6

Electricity service and innovation

Ensuring that high quality of service standards are maintained during the radical transformation to a carbon-free energy model is one of Terna's strategic objectives, pursued via investment in new electricity infrastructure and innovation.

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In brief

Alongside the goal of guaranteeing the quality, continuity and cost-effectiveness of the electricity transmission and dispatching service over time, as required under the concession arrangement agreed with the government, one of Terna's strategic objectives is to complete the transition to a new energy model, based on the large-scale integration of renewable sources.

The section begins with an assessment of the energy sector[65], followed by the results for the year relating to service quality and continuity[66] and dispatching.

Reference to SDGs 7, 9 and 13 opens the central part of the section, which focuses on the means at Terna's disposal in order to bring about the energy transition, starting from development of the grid[67] and the 2020 Development Plan, which is dependent on the four drivers of Decarbonisation, Market efficiency, Security, quality and resilience, and Sustainability[68]. This part of the section also focuses on the state of progress in implementing previous Development Plans.

Connections with new plants[69], cross-border connections (including the new Italy-Montenegro Interconnection[70]), private Interconnector projects[71] and all the various aspects of asset management[72] complete the overview of capital expenditure and work on developing the grid. The section ends with a part dedicated to innovation[73], which is increasingly focused on Open Innovation and research and development.

HIGHLIGHTS:

Availability of the service **99.99%** Average Service Availability (ASA)	€ **14** billion **to be invested** under the 2020 Development Plan	The opening of **3** **"Innovation Hub"** around the country

[65] Page 131.
[66] See the paragraph "Continuity and quality of service" on page 136.
[67] See the paragraph "Grid development" on page 142.
[68] See the paragraph "2020 Development Plan" on page 143.
[69] Page 147.
[70] See the box "New Italy-Montenegro interconnector inaugurated" on page 150.
[71] See the paragraph "Private interconnectors pursuant to Law 99/2009" on page 151.
[72] See the paragraph "Asset management" on page 152.
[73] See the paragraph "Innovation" on page 160.

Energy sector

The energy model based on production from fossil fuels that has for many years driven the world's economic and demographic growth is no longer sustainable.

Energy production from fossil fuels is one of the main causes of anthropogenic greenhouse gas emissions (including CO_2), whose impacts on the environment and climate, such as the rise in the average global temperature and the intensification of natural disasters, are scientifically recognised and increasingly frequent.

So far, global warming caused by human activities is estimated at around 1°C, with a growth trend of 0.2°C per decade. To halt this trend, a global commitment to rapid and progressive decarbonisation of all energy sectors is needed.

The unavoidable obligation to find an effective, universally shared solution has led to the drafting of international agreements aimed at defining policies and targets to curb the global warming caused by the increase in greenhouse gases in the atmosphere. The first such agreement, reached in Paris in December 2015 within the framework of COP21[74], was signed by 185 countries who committed to keeping the global temperature rise below 2°C - and, if possible, below 1.5° - compared with pre-industrial levels.

In line with the Paris Agreement, the European Union launched a legislative process that led to final approval of the CEP (Clean Energy for All Europeans Package) in May 2019[75].

In keeping with these guidelines, the Italian government approved the Integrated National Plan for Energy and the Climate (PNIEC) in December 2019.

One of the objectives of the PNIEC is to boost the share of total consumption generated by renewable energy sources from 18.6% in 2020 to 30% by 2030. The electricity sector has been set even more challenging goals, with the aim of increasing the share of total electricity consumption represented by renewables from 34.1% in 2017 to 55.4% in 2030.

Measures designed to promote security of supply for energy, above all electricity, are dependent on the introduction of the Capacity Market, which was launched in 2019, and on revision of the Emergency Plan for the Security of the Electricity System (PESSE). The strategy also includes plans to boost storage systems (above all pumping), cross-border interconnections (see page 149) and investment in resilience in order to contribute to efforts designed to increase the ability of the grid to handle extreme weather events and emergencies (see page 154).

In 2019[76], renewable sources, including hydroelectric and biomass, accounted for 40% of Italy's production (35% of demand).

[74] 21st Conference of the Parties to the Climate Change Convention.
[75] The CEP foresees a 40% reduction in greenhouse gas emissions compared to 1990, a 32% share of renewable energy in gross final energy consumption, and a 32.5% reduction in primary energy consumption compared to the trend scenario.
[76] Provisional data.

The new Presidency of the European Union has opened with a further commitment to the environment. In December 2019, the President of the new European Commission, Ursula von der Leyen, presented the Communication on the "European Green Deal" to the European Parliament, which sets out a roadmap to make the EU the first climate-neutral continent by 2050.

The European Commission will publish the legislative text ("Climate Law") by March 2020, with formal adoption of the 2050 net-carbon neutrality target and will set the new targets for 2030.

Data regarding electricity demand and production in Italy, and the performance of production sources in terms of demand, are shown below.

ELECTRICITY DEMAND IN ITALY

ELECTRICITY BALANCE IN ITALY (GWH)	2019*	2018	2017	% CHANGE 2019-2018
Net domestic production	283,846	279,845	285,265	1.4%
From overseas suppliers (imports)	43,987	47,170	42,895	-6.8%
Sold to overseas customers (exports)	-5,822	-3,271	-5,134	77.8%
For use in pumping**	-2,414	-2,313	-2,478	4.3%
Total demand in Italy	**319,597**	**321,431**	**320,548**	**-0.6%**

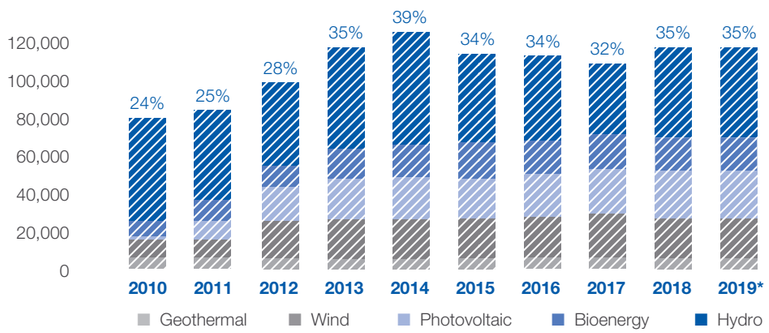
* *Provisional data.*
** *Electricity used for pumping water, solely for subsequent use in electricity production.*

ELECTRICITY PRODUCTION IN ITALY

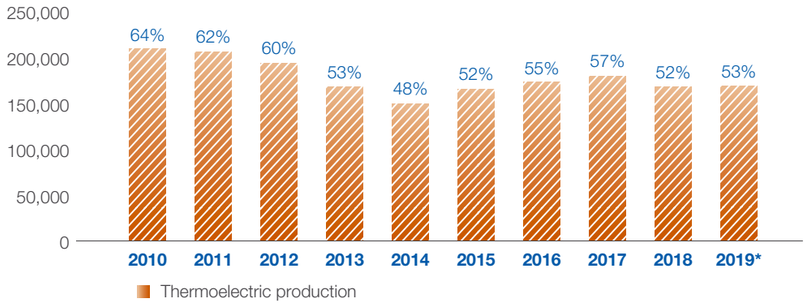
GWH	2019*	2018	2017	% CHANGE 2019-2018
Net hydroelectric production	46,959	49,928	37,557	-5.9%
Net thermal production	169,265	166,737	182,487	1.5%
Renewable production	67,622	63,180	65,221	7.0%
Total net production	**283,846**	**279,845**	**285,265**	**1.4%**

* *Provisional data.*

PERFORMANCE OF PRODUCTION SOURCES IN TERMS OF DEMAND



* *Provisional data.*



* *Provisional data.*

The percentages shown in the two graphs compared refer to the share of demand met by renewable sources (top graph) and thermal sources (bottom graph), totalling 88% of demand. The remaining 12% is covered by electricity received from overseas suppliers.

Renewable production in 2019 is in line with the figure for 2018, but the generation mix has changed, with hydroelectric production down and wind and photovoltaic production up.

NO. OF HOURS IN WHICH COVERAGE OF DEMAND BY RENEWABLE SOURCES EXCEEDS THRESHOLD

	>30%	>40%	>50%
2017	4,434	1,769	524
2018	5,653	2,610	767
2019*	**6,057**	**2,647**	**775**

** Provisional data.*

As there are 8,760 hours in a calendar year (8,784 in a leap year), it is significant that the trend in recent years has seen an increase in the number of hours during which the share of demand met by RES exceeds the 30% threshold.

This reflects both growth in renewable capacity installed and an increasingly integrated approach to managing the various renewable energy sources available.

Continuity and quality of service

EU28 >

EU29 >

Each segment of the electricity system - generation, transmission and distribution - plays a role in ensuring the availability of electricity in Italy, guaranteeing adequate quality standards and keeping the number of outages below pre-set thresholds.

In the context of the growing importance of renewables, some of which are not programmable, Terna is responsible for service continuity on the transmission grid, which is monitored through various indicators, a number of which are defined by ARERA.

The RENS and ASA indicators are the most significant, as they record the frequency and impact on the service of events affecting the electricity network and linked to faults or external factors, such as weather events.

INDICATOR	WHAT IT MEASURES	HOW IT IS CALCULATED
RENS (Regulated Energy Not Supplied)	Energy not supplied following events affecting the relevant grid*.	The sum of the energy not supplied to users connected to the NTG (following events affecting the relevant grid).
ASA (Average Service Availability)	Availability of the service provided by the NTG.	Based on the ratio of the sum of energy not supplied to users connected to the NTG (ENS) and energy fed into the grid.

** The "relevant grid" refers to all the high-voltage and very high-voltage network.*

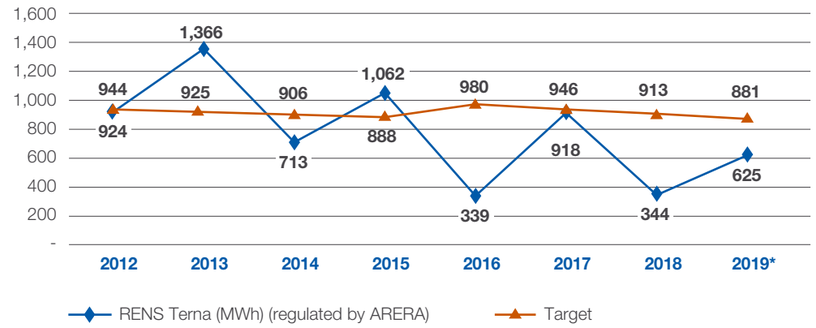
The RENS indicator is also important due to the impact it has on regulated revenue: ARERA[77] regulates the quality of service provided by Terna through a bonus/penalty mechanism based on this indicator.

As regards the ASA indicator, the operating performance shows that ASA has remained stable at a high level over the years (the higher the indicator, the better the performance).

This indicator shows that the energy not supplied following a fault on the grid - subject to ARERA's bonus/penalty scheme - represents a minimal part of the total quantity of energy supplied to users of the grid.

[77] Resolution ARG/elt 197/11. This regulates the quality of the service provided by Terna via a bonus/penalty mechanism applicable to the regulatory period 2012-2015 and relating to the Regulated Energy Not Supplied (RENS) indicator attributed separately to the grid owned by Terna S.p.A. and to the one owned by the subsidiary, Terna Rete Italia S.r.l.
Since 2016, the quality of the service provided by Terna has been regulated by Resolution 653/15/R/EEL, the latter applicable to the 2016-2023 regulatory period, which takes into account only one indicator, NTG RENS, including the grid owned by Terna S.p.A. and its subsidiary, Terna Rete Italia S.r.l.
Resolution 38/2016/R/eel recently clarified that the portion of the network acquired from the FSI Group is excluded from the bonus/penalty mechanism regarding Energy Not Supplied.

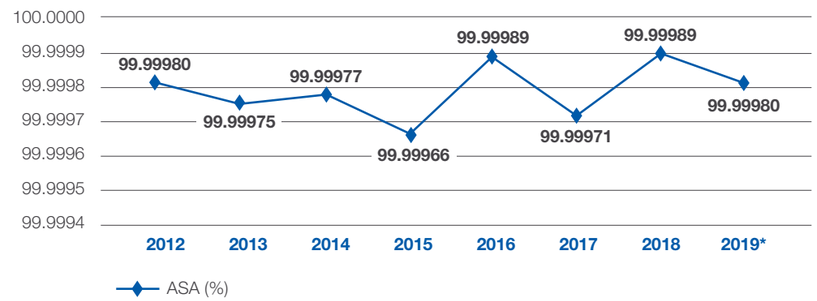
RENS INDICATOR



** The RENS indicator for 2019 is provisional and is subject to change following confirmation of the related amount by ARERA.*

For the RENS indicator, the targets for 2016-2023 have been set as an average of the RENS indicator for the period 2012-2015, with a 3.5% improvement in performance required for each year compared with the previous one.

ASA INDICATOR



** The figure for 2019 is provisional.*

The ASA indicator refers to the observation period 2012-2019.

Key dispatching activities

Dispatching activities aim to ensure that current quality and continuity of service standards are maintained over time. Key developments in 2019 are shown below.

Key events in 2019

Capacity Market

Following the closure of numerous programmable thermoelectric plants, recent years have seen a significant decline in the availability of programmable capacity in the National Electricity System.

Aside from undoubted benefits in terms of cost efficiency and sustainability, the growing use of renewable sources has reduced the profitability of programmable thermoelectric plants and put their continuing operation into question.

This has led to a reduction in the resources needed to ensure system security.

On the other hand, further closures of programmable thermoelectric plants would put the adequacy of Italy's National Electricity System at high risk. This situation has thus made it necessary to create a Capacity Market, on which Terna can procure the generation capacity needed to manage the system. This is done through fixed-term contracts awarded by competitive auction.

Following the receipt of clearance from ARERA, on 28 June 2019, the Ministry for Economic Development issued a decree continuing the implementation process. ARERA then published resolutions governing the conduct of auctions. The first auctions were held in November 2019 for the delivery period covering 2022 and 2023, with contracts awarded for total capacity of 40.9 GW and 43.4 GW.

The Capacity Market will not only make the energy market more efficient, reliable and lower cost, but will also play a key role in the energy transition and the phase-out of coal by 2025.

Opening up of the DSM to new types of resource

In accordance with ARERA Resolution 300/2017/R/EEL[78], in November 2019, Terna published a document, to be consulted on with entities interested in making use of the Fast Reserve service, in the "Pilot Projects" section of its website.

These projects aim to increase the resources available to provide grid services, try out new forms of revenue and test new kinds of fixed-term procurement of resources, partly in view of the future scenarios described in the proposed National Integrated Plan for Energy and Climate (PNIEC).

The Fast Reserve service can thus contribute to system security by improving the speed of response to frequency changes, a service up to now provided by traditional generating plants.

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[78] This resolution set up pilot projects as part of the progressive opening up of the dispatching services market (DSM) to new types of resource, including storage systems and distributed demand and generation.

Black start simulations

Black start simulations are needed to check that the electricity system is working properly and to improve its efficiency by ensuring a rapid reboot of the system in the event of a blackout. In 2019, four live tests were successfully conducted, followed by the related black starts.

In January, black start testing was carried out from overseas, from Slovenia to Puglia. In September, November and December, a further three simulations were conducted in Italy, with black starts carried out in Friuli-Venezia Giulia, central Italy (Abruzzo, Lazio and Umbria) and in Sardinia.

TERRE project

The TERRE (Trans-European Replacement Reserve Exchange) project began in 2013 as an early implementation of the Electricity Balancing Guidelines regarding the design, development, implementation and management of a platform to share balancing resources among European countries.

The project involves 11 countries of which nine are full members (France, the UK, Switzerland, the Czech Republic, Poland, Spain, Portugal, Romania and Italy) and two are observers (Bulgaria and Hungary).

In August 2019, a Cooperation Agreement was signed that marks the beginning of the implementation and operational phase of the TERRE platform for the exchange of Replacement Reserves (to be activated in over 15 minutes).

Montenegro-Italy connection

In November, the longest HVDC submarine cable to be laid by Terna was inaugurated. The cable links the electricity stations at Cepagatti (PE) and Lastva, located within the municipality of Kotor in Montenegro (for further details, see the box, "New Italy-Montenegro interconnection inaugurated", on page 150). The Dispatching unit was heavily involved in 2019, drawing up the operational rules together with the Montenegrin TSO, conducting connection tests and preparing for the auctions held to assign transmission capacity rights.

Investment and innovation for the SDGs

In the current phase of transition towards a decarbonised economic system, in addition to its traditional tasks, the Company is also responsible for promoting the integration of renewables as far as possible. This is achieved by directly connecting them to the grid or through grid upgrades, and by improving grid management capabilities when using non-programmable renewable sources to meet high demand.

Increased use of renewables and development of the electricity grid go hand in hand. Indeed, the latter is an essential enabling factor for the former.

Terna's activities are, therefore, an integral part of the form of sustainable development set out in the United Nations Sustainable Development Goals and, especially, in Goal 7 ("Affordable and clean energy"), Goal 9 ("Industry, innovation and infrastructure") and Goal 13 ("Climate action").

For the specific implementation of its contribution to the achievement of these SDGs, Terna relies on five main instruments:

- investment in development of the transmission grid (the Development Plan);
- investment in security of service (the Security Plan);
- investment in the resilience of the grid and the service (the Resilience Plan contained in the Security Plan);
- asset management (the renewal and maintenance of infrastructure);
- innovation aimed at supporting the transition to renewables and promoting energy efficiency.

GROUP CAPITAL EXPENDITURE

€m	2019
Development Plan	488.1
Security Plan	188.1
Renovation of electricity assets	372.4
Other capital expenditure	99.0
Total regulated assets	1,147.6
Non-regulated assets*	104.4
Capitalised financial expenses	12.1
TOTAL CAPITAL EXPENDITURE	**1,264.1**

** Non-regulated capital expenditure primarily relates to the private Italy-France interconnector and includes the private Italy-Montenegro interconnector.*

BENCHMARK SDGS FOR TERNA

TARGET	TERNA'S ACTIONS	SDG
7.1 - By 2030, ensure universal access to affordable, reliable and modern energy services. **7.2** - By 2030, increase substantially the share of renewable energy in the global energy mix. **7.a** - By 2030, enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology.	**7.1** - Focus on innovation to increase energy efficiency and contribute towards decarbonisation of the economy (see page 160); Carry out the investment provided for in the Development Plan (see page 143); Seek new non-regulated business opportunities (see page 57). **7.2** - Carry out the investment provided for in the Development Plan (see page 143). **7.a** - Play an active role in policy coordination at international level (ENTSO-E, see page 123) and develop overseas operations (see page 58).	7 AFFORDABLE AND CLEAN ENERGY
9.1 - Develop quality, reliable, sustainable and resilient infrastructure, including regional and trans-border infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all. **9.a** - Facilitate sustainable and resilient infrastructure development in developing countries through enhanced financial, technological and technical support to African countries, least developed countries, landlocked developing countries and small island developing States.	**9.1** - Carry out the investment provided for in the Development Plan (see page 143) and implement the Resilience Plan (see page 156); Construct cross-border interconnections (see page 149). **9.a** - Develop International Activities (see page 58).	9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
13.1 - Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries.	**13.1** - Implement the Resilience Plan; Research and Development; Innovation. Focus on innovation to increase the resilience of the NTG (see page 156).	13 CLIMATE ACTION

Grid development

Each year, Terna prepares a National Transmission Grid (NTG) Development Plan, which sets out the grid development initiatives envisaged over the next ten years, as well as the state of progress of the development works planned in previous years.

By analysing electricity flows through the grid and developing supply and demand projections - including the growing production from renewable sources - Terna is able to identify grid upgrade requirements and, consequently, to plan the new works needed to ensure the adequacy of the system.

The Plan contains all the investments that Terna is committed to carrying out in order to guarantee the efficiency of the grid, the security of supply and of the service. At the same time, it represents the community's need for a secure, efficient electricity service and Terna's commitment to meet that need.

All investment in development of the grid is subject to a prior **cost-benefit analysis**, comparing the related expenditure with the resulting benefits, expressed in monetary terms. Cost-Benefit Analysis Methodology (CBA 2.0) entails an important alignment with the criteria and methods applied by ENTSO-E and considers and includes indicators of environmental and social benefits.

A positive cost-benefit ratio is a necessary condition of the investment's inclusion in the Development Plan.

The Development Plan is assessed and approved by the Ministry for Economic Development, following the outcome of the public consultation[79] organised by ARERA, and is submitted for evaluation by the grid users' Consultation Committee (also see page 113).

The Plan is also subjected to a Strategic Environmental Assessment (SEA)[80], with a view to incorporating environmental considerations when preparing the plan, thereby ensuring its environmental sustainability.

[79] Pursuant to art. 36.13 of Legislative Decree 93/11.
[80] Or, if necessary, to the procedures for verification of eligibility for the SEA procedure pursuant to Legislative Decree 1 of 24 January 2012.

2020 Development Plan

Grid development is one of the key enabling factors in the transition to the future energy system.

Terna's 2020 Development Plan is aimed at designing the grid of the future and, to achieve this, four drivers have been identified:

- **Decarbonisation**: the electricity system's transition to complete decarbonisation requires use of all the tools necessary in order to fully integrate renewable production plants in order to reduce emissions in the long term;
- **Market efficiency**: the energy transition requires specific enabling action levers, including the adoption of new market models;
- **Security, quality and resilience**: ensuring the security of the national electricity system and the quality of the service, and creating an increasingly resilient system, capable of handling critical events external to the system itself;
- **Sustainability**: Given its importance in the energy transition process under way, this driver plays a cross-cutting role in creating value for Italy by enabling more sustainable and efficient electricity generation, while at the same time keeping down costs for users, providing a quality service to citizens and minimising environmental impacts

The **2020 Development Plan entails investment of approximately €14 billion**, which will enable the Company to achieve the following electricity system efficiencies and benefits:

300 GWH A YEAR	OVER 7,000 MW	AROUND 5,000 MW	AROUND 5,500 MW
In reduced energy losses	In reduced congestion	In increased interconnection capacity with other countries	In increased capacity provided by the connection of new renewable plants

New green bond issues to finance grid development work

In January 2019, Terna reopened its first green bond, issued in July 2018, in order to raise a further €250 million in the form of a private placement.

In April 2019, Terna launched an additional 7-year, €750 million green bond for institutional investors.

The net proceeds of both issues will be used to finance eligible green projects that Terna has already selected from among those provided for in its Development Plans, in compliance with the Green Bond Principles 2018 published by ICMA, the International Capital Market Association.

In this regard, Terna has prepared and published a Green Bond Framework, in order to facilitate the transparency and quality of the green bonds issued. The Framework and the second party opinion provided by the independent advisor, Vigeo-Eiris, are available for consultation on the Company's website (www.terna.it).

The "Green Bond Report 2019" is published as an annex to this Report (see page 248).

Reducing CO_2 emissions in the electricity system

The policies of the European Union strongly urge an increase in the energy efficiency of energy systems, and greater penetration of technologies with low environmental impact. These measures are ultimately aimed at reducing greenhouse gas emissions as much as possible, especially CO_2.

The electricity transmission system plays a central role in the integration of energy technologies that enable emissions reduction. Investment in the transmission network is a key tool for achieving the objectives set out at Italian and European level, via two main channels:

- a reduction in grid losses;
- better exploitation of power generation resources by shifting production quotas from plants with lower yields - which are nevertheless necessary to cope with grid constraints - to more efficient plants powered by less emissive energy sources (e.g. gas), or to plants powered by renewables.

In the medium to long term ahead of 2030, the various scenarios show the positive effects of development initiatives in terms of cutting emissions. These effects vary, in terms of amount, depending on the scenario analysed. The analyses carried out show that the amount of CO_2 avoided by reducing losses and increasing the efficiency of thermoelectric power plants could reach a maximum value of around 2.1 million tonnes by 2030, particularly under the PNIEC scenario.

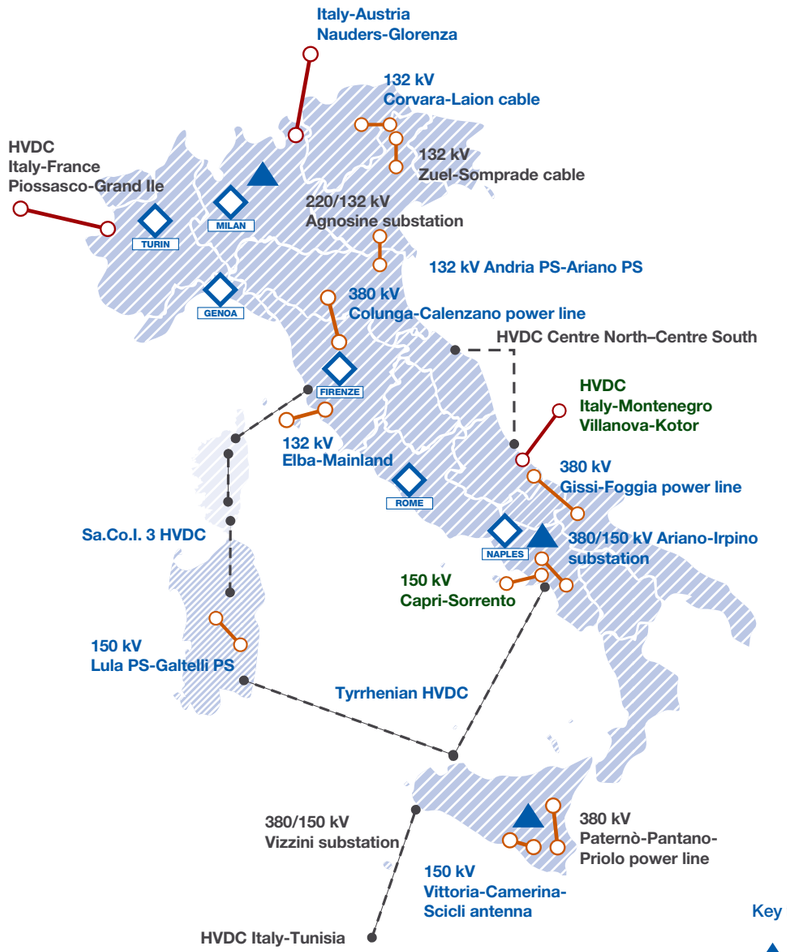
Reduction in grid losses

Reducing losses on the transmission grid - with equivalent consumption - leads to a decrease in electricity production by power plants operating throughout Italy, with a consequent reduction in CO_2 emissions linked to production from thermoelectric sources.
The entry into service of the main development works provided for in the 2020 Development Plan will lead to a reduction in energy losses of approximately 300 $ktCO_2$ a year, regardless of the scenario taken into account.

Improvement in the production mix and interconnections with other countries

Assessment of the increase in the operating efficiency of thermoelectric power plants resulting from the principal upgrades of the NTG is based on simulations that enable evaluation of representative scenarios of different stages of progress in developing the grid.
In particular, dispatching obtained on the Day-Ahead-Market is compared in two situations: one characterised by an expected easing of constraints on interconnection capacity due to the implementation of planned works, and the other characterised by the current constraints on interconnection capacity. Via this analysis, it was determined that reducing interzonal congestion will lead to the replacement of lower yielding plants, with either more efficient production plants or through greater integration of renewable production.
Reducing congestion, together with interconnection with other countries, will lead to a reduction in CO_2 emissions of around 400 to 1,800 $ktCO_2$ a year, depending on the scenario.

State of progress in implementing previous Development Plans



Investment in 2019

+15.9%

versus 2018

Key to assets

- New substations
- Reorganisation of metropolitan areas
- Interconnections
- VHV grid upgrades
- HVDC under design

Key to work in progress

- Project in progress
- Project awaiting consents
- Completed project

STATE OF PROGRESS OF PREVIOUS PLANS AT 31/12/2019

Interconnectors and lines	Terna km	Status
Italy-Montenegro interconnector	445	Entered service
Italy-France interconnector	190	Under construction
Italy-Austria interconnector	24	Awaiting consents
Italy-Switzerland interconnector	100	Awaiting consents
Italy-Slovenia interconnector	114	Awaiting consents
Sardinia-Corsica-Italy interconnector	540	Consultation
HVDC Centre South-Centre North	221	Design
HVDC Italy-Tunisia	200	Planned
HVDC Mainland-Sicily-Sardinia	882	Design
Sorrento Peninsula interconnector	20	Entered service
Restructuring metropolitan areas	182	Under construction
Chiaramonte-Gulfi-Ciminna	173	Awaiting consents
Upgrade in the Mid Piave Valley	90	Awaiting consents
Colunga- Calenzano	85	Awaiting consents
Gissi-Foggia	140	Awaiting consents
Cassano-Chiari	36	Awaiting consents
Deliceto Bisaccia	36	Under construction
North-Calabria upgrades	10	Awaiting consents
Paternò-Pantano-Priolo	63	Under construction
Elba-Mainland	35	Awaiting consents

Substations

The substations of Apecchio, La Spezia, Priolo, Brennero, Belcastro and Picerno have entered service.

Connecting new plants

Terna has an obligation to connect all potential users requesting connection to the grid[81], identifying connection solutions in terms of criteria that guarantee the continuity and safe operation of the grid to which an applicant's new plant will be connected.

In particular, Terna is responsible for high and very high voltage connections to the NTG of plants with a capacity of 10 MW or more.

At any one time, Terna handles over 2,200 applications for connection to the grid in relation to future or existing initiatives.

1,388 procedures, relating in particular to the connection of plants using renewable energy sources (RES) to the NTG and representing total capacity of 61.7 GW, are currently active.

The publication of the Decree of the Minister for Economic Development and of the Minister for the Environment (4 July 2019), providing incentives in the three-year period 2019-2021 for electricity produced by plants powered by onshore wind, solar panels, hydro power and residual gas from treatment processes, has rekindled interest in the development of projects for RES plants and a rapid increase in applications for new connections to the NTG.

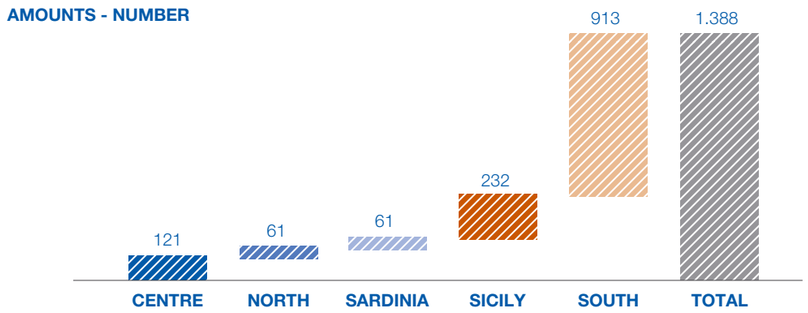
New projects at the development stage primarily regard wind and solar power plants, with a sharp rise in the number of photovoltaic projects in 2019 compared with previous years.

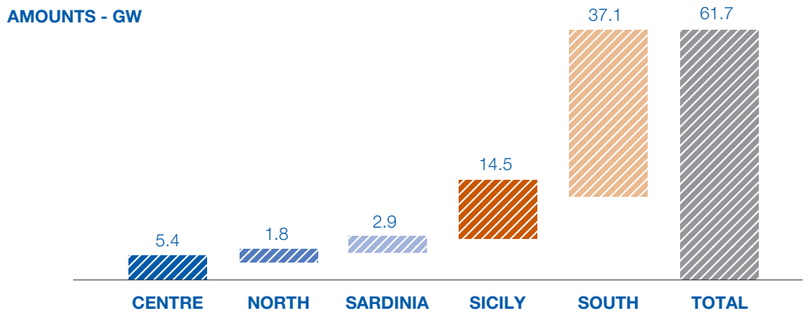
This shows that:

- 87% of the applications received are from southern Italy and the islands (representing capacity equivalent to over 88% of the total);
- a sharp increase was registered in applications for the connection of new distribution plants and for upgrades to existing plants by local distributors, with the aim of harnessing production from renewable sources;
- 12 connection contracts were signed in 2019 (representing total capacity of 222 MW), relating to the construction of new RES plants.

The chart below shows RES connection applications for connection to the NTG managed by Terna, broken down by source and geographical distribution.

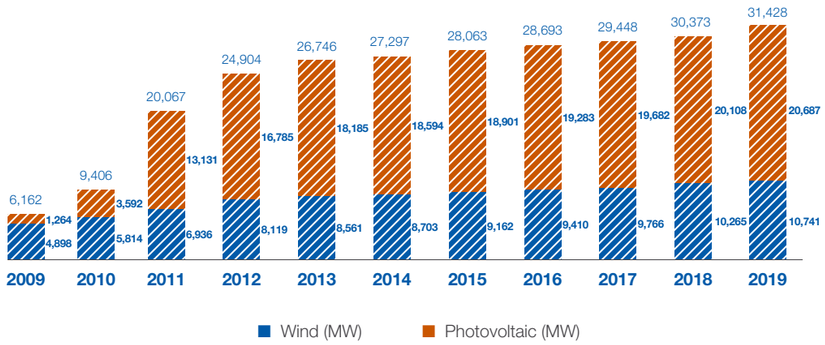
[81] Legislative Decree 79 of 16 March 1999 - art. 3, paragraph 1: "The Operator has the obligation to connect all those making such a request to the National Transmission Grid, without compromising continuity of service and provided the technical rules as per paragraph 6 of this article, and the technical and financial terms and conditions for access and interconnection established by ARERA, are complied with".





Data at 31 December 2019

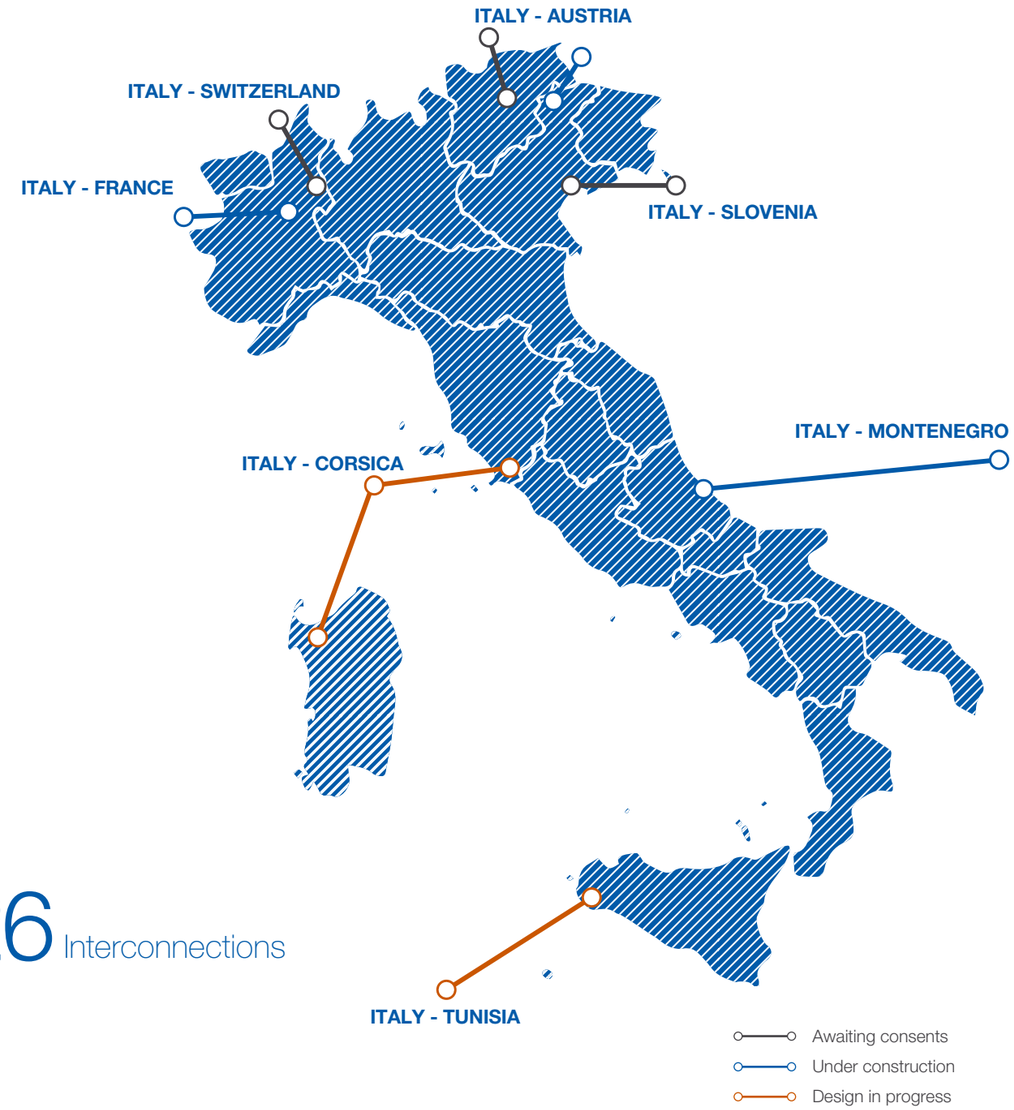
INSTALLED PHOTOVOLTAIC AND WIND CAPACITY 2009-2019* (GW)



** Provisional data from Terna for 2019.*

Overseas interconnections

Its geographical position makes Italy a natural hub in the Mediterranean area and it can count on an electricity border made up of 26 interconnectors[82], in addition to new lines under construction. This development work (shown on the following map) aims to increase interconnection capacity (Net Transfer Capacity - NTC) on the electricity borders with foreign countries, enabling a reduction in energy procurement costs and the integration of markets, with the possibility of having more resources for use in managing the Italian and European electricity system.



26 Interconnections

[82] These include 3 merchant lines, or lines not owned by Terna, and the Italy-Malta connection owned by Enemalta.




New Italy-Montenegro interconnection inaugurated

On 15 November 2019, the President of Italy, Sergio Mattarella, and the President of Montenegro, Milo Đukanović, attended Terna's inauguration of the new 445 km power line that connects Italy and Montenegro - via a submarine cable and an underground cable for the terrestrial part - between the electricity substations of Cepagatti (PE) and Lastva in the municipality of Kotor.

This interconnection is strategically important for the integration of electricity markets at continental level, enabling Italy to boost its role as a European and Mediterranean electricity transmission hub.

The project involves the longest high-voltage submarine connection Terna has ever built: 423 km have been laid under the Adriatic Sea, at a maximum depth of 1,215 metres, with an additional 22 km of underground cable, of which 16 km are in Italy (from the landfall point to the Cepagatti substation) and 6 km are in Montenegro (from Budva to the Kotor substation).

The Cepagatti and Kotor electricity substations are a prime example of civil and electrical engineering technological excellence, involving the application of world-class electrical engineering solutions.

The power line is the outcome of work carried out by a total of 124 companies (80 in Italy, of which 62% from Abruzzo, and 44 in Montenegro) at the construction sites where work began in 2012.

The two-way exchange of electricity flows will enable the diversification of supplies, and boost the reliability, efficiency, safety, environmental sustainability and resilience of the electricity grids on both sides of the Adriatic. At the same time, this will also allow for full exploitation of the potential for production from renewable sources, which are available in both Italy and the Balkans region.

Private interconnectors pursuant to Law 99/2009

In order to support the development of a single electricity market by expanding the infrastructure needed for interconnections with other countries, EU legislation was introduced, setting out guidelines for the creation of interconnections with other countries by entities other than grid operators.

The European guidelines have been introduced into Italian legislation by Law 99/2009, which assigned Terna responsibility for selecting - on the basis of public tenders - undertakings willing to finance specific interconnectors in exchange for the benefits deriving from them.

The law states that these entities, in exchange for a commitment to finance such projects, are required to commission Terna to build and operate the interconnectors.

A total of five interconnectors are planned for the borders with Montenegro (project completed in December 2019), France (at an advanced stage of completion), Austria (consents granted), Switzerland and Slovenia (currently awaiting the necessary consents).

Private "Italy-Montenegro" interconnector

On 28 December 2019, the first module of the 500kV direct current interconnector line between the substations of Villanova (IT) and Lastva (ME) entered commercial service. With a total length of approximately 445 km, and built partly with a submarine cable and partly with a terrestrial cable, it has enabled creation of 600 MW of interconnection capacity between Italy and Montenegro, of which 200 MW is available free of charge to the private backers selected in accordance with Law 99/09.

Asset management

Asset management is the set of systematic and coordinated activities and procedures that enables Terna to operate and maintain its assets in the best and most sustainable way, optimising the Group's return on investment and demonstrating its ability to create value.

The Asset Management system entails a structured approach based on best practices for managing assets throughout their lifecycle, taking into account the related cost cycles and associated risks. It plays an essential role in the efficient management of assets.

The Asset Management system combines management of both financial and engineering aspects and includes management of all the phases that make up the lifecycle of infrastructure: design, construction, commissioning, operation, maintenance, repair/replacement and, finally, decommissioning.

Terna's main benchmark is the international standard, ISO 55001:2014 "Asset Management", which specifies the requirements for an optimal asset management system. In 2018, Terna became the first Italian company to obtain the related certification.

To achieve its asset management objectives, Terna prepares an Asset Management Plan (AMP) specifying the activities to be carried out in order to maintain and renew its electricity grid infrastructure.

Infrastructure maintenance

Maintenance of electricity grid infrastructure is essential in order to guarantee quality of service.

The tools used to support maintenance activities are subject to continuous innovation, as regards identification of the most suitable interventions (MBI-Monitoring and Business Intelligence), the scheduling and execution of operations (WFM - Work Force Management) and the adoption of modern aerial inspection techniques for the electricity grid.

Infrastructure monitoring and control

- 34,740 checks on substations of various voltage levels (26,000 in 2018). There was a marked increase in checks compared with the previous year (due to a campaign to raise awareness of substation checks);
- visual inspections of 89,174 km of power line, of which 39,544 km using helicopters (visual + infra-red) with an average total frequency of around 1.3 inspections a year for each transmission line;
- a further 78,274 km of power line underwent instrumental controls, both from the ground (including with the use of the LLW or "live line working" technique), and from the air using helicopters to operate flights that use laser scanning surveys to identify any obstructions, particularly trees;
- inspections of 48,563 km of underground cable with a total average frequency of approximately 25 inspections per year.

Routine maintenance

Repairs are carried out when signs of deterioration are identified as a result of the monitoring process or by on-line sensors. These indications and any problems identified are processed by the expert system used to support decision-making (MBI-Monitoring and Business Intelligence). This system draws up the maintenance plan on the basis of engineering models developed by the Asset Management department.

Vegetation management

During 2019, vegetation was cut back on around 28,960 km of power line (the total length of line where vegetation was cut back); this has to be done to ensure the correct and safe operation of the lines.

Live line working

Approximately 3,100 checks and line maintenance interventions using live-line working were carried out. These activities, performed with the line in operation, increase the availability of the infrastructure and help to improve quality of service.

Renewal Plan

The Renewal Plan is based on an analytical method that, starting from consistent, objective technical criteria, identifies and evaluates extraordinary maintenance works ("renewal"), assessing the state of repair and technical status of components in relation to the conditions under which they operate and giving priority to components and plant that play a key role in operation of the grid.

The Plan's interventions are limited to parts of the infrastructure that effectively require attention in order to continue operating efficiently over as long a period of time as possible.

Renewal work is associated with three types of benefit:

- **Sustainability**, resulting from the use of more eco-friendly components, the installation of equipment with vegetable oil insulation, the replacement of fluid oil cables and improvements to the reliability of assets;
- **Innovation and digitalisation**, reflecting the adoption of monitoring systems for existing assets using digital and innovative solutions;
- **Resilience**: work on strengthening the NTG in order to increase the resilience of the infrastructure.

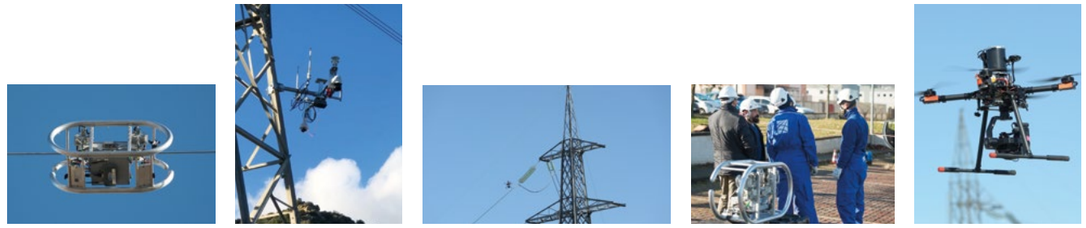
Renewal work (the replacement of components and entire systems) was carried out in 2019 at a cost of approximately €350 million in order to prolong the useful lives of power lines and substations. In terms of power lines, 2,747 km of conductors, 3,296 km of ground wires and 167 pylons were replaced; in terms of substations, 46 static machines, 221 circuit breakers, 353 disconnectors, 678 current transformers and 857 voltage transformers were replaced.

Security and resilience of the electricity system

The Electricity System Security Plan, prepared annually by Terna and approved by the Ministry for Economic Development, is a four-year programme that sets out initiatives to prevent and reduce the consequences of malfunctions on the electricity grid.

The current Security Plan describes the activities carried out during 2019, as well as those planned for the period 2020-2023. It breaks down into eight grid operation areas, regarding the planning, supervision, regulation and protection, restart and monitoring of the electricity system, as well as an area dedicated to safe and optimal management of renewable energy sources.

The Security Plan is fully in line with the evolution of the energy sector towards scenarios characterised by an increase in renewable energy sources, decommissioning of thermoelectric power plants and climate change.



The key drivers for the **2020 Security Plan** are:

1. **A system that is secure and fit for purpose** - With the gradual decommissioning of Italy's thermal power plants, accompanied by an increase in production from renewable sources on MV/LV networks not directly connected to the TSO network, the development of new strategies regarding the security and fitness for purpose of the electricity system is required. In this context, it is necessary to install:
   - reactive power compensation units in the areas of Central and Southern Italy and Sardinia, with a total amount of approximately 4,000 MVAr;
   - devices to control the grid's stability, improve voltage quality and reduce grid oscillations in central and southern Italy.
2. **Resilience of the electricity grid** - The initiatives regarding the installation of new devices to ensure the security of the electricity system in case of adverse weather events, especially those involving snow and ice, and the adoption of technological solutions to prevent the occurrence of such events and speed up the resumption of service, have been confirmed. Use of Terna's infrastructure to gather and transmit environmental data to support the grid's physical resilience is also envisaged.
3. **Digitalisation and system innovation** - Technological innovation is the factor that will enable Terna to respond to the new challenges arising from the energy transition. In this context it is necessary to create a proprietary fibre optic infrastructure, equipping high voltage systems with high-performing and reliable connectivity, as well as such features as remote control, remote operation, teleprotection systems and monitoring.

Special attention is also paid to the adoption of Cybersecurity solutions aimed at preventing/mitigating the risks of cyber-attacks, guaranteeing an adequate level of data security, and increasing the resilience of the digital services Terna provides (see page 157).

In 2019, investment in projects provided for under the Plan totalled approximately €190 million.

In the period 2020-2023, the 2020 Security Plan provides for investment totalling approximately €812 million, primarily relating to voltage regulation devices and initiatives designed to increase grid resilience and improve management and control of the grid, with the support of new digital technologies.

Resilience Plan

In accordance with MED directives[83], the Security Plan contains a specific section on the "Work plan for increasing grid resilience nationwide" (the Resilience Plan), especially in relation to the measures to be implemented in areas affected by wet snow. This section includes:

- a list of grid development, expansion and upgrade initiatives designed to increase the grid's mesh (included in the Development Plan);
- a list of extraordinary maintenance/renewal works (including scheduled interventions after an accurate assessment of the state of power lines);
- a list of mitigation initiatives.

The Resilience Plan for snow/ice presented in the 2020 Security Plan envisages investment of approximately €505 million over the five-year period from 2020 to 2024. This reconfirms the need to make the electricity system increasingly more resilient and capable of coping with extreme weather events, given that almost all the electricity transmission infrastructure is directly exposed to the immediate impact of atmospheric agents.

The experience gained in recent years, as well as the evolution of benchmark scenarios, have highlighted the need for Terna to shift from deterministic planning to a new probabilistic approach, which enables identification and quantification of the probability of multiple failures and contingencies.

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[83] Communication of 3 August 2017, regarding approval of the 2017 Security Plan.

Information and cyber security

2019 saw confirmation of the trend towards the progressive digitalisation of business processes and the growing pervasiveness of information technology, accompanied by an increase in the cyber risks associated with the use of these tools.

The entry into force of new European regulations, above all the implementation of the Network & Information Security (NIS) directive and the urgent measures regarding the "Scope of national cyber security", means that key operators in Italy's industrial sectors are having to rethink their security approach to cyber risks.

In this context, Terna's Information Security Governance model has been updated, regarding both the policy and procedural framework and the Information Risk Management operating programme.

The Model takes into account all the risk factors (organisational, technical and technological, physical, environmental and cyber, etc.) to which the Group's ICT ecosystem is exposed, including compliance with data protection legislation and efforts to combat cyber-crime, with the aim of countering their impact (disruption to computer networks or services critical to the operation of the electricity system and/or resulting in potential damage to the National Transmission Grid (NTG); loss of confidentiality; and the theft or alteration of sensitive, strategic and confidential data held by Terna relating to the electricity market and/or third parties).

Activities in 2019

Cyber security training

In continuation of similar previous initiatives, in 2019, Terna once again participated in specialist training events regarding cyber security issues, which were associated with a red-team-versus-blue-team training phase sponsored by ENTSO-E. In order to maintain a high cyber security awareness profile, at all corporate levels, cyber alerts relating to the main current cyber threats have been constantly circulated via internal communication channels (intranet, etc.)

Strengthening of the Information Security Framework

The Information Security Framework and, above all, the set of countermeasures that Terna puts in place to combat cyber risk was updated in line with the latest version of the NIST standard.

During 2019, Terna also began an assessment of the ICT systems that guarantee provision of the power transmission service and launched a plan to manage the related cyber risks.

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Consolidation of the capabilities of the Cyber Security Operations & Data Protection Centre

The process of strengthening and refining corrective actions and new initiatives designed to prevent cyber risk continued.

Terna's Computer Emergency Readiness Team (CERT) consolidated its real-time security monitoring, incident handling, threat intelligence and security content engineering, and threat hunting processes.

Information sharing with public bodies, other essential service providers and partners was further developed. The CERT also completed the accreditation processes for similar leading communities at international level.

The management of cyber threat intelligence is being consolidated via a dedicated platform.

The Cyber Security Assessment unit carried out periodic assessments of the vulnerabilities in Terna's IT systems and checks on the related recovery plans.

Identity and Access Management (IAM)

The Identity and Access Management (IAM) process regarding the management of access authorisations to critical IT resources has been strengthened, with particular regard to third parties who remotely access Terna's management systems.

Monitoring and cyber defence capabilities

During the year, the extension and update of security monitoring services for security systems and networks continued. With regard to the detection of cyber threats, a technological solution based on machine learning and artificial intelligence using non-formal logic was further developed. The continuous analysis, management and threat hunting activities using Indicators of Compromise (IOC) reports, especially those deriving from public bodies, are being consolidated. Work on the protection of SCADA systems using a whitelisting solution and on the logical segregation of networks is continuing.

418-1 >

As in previous years, no complaints have been received regarding data protection violations, or improper use or unauthorised processing of personal data entrusted to Group companies, neither via the dedicated mailbox (privacy@terna.it) nor through other reporting or communication channels.

Innovation

The current energy transition process requires a new systemic and organic approach to innovation, based around the acceleration of a portfolio of effective research, development and innovation initiatives in keeping with the Group's strategies.

In 2019, Terna decided to speed up its innovation processes.

The transition requires a new, smarter approach to managing the electricity system, which should be increasingly intelligent and flexible, both at the level of the grid, above all the Internet of Things or IoT (advanced sensors, big data, advanced analytics), and in terms of the market.

This will entail an unprecedented revolution that will rapidly result in the integration of distributed generation resources, storage and market demand for services, and the Europe-wide integration of national markets. Moreover, in the medium term, it will be necessary to ensure the progressive integrability and interoperability of electricity grids and other networks (transport, gas, water, etc.), in order to make the Italian and European economies stronger and more eco-sustainable.

The main tools Terna has put in place to develop innovation are:

- implementation of an **Open Innovation process**;
- creation of **Terna Innovation Hubs**;
- execution of projects within the Innovation Hubs via the **Innovation Factories and central departments**.

Today's form of innovation calls for an approach capable of opening up new possibilities for development and cooperation with the outside world and the creation of dynamic interactions, including close attention to start-ups.

The research, development and innovation portfolio is organised in a consistent manner via the **Innovation Plan**, from the birth of new ideas through to project development. New initiatives, which may be driven by requirements within the Company or by the Open Innovation process, are classified within a coherent framework, based on the principal new technologies earmarked by Terna:

- **Internet of Things**: IoT, industrial IoT, sensors and wearables;
- **Energy Tech**: technologies linked to the new energy resources (storage, demand side response, E-mobility) and smart grids;
- **Advanced Materials**: nanotechnologies, biomimicry and smart dust.

Open Innovation

Open Innovation is the approach adopted by Terna in developing its innovation initiatives.

This method encourages openness towards new areas for development within and beyond the Company, through dynamic interactions with universities and research centres, partnerships with peers and large industrial players, as well as access to start-ups and innovative small and medium-sized enterprises.

DESCRIPTION	STREAM
The signature of agreements and partnerships with energy businesses who are not competitors (TSOs, DSOs, utilities, etc.). Membership of and active participation in leading associations and international bodies involved in the electricity sector and innovation. Examples: SNAM, FCA, RTE, ENI, RFI, ENTSO-E, EASE	Energy sector and infrastructure peers
Collaborations to promote and coordinate studies and research with national universities and research centres of excellence in areas of strategic interest, in order to contribute to the preparation of expert researchers in this field and to promote and encourage initiatives aimed at teaching and training in the energy sector. Examples: Stanford University, Polytechnic University of Turin RSE, Ensiel	Universities and research centres
The signature of agreements and partnerships with other companies involved in the electricity supply chain (which are sometimes also suppliers) or in relevant industrial sectors not strictly related to the energy sector, regarding areas of common interest in the electricity sector or applications aimed at ensuring greater sustainability, cost-effectiveness and security in the management of grids. Example: FCA	Large companies and industries
The scouting of start-ups and mature enterprises in order to grasp opportunities for the development of specific initiatives of interest to Terna and/or business partnerships. Example: the "Next Energy" programme	Start-ups and SMEs

The examples given in the table are described on pages 164 and 166.

Terna Innovation Hubs

The Innovation Hubs are one of the main tools for implementing Terna's Innovation Plan, aimed at bringing together the key innovation players (internal and external) in a physical place dedicated to the development of ideas and projects, thereby contributing to innovation in local areas.
Within the Hubs, Terna interacts with innovative companies, start-ups, universities and research centres.

In 2019, Terna inaugurated its first three Innovation Hubs at local sites:

- On 9 April 2019, the first Innovation Hub was inaugurated at Terna's Turin site. The **Turin Innovation Hub** focuses on **IoT** (Internet of Things) and on advanced monitoring processes for power transmission infrastructure.
  Four areas of interest (satellites, drones, robots and advanced sensors) will be developed there, aimed at controlling the grid in a more dynamic and innovative way in order to guarantee the system's efficiency and security. Thanks to centralised data management it will be possible, among other things, to carry out predictive maintenance of assets, thereby cutting costs and increasing the reliability of the transmission grid.
- On 7 November 2019, the second Innovation Hub was inaugurated at Terna's Naples site. The **Naples Innovation Hub** focuses on **Digital to People**, namely on the digital transformation of business processes and the innovation of tools in the Human Resources, Organisation and General Affairs department.
  Digital Safety and Digital Human Resources projects will be developed at the Naples Hub, including processes designed to make asset maintenance more efficient, the creation of apps that virtually reconstruct field operations to be used for staff training, and implementation of a platform for collecting information about training needs for use in designing personalised training and digital coaching courses.
- On 17 December 2019, the third Innovation Hub was inaugurated at Terna's Milan site. The **Milan Innovation Hub** operates in the field of **Analytics and Energy Systems**, in order to develop tools and skills for increasingly "intelligent" power grid management, via the processing and interpretation of data and the development of algorithms and advanced simulation and forecasting tools. The Milan Hub has two separate laboratories. The first one focuses on Advanced Analytics, in order to interact with start-ups and innovative companies in a specially designed environment. The second one, nicknamed the Energy Tech Lab, is a laboratory for System Operators' innovation projects, where Terna staff can experiment with innovative technologies in order to develop solutions for secure operation of the electricity system. The Energy Tech Lab consists of three different environments:
  - **Simulation and Modelling Desk** - workstations for the simulation and modelling of process data from Terna's offline systems (historical data);
  - **Simulation and Modelling Integrated Systems** - workstations for simulation and modelling via synchronous interaction with Terna systems (online data);
  - **Operational Console** - workstations that provide synchronous interaction with Terna systems, which are capable of sending commands to the field.

Factories

The main strategies relating to Transmission Operator (TO) and System Operator (SO) activities regard two factories set up in 2018: the **Transmission Operator Innovation Factory** and the **System Operator Innovation Factory**.

The TO Innovation Factory includes the field of **Transmission Technologies** and is related to asset management, engineering and plant construction processes. It provides support for technological scouting, identification and implementation of technologies, and innovative processes and solutions for the evolution and continuous improvement of the NTG.

The SO Innovation Factory includes the **Dispatching and Conduction** process, as well as the related engineering, supervision, control, management and monitoring activities of the national electricity system to ensure the adequacy, security, economy, continuity, quality and efficiency of the transmission service, in accordance with predefined and measurable standards; and **System Engineering**, with a focus on the upgrade and management of the national electricity system, preparation of defence and restart plans, commissioning of plants, calibration and protection systems, malfunction analysis and statistics, and system innovation.

Digitalisation is the main enabler of innovation and the energy transition, to be implemented via projects in the following areas: connectivity (e.g. IoT technologies for Asset Management and dynamic network management), synchronous data management (e.g. advanced forecasting technologies for data management and electricity market processes), and asynchronous data management (e.g. big data technologies and machine learning for use in data analytics and the exploitation of historical data).

Innovation within the Company is supported and promoted via:

- **Systems and processes to support the enhancement of assets and internal expertise**;
- **Open Innovation** (see page 161);
- **Access to incentive and soft financing mechanisms** (e.g. tax relief for companies investing in research and development and patent box schemes).

Innovation, research and development initiatives

The key innovation, research and development initiatives undertaken in 2019 are summarised below.

Initiatives with universities and research centres

Stanford University

Terna has joined the research programme launched in October 2016 by the Precourt Institute of Energy at Stanford University (one of 30 research centres at this Californian university that specialises in engineering). The programme, called Bits & Watts as a reminder of the strong correlation between electricity grids and digital transformation, aims to identify solutions to facilitate and accelerate the current transition in the electricity sector, by combining university and industry expertise to develop innovative projects and solutions. The initiative's strategic value lies in its integrated approach to research focusing on three key areas, ranging from the coordinated management of electricity transmission and distribution grids, to the active integration of consumers within the electricity system and the use of data analysis in the development of new automated energy management tools.

In March 2019, the research project, to be carried out as part of the five-year partnership between Terna and California's Stanford University, got underway. The six-month project involved a member of Terna's personnel who was selected in 2018. The programme, which focused on the adoption of a nodal market model in Italy, concluded in August. The second part of the project, which is currently being organised, will see another colleague engaged as a Visiting Scholar at Stanford University to develop and investigate other aspects of the same research. The second part of the project will also last six months, starting in January/February 2020.

Polytechnic University of Turin Hackathon

The Hackathon Smart Tower was held at the Turin Innovation Hub in September. The event, involving teams made up of Polytechnic University of Turin students, was aimed at identifying profiles of potential future interest. Innovative proposals were developed to create an integrated monitoring and environmental protection system via the installation of sensors, fibre communication systems and computational environments on Terna pylons.

Initiatives with start-ups

Next Energy programme

Terna and the Cariplo Foundation ran the third edition (2018-2019) of the initiative, using the same proven structure for the three calls: "Call for Talent", "Call for Ideas" and "Call for Growth". The results of the third edition of Next Energy, which relates to the theme "Interaction between electricity infrastructure and local areas" and focuses on environmental sustainability, are:

- "Call for Talent": 10 new graduates were selected, who, from January 2019, had access to a 6-month internship at Terna's Innovation facilities;
- "Call for Ideas": 10 early-stage start-ups, with a medium to low level of technology readiness (a TRL of 2-5), were chosen for an incubation course at incubators selected by the Cariplo Factory. At the end of the course, the most promising start-up was awarded a €50,000 voucher to be exchanged for services. In May 2019, the Windcity project, which developed and produced V-Stream, a variable geometry turbine, was awarded a prize;
- "Call for Growth": In January 2019, with support from the Cariplo Factory, 5 start-ups were selected further engagement, with a view to defining use cases for subsequent partnerships with Terna.

In September 2019, the fourth edition of Next Energy was launched on the theme of energy transition, with a focus on aspects of the Innovation Plan (Full Internet of Things, Energy Tech, Advanced Materials and Sustainability Digitization Data Management & Analytics).

Advanced Materials for Sustainability (AMS) Call for Innovation

On 9 October 2019, the start-up, Particular Materials, won the AMS - Advanced Materials for Sustainability Terna Call for Innovation, aimed at developing latest-generation solutions as part of the quest for innovative materials to improve the efficiency and sustainability of electricity grid infrastructure.

Digital to Operations (D2O) Call for Innovation

On 8 July 2019, the start-up, Smart Track, won the D2O - Digital to Operations Terna Call for Innovation, aimed at improving the effectiveness of operations, with particular reference to personal safety issues, through the development of new technologies, devices, applications and high-added-value services to bring about "digital transformation".

Human Renewable Resources (HRR) Call for Innovation

On 21 June 2019, Eggup, an HR-Tech SME, won the HRR - Human Renewable Resources Terna Call for Innovation, aimed at identifying the best services, applications and latest-generation and high-added-value solutions, to help bring about a real digital transformation in human resources management.

Initiatives with large companies

MoU with SNAM

On 1st March 2019, Terna and SNAM signed a Memorandum of Understanding to define and implement joint initiatives regarding research, development and innovation and the potential for convergence between the electricity and gas systems.

In accordance with the legislative and regulatory framework, the agreement regards the development of shared scenarios for use in designing investment plans, the exploitation of convergence between the gas and electricity systems, the use of programmable renewable sources for power generation and the development of innovative technological solutions for the analysis and monitoring of infrastructure.

On 16 October 2019, Terna and SNAM signed a Memorandum of Understanding[84] regarding cyber security within the scope of the General States of the Italian Energy Transition.

Terna and SNAM will engage in synergistic actions to identify, prevent and counter potential threats, attacks and damage to IT infrastructure, in order to boost the security and protection of electricity and gas systems and networks, which are vital elements of national interest.

MOU with FCA

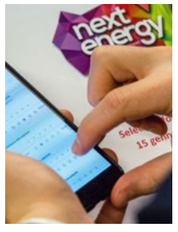
On 19 September 2019, Terna and FCA signed a MoU regarding joint testing of sustainable mobility technologies and services, such as vehicle-to-grid (V2G), which enables electric cars to interact with the grid thanks to a “smart” charging infrastructure.

Cooperation between the two companies includes the creation of the E-mobility Lab at Terna’s Turin site. This innovative technological laboratory will enable testing of the performance and capacity of electric vehicles in providing services to support the flexibility and stabilisation of the electricity grid, as well as their one-way and two-way interaction with the grid via a dedicated charging infrastructure.

MoU with The Mobility House

On 31 May 2019, Terna Energy Solutions and The Mobility House AG signed a Memorandum of Understanding to evaluate the potential for cooperation or a partnership in order to exploit commercial openings in the field of intelligent charging solutions, stationary storage and microgrids.

[84] See also page 112.



Other initiatives - Horizon 2020

OSMOSE

Work on the “OSMOSE - Optimal System-Mix of Flexibility Solutions for European Electricity” project, launched in January 2018 as part of the Horizon 2020 initiative, continued. The project aims to identify and demonstrate the technical feasibility of an “optimal” mix of flexibility solutions to maximise the technical and financial efficiency of the European electricity system, thus guaranteeing its security and reliability.

Terna’s role is to lead Working Package 5 (WP5, one of the 4 demonstrators of actual grid situations to be developed in Italy along a 150kV portion of the NTG between Basilicata and Puglia, and coordinate important Italian partners in order to develop a new Energy Management System, which will involve the combined, “optimal” use of Dynamic Thermal Rating, Power Flow Control devices, new forecasting techniques and demand side response resources, with the aim of giving the electricity system greater flexibility.