DS Elektrodag

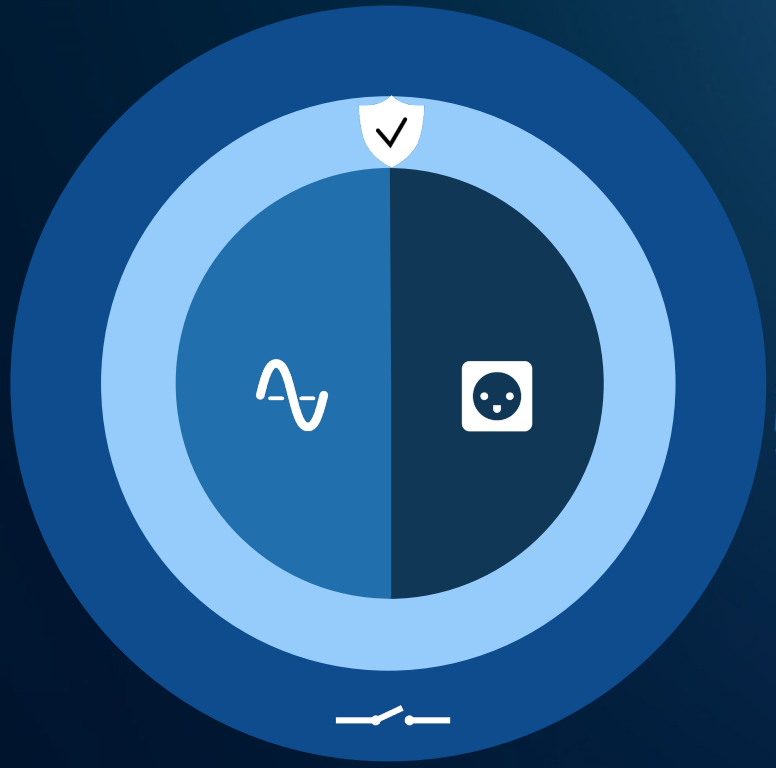
-fremtidssikret elnet

13. marts 2025

DANSK STANDARD

DS Elektrodag

-fremtidssikret elnet



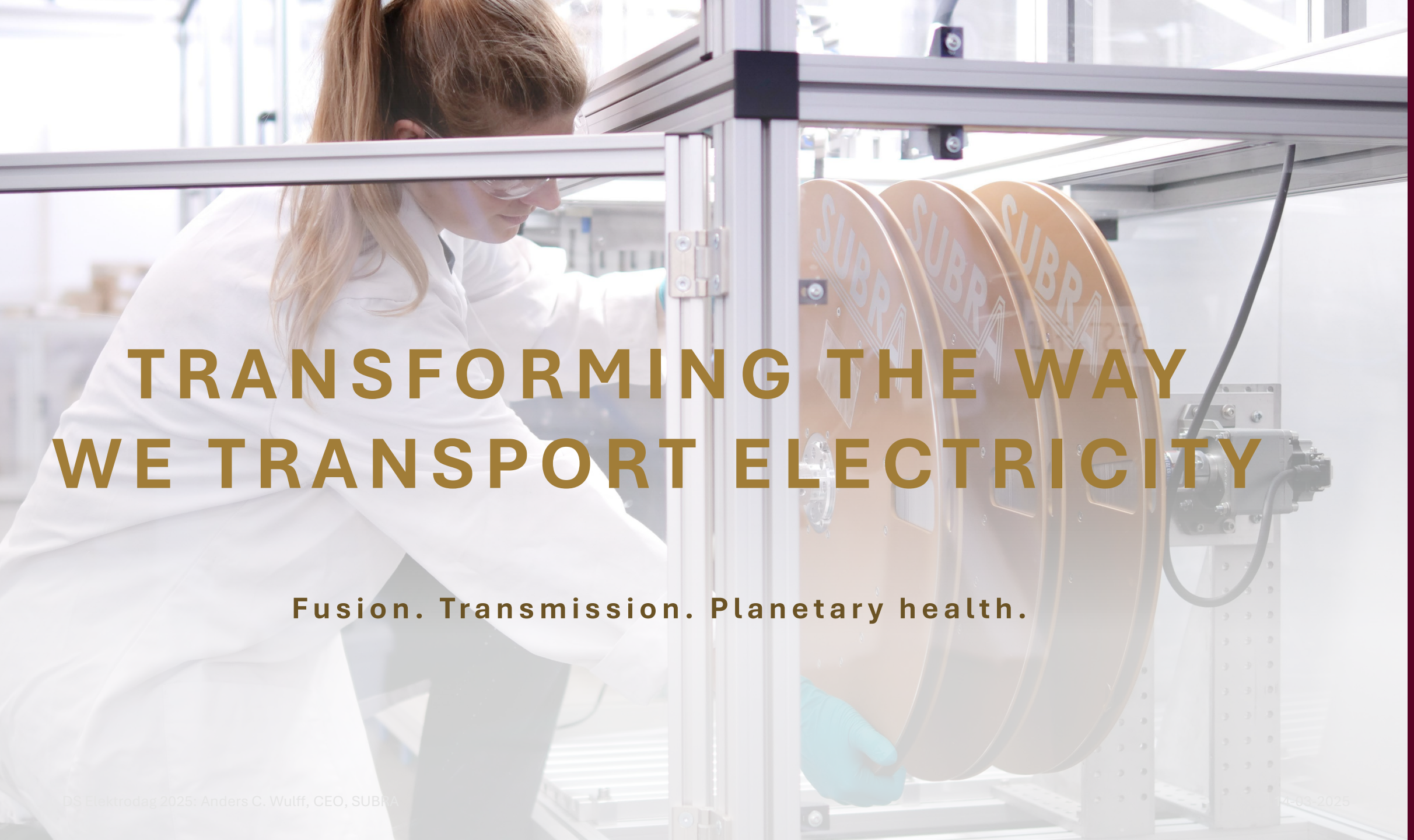
Næste indlæg:

15.45 Superledere og det fremtidssikrede elnet

v/ Anders C. Wulff, CEO & Founder, SUBRA

DS

DANSK STANDARD



TRANSFORMING THE WAY WE TRANSPORT ELECTRICITY

Fusion. Transmission. Planetary health.

Anders C. Wulff

Chief Executive Officer
SUBRA A/S

SUBRA

...is a **science based, deep-tech company** built on 15 years of research in superconductor technology and a spin-off from the Technical University of Denmark.

We are an **impact company**, strongly committed to a sustainable future and to being a key player in the **climate solution**.

SUBRA is on a path to become a **key player** in a **European superconductor supply chain**, securing important strategic development in Europe.

THE CHALLENGE

The climate crisis

Energy supply security

Scarcity of energy

Scarcity of materials

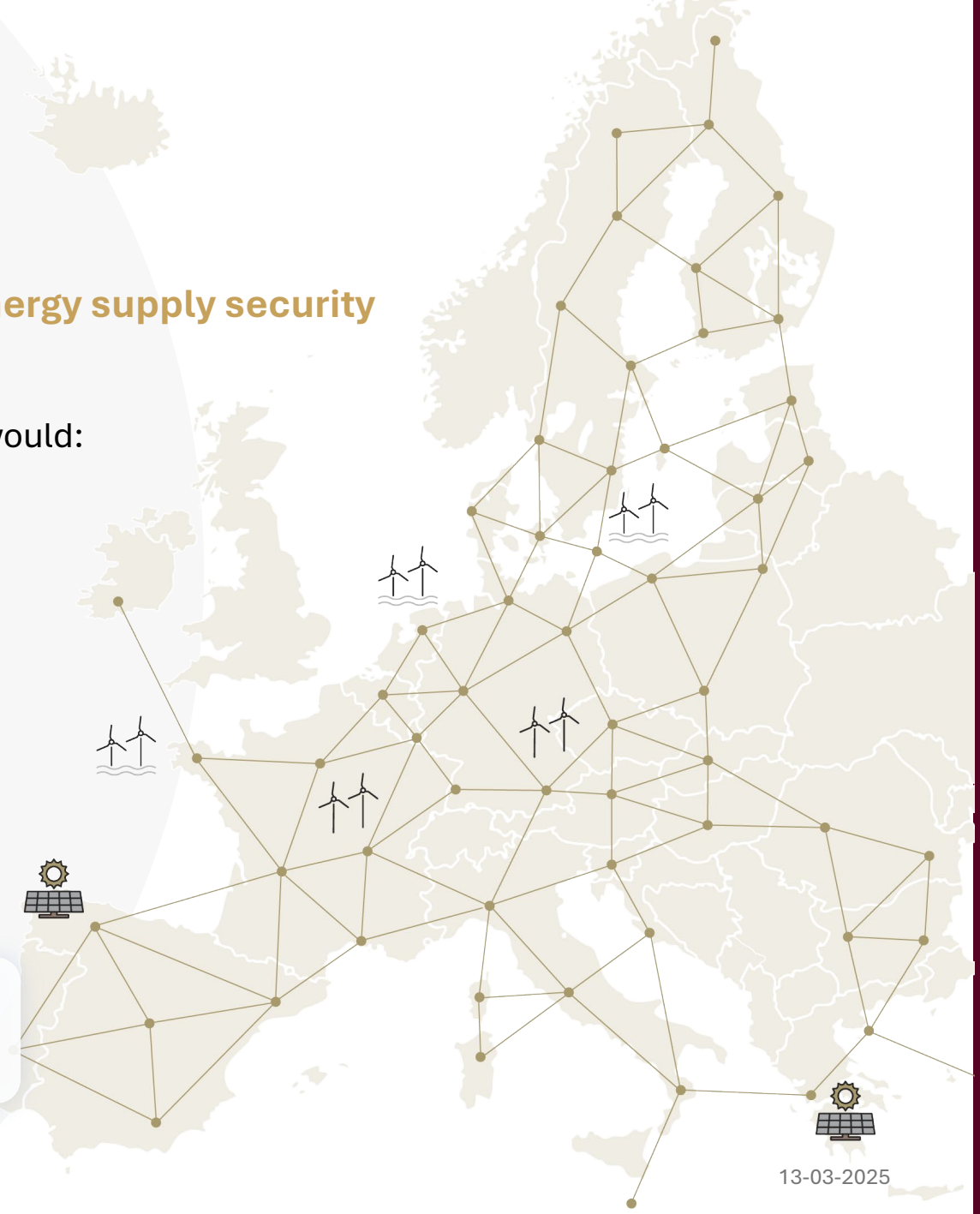
Greentech innovation gap

THE CHALLENGE

An EU electrification, decarbonisation and regional energy supply security require long-distance high-power transmission

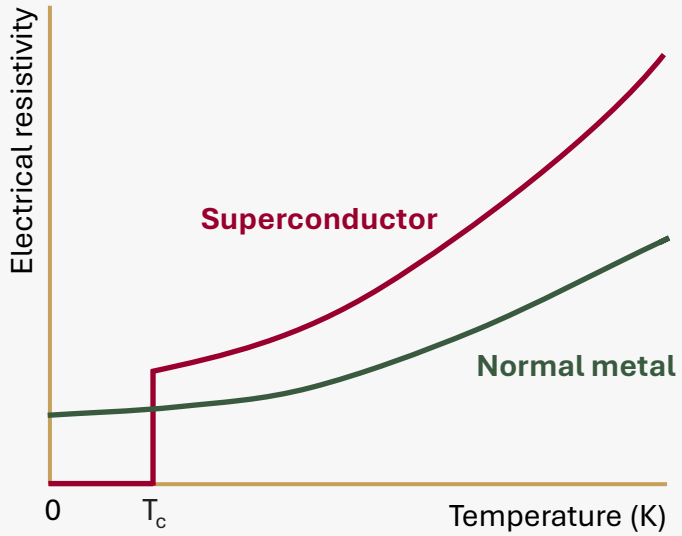
However, based on current copper technology, this transition would:

- **Require 37 M tons of copper**
  (Double of the global yearly production)
- **Waste 50 GW electricity** equal to the electricity production of 50 nuclear power plants due to electrical resistance in copper wires
- Require **huge amounts of AC/DC converters** and extensive transmission corridors across Europe
- Mean that **cost of transmission of renewable energy between regions will overcome cost of energy production** by 2030



SUPERCONDUCTORS

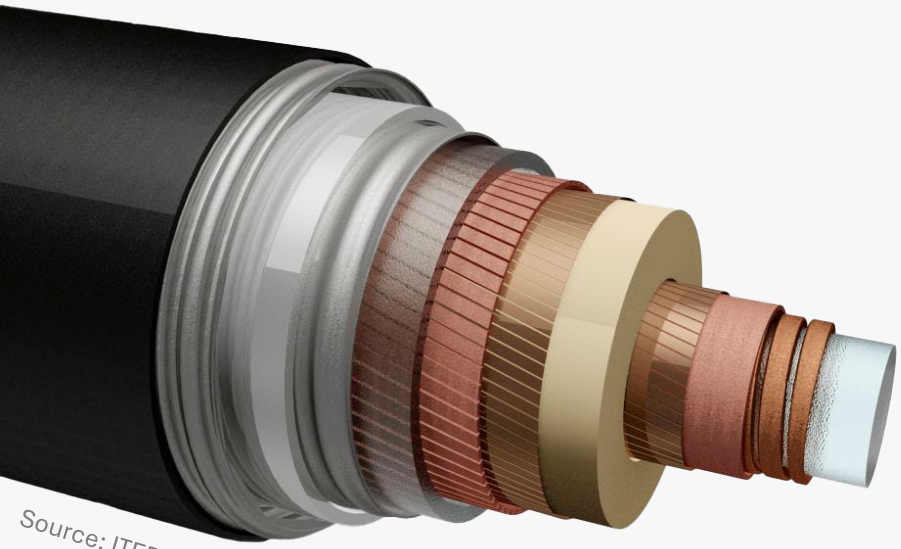
A superior material



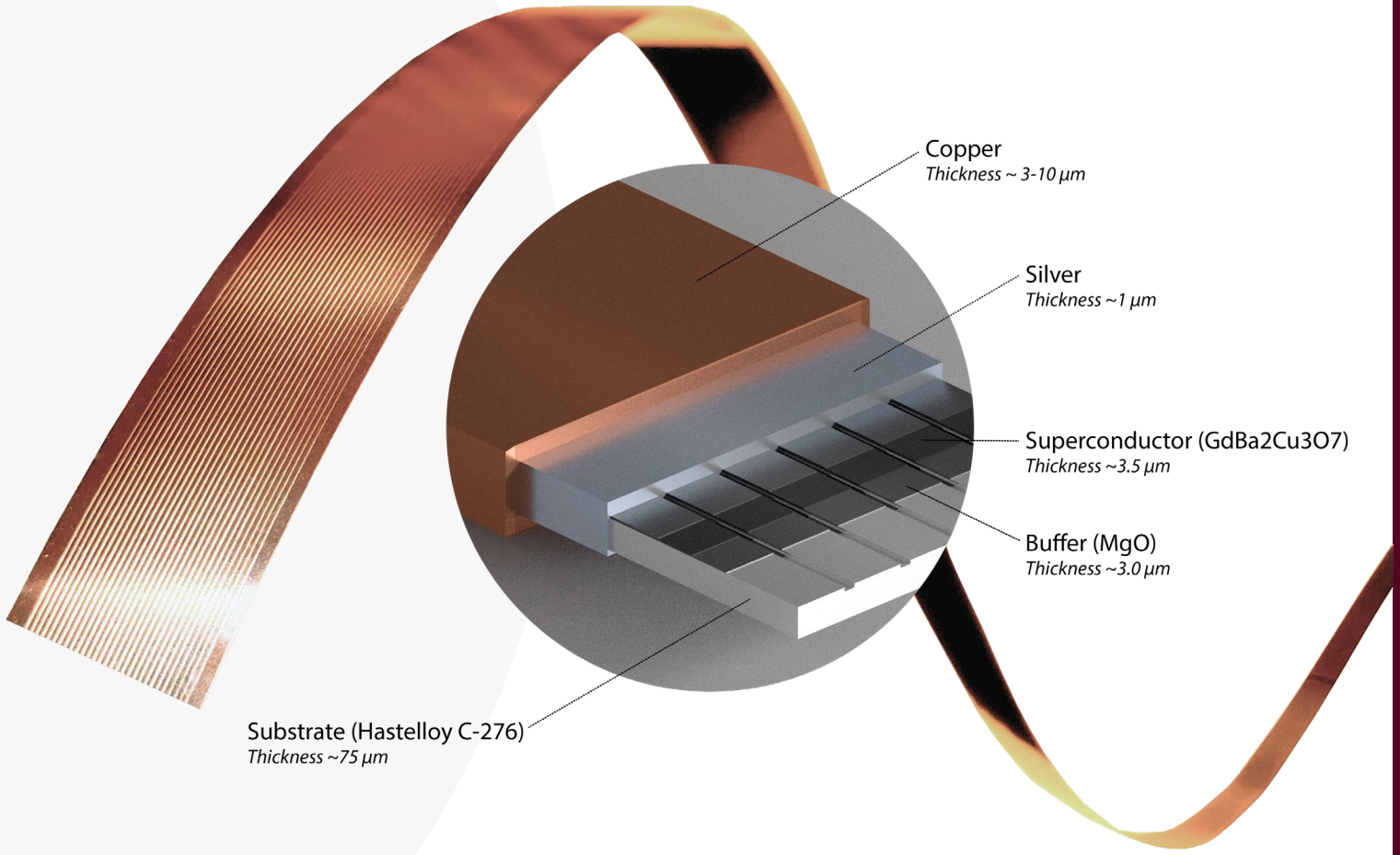
A superconductor is **an electrical conductor** - a tape, wire, or cable - which conducts electricity with zero resistance, when cooled, and so can transport vast amounts of electrical power - **300 times more compared to traditional copper cables** - and with no energy losses.

SUPERCONDUCTORS CABLES

A superior material



Source: ITEP, KIT



SUPERCONDUCTORS IN THE GRID

Less infrastructure

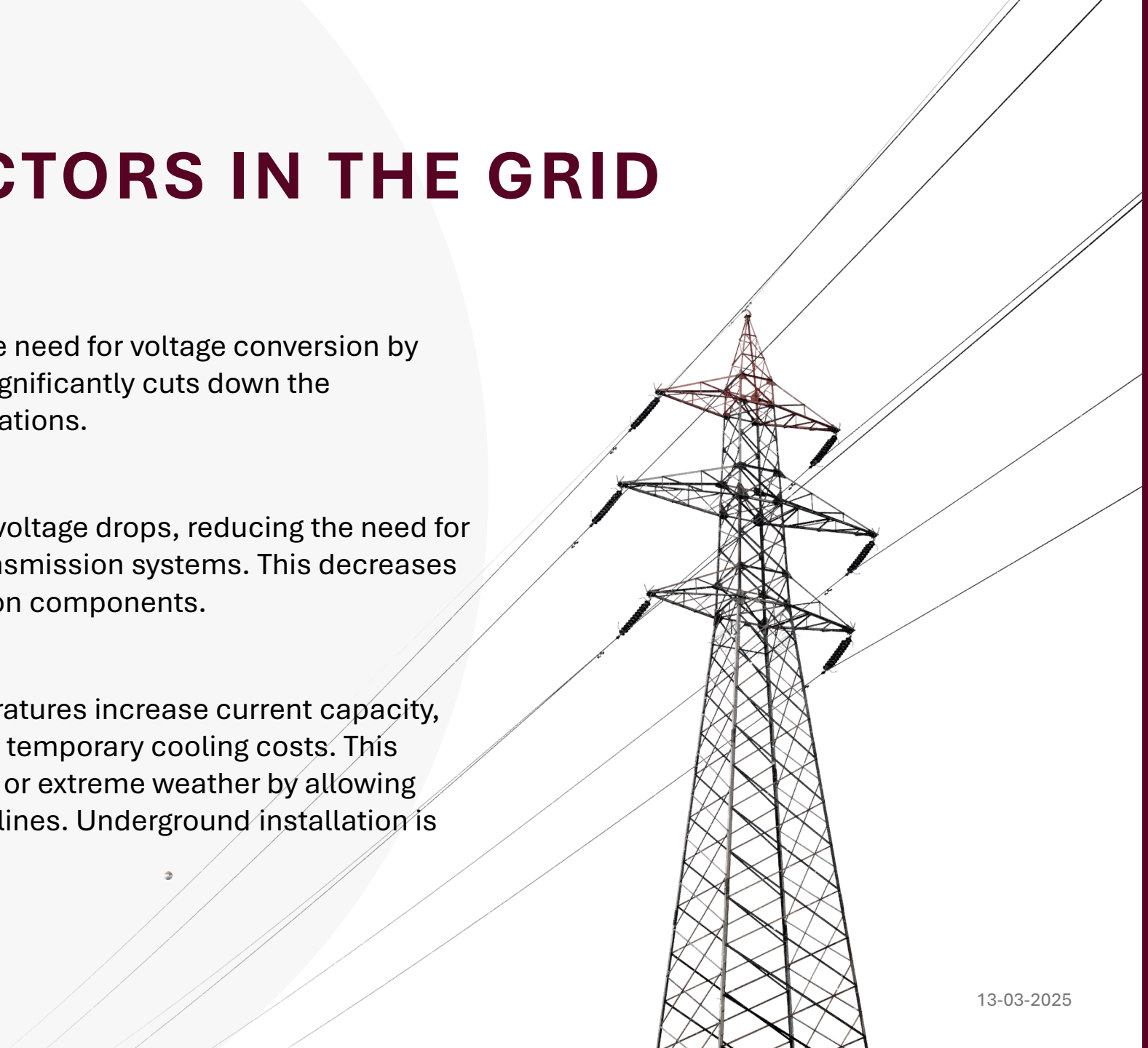
Superconducting cables reduce the need for voltage conversion by handling high current levels. This significantly cuts down the requirement for new transformer stations.

Ensuring Voltage Quality

Superconducting cables minimize voltage drops, reducing the need for stabilization in distribution and transmission systems. This decreases reliance on critical voltage regulation components.

Critical Infrastructure

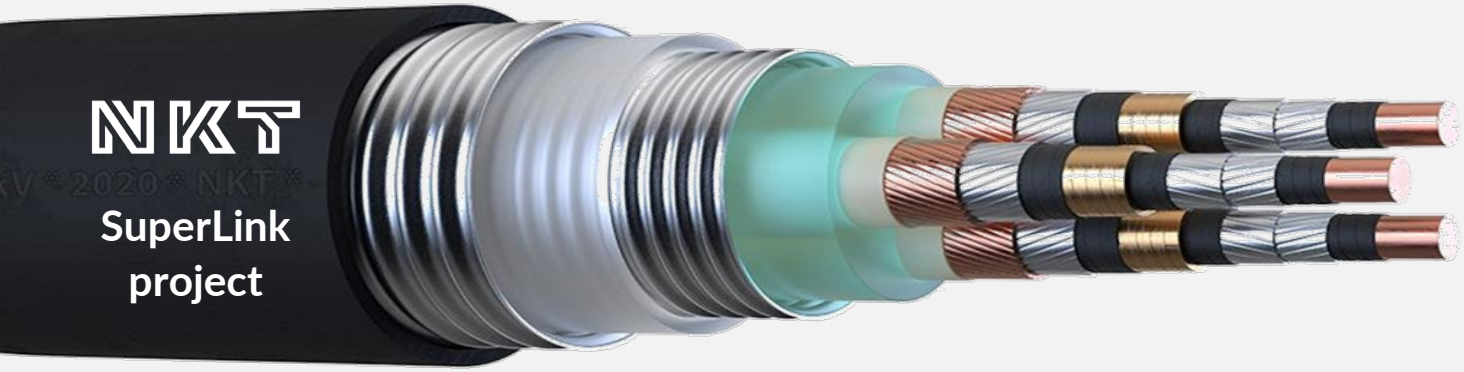
Optional lowering operating temperatures increase current capacity, enabling higher power transfer with temporary cooling costs. This ensures resilience during sabotage or extreme weather by allowing overcapacity operation in selected lines. Underground installation is preferred.



Commercial installation in Munich

NKT SuperLink project

- 500 MW HTS cable commissioned at test site
- Direct integration in grid infrastructure: 15 km up next



Successfully type-tested 110 kV terminals

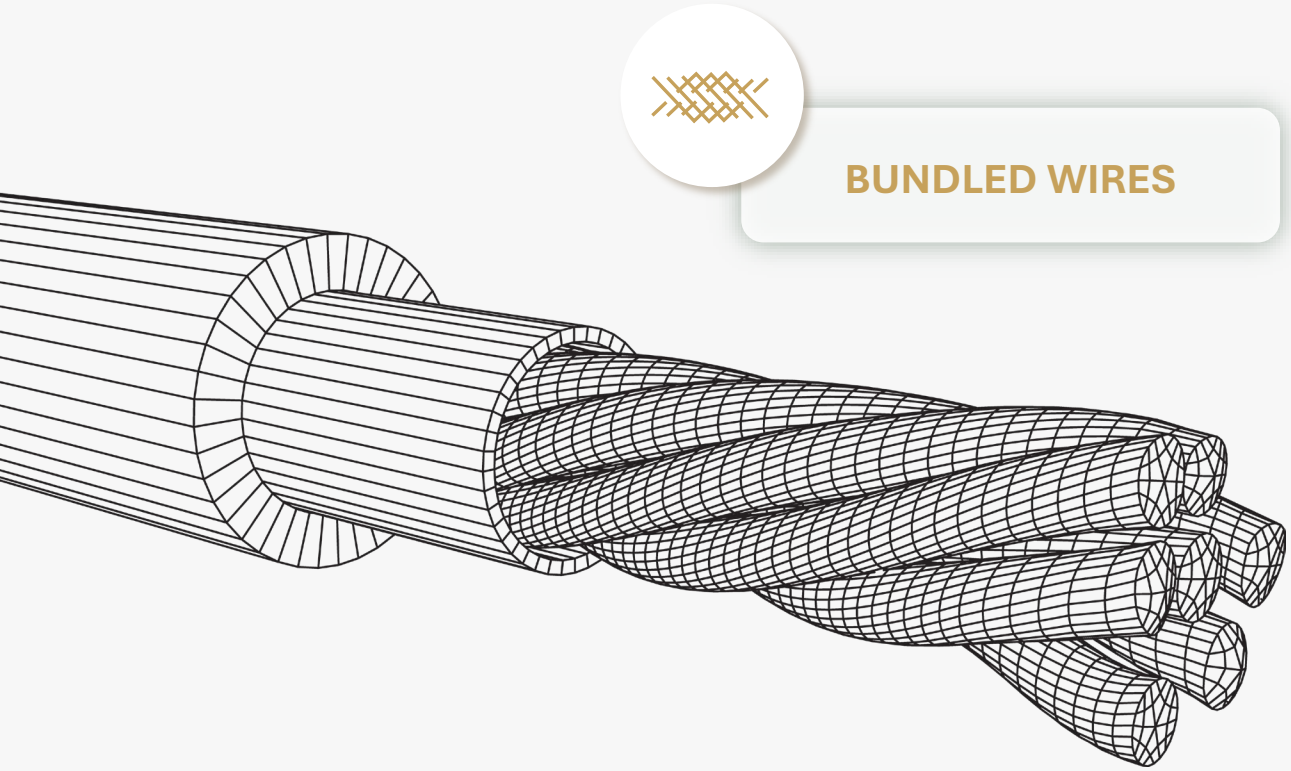
HTS cable (150 m) successfully installed in August 2024, 6 months operational testing

High voltage test successfully tested: 2.62 kA_{AC}; 500 MW

https://www.nkt.comnews-press-releases//nkt-is-developing-the-prototype-for-the-worlds-longest-superconducting-power cable

SUBRACABLE – A TECH LEAP

A radical different approach to superconductors



BUNDLED WIRES

- Cooled with **liquid nitrogen**
- Cables scalable to **100km+ length**
- Twisting & transposition
- **Reduced risk** of quenching
- **Extremely low losses** in AC transmission
- Mechanically **robust**
- **Scrap can be used** = effectively increasing superconductor production yield

SUBRACABLE – UNIQUE ADVANTAGES

Enables cost saving and game-changing flexibility to the transmission industry

90% REDUCTION OF ENERGY LOSSES

Equal to the energy production of 45 nuclear plants

99% REDUCTION OF COPPER NEED

All materials required are <3% of the global yearly production.

75% LESS LEVELISED COST OF TRANSMISSION

- 70% lower OpEx .
- 30% lower CapEx

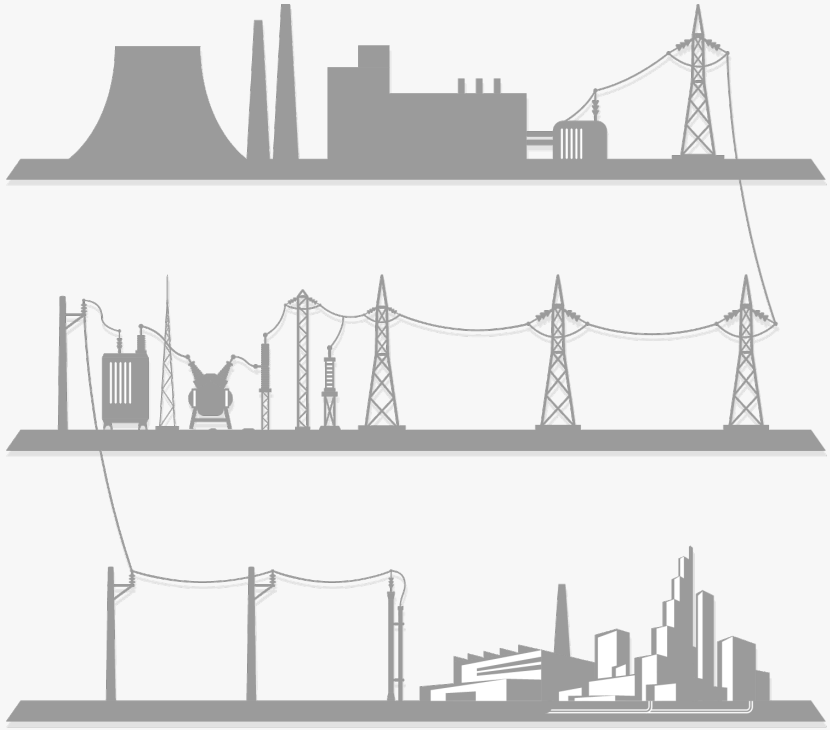
VERY NARROW UNDERGROUND DUCTS

Superconductors transport 300x more current than equal-sized copper wires.

TRANSMITTING ELECTRICITY AT ANY VOLTAGE

No need of numerous, large and costly AC/DC conversion stations.

CRITICAL INFRASTRUCTURE



Minimal influence from extreme weather events

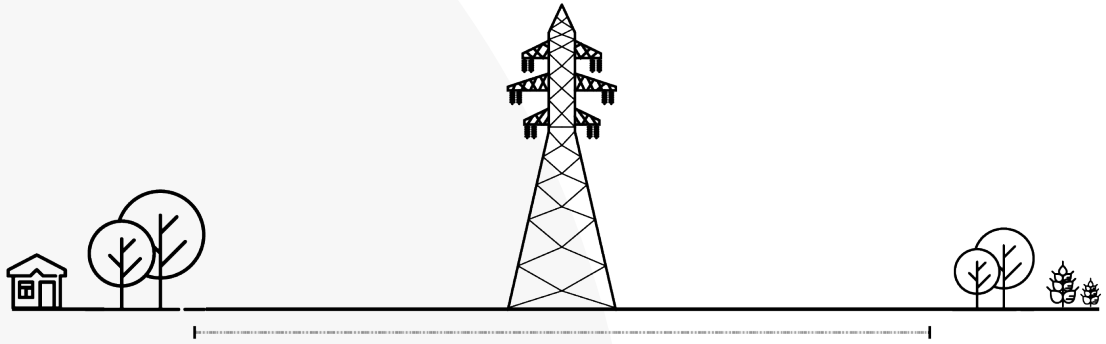
Typically, allows for **more than 24 hours to re-establish cooling** in a superconducting cable before it ceases to be superconducting

Exceptional **protection against sabotage and/or extreme incidents** with two stainless steel pipes around the cooling section

Possibility to apply **additional cooling** to the cable, when needed

CORRIDORS

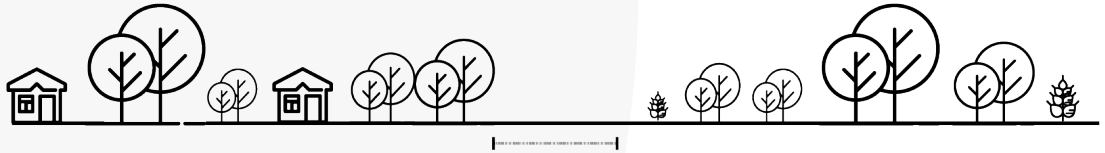
+ **800 kV HVDC**
- **6.4 GW capacity**



125 m corridor width

+ **320 kV HVDC XLPE CABLE**
- **5 GW capacity**

6 bi-pole = 12 cables

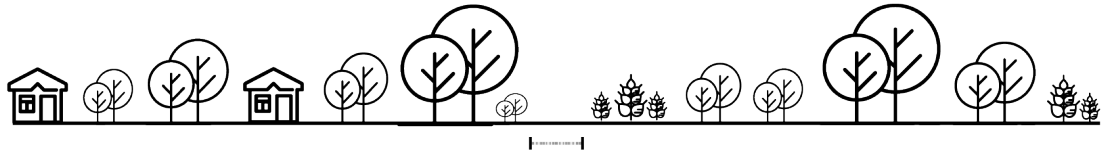


13 m corridor width forested area
8 m cables + 2 x 2,5 m safety

+ **125 kV HVDC**
- **SUPERCONDUCTING CABLE**

5-10 GW capacity

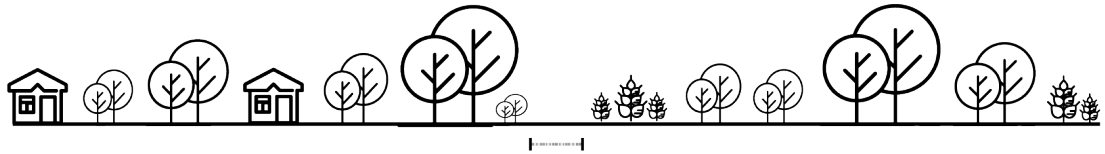
1 bi-pole = 1 cable



5,5 m corridor width forested area
0,5 m cable + 2,5 m safety

SUBRACABLE – UNDERGROUND CABLING

+ 125 kV HVDC
- SUPERCONDUCTING CABLE
5-10 GW capacity
1 bi-pole = 1 cable



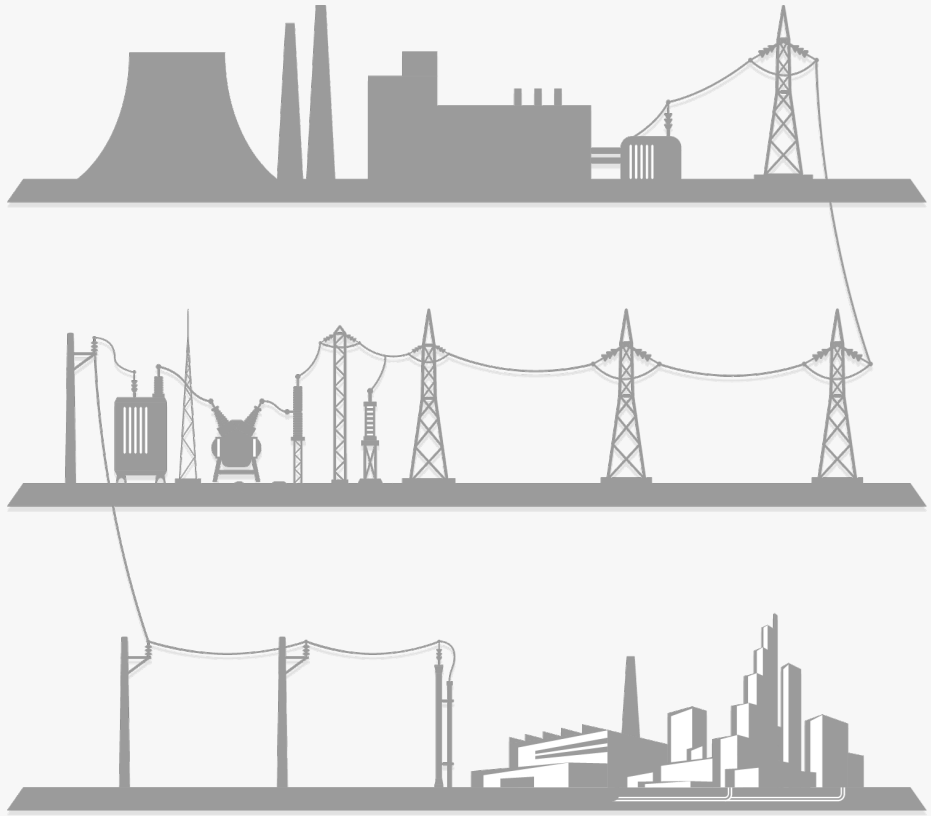
5,5 m corridor width forested area
0,5 m cable + 2,5 m safety

Lower cost

Lower loss

Lower volume

VOLTAGE QUALITY



Reduced electromagnetic interference (EMI) due to no electrical resistance and smaller magnetic fields (if a cryogenic shield is implemented), allowing cables to be installed directly next to other existing cables without cross-talk.

With no resistive losses, **voltage stability is improved** because voltage drop over long distances is reduced from source to end-use.

Greater control over voltage and **better consistency** with the source voltage.

Lower/no harmonic signal distortion + real time regulation leads to a **more stable voltage curve.**

Limited need for voltage-regulating components

BENEFITS IN OTHER SECTORS

Superconducting cables **do not inherently introduce any special sector requirements** regarding the use of a superconducting power grid

The **electrification of railways and pyrolysis** processes involving high current loads can particularly benefit from superconducting cables

Voltage quality improvements can be advantageous for certain sectors such as **Vehicle-to-Grid (V2G), Power-to-X (P2X), and pyrolysis**

WHAT'S NEXT?

SUBRA is now establishing a consortium targeting demonstration of SUBRACABLE in the Danish power grid

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