OPEN POWER FOR A BRIGHTER FUTURE.

WE EMPOWER SUSTAINABLE PROGRESS.

Our performance 2022 Innovation





Our performance

Ambition of zero emissions and clean electrification

lies at the heart of the strategy we are implementing in a sustainable and innovative way, to favor a **just transition**.

People are the mainstays of sustainable progress,

not only ours, but also customers, suppliers, communities, institutions, the financial community, the media, companies and trade associations.

Innovation, circular economy, digitalization and sustainable finance

are the growth accelerators, and embrace and enhance all strategic themes across the board.

Protection of nature and respect for human rights

form our daily commitment to the current and future generations.



Below the 2022 results related to the targets of the previous 2022–2024 Sustainability Plan, the resulting progress and the targets of the 2023–2025 Sustainability Plan, which may be redefined, added to, or surpassed with respect to the previous Plan.

SDG	Activities	2022 results	Progress	2023-2025 targets	Tag
9	 Further enhance the reach of our innovation ecosystem, to find the best solutions on a global scale Generate value by solving the ever-increasing needs of the Business Lines, by enabling open innovation tools (collaboration with startups, crowdsourcing, partners, universities, intelligence, technological communities, solution design activities) 	194 Proof of Concept launched Q	•••	Launch of 445 Proof of Concept to test innovative solutions in the period 2023-2025	I S G T
		60 solutions adopted in the business	•••	Scale-up of 126 solutions to accelerate the implementation of the Strategic Plan in the period 2023-2025	I S G T



Read more

Proof of Concept are small-scale tests of a potential innovative

Q



Innovation

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6

60

SCALE-UP OF SOLUTIONS ADOPTED IN THE BUSINESS

46 solutions in 2021 +30.4%







in 2021





DMA EU (former EU8)

In a world in which companies continue to change workflows and are becoming increasingly digital, we are concentrating on new technologies and are continuing to work toward giving life to sustainable progress.

In order to encourage new uses of power and new ways of managing it and making it accessible to increasing numbers of people in a sustainable way, we have made innovation a key component of our strategy. It is a pathway that involves traditional businesses and the development of new models and technologies, which leverage on cutting-edge innovation, passion and ideas that emerge not only from within, but also from outside the Company. Enel's Open Power model considers innovation as one of the four values that inspire our day-to-day actions, together with trust, responsibility and proactiveness. We support innovation to be certain that the best and most creative ideas help improve the lives of people. By just rethinking the way in which we innovate we can truly revolutionize the industry and develop technologies and solutions that can shake up old markets and create other completely new ones.

Since 2021, the **culture of innovation** was combined with an **"agile" approach**, with the objective of providing the business with 360° support, from the initial idea of a project to its adoption phase, through the use of creativity, lateral thinking and agile techniques.

Innovation and agile transformation have in fact a great potential for synergy as they are essential factors behind the creation of a competitive advantage and for the optimization of costs over time.

Enel's Open Innovability® for changing the future of energy

The new model (Open Innovation +

sustainability) is based on the crowdsourcing activities of the best talents, ideas and technologies to make them grow, transforming them into new business models. In this way, we are connecting all Company areas with startups, industrial partners, small and medium-sized enterprises (SME), research centers, universities and entrepreneurs, through the **openinnovability. com** platform, to face new challenges, in consideration of the drivers of the Group's Strategic Plan and the sustainable development goals (SDG) of the United Nations 2030 Agenda.

Since 2017 we have launched the openinnovability.com platform, with more than 13,000 evaluated opportunities, more than 210 challenges, 34 of which only in 2022. Over the past year, the challenges for which the most solutions were proposed concern: innovative ways for improving the albedo in solar generation plants, sustainable approaches for reusing cement, a new design for primary and secondary substations. Those who propose solutions for solving the challenges can win monetary awards and start collaborations with the Group. We can count on a global network of **Innovation Hubs and Labs** (10 Hubs, three of which are also Labs, and three Labs dedicated to startups) that collaborated with the local ecosystems to expand our vision, promoting open innovation and sustainability.

The **Hubs**, which are located in the most relevant innovation ecosystems for the Group (Catania, Pisa, Milan, Silicon Valley, Boston, San Paolo, Madrid, Barcelona, Santiago de Chile and Tel Aviv), handle a network of relations with all players involved in innovation activities and are the main source of scouting for startups and SMEs, with the objective of responding to the innovation needs of the Business Lines. The scouting activity also focuses on promoting the adoption of solutions that can maximize our sustainable profile, such as promoting circularity, guaranteeing inclusiveness and attempting to face social problems.

The **Labs** make it possible for startups to work alongside the technicians and experts of our Business Lines in order to develop and test solutions in the most fertile environment possible. In addition to the laboratories in Milan, Pisa, Catania, San Paolo and Be'er Sheva, in September 2022 we inaugurated the new **AI & Robotics Lab in Tel Aviv**, which is specialized in developing artificial intelligence (AI) and robotics for renewable energies and energy networks. This is the fourth innovative initiative launched by the Group in Israel and is managed by Enel Green Power and Enel Grids (the Group Business Lines dedicated to the generation and distribution of clean energy).

Open Innovation also means creating **partnerships** with key players. We are currently committed to 43 collaborations for innovation that cover the areas that are the most strategic for the Group and that concentrate on relevant topics, such as the new sustainable materials for Enel assets (Novamont), innovative technologies for improving the generation and storage of renewables (BASF), the promotion of space applications in the energy sector (ESA and Thales Alenia Space) and the codevelopment of innovative digital solutions (Cisco and Microsoft).

We have created specific **interfunctional work groups** (**Innovation Communities**) in order to face topics relevant for the business and new technologies and create value in an innovative manner. The active communities concern the following topics: blockchains, drones, energy storage, the metaverse, robotics, sensors and quantum computing. There are also work groups dedicated to so-called wearables, additive manufacturing, data monetization, AI and machine learning, materials and hydrogen. The Communities continuously monitor potential technological improvements and share new useful business models, added value services or use cases for types of technologies that could be adopted in various Group areas.

We constantly promote and spread the culture, knowledge and behaviors of Open Innovation in the countries in which we operate, favoring an approach called "learning by doing", which allows people to think and act in a different way and disseminate methodologies and tools for strengthening the generation of ideas and supporting their development. There are many tools and initiatives for innovation that are useful for the dissemination of the Open Innovation culture. In addition to the recurring newsletters, surveys and webinars, periodic meetings are held with all Business Lines on many levels, not just managerial, but also with the non-hierarchical communities. We make the necessary resources available for promoting a culture of knowledge and its value on all levels, increasing awareness among people also thanks to training courses, events and meetings.

ISO 56002 standard "Innovation management – Innovation management system – Guidance"

Innovation management is a strategic topic for organizations and companies, and the ability to manage innovation as a system and organize all the phases of the innovation process represents a critical success factor.

In August 2022, we were among the first companies in the world to voluntarily adopt the **ISO 56002 standard** for innovation management. This standard is part of a wider series of ISO 56000 standards and covers all aspects of innovation management: from the creation of an idea to its development on a global scale. By adopting this standard, organizations can consolidate their governance, increasing the effectiveness of innovation and therefore business opportunities, which in turn creates the conditions for a wide-spread innovation culture that stimulates the creativity of employees and stakeholders, and promotes the emergence of new

valuable proposals, in line with market developments.

The standard is based on eight pillars: coherence with the Innovability[®] vision (innovation for the Company and a more sustainable world); generation of value through innovative ideas; future-oriented leadership and challenges to the *status quo*; innovation culture as a strategic asset; innovation development based on customer requirements; management of uncertainty and risk mitigation; proactiveness and resilience; systemic approach for a solid performance appraisal.

Furthermore, in 2022 we signed an **agreement with UNI** (Italian Standardization Body) to draw up a public document known as "Reference practices", which has the purpose of making Enel a reference on a national level in Italy in the area of innovation governance.

How ideas are transformed into business solutions, creating shared value

Here are some examples of Innovability[®] projects (see also chapters: "Clean electrification", "Circular economy", "Conservation of natural capital"):



Green hydrogen

NextHy: a global initiative designed to stimulate the growth of the entire green hydrogen ecosystem. Its center is the Hydrogen Industrial Lab in Sicily, an industrial technological validation platform that will be built between Carlentini and Sortino, where new technologies will be developed for accelerating the reduction of the cost of green hydrogen and the decarbonization of the so-called "difficult to abate" sectors.

NextHy is one of the Italian projects that benefited from the IPCEI Hy2Tech loan, the 4.5 billion euro fund made available by the European Union for the development of initiatives of strategic interest centered on hydrogen. The NextHy project also includes NextHy Booster, an acceleration program promoted by Enel Green Power that has the objective of supporting the most promising startups to scale their technology and their business to green hydrogen, creating a long-term partnership with Enel and connecting to the global network of green hydrogen.



Smart City

YoUrban (Italy), a single point of access for using all Enel X solutions activated in the urban perimeter, from the digital management of public lighting system faults to the innovative City Analytics solution for optimal urban planning. In 2022, new functions were developed that provide a complete overview of communities and areas of improvement in terms of services for citizens, CO₂ and the degree of circularity.



Customer centricity

Customer recognition through biometric factors (Spain), such as, for example, vocal recognition, to guarantee safe and inclusive access to our services as an element for the authentication of customers at call centers, which improves the personalization of the service, emotional involvement and accelerating the resolution of customer requirements.

Pilot project for the **application of advanced artificial intelligence models** to improve the operation of contact centers (Italy, Romania, USA, Spain). These models personify the needs and language of our customers, generating concepts/phrases in hundreds of transcripts thanks to the pre-trained model. This is useful for testing the qualitative level of our operators, preparing ourselves, in the future, for new evolutionary sales scenarios, automatic training and proactive support. Use of **neurosciences** to obtain more in-depth information about the efforts customers make to understand the commercial communications and to simplify relationships, thanks to the interpretation of spontaneous physiological input (Italy).



Robots and safety

Innovative robots for inspections of submarine cables (Italy), operations at a height (Italy and Brazil) and for cutting vegetation (Brazil), to allow safe and remotely controlled/automatic interaction with network components for operating and maintenance activities, and to cut vegetation near the network.

New sustainable helmets (Italy and Romania), that can house intelligent glasses for hands-free operation and other accessories to improve safety. They are more ergonomic and made with recycled material.



Weather predictions, variability of natural resources and system operation

In Italy, development of four parallel projects, selected thanks to the tender launched together with ESA (European Space Agency), that are concentrated on the development of algorithms for estimating the equivalent of snow water and the content of water in the alpine snowpack via satellite, to be validated with in situ measures. To best manage the production of water in our power plants, it is in fact necessary to know not only the amount of rain, but also the volume of water contained in the snowpack (Snow Water Equivalent), which is an important temporary reserve of winter precipitation. Therefore, by improving the prediction of precipitation and the resulting prediction of hydroelectric generation through the combination of satellite data, weather prediction models and in situ data, it is possible to manage the risks related to the variability in natural resources and optimize market strategies.

The photovoltaic plant in El Paso, Colombia: the objective of the project is to automate the acquisition process of the cloud coverage above the plant and provide intraday and intrahour predictions of radiation, using satellite images and sky-cams in machine learning algorithms. The need results from the intrinsic characteristics of the area, as the El Paso photovoltaic plant is located in an equatorial area where it is very difficult to evaluate the actual amount of clouds in the sky with normal weather prediction services.

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Use of water and biodiversity

Collaboration with **Reiwa Engine** (Italy) for the **automatic cleaning of photovoltaic panels without the use of water**. In the wind park of Gibson Bay, in South Africa, an **innovative system for preventing the impact of bats and birds with wind generators** was successfully tested by means of installing an acoustic deterrent device developed by the US startup **NRG Systems**, which made it possible to reduce the risk of mortality for local bats by 80%.

New solutions based on remote image detection systems (such as satellites and LiDAR) and artificial intelligence, are able to identify the **presence of archaeological finds and vegetable species before opening the job sites**, in order to protect biodiversity.



NET-ZERO GRID

The innovation of the electricity grid to mitigate the environmental impact and improve its resilience

Lourdes García Duarte

Head of Sustainable Network Design and Resilience-Innovation Enel Grids



"Enel Grids is taking another significant step toward the decarbonization of electricity grids, thanks to the pilot installation of cutting-edge sustainable poles. An innovative combination of pine or fir materials and with an external layer made of 66% recycled polyethylene. The new poles make it possible to save up to 130 kg of CO_{2eq} as compared to similar standard poles made of concrete and without the toxic materials used in the old products. This is an important result for making our networks increasingly Net-Zero."

nel's Net-Zero strategy for the electricity grid sector is concentrated on reducing the CO₂ emissions from activities, reducing network losses and adopting circular, low-emission materials and components. An interesting direction of innovation of Enel Grids is in fact that of Sustainable Design and Resilience, targeted toward mitigating the environmental impact and improving the resilience of the network with new technologies and sustainable materials, in order to rethink the systems and components.

The pilot project of the sustainable pole was field tested in this sector. The solution was also tested by some Northern European DSOs. This is a new support for low and medium voltage. It is made of wood obtained from certified sustainable forests in order to reduce the carbon footprint of the electricity grid. The main structure is made with certified wood, whereas the external layer is comprised of 66% recycled polyethylene. The poles, thanks to the innovative combination of two materials, make it possible to save up to 130 kg of CO_{2eq} with the same dimensions of standard cement poles.

The utilized wood comes from certified sustainable forests where there is the obligation to guarantee and not alter the continuous growth of the forest, whereas the external layer of polyethylene seals the wood, protecting it from atmospheric agents, improving its fire resistance and preserving fauna from the electrical risk. The absence of impregnating material, which was used for the old wooden supports, represents an additional result in terms of sustainability, in line with the new directives issued by the European Commission.

The pilot project successfully tested mechanical resistance and resistance to aging, and was able to evaluate the operational installation and maintenance activities.

For in-depth information about the Group's activities concerning network infrastructures, see the chapters "Clean electrification" and "Circular economy".

NET-ZERO GRID

Focusing on hydroelectric flexibility to accelerate transition and promote national energy autonomy

Vincenzo Ricchiuto Short term management Italy, GECM



"The role of hydroelectrics, a clean source par excellence, in the electrical system is becoming more important as an enabling technology for transition thanks to modernization and flexibilization projects developed in full compliance with the environment and local communities. This result was made possible by an intense and lengthy synergy with Generation, Innovation and the Territory."

he challenge we are facing is to explore capacities that are not yet expressed in terms of flexibility of use of the existing renewable fleet with innovative modernization, efficiency improvement and management interventions. With experimental modeling and the implementation of new operating schemes, which keep up with the continuous regulatory changes, we are aiming to test and highlight the pivotal role that the hydroelectric fleet can take on during the energy mix evolution process thanks to its extreme versatility and wide-spread presence all over the territory.

In 2022, the first phase was completed with a 5-year time schedule of initiatives that basically involved the most of the Italian programmable hydroelectric fleet with a specific investment plan. For some it was an extension of potential in terms of regulation and flexibility of use, whereas for others it was a true start in a new activity; the purpose of it all is to guarantee also with hydroelectric a continuous service for the electricity grid oriented toward balancing the intermittence generated by NPRS (non-programmable renewable source) thereby favoring the safe penetration of new capacity. In particular, in Italy, the increase in terms of MW enabled for the secondary regulation service was more than 550 MW approx., equal to 11% approx. of the total currently enabled for all technologies in Italy. Furthermore, approx. 50 plants, for a total of 650 MW approx. have been enabled for the market of services also through aggregations and innovative modeling.

As is known, 2022 was a year with strong geopolitical tensions, but also a record shortage in the hydroelectric resource, causing considerable increases in production costs and unexpected reductions in availability of some thermoelectric plants.

In this context, the plants involved in the efficiency improvement and flexibilization program have provided a considerable contribution with regard to the safe management of the electricity grid and the containment of system charges, especially during the most critical periods.

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Sustainable innovation and intellectual property

In the Open Innovability[®] ecosystem, Intellectual Property (IP) plays a key role in protecting and enhancing the value of the innovative solutions created and developed inhouse or in collaboration with third parties.

IP is a key component to regulate and foster the sharing of ideas, technologies and knowledge between Enel peo-

ple, startups, universities, research centers, suppliers, and consultants.

As at December 31, 2022, the IP portfolio, which ensures protection from a geographical point of view on all the markets in which the Group is present, contains:



As part of the activities aimed at protecting and developing the portfolio of trademarks owned by the Group, notably, in the year of Enel's 60th anniversary, in addition to the registration of the "**Enel 60 years**" mark, the procedure for registering the Enel brand in the Special Register of Historic Trademarks of National Interest was initiated. This important recognition is awarded, following the submission of a special application, to trademarks that have been registered for at least fifty years, or for which there is proof of their continuous use for at least fifty years, and that are used to market products or services made in a national production company of excellence with long-term links to Italy.

Other notable achievements include the registration of trademarks that identify models operating in the field of sustainability, such as:

- i. Valuability[®] of the model, copyrighted by Enel SpA, aimed at fostering the inclusion at work and active participation of colleagues with disabilities;
- ii. CirculAbility[®] of the model also copyrighted by Enel SpA – for measuring circularity.

Enel has consolidated its processes for managing the generation and use of intellectual property rights in the **Intellectual Property Management and Trade Secrets Management organizational procedures**. Both of these view human capital as an essential element in the creation of IP and aim to incentivize employee participation in the inventive process, empowering them on the strategic importance of all findings. Through the **IP Reward Program**, prizes and awards, including monetary ones, are paid to Enel inventors of solutions protected (or in the process of being protected) by patent, design, copyright or trade secret. As part of the IP Reward program, the first edition of the **Enel Intellectual Property Awards** were held on November 29, 2022, where the inventions protected by intellectual property and deemed most strategically relevant to the Group were honored. These initiatives, together with regular internal communication and awareness-raising activities, have also contributed to an increase in the number of inventions proposed by employees through the company IP portal.

During 2022, intellectual property codification and protection activities continued in all the Global Business Lines. In particular:

• Enel X Global Retail focused its activity on strategic platforms, codifying copyrights on the Big Data Platform, the strategic data container for all Enel X business units, and X Customer, the global Enel X customer management system.

With regard to the circular economy, the circularity schemes in Enel X, together with their scores and operating mechanisms, have been protected under copyright law.

In the field of telemedicine, a multiple design mark was registered in the European Union on the graphical user interfaces of the "Smart Axistance eWell" app, which offers users a complete wellness package.

- In **Enel Green Power and Thermal Generation**, the following notable developments were achieved during the year:
 - in the photovoltaic sector, (i) a patent application for an industrial invention and a design patent on a solution that automates the process of installing photovoltaic panels in the field, reducing installation time and costs and increasing operator safety; (ii) a patent application in co-ownership with the Commissariat à l'Énergie Atomique et aux Énergies Alternatives (CEA) on a system to optimize the automatic removal and insertion of the wafer bar holder of the storage tray used to process wafers in chemical hoods. In addition, the generation and protection, mainly in the form of trade secrets, of the technological know-how required for the Gigafactory project continues at the 3SUN factory.

CEA-INES is one of Europe's leading photovoltaic research institutes. A collaborative research agreement was negotiated and signed with the institute for the development of the two-terminal Perovskite-silicon tandem technology, with the aim of producing high-efficiency devices that can be industrialized on the lines of the Gigafactory in Catania. The management of the IP rights arising from the collaboration was a crucial factor in the negotiation of this agreement, which is based on the strong technological background of the two partners;

- in the field of hydroelectric generation, a utility model patent application for a robotic solution that facilitates plant inspections by enabling access to all places that are difficult for personnel to reach, such as hydroelectric coils or small-diameter hydroelectric pipelines.
- Enel Grids filed two patent applications for inventions in 2022: one in the field of asset recognition and anomaly detection of grids and grid events (ODIN project) and the other in the field of safety devices for workers working at height. Other noteworthy events included: (i) the registration of the design of the new sustainable road cabin, which will be developed using recycled materials to reduce environmental impact, and (ii) the filing of a utility model patent application in the field of safety, consisting of a method for delimiting road construction sites.

Also during the year, Gridspertise consolidated its IP portfolio by filing a patent application for the Quantum Edge – QEd® device, which, by exploiting edge computing to digitize the physical components of secondary substations, reduces installation, training, operation and maintenance costs and increases network reliability.

Enel Grids concluded two major licensing agreements with Gridspertise in 2022 for the commercialization of some of its key digital assets, including the Grid Blue Sky solutions. These agreements constitute a milestone in the valorization of Enel Grids' intellectual property through an out-licensing strategy. Gridspertise will participate within the framework of these agreements as a commercial and technical partner, offering customized versions of licensed digital solutions to meet the specific needs of third-party DSOs.

In May 2022, Enel Grids founded the "Open Power Grids" association, for the first time making its historical wealth of expertise and experience on distribution networks accessible free of charge to member operators outside the Enel Group. The objective of Open Power Grids is to create a collaborative ecosystem to foster innovation, aggregating experiences, ideas, technologies and resources to make electricity grids more resilient, sustainable and participative, also based on a market-driven standardization process. In this way, the initiative can help improve the effectiveness and measurability of the concrete actions taken by Enel to achieve the Net-Zero ambition. The proposed approach is to provide open access, within the association, to the existing functional specifications (of electricity grid components and devices and network design solutions) on which Enel Grids holds copyright and, based on these, to develop new ones, in a logic of co-design, maximizing the aspects of sustainability, standardization and innovation.

Enel X Way protected the JuiceBox DC and JuiceBox 4.0 • smart home charging devices respectively through: (i) an international design registered in the European Union, the United Kingdom and the United States and (ii) an international design registered in Canada, Mexico and the United States. Intellectual property protection work on electric vehicle charging stations also extended to the registration of the JuiceMedia 2.0 and JuiceMod product designs in the European Union and the United States. In the field of electric car charging points, Enel X Way pursued the goal of inclusiveness by designing infrastructures that take into account the needs of motorists with reduced mobility. In fact, in collaboration with ANGLAT, the national trade association that protects the rights to mobility of people with disabilities, and following the criteria of Universal Design, Enel X Way has created an additional maneuvering area marked on the ground by zebra stripes and featuring bollards to protect the infrastructure from possible impacts. With the intention of promoting the project and facilitating its usability by as many users as possible, Enel X Way enhanced the intellectual property of the designs through the open property model with author protection through Creative Commons. Specifically, Creative Commons Attribution-Non Commercial licenses were applied, which allow third parties to download and use the designs free of charge.

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 Enel Global Services filed a patent application in Italy for an industrial invention on the innovation management method, also protected as the word mark Enel OOPS...! Innovation[®]. This method is based on perfecting industrial processes using the tools of Open Innovability[®].

Enel SpA also filed a patent application in Italy for a **method** of evaluating managerial positions, based on a model capable of acquiring and processing personnel management parameters using a proprietary algorithm, thus providing a meaningful index that meets the needs of the People and Organization Function.

More generally, the Group continues to invest resources in the development of IP-intensive solutions, mainly in the forms of authorship protection and trade secrecy on databases and algorithms for forecasting the electricity and gas markets, advanced quantitative models that use, among other things, scenario data to assess the impact of climate change on specific assets/production activities. The most notable investments in this area include development models that aim to: (i) characterize an asset's ability to "withstand" the possible effects of climate change; (ii) quantify the likelihood of an event or combination of climate events damaging the asset; and (iii) provide an index of the asset's "weakness" with a specific technical approach to prioritize actions/fields for improvement.

Finally, during the year, the Group consolidated its **internal non-financial intellectual property reporting process based on an internal proprietary methodology capable of codifying, protecting and valuing corporate intangibles**. This methodology aims to provide a qualitative assessment of the intellectual property and an indication of the investment that would be required to replicate the set of intangibles subject to codification.



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