Europe’s challenge is to find environmentally acceptable technologies that can increase power capacity and remove the bottlenecks in existing transmission right-of-ways, creating a stronger, smarter continental power infrastructure.

To cope with rising electricity consumption and enable the integration of more renewable energy sources (RES) into the energy mix, Europe must strengthen its transmission grids and improve controllability. This is especially true as large offshore wind parks under development in the North Sea region come online.

The integration of European transmission systems is part of a ten year plan driven by 42 transmission system operators (TSOs) comprising the European Network of Transmission System Operators for Electricity (ENSTO-E). EU legislation is driving development of a Pan-European grid, with concerns about security of energy supply, competitive and integrated continental power markets, and the secure integration of new generation sources to help meet emissions reduction targets (EU 20/20/20). In addition to managing more unplanned and intermittent electricity production, Europe needs new power corridors, but costly overhead lines are time-consuming to build and enjoy little public acceptance. The challenge is to install fast-track solutions that can transmit several GW (gigawatts) of bulk electricity and remove local bottlenecks, without protests and delays.

One solution is HVDC (high-voltage direct current) Light, VSC (voltage source converter) technology, which increases capacity and improves controllability of existing transmission grids. Converting existing AC (alternating current) lines to DC (direct current) can double or triple power capacity with minimum interruption.

Where AC solutions are predominant, power can still be transmitted by using high-voltage AC or DC technologies. HVDC technology was introduced about 60 years ago to transmit electricity underwater from mainland Sweden to the island of Gotland, and Nordic countries have built similar connections since then. Planned new interconnectors will help the Pan-European grid integrate large hydroelectric resources in Scandinavia and large wind power resources in northwestern Europe. In 1984 the Itaipu interconnection in Brazil introduced long-distance HVDC hydroelectric overland transmission, rated at ±600 kV (kilovolts). Voltage for HVDC Classic CSC (current source converters) increased to ±800 kV in China, and now transmits more than 7000 megawatts (MW) of electricity over long distances with very low losses.
The main advantage of an AC/DC conversion is the grid’s increased power transfer capability, accomplished with minimal environmental impact, investment cost and time. Additional benefits include:

- Improved power flow control
- Improved network reliability/redundancy (bi-pole)
- Easier to establish dynamic current rating
- Minor modifications possible to existing live lines
- Underground installation easier in sensitive areas

If proper preparations are done (line insulators changed on the live line and converter station and substation bypasses built while still running AC) the effective interruption can be less than one month.

The applications suitable for an AC/DC conversion include:

- Connecting increased remote generation, such as wind power, to load centers
- Increase capacity between interconnected energy markets
- De-bottlenecking congested areas by integrating DC links in the AC grid

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