## THREE QUESTIONS FOR PROJECT LEADER CHRISTIAN-ERIC BRUZEK, NEXANS

### Which project achievements are you proud of?

Firstly, we are very happy with the performance of the wires. With a transported current of 700 Amperes, magnesium diboride has proven its ability to carry huge amounts of electricity – 500 times more than a simple copper wire! It is exceeding our expectations. Our project partner Columbus Superconductors has already produced hundreds of kilometres of this wire. Secondly, we were able to develop an innovative and safe high-voltage insulation, which consists of lapped paper impregnated with liquid nitrogen. In case of an electrical breakdown, the nitrogen will automatically fill any gap in the paper and the insulation properties will be recovered. We have published our test results in a top-tier scientific journal.

### What did you find most challenging?

Technically, one of the most challenging tasks is to manage the connection between the superconducting cable and the existing grid. For me, this is the one of the most important insights of our demonstration. Other aspects need to be discussed, for instance the question of how superconducting links would impact the way we operate the grid.

### What are the next steps for this technology?

The next step would be to develop testing guidelines for HVDC superconducting cables to ensure safety and quality standards. A consortium of manufacturers would need to be formed and agree on the testing procedures. We have to include transmission system operators (TSOs) in this process because they are still cautious. So we are now calling on policymakers to provide economic incentives for TSOs to invest in superconducting cable systems.

## ABOUT BEST PATHS

The Best Paths project will help to overcome the challenges of integrating renewables into Europe's energy mix. It aims to develop novel network technologies to increase the European transmission network capacity and electricity system flexibility.

The project unites experts around five large-scale demonstrations to validate the technical feasibility, costs, impacts, and benefits of the tested grid technologies. The aim is to find solutions for the transition from HVDC lines to HVDC grids, to upgrade and repower alternating current parts of the network, and to integrate superconducting high-power DC links.

BEST PATHS stands for 'BEyond State-of-the-art Technologies for rePowering Ac corridors and multi-Terminal HVDC Systems' and involves 39 partners from 11 European countries. The project is funded by the European Commission within the 7th Framework Programme for Research, Technological Development and Demonstration under grant agreement no. 612748.

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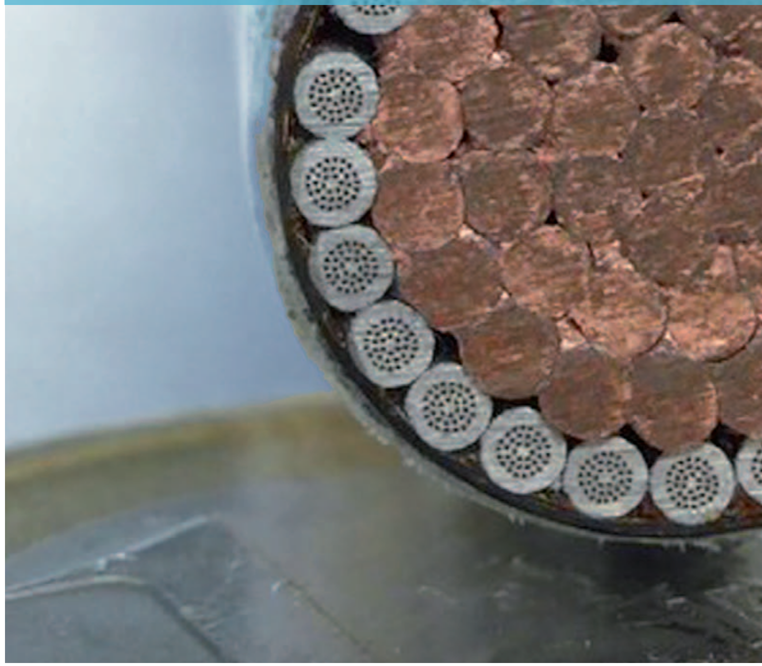
bestpaths-project.eu/en/demonstration/demo-5

**CREDITS:**
Cover image and images 1,2: Frédéric Lesur, Nexans, image 3: Nexans

# SUPERCONDUCTING POWER LINKS

## RESULTS FROM THE EU PROJECT BEST PATHS



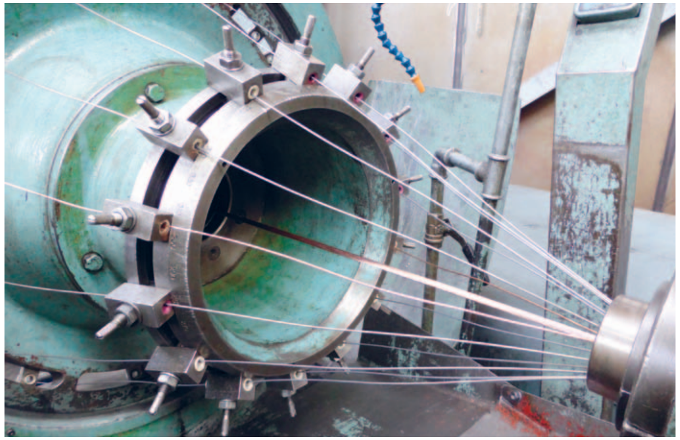
BRINGS ENERGY TO LIFE

## ABOUT THE TECHNOLOGY

Rising amounts of renewable energy coupled with increasingly decentralised power generation call for the modernisation and extension of our grids. Studies have shown that European transmission corridors with lengths of several hundred kilometers and capacities of 5 to 20 GW are needed.

Superconducting cables could help to overcome challenges presented by overhead lines and conventional underground cables. The promise of superconducting electric lines lies in their high efficiency, small size, and reduced environmental impact.

Within the EU-funded project Best Paths, ten partners have built a prototype superconducting cable. The demonstration project aims to illustrate the technological maturity of superconducting high-voltage direct current (HVDC) links. At the same time, it is a first attempt to employ magnesium diboride ($MgB_2$) as a superconductor for HVDC cables and to test all cable components, including the insulation and terminations. Special attention is paid to employing real grid conditions and assessing the economic viability of the system.

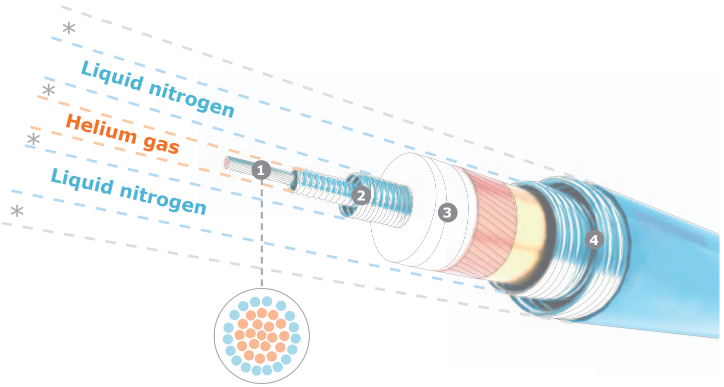


The cable conductor is produced from magnesium diboride wires wound around a copper core.

## THE BEST PATHS SUPERCONDUCTING CABLE

Key elements of a 3-GW-class superconducting cable have been validated within this project. The results will be a significant step towards the HVDC standards of the future.

### MAIN ELEMENTS OF THE CABLE:




✳ Vacuum   ● Copper (Cu)   ● Magnesium diboride ($MgB_2$)

1. 10 kA $MgB_2$ conductor in helium gas
2. Inner cryogenic envelope
3. High-voltage lapped insulation in liquid nitrogen
4. Outer cryogenic envelope

### MAJOR PROJECT RESULTS:

- Manufacturing magnesium diboride ($MgB_2$) wires and the cable conductor
- Investigating the nominal and transient behaviour of an $MgB_2$ component embedded in the grid
- Manufacturing the HVDC electrical cable insulation
- Designing and constructing high-voltage electrical terminations
- Investigating the behaviour of the grid with an operating superconducting cable
- Exploring long-length superconducting links

## PROJECT PARTNERS

Researchers are examining the samples for the space charge test of the insulation.

The project encompasses expertise from transmission system operators as well as industry and research organisations from the fields of material sciences, cryogenics, energy systems, and electrical engineering:

Nexans France (Leader)
CERN
Columbus Superconductors
ESPCI Paris
IASS Potsdam
Karlsruhe Institute of Technology
Nexans Germany
Nexans Switzerland
Ricerca sul Sistema Energetico
Réseau de Transport d'Électricité
Technische Universität Dresden
Universidad Politécnica de Madrid