European grid based on alternating current

Elia is the operator of the Belgian high-voltage electricity grid from 30 kV to 380 kV, which consists of over 8,965 kilometres of connections, comprising 5,596 km of overhead lines and 3,369 km of underground cables. More than 98% of these connections transmit alternating current.

A bit of history

Electricity exists as direct current (DC) and alternating current (AC). Both types can be used to transport energy but they do behave differently.

Two camps emerged in the late 19th century: the **DC camp**, led by Thomas Edison, and the **AC camp**, championed by George Westinghouse and Nikola Tesla. Those involved considered questions like: which type of current is the most efficient? Which one is the best solution for short and long distances? Which is the safest? The most convenient? The cheapest?

A ‘War of the Currents’ ensued, with **alternating current ultimately being crowned winner** many years later. Alternating current made it possible to build cheap, simple motors and generators so that electricity could be generated on a large scale. Alternating current is also easier to switch, and increasing or reducing voltage is more straightforward. As a result, **long-distance transmission at a high voltage** can be combined with domestic use at a low voltage. Alternating current is still the most use current in the actual grid.

Connections in a high-voltage substation

Alternating current

98% of the European grid carries alternating current, which allows **voltages to be switched and transformed easily**. Operation is simpler and branches to other connections can be established where necessary.

In a grid with many interconnections, alternating current is **self-regulating** to a certain extent. In the event of an incident (e.g. a cable fault), the electricity is automatically transported to other connections. As incidents are handled automatically, the electricity supply is not compromised.

Direct current

With the direct current, the electric current remains constant and always travels in the same direction. For examples, batteries and accumulators supply direct current. DC connections cannot yet transport as much energy as AC connections. It is still difficult to make a DC connection work well on the high-voltage grid.

Specific applications for direct current

There are several tangible cases in which direct current can successfully be used, mainly at **point-to-point connections** without branches or **connections between different networks**. For example, direct current is used in subsea connections between neighbouring countries. Nemo Link is one such interconnection.

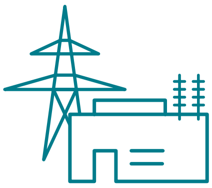
DC can also be used in high-voltage onshore applications, to link asynchronous networks with **different frequencies** (hertz), in **long high-voltage connections** with a limited capacity of transport or where active control is required, like in the ALEGrO project.

Converter stations

Converter stations are needed when integrating a DC connection into our AC grid. In a converter station, various electrical installations and devices **convert alternating current into direct current, and vice versa**. A converter station houses thousands of components that all need to be controlled individually increasing the **complexity** and that has to be regulated meticulously. Any glitch, incorrect measurement or unknown situation can result in the DC connection malfunctioning. The slightest error or fault results in the installation being shut down to **protect the high-tech infrastructure**. This can have a major impact on the operation of the grid and security of supply.

If there are many converter stations in a small network, there is a risk that **they will work against one another**, consequently causing stability issues that lead to shutdowns.

Interior of a converter station



A converter station takes up at least **5 hectares of space**.