

enel

INNOVATION

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1

Enel's innovation
leadership and strategy

“

“In a world marked by rapid transitions and complex challenges, the energy sector is undergoing unprecedented technological and industrial change. Within this landscape, innovation plays a strategic role in developing solutions that make future energy systems more resilient, flexible, and sustainable.

By deploying new technologies across its core businesses, from grids to renewable generation and energy storage, from artificial intelligence to new customer-centric services, the Enel Group scales innovation globally, actively contributing to the transformation of the system.”

”

Flavio Cattaneo

CEO Enel Group





Ensuring **access to reliable, affordable and zero-emission energy** is a global priority and a **prerequisite for economic and social progress**.

In a context marked by rapid transitions and complex challenges, **innovation is a strategic lever**, a tool for redesigning systems and accelerating high-impact solutions.

As a global leader in the energy sector, **the Enel Group is helping to shape the future of energy by adopting open innovation models and implementing new technologies at scale**. Our approach goes beyond technology: it creates lasting value for people, communities and the planet.

This document offers a comprehensive overview of how we address emerging macrotrends, applying innovative models to our business and amplifying their impact through partnerships. It also **highlights how we scale innovations globally**, transforming pilot projects into industrialised solutions that enhance performance, resilience and sustainability. From smart grids and renewable generation to AI, storage and new customer-centric services, this report **showcases the tangible results of our innovation strategy and the multiplier effect we generate within the ecosystem**.

LEADERSHIP IN THE ENERGY TRANSITION

Enel Group is a multinational energy company and a leading integrated operator in the global energy market. Headquartered in Italy and **operating in 28 countries** across five continents, Enel serves approximately **69 million end users** through the world's largest private electricity distribution network. With a **workforce of over 60,000 employees** and a managed **renewable capacity of approximately 68 GW**, Enel is recognized as the largest private renewable energy operator globally.

In 2024, Enel reduced its total emissions by 26% year-on-year, reaching 70 MtCO₂eq, and increased the share of **zero-emission electricity generation to 83%**¹. Building on this progress, the Group aims to achieve net zero greenhouse gas emissions across all scopes by 2040. The company is on track to phase out coal-fired generation by 2027, subject to the authorization processes of each individual country of presence, and is implementing a *just*

transition framework to support workers, communities, and suppliers through reskilling, local development, and inclusive innovation.

The Group's strategic commitment in sustainable energy is reflected in Enel's integrated business model, which combines financial sustainability with environmental and social sustainability.

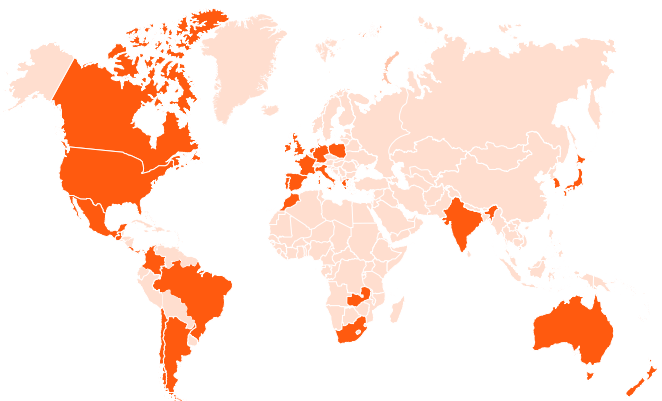
Enel's 2026–2028 Strategic Plan outlines €53 billion investments focusing on electricity grids, the expansion of renewable energy capacity, and customers.

Through a robust governance model, transparent stakeholder engagement, and a forward-looking approach to risk and opportunity, Enel continues to lead the global energy sector toward a more sustainable, inclusive, and innovative future.

GLOBAL PRESENCE

28
Countries

+60,000
N° of total
Enel employees



KEY FIGURES

POWER GENERATION



93 GW
Group Net
Installed Capacity

73 %
Net Installed
Renewable Capacity

DISTRIBUTION



69 M
End Users

1,9 M KM
Electricity Distribution
Grid

PRODUCTS AND SERVICES



33 K
Public Charging
Points

54 M
Retail
Customers

Unless otherwise stated, the Enel data presented in this document refer to 2025 and are sourced from the Group's official websites.

1. Data from Enel's Annual Integrated Report 2024

INNOVATION STRATEGY FOR SCALABLE IMPACT AND ECOSYSTEM GROWTH

Enel's innovation strategy is integrated into the Group's multi-year planning and evolves in line with the innovation policy and business priorities.

The intent for innovation is to create impact on business while positioning the company at the forefront of the energy transition. To achieve this, **Enel was among the first companies to adopt an Open Innovation model**, establishing itself as a pioneer in collaborative innovation. This model is powered by a robust set of tools and practices that enable tangible innovation, with clear and measurable processes, driven by a collaborative, consolidated and effective framework. Our approach is increasingly focused on long-lasting value creation, anticipating future trends and unlocking new business models and opportunities.

Beyond Open Innovation, we have already embraced a **community-driven innovation model** that fosters critical mass and amplifies impact across the entire ecosystem. This evolution reflects our commitment to systemic innovation, capable of generating benefits not only within the Group but also across the broader network of partners and stakeholders.

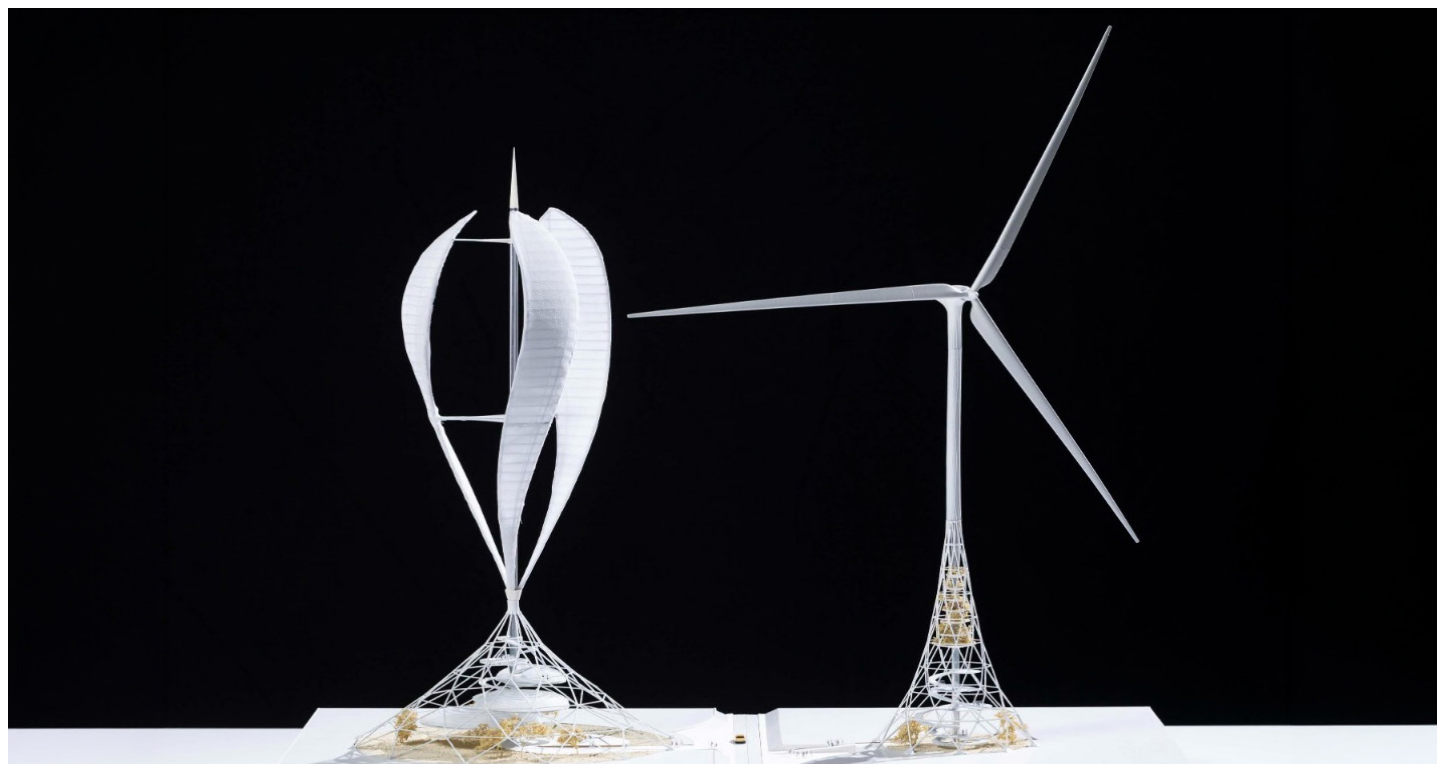
Our innovation efforts leverage a variety of instruments to identify new solutions to business needs and address new market opportunities, **engaging an extended ecosystem of industrial partners, large companies, SMEs, research centers, universities, entrepreneurs, and startups**.

Key channels include the **crowdsourcing platform** www.openinnovability.enel.com, which collects innovative solutions, and a global network of **Innovation Hubs** located in the world's most relevant innovation ecosystems, such as Europe and the United States, which serve as primary scouting source for new solutions.

To assist the development and potential scale up of these solutions, **Enel provides** participating companies with **expertise, industrial testing facilities**, and access to its **global network of partners**. Furthermore, through co-development with suppliers (the *Innovation by Vendors* program), the Group aims to rapidly and effectively implement innovative solutions at the pre-commercial stage, leveraging existing capabilities and adapting technologies already used in other sectors, with a defined path to scale up and adoption.



▲ Image 1.1
Enel's Innovation Hub Europe



▲ Image 1.2

Models of the winning project of the Enel Crowdsourcing Challenge WinDesign by Mario Cucinella Architects (MCA) and Robert Bird Group (Powering the Future)

In parallel, we foster a vibrant **internal culture of innovation**, expressed through a wide array of initiatives that encourage creativity, collaboration, idea generation and continuous knowledge sharing across the organization to create value for the company and the sector, while enhancing and valorizing internal talents.

To strengthen innovation management practices, **Enel was among the first companies globally to voluntarily adopt the ISO 56002 standard** (in 2022), which provides comprehensive guidance for managing innovation, from idea generation to global implementation. Reinforcing this commitment, in December 2023 **Enel, in collaboration with UNI (the Italian Standard Body), developed the UNI/PdR 155:2023 guideline**, titled *“Sustainable Innovation Management – Guidelines for managing sustainable innovation processes in companies through open innovation”* offering practical references aligned with the ISO 56000 series to strengthen the national innovation ecosystem. Currently, **Enel is also implementing an Innovation Management System** based on the principles of the newly published **UNI EN ISO 56001:2024 standard** and manages Intellectual Property through a Group-wide

procedure aligned with the ISO 56005:2021 principles.

To support the entire innovation process and keep it closely aligned with business needs, Enel has adopted a **multilevel organizational structure** that integrates innovation across all levels of the Group. Dedicated innovation teams are embedded within each Business Line, tailored to its specific priorities and challenges. This approach makes innovation a core component of day-to-day business activities, rather than a separate function.

At the same time, a central cross-functional innovation unit plays a strategic role in defining the Group-wide innovation strategy. It oversees resource allocation, portfolio monitoring, governance, intellectual property management, open innovation, innovation intelligence and culture, ensuring coordination and coherence across Business Lines and supporting the development and scaling of innovation initiatives throughout the organization.

This integrated model enables innovation to be both locally responsive and strategically guided, allowing Enel to generate scalable impact while remaining agile in the face of evolving market dynamics and technological trends.

INNOVATION ECOSYSTEM IMPACT

Enel's innovation model is based on **ecosystem amplification**. We act as catalysts and orchestrators, activating partnerships, enabling scaleups, and facilitating investments through our partners. The true impact is not captured solely by immediate metrics, like direct investments, but by the **long-term multiplier effect** we generate across the ecosystem, often reaching up to five times the contract value in the scaling up phase. By engaging diverse stakeholders, startups, research institutions, corporates, and public entities, we foster collaborative processes that accelerate innovation and create systemic value.

INNOVATION IMPACT IN NUMBERS

+190 Mln €

Innovation investments in the 2026-2028 plan

2000

Number of solutions scouted per year

150

Number of projects in portfolio

70

Number of Proof of Concepts approved per year

15

Number of solutions scaled up per year

18

Number of challenge launched per year

4

Number of Innovation by Vendors initiatives per year

503

Number of patents owned in Dec 2024

ENEL AS PIONEER OF INNOVATION IN THE ENERGY SECTOR

Our innovation efforts go far beyond experimentation, **we deliver real, scalable impact**. On average, we scale up around 15 solutions per year, integrating them into our operations across multiple geographies.

A standout example is the smart meter rollout, where **Enel has deployed over 45.6 million smart meters** across Italy, Spain, and Latin America, becoming a global leader in grid digitalization. The second-generation meters not only enhance energy efficiency and customer interaction but also embed circularity and sustainability, using regenerated polycarbonate from replaced smart meters and cutting CO₂ emissions by 6.5 kg per unit. This large rollout improves operational efficiency, empowers customers and accelerates the energy transition, demonstrating how innovation at Enel translates into tangible, large-scale transformation.



2

Macrotrends and
emerging technologies

EXTRACTING VALUE FROM GLOBAL TECHNOLOGICAL CONVERGENCE

In today's rapidly evolving landscape, some global technological macrotrends are reshaping every industry, each unfolding through specific use cases. Most of these **trends are interconnected**, and leveraging multiple ones simultaneously can unlock powerful synergies.

Enel, operating across diverse fronts with an open innovation model and a **systemic approach** as a technology integrator, is uniquely positioned to capitalize on this convergence. By tapping into several macrotrends in parallel and leveraging competence and a deep knowledge of the markets we can accelerate the innovation process

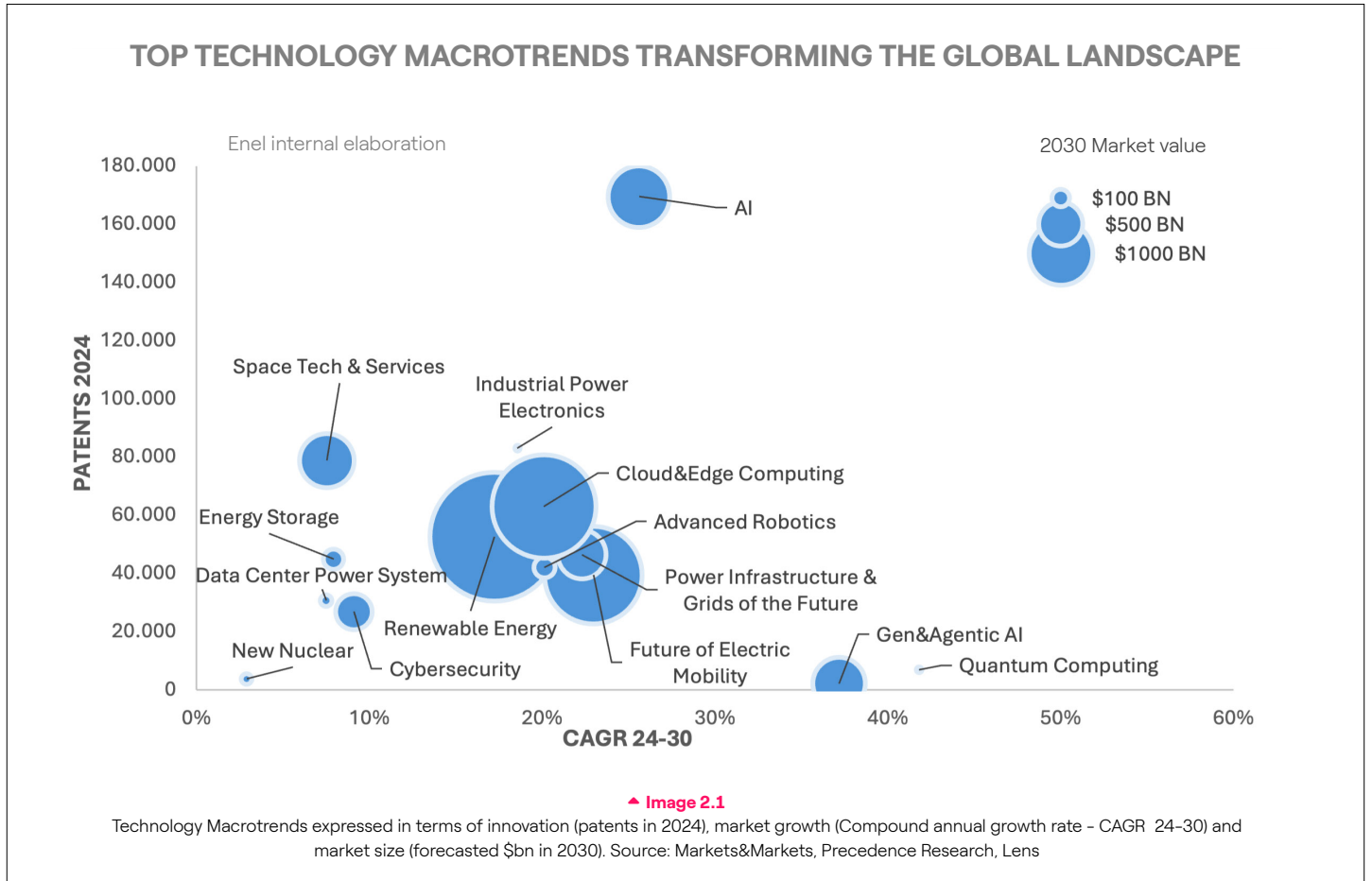
beyond what is possible through isolated efforts, creating a compounding effect that drives sector-wide development. Yet, this convergence also presents a significant challenge: understanding the pace, scope, and implications of these trends on our assets, operations, and customer relationships requires agility, strategic foresight, and continuous adaptation.

Thus, for Enel, this **transformation is both a challenge and a strategic opportunity**, one that, if proactively harnessed, can unlock value across the entire energy value chain and reinforce our leadership in the energy transition.

TECHNOLOGY TRENDS SHAPING THE ENERGY FUTURE

As technological convergence continues to redefine the energy landscape, innovation in the energy sector is becoming a cornerstone of national and global strategies for competitiveness and resilience. In 2024, equity investments and market size of **energy and sustainability**

technologies remained among the largest globally across all sectors¹. This reflects a highly dynamic energy technology ecosystem, where innovation spans both emerging and mature technologies, reshaping energy planning and influencing the broader economy.





A key driver behind this innovation surge is the urgent need to **decarbonize** the energy sector, accelerating progress in **low-carbon generation, electrification of end uses** and **digital tools**. Looking ahead, the market value of key low-emissions technologies is projected to exceed \$2 trillion within the next decade, yet 35% of the emissions reductions needed for carbon neutrality by mid-century depend on technologies not yet commercially mature².

In this context, **electrification** is more than a technological shift, it represents a systemic transformation that requires new models for grid management, customer interaction, and value creation. This transformation is already underway: global electricity demand is expected to grow by almost 30% in the next 5 years³, driven by the decarbonization of transport, heating, and industrial processes.

Its momentum is further amplified by broader innovation trends, such as the **decentralization of energy production** and the **digitalization of infrastructure**. The widespread adoption of solar, wind, and storage technologies, enabled by falling costs and improved performance, is making energy systems increasingly distributed and variable. This shift

introduces new challenges for grid stability, coordination, and reliability, demanding smarter and more adaptive system architectures. To support this evolution, **energy storage** is becoming essential, not only for peak shifting and congestion management but also for enhancing overall system resilience. In 2024, global investment in battery storage grew by 45%, driven largely by public initiatives to mitigate market volatility⁴. Innovation is focusing on advanced materials beyond lithium, improved recycling, and higher efficiency. **Long-duration storage** solutions, capable of operating for over 8 hours, are emerging as key enablers of flexibility and stability, allowing energy systems to increasingly function independently of fossil-based backup.

Complementing these developments, **next-generation nuclear technologies**, including small modular reactors, are gaining momentum as a technology for tackling the base load generation. These innovations offer the promise of safe, low-carbon, and dispatchable energy, reinforcing long-term energy security and supporting decarbonization goals alongside renewables. 31 countries have committed to tripling global nuclear energy capacity by 2050¹.

As electricity generation becomes increasingly decentralized, **smart grids** are emerging as vital enablers of flexibility, efficiency, and resilience across energy systems. In this dynamic landscape, the integration of new technologies and components is essential to maintain power quality, ensure system stability, and support the seamless incorporation of renewable energy and distributed generation. The advancement of power devices, such as **advanced inverters**, **semiconductors** and **solid-state transformers**, plays a pivotal role in building intelligent, responsive networks capable of managing bidirectional energy flows and integrating distributed energy resources at scale. **Power electronics**, in particular, marks a paradigm shift for the grid, enabling greater digitalization, automation, and the emergence of intelligent, component-based systems. This extends a well-established concept into a domain where it had

never fully belonged: the grid itself, resulting in a smarter, more adaptive, and resilient energy infrastructure.

Global investment in **grid infrastructure** is estimated to have exceeded \$400 billion by 2025 and almost doubling to \$750 billion by 2035, according to the International Energy Agency (IEA)⁴, underscoring the urgency of adopting resilient strategies. These investments reflect not only the growing complexity of energy systems but also the pressing need to withstand **climate-related extreme events** that increasingly challenge the reliability and continuity of energy distribution.

A key dimension of systemic electrification is the transformation of end-use consumption, with transport emerging as one of the most dynamic sectors.



Within the **new electric mobility paradigm**, **electric vehicles (EVs)** are driving rapid growth: global sales exceeded 20 million in 2025, up 25% from 2024, and could more than double to 39 million by 2030. In Europe, sales may triple, supported by policy incentives, expanding charging infrastructure, and more affordable models⁵. Technological advances, such as next-generation batteries and ultra-fast charging, will extend driving range and cut recharge times to under 20 minutes, enhancing the user experience⁶.

This surge introduces new complexities for grid management, accelerating the need for coordinated infrastructure, smart charging, and real-time energy optimization to ensure seamless operation.

In this context, **EVs** are also evolving into **mobile energy assets**, serving as distributed storage units, grid-balancing tools, and enablers of innovative business models. Unlocking this potential requires innovation in charging infrastructure, particularly in expanding access, enabling bidirectional charging, and ensuring full integration with smart energy ecosystems.

Digital technologies are increasingly playing a central role in energy innovation, bringing new capabilities in system optimization, customer engagement, and infrastructure resilience.

One of the most transformative trends is **artificial intelligence (AI)**, which is revolutionizing how organizations manage data, automate operations, and design user-centric services. In 2024, AI investments surpassed \$100 billion, with 78% of companies adopting it in at least one business function¹. Among the most innovative and fast-growing areas within AI are **Generative AI** and **Agentic AI**, which hold significant potential for disruption across industries due to their ability to create content, make autonomous decisions, and reshape human-machine collaboration.

AI's rapid adoption is also fueling a sharp rise in electricity demand, particularly through the expansion of **hyperscale data centers**. These facilities, driven by AI workloads and cloud services, are expected to triple in capacity by 2030, contributing to an estimated 3% increase in global energy consumption, rivaling national consumption levels⁷. This trend presents both a challenge and an opportunity, calling for innovation in clean generation, grid upgrades, and energy efficiency.

Complementing AI, **cloud** and **edge computing** represent another major macrotrend, with a market size exceeding \$1 trillion dollars. These technologies enable real-time data processing and decentralized intelligence across energy systems, supporting faster decision-making at the grid edge, improving asset performance, and

enhancing responsiveness to local energy dynamics, especially in distributed and renewable-rich environments. Combined with **High-Performance Computing (HPC)**, these technologies will enable even larger-scale data processing with minimal latency, unlocking faster and more advanced energy system optimization.

As digitalization deepens, **cybersecurity** becomes a critical pillar of energy resilience. Protecting infrastructure from increasingly sophisticated threats (*+1500 weekly per energy organization in 2024 as IEA reported⁷*), is essential to ensure system integrity, data privacy, and operational continuity. Investments in secure architecture, threat detection, and regulatory frameworks are growing in response to the expansion of digital energy ecosystems.

In parallel with this expansion, new computational paradigms, such as **Quantum technologies**, are gaining traction to address increasingly complex challenges. These technologies, backed by \$2 billion in equity investment in 2024 and 34 national programs, are redefining computational boundaries, offering long-term potential for breakthroughs in energy science and system design¹. However, while the trend is clear and momentum is growing, the hardware required for large-scale quantum computing is still immature. Software and hybrid solutions are advancing, and some use cases are already being tested, but the core infrastructure is not yet ready for widespread operational deployment. Significant technological progress is still needed before quantum computing can fully deliver on its potential.



Alongside digitalization, **robotics** continues to gain momentum as a strategic enabler of cross-sector automation, as evidenced by the high number of patents filed in 2024, including within the energy value chain. By streamlining operations, enhancing safety in hazardous environments, and enabling remote diagnostics and training, these tools contribute to a more efficient, reliable, and secure energy transition.

Finally, the energy sector is increasingly intersecting with one of the most innovative macrotrends worldwide, **the space economy**, which is shifting from exploration to infrastructure. The World Economic Forum forecasts the space economy to reach \$1.8 trillion by 2035, growing at an average of 9% per annum, well above the global GDP growth rate⁸. Space-based technologies, such as Earth

observation, navigation, and satellite communications, are unlocking new opportunities for predictive maintenance, climate monitoring, and grid resilience. Moreover, emerging concepts like micro-gravity manufacturing, **space-based solar power** and **data centers** and extraterrestrial resource harvesting, along with the rise of **space automation** powered by advanced collaborative robotics, autonomous in-orbit assembly, and remote operations, signal a bold expansion of energy innovation, extending its reach beyond Earth and opening new frontiers for new materials and products and new sustainable and resilient models. In fact, such developments not only push the boundaries of energy innovation but also foster cross-sector breakthroughs with potential benefits for terrestrial industries.



1. McKinsey & Company, Technology Trends Outlook 2025
2. International Energy Agency, The State of Energy Innovation 2025
3. Bloomberg NEF, New Energy Outlook 2025
4. International Energy Agency, World Energy Investment 2025
5. Bloomberg NEF, Electric Vehicle Outlook 2025
6. International Energy Agency, Global EV Outlook 2025
7. International Energy Agency, Energy & AI 2025
8. World Economic Forum "Space: The \$1.8 Trillion Opportunity for Global Economic Growth" 2024

An aerial photograph of a wind farm. Two large white wind turbines are visible, one in the foreground and one further back. They are situated in a vast, golden-brown field, likely a harvested crop field. The sky is a clear, vibrant blue with scattered white clouds. The overall scene is bright and open.

3

Innovation Areas
& Flagship Projects

Innovation at Enel is at the core of a continuous improvement journey, aimed at delivering increasingly efficient, sustainable, and customer-oriented services that support the achievement of our business targets. By applying emerging technologies and experimenting with new models across our operations, **we are shaping a more**

resilient, digital, and sustainable energy system. This section shares Enel's commitments in the entire value chain towards electrification, exploring the main opportunity areas and highlighting Enel's most innovative projects to meet the challenges of the new energy system.



GREEN, SECURE AND AFFORDABLE POWER GENERATION

Green, secure, and affordable energy generation is the foundation of a sustainable future. By harnessing renewable resources like solar, wind, hydro and geothermal we can reduce our carbon footprint while ensuring energy security and affordability. Innovations in technology and strategic policies are driving this transition, making clean energy more accessible and reliable than ever before. This shift not only combats climate change but also promotes economic growth and energy independence, paving the way for a

greener, more resilient world.

Innovation plays a key role in advancing sustainability, flexibility, and resilience of our green generation assets. Throughout the lifecycle of our plants, from construction to decommissioning, we apply advanced technologies and new operational models to enhance efficiency, safety, and adaptability to climate challenges, contributing to a more robust and accessible energy system.

Enel manages around **68 GW of renewable energy capacity worldwide**, making us one of the largest renewable energy operators. By 2040, we aim to achieve net-zero carbon emissions.

→ | WIND

Enel has a net installed wind capacity of about 20 GW worldwide and plans to add another 7 GW of onshore wind by 2028, representing the largest share of new renewable installations in our plan.

Technological evolution and innovation have been crucial in the development of wind energy, leading to current wind turbines.

However, various challenges must be addressed to make the development of wind technologies more profitable, reliable, and sustainable, including the effective integration of wind assets into local territories and communities:

- **Strengthening the quality of the supply:** the increasing demand for wind turbines can put pressure on the supply chain and the dependence on foreign suppliers for some raw materials and components can create vulnerabilities.
- **Improving construction efficiency:** given the ambitious wind capacity targets in the coming years, increasing construction efficiency of the entire process is essential to accelerate deployment, reduce costs, and minimize environmental impact.
- **Optimizing performances of existing assets:** increasing the potential of current assets to boost energy production and to extend projects lifetime is key for maximizing the return on investments and for guaranteeing a stable

and resilient contribution to the energy market.

- **Adopting end-of-life models:** wind turbine components typically last only 20–30 years. Recycling, especially composite blades, is difficult. Sustainable wind energy therefore requires effective end-of-life planning.

To meet these challenges, we leverage innovative solutions, starting with the use of new and reusable materials, reinforcing blades to minimize downtime, integrating AI tools to enhance operational efficiency, and applying additive manufacturing techniques to optimize construction and maintenance processes.

Interesting initiatives in the **wind turbine blade supply chain** focus on the **use of advanced materials** to improve efficiency, collaborating with startups and SMEs. At the same time, we are experimenting **blade reinforcement** solutions to increase plant reliability, reduce failures and extend maintenance intervals.





▲ Image 3.1

OM3GA – Enel's 3D printed concrete

In terms of **construction efficiency**, Enel is utilizing **Additive Manufacturing (AM)** to optimize construction of renewable energy infrastructures. Through the **OM3GA project**, in collaboration with industry partners and leveraging on the Italian Piano Nazionale Ripresa e Resilienza (PNRR) funds¹, we have 3D printed concrete substation structures achieving up to 50% reductions in time and material use, compared to traditional methods.

To enhance **wind plant performance**, Enel is deploying digital innovations across its global fleet. Two key initiatives regarding AI-based predictive models include a system developed with the **University of California Berkeley**, first tested in North America, to improve turbine bolt control and reduce downtime, and a model developed with the **Electric Power Research Institute (EPRI)** that predicts generator issues, successfully tested on our plants in Mexico. Both solutions are scaled globally across our wind fleet.

Another example is the adoption of an **AI-powered virtual assistant** in Spain, Brazil, and the US to support control room operations. Since 2024, it is streamlining complex tasks and improving decision-making.

Enel is also actively involved in regulatory and reuse working groups focused on **wind end-of-life sustainability**. A flagship initiative is **DeremCo**, an EU-funded project developing a cross-sector circular economy model for cost-effective reuse of wind turbine materials and components. Enel also received a European award for its role in the EU-funded **Blades2Build** project, thanks to a Proof of Concept carried out during the Aldeavieja repowering in Spain with **Holcim**, which demonstrated how wind turbine blades can be recycled into concrete-based construction products.

Finally, in spring 2025, Enel launched the **WinDesign challenge**, an international contest to improve the integration of wind turbines into the landscape while maintaining high standards of efficiency and respect for the environment and local communities. Concluding in January 2026, the competition, launched on the Open Innovability website, saw the submission of over 500 proposals from more than 60 countries, at a time of strong growth in wind energy globally.

1. Italy's PNRR, part of the EU's Next Generation EU initiative, aims to repair pandemic-related damage and strengthen long-term resilience. It mobilizes a total of approximately €248 billion, including €191.5 billion from the EU's Recovery and Resilience Facility and additional national funds, between 2021 and 2026, with a strong focus on resilience through energy transition, grid modernization, and renewable development, key pillars to ensure sustainability and energy security.

→ | SOLAR

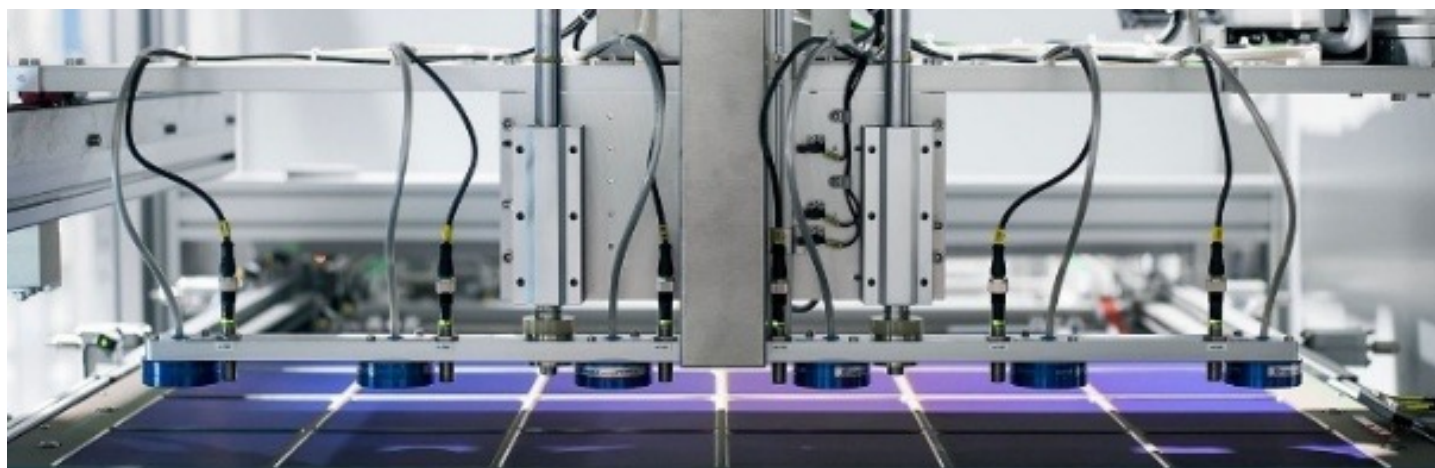
Enel reached a net installed solar capacity of over 15 GW, with an additional 3.8 GW planned for 2028.

Solar energy is a cornerstone of the renewable energy landscape, offering a clean and abundant power source. However, the sector faces several significant challenges:

- **Cell efficiency & materials:** improving solar cell efficiency (currently 15–21%) is a major focus, with promising research into perovskite² materials. On the other hand, circularity is crucial due to reliance on critical materials like silicon and silver.
- **Enhancing resilience to climate events:** solar installations are vulnerable to extreme weather events such as

hailstorms, which can cause significant damage. Evolving the current logic of control and positioning of panels is essential for resilience and performance optimization.

- **Boosting automation in the assembly and operations:** innovations in automation are transforming the assembly of solar panels and its operations. Automated and collaborative systems, including innovative solar trackers and robot installers, are making the installation process safer, faster and more efficient.



↑ Image 3.2
Enel's 3SUN Gigafactory

We know that addressing these challenges is crucial for the sustainable growth and widespread adoption of solar energy, that's why we continue working in these directions, monitoring, testing and scaling new solutions.

Regarding **cell efficiency** and **materials**, we play a key role in both the European and worldwide supply chain with our 3SUN Gigafactory. At 3SUN we combine research and innovation to produce new-generation PV modules, achieving a production capacity of 3 GW per year of

heterojunction technology (HJT) modules based on frontier technology called **CORE-H**. Thanks to our team, 3SUN tandem perovskite-over-silicon solar cells achieved efficiency records of 30.8% in January 2025. Additionally, we are completing an exciting EU project, **Photorama**, focused on recycling secondary materials like glass and silicon from photovoltaic systems. As we look to the future, these secondary raw materials will become increasingly crucial.

2. Semiconductor material with a specific crystalline structure, used in emerging technologies for the production of solar cells, LEDs, and sensors due to its high energy efficiency

To reduce **damage from extreme weather**, Enel is adopting a **nowcasting system** in Italy that alerts operators in case of extreme events, like hailstorms, allowing solar panels to be repositioned into their safest configuration. In parallel, **acoustic** and **optical sensors** are also being installed at six Enel PV plants to detect severe weather in real time, integrating with the nowcasting system to help minimize damage to solar panels and early adopt countermeasures. These solutions are being expanded to Spain and the US, focusing on high-risk areas.

In terms of **automating our assembly and overall**

operations, we are investigating the latest innovations in solar technology, such as fully robotized tracker assembly solutions. While promising, these systems are currently viable only for large plants and specific geographies, due to high costs and complexity.

In response, we have developed **Flamingo**, a patented robotic platform that shifts the assembly approach from on-site to centralized pre-assembly. Currently in use in Italy and Spain, Flamingo enhances safety, speed, and logistics, setting a new standard for solar construction.



▲ Image 3.3
Enel's Flamingo robot



▲ Immagine 3.4
Drone's inspection on PV plant

Moreover, in our solar farms, we continuously adopt advanced and sustainable **collaborative robotic** solutions for inspections and operations, significantly reducing maintenance costs and risks while improving asset

health data. For instance, we are testing **eco-friendly robotic systems** for operations and **drones** and **rovers** for inspections, enhancing operators' safety and process efficiency.

➔ | STORAGE

With a current **storage capacity of 3.4 GW**, we are committed to expanding our storage portfolio by 4.3 GW in the plan 26-28, including new battery chemicals and technologies for Long Duration Energy Storage (LoDES).

ENEL'S CATANIA INNOVATION LAB

Given the importance of storage for the energy transition and the stability of the electrical system, we have established a **laboratory in Italy dedicated to innovative energy storage solutions**. This Lab plays a strategic role by allowing us to effectively test alternative lithium storage for business with realistic results, reducing the technological risk associated with adopting new products and/or technologies directly on a large scale. The lab is equipped with a complex and flexible infrastructure with a hosting capacity of up to 2 MW, capable of conducting **performance tests** on lithium batteries and those based on other chemistries, at the battery, module, and cell level. The lab can perform tests on various battery functionalities and integrated systems, ranging from a few kW to several hundred kW. Additionally, the lab can **simulate participation in network services**, focusing on storage coupled with renewable sources, or as stand-alone systems, and replicate the functionalities of commercial and industrial microgrids, both on-grid and off-grid.

The future of energy storage depends on rapid scaling, especially in grid-scale batteries, to support renewable integration and ensure grid stability. With costs dropping significantly (over sixfold in the past decade) and performance steadily improving, innovative trends are now tackling diverse challenges within the storage ecosystem:

- **Advancing lithium technologies:** ongoing improvements in energy density, safety, and life cycle are making lithium batteries more efficient and reliable for large-scale applications.
- **Developing alternative chemistries:** emerging technologies like sodium-ion batteries could offer

sustainable, long-duration solutions and reduce reliance on critical raw materials.

- **Enhancing operations through AI-powered diagnostic systems:** intelligent monitoring systems powered by AI enhance performance, predict failures, and extend battery lifespan, supporting safer and more efficient operations.
- **Promoting circular models:** recycling and second-life battery applications improve resource efficiency and reduce environmental impact, supporting a more sustainable storage ecosystem.



▲ Image 3.5
Storage testing facility at the Enel Catania Innovation Lab

Enel is driving energy storage innovation with a technology-neutral approach.

At the Enel Catania Innovation Lab, we test the **latest lithium-ion batteries** and **alternative chemistries** like **sodium-ion** (via the EU-funded **EPISODE** project).

In addition, we have commenced the initial operational phase of a new **flow battery system** in Mallorca, Spain. This is the largest hybridized redox flow battery (non-lithium) integrated with a photovoltaic plant in Europe, boasting a power output of 1.1 MW and a storage capacity of 5.5 MWh.

These new chemistries are also under study as **long-duration energy storage systems (LoDES)**, aiming to extend renewable energy use beyond 8 hours. Among these systems, we are also exploring electromechanical technologies, like compressed gas, or pumped hydro, which can offer long-duration energy balancing without relying on critical raw materials.

Besides specific storage technology, we have completed the successful validation of an **advanced monitoring**

and diagnostic system for lithium batteries. This system improves the overall performance and availability of storage and potentially extends the useful life of our assets. The goal is to roll it out across Enel's entire renewable fleet to enable smarter and more efficient operations.

Enel is also committed to making energy storage more sustainable and circular. In Spain, with the **Second Life project in Melilla**, we have pioneered the reuse of electric vehicle batteries to create large stationary storage systems. This model was scaled up in Italy with **the ADR Pioneer project** at Rome Fiumicino Airport, where second-life batteries now support peak energy demand and grid services. The system stores up to 10 MWh of green energy, reducing emissions (*approx. 16,000 tons of CO₂ over ten years*) and improving battery supply chain sustainability.

These initiatives mark a key step toward validating innovative, low-impact energy storage solutions for renewable integration and grid stability.



▲ Image 3.6
Enel's Pioneer BESS site in Rome

→ | HYDRO

For Enel, in line with the global trend, hydropower is one of the main sources of electricity generation. With over **28 GW of Hydro capacity** under management, it alone accounts for more than 30% of the Group's installed capacity, and nearly half of all renewable power.

Hydropower is a well-established renewable power technology with almost 150 years of history. However, innovation in this field has never stopped and is currently focused on addressing the sector's main challenges:

- **Maximizing the use of hydro resources** to generate more gigawatts (GW), including the usage of mini-hydro or hybridization.
- **Providing plant flexibility** and applying new forecasting algorithms to improve **hydro plant efficiency** and **offering new services**.

Building on this foundation, we are directing our efforts to **maximize the use of hydro resources**, providing additional flexibility and investing in the **mini hydro** sector, which includes small-scale hydropower below 3 MW capacity. This sector is now part of our strategic plan and it is integrated into our *Innovation by Vendors* program to scout market-ready solutions.

To further enhance the **flexibility** of our hydro plants, an additional innovative approach is to integrate these plants with other types of renewable technologies **to increase the overall production** of the site as well as give it more flexibility. Here are a couple of examples showcasing our position in the **hybridization** stream:

- **BESS4Hydro**, recognized as a top EU innovation, marks Europe's first integration of a battery with a dispatchable reservoir hydropower plant. Located at the Dossi plant in Lombardy, Italy, the battery functions as a virtual reservoir, storing and releasing energy to enhance grid stability and enable a more flexible, sustainable energy system. This groundbreaking project has been awarded the EU STEP seal (Strategic Technologies for Europe Platform), underscoring its strategic importance for Europe's energy transition.

- **Venaus Photovoltaics and Hydropower Plant in Italy:** this project features a 2 MW floating photovoltaic plant on the surface of the hydropower plant reservoir, combining solar and hydro power to enhance energy production. The Venaus Hydropower Plant is a full-scale, living innovation site, thanks to the integration of a continuous desedimentation system powered by the floating PV plant. This setup enables the naturalization of the sediment cycle, improving sustainability and operational efficiency.



▲ Image 3.7

Enel's Hydro and PV floating plant in Venaus, Italy

To improve hydro plant **efficiency and production optimization**, Enel is implementing **satellite-based monitoring in collaboration with ESA**. By estimating snow water content and snow depth, we can better plan water usage and energy production, optimizing operations and market impact.

Moreover, we are exploring cutting-edge technologies, including artificial intelligence (AI), machine learning (ML), and deep learning, to improve **weather forecasting models**, which play a critical role in anticipating market dynamics,

strengthening Group resilience, optimizing generation portfolio and trading activities.

Looking ahead, Enel's innovation and investment activities in hydropower are expected to grow significantly. The gradual normalization of the regulatory framework is paving the way for new opportunities and Enel is well-positioned to further expand its innovative initiatives and capitalize on emerging prospects in the sector.

➔ | GEOTHERMAL

A global pioneer in geothermal energy, Enel operates one of the world's largest geothermal fleets, with an installed capacity of around 860 MW, primarily in Italy (Larderello) and Latin America.

Clean, renewable geothermal energy has a long history in Italy. The technology itself has been developed over the last 110 years in Italy. Larderello, in Tuscany, was the pioneering center of geothermal development, with its first industrial use in 1818 and in 1913, the world's first geothermal power plant.

Geothermal energy harnesses heat from beneath the Earth's surface to produce electricity and heating in a clean, renewable way. It offers a constant and reliable source but tapping into it efficiently and sustainably presents key challenges.

The main obstacles the sector faces are:

- The **high costs** and **technical complexity** of deep drilling.
- The need to **reduce environmental impacts**, preserving the **long-term sustainability of** geothermal **resources**, while maintaining high performance.

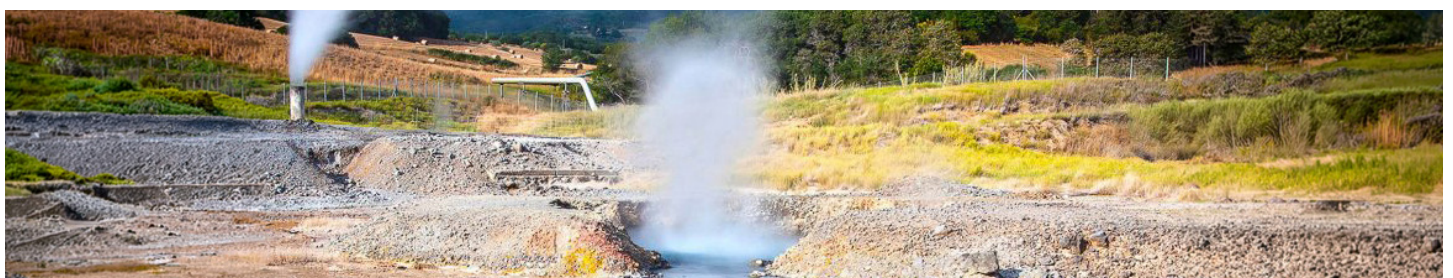
To tackle these, we are investing in advanced drilling technologies, like laser and plasma, to access deeper geothermal resources more efficiently and with lower environmental impact. In this context, through the European **DESCRAMBLE** research project, we have pushed

beyond current drilling limits reaching **supercritical temperature** conditions, representing a major milestone in deep geothermal exploration. In parallel, we are **digitalizing steam distribution networks** to improve monitoring and operational efficiency, while continuously tracking and assessing the development of **new technologies** aimed at **minimizing material erosion** in drilling equipment.

We are testing those approaches through projects in the **Valle Secolo** geothermal power plant in Larderello, where we are implementing **cutting-edge monitoring systems** and **sustainable resource management practices**.

Complementing these efforts, **Additive Manufacturing** also plays an important role in this field by enabling the repair of metal components, extending their lifecycle and reducing waste. We are currently testing this methodology with suppliers to integrate it into routine maintenance operations.

These commitments aim to make geothermal energy more efficient, reliable, and central to the clean energy transition leveraging Enel's pioneering experience in this sector.



▲ Image 3.8
Geothermal wells in Larderello, Italy

➔ | NEW NUCLEAR

Nuclear energy is re-emerging as a strategic pillar in the global energy transition, offering a reliable, low-carbon, and dispatchable source of electricity. However, its development faces several key challenges:

- **Accelerating the adoption of innovative nuclear solutions integrated with renewables**, while ensuring safety and public acceptance.
- **Improving performance and resiliency** of next-generation nuclear technologies.
- **Exploring new applications**, including fusion and space-based energy systems.

To address these challenges, Enel is taking a strategic, phased approach across short-, medium-, and long-term horizons, positioning nuclear as a key enabler of energy resilience and decarbonization. Enel founded **Nuclitalia**, a joint venture with Ansaldo and Leonardo, to assess water-cooled **Small Modular Reactors (SMRs)**, with the goal supporting the reintroduction of nuclear energy in Italy.

The company is also conducting scenario analyses to explore how nuclear and renewable energy sources can be

integrated to enhance grid stability and flexibility.

At the same time, Enel is actively participating in international associations focused on both fission and fusion technologies, aiming to rebuild and strengthen its internal expertise.

In the mid-term, Enel is screening a range of **Advanced Modular Reactor (AMR)** technologies. These next-generation systems promise improvements in safety, efficiency, and sustainability, and are being assessed for their potential role in future energy systems.

In the long-term, beyond 2050, Enel is monitoring **nuclear fusion**, collaborating with strategic global partners to unlock long-term potential. The Group is also involved as a stakeholder, in **pioneering space-related projects**, such as the **Selene Project**, a strategic national initiative focused on designing compact nuclear fission systems capable of delivering continuous, high-reliability power for future lunar habitats.

This roadmap reflects Enel's proactive role in shaping a resilient and innovative energy system, where nuclear power is one of the pillars supporting the global decarbonization effort.



SMART, DIGITAL AND RESILIENT POWER DISTRIBUTION GRIDS

The rapid growth of distributed renewables, rising electrification of final consumption, and the increasingly active role of consumers are placing unprecedented demands on power distribution networks. **These grids are now central to enabling the energy transition and supporting economic activity in advanced societies.**

To meet evolving needs and withstand more frequent extreme weather events, operators must invest in modernizing and digitalizing infrastructure, integrating distributed energy resources, facilitating widespread electrification, enabling innovative prosumer activities, and enhancing grid resilience to ensure reliable electricity

service. The EU is expected to double annual investments in distribution networks up to €65 billion by 2050³. Enel is leading this transformation with approximately €26 billion in investments between 2026 and 2028, embedding advanced digital technologies and new systems and components to improve reliability and service quality, reduce system costs, and enhance safety.

Overall, this transformation will allow the grid to evolve from a passive infrastructure into an intelligent, adaptive platform, capable of delivering clean, secure, and resilient energy for all.

Enel manages **1.9 million kilometers of electrical grid** and serves over **69 million end users** worldwide. Our 2026 - 2028 Strategic Plan calls for a gross investment in grids of about **€26 billion**.



3. "The role of electricity distribution for a safe energy transition", Ambrosetti, 2024

➔ | DIGITALIZATION: SMART GRID & AUTOMATION

Enel leads the digitalization of electrical infrastructures, with **more than 45 million end users with active Smart Meters.**

As energy systems become increasingly decentralized and complex, the digitalization of the grid is fundamental. By unlocking vast amounts of real-time data, digital grids enable more precise monitoring, predictive analytics, and, crucially, remote and instant interventions in response to specific needs.

In this evolving landscape, two strategic priorities are taking shape:

- **Enhancing grid observability, control and flexibility through advanced energy management systems.**
- **Accelerating automation by leveraging digitalization and edge computing technologies.**

To enhance grid observability, control and flexibility, Enel is relying on innovative **Advanced Distribution Management Systems (ADMS) and Distributed Energy Resource Management Systems (DERMS)**, which enable real-time monitoring and optimization of energy flows across increasingly decentralized networks. These systems are essential for maintaining stability and efficiency as

renewable penetration grows. Enel is proposing a new innovative architecture paradigm to allow continuous and effective updates of these systems to meet the challenges of an evolving grid, in line with the IEC framework (International Electrotechnical Commission). New use cases can thus emerge such as grid assistance driven by AI or significant boost to predictive maintenance.

Moreover, these digital tools are key enablers for **flexibility markets** which we are testing with different projects in Europe (**Edge** in Italy) and South America (**Enelflex** in Colombia).

In terms of **automation**, a keystone of Enel's digitalization strategy is the **edge computing solution** that virtualizes functionalities of secondary substations boosting monitoring capabilities, data acquisition and processing on the edge to enable smart metering, real time diagnostics, remote control and software-based upgrades. It enhances grid responsiveness and reliability while reducing operational costs.



▲ Image 3.9
Enel's control room in Italy

Building on the secondary substation digitalization, Enel is also accelerating the **automation of the low-voltage (LV) network** through the integration of advanced electronic switching devices and digital control functionalities. As the number of prosumers and distributed energy resources continues to grow, the ability to remotely monitor, control, and optimize LV operations becomes fundamental to ensuring grid stability and service continuity in a decentralized energy landscape.

Additionally, Enel is pioneering the deployment of **Fully Digitalized Primary Substations**, integrating also innovative

protection and control systems with traditional power components. By replacing copper wiring with fiber optics and introducing **Merging Units** that convert analog signals into digital, Enel is centralizing and virtualizing protection functions. The first deployments are planned in Brazil and Spain, with full commissioning expected by late 2026.

Through these initiatives, Enel is not only modernizing its infrastructure but also setting a new standard for smart grid innovation, ensuring that its networks are ready to meet the demands of a fully electrified and decarbonized future.

➔ | INCREASING RESILIENCY AND EFFICIENCY WITH NEW TOOLS FOR O&M

Enel operates one of the largest and most complex electricity distribution networks globally, supported by a **dedicated workforce of approximately 35,000 employees** and driven by a strong commitment to operational resilience and maintenance efficiency.

With climate-related disruptions on the rise and energy systems becoming increasingly complex, enhancing grid resilience and optimizing operations & maintenance (O&M) have become strategic priorities.

This involves two key challenges:

- **Strengthening operational and planning resilience:** utilities must improve their ability to anticipate, withstand, and recover from disruptions. Technological innovation is a key enabler to accelerate and facilitate

the adaptation of power grids to the effects of climate change, strengthening their resilience and ability to respond to the impacts of extreme events.

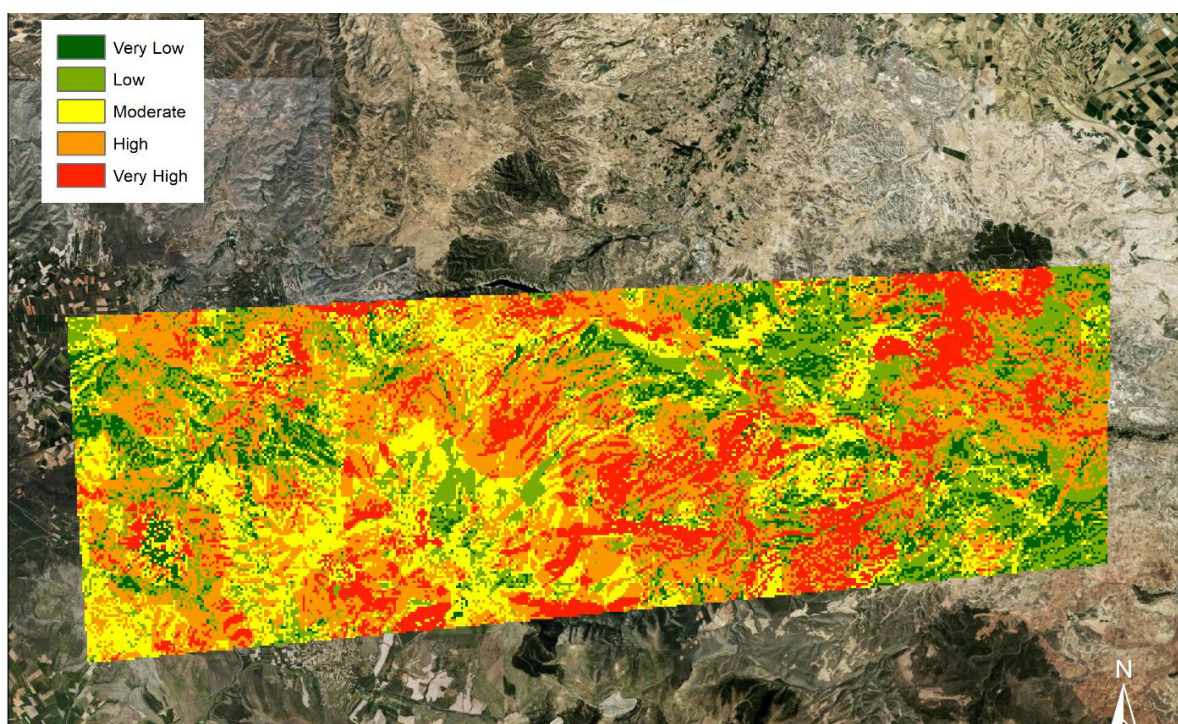
- **Progressing inspection & maintenance efficiency:** accelerating the speed, accuracy, and safety of inspections and maintenance activities is essential to reduce downtime and ensure reliable service across increasingly complex networks.



Enel is leveraging a broad set of advanced technologies to boost grid resilience and responsiveness. These include **innovative devices**, **automation tech** and **AI-powered algorithms** for predictive diagnostics and emergency management.

Predictive and **planning capabilities** are being enhanced by the development of solutions for rapid fault restoration and predictive maintenance. Integrating advanced monitoring systems, including **Phasor Measurement Units (PMUs)** for medium voltage and precise measuring instruments for low voltage, together with sophisticated **analysis algorithms**, transform the estimation of the network’s operational status and the accuracy of fault location. These capabilities, supported by **AI agents** assisting control center operators, preserve service quality and enable quick power restoration for customers and faster fault location for field operators.

Another area gaining increasing relevance within our business is the use of **Space Tech for operational planning and risk mitigation**. Building upon the digital and physical upgrades already underway, Enel is using satellite imagery for **predictive maintenance, vegetation control, and infrastructure monitoring**. Digital tools **to assess the risk level of vegetation in relation to power lines are being tested**, leveraging AI models that integrate multiple parameters (including tree health, growth forecasts, proximity to infrastructure, and environmental conditions) to anticipate potential threats to medium-voltage lines and plan targeted intervention actions. Additionally, Enel is exploring **AI-based super-resolution** of free multispectral satellite images. In collaboration with **EUSPA**, satellite-based risk mapping is being incorporated into planning processes, with a focus on flood and wildfire exposure, supporting strategic decisions for grid development and maintenance.



▲ Image 3.10
Satellite Risk Mapping

Enel is also adopting **Low Earth Orbit (LEO)** satellite communication systems to enhance connectivity in remote areas. These technologies ensure reliable communication for field teams and enable remote monitoring and automation of substations in remote areas or during emergencies, reinforcing grid resilience and operational efficiency.

At the same time, Enel is transforming field operations

through **robotics** and **advanced inspection technologies**. Robotic solutions, developed to improve safety during maintenance and operation tasks at height on the electrical grid, are currently under test. They are remotely controlled by operators and can operate under both de-energized and live voltage conditions. These platforms eliminate risks such as falls and electrocutions while enhancing efficiency and service quality.

Further enhancing diagnostic capabilities, **ultrasonic thermal cameras** are being deployed to detect faults and anomalies in electrical components at an early stage. This innovative approach significantly improves operational efficiency by enabling faster issue identification and resolution, reducing system downtime, and optimizing maintenance schedules.

Together, these innovations are redefining how Enel manages its infrastructure, shifting from reactive maintenance to a predictive, data-driven model that ensures greater reliability, efficiency, and resilience across the grid.



▲ Image 3.11

Enel's robotic test at height

➔ | NETWORK EMPOWERMENT FOR AFFORDABLE HIGH QUALITY SERVICES

Enel is managing **over 500,000 electrical substations worldwide**, supporting a resilient and increasing digital power grid infrastructure that **transported 475 TWh in 2025**.

Empowering the electricity network is essential to ensure that public services remain reliable, accessible, and cost-effective in an increasingly electrified world. As global urbanization accelerates and energy demand grows, modernizing grid infrastructure is key to delivering high-quality service while supporting sustainability and social inclusion. The main challenges utilities are facing include:

- **Improving power quality control:** as electricity production becomes more distributed and demand is rising, maintaining voltage stability and minimizing disturbances across the grid is increasingly complex, especially at the local level.
- **Enhancing energy distribution efficiency:** traditional infrastructure often struggles to keep up with a rising number of loads while containing technical energy losses, requiring smarter, more efficient solutions to deliver electricity reliably and cost-effectively.
- **Catalyzing integration in urban areas:** in dense city environments, integrating energy infrastructure

without disrupting public spaces or aesthetics demands compact, modular, and flexible solutions.

Enel is meeting the challenge of **power quality control** by introducing a new generation of intelligent grid components designed to ensure voltage stability and enhance system reliability. Among these we are adopting in our substations **solid-state transformers**, which allow for dynamic voltage regulation. One notable example is the installation in 2025 of the first hybrid transformer at Mesagne in Italy, delivering real-time voltage regulation and active load balancing.

Along distribution lines, we are deploying **Low Voltage (LV) Line Managers**, which are three-phase solid-state devices that dynamically regulate voltage on individual LV lines and independently balance power flows across phases. It is specifically designed to tackle issues such as line congestion and voltage deviations.

In parallel, to enhance **energy distribution efficiency**, Enel is investing in **advanced conductor technologies** that optimize performance while minimizing losses. Tests are performed using advanced conductors that offer aluminum encapsulated carbon core (AECC) technology. This enables existing lines to be repowered, increasing ampacity and reducing the need for civil works.

Finally, when it comes to catalyzing **integration in urban areas**, Enel is reimagining how infrastructure fits into the modern cityscape. Compact and modular solutions like the **Enel Street Box**, recognized with the prestigious ADI

award, promoted by the Italian Association for Industrial Design, along with **redesigned secondary substations**, are being developed to minimize spatial and visual impact. Furthermore, these assets also support the installation of advanced components that enable the digitalization, automation, and smart management of the low-voltage (LV) network.

These innovations allow for seamless integration of energy infrastructure into dense urban environments, supporting the electrification of cities while preserving public space and aesthetics.



▲ Image 3.12
Enel's innovative street box



▲ Image 3.13
Enel's new secondary substation

ELECTRIFICATION OF CONSUMPTION AND CUSTOMER CENTRICITY

As the global energy landscape undergoes a profound transformation, two powerful trends are emerging at the forefront: **the electrification of end uses** and the growing demand for **customer centric solutions**. These shifts are not only accelerating the transition to a decarbonized

future but are also redefining the role of energy utilities. Enel is positioned to lead this evolution by enabling electrification across sectors, reimagining the customer journey through digital innovation, and addressing key challenges and opportunities in this new energy ecosystem.

In 2025, Enel sold approximately 250 TWh of electricity in the global retail market, an amount equivalent to the annual consumption of over 90 million households⁴.

4. Calculation based on a household average energy consumption of 2,700 kWh per year, according to ARERA's standard for analyzing household consumption in Italy.

→ | ELECTRIFICATION AND NEW PRODUCTS OFFER

Enel is managing **10 GW of aggregated Demand Response capacity** to support decarbonization while facilitating EV penetration by operating **over 33,000 public charging stations**.

The global momentum toward decarbonization and electrification is reshaping energy systems, but significant challenges in electrifying specific applications or adopting clean energy solutions remain:

- **Decarbonizing hard-to-abate sectors:** industrial processes that rely heavily on fossil fuels remain among the most difficult to decarbonize. These sectors require high-temperature heat and continuous energy supply, which are not easily replaced by conventional renewables.
- **Democratizing access to renewables and energy production:** many consumers still face barriers to participating in the energy transition, whether due to infrastructure limitations, regulatory complexity, or scarcity of tailored solutions for self-consumption and community energy.
- **Enabling electric mobility at scale:** the rapid growth of electric vehicles (EVs) demands new infrastructure and services to ensure grid stability, optimize charging, and unlock the full potential of EVs as flexible energy assets.
- **Modernizing urban infrastructure to enable smart and sustainable cities:** many urban areas still rely on outdated public lighting systems that are energy-inefficient and

lack digital capabilities for intelligent management, predictive maintenance, and enhanced public safety.

Enel is tackling these challenges through a portfolio of technologies and services that accelerate electrification, support renewable self-consumption, and enable a more flexible, customer-centric energy ecosystem.

A key strategic initiative developed with **Magaldi** focuses on **electrifying hard-to-abate sectors** using **power to heat** and **thermal energy storage**. The first installation took place in 2025 at the Buccino plant, near Salerno, Italy. It stores renewable energy as medium-temperature heat (about 400–600°C), making it available for industrial processes with significant thermal requirements. With a capacity of 7.5 MWh, the system helps reduce natural gas consumption, increase grid flexibility, and cut over 500 tons of CO₂ emissions per year. More broadly, this solution supports emissions reduction and boosts competitiveness in sectors that are traditionally difficult to decarbonize.



▲ Image 3.14

Enel's thermal storage project with Magaldi



▲ Image 3.15
Enel's ebitts interface

Another innovative project is **ebitts**, launched in Italy **to make the energy transition more inclusive**. This solution developed by Enel, using a digital token, allows individuals to participate in renewable energy production without installing physical systems, creating a new, flexible business model that turns users into virtual prosumers. ebitts also promotes conscious energy use, benefiting the entire grid and enhancing public acceptance of renewables. By combining blockchain technology with a people-centered approach, Enel is making the energy transition more

accessible.

Enel is also **democratizing access to renewables** through **Renewable Energy Communities (RECs)**, empowering citizens, businesses, and municipalities to co-produce and share clean energy locally. Acting as a service provider, Enel supports REC creation with turnkey solutions and dedicated offers. With 14 active communities and 55 more in progress, this model fosters economic, environmental, and social impact, turning energy into a shared, participatory resource.



▲ Image 3.16
Enel's energy community in Italy

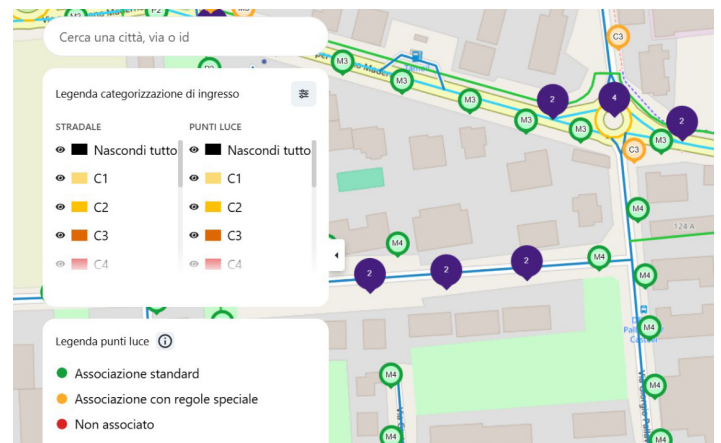
In the field of **electric mobility**, Enel is deploying a comprehensive suite of services to support the widespread adoption of electric vehicles. These include **Vehicle-to-Grid (V2G)** technologies that allow EVs to return energy to the grid, and **smart EV parking solutions** integrated with urban infrastructure. On the supply side, Enel has developed and launched the **SplitCharge** offer, which makes it possible to distinguish the consumption associated with EV charging from all other household uses, and consequently enables tailored energy offers for EV recharging.

In the context of the energy transition and **urban digitalization**, Enel is redefining how **public lighting systems** are **designed, managed** and **maintained**. By integrating advanced technologies such as artificial intelligence, machine learning, computer vision, and predictive modeling, Enel has transformed every phase

of the project lifecycle, from initial asset mapping to design, maintenance, and operations. This transformation pursues a dual objective: to enhance the efficiency and speed of processes, while ensuring increasingly higher standards of safety, sustainability, and service quality. Many of the developed solutions are patented and now serve as benchmarks for intelligent and adaptive public lighting systems. For instance, asset mapping now uses satellite imagery and machine learning to identify lighting points remotely, speeding up project initiation. Design is automated via a patented tool that classifies roads and assesses risks using open data, ensuring faster and more accurate planning. Maintenance relies on a Bayesian model to predict failures and prioritize interventions based on environmental impact. Operations feature adaptive lighting with real-time traffic and weather analysis, enabling dynamic light regulation and energy savings up to 35%.



▲ Image 3.17
Enel's EV charging point



▲ Image 3.18
Enel's Public Lighting Services Portal

➔ | CUSTOMER JOURNEY

Enel manages over **54 million retail customers** across all the geographies of presence in the retail energy market.

As energy systems become more decentralized and digital, customer expectations are evolving rapidly. Today's energy consumers, whether households or businesses, demand personalized, seamless, and responsive experiences across all touchpoints.

- **Tailoring the customer journey:** one of the main challenges is delivering highly personalized experiences to a diverse customer base. Traditional one-size-fits-all approaches are no longer sufficient,

especially as customers seek greater control over their energy usage, costs, and sustainability impact.

- **Enhancing client support:** as the complexity of services increases, so does the need for efficient, intuitive, and proactive customer support. Reducing friction in interactions, resolving issues quickly, and anticipating customer needs are essential to building trust and loyalty.

Meeting these expectations requires a transformation of the customer journey, powered by data, artificial intelligence, and a deep understanding of individual needs. To address these challenges, Enel is leveraging digital innovation and AI to redesign customer experience.

For B2C customers, Enel has launched **Enel Lumiè**, a digital platform that personalizes the customer journey by offering tailored energy solutions, intuitive interfaces, and proactive engagement. For B2B clients, the **SME Simulator** enables small and medium enterprises to model their energy consumption and identify optimal solutions, supporting smarter and more sustainable business decisions.

On the support side, Enel is driving its customer-centric transformation through AI-powered initiatives, notably leveraging generative AI to interpret customer issues and needs on the retail side. This enables both proactive and reactive actions tailored to prevent claims, while also maximizing opportunities for up-selling and cross-selling. Moreover, such approach enhances service personalization and improves satisfaction. Enel is also implementing, on the distribution clients, an innovative approach using a multi-agent orchestrator based on standard protocols to optimize the claims process, to improve first contact resolution and enhance customer satisfaction.



Scopri con Enel Lumiè, in pochi minuti, come migliorare l'efficienza energetica della tua casa e risparmiare sui consumi!





Cosa tenere a portata di mano per la tua simulazione

Per calcolare quanto potresti **ridurre i tuoi consumi**, avremo bisogno di alcune informazioni sulla tua casa e sulle **spese attuali di luce e gas**. Ti consigliamo di tenere **l'ultima bolletta** a portata di mano.



Aiutaci ad elaborare la tua simulazione

Rispondi a **quante più domande possibile**. Troverai alcuni dati già **precompilati** per rendere il tutto più veloce, ma se necessario **puoi modificarli**.



Cosa otterrai con questa simulazione?

Riceverai una **stima** del possibile risparmio sui tuoi consumi, calcolata attraverso un modello di calcolo validato da Bureau Veritas secondo i principi identificati nella "UNI EN ISO 14064:2019 Gas a effetto serra".

Ti forniremo **consigli** su come ottimizzare la tua casa per **ridurre il consumo di energia e abbassare le spese in bolletta**.

CERTIFIED
ISO 14064-2




Metodologia di calcolo delle riduzioni delle emissioni di GHG validate secondo i principi della ISO 14064-2 - Opzione di Validazione IT338488 del 17/12/2024

← Image 3.19

Enel's Lumiè energy efficiency configurator, available in Italy

SUSTAINABILITY AND SAFETY ACROSS THE ENERGY VALUE CHAIN

Enel places sustainability and safety at the core of its innovation strategy, with a strong focus on protecting biodiversity and preserving ecosystems. The Group adopts internationally aligned principles to minimize environmental impact and ensure long-term ecological resilience.

Safety is embedded across all operations, supported by a culture of prevention and continuous improvement. Through innovation and collaboration, Enel develops solutions that safeguard both people, biodiversity and the environment.



➔ | SUSTAINABILITY AND NATURE-BASED SOLUTIONS

Enel has implemented over **240 projects⁵** dedicated to protecting species and preserving natural habitats across its operating plants and construction sites.

The growing global focus on environmental protection and biodiversity is pushing energy utilities to rethink their territorial footprint. Enel is facing these challenges through

an integrated approach that combines technological innovation, stakeholder engagement, and nature-based solutions.

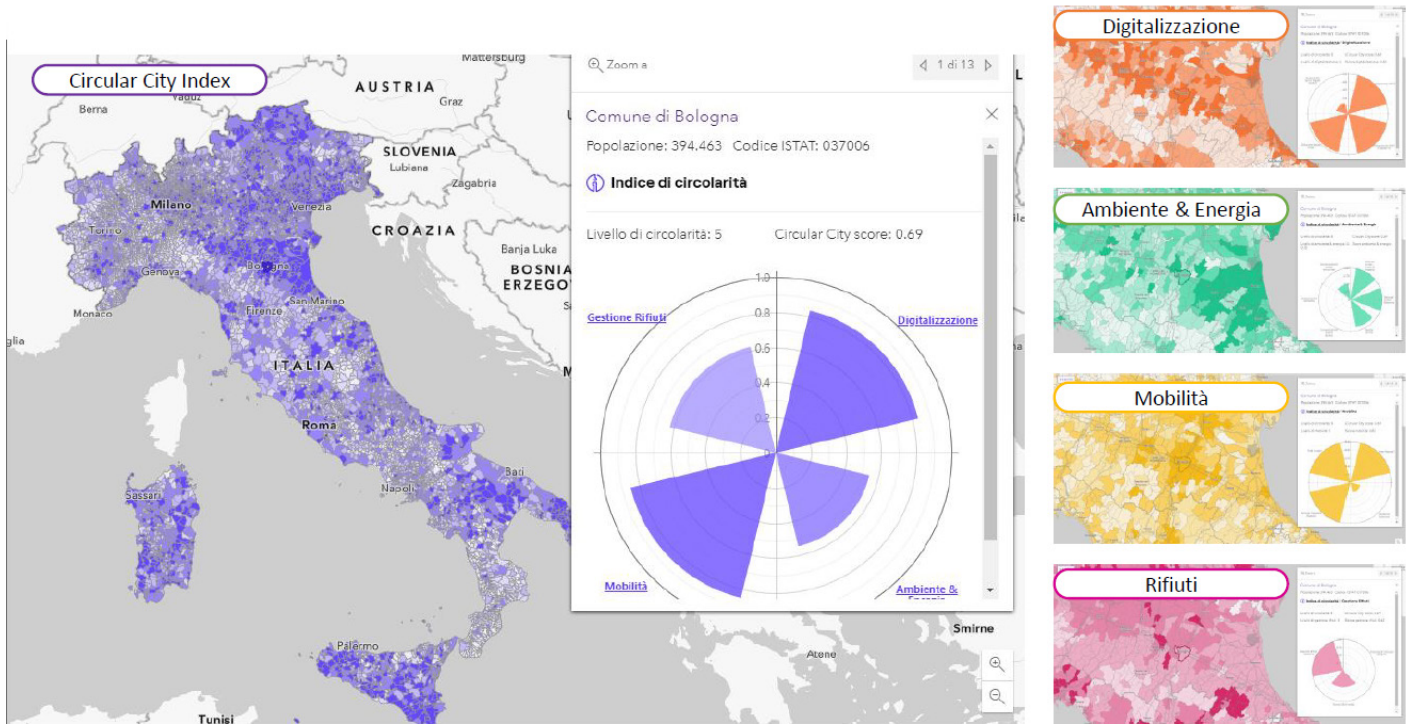
⁵ Data from Enel's Annual Integrated Report 2024

The goal is to reduce the ecological impact of infrastructure, safeguard ecosystems, and contribute to urban resilience, promoting sustainable and inclusive energy models.

- **Protecting biodiversity along energy assets:** Enel has launched the **WEBB** project, which uses radar and AI-based detection systems to monitor bird flight paths near wind farms and activate deterrent mechanisms to prevent collisions. In parallel, we are testing self-powered IoT sensors along power lines to detect the presence of sensitive species, supporting environmental management plans and habitat conservation.
- **Reducing landscape impact:** through the **WinDesign Challenge** initiative, Enel is optimizing the design and layout of wind turbines to better integrate them into the landscape. This includes visual impact assessments and community engagement to enhance social acceptance

and minimize disruption to natural views.

- **Smart and sustainable city services:** Enel is developing a comprehensive suite of digital tools and innovative solutions to support cities in their journey toward sustainability and efficiency. Among these, **The Open Data Program 4 Smart & Sustainable Cities** helps public administrations assess and accelerate their sustainable urban transition. It uses only open data sources to generate scientifically validated indexes, which are visualized through a multiservice city dashboard named YoUrban Portal. The program includes three main indexes: **Circular City**, **15 Minute City**, and **CO₂ City**, each updated annually. These tools support strategic planning, decarbonization, and urban design, and are already used by over 2,100 municipalities.



▲ Image 3.20

Enel's YoUrban portal for smart cities monitoring (Environment&Energy, Mobility, etc.) available in Italy

➔ | SAFETY AND OPERATIONAL EXCELLENCE

During 2024, a total of approximately **1,600,000 hours of training** on health and safety topics was provided to Enel people (up 10% from 2023)⁶.

Workplace safety is a central pillar of Enel's strategy, aimed at ensuring protected and resilient environments for employees and partners. In the context of increasing operational complexity and digital transformation, Enel invests in solutions that combine automation, artificial intelligence, and smart devices to prevent accidents, reduce exposure to risk, and foster a shared safety culture.

On one hand, the integration of **artificial intelligence** and **robotics** is actively being pursued to monitor field activities and minimize human exposure to hazardous environments, thereby **enhancing intrinsic safety** across operations. Enel is testing **innovative solutions for vegetation management** along power lines, aiming to eliminate the need for operators to work at height. The Group is also exploring the use of **AI-powered intelligent assistants** to support workers by recommending best practices and ensuring adherence to safety protocols. AI plays a pivotal role in field operations by monitoring task execution for accuracy and completeness. By detecting potential omissions or procedural deviations, it can promptly alert

personnel, thereby strengthening safety measures and minimizing the risk of accidents or non-compliance.

On the other hand, Enel is committed **to equip its workforce** with more comfortable and high-performance **personal protective equipment (PPE)**, designed to improve mobility, reduce fatigue, and enhance overall safety. Enel is testing **advanced gloves** offering improved protection in extreme environments. The investment in the development of effective, comfortable and secure PPE allowed the design of **new enhanced materials for coveralls** that support greater mobility and comfort, thereby improving the quality of work and operational safety. These innovative coveralls will be adopted by Enel's field operators working on electric distribution lines in each country of presence.

Through the integration of advanced technologies and the continuous improvement of protective equipment, Enel reaffirms its commitment to a proactive safety culture and operational excellence across all its activities.



▲ Image 3.21
Enel's new coveralls

6. Data from Enel's Annual Integrated Report 2024



This white paper outlines how innovation at Enel is a dynamic process; one that evolves through collaboration, experimentation, and strategic foresight.

The journey ahead is open, and Enel is ready to shape it with purpose and agility, creating long-lasting value for the company and its stakeholders.