

# Torrevaldaliga Nord Civitavecchia

High-efficiency thermoelectric power plant



ENERGY IN TUNE WITH YOU.





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# Enel in numbers



Enel is the largest electricity company in Italy and Spain, the second-largest listed utility in Europe by installed capacity and the largest private operator in Latin America.

With output totalling more than 96,400 MW and 1.8 million km of power lines, it delivers energy to over 61 million residential and business customers in 40 countries on four continents.

Countries	Continents	Total net installed capacity
40 <sup>1)</sup>	4	96,473 <sup>2)</sup> MW
Total renewable installed capacity	Total production	Extension of electricity lines
34,727 <sup>2)</sup> MW	285.5 TWh/year	1,810,950 km
Distribution of electricity to end users	Customers	Investments
430.5 TWh/year	61.1 Millions	30.9 <sup>3)</sup> Billion euros
Human resources	Shareholders	EBITDA
75,997 <sup>4)</sup> People	1.5 Millions	17.5 <sup>5)</sup> Billion euros

Data source: Enel 2010  
Value pro-forma as of 31.12.2010

1) It includes all countries where the Group has at least 1 MW in capacity or where sales activities are carried out. It also includes the countries where the Enel Group has business relations, projects in progress or representative offices. It includes El Salvador where Enel has a non-consolidated partnership with LaGeo

2) Value as of 31.12.2010. It does not include 808 MW and 4.7 TWh which are classified as "to be sold"

3) Cumulative investments planned in the period 2011-2015, of which 16.1 billion Euros in development. Total capex not includes connection fees and includes capitalized financial expenses

4) Value as of 31.12.2010. It does not include 2,316 persons who are classified as "to be sold"

5) Ebitda consolidates as of 31.12.2010 by Enel Group





# One of the most advanced plants in the world

## High-efficiency coal power plant

The new Torvaldaliga Nord power plant in Civitavecchia is a high-efficiency coal plant consisting of three 660 MW units for an overall **power capacity of 1,980 MW**.

Due to the array of technologies, structures and equipment used for the benefit of production efficiency and the environmental impact, it represents one of the most advanced coal plants in the world.

The current power plant replaces the fuel-oil plant, which stated operating between 1984 and 1986, consisting of four sections for a total of 2,640 MW. The reconversion project was launched by Enel in 2003, with a twofold objective: on one hand, to help increase the efficiency of electrical energy generation in our country, on the other hand, to improve the environmental performance of the plant through the most advanced technologies.

Installed  
capacity  
1,980 MW



The numbers speak with regard to the dimension of the project:

- 4 months for the demolition of the existing structures
- 50 months for the commissioning of the first unit
- A presence of 3,500 people per day in the construction site during peak periods
- 18 million hours worked
- 200,000 metric tons of structure and equipment
- 400,000 m<sup>3</sup> of reinforced concrete used
- 4,000 km of cables installed

At full capacity, the new power plant will produce about 12,000 GWh per year, equal to half of the electrical requirements of the entire Lazio Region.

18 million  
hours worked





# The energy pathway

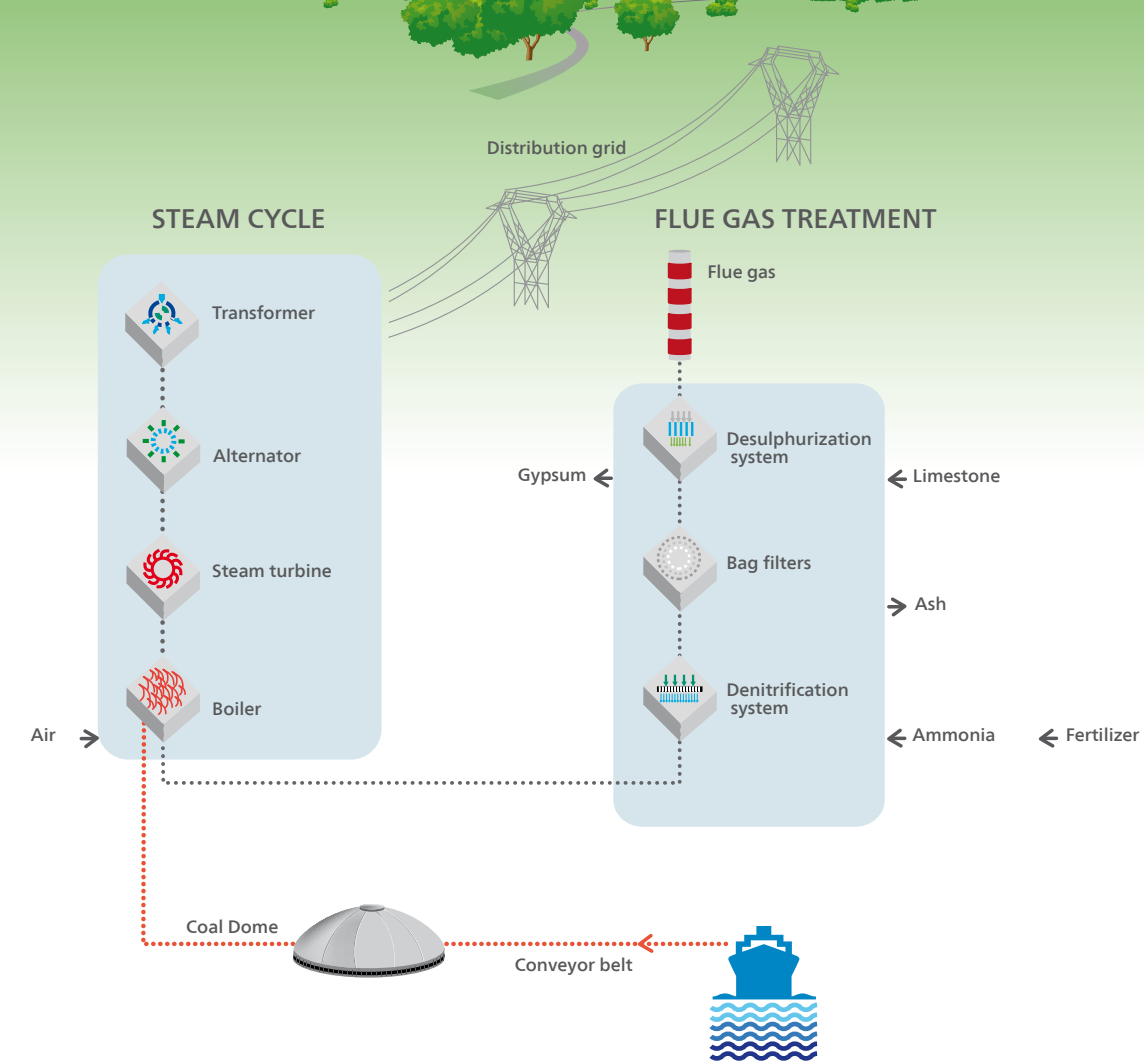
The trip begins at the jetty where the coal is unloaded from the ships for up to 250 meters, with a load capacity of between 70 and 100,000 metric tons.

The coal is transported inside hermetic conveyor belts, stored in sealed coal domes and, afterwards, ground in the mills before arriving at the steam boiler burners, where combustion takes place. The large quantities of heat produced at high temperature transform the water into steam which circulates within the boiler pipes. At 600 °C (1112 °F), the steam is conveyed in large pipes and reaches the turbine where the heat energy of the fluid is transformed into mechanical energy. Finally, the alternator is connected

to the turbine where the final transformation of mechanical energy into electrical energy takes place. Electrical energy is then raised to a voltage of 380 kV by a transformer to be introduced into the electrical network.

After having yielded most of its energy to the turbine, the steam is conveyed to the condenser where it returns to the liquid state. The water is transported back to the steam boiler by special-purpose pumps for a new cycle.

The effluent flue gas is sent to the chimney after having passed through the denitrification system, bag-house filters and desulphurization system to abate nitric oxides (NO<sub>x</sub>), particulates and sulphur dioxides (SO<sub>2</sub>) respectively.





# An environmentally-friendly technology

The Torrevaldaliga Nord power plant is **certified by EMAS** (Eco-Management and Audit Scheme), an instrument created by the European Union to which organizations may adhere voluntarily **to evaluate and improve the environmental performance** and to provide information regarding the management of technologies and structures to protect the environment.

## The coal pathway

Coal handling and storage take place in absolute safety thanks to the use of totally sealed and automated structures, beginning with removal from the holds of the ships, until it is introduced in the boiler.

In particular, the coal is removed directly from within the holds by continuous-bucketed unloaders: from this point on, the coal "no longer sees the light of day" since the transfer takes place through closed vacuum conveyors which prevent the dust from leaking out.

The coal bunker is covered with a tubular aluminium and steel structure, the coal dome, used in few plants in the world.

3,000  
metric tons/h  
coal handling  
capacity





## Cutting-edge emissions technology

In the new plant, flue gas purification is guaranteed by very high efficiency systems:

- **DeNO<sub>x</sub>**, the denitrification system, reduces the nitric oxides present in the boiler exhaust gas to pure nitrogen through a chemical process which utilizes gaseous ammonia. There is a special feature which distinguishes the Torreal-daliga Nord power plant: the ammonia is not transported from other sites but it is produced on site from a commonly used fertilizer, thus limiting the hazards related to transportation. The nitric oxides are 61% lower than the pre-existing plant.

- **Latest generation bag-house filters** for the abatement of particulates. The flue gas passes through a fabric capable of blocking the particles and of retaining more than 99.9% of the total particulates with a reduction of 88% as opposed to the old fuel-oil plant.

- **DeSO<sub>x</sub>**, the desulphurization system, limits the sulphur dioxide content in the combustion gas, before it is sent to the chimney. The wet limestone-gypsum flue gas desulphurization process is used: the limestone reacts with the sulphur dioxide in the previously washed and wet flue gases and produces gypsum. The limestone is introduced into the aqueous solution while the gypsum is extracted with humidity below 10%.

In this way, sulphur dioxide emissions are reduced by 88% compared with the old power plant.

An additional measure of quality in the new plant is given by the specific emission values: they are exactly half of that provided for by new European Standards in force since 2008.



## Environmental improvement through coal conversion

(total emissions for 6,500 hours of operation)

Sulphur dioxide (SO<sub>2</sub>)

-88%

Nitric oxides (NO<sub>x</sub>)

-61%

Particulates

-88%

## Pollutant concentration limits

	Clean-coal power plant TVN (Authorized limits MD 11/06/03)	New large combustion plants (Directive 2001/80/CE)
SO <sub>2</sub>		
NO <sub>x</sub>	100	200
Particulates	100	200
	15	30

Values expressed in mg/Nm<sup>3</sup>





# Benefits for the territory

## Efficiency and conservation of resources

The plant uses the best available technologies which allow it to achieve very high performance. Thanks to the installation of latest-generation boilers, net efficiency reaches 45% compared with 38% of the earlier plant, with fuel savings of about 17% for the same amount of energy produced.

Moreover, the new plant's CO<sub>2</sub> emissions are 18% lower for the same hours of operation.

CO<sub>2</sub> emissions  
18% lower

## A better "relationship" with the sea and the constant reutilization of the resources

In order to contribute effectively to environmental improvement, the treatment and full recovery of the water used by the plant will be achieved through the adoption of new technologies such as evaporation and crystallization systems. Additionally, the materials deriving from the flue gas treatment systems such as ash and gypsum will be reutilized. No product will be sent to dumps for disposal: the ash retained in the bag-house filters is destined for use in cement factories for the production of concrete while the gypsum produced by the desulphurization system will be used in the production of plasterboard panels.

## An increase in employment

The investment for the conversion of clean-coal power plant was almost 2 billion euros with a return for local entrepreneurs of about 250 million euros.

Average employment in the construction site during conversion was 1,600 people with peaks of 3,500. Operation at full capacity anticipates the use of about 380 units for the entire economic life of the plant and of another 350 units for maintenance by local companies.

A custom-fit permanent vocational training program for yard safety was and is guaranteed for the entire technical staff. These courses are in addition to those provided for by law and are recognized and valid in other occupational sectors as well.

3,500 people per day  
in the construction site

More than 700 people  
employed to operate  
the plant



## Projects for the community Heat recovery

Work has begun in the Municipality of Civitavecchia for the burying and rationalization of the long-distance power lines to improve the environmental impact of the distribution grid.

The construction phase for the new plant was accompanied by several initiatives which, together with the local communities, have improved the surrounding territory, thus making it more usable: from the removal of waste along the coast, to the adjustment of dirt roads in the coastal area; from the PlayEnergy educational project intended for students and teachers to the support of Enel Cuore Onlus (the Enel non-profit organization) for the territory's non-profit associations; and also musical, scientific and sporting activities that have enriched the city's cultural offerings.

An agreement was stipulated with the Port Authority of Civitavecchia, Gaeta, and Fiumicino, which anticipates the design of an innovative system for the electrification of a pier at the port of Civitavecchia.

The inauguration of the VTMS Maritime Supervision Centre is included in this context, the new operative offices of the Harbour Master's Office, created and financed by Enel. The same incoming and outgoing ship monitoring system was adopted, designed by the company to guarantee the safety of the ships' manoeuvres for the transportation of coal to the plant's coal dome.

The heat that cannot be used for the production of electrical energy is used for entrepreneurial activities performed in the areas near the power plant. In particular, the sea water used for the cooling of the capacitors provides water for the surrounding fish farm. The heat is also used to supply the heating system of greenhouses used for the intensive cultivation of plants and flowers. The residual heat of the productive process was implemented for new entrepreneurial activities.



## Photovoltaic plants installed on the roofs of 12 schools

## Renewable sources and energy conservation

In agreement with the Lazio Region, Enel has identified a series of works for the Municipalities in the Civitavecchia district regarding the spreading of renewable sources and support for energy conservation.

These are the main activities already performed by Enel:

- Enel has arranged for the production of photovoltaic plants on the roofs of 12 schools with total installed power of about 190 kW and an investment of more than 1.1 million Euros. The installation of an additional 400 kW is planned in the territory;
- The construction of Forte Michelangelo artistic lighting plants at the port of Civitavecchia and Rocca dei Frangipane in Tolfa. Photovoltaic plants installed on the roofs of 12 schools.

## A centre of excellence for energy education

The plant area dedicated for service has been renovated and today hosts an information centre. The spaces offers students of all ages, teachers and citizens the possibility of taking a virtual "tour" of the plant through an animated film with a self-guided audio and video system in Italian and English along with a 3D video that reconstructs the path of fuel around the plant. There is also a conference area



# Benefits for the national electrical system

Electricity production mix percentage  
(Italy and EU 2009, World 2008)

	Italy	UE27	World
Renewables	26%	19%	19%
Nuclear	0%	28%	14%
Coal	13%	27%	41%
Gas	51%	23%	21%
Fuel oil, etc	10%	3%	5%

Production efficiency  
procurement safety

The production cost and the prices of electrical energy in Italy are considerably higher than the average of the other European Countries. The production mix for electrical energy in Europe is based mainly on nuclear energy and coal. Italy, on the contrary, produces more than 60% of its electricity from oil and gas, the most expensive sources and originating from politically more unstable countries. Therefore, the conversion of the Torrevaldaliga Nord power plant to clean coal improves the environmental performance of the pre-existing oil plant but also contributes to the balance and the efficiency of the entire national electrical system.

The choice of clean coal, in combination with the use of the most modern technologies to clean smoke, in fact:

- reduces the production costs of electricity thanks to the greater convenience of coal with respect to other fossil fuels and to the recent recovery in the competitiveness of the coal industry;
- increases security in procurement due to its extensive regional diffusion and it reduces energy dependency on a few oil exporting companies.





To see the video of the new clean coal plant in Torrevaldaliga Nord, scan the QR code with your mobile phone or webcam. If you do not have the right software, you can download it online, free of cost, or view the video directly at [www.enel.com/tvn\\_eng](http://www.enel.com/tvn_eng)

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