ASIA CLEAN ENERGY FORUM 2025

2–6 June | ADB Headquarters, Manila

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Deep Dive Workshop

Doubling Down to Triple Up: HTLS Conductors for Improved Grid Efficiency and Grid Security

(ADB)

4 June 2025 (Wednesday) • 2:00–3:30 p.m.

ASIA CLEAN ENERGY FORUM 2025

Empowering the Future: Clean Energy Innovations, Regional Cooperation and Integration, and Financing Solutions

2–6 June | ADB Headquarters, Manila

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Luke, Ogoshi

Division Director
Tokyo Rope International ACFR Division

Featured Speaker

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ACFR®

ALUMINUM CONDUCTOR FIBER REINFORCED

HTLS Conductor With a Stranded Carbon Fiber Core

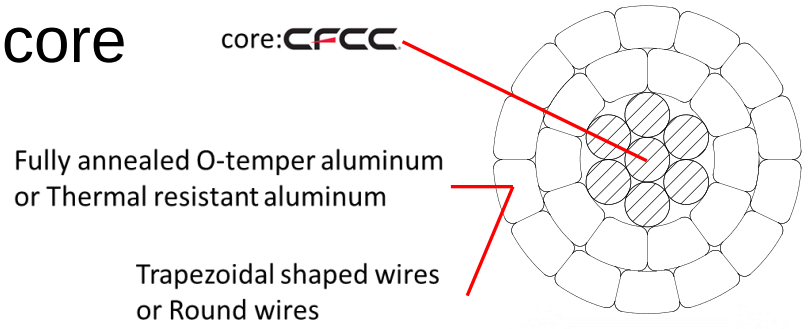
June - 2025

TOKYO ROPE INTERNATIONAL INC.

TRI
TOKYO ROPE INTERNATIONAL

Design

- Carbon Fiber Composite Cable core
- 7 strand core in several sizes
- Flexible & robust



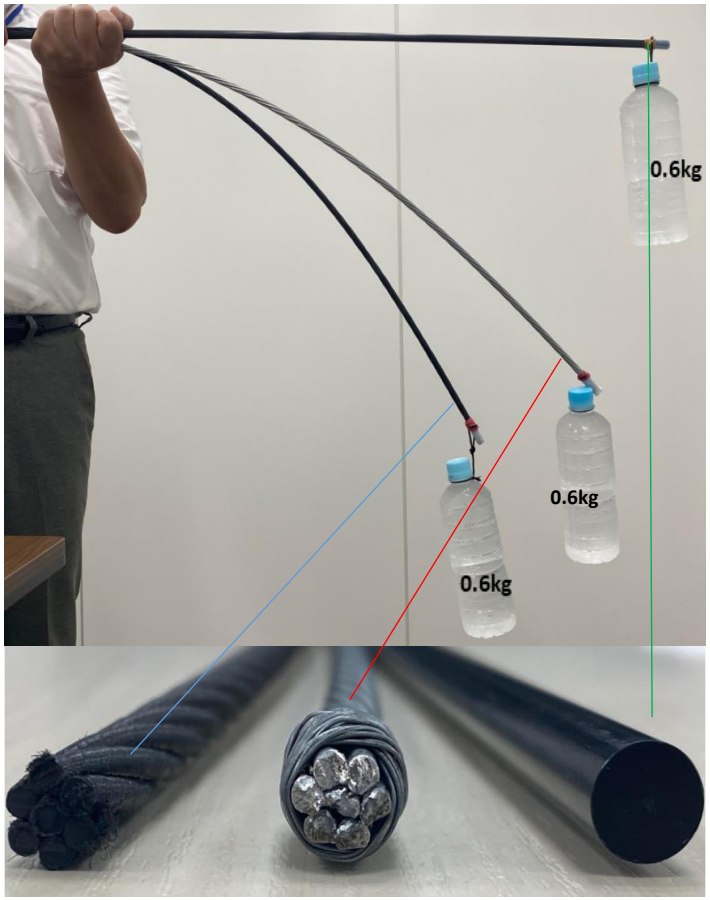
- Fully annealed 0-temper aluminum
- Thermal resistant aluminum

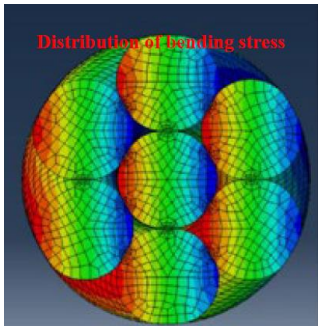
- Trapezoidal shaped wires
- Round wires

- Easy installation
- Conventional equipment
- Conventional hardware design

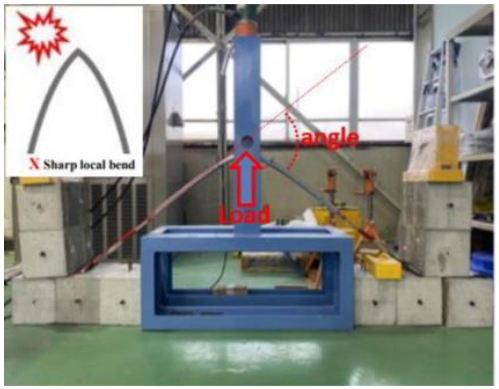
CFCC is stranded core: Flexible & Robust

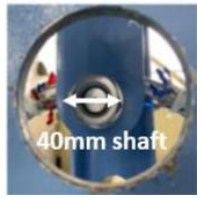
- The CFCC is more flexible than a similar size steel core
- Severe bending test shows that the CFCC is difficult to break
- In case there is a problem during installation, it will be clearly visible on the outside of the conductor



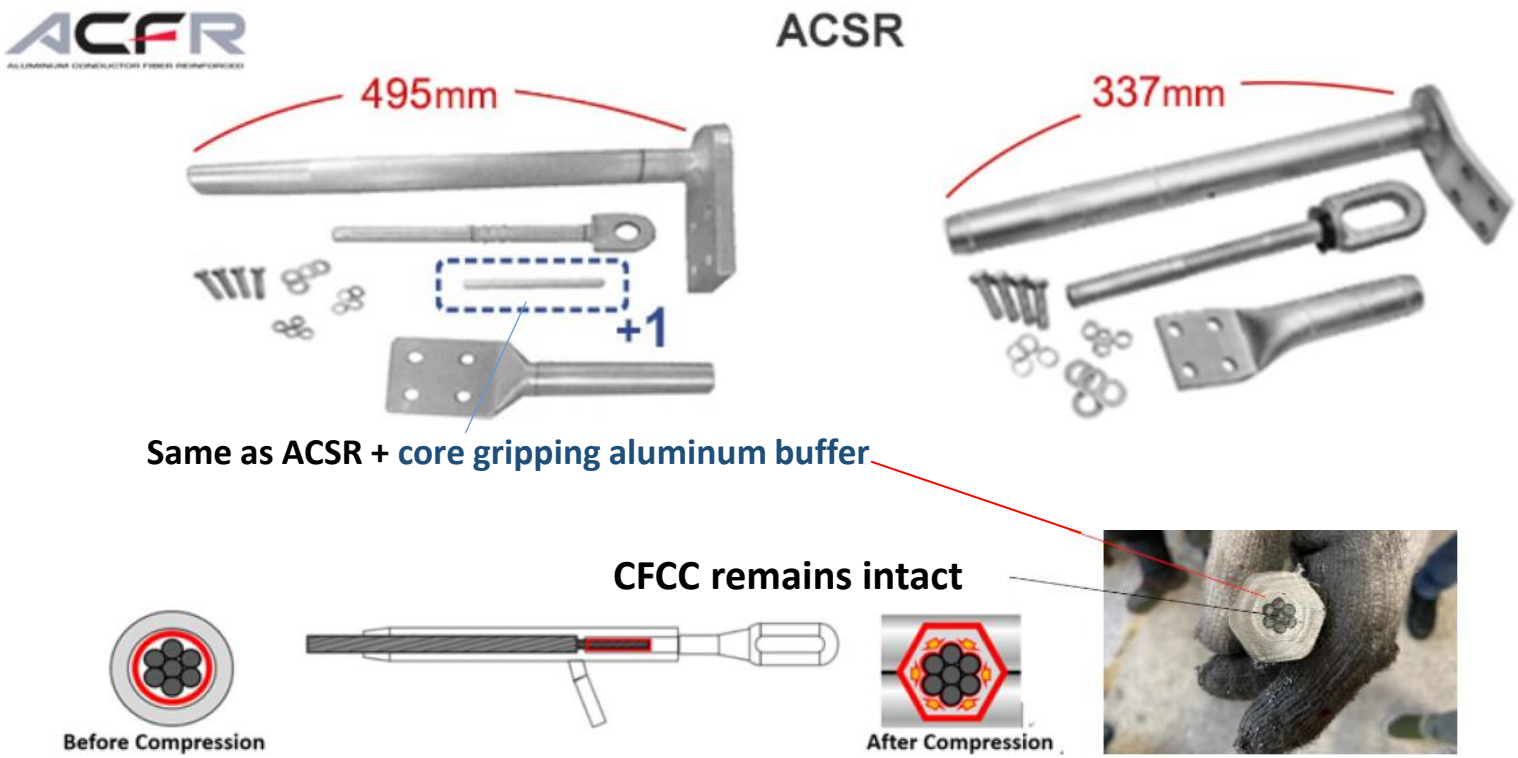


Avoids a single-point-of-failure
↓
Longevity





Compression-Type Fitting just like ACSR



<ACFR Hardware >

- No special equipment or procedure required
- Reasonable pricing
- Local manufacturing (subject to approval)
- Virtually same installation time as ACSR (more advantageous for multi-bundle)
- Same QC method as ACSR (Checking across-flat width)

Design Concept for ACFR Technology

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	ACFR	ACSR
		
Aluminum Shape	Round or Trapezoidal	
Core Shape	Stranded	
Hardware Method	Compression	

ACFR is ACSR Like HTLS Conductor

Design Example: ACSR vs ACFR

Precondition: Same conductor diameter (Zebra size)

Type		Size	Dia.	Operating Temp.	Transmission Loss	Transmission Capacity	Sagging	
							Reconduc-toring	New Line
ACSR	"Conventional“	Zebra (430/55)	28.62	75 °C	Standard	Standard (700A)	Standard	
ACFR	"Low Loss"	Zebra Eq. (542/56)	28.62	**67 °C**	**26% Less**	Same (up to +29%)	Same	**16% Less (700A)**
	"High Capacity"	Zebra Eq. (494/95)	28.62	**180 °C**	More (※)	**More than double (218%)**	Same	**26% Less (700A)**

(※) Transmission Loss of ACFR is bigger operating at 218% of course but ACSR need another new circuit to get near the same transmission capacity of ACFR.

- Using ACFR for Low loss can have a payback time of only 3-5 years

Basic business model

Installation Advice / Training

ACFR Design Advice

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CFCC

Conductor Cable Producer

ACFR

EPC Contractor

Transmission Line

Utility Co.

ACFR sample for Accessories development

Accessories Producer

Accessories

CFCC sample for Accessories Development

Supply for 60+ projects

Supply	ACFR Size	Voltage	Country	Utility Name
2002	160/37-T1-RR	66kV	Japan	Tohoku Electric
2003	160/37-T1-RR	66kV	Japan	Tohoku Electric
2012	320/35-FA-TT	110kV	China	Hainan Power
2013	320/37-FA-TT	220kV	China	Hainan Power
2015	312/37-FA-TT	150kV	Indonesia	PLN
2015	312/37-FA-TT	150kV	Indonesia	PLN
2017	312/37-FA-TT	150kV	Indonesia	PLN
2018	312/37-FA-TT	150kV	Indonesia	PLN
2018	312/37-FA-TT	150kV	Indonesia	PLN
2018	493/69-FA-TT	138kV	USA	CenterPoint
2018	492/56-FA-TT	22kV	India	JSW
2019	312/37-FA-TT	150kV	Indonesia	PLN
2019	493/69-FA-TT	138kV	USA	CenterPoint
2019	200/28-T1-TT	138kV	Brazil	CEMIG
2020	242/56-FA-TT	138kV	USA	LCRA
2020	665/71-FA-TTT	230kV	Thailand	EGAT
2020	99/17-T3-RR	66kV	India	Sikkim Board
2020	312/37-FA-TT	150kV	Indonesia	PLN
2020	281/37-FA-TT	132kV	India	APTRANSCO
2021	103/44-T3-TT	69kV	Canada	NB Power
2020	377/37-T1-TT	138kV	Brazil	CTEEP
2021	220/28-T1-TT	138kV	Brazil	CEMIG
2021	245/37-FA-RR	230kV	Ecuador	CELEC
2021	492/56-FA-TT	220kV	India	MPPTCL
2021	281/37-FA-TT	132kV	India	JKPTCL
2022	483/97-T3-TT	230kV	USA	Entergy
2022	493/69-FA-TT	230kV	USA	Entergy
2022	493/69-FA-TT	115kV	USA	Entergy
2022	493/69-FA-TT	138kV	USA	Centerpoint
2022	470/56-FA-TT	275kV	Malaysia	TNB
2022	281/37-FA-TT	132kV	India	UPPTCL
2022	281-37-FA-TT	132kV	India	UPPTCL
2022	267/37-FA-TT	132kV	India	JKPDD
2022	539/56-FA-TTT	220kV	India	PSTCL

Supply	ACFR Size	Voltage	Country	Utility Name
2022	190/37-T1-TT	66kV	Japan	Tohoku Electric
2023	539/56-FA-TTT	220kV	India	PSTCL
2023	220/28-T1-TT	138kV	Brazil	CEMIG
2023	539/56-FA-TTT	220kV	India	JKPTCL
2023	483/97-FA-TT	230kV	USA	Oncor
2023	806/97-T3-TTT	ND	USA	Entergy
2023	483/97-FA-TT	138kV	USA	Austin Energy
2023	806/97-T3-TTT	ND	USA	Entergy
2023	214/28-FA-TT	115kV	USA	BGE-Exelon
2024	281/37-FA-TT	132kV	India	MPPTCL
2024	768/55-T1-RRR	138kV	Brazil	EDP
2024	215/23-FA-TT	66kV	India	PSPCL
2024	281/37-FA-TT	132kV	India	WB Area
2024	415/44-FA-TT	33kV	Indonesia	Aman
2024	515/55-FA-TT	150kV	Indonesia	Aman
2024	211/28-FA-TT	66kV	Malaysia	SESB
2024	265/44-T3-RR	220kV	Austria	APG
2024	281/37-FA-TT	132kV	India	PGCIL
2024	367/44-FA-TT	220kV	Vietnam	NPT
2024	534/55-T1-TT	230kV	Brazil	Copel
2024	312/37-FA-TT	150kV	Indonesia	PLN
2024	312/37-FA-TT	150kV	Indonesia	PLN
2024	165/23-FA-TT	66kV	India	KPTCL
2024	131/18-FA-TT	33kV	India	Jindal
2024	146/17-FA-TT	66kV	India	Kudan
2024	165/23-FA-TT	66kV	India	KPTCL
2024	805/96-FA-TTT	ND	USA	SCE
2025	303/67-T3-TT	400kV	HK/China	CLP

Project Profile : Japan – First Projects

Project Overview

Customer	Tohoku Electric Power Co
Project	Kashimadai Line / Sekiya Line
Location	Miyagi, Niigata / Japan
Type	Reconductoring project
Year Installed	2002 / 2003
Voltage	66 kV

Solution

ACFR 159/37-T1-RR (ACFR 160)

Result

20% capacity increase while maintaining clearances
Utilized existing towers without modification
Maintained existing right of way

2003 still in operation
The olderst transmission line using carbon core in the world with 20+ years of operating to date without problems

Disassembly and Inspection of old line

4. Performance verification test results of ACFR

- After using ACFR for 16 years near the coast, Performance verification tests conducted.

1. Appearance of CFCC
   ⇒ No damage or corrosion was observed in the CFCC
2. Cross section of CFCC
   ⇒ No cracks, damage, or other abnormalities were observed in the CFCC
3. Tensile test result of ACFR
   ⇒ Almost the same tensile load as in the acceptance test

CFCC at the bottom of sagging

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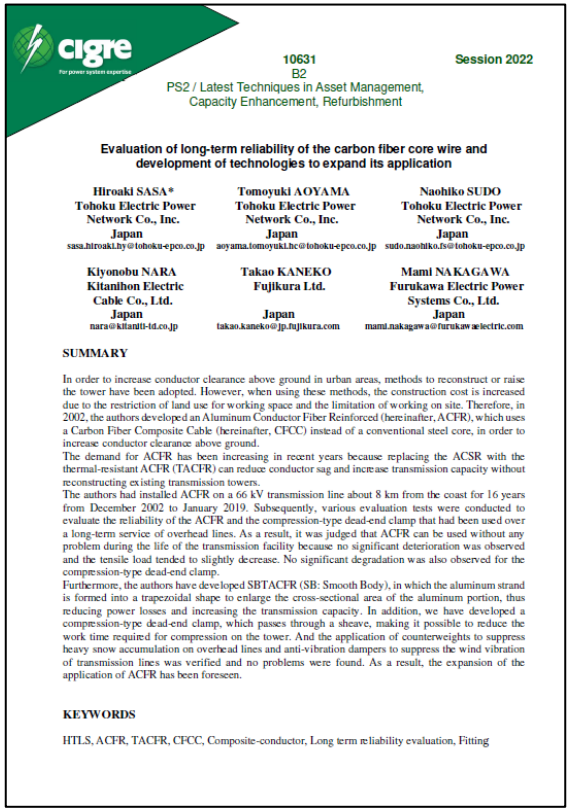

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Session 2022

PS2 / Latest Techniques in Asset Management, Capacity Enhancement, Refurbishment

Evaluation of long-term reliability of the carbon fiber core wire and development of technologies to expand its application

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SUMMARY

In order to increase conductor clearance above ground in urban areas, methods to reconstruct or raise the tower have been adopted. However, when using these methods, the construction cost is increased due to the restriction of land use for working space and the limitation of working on site. Therefore, in 2002, the authors developed an Aluminum Conductor Fiber Reinforced (hereinafter, ACFR), which uses a Carbon Fiber Composite Cable (hereinafter, CFCC) instead of a conventional steel core, in order to increase conductor clearance above ground.

The demand for ACFR has been increasing in recent years because replacing the ACSR with the thermal-resistant ACFR (TACFR) can reduce conductor sag and increase transmission capacity without reconstructing existing transmission towers.

The authors had installed ACFR on a 66 kV transmission line about 8 km from the coast for 16 years from December 2002 to January 2019. Subsequently, various evaluation tests were conducted to evaluate the reliability of the ACFR and the compression-type dead-end clamp that had been used over a long-term service of overhead lines. As a result, it was judged that ACFR can be used without any problem during the life of the transmission facility because no significant deterioration was observed and the tensile load tended to slightly decrease. No significant degradation was also observed for the compression-type dead-end clamp.

Furthermore, the authors have developed SBTACFR (SB: Smooth Body), in which the aluminum strand is formed into a trapezoidal shape to enlarge the cross-sectional area of the aluminum portion, thus reducing power losses and increasing the transmission capacity. In addition, we have developed a compression-type dead-end clamp, which passes through a sheave, making it possible to reduce the work time required for compression on the tower. And the application of counterweights to suppress heavy snow accumulation on overhead lines and anti-vibration dampers to suppress the wind vibration of transmission lines was verified and no problems were found. As a result, the expansion of the application of ACFR has been foreseen.

KEYWORDS

HTLS, ACFR, TACFR, CFCC, Composite-conductor, Long term reliability evaluation, Fitting

Page from a presentation by the Utility in Cigre forum

Project Profile : Hill Stringing in India

Project Overview

Customer	JKPTCL
Project	Cheshmashahi – Pampore line in Srinagar
Location	India
Type	Reconductoring project
Year Installed	2022
Voltage	132 kV

Solution

ACFR 281/37-FA-TT

Result

Total line length of the project was 13 kms and more than 90% was in hill.

It was difficult to access with equipment due to the hills and military area restriction.

The conductor had to be carried by people for 10 kms to the site for pulling

Manual stringing method had to be used extensively but that was possible due to the robust and flexible ACFR conductor.

Project Profile : Mountain Crossings in Brazil

Project Overview

Customer	Cemig
Project	Minas Gerais
Location	Brazil
Type	New line project
Year Installed	2021
Conductor Length	60 km
Voltage	138 kV

Solution

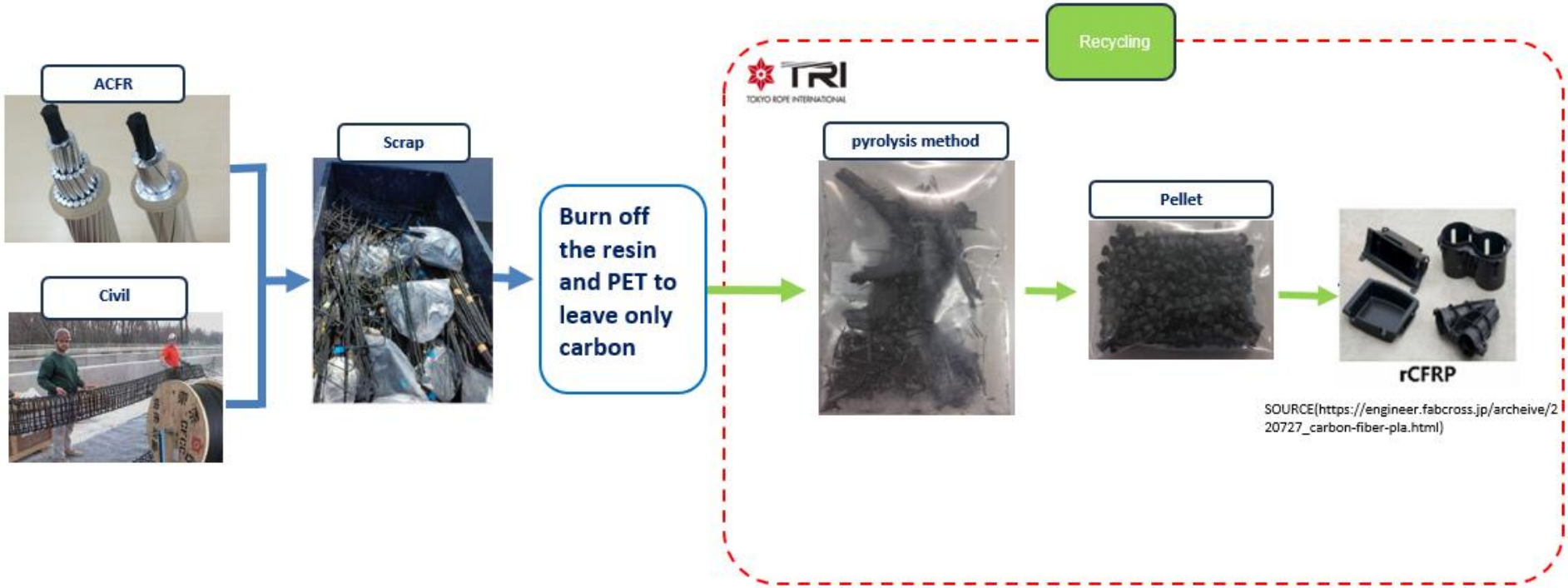
ACFR 220/28-T1-TT

Result

Crossings in mountainous area up to 1.1 km and up to 300 m elevations
Doubled capacity of line while maintaining clearances
This was a new field installation where ACFR made crossings easier
The flexibility and robustness of ACFR also made Lay-Out pulling possible when it was difficult to place pulling equipment

For Sustainable Circular Economy

Thanks to its unique material composition, CFCC can be recycled at a reasonable cost, making it both economically and environmentally sound.



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Thank you !