Terna

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The electricity grid's development, between past and present

130 years of history for electricity transmission

In 1882 the first electricity line between Tivoli and Rome
The pylons of the National Transmission Grid are presently 200,000

The first industrial **electricity transmission line** in Italy, between Tivoli and Rome, entered into operation **in 1882:** a 5,100 Volt single-phase electricity line, formed by metal supports made of double beams, concrete bases and insulators mounted on bolt hooks on cables fixed on oak crossbars. Wires (those that are normally called "electrical wires") used to be four and were made of copper (2 single-phase circuits).

Until then, only many different types of experiments had been carried out, such as the one conducted by Alessandro Volta who already in 1777 was the first to suggest the idea of an electricity transmission line, writing poetically, "*the igniting spark could be transported from* ***Como to Milan*** *with barbed wire supported by wooden poles planted here and there*". A "vision" of the first pylons, since the ones that were in use at the time for telegraph lines were wooden poles with zinc iron barbed wire supported by porcelain insulators fixed to the pole with screws and with bolt hooks that supported the wire.

The first energy transmission experiment dates back to 1884. During the Turin Expo, under Galileo Ferraris' direction, 3000 Volt single-phase current was used that was transmitted for 42 km reaching Lanzo. The supports were wooden poles with bell insulators and bronze wires 3.7 mm in diameter. While in 1882 in **Munich,** Thury had carried out the first experiments in transporting direct current.

The Tivoli-Rome line was followed in 1898 by the **Paderno-Milano** line (32 km), the first three-phase line with metal "pylon-type" supports and "delta-type" multiple bell insulators with copper wires.

At the same time, also in the **United States** the first industrial power lines with bronze or copper wires were used. However, already in 1897, in **Chicago,** a telephone copper wire, corroded by locomotive steam, was replaced with an aluminium wire and a year later a 73 km three-phase line was equipped with aluminium wires.

A technological turning point was represented by the fine-tuning of overhead insulators and by the use of aluminium-steel wires that allowed reaching higher voltage and consequently improving pylons. In 1913, the famous **Big-Creek line** (150,000 Volt) was built, 400 km long, that for many years remained the longest one with the highest voltage in the world.

The years that followed were of intensive development and new lines began springing up both in Europe and the United States. In 1928, almost at the same time, in **Germany** and Italy the first 220 kV lines entered into operation. In 1936, the 287 kV line was built between Hoover Dam and Los Angeles. In 1953, in **Sweden,** the first 380 kV power line from Harsprannget to Stockhom (954 km) was built. The increased voltage, however, did not bring any substantial changes in the way electricity lines were built: aluminium-steel wires, V-shaped or portal pylons, overhead insulators with up to 26 components, with average bays between pylons between 300 and 500 meters.

The pylon's shape dates back to the first iron structures that starting in 1829, marked the beginning of the so-called iron architecture. The epitome of this type of architecture was expressed in Paris in 1889 with the building of the Eiffel tower during the Universal Expo. With its 324 meters in height, it was the tallest building ever to be built for a long time. It is formed by 18,038 pieces of iron joined by over two million rivets weighing a total of 7,300 tons.

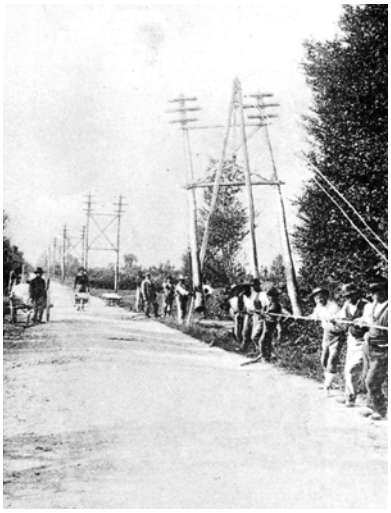
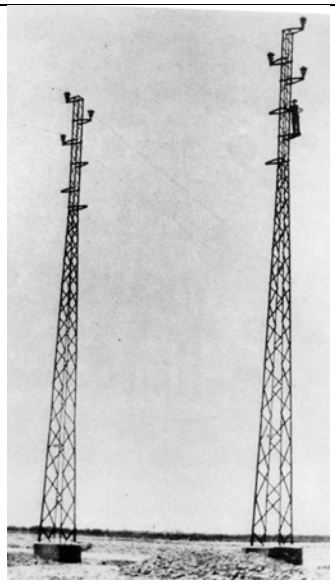
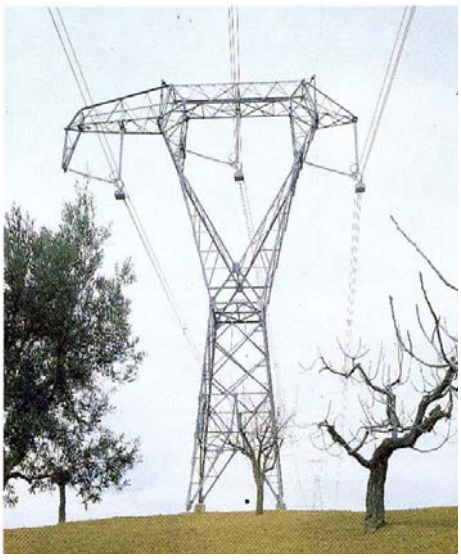
The pylon structure allows building a power line along any route, even the most critical, while also complying with technical rules and load conditions, including the most extreme ones (earthquakes, angles, uneven terrain, crossing of waterways). The most significant example of this is the crossing of the strait of Messina with a 220 kV double circuit line, no longer in operation, that was built in 1955 in a seismic area with 224-meter-tall tower pylons and a single 3,600 meter bay that represented the world record in building large electricity infrastructures for a long time.

50 years later, the record is now held by the crossing of the Yangtze river, the longest and most impetuous river in China, also known as the "blue river" in the Western world. The infrastructure, with a 500 kV AC double circuit line, allows transporting 2,000 MVA on each circuit with a 2,300 meter bay built with two 346-meter-tall tower pylons each weighing 4,200 tons.

THE NATIONAL TRANSMISSION GRID IN NUMBERS

- High Voltage Grid: approximately 60,000 km
- Number of High Voltage pylons: nearly 200,000
- Average distance between High Voltage pylons: 300 meters
- Average height of High Voltage pylons: 30-50 metres, the range is between 150 kV (30 meters of height) and 380 kV (50 meters of height)
- Average weight of a High Voltage pylon: 30 tons

Pylon development over the years

		
1905	**1911**	**1929**
		
1986	**2005**	**2008 (Norman Foster)**

2009 (Rosental Group – Dutton)