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THE ROLE OF ELECTRICITY DISTRIBUTION FOR A SAFE ENERGY TRANSITION

Achievements and a new season of major investments in grids for decarbonization, safety and quality of electricity service

EXECUTIVE SUMMARY

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ACHIEVEMENTS AND A NEW SEASON OF MAJOR INVESTMENTS IN GRIDS FOR DECARBONIZATION, SAFETY AND QUALITY OF ELECTRICITY SERVICE

Executive Summary

September 2024

Executive Summary prepared by TEHA Group in collaboration with Enel S.p.A.

The contents of this Executive Summary refer exclusively to the analysis and research carried out by TEHA Group and represent its opinion which may not coincide with the opinions and viewpoints of the individuals interviewed and involved in the Study.

INTRODUCTION

This Strategic Study was prepared by TEHA Group in collaboration with Enel. The work was guided by an Advisory Board that supervised the initiative, comprised of:

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- **Nicolò Mardegan** (Director of External Relations, Enel);
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- **Giacomo Aiello** (Lawyer, State Attorney General's Office);
- **Guido Bortoni** (President, CESI; former Head of Energy Department, Italian Government; former President, ARERA);
- **Claudio De Vincenti** (President, Azzurra Aeroporti; former Italian Minister for Territorial Cohesion and the South; former Secretary of the Council of Ministers);
- **Gennaro Terracciano** (Full Professor and Pro Rector, University of Rome 4 Foro Italico; former Administrative Magistrate and State Attorney);
- **Valerio De Molli** (Managing Partner and CEO, The European House – Ambrosetti and TEHA Group).

We would like to thank the members of Enel's Executive Committee for their contributions and the suggestions made for the realization of the Study:

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PREFACE

Gianni Vittorio Armani
Direttore Enel Grids and Innovability, Enel

Electricity is the beating heart of modern economies, and its demand is set to grow rapidly, driven by new and diversified demands, while variable sources of renewable energy, particularly photovoltaic energy, will grow exponentially.

The study, "The Role of Electric Distribution for a Secure Energy Transition," analyzes and details how the impressive growth of distributed RES, the increased electrification of final consumption in terms of volume, and the increasingly active role of consumers dictate at the center of the current energy debate a new development of the distribution grid as an essential means of enabling this evolution and as the main carrier of energy for all key activities in advanced economies.

In light of this context as well as a prospect of intensification in frequency and intensity of extreme weather phenomena, the challenges facing electric distribution operators are highlighted, underscoring the relevance and strategic importance of grid infrastructure for society and for the proper functioning of productive economic activities.

The analysis clearly outlines a current virtuous picture for the distribution sector that has invested capital effectively by enabling high rates of innovation, efficiency and infrastructure development. Confirming these achievements, including in terms of safety and quality, while addressing the changes in the electricity system currently underway and those required to achieve decarbonization, requires major new investments to upgrade and digitize the grid, to connect, integrate and manage distributed energy resources, to facilitate widespread electrification and enable innovative activities for "prosumers." In addition, to ensure continued reliability of the electricity service, there is an increasingly urgent need for investments to increase the resilience of the distribution network, taking into account its increased strategic nature, through effective plans based on established methodologies that are also the result of cooperation and harmonization work among operators.

According to the European Commission, in Europe, annual investments in the distribution network between 2024 and 2050 could grow to double current values [36 billion 2023 vs €65 billion average 2024-2050], reaching 65 billion euros per year. In Italy, over the next 10 years, about 6 billion euros per year of investment is estimated compared to an average of about 2.6 billion euros over the 2018-2023 period.

To support this important new phase of investment, consistent with the transformations that have taken place and are expected for the energy transition, it is therefore necessary to ensure a continuity structure that allows financial stability and sustainable management for distribution network operators.

"The best possible way to prepare for tomorrow is to concentrate with all your intelligence, all your enthusiasm, on doing today's work superbly. That is the only possible way you can prepare for the future."

Dale Carnegie

Valerio De Molli
Managing Partner & CEO, The European House - Ambrosetti and TEHA Group

In 2022, the "*Net Zero E-conomy 2050*" Report, developed by TEHA and Enel, analyzed the decarbonization trajectories in Italy for 2030 and 2050, estimating the environmental, socio-economic, and energy benefits associated with a more ambitious decarbonization pathway. To continue the analyses presented in the 2022 Report, in 2023 — together with Enel's colleagues — we identified the key industrial supply chains for the energy transition in Europe and Italy, namely photovoltaic panels, batteries, and heat pumps, highlighting the need to develop local expertise and strengthen "green" industrial value chains.

The genesis of this Report lies in the previous two: the electricity distribution grid is indeed a necessary enabling factor to achieve a net zero economy by 2050 and to optimize the growth of renewable energy sources.

By 2050, the EU will need to double the annual installation rate of renewable energy sources (RES) with respect to the average of the past 5 years, mostly in the electricity sector, which will have to cover 60% of Europe's final consumption (compared to 22% in 2022). The significant growth of RES distributed across the territory in the electricity generation mix and the increased electrification of final consumption in terms of volumes place at the center of the current energy debate the need for a new development of the distribution grid as an essential mean to enable a smooth transition.

The distribution grid plays a key role in enabling the energy transition, both for the increasing connection of distributed plants (between 70% and 75% of the additional RES capacity to be installed by 2030 in Italy will be connected to the distribution grid) and for the increasingly active role of final consumers in the electricity system, who are becoming "prosumers" and promoters of innovative "activities." Indeed, while in the past the distribution grid was unidirectional with well-defined flows, today and tomorrow the distribution grid will increasingly be characterized by a distinct flow cycle between day (when photovoltaic production is at its peak) and night (when photovoltaic production is at its lowest), resulting in a completely new sizing.

At the same time, extreme weather events can cause significant damage to electrical infrastructure, impacting the production system and the community. In this context, Italy is one of the countries most exposed to climate change and currently ranks 1st in the EU-27 for

the value of per capita economic damage caused by adverse climate events, with a value of 284 Euros compared to a European average of 117 Euros.

The importance and strategic nature of the electricity distribution grid is also highlighted by the particular attention that national and European Institutions have devoted to modernizing and strengthening it in recent years. In Italy, not by chance, the electricity grid is among the strategic infrastructures defined by the Golden Power, while at the European level, with the Directive (EU) 2022/2557, the Commission established obligations for Member States regarding the adoption of specific measures aimed at ensuring that essential services for maintaining vital societal functions or economic activities are provided without hindrance in the internal market, including among the critical entities the operators of the electricity distribution system.

The Report also developed an analytical assessment model to identify the salient and main characteristics of the performance of the distribution grid in Italy, comparing it with other benchmark countries (France, Germany, the UK, and Spain). From this model, it emerged that the Italian distribution grid (in its current set-up) is among the most virtuous in Europe, thanks to effective capital investment that has enabled high rates of innovation, efficiency, and infrastructure development. In particular, the Italian grid ranks 1st in Europe for investment effectiveness, smart meter penetration rate and functionality, and network cost-effectiveness, 2nd for distribution loss performance and distributed electricity growth.

This virtuousness of the Italian system has been supported by a multi-level legislative-regulatory framework. In particular, the combination of regulatory stability and financial stability of the system has allowed effective investments in the grid, innovating and improving its quality without burdening costs for end users.

To ensure the continuity of performance, also considering the evolution of extreme weather phenomena, the distribution grid requires further significant new investments. In Italy, between 2025 and 2034, we estimate that investments of around 6 billion Euros per year will be required. These investments, moreover, could activate significant impacts (direct, indirect, and induced) on the country's economy, generating over 13 billion Euros of added value each year in industrial supply chains (about 0.7% of Italian GDP), enabling over 170,000 jobs, and guaranteeing over 12 billion Euros of additional income for Italian households.

As Dale Carnegie also stated, "*The best possible way to prepare for tomorrow is to concentrate on doing today's work superbly today*". Therefore, considering the current performance of the distribution sector in Italy, it is necessary that the prospective evolution of the legislative-regulatory framework does not become, in the second half of the current decade, a brake on the investments needed for the grid's evolution. The fragmentation of supply chains, both vertical and horizontal, would make management more complex and challenging, with the risk of increased costs for the electricity system. Therefore, to realistically pursue national and

European goals and avoid risks of deterioration in the efficient management of the grid, it is necessary to build a certain regulatory framework and appropriate governance.

This ambitious Strategic Study would not have been possible without the joint efforts of the TEHA working group and Enel's management in exploring an issue that is at the center of the energy transition debate today, and without the valuable contribution of the Scientific Committee composed of Giacomo Aiello (Lawyer, State Attorney General's Office), Guido Bortoni (President, CESI; former Head of Energy Department, Italian Government; former President, ARERA), Claudio De Vincenti (President, Azzurra Aeroporti; former Italian Minister for Territorial Cohesion and the South; former Secretary of the Council of Ministers), and Gennaro Terracciano (Full Professor and Pro Rector, University of Rome 4 Foro Italico; former Administrative Magistrate and State Attorney), to whom I would like to express my deepest gratitude.

Finally, my sincere thanks also go to the TEHA team: Lorenzo Tavazzi, Nicolò Serpella, Giovanni Abramo, Filippo Barzaghi, Jenny Cirincio, Ettore Grechi, Alessandro Sarvadon, and Ines Lundra.

REMARKS BY THE SCIENTIFIC COMMITTEE

Giacomo Aiello
Lawyer, State Attorney General's Office

Electricity distribution represents an essential service for the economic and social life of our Country, and the national infrastructure that ensures its daily operation serves an increasingly strategic function.

Recent events related to the Russian-Ukrainian conflict have brutally reminded us that the disruption of electricity supply, even in limited areas of a country, can have systemic and potentially uncontrollable effects on the lives of citizens and businesses, suddenly and sometimes irreparably impairing the exercise of fundamental human rights.

Following the attack on the Nord Stream 2 gas pipeline in the Baltic Sea, which highlighted the vulnerability of energy infrastructures, EU member states have focused their cohesion and development policies on strengthening infrastructure networks. They have recommended initiating significant investments to ensure their resilience against incidents, including those of malicious intent such as terrorist or cyber-attacks.

Among the main goals promoted at the community level there are improving essential services for the society and consequently increasing the resilience of the entities that provide them.

EU guidelines also aim for a high level of cybersecurity common to all member Countries, to better address the growing interconnection between the physical and digital worlds, which must be considered in designing effective national and community security strategies.

Additionally, there has been increased attention to the acquisition of control over networks by extra-EU operators. The Regulation 452/2019/EU allows for the exercise of special powers (so-called Golden Power) at the governmental level to impose conditions, up to the right of veto, on acquisitions affecting the energy infrastructure.

There is now a heightened awareness at the supranational level of the need to strengthen each Country's energy infrastructure to ensure the full achievement of the European electricity market objectives defined by Directive 96/92/EC.

New investments are also necessary for the implementation of the electricity distribution grid to achieve the full implementation of the REPowerEU package, which aims to reduce greenhouse gas emissions by at least 55% by 2030 and achieve climate neutrality by 2050, in line with the European Green Deal.

The energy infrastructure increasingly resembles the circulatory system of the human body because, unlike in the past, it no longer solely serves the function of transporting energy from production to consumption only.

The vast increase in production points, due to the boom in alternative energy sources and distributed generation, drives a radical change in the grid's architecture, increasing its storage capacities to support the development of renewable energy communities and smart grids.

The growing electrification of transportation will also intensify the dependence on electricity grid, batteries, and related infrastructure.

Based on these premises, the following Study precisely defines the goals to be achieved and outlines their economic impact in a long-term planning context, to provide useful elements of evaluation for the purpose of better shaping national energy policy.

The Report also lays the groundwork for a reflection on the adequacy of the current regulatory system to support the challenges ahead, in a scenario completely changed from the socio-economic context that, in 1999, inspired the Legislator in the regulation of this matter.

It is known that the regulatory framework must ensure, on the one hand, balance among market players and, on the other hand, greater system efficiency to enhance service quality while keeping costs for users as low as possible.

Considering these goals, among the forthcoming choices destined to significantly impact our future, it will also be necessary to identify the most appropriate regulatory framework for attracting investments for the implementation of the electricity distribution grid, also aiming to maximize the value of any public resources used to achieve this goal.

Guido Bortoni
President, CESI;
former Head of Energy Department, Italian Government;
former President, ARERA

<<Regulation or competition for the market>> in state electricity distribution concessions? Italy faced this choice back in 1999 during the major energy liberalizations in our Country. Given the general objective driving the legislators of that time — to pass on the undeniable economies of scale and scope of distribution activities to the final consumer via tariffs — the question was: which of the two tools — truly or seemingly antinomian — would be better suited to transfer benefits to the final consumer? The seed of doubt might well have been planted in the minds of policymakers. They had to make a legislative choice without yet seeing the results of regulation applied to grids, as the Italian Energy Regulator — just established — was still in its initial methodological steps. They could also not foresee what kind of market mechanism (tenders) would bring out those efficiencies to pass on to consumers. Thus, they decided to consider both regulation and market mechanisms — albeit with staggered applications over time. Regulation was given the *jus primae noctis*, consistent with the free of charge issuance of new 30-year concessions to (then) already active distributors, which would end in 2030, followed by a generic market mechanism, all to be defined by 2025. In my view, the two tools were properly coordinated by the law, providing that the bidding mechanism would act as a potential backup to regulation in case it, over the subsequent 30-year period, failed to live up to the task assigned to it in terms of pro-consumer efficiency gains.

At that time, the primary goal was to create pre-conditions for maximizing economies of scale and scope in distribution grid management in order to pass them on to the demand side. This led to the idea of promoting the expansion of urban distribution grids (which happened in 2001) to extend the size of medium-to-large utility grids, thus gaining economies of scale compared to previous urban areas, achieving management uniqueness, and greater specialization in some metropolitan service areas. This aggregation trend, though slow, has taken the distribution sector from 160 distributors in 2001 to about 120 today (2023), forming a group of large/medium distributors. The top 10 alone account for 98% of the annual kWh distributed and serve 98% of Italian end-users. Recently, this trend has been complemented by intra-sector adjustments, evident from voluntary transactions among large/medium distributors in 2023 and 2024, further enhancing the sector's overall economies of scale.

Among these large/medium distributors, the presence of a single distributor (Enel, now named e-distribuzione since 2016) covering most of the electrified Italian territory, despite some scattered "singularities" due to special autonomous regions, island peculiarities, or historic cooperatives that has electrified their small mountain enclave, has ensured Italy's

excellence in terms of economies of scale and scope (transport, delivery, and measurement of kWh).

The combination of structural preconditions and the chosen efficiency tool has provided the electric consumer — almost 25 years later — with levels of efficiency and innovation previously unimaginable in the Italian distribution sector, even when compared to EU member states with similar economies. The TEHA Study below presents results and indicators that indisputably attest to the excellence of our electric distribution.

Today, with five years remaining until the end of the 2001 concessions, the Regulation/Market question arises again regarding how to organize competitive procedures for assigning new concessions from 2031. As mentioned, we now have actual results about the excellent performance of the regulation tool for network efficiency as seen over the past two decades, which could help resolve the apparent antinomy. However, in re-evaluating this question, one must not assume that the energy systems are in static equilibrium — meaning that the conditions from 1999 are still constant and verified nowadays. Indeed, we are now facing radical changes in public policies (including European and, to some extent, global) that deeply influence the context for re-evaluating our question, as well as unprecedented contextual situations in which electricity distribution grids in Italy are and increasingly will be operating.

On the one hand, there are climate and environmental sustainability policies aimed at reducing greenhouse gas emissions in the EU and Italy (climate-change mitigation), which largely affect electricity distribution grids. For instance, since the main driver of electrical decarbonization and related end uses relies on the development of renewable sources, it should be noted that mature "renewables" mean dedication of significant portions of "territory" (given the low energy density of solar and wind) and that "territory" translates to distribution grids. These grids must now adopt a completely new role, not foreseen in 1999, in addition to their traditional function of delivering kWh. They must handle the collection of renewable productions synchronized across regions (when the sun shines on one photovoltaic panel, it shines on all panels in that area) but with highly variable production forecasts. Additionally, they must channel renewable productions into the electrical midstream or directly to local consumption/self-consumption.

On the other hand, the overall security and reliability of the electricity service, occurs by serving 37 million end-users across the "territory" and increasingly facing challenges from adverse weather conditions for the grid and extreme intensity of disruptions (adaptation to climate change). This places the final mile, served by distribution grids, at significant risk. This underscores the need to profoundly revise distribution grid projects, adopting innovative solutions to handle the increasing frequency of stress situations (thermal, hydraulic, structural) that the grids face today, which were considered extremely rare or unlikely at the beginning of the century.

The TEHA Study, to which this brief introduction is a personal preface, thoroughly argues the new functional requirements for sustainability and redesign for distribution networks that must demonstrate resilience under increasingly unfavorable conditions. This leads to a single conclusion: a pressing need for substantial investments that cannot be delayed until the end of the thirty-year concessions (2031) but must be made immediately, now and on existing grids.

From my extensive experience as a regulator, I can provide many examples, both in the energy and water infrastructure sectors in which — where there is a need for major investments — a golden rule of twofold nature applies: regulation must aim to maintain *1)* the capacity of the infrastructure manager to make significant investments in their networks and *2)* its ability to make efficient investments. This means that the distribution sector configuration must promote high-level investments. Therefore, it is not beneficial to have distribution managers diverting resources to goals other than investment nor it is appropriate to have short remaining concession periods (6 years are insufficient for investment returns). It is essential to avoid increasing investment risk in grids, both to prevent a slowdown in investments and to avoid a harmful (to consumers) increase in the required returns from regulation, leading to inefficiencies. The updated goal of distribution today is thus to transfer not only efficiency to the electricity user, as was considered in 1999, but also, and above all, the effectiveness of new functions and safeguards developed at the lowest possible cost.

The clear message I want to convey is: *a*) it is important not to retreat from the economies of scale and scope achieved in 25 years of experience; rather, further aggregation of smaller entities and spontaneous adjustments within the current large/medium distributor complex should be welcomed; *b*) given the new functions and goals for distribution, it is necessary to ensure that current distributors retain the capacity to make significant and efficient investments in their sector, by introducing appropriate measures to minimize investment risks, particularly by addressing the regulatory risks mentioned above. Those who agree can only recognize the necessity and opportunity for a prompt regulatory evolution.

Claudio De Vincenti
President, Azzurra Aeroporti;
former Italian Minister for Territorial Cohesion and the South;
former Secretary of the Council of Ministers

At the core of the analysis contained in the Report are the profound changes in the role that electricity distribution grids are called upon to play as a result of ongoing technological innovations and the challenging goals of the green transition and energy security in Europe and Italy. The need for an accelerated evolution of the electricity generation mix towards renewable sources, the growing importance of distributed generation, and the development of electricity use in both productive and consumer sectors are all factors that change the tasks and goals of the distribution grids, which are now required to support both the energy transition and energy security.

These networks are no longer simply conductors for unidirectional energy flows from generation plants and the national transmission grid to users — businesses and households — but rather essential frameworks that enable bidirectional —or better yet, multidirectional — flows between producers and consumers of electricity, with roles that are, at least in part and to a significant extent, interchangeable.

This new positioning of distribution networks within the electricity system, along with the need to strengthen their resilience against damage to infrastructure due to increasingly extreme weather events, implies a current and future need for substantial investments in grid innovation and development. These are economic and financial commitments that, to minimize the overall burden on society, require grid operators capable of leveraging the economies of scale and differentiation enabled by available technologies and possessing the financial strength necessary to channel the required resources.

Based on the “Bersani Decree” (DLvo 79/1999) and thanks to the activities of the sector’s regulatory Authority, our Country has developed a legislative-regulatory framework over the past twenty-five years that has been able to support the evolution of the national electricity system in response to the various challenges that have arisen over time.

In particular, significant system performance has been achieved in the distribution segment in terms of efficiency, effectiveness, and innovation, as evidenced by the international comparisons presented in the Report. An important feature of the framework that has taken shape has been the aggregation processes, which have made it possible to rationalize some of the local grids, and the virtuous behavior of larger operators — Enel and listed multi-utility companies — in capitalizing on their economies of scale and differentiation, as well as their financial strength.

Now, further regulatory evolution is needed to enable an orderly dynamic of the system that can guide distribution grid operators through the complex phase of transition that lies ahead. Specifically, it is necessary to provide medium-to long-term regulatory certainty that allows for: stimulating the investment capacities of the larger Italian operators, so they can leverage their technological and financial strength for grid development; promoting further aggregation processes to overcome the most fragmented management structures and foster industrial set-ups capable of better exploiting economies of scale and differentiation.

Gennaro Terraciano
Full Professor and Pro Rector, University of Rome 4 Foro Italico;
former Administrative Magistrate and State Attorney

Distribution grids for the transport and transformation of electricity and for delivery to end users, up to the meter, constitute, in hindsight, strategic infrastructures to ensure a supervised, protected and, ultimately, safe energy transition, including through suitable investments that allow for the best possible evolution of the infrastructure itself in terms of modernity, efficiency and sustainability, and thus achieve the EU objectives requiring stable and interconnected grids.

Energy distribution remains a strategic factor, for the national economy as well, taking into account the need for protection and resilience, not only with regard to environmental and climatic factors, but also geopolitical ones, as appears evident in recent years. Moreover, a robust and resilient national electricity grid makes a state less vulnerable, and, also in these respects, the public interests underlying these areas have led to a system governed by public authorities and managed through public concessions.

The digital transition also promotes the modernization and reliability of grids (smart grids), and, hopefully, an acceleration in the expansion of distribution to meet the obvious growing needs for electricity: the distribution model seems to require some decentralization, also to accommodate production from renewable sources. At the same time, the use of digital technologies requires careful cybersecurity activities, especially for the amplification of the interconnection of electricity grids.

The current and foreseeable scenarios are far from the one in the late 2000s, a period during which both at the European and national level it was intended to affect the situation of substantial monopoly that characterized the electricity market, in order to liberalize the sector.

As is known, following Directive 96/92, DLvo 79/1999 (the so-called “Bersani Decree”), profoundly reformed the discipline of the electricity market, providing, for distribution activities, a reorganization and an aggregation process.

In this regard, it is noted that the expiration of the current existing concessions (2030) should not necessarily involve the process envisaged by the “Bersani Decree”, including the limitation that new concessions cannot exceed a maximum of one quarter of the total number of end users.

It is difficult to say what are the optimal areas today and in future, but what emerges is the need to overcome the no longer useful rigidities of the “Bersani Decree” and to take into account the actual investment capacity that the main players in the sector can guarantee. In this sense, the Study carried out really seems to be a useful contribution to the operators in the sector but also to the policy makers, who will have the task of filling, in any case, the gaps in the current (and perhaps outdated) regulatory framework.

KEY MESSAGES OF THE STUDY

1. According to the European Commission, to achieve the 2050 decarbonization targets, the EU will need to double the annual rate of installation of renewable energy sources (RES) with respect to the average of the past 5 years, mainly electricity, which will have to cover 60% of European end-use consumption (compared to 22% in 2022). The marked growth of RES scattered throughout the territory in the electricity generation mix and the increased electrification of end-use consumption in terms of volume are the focus of the current energy debate on renewed development of the distribution grid as an essential means of enabling this evolution.

Over the past 10 years, **decarbonization** has been at the **center** of the strategic agenda of **European institutions**, with ongoing **geopolitical changes** helping to accelerate this process.

Specifically, the **European strategic vision** for the energy transition at 2030 — as established in the ***Fit for 55*** program — can be summarized in 3 major goals: *(i)* growth in the **renewable energy sources (RES) share of gross end-use consumption**, to increase from 20% in 2022 to **40%** by 2030 (**42.5%** considering the **Repower EU Plan**); *(ii)* a decisive boost in **energy efficiency** to **reduce consumption** by **39%** by 2030 compared to 2007 levels; and *(iii)* a marked **reduction** in greenhouse gas (GHG) **emissions**, to decrease by **55%** by 2030 compared to 1990 levels.

These goals are also grounded in the **European Green Deal**, which sets the first official and binding 2050 targets to **achieve climate neutrality** across the entire European continent. In light of the new goals, in order to meet the targets related to the energy transition by 2050, the EU will need to **double the annual rate of installation** of RES with respect to the average of the past 5 years.

In this context, **power grids** are an essential building block for guaranteeing the energy transition, both in terms of energy **supply**, which in the years to come will be driven primarily by the development of RES in electricity generation, and in terms of electricity **demand**, driven by increased electrification of end-use consumption.

In this context, Italy will need to accelerate its annual renewable energy installations. To reach the 2030 RES capacity targets set in the new version of the **Integrated National Energy and Climate Plan** (INECP) published at the end of June 2024, annual installations will have to **increase** to **more than 9 GW per year**, 6.7 fold the 2021 values (during which 1.4 GW was installed), **3 fold** the 2022 values (3.1 GW installed during the year), **1.6 fold** the 2023 values (5.7 GW installed).

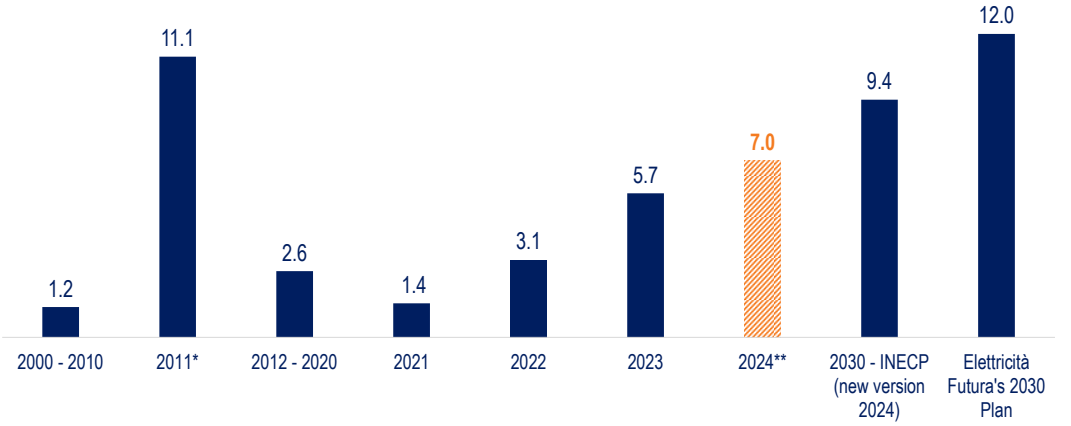

Figure I. Comparison between the annual RES installation rate and the annual rate needed to reach the targets in Italy (GW), 2030. *Source: TEHA Group elaboration on Terna and INECP data, 2024.* (*) The incentive mechanism "Conto Energia" has been the main architect of this growth. (**) Estimates at 2024 were made based on the installed power of the first 4 months of 2024. N.B.: Annual RES installation rates to meet the INECP and Elettricità Futura's targets has been calculated assuming a constant linear trend over the next years.

On the **demand** side, instead, it is necessary to emphasize that European grids must be able to respond to the **increased electrification of end-use consumption** estimated for 2050. Indeed, to reach the decarbonization targets, electricity will have to cover **60%** of **European end-use consumption** compared to a 22% share today. Specifically, in Italy, electricity is predicted to reach 55% by 2050 (+32 p.p. compared to 2022).

It is no coincidence, then, that the European Commission's **Net Zero Industry Act** (NZIA) identifies the **power grid** as a strategic technology for achieving net zero emissions by 2050. To this end, the European Commission also published in November 2023 an **Action Plan for grids** that proposes precisely **14 lines of action** for grids to be implemented by 2030 to support and accelerate the development of electricity grids.

2. The distribution grid has a key role to play in enabling the energy transition both because of the increasing connection of distributed plants (between 70% and 75% of the additional RES capacity to be installed by 2030 in Italy will be connected to the distribution grid) and the increasingly active role of end users in the electricity system, who become "prosumers" and promoters of innovative "activities". These two dynamics, considered together, highlight the strategic nature of the distribution grid: more than 370,000 connections were made in Italy in 2023, 7 fold those made 10 years ago.

The gradual **increase in electricity generation from RES** and the increased **electrification of end-use consumption** make the power grid an essential building block for achieving transition goals.

To date, **37.2 million users**, including households, stores, commercial activities and production facilities, are reached in Italy through the distribution grid. Again, in Italy, there are **119 DSOs** (Distribution System Operators o Gestori del Sistema di

Distribuzione) responsible for the management and operation of the power distribution grid. Italian DSOs distributed a total amount of electricity of **251 TWh** in 2023 (down 6.3 TWh compared to 2022)[1]. The **top 10 distributors** serve **98.5%** of the users and supply 98.3% of the distributed electricity.

The increasing centrality of the power distribution grid, a pivotal element of the current electricity system, underscores its need for upgrading. Indeed, the **power distribution** grid is an **enabling factor** to ensure a **"smooth" transition**. Specifically, for the grid to be fully upgraded, investments are needed above all to enable it to handle the changing structure of the electrical system.

One of the **main indicators** of the changing structure of the electrical system that contribute to placing the distribution grid increasingly at the center of the energy transition is the significant increase in **grid connections**. In 2023, there were **371,500 new connections**[2] in Italy, **seven times more** than ten years ago, when there were only **52,000**, and up **76.9%** from **2022**.

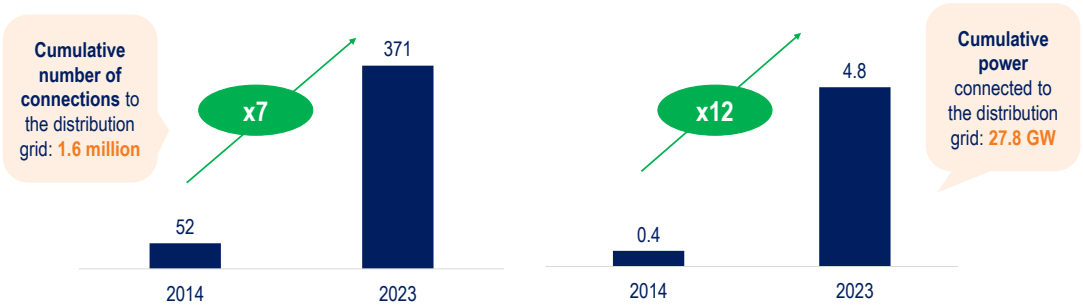

Figure II. Left: Evolution of the number of annual additional connections to the distribution grid (thousands of units), 2014 and 2023 and Right: Evolution of additional power connected to the distribution grid (GW), 2014 and 2023. *Source: TEHA Group on GSE "Rapporto Statistico 2023" data, 2024.*

The trend of **grid connections** has grown significantly in the recent period. From **2014** to **2020**, grid connections increased by about **287,000** units, corresponding to a growth of **+44%** in **7 years**. On the contrary, from 2021 to 2023, the number of connections increased by more than 581.000 units, a growth of nearly 60% in just 3 years.

This dynamic underscores the growing importance of decentralized electricity generation, in which there are smaller power plants (usually less than one MW in capacity) that are closer to end users.

It is often end-users who, by installing small RES power generation systems on their homes, become energy producers themselves, changing from ***consumers*** to ***prosumers***. Indeed, in the **last 5 years**, production from self-consumption has increased by **52%**, from **4,932 GWh** of photovoltaic production from self-consumption systems in **2019** to **7,498 GWh** in **2023**.

[1] The 2.8% reduction was accompanied by a slight increase in the number of points of delivery, which grew by 0.4%, equal to approximately 137,000 additional units.

[2] Source: GSE, "*Rapporto Statistico 2023*", 2023.

The increase in **distributed generation**, however, is leading to an increase in flow **reversal phenomena**, which occur when end-user power generation exceeds the required electricity demand, leading to a "**backflow**" of power from the distribution grid **to the transmission grid**.

In conclusion, the distribution grid needs to adapt to these **new requirements** dictated by the **changing structure** of the electrical system. While, in fact, in the **traditional grid**, electricity followed a **one-way** flow (large power plants located far from consumers connected to high-voltage transmission lines and distributed to end-users using power distribution grids) with end-users playing a passive role, the modern power grid, in contrast, must be able to handle not only an **increasing number of distributed electricity generation sources** (mainly intermittent ones due to the growing share of RES) but also a **shift in the role of consumers**, who have become *prosumers* (active consumers who are able to supply electricity to the grid and will therefore need to be able to manage a **multidirectional** flow of energy).

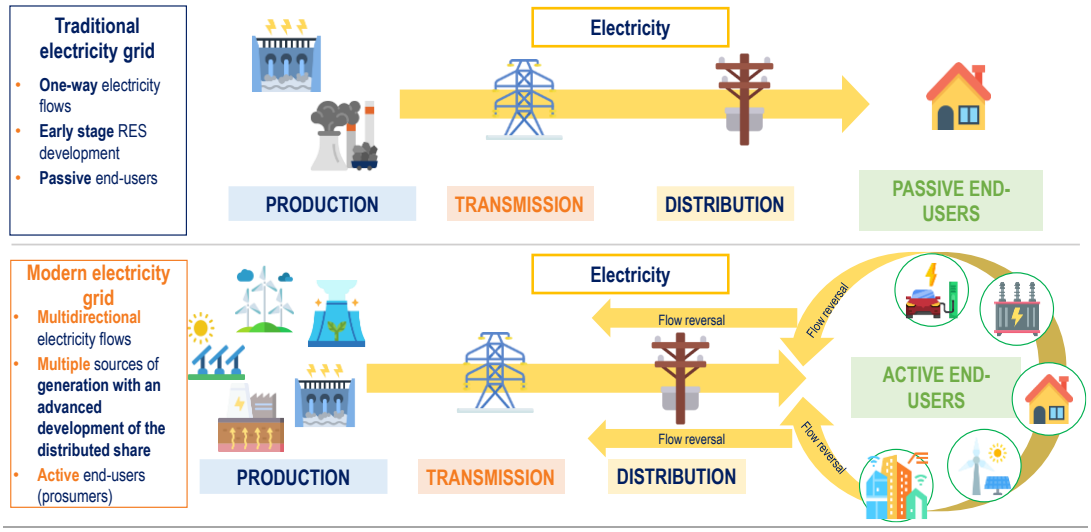

Figure III. Representation of the traditional electricity grid (upper section) and of the modern electricity grid (lower section), infographic. *Source: TEHA Group elaboration on GSE "Rapporto Statistico 2023" data, 2024.*

3. Extreme weather phenomena - such as heat waves, rainstorms, and wind gusts above seasonal averages with extensive hydrogeological impacts - can create major damage to electrical infrastructure, with effects on the production system and the community. Italy is one of the countries most exposed to climate change and is currently ranked 1st in the EU-27 in terms of the relative economic losses per capita. In order to ensure continued reliability of the electricity service, therefore, investments are needed to increase the resilience of the distribution grid.

Globally, in the first half of 2024 climate change continued to cause significant **anomalies**, especially in **temperatures**. Suffice to say that the **global surface temperature** for May 2024 was **15.9 °C**, 1.1 °C above the 20th century average (14.8 °C), making it the warmest May on record. The same month also saw a record global ocean

surface temperature for the 14th consecutive month of 20.9 °C, 0.98 °C above the 20th century average. Moreover, the **average European temperature** this Spring was the highest ever recorded for the season, **1.5 °C** warmer than the 1991-2020 average.

In Italy, in particular, after a slight slowdown in 2023 (during which temperatures were 1.07 °C higher than average), 2024 is estimated to reach the highest temperature anomaly in Italian history with +1.75 °C difference compared to the average[3].

Alongside the temperature anomalies, which generated several drought phenomena, **rainfall** in 2023 **returned to an upward trend**: while **217.3 billion m³** of rainfall were recorded in 2022 (**-24.3%** compared to the **historical average**[4]), 279.1 m^3 (-2.7% compared to the historical average[5]) were recorded in 2023. In addition, **extreme rainfall** and **flooding** increased significantly. There were **892** extreme rainfall **events** in Italy in **2023**, a sharp increase compared to 2005, registering a compound annual growth rate (CAGR) of **+45.9%**. In line with the increase in extreme rainfall events in recent years, there has also been a rise in urban flooding. In **2023**, **115 flooding incidents** were recorded, with a CAGR of **+26.1%** over the period 2005-2023. In the first **6 months**[5] of 2024, there have already been **497** cases of heavy rainfalls and 46 instances of urban flooding.

These extreme weather phenomena result in significant **economic damage**. Italy, in particular, **ranks 1st** in the EU-27 for climate-related **economic losses**, with **284 Euros** of per capita losses in **2022**, 167.1 Euros more than the European average (116.9 Euros per capita). On average, losses are caused by **floods** (44% of cases), **storms** (34%), **heat waves** (14%), and other events[6] (8%).

[3] Average for the 1991-2020 period.

[4] Average of the 1951-2023 period from source ISPRA and Report of the National Special Commissioner for the Adoption of Urgent Measures related to the Drought Phenomenon to the Steering Committee.

[5] Data updated at June 19 from source Severe Weather Database (ESWD) and Legambiente.

[6] Such as, for example, wildfires, cold waves, etc.

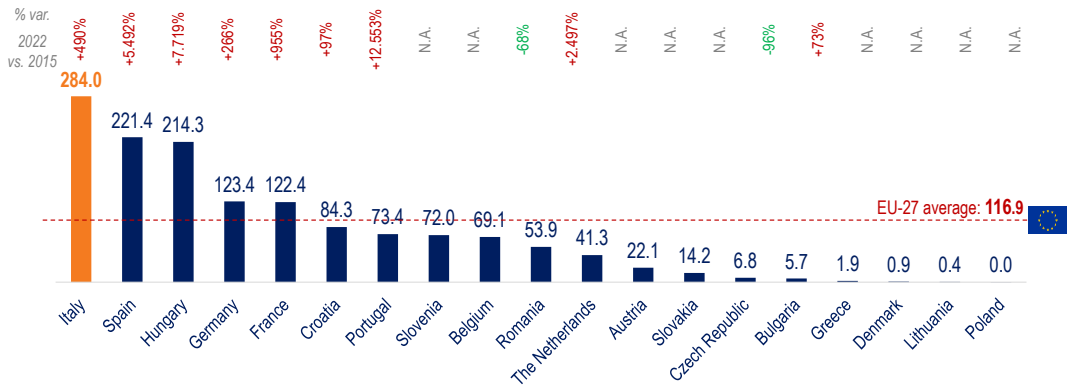

Figure IV. Climate-related economic losses* in EU-27 countries** (Euros per capita), 2022. *Source: TEHA Group elaboration on Value of Water for Italy Community data, 2024.* (*) The "climate-related economic losses" indicator measures economic losses due to weather and climate events. Weather and climate events are defined as meteorological events (storms), hydrological events (floods, landslides) and climate events (heat waves, cold waves, droughts, forest fires). (**) Data is not available for: Estonia, Ireland, Cyprus, Latvia, Luxembourg, Malta, Finland, Sweden.

In this context, the possible **adverse effects** of climate change greatly **jeopardize** the **resilience of the power distribution grid**, such as in the case of rising temperatures, storms and floods. Considering the rapidity of climate change, it is critical to **plan** and **act in advance** to **effectively manage** future dynamics. The solutions will need to be forward-looking and will need to be implemented in the short term, by 2030, to try to foresee and limit as much as possible the damage to the grid caused by extreme weather events. Indeed, only through careful planning and timely action will it be possible to meet the challenges posed by climate change and ensure a **resilient and reliable power grid**. Specifically, there are **3 elements** that necessarily need to be implemented to increase the resilience of the grid so that it is able to handle the increasing frequency of extreme weather phenomena: **anticipatory risk monitoring, grid reinforcement to adapt to new extreme stresses, and continuous dialogue with communities and Institutions.**

4. The relevance and strategic importance of the power distribution grid is also highlighted by the European Commission, which considers this sector as essential to the maintenance of vital societal functions and critical to the proper functioning of productive economic activities.

Recent geopolitical developments have brought the **resilience of infrastructure strategic for energy security** to the forefront of the debate. The attack on the Nord Stream 2 pipeline, Russia's main gas transportation infrastructure to Germany, on September 26, 2022, is a perfect example. The attacks affected the price of raw material: the next day, the price of gas on the TTF market in Amsterdam reached **€200/MWh** (4.3 times the price of gas in 2021, equal to €46/MWh).

Indeed, it should be noted that there has been a **steep rise in cyberattacks** in recent years, particularly in the utilities sector[7]. In Europe, in particular, looking at the time

[7] The utilities sector includes electricity, gas and water.

period between 2020 and 2022, there was a significant increase in attacks on the utilities sector: during 2020, around 504 incidents were recorded on a weekly basis, rising to 736 in 2021, and in 2022 the number exceeded 1,000.

For these reasons, too, the **strategic nature** of the power grid in Italy is confirmed by its **presence** in the list of **strategic infrastructures** defined by the **Golden Power** Directive. To protect the ownership structures of companies operating in sectors considered strategic and of national interest, the legislation concerning special powers exercisable by the Government was fully reorganized in 2012 with Decree-Law no. 21 of March 15. Specifically, the powers exercisable under the Golden Power refer to the areas of **defense** and **national security**, as well as certain areas of activities defined as strategically important in the **energy**, **transportation** and **communications** sectors.

In this context, according to the **Directive (EU) 2022/2557** of the **European Commission**, the power distribution grid is considered a **strategic** and **critical** sector for the **maintenance** of **vital societal functions**. Specifically, member states are obliged to identify critical entities responsible for these essential services and to support them in fulfilling their obligations, including improving their resilience and capacity to deliver services. The Directive directly includes **distribution system operators** among the **critical entities** in the **electricity** sector, thus becoming **providers** of a service that is essential for the maintenance of vital societal functions or economic activities[8].

The power distribution grid is, in fact, an **essential service**, not only for the maintenance of vital societal functions (serving more than **30 million households**), but also and above all of economic activities, since **more than 7 million commercial and industrial users** connected to the distribution grid. In general, **more than 80%** of the electricity consumed in Italy comes from the distribution grid.

Of the 306.1 TWh consumed in Italy in 2023, a share of **251 TWh** was consumed on **medium-low voltage** lines, while a share of **55 TWh** was consumed on **high voltage** lines. It should also be noted that, considering the breakdown of users connected in medium-low voltage, 77.4% of the electricity delivered is to non-domestic users, despite the lower presence of points of delivery for this category of consumers. Non-domestic users total **7.1 million**, almost all of whom, **98.5%**, are on the **low-voltage** line. Indeed, around 100,000 non-domestic users are connected to medium voltage, accounting for

[8] In particular, the criteria used to identify critical entities refer to: the number of users who depend on the essential service provided by the entity in question; the extent to which other sectors and subsectors depend on the essential service in question; the impact that incidents could have, in terms of magnitude and duration, on economic and social activities on the environment, public safety, public security, or public health; the entity's market share in the market for the essential service(s) involved; the geographic area likely to be affected by an incident, including any cross-border impacts, taking into account the vulnerability associated with the degree of isolation of certain types of geographic areas, such as insular, remote or mountainous ones; the importance of the entity in maintaining a sufficient level of the essential service, taking into account the availability of alternative means of providing that essential service.

around **95 TWh** of the total consumption and representing a large part of the **national production fabric**.

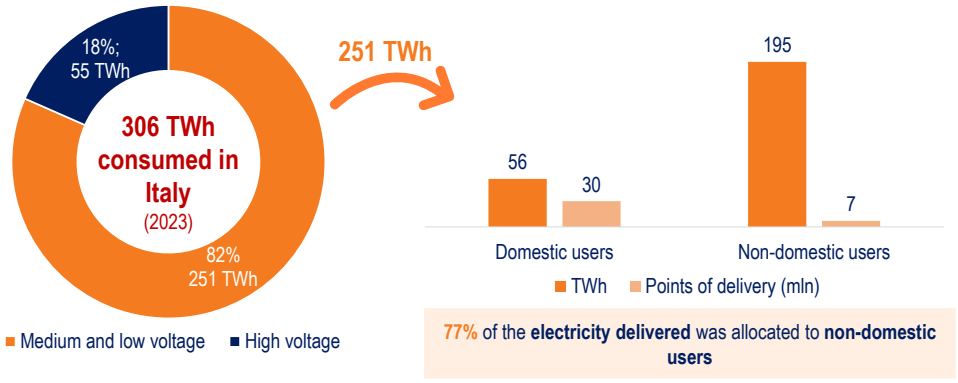

Figure V. Left: Distribution of low, medium and high-voltage electricity consumption in Italy (% values), 2023 and Right: Distribution of users connected to the power distribution grid (TWh and millions of points of delivery), 2023. *Source: TEHA Group elaboration of ARERA data, 2024.*

5. The analytical assessment model developed shows that the Italian distribution grid (in its current set-up) is among the most virtuous in Europe, thanks to effectively invested capital that has enabled high rates of innovation, efficiency and infrastructural development. Specifically, the Italian grid ranks 1st in investment effectiveness (RAB per customer and grid km), penetration rate and functionality of smart meters, and cost-effectiveness of grid charges, and 2nd for grid loss performance and growth in distributed electricity.

TEHA's aim was to **identify the salient features** of distribution grid performance in Italy, comparing it with other benchmark countries in Europe. In order to present an effective comparative analysis, it has been chosen to analyze the distribution set-up of **5 countries that are comparable in terms of economic-social size and electricity distribution management model** (also called peers): Italy, France, Germany, Spain and the UK[9].

Specifically, comparison on the performance of the distribution sector was performed based on some selected *ad hoc* Key Performance Indicators (KPIs) that can be reclassified as: **invested capital**, **innovation**, **efficiency** and **effectiveness**.

What emerges from the analysis is that the Italian power distribution grid appears to **be one of the most virtuous in Europe**. The high quality of Italian distribution was made possible by **effectively invested capital**, which enabled the achievement of **high rates of innovation**, **efficiency** and **infrastructural development**.

As regards the first macro-category of indicators, which is **invested capital**, the performance analysis was based on the **Regulatory Asset Base (RAB)**. In particular, the RAB identifies the value of invested capital and is used to calculate the annual remuneration to operators. A lower RAB per customer results in a **reduced impact of the**

[9] Depending on the data availability.

invested stock on the consumer's bill and, given the same performance, provides **an indication of the effectiveness** of investments made by the operators. The analysis shows that Italy is the Country with the lowest **RAB per customer (€0.71 thousand** per customer) and **RAB per km (€19.6 thousand** per grid km) of grid compared to European peers.

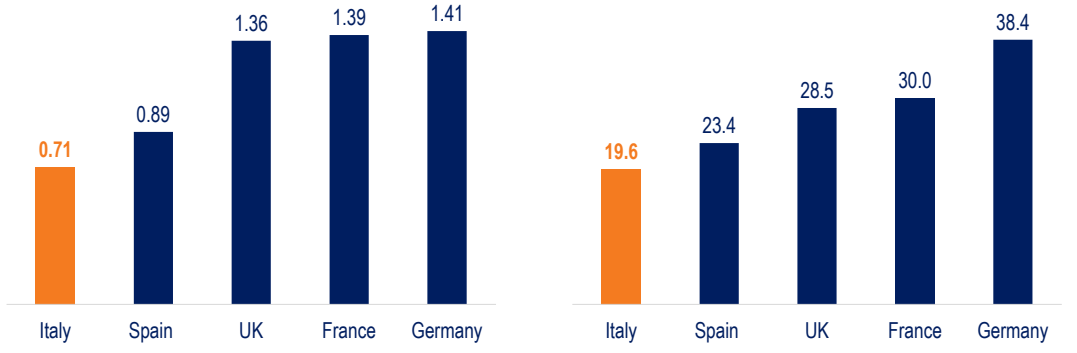

Figure VI. Left: Regulatory Asset Base (RAB) per customer in selected European countries (k€/customer), 2023 or latest available year and Right: Regulatory Asset Base (RAB) per km in selected European countries (k€/grid km), 2023 or latest available year. Source: *TEHA Group elaboration on Eurostat and DSO data of the countries taken as reference, 2024.*

Focusing on the **innovation** capacity of the electricity grid, it is important to point out that Italy was the pioneer in Europe, and one of the first countries in the world to replace traditional meters[10] with "smart" ones. The installation of smart meters represents a major advance in the management and monitoring of energy distribution as these new electronic meters enable **complete remote management of utilities**, enabling, among other things, remote reading operations, commercial power change operations, disconnections and reconnections. In detail, among the European peers, **replacement has been completed only in Italy and Spain**, in 2017 and 2019, respectively.

It is noteworthy that Italy, not only was the first European country to complete the replacement of traditional meters with smart ones, but also, in **2017 it began** the second rollout of innovative meters: **Open Meters**. The latter are second-generation devices, which, among other functions, enable better monitoring of electricity flow. Open Meters are innovative in that they are capable of **recording both energy outputs and inputs in near real time**, enabling much more refined metering than previous models, ensuring **remote management, consumption monitoring every 15 minutes**, and a **more accurate measurement of losses**. The installation of innovative Open Meters is on track to be completed in Italy in 2024, whereas in the other benchmark countries analyzed, it has not yet been initiated.

As regards service **efficiency**, the most illustrative indicator in this area of measurement is undoubtedly **grid losses**. Distribution grid losses, defined as lost electricity compared to total distributed electricity, recorded in Italy stand at around **4.8%**. This is **lower** than

[10] The term "traditional meters" refers to electromechanical meters, which operate by means of a metal disc moved by current at a rate proportional to the committed power.

the values reported by Spain (9.4%), the UK (6.7%) and France (5.8%), further reaffirming the virtuosity of the Italian power distribution system compared to European peers. It is worth mentioning that, despite **distributing a similar amount of energy as the UK** (306 TWh in Italy[11] compared to 295 TWh in the UK), Italy records distribution grid loss levels that are **1.9 percentage points lower** than those of the UK (4.8% in Italy vs. 6.7% in the UK).

A second performance indicator that is worth assessing the efficiency of the power distribution grid is the **distribution charges paid** by end-users. Again, **Italian performance is the most virtuous** compared to the peers. Specifically, taking into consideration energy distribution charges **for domestic consumers** of the main European peers, Italy has always recorded a **lower price per kWh** during the last 7 years (**€0.042/kWh** compared to €0.060/kWh in France, and €0.063/kWh in Germany and Spain). The fact that distribution charges are low, despite the fact that Italy is the sixth most expensive Country in Europe in terms of the cost of electricity, underscores even more markedly the efficiency of Italian electricity distribution.

Similar considerations regarding power distribution charges can be made about the charges **for small and medium-sized enterprises**[12] among the European peers. Note again that the costs for these categories of utilities in Italy are **the lowest** of those recorded among benchmark countries. In 2023, electricity **distribution charges** for SMEs in Italy were **€0.009/kWh**, lower than the €0.024/kWh recorded in France, €0.027/kWh in Spain and €0.041/kWh in Germany.

6. The efficiency, effectiveness, cost-effectiveness and innovation of the distribution sector have been supported by a multi-level legislative-regulatory framework that is advanced and particularly well-suited for the grids. The combination of regulatory stability and financial stability of the system has made it possible to make effective investments in the grid, innovating and improving its quality, without burdening end users with costs.

The **efficiency**, **effectiveness**, **cost-effectiveness** and **innovation** of Italy's electricity distribution outlined above have been ensured by a multi-level **legislative-regulatory framework**. Legislative-regulatory framework means the set of laws, regulations and control mechanisms that **govern the operation** of a Country's electricity distribution grids, ensuring and monitoring that they operate **fairly**, **transparently** and **efficiently**.

[11] For consistency and comparability among all the countries analyzed, Eurostat variable "*Electricity available for final consumption*" was used as the estimate for distributed energy. For Italy it has been used the 2023 total electricity consumption (transmission and distribution) reported by TERNA, equal to 306 TWh.

[12] According to Eurostat definition, Small and Medium Enterprises (SMEs) have between 10 and 250 employees and an annual turnover of between €2 and €50 million. On average, the annual consumption of these enterprises varies from 500 to 70,000 MWh.

In Italy, the framework is characterized by several **key components** that together contribute to making the electric power distribution sector **one of the most advanced and reliable in Europe**. These components include:

— **Regulatory incentive mechanisms aimed at efficiency**: these mechanisms reward operators for their performance, incentivizing them to exceed quality standards through rewards and penalties for underperformance.

— **A congruent and stable investment remuneration system**: investments in the electric power distribution sector are remunerated according to a rate-of-return logic, which ensures that actual costs are covered, thus providing incentives for efficiency and innovation.

— **Elements of legislative-regulatory protection for consumers**: with a **single national tariff**, consumers pay the **same distribution charges** regardless of the **actual costs incurred** by their distributor, ensuring that prices remain under control and protecting consumers from excessive bill increases. Tariffs are adjusted **annually** to reflect **inflation** and other **economic** factors.

— **Widespread and innovative metering systems** (**smart and open meters**): the Italian distribution sector was the first in Europe to adopt smart meters and second-generation "Open Meter" devices, which allow a near real time monitoring of consumption and improve grid efficiency.

— **Independence and stability of the regulatory body**: ARERA is recognized for its political and operational independence, essential in maintaining the integrity of the regulatory process and ensuring a transparent and accountable system.

— **Data transparency and continuous monitoring**: the availability of detailed data on operator performance, energy consumption statistics and information on prices and investment projects ensures a high level of transparency and accountability.

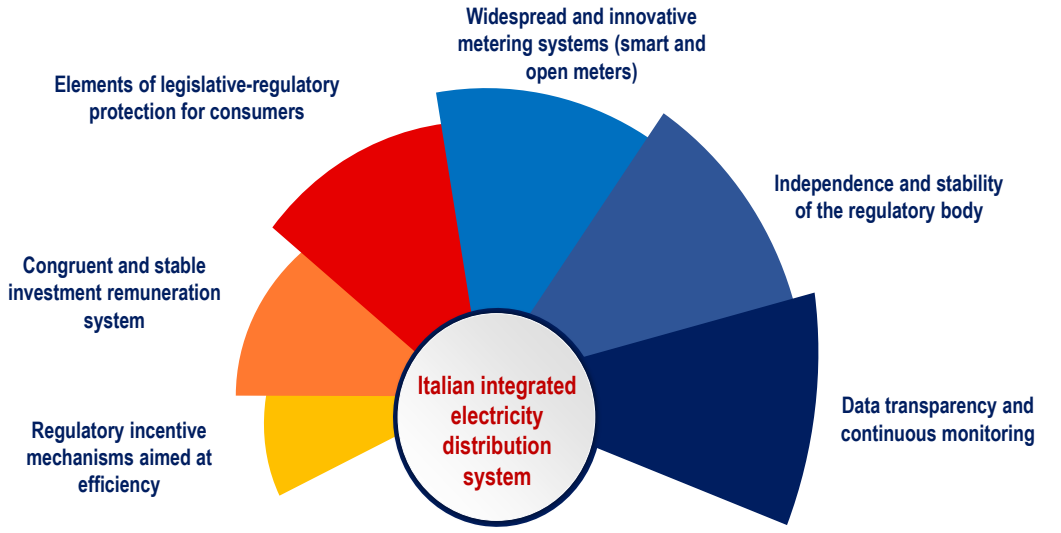

Figure VII. Components of the Italian multi-level electricity distribution system, 2023. *Source: TEHA Group data elaboration, 2024.*

7. The evolution of the electricity system and the role of distribution require major new investments in the grid to ensure continuity of performance, also in light of the evolution of extreme weather phenomena. Between 2024 and 2050, €65 billion per year will have to be invested in the distribution grid in Europe. In Italy, around €6 billion per year of investment will be required over the coming 10 years.

At the **European** level, according to estimates provided by Eurelectric[13], between **2020** and **2023**, annual investment in the distribution grid increased by **24%**, from **€29 billion** invested in **2020** to **€36 billion** invested in **2023**. However, in order to meet the **challenges** that the distribution grid will face (and for some of which, it is already facing), compared to **2023** alone, annual investment in the distribution grid is forecast to increase by **80%** between 2024 and 2050, reaching a share of **€65 billion** per year over the next **27 years**. To reach the estimated investment needs by 2050, compared with the average for the period 2020-2023, annual investment would have to increase **1.9 fold**.

As regards **Italy**, between 2025 and 2034, an investment of around **€6 billion** per year is planned in the distribution grid. With reference to historical trends, Italy's investment **growth** trend doubled **between 2018 and 2023**, **from €1.8 billion to €3.7 billion** invested in 2023. According to early data and business plans of major industry operators, **€4.7 billion** are forecast for **2024**, **1.8 fold** more than the **2018-2023 average**, underscoring the current effort that operators are making to meet the growing challenges of the electric power distribution industry.

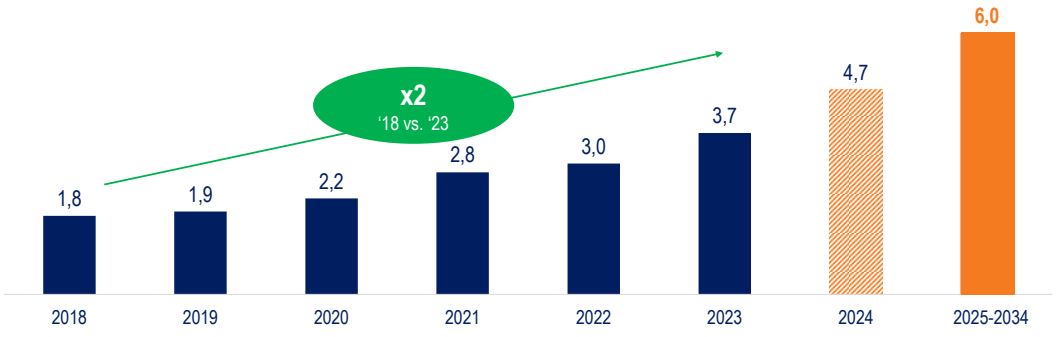

Figure VIII. Annual investments in the development of the power distribution grid in Italy (billion Euros), 2018-2024 and 2025-2034. *Source: TEHA Group elaboration on Eurelectric data and those of the main sector operators, 2024.* N.B. The investments consider the major Italian distribution grid operators. The year 2024 considers business plans and investment projections of the major Italian distribution grid operators.

[13] Eurelectric is the leading trade association that represents the common interests of the electrical industry at the European level.

8. The estimated average annual investments in the power distribution grid in Italy (€6 billion per year) will be able to create significant impacts (direct, indirect and induced) in the country's economy, generating over €13 billion of Added Value in the System every year (approx. 0.7% of the Italian GDP), creating over 170,000 jobs and guaranteeing over €12 billion of income for Italian families.

Investment in the power distribution grid generates a significant positive impact on the **national economy**. Suffice to say that, on average, each year it is estimated that around **6 billion Euros** could be invested by operators in the power distribution grid in Italy in the coming years. These investments could in turn generate:

- Around **13 billion Euros** in **Added Value**. In other words, investment in the power distribution grid is able to contribute **13 billion Euros** to the generation of **0.7% of national GDP**.
- Around **27 billion Euros** in **production value**. Indeed, investment in the distribution grid will be able to generate a significant **increase in revenue** for the companies involved, creating a positive impact on the entire economic ecosystem. To give an example, when **investments** are made to **modernize** and **expand grid infrastructure**, companies involved in these activities see a **direct increase** in **business opportunities** (e.g., construction and upgrading of grids require the use of material suppliers, engineers and skilled technicians).
- Around **170,000 people employed**, investment in the distribution grid not only creates **jobs** directly related to infrastructure construction and maintenance, but also stimulates a number of **indirect employment opportunities**, with a positive effect on the entire labor market and local economy, representing an important le**ver** for long-term employment growth and stability.
- Around **12 billion Euros** in **household income**. The increased demand for skilled and specialized labor, the pos**itive effect on direct wages and the broader economic impact** on upstream and downstream sectors of the distribution grid all contribute to raising workers' wages and purchasing power, creating a cycle of economic growth and stability.

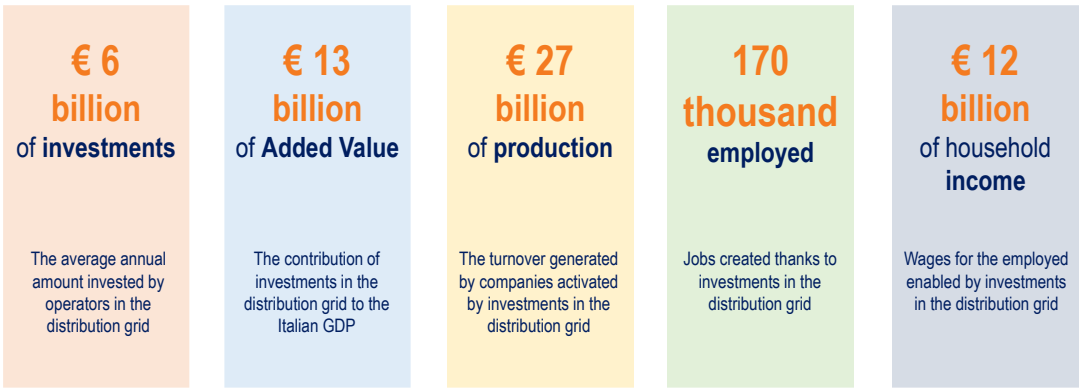

Figure IX. Quantification of investments and impacts enabled by investments in the distribution grid (illustrative). *Source: TEHA Group elaboration on OpenEconomics data, 2024.*

9. In the light of the current performance of the distribution sector in Italy, represented by investment capacity and effectiveness, service quality, innovation and cost-effectiveness for end-users, it is to be hoped that starting from the current set-up, which is consistent with European legislation, future development preserves and enhances, in a long-term perspective, the important benefits also guaranteed so far by a multi-level legislative-regulatory framework.

The **power distribution system** in Italy has achieved remarkable results in terms of efficiency, effectiveness and innovation. This has been possible thanks to an advanced **legislative-regulatory framework** and a **set-up of the sector** able to positively address changes in the context, factors that have made it possible to balance the interests of the various stakeholders, **incentivizing the investments** needed to modernize the grid and respond to evolving needs.

From a forward-looking perspective, it is vital to guarantee the **conditions for optimizing** the legislative-regulatory framework for the electric power distribution sector in Italy. In the light of the need to **make large** and **ever greater investments** in the grid already in the **short and medium term**, it is important to **ensure the continuity** of the performance achieved in terms of investment capacity and effectiveness, service quality, innovation and cost-effectiveness for end users.

Careful assessment of the adequacy of the legislative-regulatory framework is essential to **avoid potential risks**, which can be divided into two categories: **risks to end-users** (reduced efficiency, effectiveness and cost-effectiveness of the service and a potential rise in tariffs) and **risks to operators** (potential delays in investment and lower propensity to invest).

To meet these challenges, a **stable** and **predictable legislative-regulatory framework** that incentivizes investment and ensures efficient grid management is needed. Only through a **stable regulatory framework**, **appropriate regulation** and **effective**

coordination among the various players in the industry will it be possible to maintain and improve the **service standards** and **competitiveness** of the Italian electricity system.

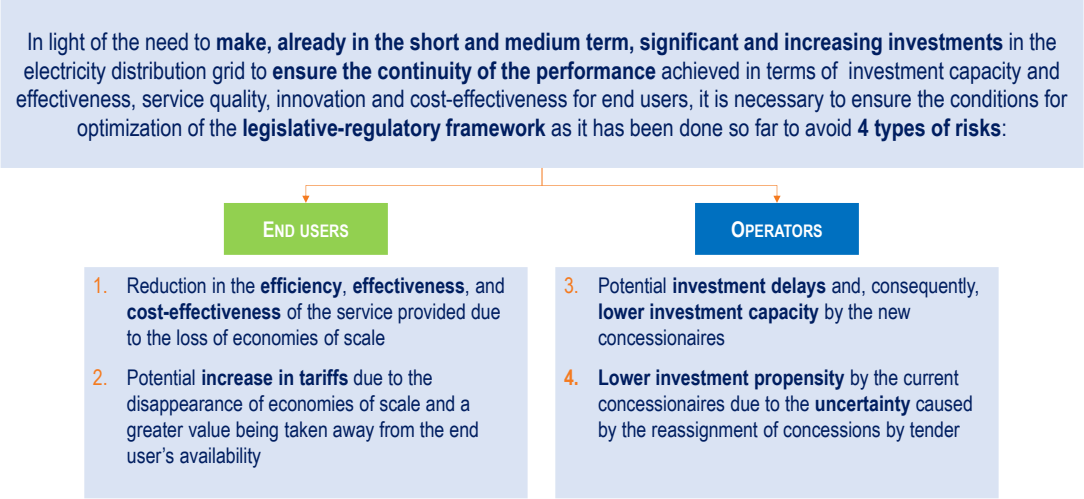

Figure X. Potential risks associated with the inadequacy of the Italian electricity distribution legislative-regulatory framework, 2024. *Source: TEHA Group data elaboration, 2024.*

TEHA also carried out an **international comparative study** of electric power distribution concessions that ultimately highlights how both the **structure of the sector** and the **mechanisms** for granting power distribution **concessions** can significantly impact efficiency, cost-effectiveness and innovation performance. The **German model** — characterized by **marked** fragmentation — has led to **poorer performances** than in Italy, such as lower smart meter installation and higher distribution costs. Instead, the **French model**, by ensuring **continuity** and **stability** through an **automatic concession renewal** mechanism linked to the achievement of performance targets, ensures **centralized control of infrastructure** and facilitates **long-term planning**. It is therefore important for Italy to maintain a **balance** between **system efficiency** and **stability**, ensuring an **high quality service at low cost** with the necessary **innovative push**.

To realistically achieve national and European goals and to avoid risks of system deterioration, it is therefore crucial to **build a clear and stable legislative-regulatory framework**. A well-structured regulatory framework is essential not only to maintain reliability and service quality, but also to promote innovation and economic efficiency in the long term. Effective governance, supported by a reliable and lasting regulatory framework, is the key to ensuring that the Italian energy system can meet future challenges and continue to grow sustainably and resiliently.