ELECTRICITY TRANSMISSION OF TOMORROW

UNDERGROUND AND SUBSEA CABLES IN EUROPE

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"To truly integrate its electricity market, Europe needs to significantly expand its high voltage power transmission networks. In many areas, undergrounding will increasingly replace overhead lines to facilitate public acceptance. Underground cable technology is fully available and has a proven track record across the world.

The European wire and cable industry is ready to deliver its technology, thereby creating an ever stronger and thoroughly integrated European electricity grid."

Valerio Battista
President of Europacable

EUROPE NEEDS MORE GRIDS

Aging infrastructure, the rise of renewable energy sources (RES) and Europe´s future Energy Union necessitate an expanded and upgraded power transmission grid that better interconnects all member states. Furthermore, as our society relies more and more on electricity, the wellbeing, prosperity and progress of Europeans will increasingly depend on a secure and reliable power supply.

INTERCONNECTIVITY AND RES INTEGRATION

By increasing the connectivity between national power grids, the supply and demand of electricity can be matched on a European scale, reducing power outages, shortages and price fluctuations. Increased interconnectivity is also key to harnessing the full potential of renewable power sources, which are characterised by fluctuating output levels. The EU has therefore set several targets, including a 15% transmission capability for each individual national power grid by 2030. An estimated 44,700 km of new or refurbished power transmission lines across the EU are needed to achieve this.

+15%
interconnectivity

44,700 km
transmission lines

THE CHALLENGE AND THE SOLUTION

One third of all power transmission projects have already been delayed due to public resistance against overhead power lines and lengthy permit procedures. Today, the average project takes 15 years from planning to completion. Underground and subsea cables provide a crucial solution to these challenges.

EUROPACABLE

Founded in 1991, Europacable represents all leading European wire and cable manufacturers, covering the full range of power and telecommunication cables. Europacable engages in EU infrastructure debates by providing reliable information on underground and subsea cables to all interested parties.

THE FUTURE IS NOW: UNDERGROUNDING IS HAPPENING IN EUROPE

Cable technologies to safely transmit electricity over long distances underground or under the sea are fully available and in use across Europe. Governments, regulators and transmission system operators (TSOs) are more and more aware of the increased need for integration of renewable energy sources and grid interconnections. They are working with the European cable industry to realise underground and subsea cable projects to overcome the obstacles associated with overhead lines.

THE INDUSTRY DELIVERS

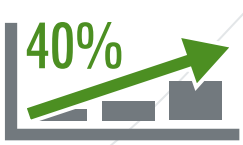
Over the last decade, European cable makers have steadily expanded their production capacity for extra high voltage subsea and underground cables, increasing their output by 40% between 2008 and 2011 alone. Today, Europacable's members are producing an average of 3,500 kilometres of underground and subsea cables annually. The future is now.

GLOBAL LEADERSHIP

Europacable includes the world's largest cable makers, known for their global technology leadership, as well as highly specialised small and medium-sized enterprises (SMEs) from all over Europe. Europacable's members and partners employ 70,000 people worldwide, 50% of which are in Europe alone, realising a turnover of € 20 billion in 2014.

COMMITMENT

To sustain and expand their position as a leading European manufacturing industry, Europacable's members are investing in high-quality production and highly specialised R&D facilities in Europe. This commitment is demonstrated by the Europacable Industry Charter, adopted in April 2015. The Charter expresses a collective commitment to our shared principles and objectives of ethical, sustainable and high-quality cable development and manufacturing.



Production capacity


Total underground and subsea cable
3,500 km/y


70,000
50% in Europe

EUROPEAN UNDERGROUND AND SUBSEA CABLE PROJECTS

HIGH VOLTAGE ALTERNATING CURRENT (HVAC)

STEVIN

A Belgian HVAC project for a new 380 kV power transmission line with partial undergrounding to increase public acceptance.

KASSØ-TJELE

A vital north-south HVAC land transmission axis in Denmark that was undergrounded in several locations to overcome obstacles and preserve areas of natural beauty.

HIGH VOLTAGE DIRECT CURRENT (HVDC)

INELFE

A new HVDC underground power connection that cuts through the Catalan Pyrenees to double the interconnectivity between France and Spain.

SKAGERRAK 4

An HVDC subsea cable carrying high loads over a long distance to integrate Norwegian and Danish renewable energy sources and reduce the dependency on fossil fuels.

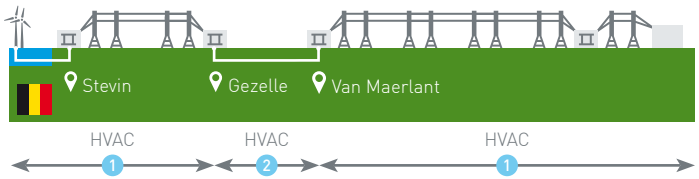
Photos: © General Cable.

STEVIN - 380 kV AC

BELGIUM

The Stevin 380 kV power line runs through 8 municipalities from the area of Gent up to Zeebrugge. Around the historic town of Bruges, a 10 kilometre stretch was undergrounded to ease concerns of local communities and to protect landscapes. Undergrounding and rerouting significantly reduced the total length of overhead lines, strengthening public acceptance.

Once finished, the Stevin project will improve the stability of power supply for the West Flanders region, with plenty of spare capacity for a future expansion of the nearby port of Zeebrugge. It will connect the Belgian grid to offshore wind parks, as well as to the British power grid through the Nemo subsea interconnector. Moreover, it will create opportunities for investments in renewable coastal and decentralised power generation, such as wind and solar energy.



1 OHL (Overhead line)

2 Underground cable

FACTS & FIGURES

380 kV AC

120 km
4 cables per phase (3 phases)
12 parallel cables of 10 km
Total underground cable

47 km
Total path length

Transmission capacity
3,000 MW

Cable trench depth/width
2.2 M/12 M

Technology
HVAC

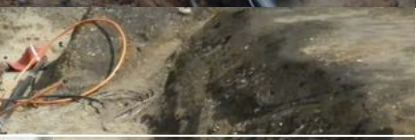
Total construction period
3 YEARS

Total project duration
10 YEARS

OBSTACLES CROSSED

- Boudewijn channel (two micro tunnels)

Photos: © General Cable.



KASSØ-TJELE - 400 kV AC

DENMARK

To realise its ambitious goals for sustainable power generation, Denmark has invested heavily in wind farms along its extensive coast line. However, an increased reliance on renewable energy also meant that Denmark had to strengthen its existing grid to ensure that it was flexible enough to deal with low-wind days.

The Kassø-Tjele line is a key north-south section in the Danish grid. When its upgrade was announced, citizens and politicians voiced their opposition to overhead lines. In response, the HVAC project was adapted and several stretches totalling almost 9 kilometres were undergrounded to preserve natural landscapes and environmentally sensitive areas.

1 OHL (Overhead line) 2 Underground cable

FACTS & FIGURES

400 kV AC

108 km
2 cables per phase
12 cables in parallel
Total underground cable

9 km
Total path length

Transmission capacity
+2,000 MW

Cable trench depth/width
1.4 M/2.1 M

Technology
HVAC

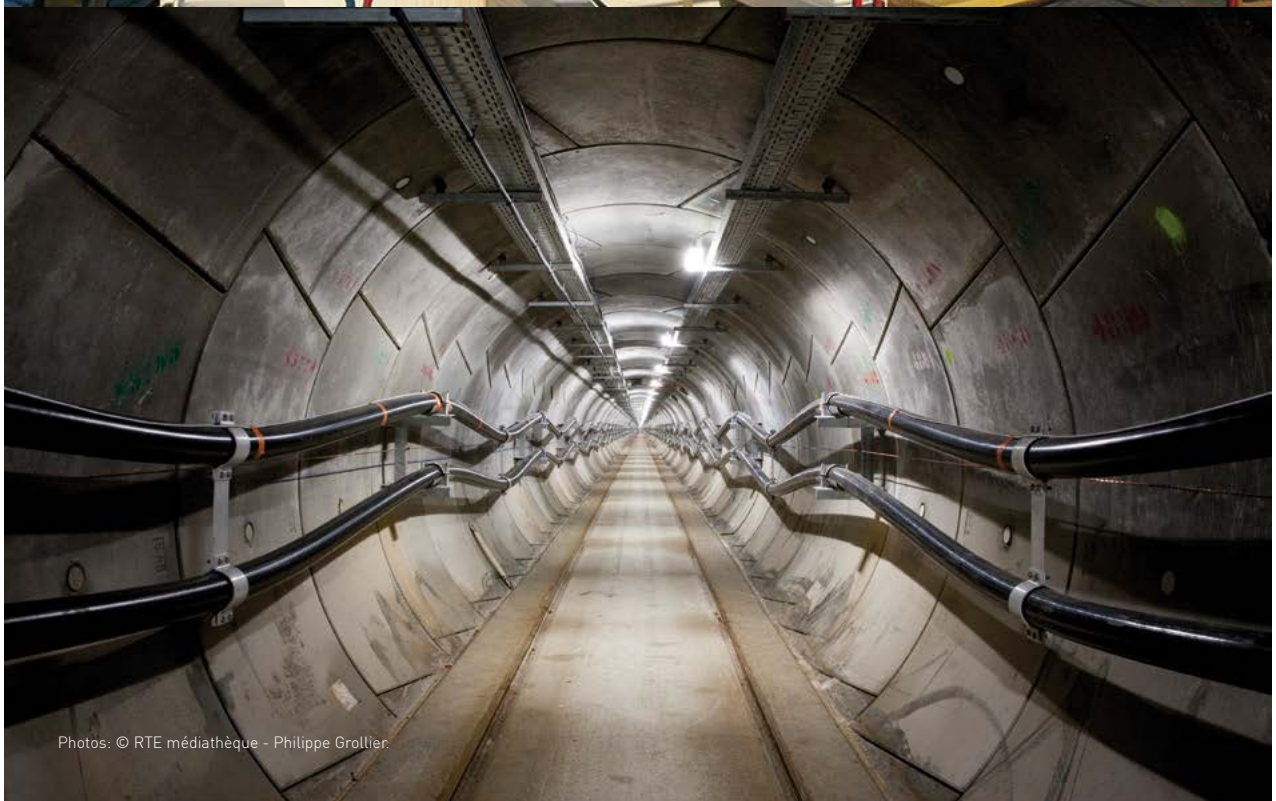
Total construction period
3 YEARS

Total project duration
7 YEARS

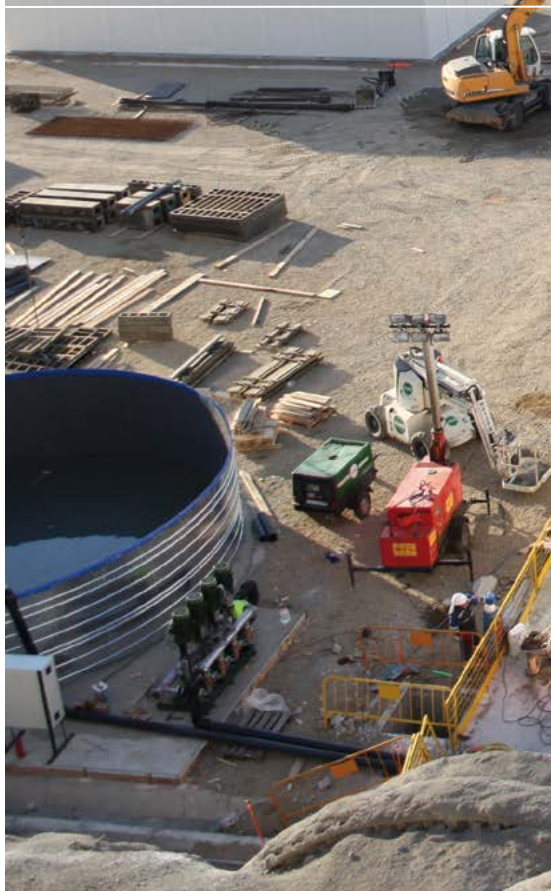
OBSTACLES CROSSED

- Lake (1.3 km standard single core cable inside a pipe)

Photo: © Prysmian Group



Photos: © RTE médiathèque - Philippe Grollier.

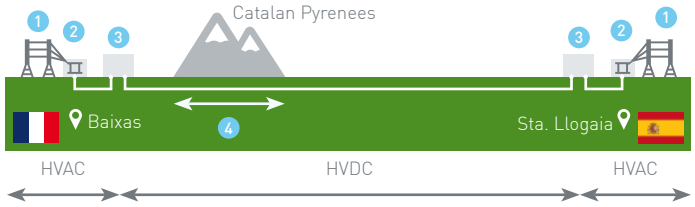


INELFE - 320 kV DC

FRANCE/SPAIN

On the 24th of February 2015, the Spanish and French prime ministers inaugurated the INELFE project, a new 64.5 kilometre HVDC underground line connecting France and Spain through the Catalan Pyrenees. INELFE doubled the power exchange capacity between the two countries, enabling them to provide or receive twice the assistance in case of a failure or peak demand in either power grid.

In addition, INELFE will increase competition on the French and Spanish electricity markets, lowering prices for the benefit of consumers. INELFE also enables new investments in renewable energy sources, which typically have a fluctuating output level and therefore require flexible power trading and sourcing solutions across the European continent.



1 Existing AC grid system
2 AC substation
3 Converter station (AC/DC)
4 Tunnel

FACTS & FIGURES

320 kV DC

252 km
2 cables per phase
12 cables in parallel
Total underground cable

64.5 km
Total path length

Transmission capacity
2,000 MW

Cable trench depth/width
1.5 M/1 M

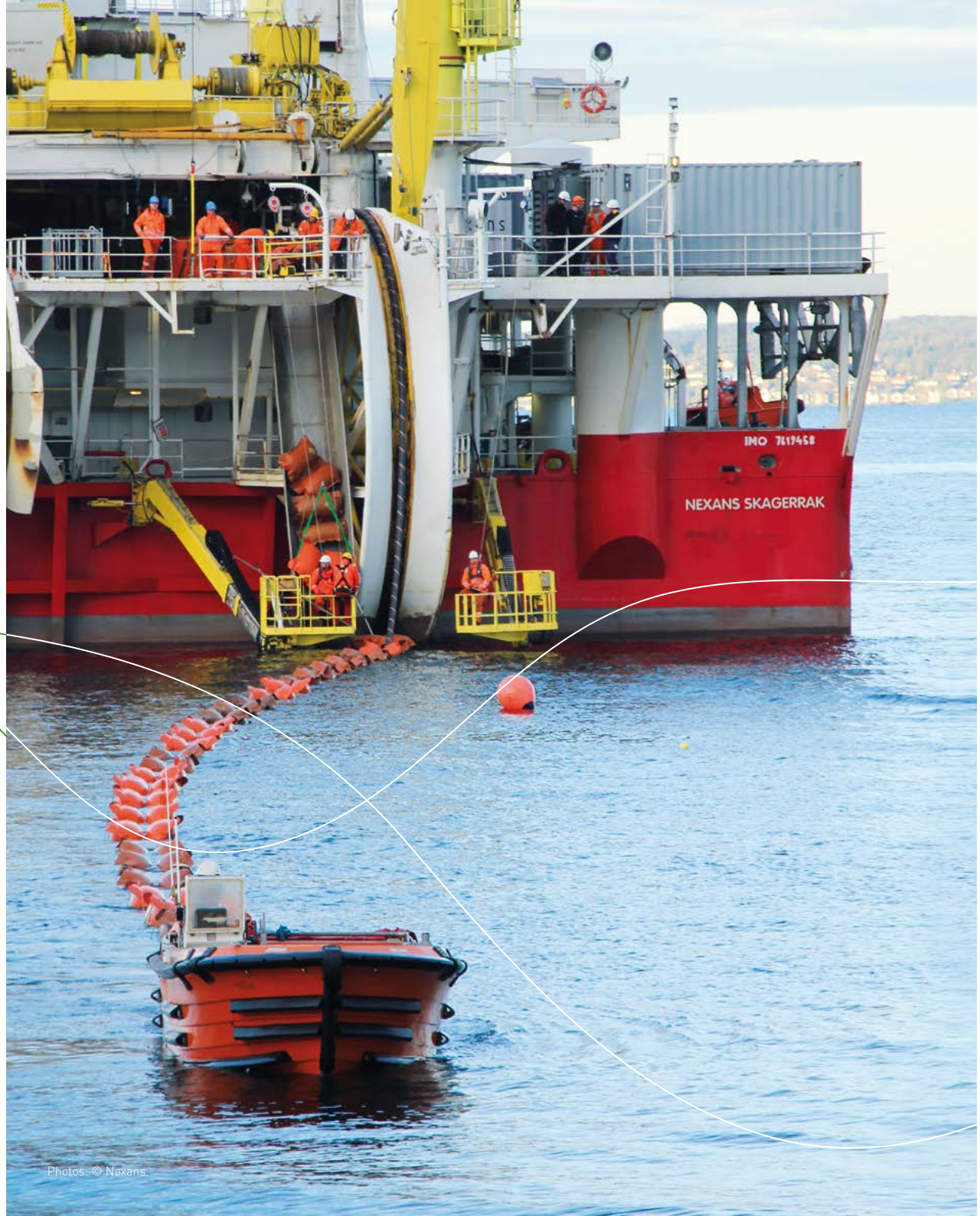
Technology
HVDC

Total construction period
4 YEARS

Total project duration
7 YEARS

OBSTACLES CROSSED

- Pyrenees mountains (8.5 km tunnel with a 3.5 m diameter)



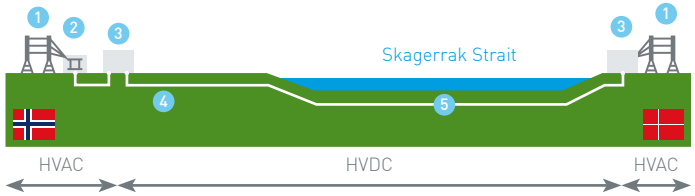
Photos: © Nexans.

SKAGERRAK 4 - 500 kV DC

DENMARK/NORWAY

Late 2014, the Skagerrak 4 interconnector between Norway and Denmark became operational, increasing the existing power exchange capacity between the two countries. Totalling more than 100 kilometres of land cables and 137 kilometres of subsea cables, this project proves that Europe has the technology to transport large quantities of high voltages over very long distances.

Skagerrak 4 will make the supply of electricity to and from Norway more reliable and provide opportunities for increased renewable power generation on both sides of the Skagerrak. Surplus Norwegian hydropower can be exported to Denmark when Danish wind farms are experiencing little wind, increasing cable earnings and reducing the need for coal and gas power reserves in the Danish system.



1. Existing AC grid system
2. AC substation
3. Converter station (AC/DC)
4. Underground DC land cable
5. Subsea cable

FACTS & FIGURES

500 kV DC

237 km
100 km land
137 km subsea
Total underground cable

239 km
Total path length

Transmission capacity
700 MW

Cable trench depth/width
1.3 M/2.0 M

Technology
HVDC

Total project duration
5 YEARS

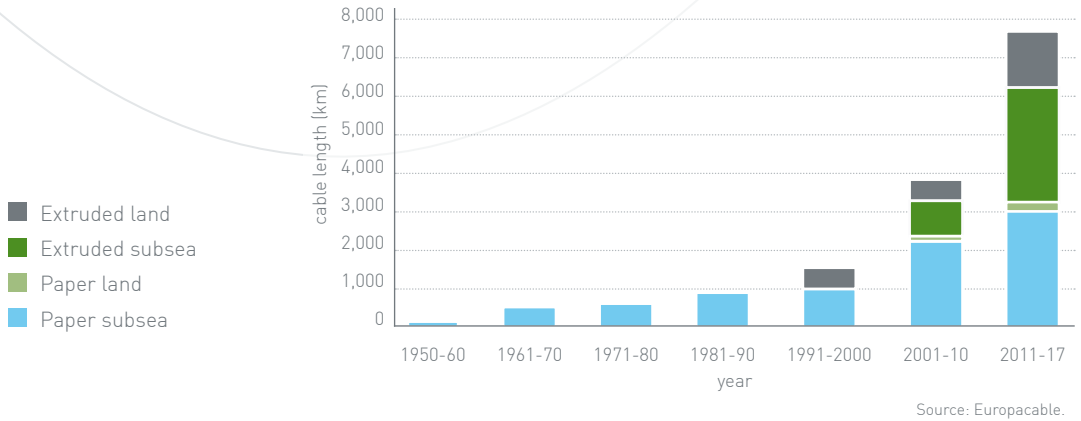
OBSTACLES CROSSED

- Skagerrak strait

THE TECHNOLOGY IS IN USE

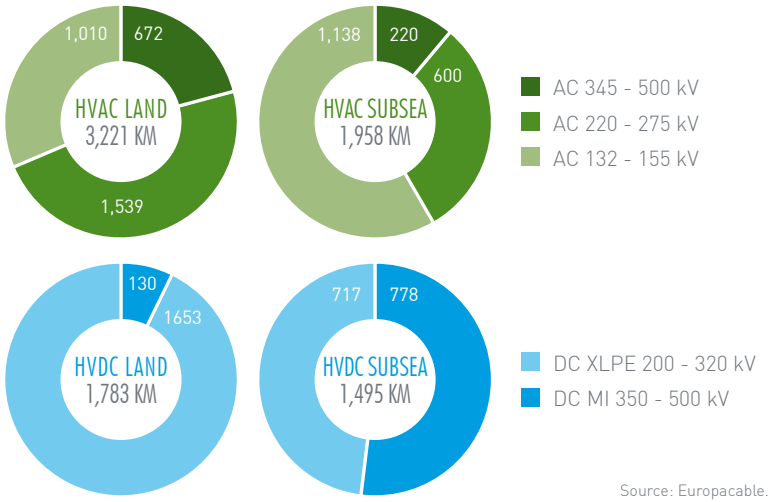
In the last few decades, the application of underground and subsea DC and AC cables has grown exponentially. All over the world, this technology has become essential for connecting grids and powering society.

INCREASE OF HVDC CABLES



Source: Europacable.

OVERVIEW OF HIGH VOLTAGE UNDERGROUND AND SUBSEA PROJECTS, 2010-2014



Source: Europacable.

Between 2010 and 2014 alone, over 8,000 kilometres of subsea and underground AC and DC cables were installed globally. High voltage AC cables are being deployed to enable grid connections and power transmissions over shorter distances, while high voltage DC cables are used for long distance transmission with low losses. Underground and subsea cable technology has matured to the point where it covers the entire scope of power transmission and distribution – both on land and at sea.

INVESTING IN UNDERGROUNDING

As with any large-scale infrastructure project, when it comes to assessing the costs of undergrounding it is crucial to consider overall operational expenditure over the entire lifetime of at least 40 years of the transmission line, rather than only the initial capital expenditure that will be incurred.

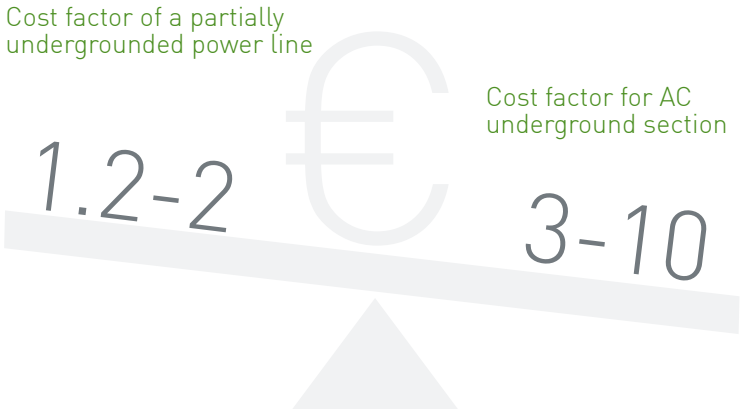
LONG-TERM SOCIETAL BENEFITS OUTWEIGH INITIAL INVESTMENT

Legislators reference the fact that faster project realisation facilitated by the deployment of underground cabling will reduce and may even neutralise higher initial investments. This is due to the fact that the cost of "not having a line" – or even delays in completion – entail a significant financial burden on society. Additionally, factors such as lower operating costs, lower maintenance efforts and lower depreciation of land value in proximity to the line are positive effects to be considered in the assessment of the convenience of undergrounding.

When undergrounding is limited to sensitive parts such as residential areas or nature reserves, total investment costs for an average project will increase by a factor of just 1.2-2. This is because, depending on project details and soil conditions, installing a 400 kV AC cable instead of an equivalent overhead line requires an investment that is generally 3-10 times higher for the underground section.

MINIMAL COST IMPLICATIONS TO END CONSUMER

Examples from Germany and the UK show that an increase in undergrounding will result in a mere 1% increase of the total electricity bill for the end consumer, or approximately € 3 to 14 per average household per year. This is because grid charges make up less than a quarter of the actual price of a kilowatt hour, with the largest components consisting of generation costs as well as taxes and subsidies imposed by governments. The examples from Germany and the UK showed that this 1% overall increase was the result of a 3 to 6% increase in grid charges. This increase only reflects the higher initial investment expenditures and does not consider the societal benefits outlined above.



THE SUSTAINABLE PATH

Sustainability is a key factor in every infrastructure project today. Balancing the interests of families, communities, the industry, the economy and the environment requires access to the right information. Arguments need to be weighed carefully to reach the decision that benefits most, and if possible, all stakeholders. Underground and subsea cables can play a vital role in addressing these concerns and interests.

CONSTRUCTION

Building a new power transmission line is always a major undertaking, but putting high voltage cables underground increases the impact of construction. Trenches need to be dug, soil needs to be moved and vegetation may have to be cut down. Farmers may not be able to work their land during this time. In every project, extensive precautions are taken to minimise the temporary environmental impact. Once the new underground transmission line is operational, it may take one or two years for the landscape to fully recover.


Photos: © Tennet.

A SMALL SACRIFICE FOR DECADES OF UNDISTURBED OPERATION

After the landscape has recovered, the new underground transmission line will be practically invisible in any open countryside for its entire lifespan of over 40 years. There will be no limitation to agriculture and farming on top of the trench. The only limitation is on deep rooted trees. Thorough cable system design and cautious soil backfilling will prevent any drying of soil.

OUT OF HARM'S WAY

In the case of a cable fault, today's monitoring technologies allow for an immediate and precise fault location. While repair times may be longer than on single faults of an overhead line, the underground cable system will be able to carry the full load over a limited period of time while repairs are ongoing. Hence there will be zero downtime in terms of electricity supply.

TOWARDS A MORE SUSTAINABLE EUROPE

Expanding the share of renewable energy in Europe can only be achieved when supply and demand are connected across the continent. Advanced cable technologies are necessary to realise this, and therefore instrumental in making our society more sustainable.

THE BOTTOM LINE

High voltage cables are increasingly used across Europe, made by European cable manufacturers who are global technology leaders. All over our continent and around the world, stakeholders are increasingly turning to underground and subsea cables to overcome challenges and obstacles linked to grid interconnectivity and expansion.

The long-term societal benefits outweigh the initial investment costs and result in minimal cost implications to the end consumer. High voltage cables embedded underneath the soil secure long term electricity supply. Thereby they contribute to fully harnessing renewable energy resources while preserving landscapes. That is why underground and subsea power cables are the future of electricity transmission in Europe.

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BRUGG CABLES Well connected.

HELLENIC CABLES S.A. HELLENIC CABLE INDUSTRY S.A.

General Cable

Nexans

nkt cables

Prysmian Group

An initiative of Europacable and its associate partner, Borealis.

BOREALIS
Keep Discovering

GLOSSARY

Voltage of the underground or subsea power line, Alternating Current (AC) or Direct Current (DC)

Length of the underground or subsea cable

239 km
Total path length

Total length of the power line

Cable trench depth/width
1.5 M/1 M

Depth and width of the trench for the underground cable

Transmission capacity of the power line in megawatts (MW)

Technology
HVDC

Technology used for the underground or subsea cables; High Voltage (HV) AC or DC

Construction period and total project length including preparation

Remarkable obstacles that were overcome

In compliance with EU regulations, Europacable is listed in the EU transparency register, under number 453103789-92. Europacable is also a partner of CENELEC, the European Committee for Electronical Standardization.

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