

Managing waste

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Optimal waste management is a strategic objective of Enel's environmental policy, which results in a constant commitment to reducing its generation, as well as to constantly devising new methods of reuse, recycling and restoration in the perspective of a circular economy of resources, in line with the principles indicated by the new

EU proposal EFRAG ESRS E5 "Resource use and circular economy". These principles are further strengthened and integrated into Enel's operations in the Group Guidelines for Waste Management (PL No. 473), which Enel has adopted in order to collect and share best management practices and rules developed within the Company.

The target of reducing waste from operational and maintenance activities

For several years, Enel has been pursuing an important target of reducing waste produced by direct, operational and maintenance (O&M – Operation and Maintenance) activities carried out on its plants. The reduction target previously set, linked above all to the ongoing energy transition and to Enel's strategic decision to bring forward the closure of its coal-fired thermal plants, which accounted for the majority of waste produced (mainly ash and gypsum), has already been reached in the last few years (1.2 Mt in 2020 and 2021, which is the target value previously set for 2030).

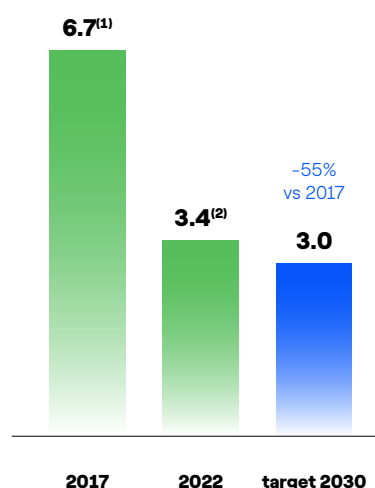
Starting this year, this target has been made more challenging by extending it to O&M waste produced by contractors who, operating on behalf of Enel, generate waste which they manage under their own responsibility as producers, in compliance with applicable laws, authorizations and mandatory qualification and management compliance criteria regularly verified by Enel as the contracting company.

This new adjustment of the target reflects the principles of extended responsibility of the waste producer, as recommended by the recently proposed EU standard EFRAG ESRS E5 "Resource use and circular economy". It also makes it possible to highlight, in the context of the ongoing energy transition, the growing role within the Company of the management of renewable plants and electricity and service distribution networks (for example, public lighting networks) with respect to the operational processes of thermoelectric plants.

The increase in the values reported this year is therefore attributable to the inclusion of O&M waste produced and managed by our contractors, mostly consisting of excavated earth and rocks and inert materials from civil and road construction and demolition, which in some main countries, including Italy, are classified and managed as waste and entirely destined for recovery.

The new target commits the Company to a 55% reduction in waste produced by direct and contracted O&M activities in 2030 compared with the base year 2017.

Waste production from O&M activities (Mt)



(1) Values calculated net of corporate deconsolidations as at December 31, 2022.

(2) The value for the year 2022 recalculated net of previous corporate deconsolidations is also 3.4 Mt.

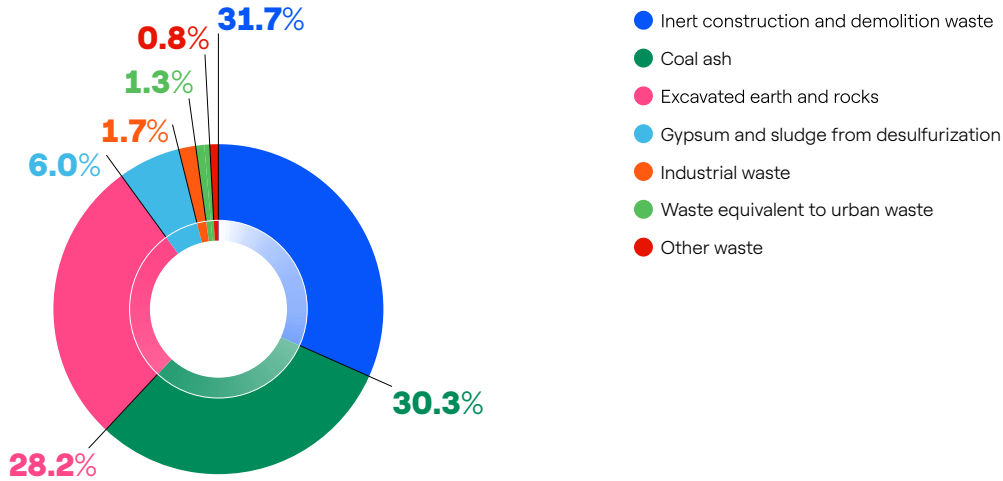
Waste produced in 2022 amounted to 3.4 Mt (corresponding to -50% compared with 2017), a moderate increase compared to that recorded in 2021 (3.1 Mt, also recalculated to include waste produced in O&M activities by contractors), mainly as a consequence of the increase in coal-fired thermoelectric generation in some countries, mainly including Italy, following the ongoing international energy contingency.

The vast majority of waste produced (98.3%) is accounted for by waste classified as non-hazardous and mainly consisting of inert waste from construction and demolition, coal ash and excavated earth and rocks. In particular, pro-

duction of ash from coal and gypsum from desulfurization, which is expected to be completely eliminated by 2030 following the planned decommissioning of coal-fired plants,

was respectively 1.02 Mt in 2022 (52% vs 2021) and 0.11 Mt (57% vs 2021).

Waste produced by O&M activities (3.4 Mt)



The overall percentage of O&M waste sent for recovery totaled 84.4%. The commitment to a continuous increase in the percentile recovery of waste produced is essential for an effective transition towards a circular economy that minimizes the exploitation of natural resources, in accordance with the objectives of sustainable development and reducing the Company’s environmental impact and dependence on ecosystem services. Excavated earth and rocks (94.6%) and construction and demolition waste (86.9%) were recovered almost in their entirety, deriving mainly from the maintenance of power grids as well as of generation plants. Process waste from thermoelectric

generation was also recovered to a significant extent, including coal ash and desulfurization gypsum, which were reused in building works to produce cement, concrete and bricks according to specific technical and environmental control requirements. In particular, the percentage sent for recovery was 80.4% for coal ash and 88.3% for desulfurization gypsum, improving on the results of the previous year (respectively 67% and 81% in 2021). Finally, industrial waste deriving from the maintenance of generation plants and electricity grids was mainly destined for recovery (88.1%), as was an even higher percentage (95.6%) of WEEE and metal waste, including iron, copper and aluminum.

Waste produced by construction site activities

The objective of reducing waste produced by the operating and maintenance activities described above does not currently include waste deriving from the construction of new renewable plants and the demolition of thermoelectric plants at the end of their life, as these flows are specifically linked to the Group’s strategy of decarbonization and energy transition. Above all, these activities are linked to the generation of inert materials, such as excavated earth and rocks, as well as valuable metal waste, in the case of the end-of-life decommissioning of plants. Enel is constantly committed to maximizing their recovery. In particular, for the recovery of waste deriving from the end-of-life decommissioning of plants, selective demolition techniques of the structures and dedicated management procedures

are adopted to maximize their economic value. For more details, see the chapter “Circular economy”.

In 2022, waste produced on the construction sites of new renewable plants (wind and solar) and by the 3SUN Giga-factory totaled 0.09 Mt, which consisted almost exclusively of non-hazardous waste (99.9%). The same activities also produced 3.31 Mt of excavated earth and rocks, which was entirely reused *in situ*.

By contrast, waste from the end-of-life demolition of thermoelectric plants totaled 0.39 Mt. Waste from these activities consisted of 92.3% non-hazardous waste (mainly excavated earth and rocks, inert waste from construction and demolition and industrial waste, including mainly metals) with average recovery values of 76%, rising to 93% for

the metallic portion. Programs at country level and dedicated initiatives at plant level are aimed at optimizing the management of this waste, with a view to maximizing its recovery and value (see also the paragraph on the circularity of resources).

Finally, with reference to the specific redevelopment site of the Enel headquarters in Viale Regina Margherita (Rome,

Improvement initiatives

Among the most significant initiatives, within the Enel Green Power and Thermal Generation Division, the commitment made in 2020 continued with the launch of “Zero Waste”, a global project that aims to reduce the amount of waste produced and improve the percentages of waste recovered through the sharing of best initiatives and good practices implemented in the various Countries. The global initiatives carried out in 2022 continued, notably including the commitment to engage Enel’s contractors through awareness-raising and training initiatives and the adoption of contractual instruments to incentivize waste recovery. Particular attention was also paid to wind and solar technologies, in order to identify possible strategies for the reuse of components that are subject to replacement and disposal at the end of their life, mainly starting from 2030. As regards wind technology, the “Wind New Life” project for the recovery of wind blades is continuing. Among the possible alternatives for their recovery, the project has also considered the processes of reusing and recovering energy from the turbine blade materials for concrete production. Meanwhile, the “Photorama” project is dedicated to the reuse of photovoltaic panels, focusing above all on the most valuable and difficult-to-source materials, which are potentially reusable for the generation of new panels.

As regards waste produced by grid management activities, in continuity with the programs launched in previous years, Enel is continuing in its commitment to restoring hazardous and non-hazardous special waste, especially as regards dielectric mineral oils used as insulators in electrical equipment, which is delivered to authorized companies for regeneration or, if this option is not feasible, destined for waste-to-energy processes. Also ongoing are the initiatives launched in the various countries for the sustainable replacement of first-generation smart meters and the recovery of their constituent materials.

Italy), launched in November 2019 for a duration of approximately 40 months and involving a total area of approximately 80 thousand m², the amount of waste produced in 2022 totaled 26.4 kt, of which 98.2% (about 26.0 kt) consisted of demolition aggregates, glass and metals, which was entirely sent for recovery.

For further initiatives, see the chapters “Circular economy” and “Sustainable supply chain” in this document.

As part of the provision of products and services for energy efficiency, in 2022 Enel X Global Retail continued its commitment to a sustainable approach that extends to the entire value chain, by further extending the requirement for its suppliers to provide transparent and comparable information on the environmental impact of the materials and products they supply. In particular, for own-brand products, Enel X Global Retail adopts the Extended Producer Responsibility (EPR) model, which also includes the post-consumer phase, by adhering to collective WEEE collection systems in all the markets in which it operates, as well as collection of batteries and packaging, and by launching end-of-life management initiatives for marketed products and optimizing their design with a view to maximizing their reuse and recycling. These initiatives notably include:

- the ALVA (ALternativas de VALorización) project in Spain, aimed at improving performance in the management of waste from electrical and electronic equipment (see the dedicated box);
- the agreement between Enel X Italia and CdC RAEE (Centre for the Coordination of Waste from Electrical and Electronic Equipment), whose partnership enables B2C distributors/installers contracted with Enel X Italia to use the WEEE collection service free of charge, as well as providing greater control/traceability of WEEE along the entire supply chain to the plants where they are ultimately destined;
- a similar project in Peru, but applied to B2G public lighting, with the objective of both extending the life cycle of light bulbs that are still functional and the restoration treatment of spent bulbs through the WEEE RECOLECC consortium in order to recycle the raw materials, thereby creating value and reducing greenhouse gas emissions.

Spain – ALVA Project (ALternativas de VALorización)

With the aim of applying the principles of the circular economy and in compliance with environmental regulations on waste, Enel X Global Retail has developed a project for reusing and recycling electrical and electronic equipment (EEE) products or components taken back from customers.

The project applies to electronic devices marketed by Enel X which are subject to return, in the case of rentals, or replacement of EEE installed at the customer's premises (1-for-1 takeback). The objective of the project is to ensure virtuous management and traceability of products/waste in order to prioritize EEE reuse operations over disposal. The project engages installers, a qualified repair company and the ECOTIC consortium in managing waste electrical and electronic equipment (WEEE) in order to improve circularity, by providing full traceability of the installation/replacement process, and to increase the reuse and restoration percentages of WEEE in treatment plants, and consequently to reduce CO₂.

2022 results

61 installers
who have signed the
agreement with ECOTIC

103 t WEEE collected
(93–96% material
recovery / 1–3%
energy recovery)

119 t CO₂
equivalent saved



Protection of soil, subsoil and groundwater

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Enel is committed to the continuous application of the most advanced technologies available and best practices in order to minimize the possible environmental impacts deriving from its activities, using international standards as a benchmark even where the required environmental protection is less stringent. Among the areas of prevention, the highest level of attention is paid to the protection, monitoring and remediation of soil, subsoil and groundwater in the areas where plants and generation and service facilities are present in all Countries.

The protection of the environment matrices guides every phase of each asset's life, from design choices to construction, operation and end-of-life management. Both active and passive protection and safety measures will be used in the project phase to prevent and, in any case, minimize the risk of uncontrolled or accidental contact of potentially polluting substances (such as fuels, reagents, liquid and waste flows) with soils and subterranean waters. During plant operations, every process undergoes compliance controls as well as ongoing upgrades as required by the Environmental Management Systems to prevent and minimize the risks of any potential environmental contamination. At the same time, control plans are executed to monitor the condition of the previous environmental matrices. In the event of an accident, for example the accidental spillage of polluting substances, the timely application of the Stop Work and Emergency Management Policies makes it possible to prevent or minimize the risk of environmental impacts, rigorously complying with the provisions and the legal obligations of the various countries. For the end-of-life management of power plants, once they have been made safe and prior to them being dismantled and the area reassigned for new development projects, Enel proceeds to verify further the environmental quality of the soil, subsoil and groundwater in the areas where the plant is located, according to the authorized provisions and legal requirements of the various countries. In the event of potential contamination phenomena, characterization of the environmental matrices in the areas potentially affected and, if necessary, implementation of

safety measures and subsequent remediation, are executed according to intervention plans shared with the competent authorities and by resorting to specialist, qualified companies that are able to promptly restore the level of quality suitable for the intended use of the area (industrial, commercial, residential etc.). Particular focus is on power plants falling within large industrial hubs. In order to mitigate further the risk connected to the detention and consequent potential uncontrolled release of substances that can have an impact on the environment, numerous projects have commenced for their progressive substitution, for example, verifications under way on the use of vegetable (hence biodegradable) oil, replacing the traditional dielectric oil of mineral origin.

Within the context of the energy transition launched by Enel, particular importance is given to projects for converting decommissioned plants, with the aim of hosting new renewable generation and energy storage plants, in order to reuse the industrial areas, some common parts of the plant, and the main infrastructures. In this way it is possible to reduce the environmental impacts deriving from demolition and new construction activities, as well as the consequent social and economic impacts on the surrounding communities and stakeholders. In order to optimize the management of plant decommissioning projects, in 2021 Enel adopted dedicated Guidelines ("Environmental issues management in power plants decommissioning"), with the purpose of guaranteeing a standardized approach to identifying, preventing and managing environmental aspects related to the decommissioning of power plants. These Guidelines provide global guidance on applying best management practices in relation to all environmental aspects, including soil and groundwater management.

With a view to continuous improvement and minimizing the possible environmental impacts deriving from decommissioning activities, at the end of 2022 a further set of Guidelines was also issued ("Sustainable Repurposing Model") in order to ensure the increasingly sustainable end-of-life management of plants (see the dedicated box below).

Habitat restoration to protect native species

The area affected by the environmental restoration project was previously used to store combustion ash from the “Eugenio Montale” thermoelectric plant in La Spezia, Italy. Starting from 2020, following a project authorized by the competent bodies, a waterproof top cover (cap) was created for the two reservoirs on the site, aimed at making them permanently safe while also guaranteeing landscape restoration by planting and grassing the area. The capping activity, completed in July 2022, was carried out in conjunction with a habitat restoration project aimed at restoring and maintaining biodiversity in the area, which is considered “core”, due to the presence of *Rana dalmatina*

frogs (a protected species included in the IUCN National Red List).

The habitat restoration project envisaged the recreation of a semi-open humid environment (azonal *Phragmites australis* reed bed habitat) fed by a channel that conveys runoff surface water from the reservoir caps, in addition to planting native arboreal and herbaceous essences characteristic of submerged wetlands and humid and perhumid environments. This habitat, in addition to providing a safe place during the reproduction period for a species in need of protection such as *Rana dalmatina*, also plays an irreplaceable ecological role by providing a place of rest, shelter and food for numerous other animal species.

For further details, please refer to the chapter “Our commitment to a just transition: leaving no one behind”.



Sustainable Repurposing Model

The sustainable repurposing model aims to promote the standardized adoption of sustainable practices during all end-of-life disposal activities of plants and assets. The aim is to create synergies with the future redevelopment of the sites, while maximizing the positive environmental and social impacts of the entire process.

To achieve and monitor these objectives, a set of guidelines, a catalog of sustainable practices and specific KPIs have been created. In order to launch and promote the model, some pilot projects on decommissioned plants have been launched in Chile, Spain and Italy. The contin-

uous monitoring, through KPIs, of environmental performance on important aspects such as the reduction of atmospheric emissions, the recovery and recycling of materials and waste, the efficient use of water and the improvement of soil and biodiversity will allow us to continue on our path towards an increasingly efficient energy transition. The proposed model includes, in particular, the identification and application of sustainable principles and practices related to the management of the environmental matrices of soil and groundwater, such as the restoration of reclaimed areas in compliance with the morphological, vegetative and landscape characteristics of the surrounding area, as well as the creation of habitats aimed at promoting biodiversity and ecosystem services.

Energy efficiency

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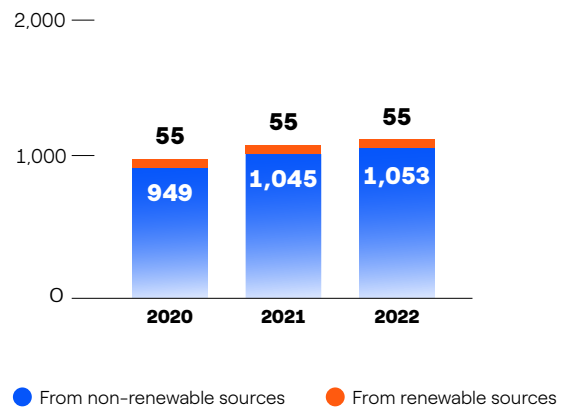
Energy efficiency in production processes

For Enel, the efficient use of energy is a constant commitment that extends to the entire value chain and which is pursued through the implementation of operational excellence programs across the different Business Lines, both for operations and in buildings. In particular, targeted interventions are aimed at maximizing the efficiency of power generation plants as well as improving the operational efficiency of distribution networks.

Energy consumption is mainly represented by fossil fuels, to operate thermal power plants (with coal accounting for 19% and natural gas 45% in 2022), and by uranium, to operate nuclear power plants (27%). By contrast, a smaller amount of energy consumption is related to the operation of power generation plants relying on renewable sources (biomass and geothermal). Total direct consumption of energy for electricity generation in 2022 amounted to 1,108,069 TJ (26.5 Mtoe), which was basically in line (0.8%) with the energy consumption of fuel recorded in 2021 as a result of the increase in thermoelectric generation from coal (64,571 TJ, up by 46% on 2021), as well as from diesel and nuclear to a lesser extent, replacing generation from natural gas (-79,774 TJ, down 15% on 2021). The Group's energy intensity, which provides a measure of its operational efficiency, was 4.81 MJ/kWh_{eq} in 2022, slightly down on the previous year (-0.36%). Activities to optimize the grid structure continued in 2022, allowing for a significant reduction in grid losses. These include pro-

gressively reducing single-phase power lines, constructing additional power lines to alleviate the overload on existing lines, using low-loss transformers, boosting the grid by using conductors with a greater cross-section, and rephasing primary transformer substations. Finally, the realization of new transformer stations that help reduce the length of low-voltage lines, which are characterized by higher levels of loss.

Consumption of primary energy from renewable and non-renewable sources (,000 TJ x10³)



Energy efficiency and electrification products for customers

The electrification of final consumption has become a central element of Enel's strategy. Its intrinsic efficiency makes it the key partner in achieving sustainable goals globally. In line with this approach, several initiatives across our businesses were strengthened and consolidated in 2022 to support commitments towards clean electrification. In 2022, the interventions carried out by the Enel X Global Retail Business Line in relation to efficiency, technological innovation and reduction of CO₂ emissions in the sectors in which the division operates, were strengthened and consolidated. In the public lighting sector, work performed in 2022 by Enel X Global Retail in Italy, Spain, Chile, Colombia and Peru resulted in cumulative savings of approximately 177 GWh. In public transport, Enel X Global Retail participated in the commissioning of more than 500 new electric buses in Chile, Colombia, Spain, Italy and the United Kingdom in 2022.

For its B2C (Business to Consumer) customers in Italy, Spain, Chile and Romania, in 2022 Enel X Global Retail in-

stalled about 78 thousand energy-efficient products, including condensing boilers, air conditioners, air-to-water heat pumps and photovoltaic plants (some with storage systems), while in the B2B (Business to Business) sector, the photovoltaic plants managed by Enel X Global Retail for its customers in Brazil, Spain, Italy, North America and Korea in 2022 made possible a generation of distributed renewable energy equal to about 42 GWh, in addition to the energy savings obtained by the cogeneration and trigeneration plants managed by Enel X Global Retail in Italy and Spain. Overall in 2022, Enel X Global Retail's efficiency and electrification products and services enabled its customers to avoid the emission of approximately 130 thousand tons of CO₂, equivalent to an environmental benefit of more than 7 million trees per year, values calculated by applying algorithms validated by an internationally recognized certification body according to the principles identified in the UNI EN ISO 14064-2:2019 standard.

For further details, see the chapter "[Clean electrification](#)".

Environmental legal disputes

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At December 31, 2022, the number of legal proceedings pending was 168 across the whole Group. The main environmental disputes related to Italy, Latin America and

Iberia. The amount of fines imposed or paid in 2022⁽³¹⁾ was approximately 1.8 million euros. In addition, 22 non-monetary sanctions were issued.

(31) The relevance threshold for fines is 10,000 USD, therefore only sanctions that individually exceed this amount are reported.