Terna

Terna is a leading grid operator for energy transmission, being the largest independent grid operator in Europe. With around **63,900 km** of lines, Terna is the owner of the National High Voltage Electricity Transmission Grid. It designs and builds infrastructure for the transmission of electricity at high voltage, in the general interest of quality, efficiency, safety and sustainability. Terna operates through its two subsidiaries Terna Rete Italia and Terna Plus. Terna Rete Italia manages and develops the national electricity transmission grid; it ensures continuity of electricity supply in the country **365 days** a year, **24 hours a day**; it safely and efficiently manages the increasing flows of electricity. Terna Plus captures and develops, in Italy and abroad, the new business opportunities arising from the changes in technology and trends in the energy sector. The two companies operate in accordance with the strategic guidelines issued by the parent Terna S.p.A. Even the **focus on sustainability** is an area of excellence at Terna that is globally recognized: its responsible approach to the environment, land and communities, as well as its daily commitment to the sustainable development of electricity infrastructure, are a keyelement in the company's strategic choices.

The **BESTGRID** project

With nine partners, comprised of European non-governmental organisations (NGOs) and transmission system operators (TSOs) and a research institute, the EU-funded BESTGRID project works towards modernising and expanding the current European electricity grid for the integration of a growing share of electricity from renewable sources.
Launched in April 2013, BESTGRID is made up of four pilot projects located in Belgium, Germany and the UK. During the project, TSOs and NGOs work together to improve local and public acceptance for grid development processes. Objectives of the project are to enhance transparency and public participation, to speed up permitting procedures by proactively addressing or even surpassing environmental protection standards, and to encourage the implementation of constructive public engagement in permitting procedures for European energy infrastructure "projects of common interest." Jointly, partners learn about how to implement better practice in developing the grid. Three of the pilot projects have a stronger focus on designing and testing new activities, while the fourth one focuses on evaluating activities that have already been developed and implemented. The International Institute for Applied Systems Analysis (IIASA) will lend support by evaluating the activities from a scientific perspective.

For more information, please visit www.bestgrid.eu

BESTGRID partners include two NGOs (BirdLife Europe and Germanwatch), five TSOs (50Hertz, Elia, National Grid, TenneT and Terna Rete Italia), one research institute (IIASA) and the Renewables-Grid-Initiative.

The **INSPIRE**-Grid

INSPIRE-Grid is an EU-funded research project that stands for "Improved and eNhanced Stakeholders Participation In Reinforcement of Electricity Grid."With ten partners from six different countries, INSPIRE-Grid aims to increase stakeholder engagement in grid expansion projects, better manage conflicts, and speed up the permitting process. By way of an interdisciplinary approach, INSPIRE-Grid will develop stakeholder-led processes and design an expert-led European good practice guide. Methods to facilitate decision-making will be newly combined with engagement tools and tested with stakeholders from existing or concluded grid development project case studies.

INSPIRE-Grid partners: research institutes (Ricerca sul Sistema Energetico - RSE SpA (coordinator), Association pour la recherché et le developpement des methods et processus industriels – ARMINES, Eidgenössische Technische Hochschule Zürich – ETHZ, Institut für ZukunftsEnergieSysteme – IZES, Potsdam-Institut für Klimafolgenforschung – PIK, Poliedra Centri di Conoscenza e Formazione del Politecnico di Milano – Poliedra), transmission system operators (National Grid, RTE, Statnett), and the stakeholder platform Renewables-Grid-Initiative – RGI.

More information: www.inspire-grid.eu

Terna
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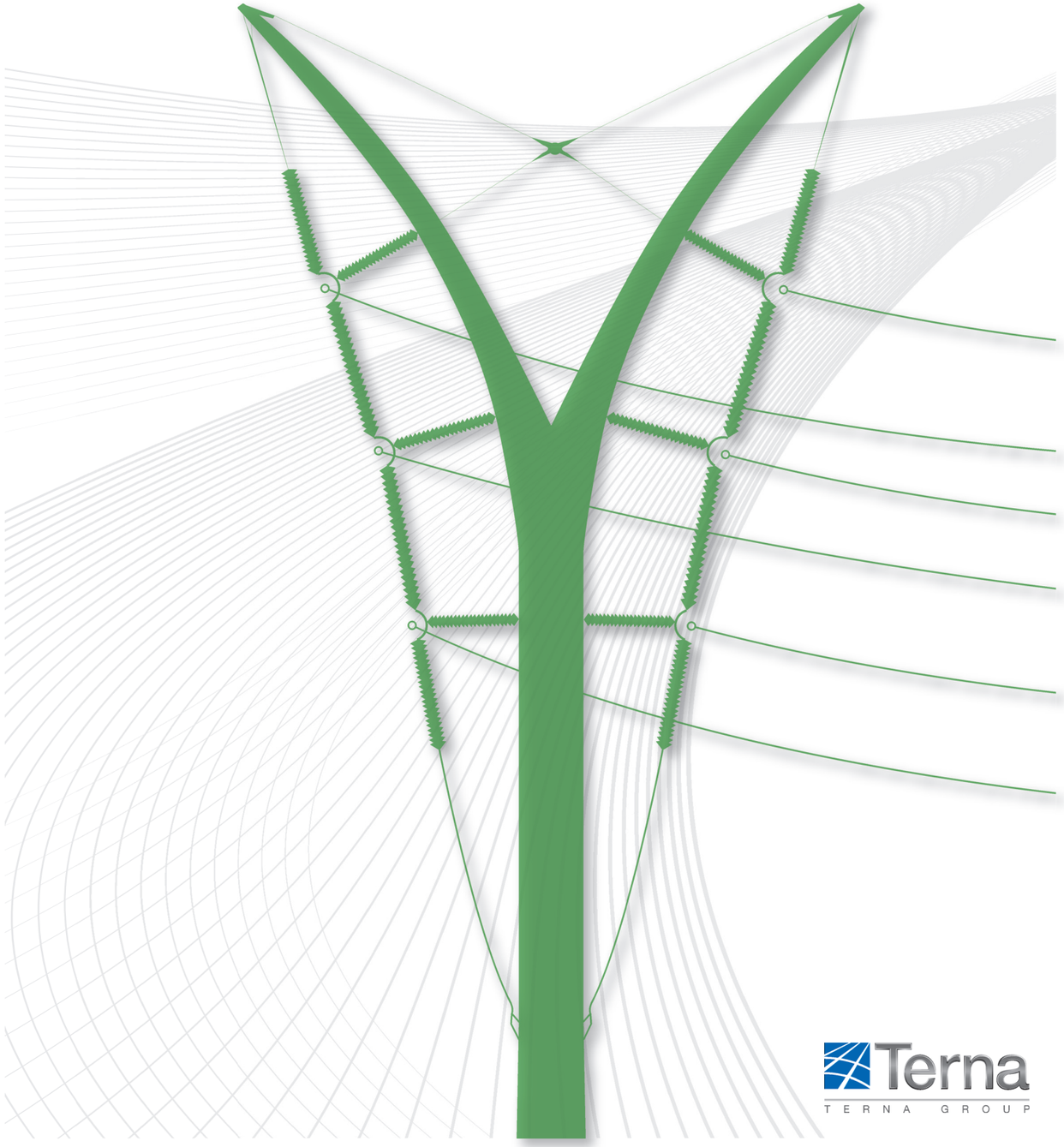
www.terna.it

TOWARDS THE GRID OF THE FUTURE: DESIGN, INNOVATION AND TECHNOLOGY AT THE SERVICE OF THE ENVIRONMENT



Terna
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It is not yet time to say farewell to the old pylon, but the Italian electricity grid is nonetheless undergoing some radical changes, becoming ever-more environmentally friendly and technologically “smart”. For several years now, Terna has been driving both the creation of infrastructure and the technological evolution of the grid: **the company has implemented an extensive project of renewal with the installation of new pylons** that are technologically advanced and more environmentally friendly, such as single pole pylons or new concept supports such as those designed by **Foster and Dutton** (group project manager: Studio Rosental), designed for areas of high scenic interest. About 60% of the main electrical infrastructure that Terna is currently building involves the use of these new pylons.

The new Terna pylons

Germoglio: new pylons of the future

Abandoning traditional and technically consolidated solutions for supports with new forms able to provide different sensations in terms of perception of environmental harmony and aesthetic impact. This was the intent of the 'Pylons of the Future' competition, launched by Terna in 2007 and concluded in 2009, with the victory of “Germogli”, the new type of pylon designed by architect Hugh Dutton (group project head: arch .Rosental) of the study, which can be understood from the motivation, “it stood from the rest for its distinct lightness and elegance; innovative and challenging in terms of realization”. As the supports were destined for the transport of high voltage electricity, participating designers were forced to comply with stringent technical requirements: structural functionality, high flexibility in use, industrial feasibility and accessibility for grid maintenance operations: structural functionality, high flexibility in use, industrial feasibility and accessibility for grid maintenance operations. The architectural quality of the projects was also evaluated in terms of environmental impact and innovation: in fact, no restrictions were imposed in terms of shape or structure, the only requirement was for the solutions to be realizable using manufacturing processes and materials readily available on the market. Between 48 and 76 meters tall, just 4 meters wide and weighing up to 128 tons, the new pylons designed by Dutton manage to combine innovation, technology, design, creativity and respect for the surrounding landscape, demonstrating that energy and the environment can go well together. In short, they combine aesthetics to feasibility. The competition “Pylons of the future” was conceived from the need to modify the collective image of the power pylons, to embrace a more elegant, harmonious, aesthetically pleasing portrayal while guaranteeing the highest levels of efficiency and safety. The “Y-Shaped” pylons have a reduced environmental impact compared to traditional ones; they take inspiration from nature, particularly from the leaves of trees, and are designed for areas of special environmental interest. Terna installed them, in metallized steel, along a major “energy highway” in Northern Italy, the “Trino-Lacchiarella” extra-high voltage power line, in operation since 2014.

Single pole tubular pylons

The single pole pylon is a low-environmental impact pylon, occupying 15 times less space in terms of power lines and floor area: 10 sq. meters compared to 150 sq. meters for a traditional truncated pyramid pylon. The characteristics of single pole pylons include quick assembly: installation time is 10 times faster compared to traditional pylons (just a few hours compared to an average of 5 days). Furthermore, installation of single pole pylons mainly involves the use of mechanical means such as helicopters and cranes, thus reducing working at height and significantly increasing safety for personnel. This innovative pylon has been used in various electricity lines in Italy, either already completed or currently under construction by Terna, and will become more widespread in the future. Today, single pole pylons have been installed along the “Chignolo Po-Maleo” extra-high voltage power line (installed along about 70% of the line) in Lombardy; “Trino-Lacchiarella”, between Piedmont and Lombardy (installed on about 80% of the line) and “Foggia-Benevento”, between Apulia and Campania; and along most of the “Sorgente-Rizziconi” power line between Sicily and Calabria, which is under construction.

Foster pylons

Since 2008, along the “Tavernuzze-Santa Barbara” power line in Tuscany, Terna has been installing pylons designed by architect Sir Norman Foster, a leading exponent of high-tech architecture. This was the first time that the electricity sector, which normally follows an essentially technical approach, opened itself up to the concept of design by experimenting with new methods and systems. Foster's new architectural project won the international contest “Pylons for the Environment”, launched by Terna in 1999 with the objective of designing high voltage electricity pylons to be installed in the countryside and in urban areas and to blend more harmoniously with the Italian landscape. An innovative architectural work, this next generation pylon, named after the English architect, can be installed in urban or farming areas with reduced impact on the surrounding environment. The Foster pylon has a maximum height of 46.5 meters and is 8 by 3.5 meters wide at the base.

The history of electricity transmission

In 1882 the first electricity line between Tivoli and Rome
Today there are about 200,000 pylons of the National Transmission Grid

The first electricity transmission line of industrial scale began operation in Italy, between Tivoli and Rome in 1882. A line at 5,100 volts in single-phase current, consisting of metal supports formed from coupled beams, concrete foundations, insulators mounted on hooks with shank loops mounted on oak cross-beams. The conductors (those that are normally called “wires”) were four copper lines. This is the first power line in the world for the transmission of electricity as we know it today, of industrial and non-experimental nature.

Until then only many experiments, such as Alessandro Volta that already in 1777 was the first person to conceive power line transmission writing, almost poetically, “the moving spark could be brought from Como to Milan with the wire suspended above ground by wooden poles planted here and there”. A “vision” of the first pylons, as those used for telegraph lines were wooden poles with galvanized zinc wires, supported by porcelain insulators bolted to the pole and carrying a hook that supported the conductor.

The first experiment of energy transmission dates back to 1884. In occasion of the Turin exhibition, with the guidance of Galileo Ferraris, a single-phase current of 3,000 V was used and transmitted for 42 km to the town of Lanzo. The supports were wooden poles with bell-shaped insulators and bronze wires 3.7 mm in diameter. While in 1882 in Monaco, Thury had carried out the first experiments of DC transmission. In 1895 regular operation of the first electric streetcar service in Rome began.

The Tivoli-Rome was followed in 1898 by the Paderno-Milan (32 km) line, the first three-phase line with “pylon” iron supports and “delta” multi-bell insulators with copper conductors. Simultaneously, the first major industrial lines with copper or bronze conductors sprout in the United States. Already in 1897 in Chicago a copper telephone wire, corroded by the smoke of locomotives, is replaced with an aluminium wire and the following year a three-phase line of 73 km is equipped with aluminium conductors.

In 1913 the famous Big Creek line (150,000 Volts) 400 km long was built that for many years remained the longest line and with the highest voltage in the world. Years of intensive development began and the new lines in Europe and in the US were installed. In 1928, almost simultaneously, in Germany and Italy the first 220 kV lines are put into service. In 1936 the first line from the Hoover Dam to Los Angeles at 287 kV was installed. In 1953 in Sweden the first 380 kV line from Harsprannget to Stockholm (954 km) was installed. The increase of the voltage has not led to substantial changes in the construction of power lines: aluminium steel-conductor V-pylons or portals, suspended insulators with up to 26, average spans between the pylons of 300 to 500 meters.

In 1962 ENEL, Ente Nazionale per l’Energia Elettrica, was founded. The Italian Legislative Decree 79/99 of 1999 started the liberalization of the electricity market, with the birth of the National Electricity Grid Operator (GRTN), whose ownership is largely entrusted to Terna, ENEL Group company. In 2005 ENEL relinquished control of Terna to Cassa Depositi e Prestiti. Terna acquires the branch of GRTN active in electricity transmission and dispatching of electricity: the new Terna was founded, owner and independent operator of the national electricity grid, the largest in Europe in terms of assets currently with around 63,900 km of electricity lines.

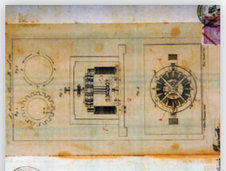
The pylon structure has its origins in the first iron constructions that, starting from 1829, marked the emergence of the so-called iron architecture. The most famous and highest expression of this discipline was first seen in Paris in 1889 with the construction of the Eiffel Tower at the Universal Exhibition which, with its height of 324 meters, remained for some time the tallest structure ever built. It consists of 18,038 pieces of iron joined by over two million rivets and in total weighs 7,300 tons.

The pylon allows power line construction on every tract, even the most critical, allowing compliance with the technical standards and most extreme load conditions (earthquake, corners, gradients, river crossings). The most significant example of this is the crossing of the Strait of Messina in 220 kV-double line, which has not been in operation for years, which was built in 1955, in a seismic zone, with pylon towers 224 meters high and single span of 3,600 meters and that held the world record for a long period of time for great works of electricity infrastructure.

After 50 years, today the record belongs to the crossing of the Yangtze River, the longest and impetuous river in China, known in the West as the “blue river”. The infrastructure, with a 500 kV AC double line, allows the transport of 2,000 MVA on each line, with spans of 2,300 meters realized by two pylon towers 346 meters high and 4,200 tons each.

The first power line in the world from Rome to Tivoli, Italy (1882).

A pylon of the Paderno-Milan power line (1898)



The patent of the Pacinotti dynamo (1860)

A work team performing operations on pylons

The first thermal power plant in Europe, Santa Radegonda in Milan, Italy (1884)

A hydraulic turbine being transported

Historical photos taken from Terna's book, “150 Years: The Grid that Unifies Italy”, published by Affaritaliani Editore.