

Transmission Opportunities and Challenges in the West

The Multiple Benefits of High Performance Transmission Conductors (HPTC):

Efficiency, Capacity, Reliability, and Carbon Reductions

CTC GLOBAL

WHY ARE WE HERE?

Transmission Opportunities and Challenges in the West

- Update aging infrastructure
- Reduce bottlenecks and increase capacity to provide for exchange of lower cost renewable energy across the region
- New lines carry long lead times
- Constraints are costly and threaten reliability
- “low hanging fruit” in existing ROW to do line-for-line re-conductoring with HPTC

High Performance Transmission Conductors (HPTC)

- Technologically advanced conductors providing much higher efficiency, capacity, reliability, and strength than traditional conductor
- HPTCs also deliver energy savings and cost-effective carbon reductions

- Carbon Reduction => ALL Regulated Air Emissions from Power Plants

The Situation

- **CTC Global:** Inventor of ACCC[®] conductor; one of several HPTC technologies*
- **ACCC: 12+ Years of Excellent Global Performance**
 - >450 Projects in 40 countries
 - 150 utilities
 - ~45,000 km installed
 - 25 global suppliers
 - 2016: 30 million feet produced in Irvine, CA
- **ACCC Multiple Benefits**
 - **Efficient:** cuts line losses by 30% +/-

2X Capacity: uses existing ROW; no new structures

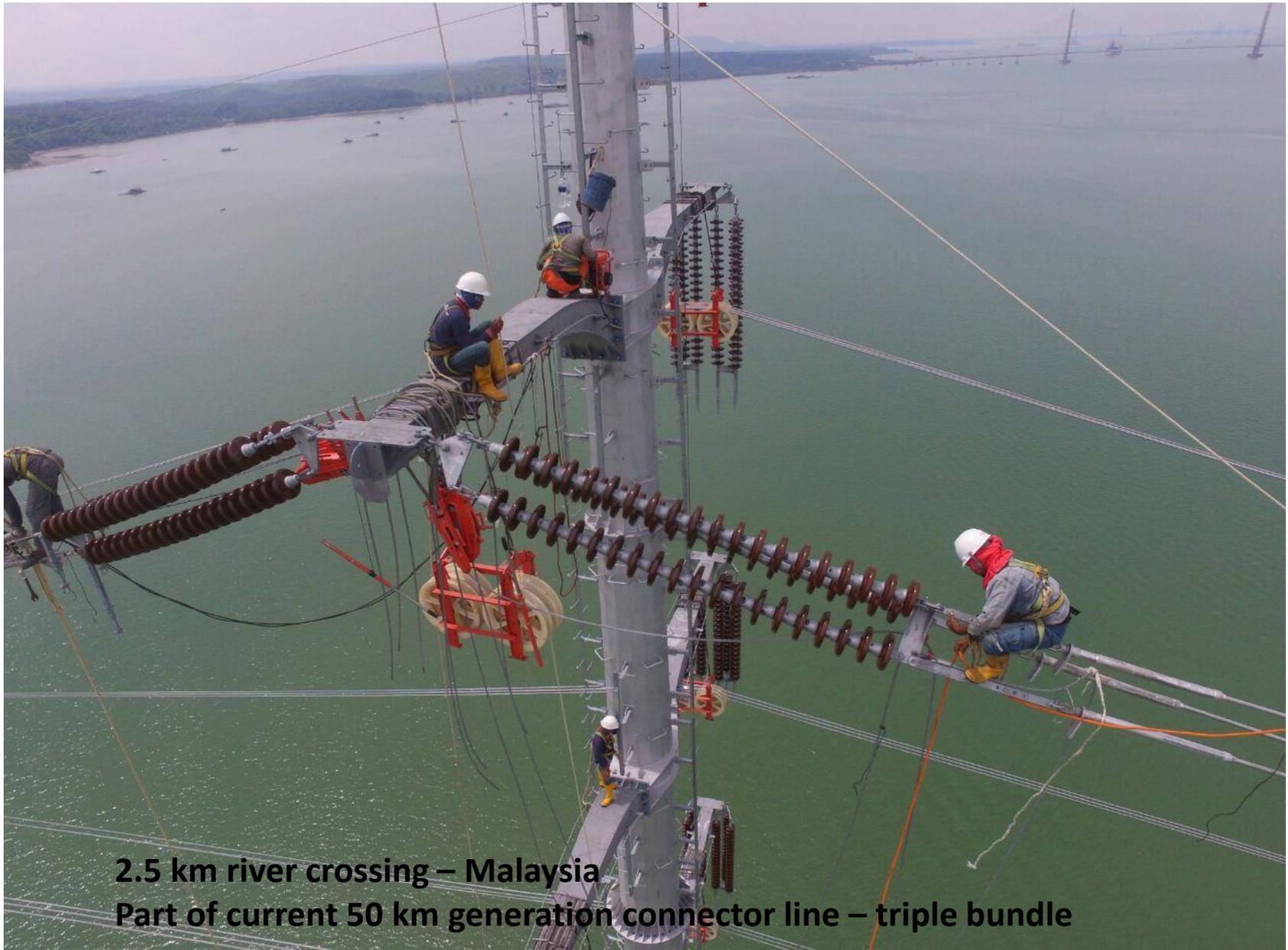
Reliable: eliminates line sag, stronger, resists corrosion

Lower impact, cost: longer spans, fewer & smaller towers



* 3M, CTC Global, Nexans, Southwire, Tokyo Rope, KNOWN ALSO AS HTLS CONDUCTORS

The Original Use of HPTC



2.5 km river crossing – Malaysia

Part of current 50 km generation connector line – triple bundle

Post-Tornado: Oklahoma G&E (2016)



The Situation

Billions \$\$ for
Generation Efficiency



100 year old
conductor technology



Billions \$\$ for
End-Use Efficiency



Improved Power Flow



Outdated Conductors Can't Meet Critical Needs of the Modern Grid:

- *More capacity to accommodate renewables and new loads*
- *Efficiency to cut costs and emissions*
- *Ever increasing demands for reliability, resiliency, and security*

Modern Conductors carry twice the power & cut losses by 30%

How ACCC Works: Carbon Fiber Replaces Steel



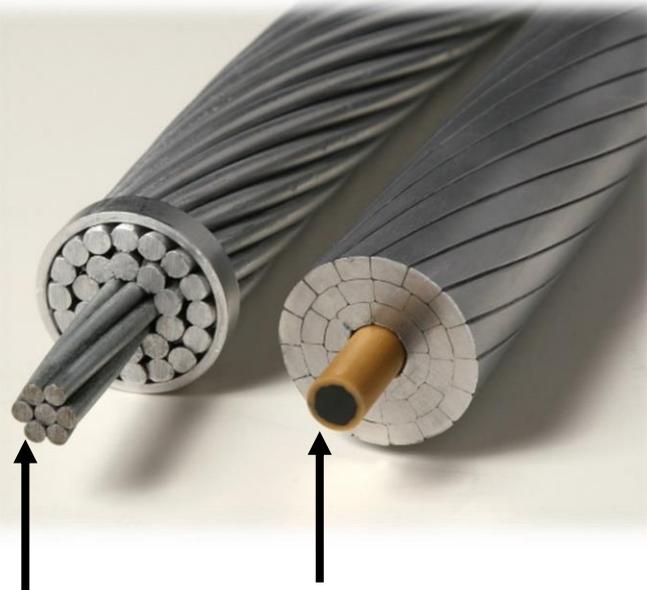
CTC GLOBAL ACCC



Carbon-fiber core enables lighter, stronger & more efficient conductors

28% more aluminum for same weight & diameter

Annealed aluminum is more conductive



**Conventional Steel Core
(100 year old technology)**

Advanced Composite Core

Trapezoidal design further improves efficiency

Minimal expansion at high load & temperature

Does not rust, corrode, yield, or fatigue

Stronger and more resilient

2016 Edison Award Winner

AEP Texas: 240 circuit miles, 345 kV line, 3 Phase

Replace Standard Conductor (ACSR) with High Performance Conductor (CTC Global ACCC®)

They Wanted:

- Increased transfer capacity to accommodate load growth
- Improved reliability from storms & corrosion

They Got:

- **Efficiency Savings (line losses cut by 30%):**
 - >283,000 MWh or ~\$34 million Annually PLUS 34 MW of avoided generation capacity (~\$34M value) – Fast Payback
- **Capacity:** 14.6% “Free Capacity”; 2X using existing towers and right of way
- **Reliability:** Eliminated line sag; stronger than steel; Corrosion resistant; performance at high loads & temps (resilient)
- **Ahead of Schedule:** Faster permitting, Live reconductoring

AND

>166K Metric Tons CO₂/yr . . . FOR FREE!!

Equivalent to removing > 34,000 cars off the road



AEP Project-Hot Reconductor

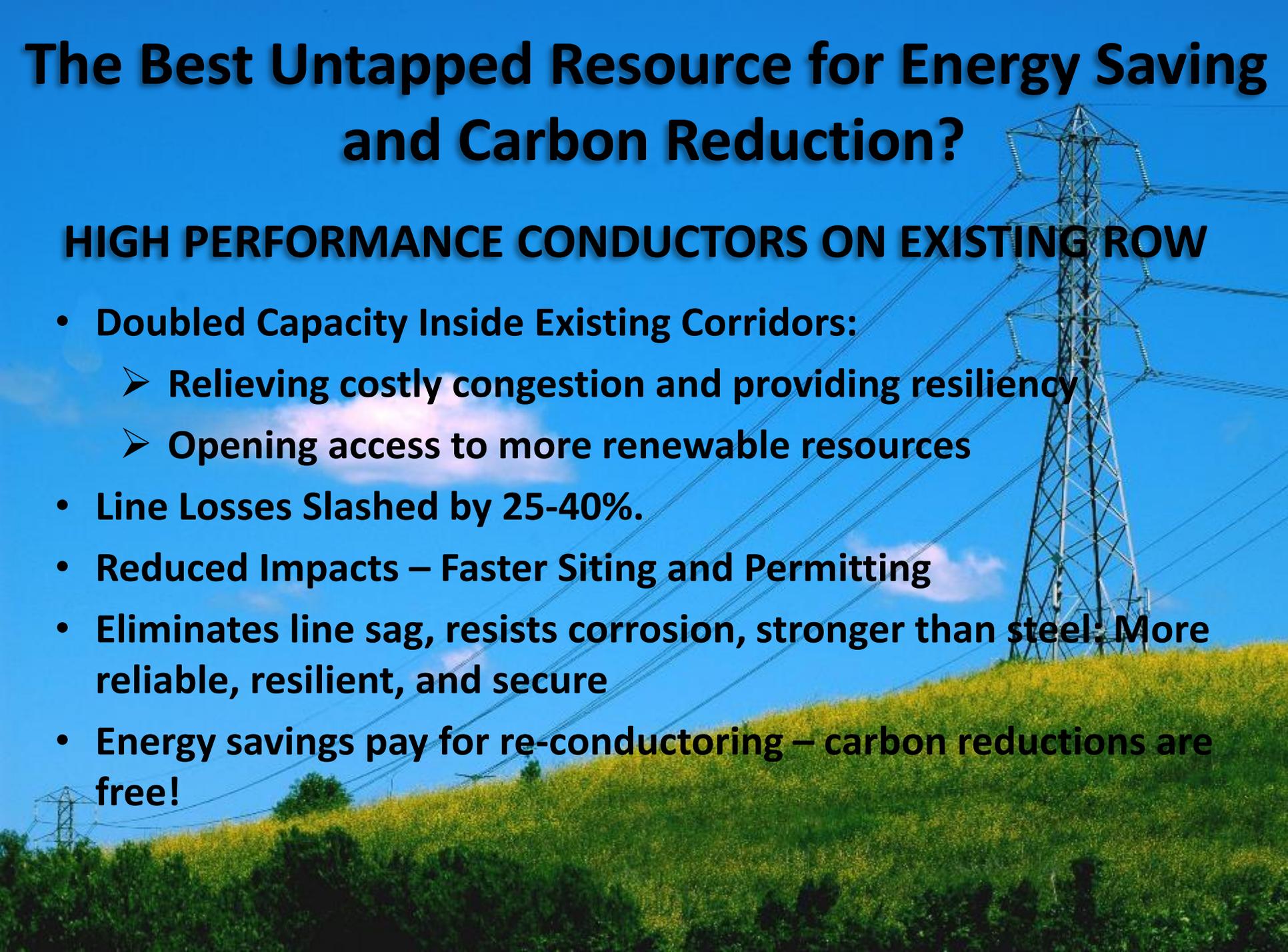


Temporary Pole

Move A to pole; reconductor A; ELECTRICALLY move B To pole; reconductor B; repeat for C; remove old line and temporary pole.

The Best Untapped Resource for Energy Saving and Carbon Reduction?

HIGH PERFORMANCE CONDUCTORS ON EXISTING ROW

- **Doubled Capacity Inside Existing Corridors:**
 - **Relieving costly congestion and providing resiliency**
 - **Opening access to more renewable resources**
 - **Line Losses Slashed by 25-40%.**
 - **Reduced Impacts – Faster Siting and Permitting**
 - **Eliminates line sag, resists corrosion, stronger than steel: More reliable, resilient, and secure**
 - **Energy savings pay for re-conductoring – carbon reductions are free!**
- 

What is changing?

Drive to “Get the Most” from the Existing High Voltage Grid:

- Expand & Balance Renewables
- Improve Reliability & Resiliency
- Universal Access & Affordability

What has not yet changed?

Transmission owners, planners, and regulators are not considering the capacity and efficiency benefits of High Performance Transmission Conductors in their decisions.

What can we do?

Just ask the Question:

Have you considered HPTC for this project?

Consider High Performance Transmission Conductor (HPTC) for EVERY transmission project:

- **Re-conductor heavily used lines to maintain reliability, reduce losses, and increase capacity**
- **New lines: minimize environmental impact and maximize capacity & efficiency**
- **Renewable “feeder” lines**





THANK-YOU

**High Performance Conductors
Providing
Efficiency, Capacity, Reliability
AND
Cost-Effective Carbon Reductions:**

CTC GLOBAL

Back-up and additional info slides follow

See June 2016 Public Utility Fortnightly

Pages 52-54

High Performance Transmission Conductors Are Improving Grid Efficiency

And Why it matters

By Dave Bryant

“Leveraging high performance conductors has become particularly important today. They not only serve to improve efficiency and reliability, they also allow us to increase the capacity of existing transmission lines so we can access cleaner sources of generation.”

<http://www.fortnightly.com/fortnightly/2016/06/high-performance-transmission-conductors-are-improving-grid-efficiency>

The US National Perspective...

Benefits of Upgrading the Grid with High Performance ACCC Conductor		
US Generation	4,093,606,000	MWh
Delivery System Losses (6%)	245,616,360	MWh
30% Reduction using ACCC	73,684,908	MWh
Annual CO2 Reduction (1,100#/MWh)	35,842,454	Metric Tons
<i>Value of Line Loss Reduction (at \$50/MWh)</i>	\$3.7	Billion
Generation Capacity Savings (80% Capacity Factor)	10,514	MW
<i>Value of Generation Capacity Savings</i>	\$10.5	Billion

The California Perspective...

Benefits of Upgrading the Grid with High Performance ACCC Conductor		
California Generation (total-direct use)	199,996,478	MWh
Delivery System Losses (7%)	13,999,753	MWh
30% Reduction using ACCC	4,199,926	MWh
Annual CO2 Reduction (633 #/MWh)	1,208,433	Metric Tons
<i>Annual Value of Line Loss Reduction (at \$50/MWh)</i>	\$210	Million
Generation Capacity Savings (80% Capacity Factor)	599	MW
<i>Value of Generation Capacity Savings</i>	\$599	Million

AND DOUBLE THE POWER CAPACITY OF THE UPGRADED LINES!

The Georgia Perspective...

Benefits of Upgrading the Grid with High Performance ACCC Conductor		
Georgia Generation (total-direct use)	121,271,378	MWh
Delivery System Losses (5.9%)	7,181,503	MWh
30% Reduction using ACCC	2,154,451	MWh
Annual CO2 Reduction (1,093 #/MWh)	1,177,407	Metric Tons
<i>Annual Value of Line Loss Reduction (at \$50/MWh)</i>	\$108	Million
Generation Capacity Savings (80% Capacity Factor)	307	MW
<i>Value of Generation Capacity Savings</i>	\$307	Million

AND DOUBLE THE POWER CAPACITY OF THE UPGRADED LINES!

AEP Wins the EEI EDISON AWARD

The EEI announcement... (Please also note outstanding video link)

<http://www.eei.org/resourcesandmedia/newsroom/Pages/Press%20Releases/American%20Electric%20Power%20Awarded%20EEI%E2%80%99s%202016%20Edison%20Award.aspx>

American Electric Power Awarded EEI's 2016 Edison Award

CHICAGO (June 13, 2016) – American Electric Power (AEP) today received the Edison Electric Institute's (EEI's) 2016 Edison Award, the electric power industry's most prestigious honor, for its Energized Reconductor Project in the Lower Rio Grande Valley of Texas. A panel of former electric company chief executives selected AEP for the 89th annual award from a group of distinguished finalists.

A video overview of the project is available online.

<https://www.youtube.com/watch?v=aPaNHawldFA&feature=youtu.be>

3rd Party Certification of Line Loss Savings and CO² Reduction

Download SCS Assessment Report at <https://www.ctcglobal.com/scs-certification/>

CTC Global ACCC[®] conductor is the first electric transmission conductor in history to earn 3rd Party certification for CO₂ emission reductions resulting from improved energy efficiency. ACCC conductor was verified to reduce CO₂ emissions associated with transmission line losses by 27 to 31 percent under certain design conditions compared to conventional steel reinforced ACSR conductors, the 100-year old technology currently used in most electric transmission and distribution power lines.



SCS Global's Certification Assessment of the ACCC conductor considered a range of conductor sizes, line lengths and voltages representing a number of project types in countries such as the U.S., Indonesia, Germany, India and Chile that have varied grid mixes and associated emission factors.



The SCS certification was conducted in accordance with ISO 14044:2006 standard for Life Cycle Assessment (LCA), a methodology used for evaluating the environmental performance of various products.