2011

Responsibility for the electricity service

Terna

Our approach

Terna's core business is electricity transmission and dispatching. These are general interest services that, as in other European countries, are carried out based on a concession by the government, which assigns Terna the role of National Electricity System Operator (TSO). The service provided by Terna is indispensable for the operation of the entire electricity system and thus for supplying electricity to the population.

Given the nature of the service, Terna is not affected by the problems of product responsibility typical of producers of goods or services for end customers, such as the explanatory content of labels, marketing, and advertising.

Even though the end users of the electricity service are not direct customers of Terna, but rather of companies that distribute and sell electricity, **the role it performs in the electricity system makes Terna ethically responsible to all of Italian society for the service**; the sense of responsibility for a public service is part of the work culture of the Company's personnel.

Thus Terna strongly feels the responsibility entrusted to it by the government concession and takes on its objectives. In particular, in Italy, the Company undertakes to:

- provide a service characterized by security, reliability, quality, continuity, and cost-effectiveness, constantly maintaining a balance between electricity demand and supply;
- keep the transmission system efficient and develop it;
- comply with the principles of impartiality and neutrality to ensure that all grid users are treated equally.

The responsibility regards both everyday operation and the medium and long term. The grid is Terna's asset, but it is also an essential infrastructure for the country, and its current management, maintenance, and development must ensure its efficiency and security in the near future, as well as for future generations.

Our managerial objectives are therefore first of all **connected to complying with regulations and meeting the specific targets established by the industry's regulatory authority** (the AEEG, Electricity and Gas Authority). Particularly important among these are the different measures for service continuity. Terna's performance in the last few years has always been in line with or exceeded the targets set.

Terna's role in the Italian electricity system entails specific objectives regarding the security and development of the grid. **The security objectives are stated in the Security Plan for the electricity system**, in which the investments are planned that are necessary to improve various aspects affecting the security of the electricity system.

The grid development objectives are published in the Development Plan, which is approved every year by the Ministry for Economic Development and sets forth the construction of new electricity lines and stations necessary to ensure the efficiency and cost-effectiveness of the system. Terna selects development projects also according to the condition that overall benefits for the electricity systems are greater than their costs.

The task as operator of the electricity system entails knowledge of confidential data of transmission and dispatching services users, particularly electricity producers. Furthermore, **Terna is entrusted by the National Statistics System with the task of compiling the statistics of the Italian electricity industry,** for which information is collected from the companies concerned. For these data and those it processes to manage its economic relations with grid users, Terna follows the best practices for protecting confidential data in order to prevent the information in its possession from being accessible or communicated to third parties that are not entitled to it.

The security of the electricity system

Ensuring the security of the Italian electricity system which is interconnected with the European grid is a sensitive task, which Terna performs through a series of actions based on a scrupulous assessment of operating risks.
The objective is to maintain the risk of service outage within pre-established limits and mitigate as much as possible the negative consequences of malfunctioning in the event this occurs.
To keep high security levels, Terna must maintain an excellent performance in all the phases of its activities, from the development and construction of infrastructures to plant maintenance and real-time operation. The benchmark for the criteria to adopt is the best European practices in the field of managing interconnected electricity systems. These practices are the result of the cooperation that has taken place for some time within the international organizations in which Terna participates as a transmission system operator (TSO). It is particularly in the ENTSO-E, the European Organization that groups TSOs, that Terna cooperates for writing international Grid Codes and the ten-year Development Plan for the European electricity grid, with the objective of managing service security and at the same time favoring the integration of renewable sources into the interconnected system and the development of electricity markets (see box, page 79).
For Terna, preventing and limiting the risk of outages means monitoring and protecting the physical integrity of its plants, preparing defense plans to limit the consequences of outages, carrying out preventive operation planning, improving real-time control, and training the employees involved also through modern simulation instruments that reproduce the system operation; it also means developing new methods for supporting the planning and control processes, improving the reliability of support tools and coordinating the management of the interconnected system with neighboring TSOs. EU6
Terna's commitment to continual improvement is expressed in the Plan for the Security of the Electricity System prepared by the Company and approved by the Ministry for Economic Development. The Plan is drawn up every year with a three year time horizon. In the different editions of the Plan since it was introduced in 2003, the approach to the security of the electricity system has become increasingly complex.
The initiatives that were presented in the past editions of the Security Plan regarding planning, control, regulation and protection, restoration and monitoring of the electricity system, have been confirmed and partly reviewed in order to better focus on new requirements, such as a more flexible management of the system, in coordination with neighboring TSOs and distributor companies.
The presence of a subject area dedicated to renewable sources, which was introduced during the previous edition of the Plan, was confirmed due to their importance with regard to the security of the system and the objective of ensuring the full integration of renewable energy plants into the interconnected system.
The following are the main objectives achieved in 2011:

- consolidating optimization tools for the procurement of dispatching resources and the verification of congestions (of the following types: *Optimal Power Flow* and *Optimal Reactive Power Flow*);
- improving the process of and the tools for the assessment of the risk conditions related to non meeting the demand (of the *Advance Dispatching* type);
- improving the forecasting of wind power production and introducing the forecast of PV power generation also of the distributed type;
- automatically correcting congestions occurring in the most critical segments of the grid also in the sub-transmission grid to which renewable energy plants are connected;
- launching testing activities of the new control System;
- strengthening the telecommunication infrastructure in support of the Control System and defense systems.

The 2011 Security Plan also highlights the need to identify ways to operate the electricity system over the medium term that are characterized by new elements such as the significant development of renewable energy sources, the widespread presence of electric vehicles and an active demand that is increasingly aware of price indications from energy markets.
These new elements indeed increase the complexity of managing the system and the need to adopt new control systems of the Smart Grid type (see box page 68). The initiatives that are currently under study include coordination proposals to be made to distributor companies for the control of the distributed power generation and the active demand, the management of energy storage systems for the management of the variability in the renewable energy production (see box, page 69) and the dynamic management of grid elements.
In 2011, the investments associated with the Security Plan totaled 96 million euros.
The eighth edition of the 2011-2014 Security Plan provides for investments of 206 million euros.

EU8

Terna and Smart Grids

The development of generation from renewable energy sources – which is bound to continue in the near future at high growth rates, also thanks to the European strategy for limiting CO_2 emissions – poses new challenges for the transmission and distribution of electricity.
In particular, the unpredictable variability of wind and sun availability and the increasing production by small plants located along the distribution grids and the prospects of a greater role of active demand (daily consumption based on price variation), conflict with the traditional structure of the electricity system, which is based on a transmission grid that transfers huge quantities of power from large production centers concentrated in the connection points with the distribution grids, where it is consumed in a widespread way.
The need to change this structure renders it necessary to develop networks and control techniques capable of fostering the dissemination of renewable energy sources without lowering service security: the so-called Smart Grids. Multifunctional smart grids can regulate multi-directional power flows, integrate renewable sources, and make access to the electricity system more flexible for grid users.
Even though transmission grids are already capable of managing variable and multi-directional flows, the increased production of electricity from renewable sources also affects Transmission System Operators, requiring the introduction of innovative solutions for the security and efficiency of the dispatching service.
Furthermore, the system must be able to cope with malfunctions and other abnormal situations by redistributing power flows without suffering service outages and permanently violating the working limits of the equipment that forms the entire system.
It is on the basis of these objectives that Terna has concentrated its development priorities regarding Smart Grids on 4 main aspects:

- **Non conventional storage systems** (see box, page 69) through which the coordinated management is ensured of production injections from renewable sources and energy storage, maximizing production from renewable sources and the system's efficiency and increasing the regulation capability of the electricity system.
- **SPS - Special Protection Systems**, i.e., technologically advanced automatic devices that react to large malfunctions. These systems require the construction on a large scale of immediate-remedial-action schemes that can limit the consequences of a malfunctioning and even trigger self-healing mechanisms.
- **Advanced forecasting instruments** for obtaining a more accurate prediction of production from renewable sources based on real time processing of meteorological data and of the production from wind and photovoltaic plants.
- **Dynamic line rating**, i.e. the dynamic determination of the capacity limits of lines according to environmental conditions, aimed at maximizing the use of the transfer capacity or at a more efficient grid use, as opposed to fixed and excessively reductive limits in favorable meteorological conditions.

Energy Storage, a solution to the problems associated with Non-Programmable Renewable Energy Sources

The sharp increase in power generation plants from Non-Programmable Renewable Energy Sources (NPRS), especially in Southern Italy and on the islands, has a significant impact on the management, operation and cost of the national electricity system.

A high concentration of production distributed by the NPRS compared to the amount of local power load often requires limiting its injection into the grid – in particular with regard to wind power production – to solve local congestions on the high voltage segments of the grid. The presence of NPRS often increases the number and extent of grid congestions. The result is **higher production costs for the national electricity system** which is linked to the need to resort to less efficient electricity production with higher marginal costs.

With regard to the **security of the electricity system**, the widespread presence of production from NPRS implies a reduced availability of primary reserve (that is the capability of automatic regulation, which is typical of thermoelectric groups, in case of deviation from the default parameters of grid frequency) caused by a reduction of regulating production units, based on equal electricity demand, which are excluded from the market by the presence of renewable generation with dispatching priorities. Moreover, scant predictability and high intermittency, especially of wind power, require the availability of greater secondary and tertiary reserve margins in order to allow for real time regulation.

Grid development activities planned by Terna only partially address the critical issues posed by the increase in production from NPRS, given that – due to the long implementation timetable – they can provide a solution to the congestions but not to the safe management of the National Electricity System. For this reason, Terna has identified storage systems – **in particular electrochemical storage (batteries) and hydroelectric pumping** – as a proper technical response to promote the development of electricity production from NPRS and improve the overall efficiency of the National Electricity System, along with the construction of new power lines and stations, based on the same security levels. There are in fact many advantages stemming from the use of storage systems.

The installation of energy storage systems in areas with the largest presence of NPRS' would help reduce congestion during excessive power production times. Furthermore, storing energy during off peak hours (when the demand is low) followed by electricity output in peak hours (i.e., during periods of high demand) would reduce the problems associated with the management of "exhausted" electricity grids during off peak periods and avoid having to resort to less efficient systems during peak periods (a strategy called "peak shaving"). This method would have a positive impact on the costs and security of the system and would help reduce CO_2 emissions.

Storage systems may also be used to satisfy the increased need for real-time regulation reserves. The capacity of storage systems to rapidly inject or withdraw electricity from the grid allows every MW installed to potentially generate twice the capacity amount in terms of reserves, since it can modulate the absorption or injection into the grid as well as quickly goes from full absorption to full injection of electricity into the grid. Storage systems could also guarantee primary frequency regulation where performance is higher than that of conventional power plants.

Considering both technical specifications and the implementation timetable, Terna's technical experts and a group of professors from Massachusetts Institute of Technology performed an analysis which has allowed them to identify **batteries as the storage system that can provide the best solution to current problems in a short period of time**. Pumping units, indeed, cannot be built everywhere and require longer periods of time to be implemented.

Batteries not only allow for the storage of adequate amounts of electricity with a return capacity of the stored power lasting several hours each cycle, but they are also characterized by a high modularity, thus they are easy to install, and can be used with considerable flexibility. A very short timetable for implementation, especially if compared to that of other types of storage systems, the capability of widespread location on the grid also in the vicinity of the numerous NPRS injection points, and the fact that they are not dependent on the suitability of the site, are further elements playing in favor of batteries.

Overall, Terna's plans include the installation of a mix between batteries and pumping units that are properly deployed on the territory according to the specific needs of the electricity system, so as to increase the grid capacity to manage an electricity system where the NPRS play an increasing role.

EU21 Information security

For its role in the electricity sector, Terna has in its databases confidential information of the users of the transmission and dispatching services, in particular electricity producers and traders. Such information includes, for example, specific data regarding plants, with the related production capacity and injection plans presented to the electricity exchange.
Considering its significant commercial value, this information **is classified and handled as sensitive data** and specific protection measures are in place for preventing information being accessible to unauthorized third parties or subjected to undue violations. The same also applies to:

- the data collected from industry companies for the purpose of compiling the industry statistics, a task performed by Terna within the framework of the National Statistics System;
- the data made available by the industry Authority for monitoring the electricity market (as established by Resolution no. 115/08 of the AEEG).

Terna also increasingly uses "Information & Communication Technologies" (ICT) systems to support its core activities regarding the electricity system, joining high standards of operating continuity with efficient cyber-security practices.
To guarantee security to corporate information and ICT systems, Terna adopted an advanced **Information Security Governance Model**, based on the main international standards, where the **framework** and **policies** are established for also protecting law requirements regarding handling of personal data provided to Terna in compliance with the Security Planning Document, with relative roles, responsibilities and executive modalities.
2011 registered an increase in the application level of the Security Framework within the ICT field and verification, control and monitoring systems were finalized for the security level. The year was also characterized by an extensive plan for training and creating awareness within the company of the security of information resources, with the twofold objective of increasing the widespread awareness and trust of people involved in these issues with the framework's rules and methods.
The most significant initiatives and projects include the following:

- achieving, in July 2011, **the ISO/IEC 27001:2005** certification of the TIMM (Integrated Text for Monitoring the electricity market) application, an accomplishment that marks Terna's concern for security governance and improves trust between the Company and its stakeholders. The new certification, even if it refers to a specific corporate area with a reduced ICT boundary, underlines a high management / organization standard. Many of the controls provided by the standard and verified by the certifying Body, indeed, do not only have positive effects on the field being certified, but rather they generate cross-cutting benefits for protecting the entire Company's information assets. The structure of the ISO / IEC 27001 standard, by adopting a continuous improvement approach, is consistent with that of other corporate management systems at Terna (Quality-Environment-Security);
- establishing an **advanced corporate platform for vulnerability management** of ICT infrastructures, capable of rendering systematic the technological assessment and vulnerability analysis activities that can expose Terna to cyber-risks. The platform functions – applicable to the whole ICT assets (networks, workstations, servers, etc…) – provide detailed information on the vulnerabilities, as well as correction or deletion methods and have the ability to perform trend analysis. In the 2012-2013 two-year period, they will be further enhanced by the addition of new features, such as testing and reporting;
- extending the real time security monitoring services with **new functions in the SIEM system** (Security Information Event Management) which is active within the Security Operations Center, i.e. the control center which monitors the security of facilities and of computer networks. By strengthening this event management platform, a greater capacity is ensured to monitor the security status and provide a timely response to any anomalous events affecting grids and IT assets.

PR8 Regarding personal data protection, as in previous years, in 2011 no complaints were recorded regarding violations of privacy or imprudent use by unauthorized users of personal data entrusted to Terna, neither through the specific email for reporting (privacy@terna.it), nor through or any other reporting channel.

EU28
EU29

Service continuity and quality

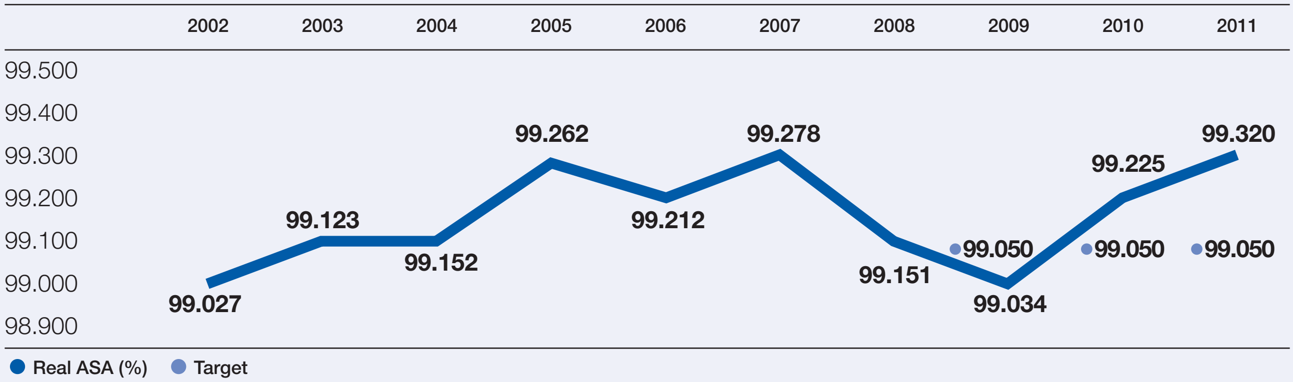
Continuity is the most important parameter for measuring the performance of the electricity service. All the segments of the electricity system (generation, transmission and distribution) contribute to the final result: to ensure society the availability of electricity with outages below pre-established thresholds and with appropriate standards of technical quality. Terna has always monitored service quality by means of various indexes and identifies specific targets as annual goals for improvement. The following pages show benchmarking trends of “service quality and practices of Terna's NTG plants”, as defined by AEEG Resolution 250/04 and Terna's Grid Code.

It should be noted that the variation of the indexes within the given time period does not indicate significant trends: each index undergoes indeed minimal changes in relation to the whole service measured. Moreover, among the causes of variation, are both external factors, such as weather conditions, and events (e.g. failures) attributable to the management of the NTG: an analysis of the latter shows no systematic trends.

Service continuity is a goal that since 2008 has also been the subject of incentives by the Electricity and Gas Authority (AEEG) through specific bonus/penalty schemes based on performance compared to predetermined targets. (See

AVAILABILITY INDICATOR

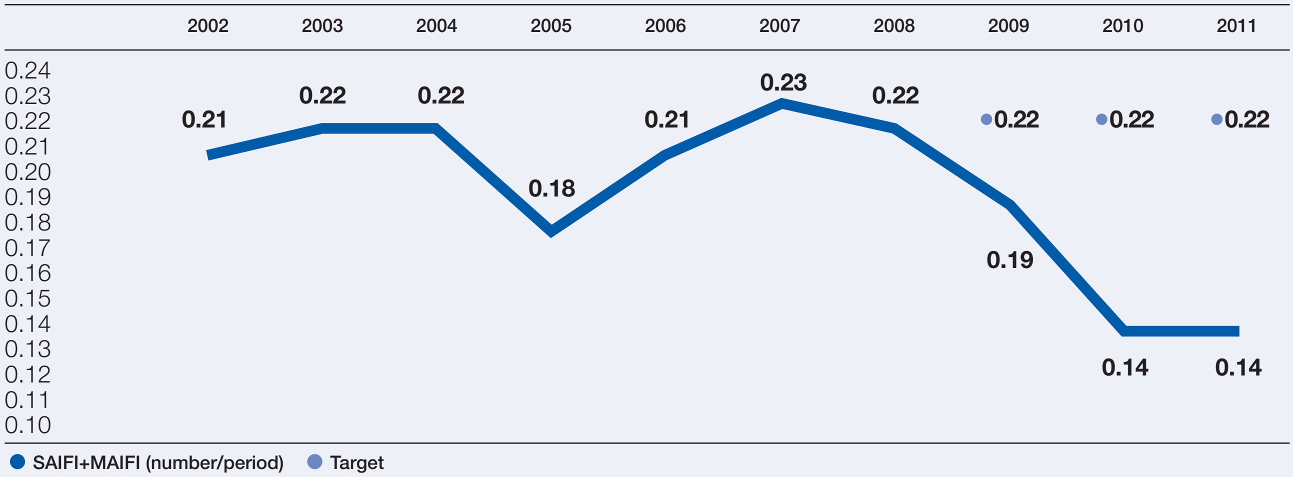
ASA (Average System Availability)
This measures the average availability of the electricity grid components for use in a given period. This index can be expressed with regard to specific categories (for example, by voltage level), grid areas, or – as in this case – the entire National Transmission Grid. Service performance improves as the indicator level rises. The performance achieved in 2011 exceeded the target set.



Target 2010 **99.050%** → Target 2011 **99.050%** → Target 2012 **99.050%**

CONTINUITY INDICATOR

Short Average Interruption Frequency Index + Medium Average Interruption Frequency Index (SAIFI+MAIFI)
This interruption frequency index is calculated as the ratio between the number of customers involved in short (less than 3 minutes) and long (more than 3 minutes) interruptions and the number of users of the National Transmission Grid. A lower indicator level indicates better service performance.
The performance achieved in 2011 exceeded the target set.



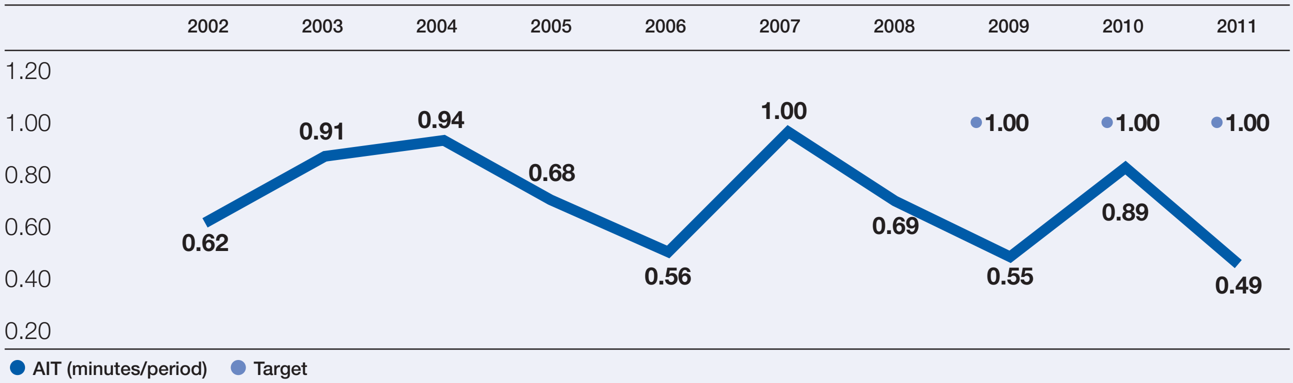
Target 2010 **0.22** → Target 2011 **0.22** → Target 2012 **0.22** paragraph, page 92). In 2011, the two indexes for which incentives were provided have performed better than the targets set by the AEEG:

- Regulated Energy Not Supplied (R-ENS) amounted to 1,210 MWh, lower than the target of 1,369 MWh;
- Number of Outages per Users (NOU) equaled 0.179, lower than the target of 0.209.

During 2011, the Company continued the campaign to measure the voltage quality data in its plants through the monitoring network that has been operating since 2006. The campaign also included cooperation with end HV customers and distributor companies. Devices installed on the grid provide important information on the quality of electricity supplies.

SYSTEM CONTINUITY INDICATOR

Average Interruption Time (AIT)
The average interruption time of the electricity system (NTG) in one year. It is calculated as the ratio between the energy not supplied in a given period (ENS value) and the average power absorbed by the system in the period in question. The figure is rounded to the second decimal. A lower indicator level indicates better service performance. The performance achieved in 2011 exceeded the target set.

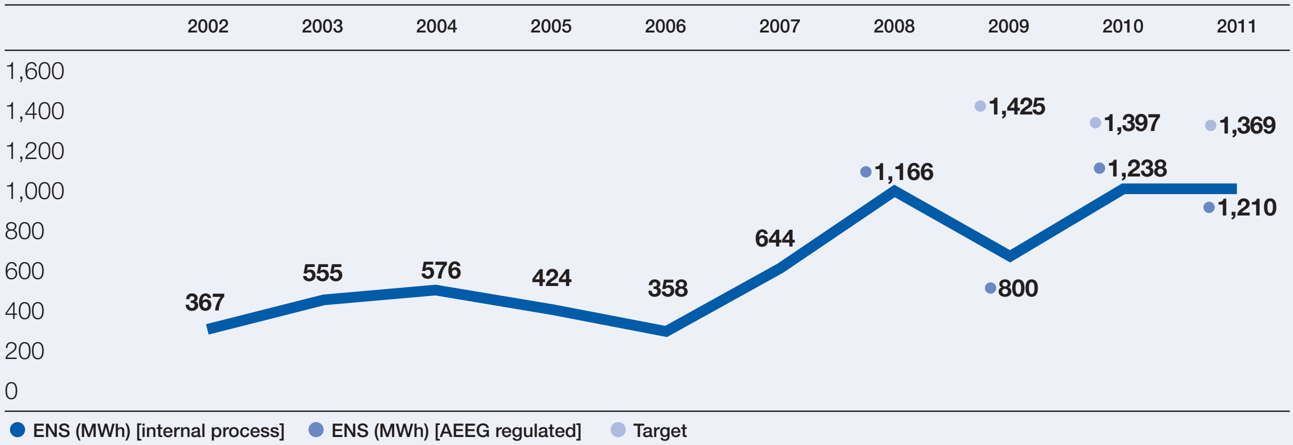


Target 2010 **1.00** → Target 2011 **1.00** → Target 2012 **1.00**

SERVICE CONTINUITY INDICATOR

Energy Not Supplied (ENS)
Until 2007 the ENS indicator was used as an internal process indicator for the purpose of constantly improving Terna's performance. This indicator regarded the energy not supplied to users directly connected to the NTG because of events that affected the latter and did not consider the shares that were due to significant incidents [1].

Regulated Energy Not Supplied (RENS)
Since 2008, with AEEG Resolution 341/07, the Authority regulated the quality of the service provided by Terna through a mechanism based on incentives and penalties, which, among other things, revised the ENS indicator. The new index also includes the energy not supplied to directly connected users caused by events on other connecting grids that are not part of the NTG and a share of the energy not supplied because of force majeure events or by significant incidents [2]. A lower indicator level indicates better service performance. The performance achieved in 2011, based on the new index, exceeded the target set.



Target 2010 **1,425 MWh** → Target 2011 **1,397 MWh** → Target 2012 **1,369 MWh**

(2) "Significant incident" means any interruption with net energy not supplied exceeding 250 MWh. The share that affects the ENSR index is a percentage that decreases as the energy not supplied increases during a single significant incident.

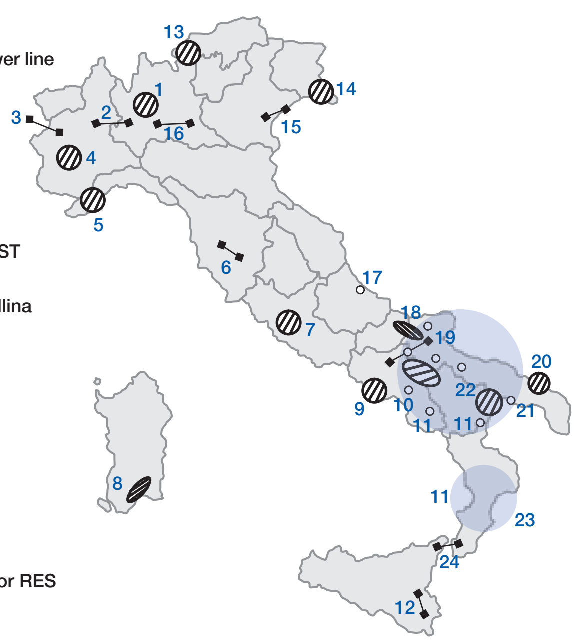
Grid Development

The transmission grid must be gradually modified and expanded in compliance with the developments of electricity production and consumption.
Electricity demand and supply grow at different rates in the different areas of Italy: the combination of these elements changes electricity flows and can cause congestion on the existing grid.
For this reason, Terna prepares **investment plans for grid development**, in order to increase its efficiency and to keep up with the evolution of the power plants and of consumption. The works that Terna plans and implements also have positive repercussions on society: the condition for their construction is that the collective economic benefit they generate is greater than the cost. **Every year Terna prepares a Grid Development Plan with the works scheduled for the following 10 years**, as well as the progress made on the works planned in previous years.
Since 2008, Terna has been submitting its Development Plan to the Strategic Environmental Assessment (SEA) procedure, as provided for by the European Union's Directive no. 42 of 2001.
Like the previous editions, the 2012-2021 Development Plan is organized in two sections. The first section contains a detailed analysis of grid status and the new development requirements that emerged in 2011; a chapter is dedicated to grid infrastructures for the development of renewable energy sources and to new widespread energy storage devices, aimed at facilitating the achievement of national targets with maximum utilization of installed capacity; there is also a new chapter containing the environmental description of areas affected by the new measures set forth in the Plan. The second section describes the progress made on the works and the environmental assessments on the development measures included in the previous Plans.
Furthermore, there is an attachment named "Connections" which contains the details of the development work that has been planned for the connection of third party plants to the NTG.
The Development Plan is available on Terna's website www.terna.it, in the Electricity System section.
Approved by Terna's Board of Directors on January 31, 2012, the 2012-2021 Plan was sent for approval to the Ministry for Economic Development and to the Electricity and Gas Authority on January 31, 2012, while in March 2012 the consultation stage of the proposed 2012 Development Plan and the related Environmental Report began, according to the SEA procedure. To verify the main expectations of our stakeholders, the Plan was submitted for prior assessment to the Grid Users' Consultation Committee (see the "Stakeholder engagement" section), both for the new development projects and for the Plan as a whole.

Grid Development Activities in 2011

SUMMARY OF THE MAIN WORKS THAT HAVE BEEN COMPLETED OR AUTHORIZED OR THAT ARE STILL BEING IMPLEMENTED

- 1. Restructuring City of Milan
- 2. 380 kV Trino-Lacchiarella power line
- 3. HVDC Italy-France Interconnection
- 4. Upgrading Turin
- 5. Strengthening Italy-France PST
- 6. S. Barbara-Tavarnuzze-Casellina
- 7. Restructuring Rome
- 8. Cagliari Sud-Rumianca
- 9. Restructuring Naples
- 10. Power Station Avellino N.
- 11. Measures along the HV line for RES
- 12. 380 kV Melilli-Priolo cables



- 13. Upgrading Alta Valtellina
- 14. Upgrading the Monfalcone area
- 15. Upgrading between VE and PD-Dolo-Camin power line
- 16. 380 kV Chignolo Po-Maleo and stations
- 17. Installing PST in power station Villanova
- 17. HVDC Italy-Montenegro interconnection
- 18. power station S.Martino in Pensilis + 150 kV P.cannone-S.Severo power line
- 19. Foggia-Benevento II power line line and installing PST in S/E Foggia
- 20. Power station Brindisi Pignicelle
- 21. Power station 380 kV collection: (Bisaccia,Troia, Deliceto)
- 22. Power station 380 kV collection: Spinazzola, Castellaneta, Montesano M., Gravina, Erchie, Scandale, Cerignola, Manfredonia, Belcastro
- 23. Power station Aliano and Raccordi
- 24. Sorgente-Rizziconi power line

In progress · Completed · Authorized

Main works implemented

In 2011, an increase in processing capacity of nearly 1,500 MVA was reported and more than 70 km of new high and extra-high voltage lines entered into operation.
During 2011 and in early 2012, in addition to the two 380 kV Chignolo Po-Maleo power stations, the new 380 kV d.t power line connecting Chignolo to Maleo was also completed, as part of the “380 kV Upgrading Plan in the Province of Lodi” (see box 86).
During the year the following works were also completed:

- 220 kV Camporosso station and installation of a PST on the 220 kV “Camporosso-Trinitè Victor” power line;
- 220 kV cable power lines and overhead lines included in the 220 and 132 kV upgrading in the province of Turin;
- new 220 kV station in Torino Nord and relative connections;
- 220 kV Gadio-Porta Volta buried cable power line, as part of the upgrading of the electricity grid in Milan;
- installing a condenser battery in the Cislago and Cremona stations;
- new 220 kV power station in Cardano, Trentino Alto Adige;
- 150 kV “Portocannone-S.Martino in Pensilis” power line;
- 220 kV Frattamaggiore-Secondigliano buried cable power line, as part of the upgrading of the electricity grid in Naples;
- new 380/150 kV station in Deliceto, bypass connection for the 380 kV “Candela – Foggia” lines and 380 and 150 kV connectors: “Agip Deliceto-Ascoli S.” power line, functional for connecting renewable source plants being built;
- new 380/150 kV station in Troia, bypass connection for the 380 kV “Foggia-Benevento II” line and 380 kV connectors, functional for connecting renewable source plants being built;
- new 150 kV PS 380/150 kV Bisaccia connectors: 150 kV “Bisaccia-Calitri” power line, functional for connecting renewable source plants being built;
- significant measures for strengthening the 150 kV main lines for wind power production in Campania, Basilicata and Puglia;
- 380 kV station in Brindisi Pignicelle with finishing and adapting the 150 kV section;
- installing a new reactor in the 380 kV stations in Scandale and Rossano;
- strengthening the HV grid in Gallura.

Main works authorized

During 2011, Terna obtained authorization for a number of important development works, including:

- new HVDC “Piemonte-Savoia” cable interconnection and related works;
- 220 kV Baggio-Ric. Ovest cable power line as part of the upgrading of the electricity grid in Milan;
- new 380 kV “Dolo-Camin” power line and related works as part of the upgrading of the HV grid in Venice and Padova;
- new 150 kV switching station in S. Salvo and related connectors;
- new “Italy-Montenegro” HVDC submarine cable interconnection;
- installing a PST at the 380 kV station in Villanova;
- 380 kV “Foggia-Benevento” power line between Puglia and Campania;
- installing a PST in the 380 kV station in Foggia;
- 380 kV buried cable connectors between the 380 kV power stations in Priolo Gargallo and Melilli and related works as part of the new 380 kV “Paternò-Pantano-Priolo” power line.

Main works being authorized

During 2011 Terna began the authorization process for a number of important development works, including:

- new 220 kV “Torino Sud-Politecnico” buried cable power line linked to the 220 kV upgrading of Turin;
- 220 kV Ponte-Verampio bypass (upgrading of HV grid in Val Formazza), in concomitance with the new 380 kV Trino-Lacchiarella power line;
- a new part of measures linked to the 220 kV upgrading of Milan;
- new 380/132 kV station in the Southeastern area in Brescia and related works;
- new 220/132 kV station in Agnosine, as part of the upgrading of Val Sabbia;
- first upgrading phase of the HV grid in the province of Lodi;
- new 220 kV Polpet station involved in the upgrading and development of the NTG in Media valle del Piave;
- new 380/132 kV station north of Bologna and related connectors to the HV and EHV grid with burial of existing 132 kV line segments;
- new 150 kV switching station in Celano and related connectors to the NTG;
- other measures linked to the upgrading of Rome’s metropolitan area;
- new 150 kV Sorrento station, new 150 kV marine cable connection “CP Castellammare-Sorrento-Capri” and new 220/150 station in Scafati and connectors, as part of the restructuring of the HV voltage in the Sorrentina peninsula;
- significant measures linked to the 220 kV upgrading of Naples;
- other measures on the HV grid for collecting wind power production in Campania and Calabria;
- new 380 kV power line between the power station in Deliceto and the 380 kV power station in Bisaccia and the new d.t. connectors of the power station in Deliceto to the existing 150 kV “Accadia-Vallesaccarda” line and the new 150 kV d.t. PS Troia-SE Roseto power line, functional for connecting renewable source plants being built in the area between Foggia and Benevento;
- upgrading the HV grid in the municipality of Castrovillari, functional for restructuring the Nord Calabria grid;
- initial restructuring of Palermo’s metropolitan area;
- new 380 kV “Chiaramonte Gulfi-Ciminna” power line.

Main building sites open

In 2011, upon receipt of the approvals, Terna opened several sites for important development works, including the following:

- construction for the new 380 kV “Trino-Lacchiarella” connection which will allow for greater transfer capacity between Piedmont and the load area of Milan and greater benefit for the electricity system between segments of the NTG in Piedmont and Lombardy, by improving the flexibility and operational safety of the grid on the territory, thereby reducing the risk of grid congestion;
- measures for strengthening the 380 kV “Foggia-Benevento II” power line which will help increase the production from small generation centers and power exchange between the two regions, improve the dispatchability of high-efficiency renewable and thermal energy sources, improve the reliability and quality of the electricity transmission service, thereby reducing the probability of energy not supplied;
- works for installing a power flow controlling device (PST - Phase Shifting Transformer) on the “Foggia-Benevento II” line, to optimize the use of transmission assets and reduce the risk of congestion and any subsequent production limitation regarding the new plants in Southern Italy, specifically the renewable power plants that are being built between Foggia and Benevento.

Terna has also opened sites for installing a flow controlling device (PST) at the 380/150 kV Villanova power station; this will regulate power flows on the extra-high voltage grid and will be functional for connecting renewable power plants which are being built in the area.

Also in 2011, Terna started work on the new 380 kV “Dolo-Camin” connection which will improve the security of power loads and facilitate power exchange between eastern and western areas, thereby achieving a reduction in transmission losses.

Of significant importance are the many sites that Terna has opened during the year for the construction of new 380/150 kV power stations which will be used for collecting renewable power produced in central and southern Italy.

In keeping with its fully transparent approach to stakeholders, Terna has developed a new web platform which as of March 2011 has enabled users to view online updates on the progress status of the works indicated in the Development Plan. Available at: www.terna.it/default/Home/SISTEMA_ELETTRICO/CantieriTernaPerItalia.aspx.

Measures for the use of renewable energy sources as provided in the Development Plan

By implementing Directive 2009/28/EC, the National Action Plan (NAP) drawn up by the Ministry for Economic Development, Terna has added a special section to the National Development Plan that contains the measures needed to fully utilize electricity produced by renewable energy plants.

The analysis of the power grid aimed at promoting the use and development of electricity produced from renewable sources has identified a number of measures to be implemented on the primary 380-220 kV transmission grid as well as on the 150-132 kV high voltage grid. The schematic diagram below shows the main development measures affecting the extra-high voltage grid.

MEASURES NEEDED TO MAKE FULL USE OF THE ELECTRICITY PRODUCED BY RENEWABLE ENERGY PLANTS

1. HVDC Sardegna-Corsica-Italia (SA.CO.I. 3)
2. 80/150 Tuscania
3. 380kV Foggia-Benevento power line
4. 380KV Deliceto-Bisaccia power line
5. 380kV Calabria-Basilicata-Campania power line
6. 380/150 kV M. sulla Marcellana
7. 380kV Laino-Altomonte power line
8. 380/150 kV Feroleto (extension)
9. Partinico-Fulgatore
10. 380 kV Sicilia ring
11. Doubling the Adriatic main line
12. 380/150 kV Larino (extension)
13. 380/150 kV Rotello

14. 380/150 kV S.Severo (extension)
15. 380/150 kV Foggia (extension)
16. 380/150 kV Spinazzola
17. 380/150 kV P. del Colle (extension)
18. 380/150 kV Brindisi S. (extension)
19. 380/150 kV Castellaneta
20. 380/150 kV Aliano
21. 380/150 kV Galatina (extension)
22. 380/150 kV Scandale (extension)
23. 380/150 kV Belcastro
24. Trasversale Calabra
25. 380 kV Sorgente-Rizziconi
26. 380/150 kV Sorgente 2
27. 380/150 kV Mineo

Development measures on the 150 kV transmission grid are taking place in several Italian regions, especially in the South, and include the construction of new 380/150 kV collecting and transforming stations, new switching stations, strengthening existing lines and the installation of energy storage devices on the 150 kV grid segments which are more likely to experience problems over the short to medium term.

ENTSO-E: European Network of Transmission System Operators for Electricity

Terna belongs to the ENTSO-E, the European Network of Transmission System Operators for Electricity that represents 41 Network Operators belonging to 34 European countries including the South-East European ones (excluding Albania and Kosovo).
As of March 3, 2011, the date on which the EU Third Energy Package was applied, ENTSO-E, with its head office in Brussels, is the EU cooperation body for all Network Operators. ENTSO-E's activities are conducted in close coordination with the European Commission and the Agency for the Cooperation of Energy Regulators (ACER).

European Grid Codes

ENTSO-E has the task of drafting European Grid codes, on the basis of annual priorities established by the European Commission in line with the framework guidelines adopted by ACER, following consulting with stakeholders. European grid codes, adopted by the Commission, will become supranational and binding legislative deeds that will prevail over the national ones regarding cross-border issues.
In 2011, the European Commission, ENTSO-E and ACER established a three-year work plan that includes twelve European grid code projects in the electricity sector, pursuant to the political conclusions of the European Council of February 4, 2011, which set 2014 as the target date by which the integration of electricity markets should be completed.
Terna is working within the ENTSO-E on the establishment of European grid codes for network connection (generators, distributors and end users), with regard to the market and operation of the electricity system.
The first European grid codes will be adopted in 2012. Among them, the code on generation connection is at the most advanced level and will be approved by ENTSO-E by mid-2012, after an extensive consultation process. Upon approval of this code, the market grid codes will follow. Lastly, in 2012, the adoption process of codes for the connection of distributors and the operation of the electricity system and cross-border balancing will begin.

Market transparency

Among its activities, ENTSO-E is also responsible for increasing electricity market transparency, also through the use of a centralized management platform for publishing data and sensitive information. These activities are instrumental in adopting future European Commission guidelines on transparency.

Ten-year Development plan of the European Network

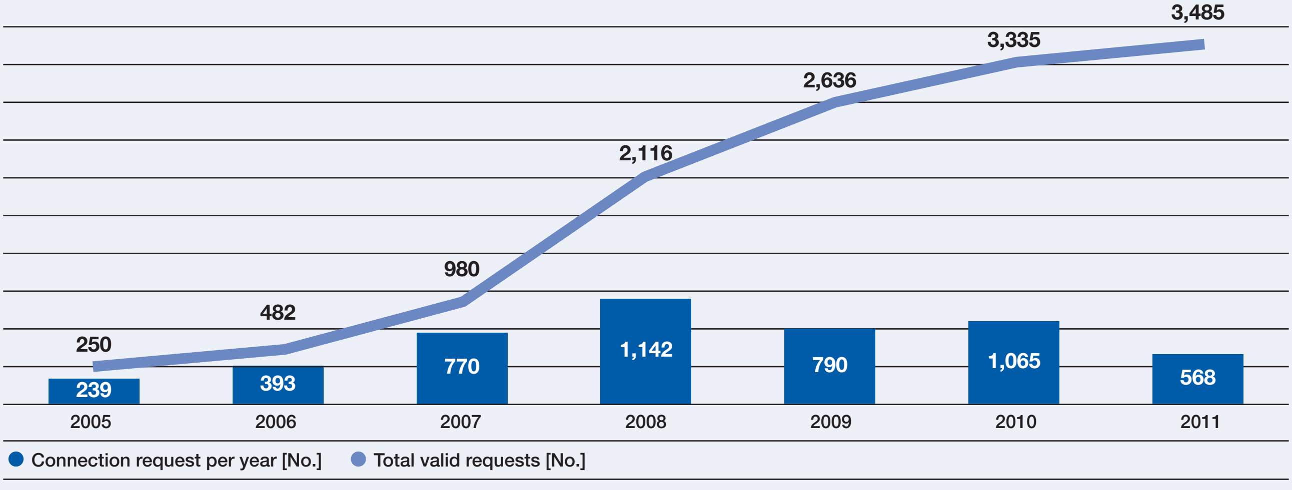
Pursuant to EC Regulation no. 714/2009, ENTSO-E has the task of adopting every two years and publishing a non-binding EU-wide ten-year network development plan that includes integrated market and network models as well as new scenarios and forecasts on the adequacy of supply and demand in Europe. The development plan of the European network is based on national investment plans and takes into account Community guidelines for the development of trans-European energy networks.
The plan also identifies the development needs of cross border transmission capacity and any obstacles, such as those due to authorization procedures.
Although it is not binding by its nature at the national level, the ENTSO-E Development Plan enables national Regulatory Authorities to verify the compliance of national development plans with the European plan. ACER also issues its opinion on this matter.
Terna is working within the ENTSO-E to define the ten-year network development plan which will be published at

the end of June 2012, following an extensive consultation process started in March 2011. The 2012 Community development plan consists of six regional investment plans, of the development plan of the European network and of the report on forecast scenarios and adequacy of the European electricity system. Overall, the plan provides for development investments amounting to nearly 104 billion euros for the 34 countries belonging to ENTSO-E to be made over the next 10 years.
According to the Regulation, ENTSO-E ensures coordination of the European Electricity network operations through common tools in ordinary and emergency conditions, adoption of European research plans and security and adequacy assessments of the electricity system during the summer and winter periods.
In addition to performing activities and tasks under the third energy package, ENTSO-E carries out advisory activities and makes proposals to the European Commission and ACER on several aspects related to the regulation of the electricity transmission sector. For example, it carries out activities aimed at promoting the development of smart grids or defining a modular development plan of "Electricity Highways" by 2050 that is in line with the '"Energy Roadmap 2050" objectives of the European Commission.
Within ENTSO-E's current Governance structure, Terna is present, for the second consecutive term, in the Board, a body limited to the participation of 10 grid operators, with coordination tasks and decision-making powers on the issues assigned by the General Assembly. Terna also supervises the activities of various working groups established in the System Development Committee and participates in the Legal and Regulatory Group, in the "System Operation", "System Development", "Market" and "Research & Development" Committees and in the respective working groups, with the commitment of over 60 employees.

Connecting new plants

Terna is obliged to connect to the Grid all potential users that so request and identify connection solutions based on criteria that allow continuity and security in operating the grid where the new plant will be connected. In particular, Terna is entrusted with the task of connecting to the National Transmission Grid plants with 10 MW of power or more, and of coordinating the interconnection among grids belonging to other operators, if the requests they receive determine the need of strengthening also the NTG.
Access to grid infrastructure is regulated by the Electricity and Gas Authority (AEEG).
Current regulations govern many stages of the process of accessing the grid, establishing timeframes and costs.
During 2011, Terna received more than 550 new connection requests, of which 64% regarded renewable-energy plants, which together with those received previously, raised the total to over 3,400 dossiers being processed at the beginning of 2012. Among these there were:

- nearly 2,700 requests with an accepted estimate (not yet authorized), of which nearly 2,400 regarding renewable-energy production plants;
- nearly 70 dossiers regarding authorized initiatives, of which 64 for renewable-energy plants.



In compliance with AEEG resolutions, Terna has also created an IT system to manage connection requests, which makes the process transparent and traceable, as well as making more information available to the counterparty.
During 2011, Terna completed the main grid works to connect 4 renewable energy plants and 1 production plant from conventional sources.

Provision of service connection

Pursuant to the preliminary inquiry established by the Electricity and Gas Authority (Resolution VIS 42/11), with regard to grid connections of electricity production plants by grid operators, all grid operators, including Terna, as the national electricity transmission grid operator, as well as the main category associations, were requested to provide information on the grid connection of electricity production plants and to differentiate the data provided in relation to the reference resolutions. The inquiry results contained in Resolution VIS 99/11, show that Terna's activities are substantially in line with the requirements set forth in the Regulation.
The table below shows the level of compliance with the maximum estimated time – set forth in the various resolutions adopted by the Authority on the matter – for activities carried out by Terna to fulfill connection requests received between 2005 and 2011. These activities include the preparation of a Minimum General Technical Solution (STMG), a document that is created in response to a connection request, and of a Minimum Detailed Technical Solution (STMD), a document that is needed to carry out the final planning of a grid apparatus by the producer upon receipt of the proper authorization.

OVERVIEW OF THE INQUIRY RESULTS RELATED TO THE AVERAGE RESPONSE TIME

	Response time by TERNA				
	Connection estimate (STMG) (days)		STMD (days)		Building the connection
	As per resolution	Actual	As per resolution	Actual	Average time
Reference Resolution for Connection Requests					
Resolution 281/05- AEEG	90	Between 59 and 88	90	Between 39 and 59	13 Months
Integrated text of active connections AEEG	90	Between 68 and 89	90	Between 30 and 77	14 Months
Integrated text of active connections modified AEEG	90	Between 43 and 93	90	15	-

Plant maintenance

EU6

Plant maintenance is essential for ensuring service quality and continuity.
To ensure that plants can be immediately identified, especially in the event of malfunctions, as well as reached as quickly as possible, Terna's staff uses a handheld device integrated with a navigation system that shows all the plants superimposed on a geo-referred map.
The main activities performed in 2011 with regard to power stations and lines were the following:
Plant monitoring and inspection: in addition to mandatory checks established by the law, Terna:
- performed 21,900 periodical technical and surveillance checks on stations at the different voltage levels;
- inspected 144,000 km of three-phase circuits with on-site checks, including 4,500 km by helicopter, with nearly 2 inspections a year on average;
- carried out 16,900 instrumental checks of lines, using thermal cameras to identify hot points, DayCor UV cameras to pinpoint the corona effect on insulators and conductors, also climbing the supports using the “works on live wires” technique (LST).

Ordinary maintenance: Terna identifies the work to be done on the basis of deterioration signaled by the integrated remote-management system, online sensors, and plant monitoring. For this purpose, since 2005, it has also been using an expert system to assist line and station maintenance called MBI (Maintenance and Business Intelligence), which enables the Company to optimize its maintenance work.

Controlling vegetation: the proper operation of lines also requires ongoing monitoring to assess the growth of vegetation in order to prevent the latter from getting too close to the conductors and the consequent risk of short circuits and line interruption. EN12

Vegetation control normally consists in cutting it down to the ground or – if there are particular environmental restrictions – in branch removal aimed at keeping trees at a safe distance. Herbicides are never used.

During 2011, vegetation was cut along 16,300 km of power lines.

Work on live wires (LST): maintenance work on live wires was performed nearly 3,300 times.

Performed with the line in operation, such work increases system availability and contributes to the improvement of service quality and continuity.

Special maintenance: during 2011 Terna reconstructed 54 km of overhead lines and 19 km of buried cable lines.

Line inspection by helicopter: the LIDAR project

In the second half of 2009, Terna started the LIDAR (Laser Imaging Detection and Ranging) project, with the objective of creating a geo-referred platform of the National Transmission Grid thanks to the use of laser imaging by helicopter.

The project was implemented to respond to the Ministerial Decree of May 29, 2008, which establishes the criteria for calculating the areas of limited safety along power lines and obliges Terna, as the owner and operator of power lines, to provide municipalities, regions, and other institutions entrusted with the inspections with a series of data such as, for example, the geographical coordinates and heights of pylons, the spatial position of conductors, approximate distances, and the limited-safety areas. For its latest-generation power lines, Terna already had this information, while for its lines with inadequate or obsolete mapping, it had to develop a project to obtain the data quickly. Therefore, the Company decided to use the laser technology, developed by the military, to "photograph" the lines quickly and in detail by installing the required devices on a helicopter.

The laser technology made it possible not only to create an up-to-date database for the HV grid, but also to thoroughly survey the position of the main elements, such as buildings, vegetation, and roads, interfering with electricity lines. In particular, on the entire HV grid, it was possible to measure the distance of each element from the conductors, which had been previously possible only with targeted surveys. Since 2012 the goal has been to define and test a new method of inspection of HV lines using helicopters to optimize resources, express results and comply with the best practices of the main Transmission System Operators in Europe.

A new method of working on high voltage power line conductors: the three-dimensional isolated platform

In 2011, a new methodology was implemented to facilitate work on overhead power line conductors, which up to now was only possible by climbing a pylon and walking directly to the conductors or by lowering them to the ground: the use of a truck equipped with an insulating bucket for accessing the workplace on the line, while the power line is in operation, thereby increasing the availability of the systems and improving service quality and continuity. The vehicle has been in use since early 2011; it is located at the territorial area of Milan but it is also available for other areas. This type of work has already been carried out at all voltage levels for repairs in case of malfunction, replacement of spacers and resolution of hot spots, for a total of 70 components that were either repaired or replaced.

EU8 Engineering and innovation

To introduce new technological and plant-engineering solutions, new instruments and methods aimed at improving plant reliability and thus service quality, Terna mainly uses internal engineers, who base their work on careful monitoring and analyzing the operation of equipment and plants. Terna also makes use of the specialist assistance of builders, of cooperation with universities, of RSE S.p.A. (Ricerca Sistema Energetico), and of CESI S.p.A., a company providing specialist services, in which it holds a 42.4% equity interest.

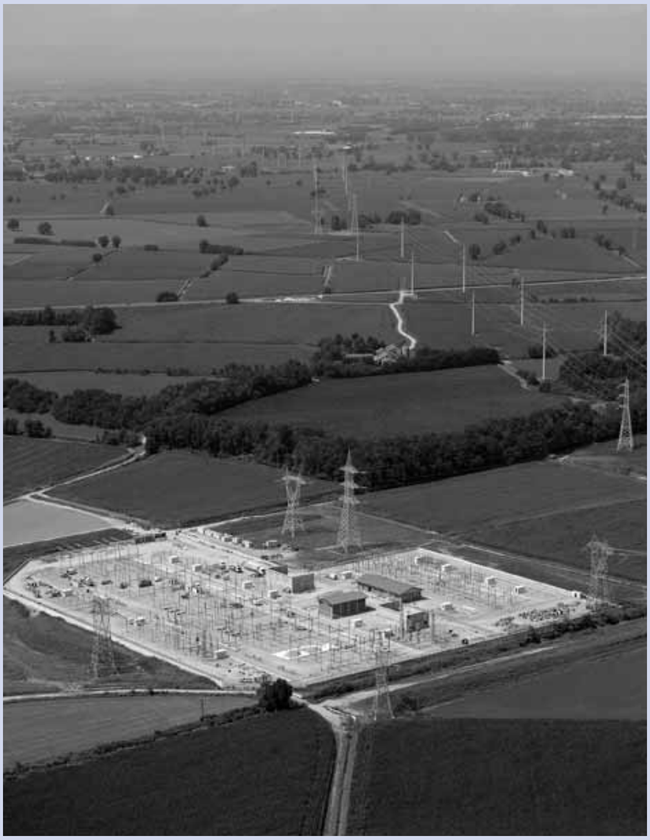
Research on innovation and the development of new engineering solutions is organized in four categories.

Aim	Projects and progress made in 2011
STRUCTURE AND MATERIAL OPTIMIZATION	
Designing towers with less visual encumbrance and/or better environmental integration	**High-performance tubular single-pole towers** Designing completed of special high-performance towers for 380 kV lines. (See box on page 86) **International "Pylons of the Future" competition** Executive designing begun of single and double circuit prototypes of the Dutton-Rosental winning pylon.
Upgrading the transmission capacity of existing lines	**Innovative, high-performance conductors** Experience consolidated of the INVAR-ZTAL conductors, featuring a high temperature limit and reduced elongation, which are useful for solving problems connected with distance from sensitive places. Feasibility studies have begun for the installation of high-temperature conductors of a type other than INVAR-ZTAL. A first type of these conductors has a highly resistant steel support and aluminum cladding. A second type uses carbon fiber cables. For these conductors, experiments are under way on a segment of a high-altitude line. An experimental installation has also been developed with a carbon fiber conductor on a mountain stretch. The study and experimental installation have been completed of an innovative conductor that limits overload by wet snow.
New technology for high voltage cables	**P-Laser** The new generation HV cable (using technology that has already been consolidated on MV), completely produced with recyclable raw materials, is currently being experimented. It will ensure a reduction in the environmental impact of grids and, at the same time, a rise in the capacity to transfer energy.
EQUIPMENT DIAGNOSTICS	
Early warning of abnormalities	**New sensors on equipment and machinery** In the Lacchiarella station, installation of the new sensors on the equipment and machinery of the 380 kV section was completed. Another kind is currently being installed on the 132 kV section. They will be closely observed for a period in view of their potentially widespread installation.
Analysis and monitoring of line components	**Insulator Test Laboratory** A project is currently being planned for developing an experimental station for the study and monitoring of insulators. At present, the feasibility study has been concluded, which has enabled the identification of the most appropriate sites.

Aim	Projects and progress made in 2011
EQUIPMENT DIAGNOSTICS	
Temperature monitoring on high voltage cables	**DTS (Distributed Temperature Sensing)** On cable connections, in order to monitor and exploit transfer capacity to the fullest, a study has begun on temperature monitoring systems available on the market with an analysis of their reliability. The technical specification for the purchase of this technology is being defined.
NEW EQUIPMENT	
Reduced space and time of power station construction	**Integrated compact station equipment (MCI)** This new equipment was introduced, which performs several functions within a single container, thus reducing the space occupied by station construction. By now the installation of this innovative equipment is routine in plants requiring greater compactness and more rapid construction time. To ensure that service will be quickly restored in the event of “Disaster Recovery”, a 150-kV mobile station was designed and built. It is entirely mounted on three trucks that can be transported to the site of use without the need for special means of transportation
Compact, rapidly installable stations	The mobile station was conceived to be quickly installed on 150 kV lines through connections with connector cables. Everything has been factory-tested. The SCRI (Compact, rapidly installable stations) was first used to connect a photovoltaic plant in Aprilia; it entered into regular operation on December 21, 2010. As of 2011, the installation of other stations has continued (in the regions of Lazio, Apulia, Sardinia and Sicily). Given the advantages of this solution, a 380-kV mobile station has also been designed. Contact is currently being made with constructors to assess the possibility of developing it.
PLANT SAFETY	
Transformer Safety	**New power-transformer project** Owing to serious malfunctioning in power transformers, a series of improvements was introduced aimed at increasing their safety. In particular, polymeric insulators will be installed, which tolerate stress better. In addition, a series of measures will be taken to reinforce windings and cases, which will be tested with the “short-circuit trial” carried out for each type of transformer. “Short-circuit trials” will be repeated on all types, since the majority of the previous trials date back to several years ago.

EU8

The first sustainable “super grid” in Lombardy: “Chignolo Po-Maleo”



In the early months of 2012, the extra-high voltage “Chignolo Po-Maleo” power line entered into operation, an energy highway that runs for 24 km between the provinces of Pavia and Lodi. Built by Terna in record-breaking time - since the opening of the construction sites, the works were completed after only 18 months - this energy infrastructure has become operational 6 months ahead of schedule. More record-breaking results for this power line: the “Chignolo Po-Maleo” is in fact the most ecological power line in Italy with about two thirds of the track built using low environmental impact “single-pole” tubular pylons. Terna has installed 88 of these pylons, out of a total of 136 pylons making up the work, of which 11 are of a high performance, special type, mounted for the first time ever on this line: they are unique in the world, since they can also be used on non-linear routes and on impervious and mountainous terrains. Single-pole pylons represent for Terna a breakthrough in sustainable technology; they stand between 24 and 51 meters high, weigh between 20 and 70 tons, have a base diameter between one and a half and four meters, and reduce the occupied ground volume by 15 times compared to traditional truncated-pyramid pylons.
The environmental data of the first phase – already completed – involving the removal of the old line are also particularly important: 91 pylons removed for a total of 31 km of old power lines; 310,000 square meters of land freed from the power line, 910 cubic meters of concrete removed, 1,000 tons of steel recovered and re-entered into the production cycle, 246 km of power conductors recovered for disposal and recycling (a length of more than 7 times the distance between Pavia and Lodi).
The “Chignolo Po-Maleo” power line, approved in November 2009, is of strategic importance for the Lombardy region and will allow the electricity system to save over 25 million euros a year compared to 250 million euros invested. It will create greater efficiency for the electricity system in one of the country’s most critical areas that alone represents 20% of the entire national demand and is the most important industrial pole in Italy and a crucial hub for central Europe.

The INTEGRIT project

The INTEGRIT project (integration of power transmission cables into large road and highway infrastructures), launched in 2011, is aimed at studying and identifying technical solutions useful in developing cabling projects in synergy with road and highway infrastructures. In addition to Terna, the Universities of Padua and Turin and a number of specialized companies will take part in this project.
The project is partially funded by the CCSE (Electricity Equalisation Fund) and will run for three years.
The solutions developed during the project may be used for the future cable connection linking Piedmont to Savoy (Italy-France) and for the new HVAC submarine cable for future submarine connections with the islands of Campania and the Island of Elba.