



HVDC is the key to an integrated European power network

The goal of European energy policy is to provide a secure, sustainable and competitive energy supply for all European citizens and companies.

Electricity is central to this goal because it can be generated from a variety of sources (including renewable sources), and because millions of people use it every day.

To ensure that electricity supplies are maintained, the European Union wants to hasten the integration of dozens of electrical grids across the continent and establish a competitive, secure, transparent and completely harmonized Europe-wide internal electrical energy market.

Key role for HVDC

High-voltage direct current (HVDC) transmission technology, developed by ABB 50 years ago, is playing a key role in the realization of this vision because of its unique capabilities. In particular, HVDC can provide fast, precise and flexible control of transmission flow, which greatly improves grid reliability, capacity and efficiency.

The EU's goal is to increase cross-border cooperation in Europe's electrical power market, but working out the details of multi-national transmission, harmonized grid safety standards, cross-border market access and renewable energy trade is no easy task.

Historically, European grids were not designed for the long-distance, cross-border exchange of power, but times are changing. For example, in July of this year, eight transmission system operators in Central Europe set up an office to allocate cross-border electricity transmission and provide payment within their region.

Develop existing networks

As part of the continuing harmonization process, the EU also wants to adapt, upgrade and develop existing transmission networks to eliminate transmission bottlenecks and congestion, and efficiently integrate electrical generation from renewable sources, such as wind and solar.

Meanwhile, public acceptance of visible new power infrastructure in populated or environmentally sensitive areas remains low, which means new power infrastructure must tread upon the landscape as lightly as possible.

Consequently, new ideas are needed to balance Europe's requirement for secure, reliable, and sustainable power with a low tolerance for extending infrastructure in sensitive areas.

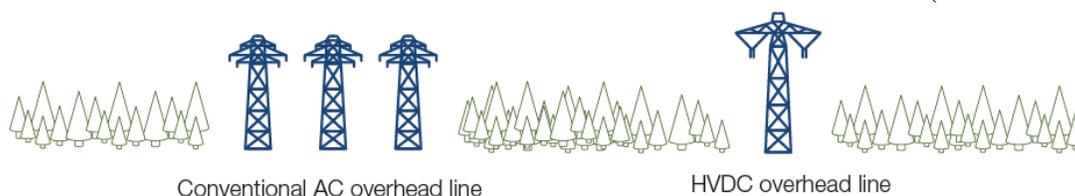
DC an ideal solution for long-distance and underwater transmission

HVDC transmission technology is an ideal solution, and has some key advantages over the alternative, alternating current (AC):

- Power flow in a DC transmission line can be precisely controlled. This stabilizes the transmission network, and prevents the cascading outages that have occurred in Europe and the U.S. in recent years



- Electricity can flow in both directions in a DC link, so that demand and supply can be balanced more effectively, which also enables power trading. HVDC systems are widely used to connect asynchronous (ie incompatible) grids or networks, so that power can be exchanged between them.
- DC electromagnetic fields share the same characteristics and magnitude as the earth's natural magnetic field, which is all around us. When using two conductors, one plus and one minus, the electromagnetic field in DC transmissions is negligible.
- DC is the only option for the underground and underwater transmission of power over distances of more than about 50 kilometers
- DC power losses are significantly lower over long distances. A 2,000-kilometer DC transmission line at 800 kilovolts loses about 5 percent of its power to heat, while the power losses in an AC line of similar voltage are about twice as high
- DC transmission uses a much narrower transmission corridor than AC (see illustration)



These advantages, particularly in controlling the power flow and facilitating power trading, led the EU in 2003 to identify 22 interconnections as priority projects. Five have been built so far.

The surge in interest in this 50-year-old technology can be seen in the number of projects carried out in recent years. In the last decade, 17 HVDC links have been built in Europe, compared with 27 in the previous 40 years. Several more HVDC projects are currently under construction.

Table: Selected project examples in Europe

Project	Country	MW	Year	Main purpose
SwePol	Sweden-Poland	600	2000	Subsea cross-border connection
Italy-Greece	Italy-Greece	500	2001	Subsea cross-border connection
Troll A	Norway	84	2005	Power to offshore gas platform from shore
Estlink	Estonia-Finland	350	2006	Underground/subsea cross-border connection
NorNed	Norway-Netherlands	700	2008	Subsea cross-border connection
Nord E.ON 1	Germany	400	2009	Underground/subsea offshore wind park
SAPEI	Italy	1000	2009	Subsea island connection
BritNed	UK-Netherlands	1300	2009	Subsea cross-border connection