (instead of traditional steel cores) to improve efficiency and increase capacity with limited sag"

* April 2024 Liftoff Report formerly available at https://liftoff.energy.gov/wpcontent/uploads/2024/04/Liftoff_Innovative-Grid-Deployment_Final_4.15.pdf

CTC GLOBAL

Trusted by US and Global Customers

United States & Canada

Europe

Rest of World

Advanced Reconductoring: A Unique Capability

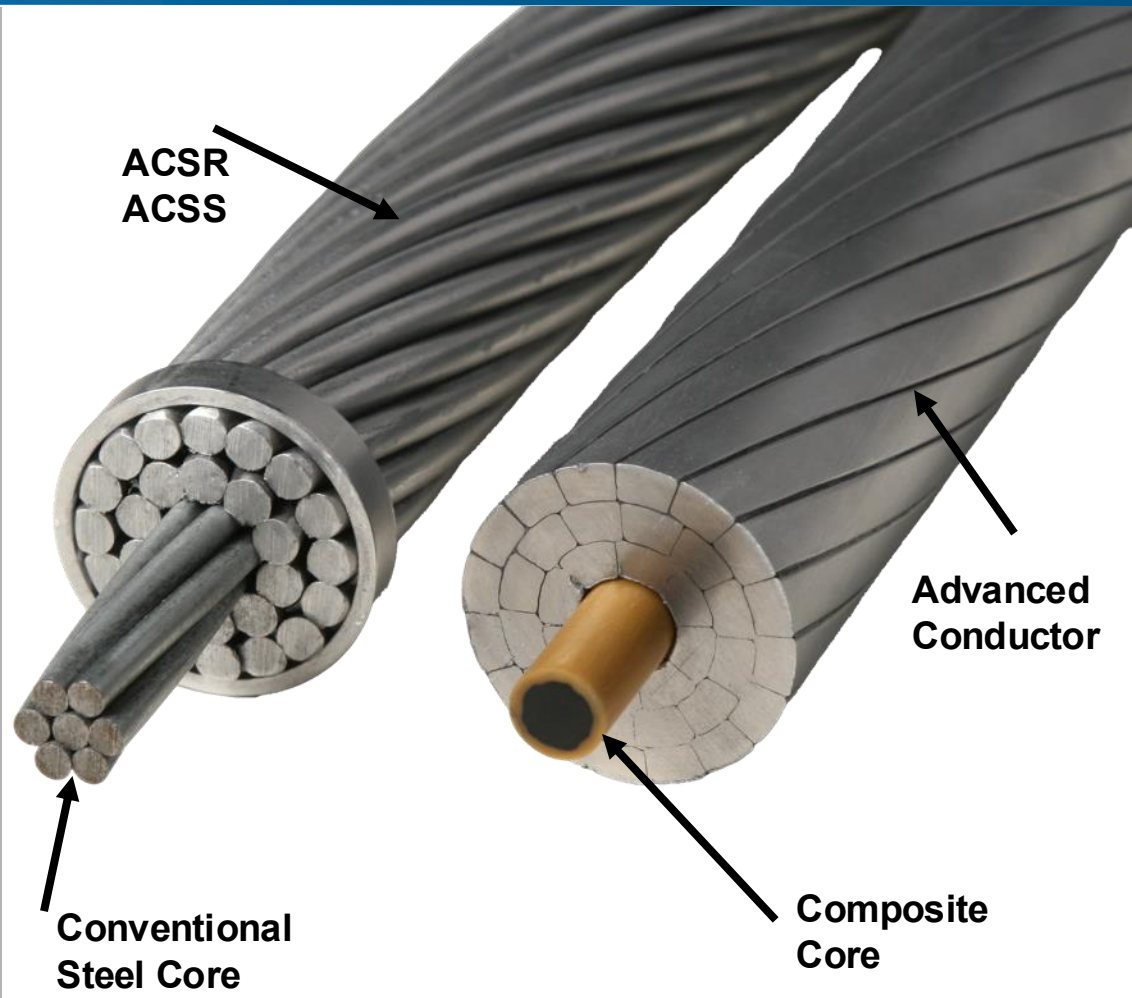
Even after more aluminum is added, the carbon-core Advanced Conductor **weighs about the same** as the conventional ACSR of the same diameter.

The carbon-core is **stronger and lighter** than the same diameter steel core.

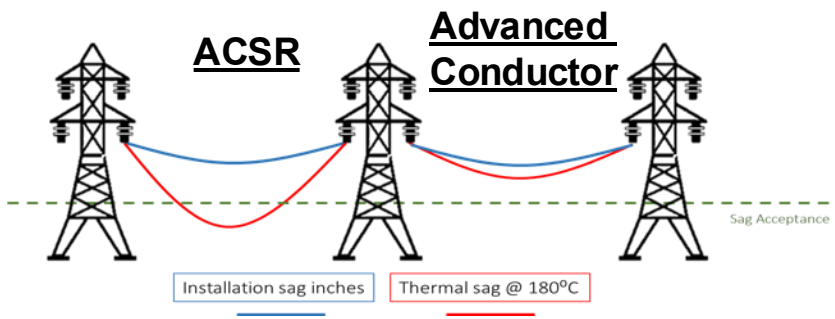
Enables a unique capability: advanced reconductoring

High-efficiency carbon-core Advanced Conductor can be installed on the same tower/structure that was designed for the conventional ACSR (same diameter & weight) and provides much greater capacity and energy efficiency (with MUCH lower sag).

Advanced reconductoring also provides an option to **defer non-critical line rebuilds** and **increase line capacity sooner**; with a lower total NPV compared to rebuilding the line early



What Does Advanced Reconductoring Enable?



SPEED. LOWER COST. MORE CAPACITY & LOWER LOSSES. WILDFIRE RISK MITIGATION & RESILIENCE.

Reconductoring with Advanced Conductor using the same structures in existing ROW, results in:

50%-100% More Operating Capacity	**50% Less Thermal Sag**	**~ 30% Lower Resistance**	**Up to 40% Lower Line Losses**
~25% the Cost of a New Line	**Faster Process ~ 8 - 24 months***	**Wildfire Risk Mitigation****	**There is an ACCC® option to meet ANY extreme ice criteria**

* Construction & Environmental permits (& processes) are eliminated

** GREATLY REDUCED sag; LOWER operating temperature of lines – Max 356°F v. 482°F for ACSS; ACCC can better withstand wildfire temperatures for faster service restoration - RESILIENCE

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

More than Reconductoring

Advanced Reconductoring	**2X capacity with ACCC®** on existing structures with **minimal retrofitting**	Similar capacity upgrade with traditional conductors requires more structure replacements or full rebuilds with significantly higher total project costs
New Lines & Rebuilds	**Substantially lower** structure & construction **costs when using ACCC®**	Lower sag allows for longer span (fewer structures) and/ or shorter structures requiring less right of way
Adding Unexpected Needed Capacity	**Faster & lower cost project completion** when replacing ACSR with ACCC®	Avoid costly project redesign and delays to quickly increase line capacity between project design and pre-construction stages due to unforeseen increased capacity needs

Adding Unexpected Needed Capacity Mid-Project

Situation

Need to **add more capacity than in initial project design**

ALTALINK
A BERKSHIRE HATHAWAY ENERGY COMPANY
ATCO

2019: Project design for new line completed

2023: Pre-construction begins post surveys, project planning, land acquisition and permitting

During this time, **generation growth forecasts grew faster than originally planned**

As a result, **original line capacity would be insufficient** to meet the demand

Problem solving with ACCC®

Replace ACSR with ACCC®: **avoid redesign and re-permitting; increase capacity at lower cost**

Complete project with ACSR = **costly redesign** and **delaying the project** by several years

Utilities replaced ACSR with **ACCC® Conductors** of same weight and diameter and **increased line capacity by 65%**

1,100+ mi of ACCC® to be installed with same line design and right-of-way **meeting construction schedule** for planned 2026 in-service date

Results

$30M
Cost savings from switching to ACCC® from ACSR

3 Years
Time savings from avoided redesigning, land renegotiations and re-permitting

65%
Extra line capacity added future proofing the grid

~$17M
Line loss savings lowering total cost of ownership*

Note: * 30-year savings using the Aluminum Association Method w/ 55% load factor

Lower Cost New Build & Rebuild Projects

Significant savings on total project costs for new build and rebuild projects by lowering structure and construction costs

Lower sag and weight of ACCC® Conductor allows for either **longer span (fewer structures)** and/ or **shorter structures** for the same line

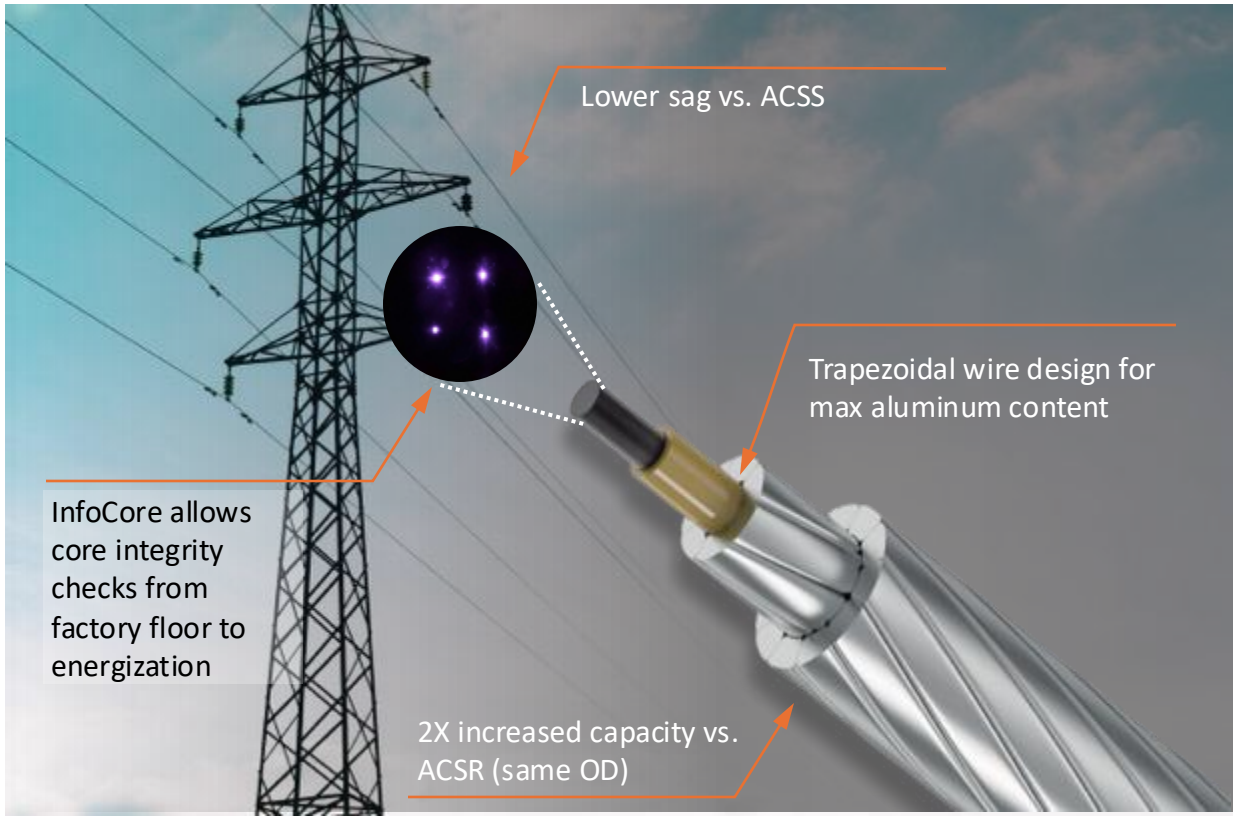
- Saves you time and capital
- Reduces new ROW permitting and timeline
- Helps address environmental sensitive areas

Ice loading performance is the same as the best performing steel core; heavy ice-centric options are available (e.g., AZR Al).

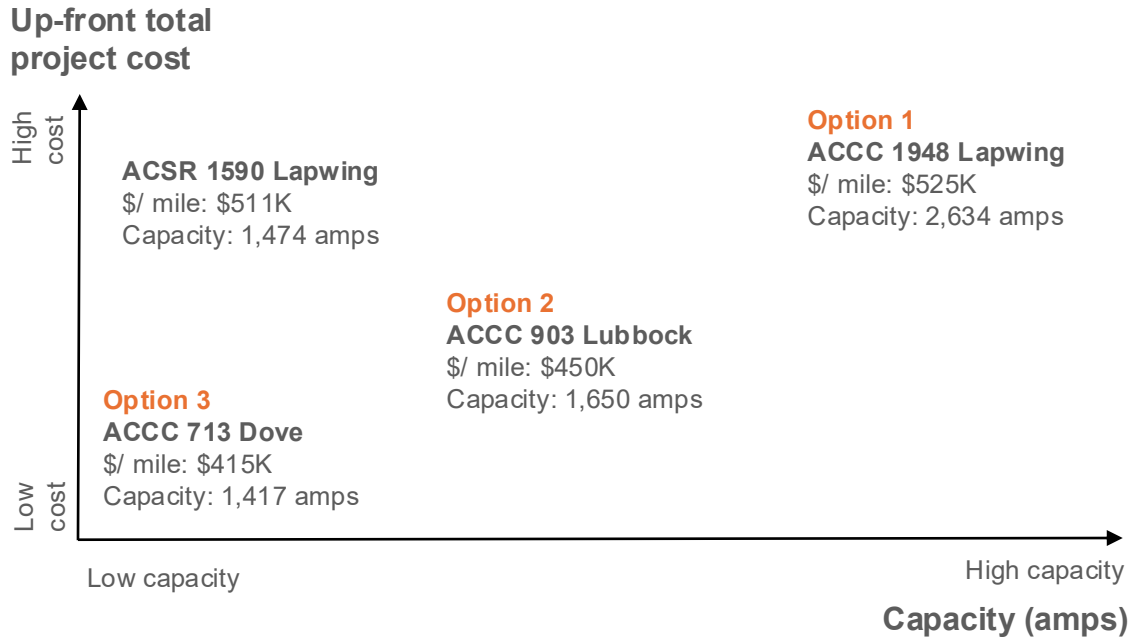
There is an ACCC® option to meet ANY extreme ice criteria

Based on findings from recent Power Engineers study with structure height as varied parameter		ACSR	ACCC®
Design parameters	**Conductor name**	Tern	Cardinal
	Line configuration, 230 kV	Double bundle	Single
	Diameter (in) per wire	1.063	1.198
	Aluminum area (kcmil) per wire	795	1221.8
	Ampacity @ max op	1917	2005
	Weight (lbs/kft)	1790	1225
	Span length (ft)	500 – 1000	500 – 1000
	Structures needed/ mile	5.3 – 10.6	5.3 – 10.6
	Structure Height (ft)	81.3 – 102.2	75.6 – 95.6
	Resistance at average load of 800A	0.0637	0.0896
	NESC case	Medium	Medium
	Tension @ NESC 250B (lbs/wire)	6,928 - 8,320	8,857 - 10,089
	Maximum thermal sag (ft)	14.8 – 35.7	9.1 – 29.1
Project costs ($/mile)	**Conductor costs**	$139,709	$172,973
	Structure, construction and other costs	$1.54M - $1.63M	**$1.12M - $1.25M**
	Total capital cost	$1.69M - $1.77M	**$1.30M - $1.42M**
	20 - 23% lower cost with ACCC® enabled by shorter towers		

Lower Up-Front Costs & Higher Line Capacity



ACCC® lowers total project costs while providing more line capacity



ACCC InfoCore® System offers a **quick & convenient way to assess powerline condition**

Gives you ability to evaluate conductor integrity and **identify and prioritize repairs, preventing costly outages**, especially after severe weather events or suspected physical damage

Cost-effective Transmission Expansion

- **ADVANCED RECONDUCTORING means grid capacity with SPEED and RESILIENCE**
- **REBUILD** faster and at lower cost
- **NEW LINES** with Advanced Conductors is **a win for consumer, the environment, and the grid**
- **ACCC® Conductor** has experience and performance: **THE ADVANCED CONDUCTOR**

The most tested, certified and used advanced conductor