

CMAEL-GUSEE

BIENNAL JOINT MEETING

2023

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Head of Power System Planning & Permitting • Terna SpA

Naples

September 19th, 2023



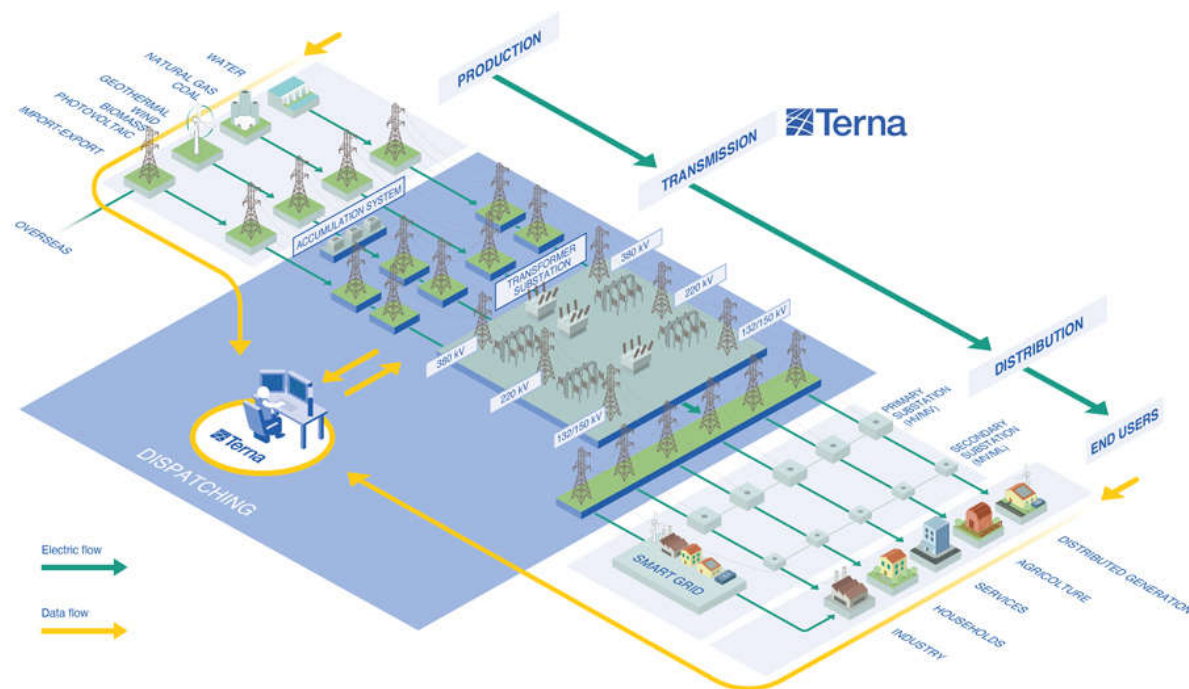
Agenda

- 1 Energy transition and challenges for the TSO
- 2 Connections requests
- 3 Italian National Development Plan 2023
- 4 Energy transition skills projects

Introduction to Terna TSO

WHO'S TERNA

- Responsible for the **planning, development and maintenance** of the national transmission grid (NTG) and for the management of the electricity flows.
- It operates under a **monopoly regime** according to the rules of the Regulatory Authority for Energy, Networks and the Environment (ARERA) and the guidelines of the Ministry of the Environment and Energy Security (MATE).
- First independent operator** in Europe for km of lines managed.
- Owner of **99,7%** of **transmission grid**.



ELECTRICAL DEMAND

- 340** TWh highest annual demand (2007)
- 60,5** GW historical peak load (22 July 2015)
- 38%** of electrical load covered by RES (2020)

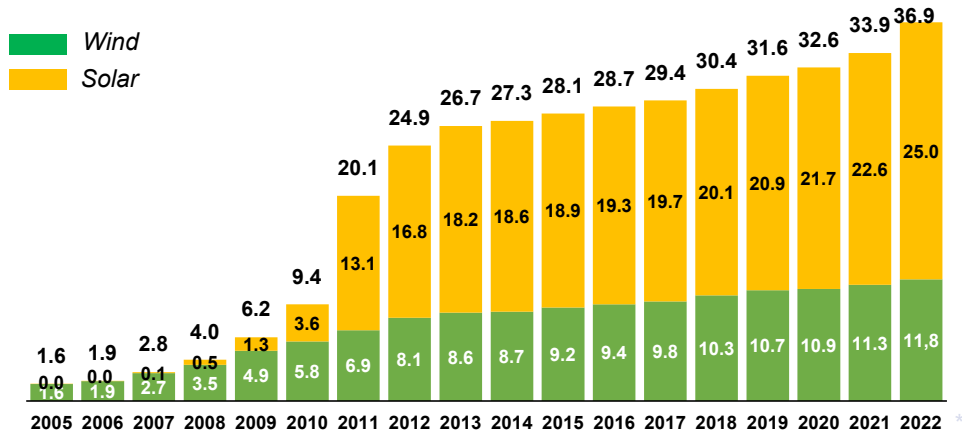
THE GRID



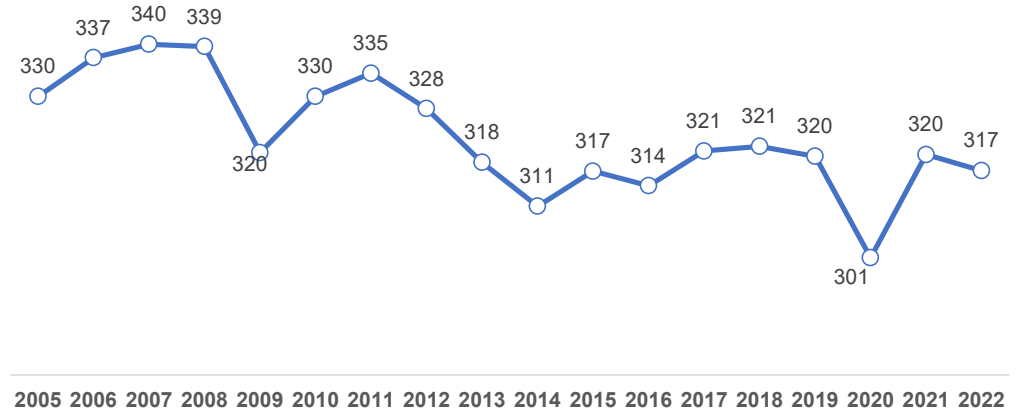
km of lines	Interconnection	Substations	Transformers
74,855	26	889	750

Italian power system trend

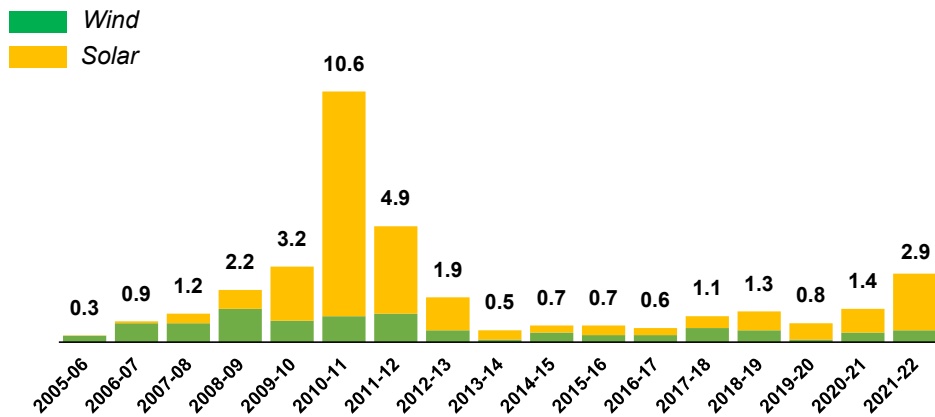
Total installed capacity of wind & solar* (GW)



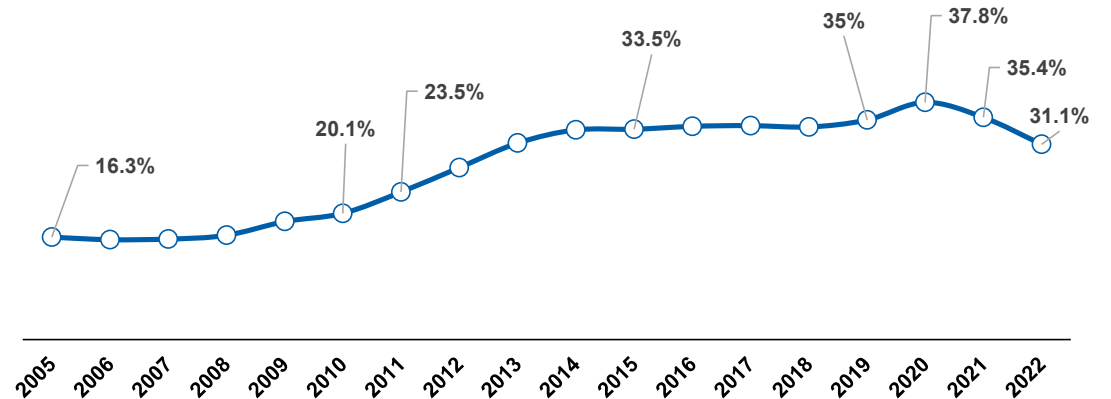
Electricity demand (TWh)



Annual installations of wind & solar (GW)



RES-E share** (%)



European and National packages for Climate and Energy

Europe 2020

Within 2020:

- 20% GHG emission vs 1990 levels
- 20% RES share in energy consumption
- 20% energy efficiency

Green Deal/ Fit for 55

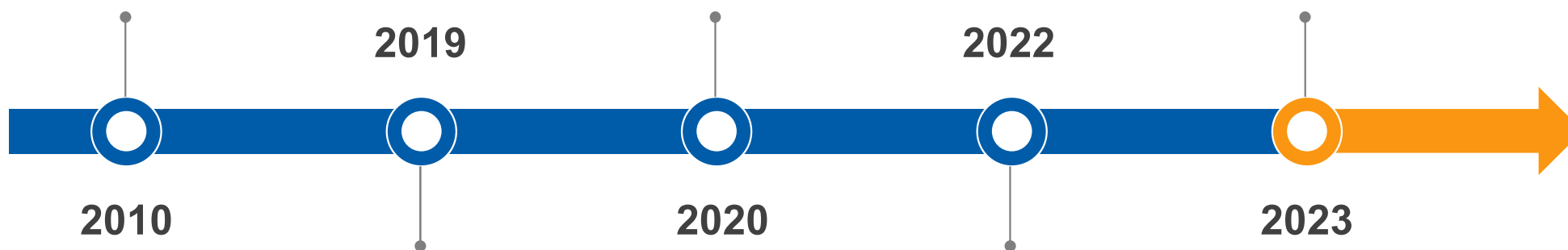
Within 2030:

- 55% GHG emissions vs 1990 levels
- 40% RES share in energy consumption
- Climate neutrality within 2050

Draft updated NECP¹

Within 2030:

- 62% GHG emissions for the ETS sectors vs 2005 levels
- 65% RES share in energy consumption



Clean Energy Package

Within 2030:

- 40% GHG emissions vs 1990 levels
- 32% RES share in energy consumption
- 32,5% energy efficiency

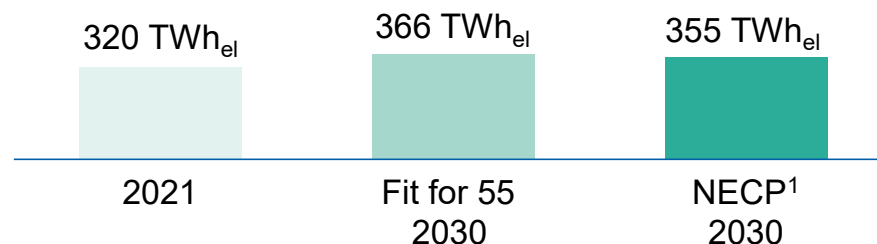
REPowerEu

- Extraordinary measures to make Eu independent from Russia. Within 2030:
- 45% RES share in energy consumption
- 300 bln€ of investments

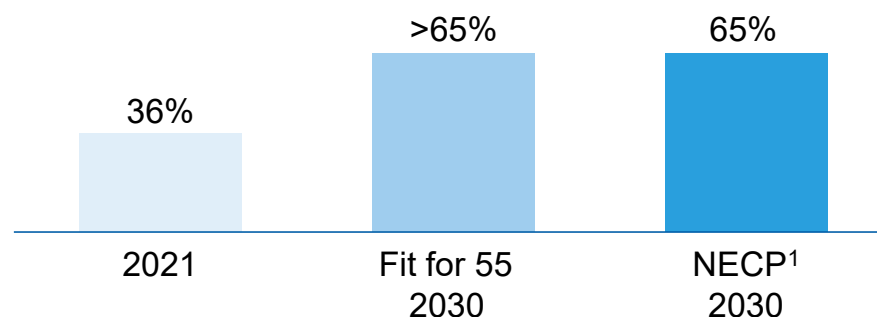
1. These will be analysed by the Commission with an overall assessment and country-specific recommendations published in December 2023. Taking these recommendations into account, Italy is then required to submit its final NECP by 31 December 2024.

Italian RES increase to meet Eu climate targets

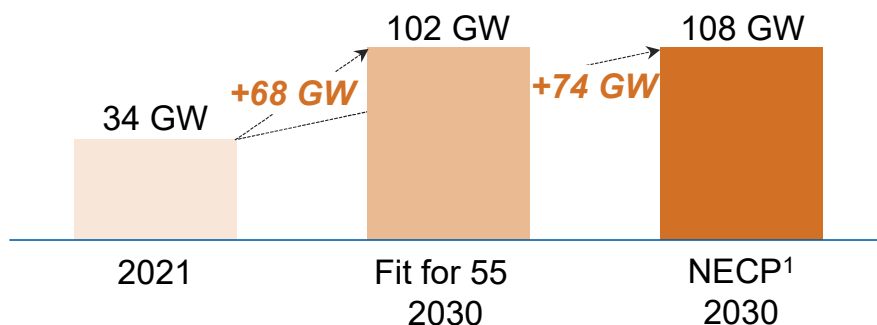
1 Total electricity demand



2 RES share in electricity consumption



3 PV and wind capacity



➤ 2030 targets for electricity sector

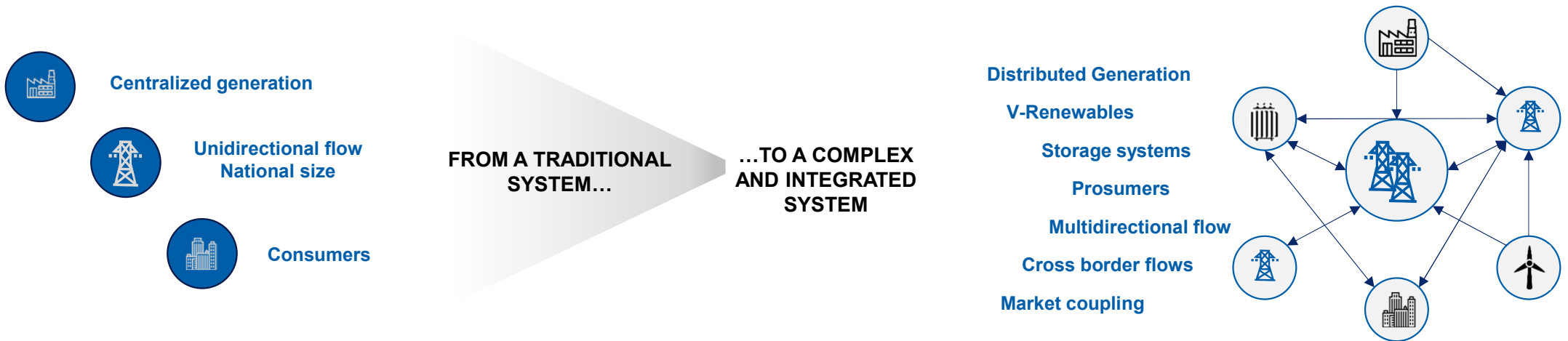
On 30 June 2023, the Italian Ministry of Environment and Energy Security (MASE) submitted to the Commission the draft updated integrated National Energy and Climate Plans (NECP) for the period 2021-2030.

Updated national targets for 2030²:

- Reduction of GHG by **62%** (as compared to 2005 levels) for all plants subject to the EU ETS
- RES share in electricity consumption of **65%**
- Total wind and solar installed capacity of **≈108 GW**

The new paradigm: impacts of renewable power's growth on system operations

The Electricity System is going through a **deep change across the whole value chain**, from generation to consumption. The increasing penetration of RES and the continued decommissioning of conventional thermal capacity **pose new challenges to TSOs**



IMPACTS ON THE ELECTRICITY SYSTEM OPERATION



Technical characteristics of RES and Thermal decommissioning

- Reduction of **system inertia**
- Reduction of resources for **frequency and voltage control**



Intermittency of RES

- Reduction of **adequacy margin**
- Growing periods of **over-generation** during noon hours
- Increasing steepness of **residual load evening ramp**



Location of RES

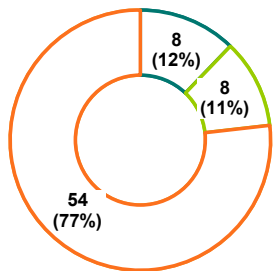
- Increasing **grid congestion** due to the geographical distance btw RES supply and load centers
- **Operational challenges**, due to the increasing role of DG (reverse flow, protection system...)

Grid connections request from renewable energy

SOLAR & WIND CONNECTION REQUEST

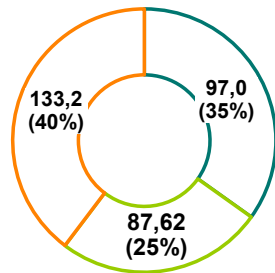
The **connection applications** to the national electricity transmission grid differs significantly from the «Fit-for-55» reference scenario in terms of **volume**, **distribution** and **technology mix**.

The effective realization of these projects may require additional network reinforcements.



+70 GW

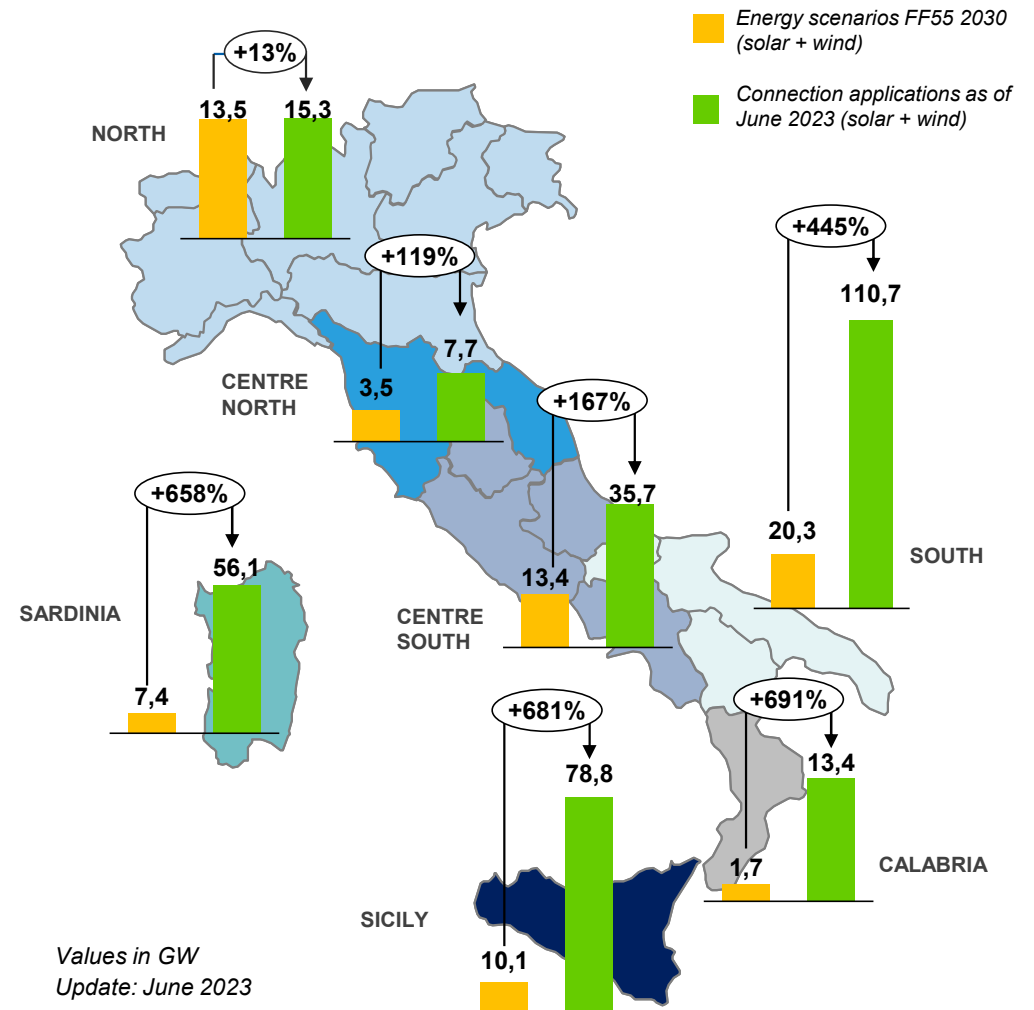
RES capacity increase
«Fit-for-55» 2030¹



+318 GW

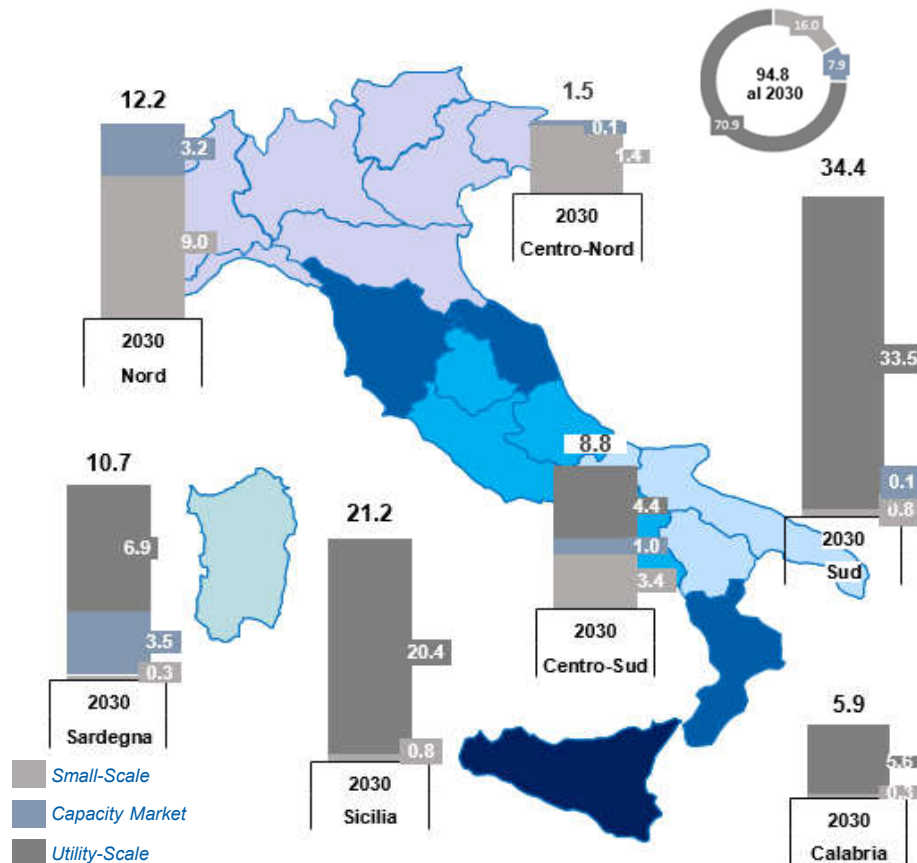
Connection applications
(June 2023)²

Wind off-shore Wind on-shore Solar³



New capacity from Energy Storage System to reach the Fit-for-55 targets

Energy storage need in the FF55 2030 scenario¹ (GWh)



Future Energy Scenario 2022

New storage capacity

Documento di Descrizione degli Scenari 2022

- Additional 95² GWh storage installations are required in the FF55 2030 scenario.
- The optimal dimensioning of storage capacity need and its location depend both on the evolution of the RES requests and on the timing of the development of the network infrastructure.
- Coordinated resource planning is needed to minimize system costs.
- The increase in RES results, and is in turn enabled, from an increase in the available storage capacity.



1. Delta between 2019 and 2030 scenario «Fit-for-55» (FF55)
 2. Corresponding to ~15 GW of energy storage (the calculation is made taking into account the different hours of operation of three technologies, on average equal to 6 operating hours)

Econnexion platform: map of renewable connections

Econnexion

Earlier this year, Terna has developed a digital platform that, for the first time, centralises all information on high-voltage connection requests from renewable plants in Italy.

Main charts:

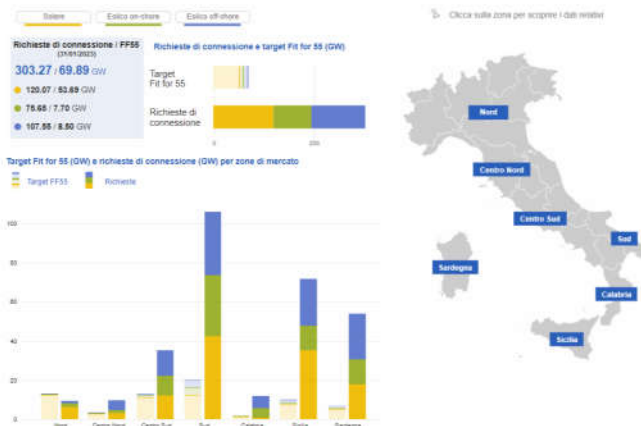
1. Requests by type of source (solar, wind on-shore and off-shore) in terms of number and power. Data grouped by **regional/ provincial/ municipal level** and **status of the application**
2. Comparison of connection requests and the **2030 target set by the Fit for 55 package**

The dashboard is updated every three months (<https://www.terna.it/en/electric-system/grid/econnexion>)

Data on the geographic location



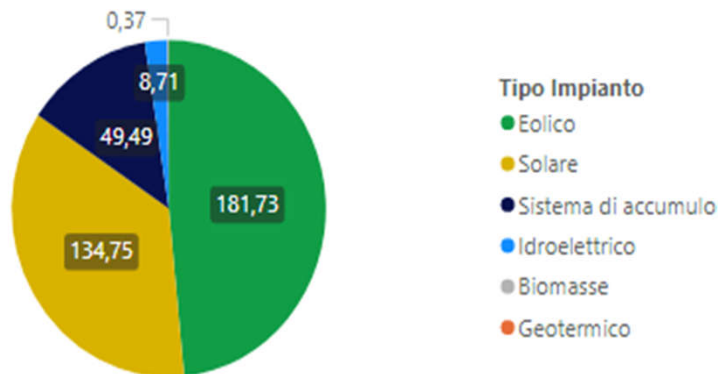
PV and wind power initiatives by market area, compared to FF55 targets



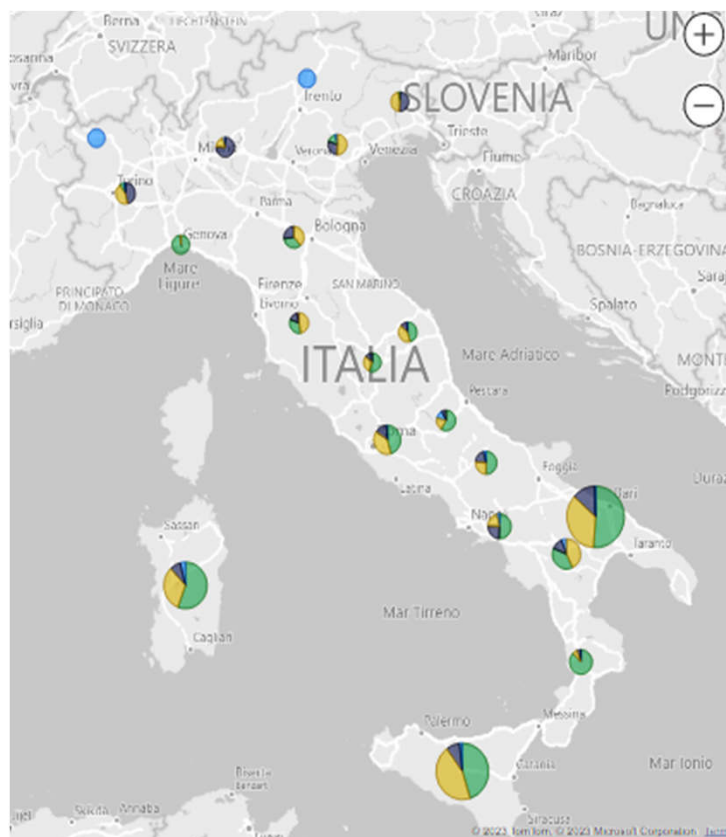
Requests to connect energy plants – Econnexion

375_{GW}

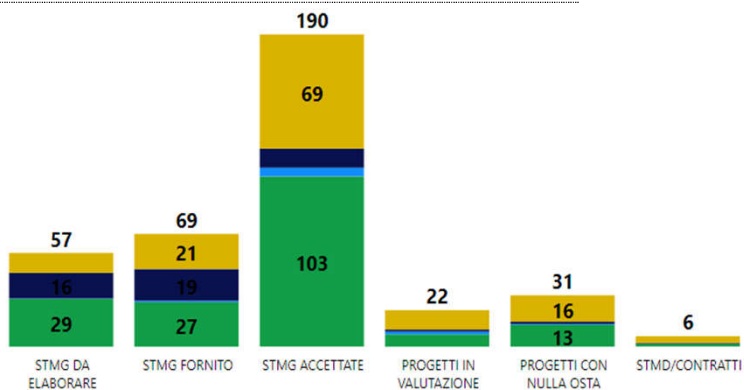
Requests by source



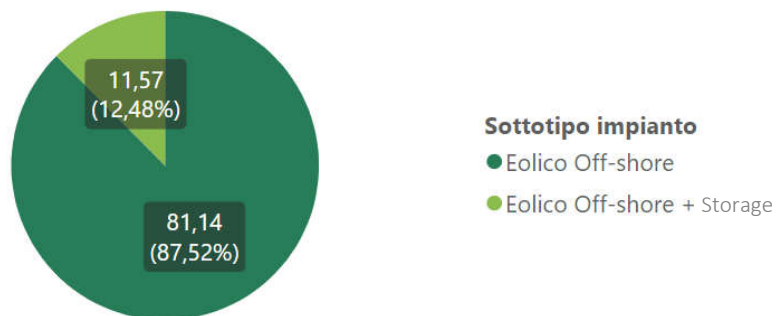
Request by region and source



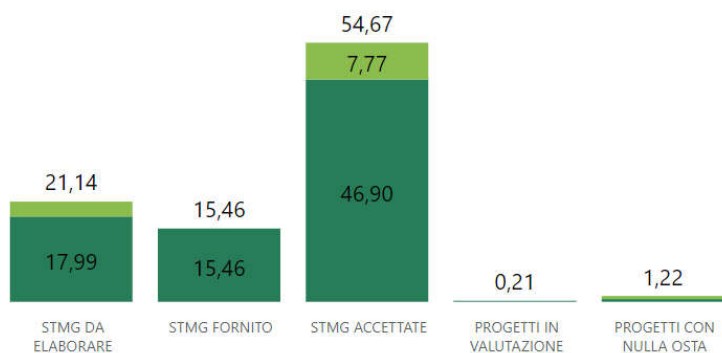
Requests by authorization status



Requests by type of plant



Requests by authorization status



Request by region and type



Requests to connect off-shore wind parks

HIGHLIGHTS



- Wind off-shore connection applications are **11 times higher** than in 2030 policy scenario. As of June 2023, Terna received connection requests for **~100 GW**, as compared to the 8.5 GW foreseen by the FF55 scenario
- The **average** size of wind offshore projects is **very large** (~45% > 700 MW)



- **Approx. 81% of the connection applications are in the Southern peninsula and main islands**, where the primary energy source is available and higher producibility is expected
- The regions showing most significant initiatives are **Apulia, Sicily and Sardinia**



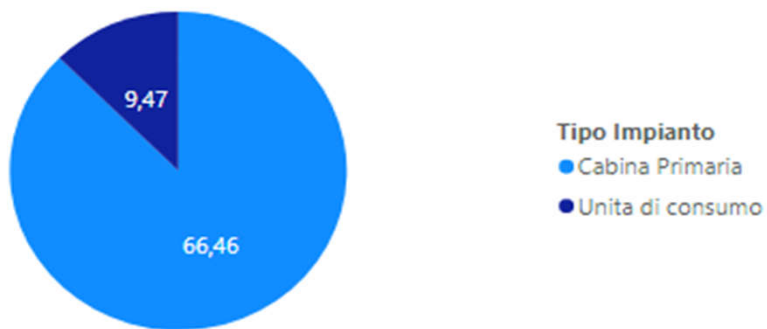
- **The floating solutions** may be suitable for the bathymetry of the **Mediterranean Sea**, which is characterized by **depths of several hundred meters** just a few km away from the coast

ITALY - OFFSHORE WIND FARM PROJECTS MAP

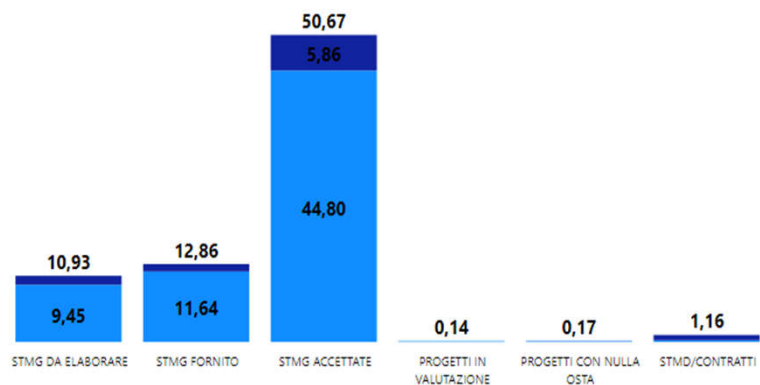


Update: June 2023

Requests by type of plant



Requests by authorization status



Request by region and type



2023
PIANO DI SVILUPPO
OVERVIEW



The 2023 Development Plan is issued in a historic moment that increasingly places the theme of energy at the center.

In this context, Terna must design a network capable of supporting progressive decarbonization and increasing **integration of renewables** while ensuring **efficiency, security and resilience** of the electricity system.

This challenge requires an effort to **plan, authorize and realize** grid infrastructures that is unprecedented in Italy.

The big news is the introduction of the innovative **Hypergrid project**, which will use the technologies of high-voltage direct current power transmission (HVDC) to achieve the goals of transition and energy security set by the European directive «Fit-for-55».

To meet these challenging goals, the 2023 NDP foresees **innovative and enabling solutions** (DC circuit breakers, 5-phases pylons, series compensation, capital light, etc.)

>21 MId€

Network Development Plan 2023

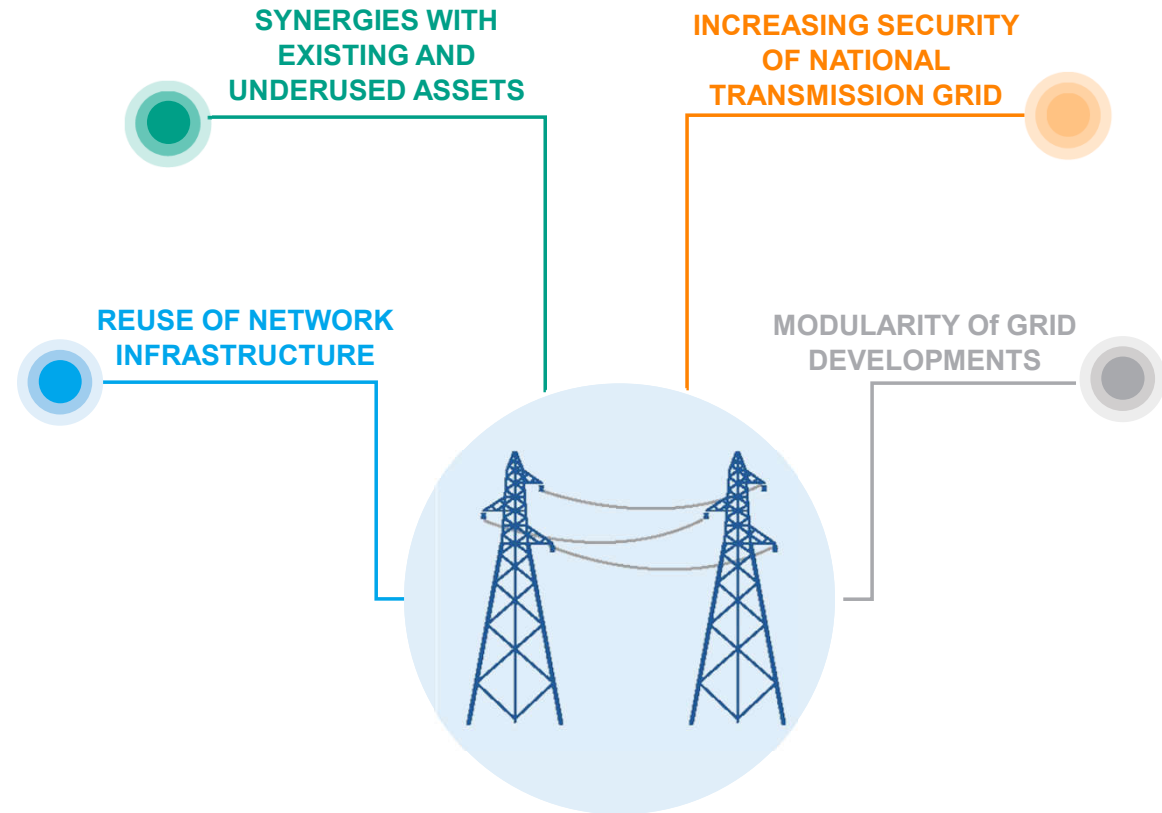
+17%

Compared to the NDP 2021

MAIN DRIVERS

The NDP 2023 applies an **integrated and holistic planning approach** taking into account the whole electric power system.

- **Synergies with existing and not fully exploited assets**, enhancing the use of existing corridors through innovative DC or AC solutions with increased transport capacity
- **Reuse of network infrastructures** already decommissioned or in decommissioning, located in the area of strong network nodes
- **Increasing security of National Transmission Grid**, strengthening the grid with DC technology to increase the grid transfer capacity
- **Grid developments modularity** according to the amount of RES power plants in commissioning and expected to be connected to the grid



Italian National Development Plan 2023

HYPERGRID PROJECT

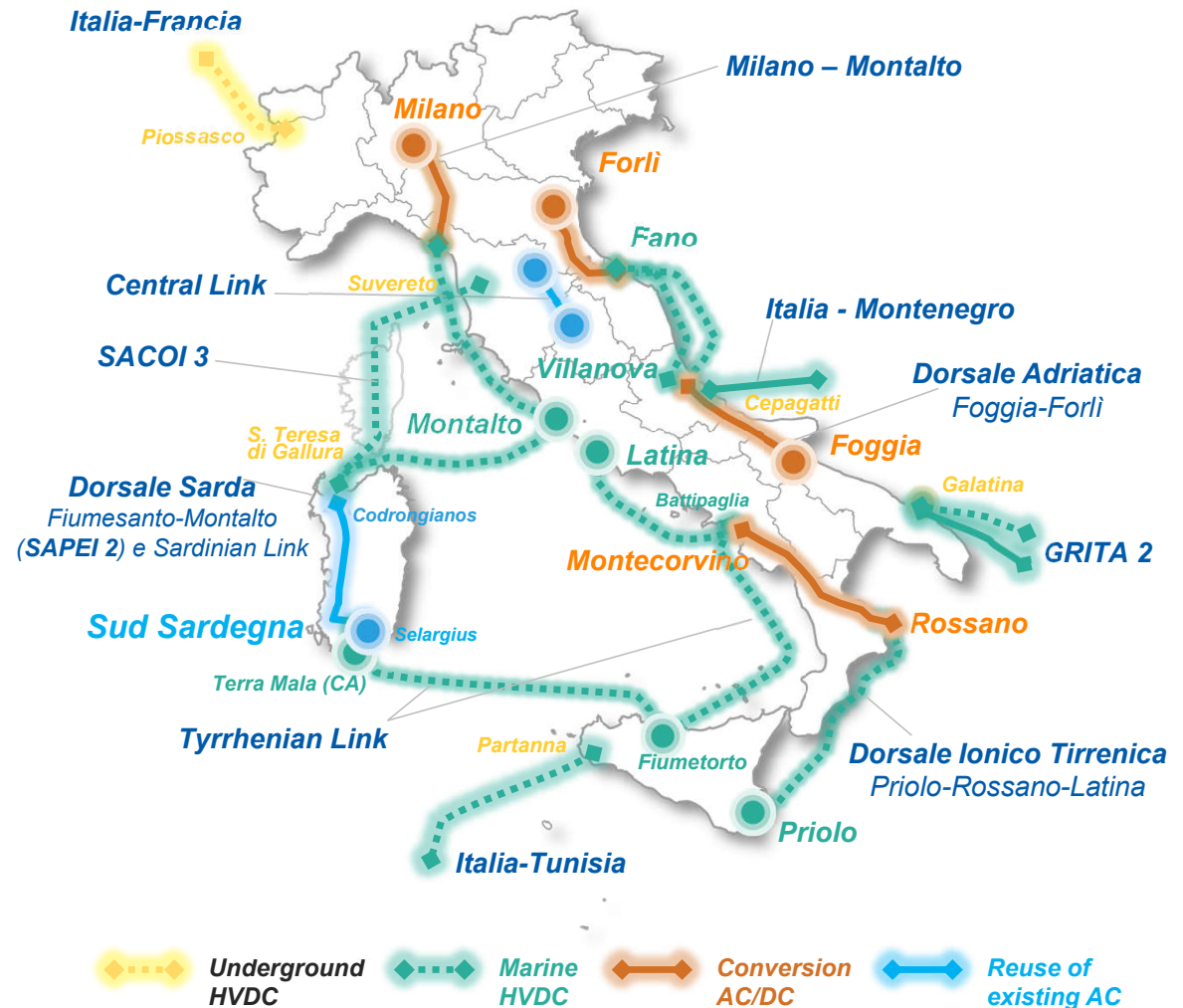
- Hypergrid will support and accelerate energy source diversification and climate neutrality, **increasing the NTC bidirectionality** among all the Italian market zones. The new HVDC links will ensure operational flexibility, strengthening the grid in synergy with existing and underexploited assets and allowing a modular configuration.
- The planned corridors are:
 - ✓ **HVDC Milano - Montalto**
 - ✓ **Central Link**
 - ✓ **Sardinian Corridor¹**
 - ✓ **Ionian – Tyrrhenian Corridor²**
 - ✓ **Adriatic Corridor³**

+16 GW

Transfer capacity across all bidding zones

~11 Bln€

Total value over ten-year horizon (23-32) and beyond



RES integration in the Italian transmission system: action plan

2030

INFRASTRUCTURE DEVELOPMENT



- Strengthening grids and interconnections
- Increasing investments in voltage regulation devices
- Increasing resiliency

MARKET DESIGN



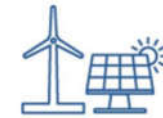
- Identifying the right mix of market design to integrate future and spot markets, for both energy and services.
- Enlarging supply of flexibility services by “new” sources

STORAGE



- Developing new hydroelectric and electrochemical storage systems.
- Dealing with overgeneration and residual load ramps
- Contributing to adequacy

RENEWABLE INTEGRATION



- Speeding up installations, through swift permitting process
- Ensuring optimal location planning of new RES installations

Developing the infrastructures needed to enable RES integration

Transforming participation in smart and sustainable markets

Sizing amount needed and technology mix

Addressing technology mix and optimizing location

Strategies to develop the skills needed for energy transition



1. Industry and academia cooperation

Open collaborations with universities, research centers and testing hub to promote innovation and the networks "smartization" of (e.g. Terna-EnSiEL protocol)



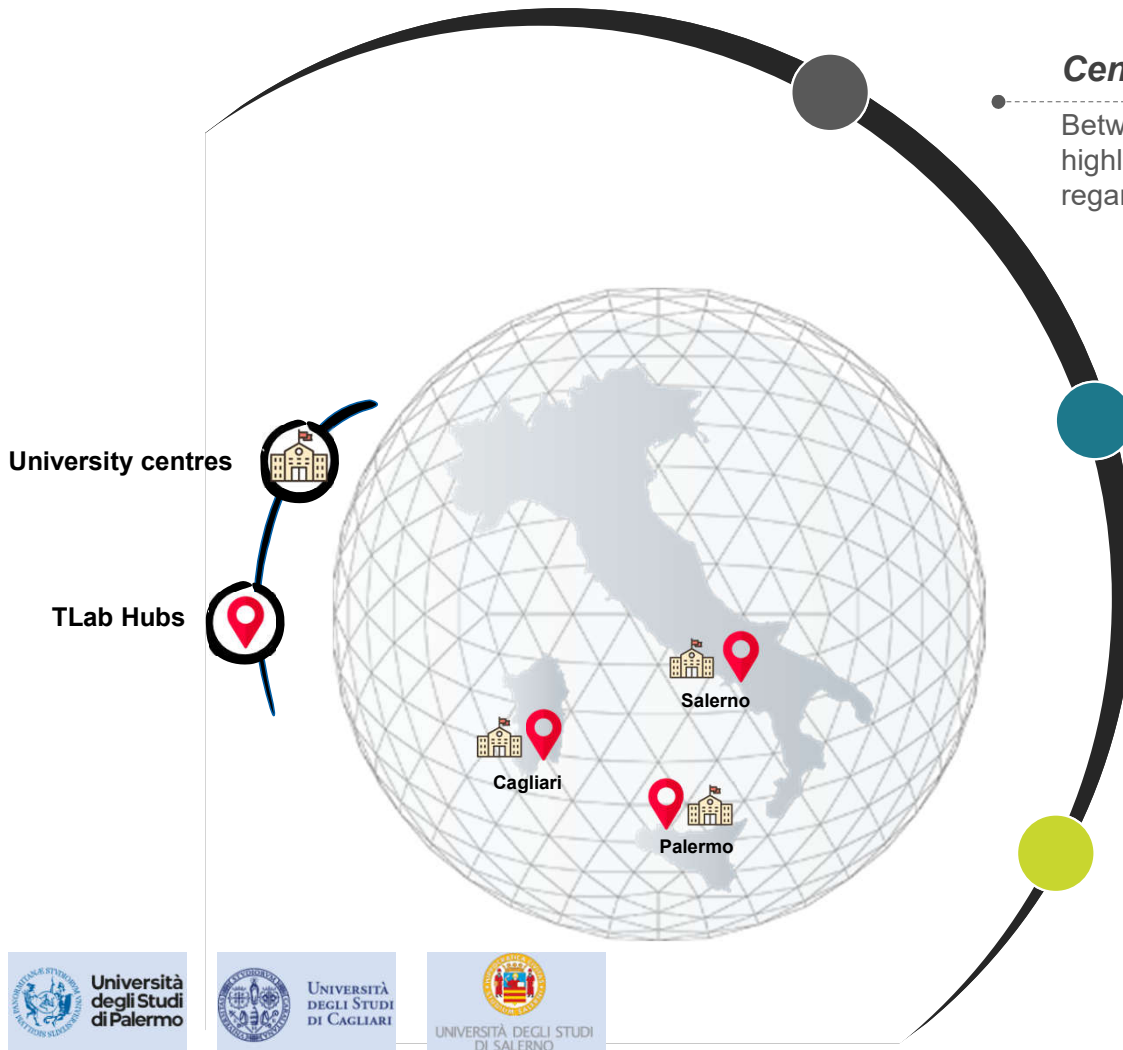
2. Development of internal skills

Develop figures with technological, digital and strategic skills able to manage the electricity system of the future and lead the evolution of energy markets (Terna Academy)



3. Tailored training

Financing university master's degrees and courses for the training of resources of excellence, the transfer and development of business know-how (e.g. Tyrrenyan Lab)



Centre of excellence to foster technological & digital skills

Between 2022 and 2025, Terna is planning to train more than 150 highly expert professionals with a 12-month university master's degree regarding the key strategic skills to address the challenge

Training

- Topics: management of low inertia zerocarbon systems; technologies applied to operation and planning; system protection, automation and control; interaction of the electrical system with the electricity market
- Courses will include both classroom study and field experience
- After master graduates, is foreseen an internship experience (4 months) at the end of which will be the recruitment by Terna

Collaboration with universities and research centres

The Master, organized in collaboration with the Universities of Cagliari, Palermo and Salerno, will help to develop managerial, computer engineering and statistical skills



To **create the professionals of interest to Terna**, it is **essential to strengthen existing collaborations with universities and develop new ones** to build together study and research paths aimed to develop specialist skills not even present in the market.



The **T-Lab project is part of the Tyrrhenian Link** a strategic infrastructure included in Terna Development Plan, **which will link**, through marine and terrestrial cables, the Regions of **Campania, Sicily and Sardinia**



The **Tyrrhenian Lab is a sustainable project**, which will boost the entire electricity system and valorize the southern Italy territory.



Terna
Driving Energy