



Decarbonization and reduction of emissions

[GRI 2-23, 3-3, 302-1, 305-1, 305-2, 305-3, 305-4, 305-5, 305-6, 305-7]

Iren Group has made a commitment in its strategic guidelines to the constant containment of emissions into the atmosphere, defining objectives for the reduction of CO₂ emissions and the increase in those avoided thanks mainly to the use of renewable sources, the recovery of waste as matter and to district heating.

Decarbonization and reduction of emissions



Risks

- Failure to meet the targets set out in the Business Plan and consequent negative impacts (operational, economic and reputational) also on accessibility to sustainable finance instruments
- Negative impacts on environment, health and safety with consequent negative reputational and economic impacts
- Unintentional exceeding of emission thresholds provided for by environmental authorisations or regulations
- Chronic or extreme natural phenomena from climate change that may cause impacts on assets/ performance
- Loss of environmental certifications
- Tightening of emission constraints and need for adaptation of processes/plants
- Errors/omissions in the design/permit/implementation activities with subsequent impairment of plant operating continuity



Opportunities

- Growth in renewable production contributing to decarbonization
- Reducing environmental impacts leading to climate change
- Business opportunities related to green transition



Management methods

- Planning and monitoring of business plan objectives and targets (economic/financial and ESG)
- Sustainable Financing Framework
- Code of Ethics
- Sustainability Policy
- Organisational Model 231 and information flows to the Supervisory Bodies
- Sustainable Financing Framework
- MbO and LTI system with ESG objectives
- Improvement plans and related investments
- ERM system (Operational Risk Policy and Climate Change Risk Policy)
- Integrated Certified Management System (risk assessment, containment measures and third-party audits)
- Procedures: Environmental analysis; Management of emissions from waste-to-energy plants, thermoelectric plants and wastewater treatment plants; Management of emergencies aimed at returning within certain times within the established emission thresholds; Car fleet management and maintenance
- Adoption of best available technologies
- Continuous emission monitoring systems and real-time connection with control bodies
- Periodic audits by control bodies
- Environmental authorisations

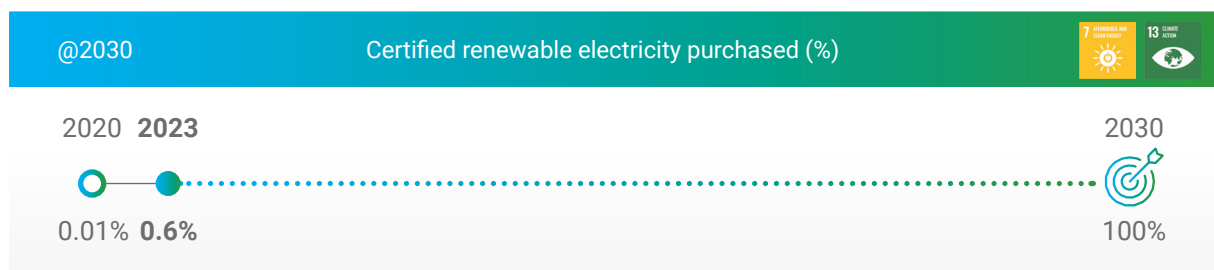
Direct and indirect energy consumption

The **direct energy consumption** of the Group concerns the use of fuels for the production of electricity and heat (co-generation plants, thermal plants, boilers, waste-to-energy plants and landfills), and the non-renewable primary energy flows not directly associated with the production of energy (e.g. site heating, fuel for the company vehicle fleet, etc.), used in carrying out its activities. Energy consumption increased slightly by 6% compared to 2022, mainly related to an increase in energy production from thermoelectric and the expansion of the perimeter.

The strategy of gradually reducing the use of natural gas, and the consequent emission impacts, is integrated in the Group's Business Plan, which envisages the gradual growth of renewable energy sources, also supported by storage systems, to reduce natural gas consumption by one-third in 2030, compared to 2020.

Indirect energy consumption refers to the electricity purchased and consumed by the Group, both for its offices and plants. The electricity used by the energy production plants is self-generated and can be partly purchased from third parties, if the needs exceed self-generation. In 2023, indirect energy consumption amounted to 442 GWh, equivalent to 82,744 TOE (3,463,644 GJ), with a slight increase of 5% compared to 2022, mainly due to the expansion of the scope of the Waste Management BU plants, deriving from the start-up of newly-built material recovery plants, and of the Networks BU, as a result of the company acquisitions that took place during the year, more than offset by the reduction in consumption recorded in the areas of business historically managed.

To mitigate the impact of electricity consumption, the Group has set a goal in its Business Plan to purchase 100% of its certified energy from renewable sources by 2030. In 2023, electricity was purchased from renewable sources, certified through a Guarantee of Origin (GO), covering about 0.6% of the total purchased.



Direct energy consumption by fuel type	u.m.	2023	2022	2021	2020
Natural gas	sm ³ /000	1,470,780	1,395,057	1,689,348	1,723,470
	TOE	1,229,572	1,166,267	1,412,295	1,440,821
Diesel	t	60	46	62	44
	TOE	62	47	63	45
Biogas from landfills, treatment plants and biodigesters ⁽¹⁾	m ³ /000	43,893	39,652	32,152	30,443
	TOE	18,023	16,401	11,984	11,497
Fuel for motor vehicles	t	18,477	15,617	11,849	10,643
	TOE	19,053	16,023	12,137	10,900
	TOE	1,266,710	1,198,738	1,436,479	1,463,262
TOTAL ⁽²⁾	GJ	53,034,621	50,188,763	60,142,518	61,252,146
	MWh	14,743,617	13,952,482	16,719,616	17,031,363

⁽¹⁾ Energy consumption from renewable sources.

⁽²⁾ The conversion to GJ is done using the conversion factor 1 TOE = 41.868 GJ; the conversion to MWh is done using the conversion factor 1 GJ = 0.278 MWh.

Direct energy consumption by energy source	u.m.	2023	2022	2021	2020
Non-renewable source	MWh	14,533,846	13,761,585	16,580,130	16,897,546
Renewable source	MWh	209,771	190,896	139,485	133,817
TOTAL	MWh ⁽¹⁾	14,743,617	13,952,482	16,719,616	17,031,363

⁽¹⁾ Conversion to MWh is done using the conversion factor 1 GJ = 0.278 MWh.

Atmospheric emissions

The emissions of greenhouse gases (GHG) are produced by Iren Group directly in the operational processes (scope 1) and indirectly both through the possible supply of electricity from third parties (scope 2) and along the value chain (scope 3).

Here they are considered and reported as GHG emissions (in terms of CO₂ equivalent):



all direct emissions produced by sources owned by the Group, i.e. emissions generated by the combustion of fuels and waste for the production of electricity and heat, those originating from the company vehicle fleet, fugitive emissions related to the dispersion of methane gas into the atmosphere in the gas distribution service, emissions related to methane dispersion produced by the decomposition processes of organic waste in landfills, those related to fluorinated gases (including the insulating SF₆ used in electricity distribution infrastructures), refrigerant gases normally contained in air conditioning/refrigeration systems, and finally, those deriving from the consumption of fuels for heating the buildings of the offices and for other activities supporting production;

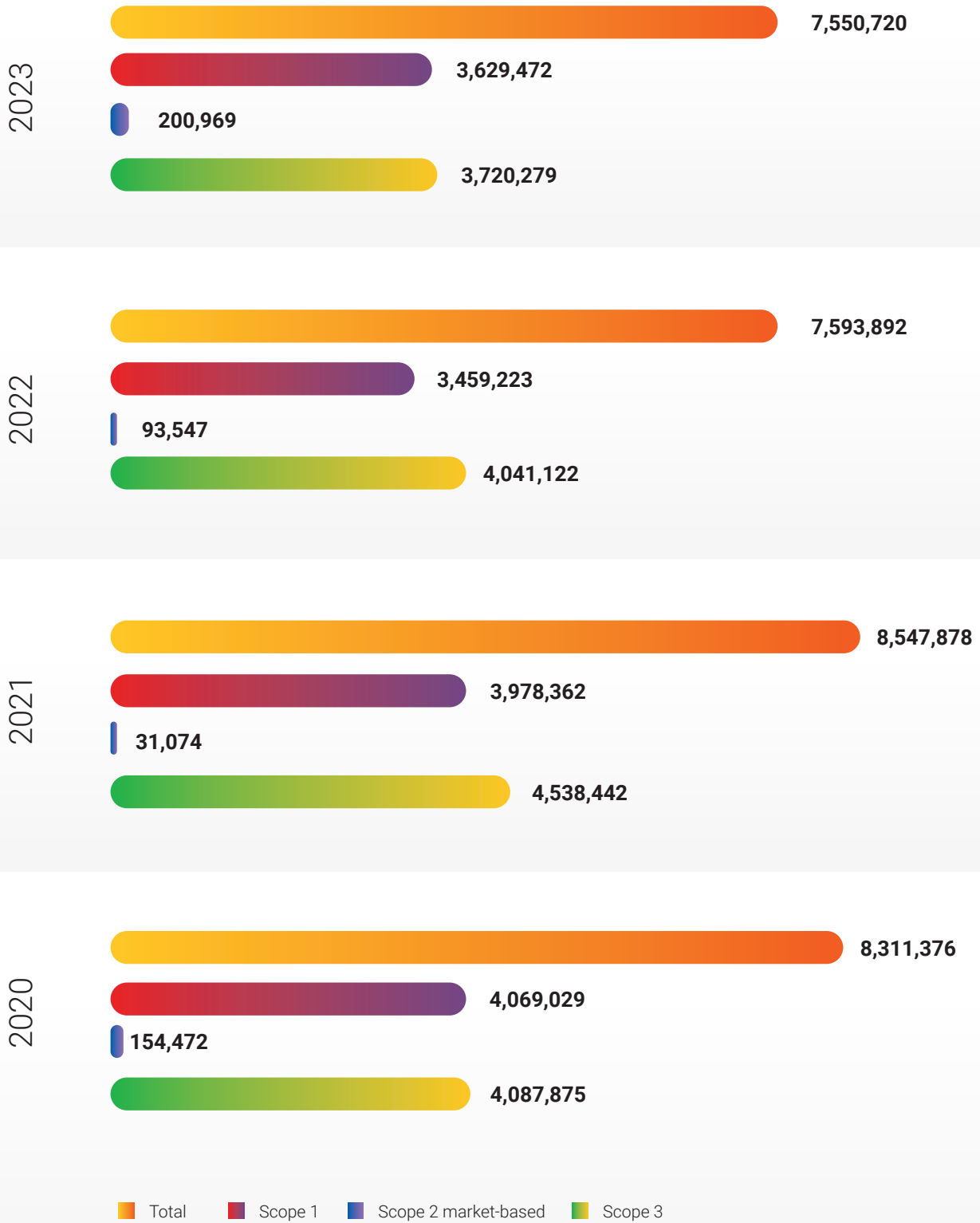


emissions deriving from the Group's indirect consumption, i.e. the emissions generated by electricity purchased from third-party suppliers and consumed both in the Group's plants and offices;



all emissions which, although connected to core and business activities, are not directly controlled by the Group but are produced in Iren's value chain, both upstream and downstream.

Total GHG emissions (tCO_{2eq})



Total GHG emissions are down compared to 2022, although impacted by the expansion of the Group's scope of operations and managed activities, which are reflected in the trend of scope 1 and scope 2 emissions. The decarbonization strategy adopted by the Group has led to the definition, in the Strategic Plan to 2030, of significant targets for the reduction of GHG emissions that affect production processes, procurement and commercial policies: These emission reduction targets were validated by the Science Based Target Initiative (SBTi):

- 47% reduction in the carbon intensity of energy production (scope 1) by 2030 compared to 2020;
- zeroing of scope 2 emissions, calculated according to the GHG Protocol market-based methodology, by supplying 100% renewable electricity by 2030;
- reduction of 25% of scope 3 emissions related to the use of products sold (category 11 of the GHG Protocol) and 13% of scope 3 emissions related to the purchase of energy (category 3 of the GHG Protocol), by 2030 compared to 2020.

SCOPE 1 EMISSIONS

Direct GHG emissions - Scope 1 (tCO _{2eq})	2023	2022	2021	2020
Production facilities ⁽¹⁾	3,428,303	3,256,849	3,764,218	3,856,284
· of which co-generation, thermal and thermoelectric power plants ⁽²⁾	2,972,814	2,808,945	3,333,617	3,418,020
· of which waste-to-energy plants (non-biogenic portion)	455,471	447,882	430,573	438,232
· of which combustion reactions for process uses or services	18	22	28	32
Company vehicles ⁽³⁾	30,143	25,258	19,978	18,555
Gas distribution network ⁽⁴⁾	17,361	18,927	22,699	21,039
Landfills ⁽⁵⁾	145,996	149,573	163,106	166,025
Other emissions (heating, air conditioning, and other production support activities) ⁽⁶⁾	7,667	8,616	8,361	7,126
TOTAL	3,629,470	3,459,223	3,978,362	4,069,029

⁽¹⁾ The fuel emission coefficients published in the 2022 National Standard Parameter Table of the Ministry of the Environment and the Energy Security are used.

⁽²⁾ 87% of emissions from cogeneration plants, thermal power plants and thermoelectric plants are covered by the purchase of carbon allowances within the ETS (Emission Trading System).

⁽³⁾ INEMAR - ARPA Lombardia (2018) emission coefficients are used.

⁽⁴⁾ A gas leakage rate value of 0.1% and methane GWP (Global Warming Potential) of 28 is assumed.

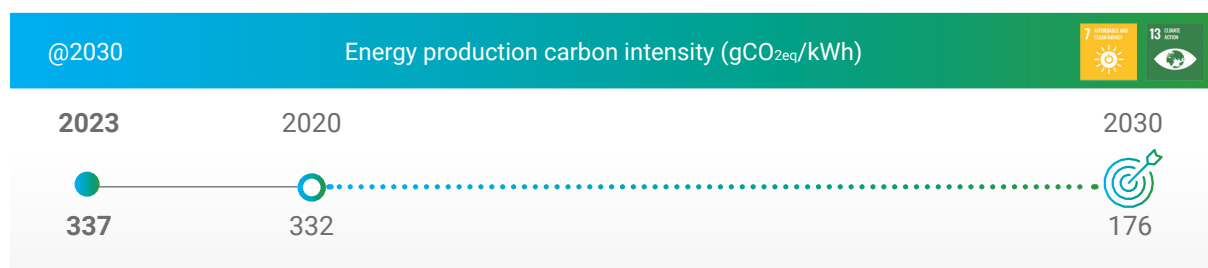
⁽⁵⁾ The GWP of methane of 28 is used.

⁽⁶⁾ Fuel emission coefficients published in the 2023 National Standard Parameters Table and specific GWPs for individual fluorinated gases are used. This includes SF6 emissions equal to: 203 tCO_{2eq} in 2023, 157 tCO_{2eq} in 2022, 109 tCO_{2eq} in 2021 and 25 tCO_{2eq} in 2020.

Direct biogenic GHG emissions (tCO _{2eq})	2023	2022	2021	2020
Waste-to-energy plants	474,062	466,163	448,147	456,119
Landfills, treatment plants and biodigesters	53,277	46,447	32,796	24,915
TOTAL	527,338	512,610	480,943	481,034

The carbon intensity of energy production stands at 337 gCO_{2eq}/kWh in 2023 (the index is calculated according to SBTi considering all scope 1 emissions of energy production plants, related to all electricity and heat produced). The decrease, compared to the previous year, is mainly due to an increase in energy production from renewable sources (especially hydroelectric, photovoltaic and wind) and a decrease in energy production from cogeneration plants and boilers.

The objective set out in the Group’s Business Plan is to reduce the carbon intensity of energy production to 176 gCO_{2eq}/kWh in 2030. The path, defined for the achievement of this objective, includes several variables: industrial, such as the development or acquisition of renewable sources for energy production, scenario, such as the availability of hydrogen and renewable gases that allow the use of fuel blends to replace natural gas alone, and technological, such as the capture and storage of CO₂ emitted by plants.



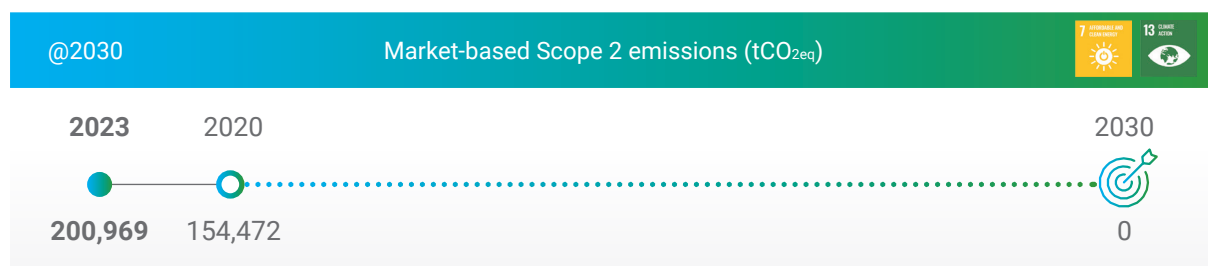
SCOPE 2 EMISSIONS

GHG emissions - Scope 2 (tCO _{2eq})	2023	2022	2021	2020
Location-based methodology ⁽¹⁾	118,584	109,857	111,869	99,720
Market-based methodology ⁽²⁾	200,969	93,547	31,074	154,472

⁽¹⁾ The location-based methodology considers the average emission intensity of the networks where energy consumption occurs (using primarily network average emission factor data). Emissions are therefore obtained by multiplying the electricity purchased from third parties by the emission factor of the national production electricity mix, which for 2023, is equal to 268 kgCO₂/MWh, for 2022, it is equal to 260 kgCO₂/MWh, for 2021, it is equal to 278 kgCO₂/MWh and for 2020, it is equal to 296 kgCO₂/MWh (source: Italian National Inventory Report 2023, ISPRA).

⁽²⁾ The market-based methodology considers the emissions of the type of electricity the company has chosen to purchase. The emissions are, therefore, obtained by setting at zero emissions the share of electricity purchased from renewable sources certified by Guarantee of Origin and multiplying the share of electricity purchased from non-renewable sources by the emission factor that refers to the national residual mix of the previous year, which for 2023, is 457.15 kgCO₂/MWh, for 2022, is 456.570 kgCO₂/MWh, for 2021, is 458.57 kgCO₂/MWh, and for 2020, is 458.57 kgCO₂/MWh (source: European Residual Mixes, AIB).

In 2023, there is a slight increase in scope 2 location-based emissions compared to the previous year, due in particular to the commissioning of newly built plants in the environment sector and the acquisition of new companies in the integrated water service. In the management model adopted by the Group, the main source of “clean” energy (certified with a guarantee of origin - GO) for internal consumption and sales to end customers is the renewable energy production of the Group’s plants. In 2023, the strategy adopted favoured the use of renewable GO energy produced to meet the growing demands of end customers. Scope 2 market-based emissions, which result from domestic consumption, have therefore increased compared to 2022.



SCOPE 3 EMISSIONS

The Group is indirectly responsible for emissions produced by its suppliers and customers and by the entire value chain. This is why it is committed to constantly refining the scope 3 emissions reporting scope.

When analysing total orders - the figure on which the calculation of scope 3 emissions of purchased goods and services, capital goods, transport services and upstream distribution is based - scope 3 emissions are reduced overall compared to 2022, mainly due to the lower contribution of emissions from efficiency produced in terms of purchased capital goods and goods and services, the use of products sold, and emissions related to waste produced. Added to these effects is that of the consolidation of the companies Amter and Acquaenna, whose emission contribution, previously included in scope 3 investment category emissions, was inventoried in scope 1 and 2 emissions.

GHG emissions - Scope 3 (tCO _{2e})	2023	2022	2021	2020
Goods and services purchased ⁽¹⁾	772,936	1,019,014	993,814	765,777
Capital assets (plants and machinery) ⁽¹⁾	13,069	17,501	7,190	3,256
Use of fuel and energy (not included in Scope 1 and 2 emissions) ⁽²⁾	425,322	402,180	470,642	480,459
Upstream transport and distribution services ⁽¹⁾	201,986	157,273	107,164	35,389
Transport of waste produced ⁽³⁾	50,491	62,652	57,759	75,379
Business trips ⁽⁴⁾	256	477	220	137
Employee commutes ⁽⁵⁾	20,400	20,400	12,750	12,750
Use of products sold ⁽⁶⁾	2,066,851	2,238,594	2,673,920	2,464,655
Downstream leased assets ⁽⁷⁾	11,087	10,326	9,268	8,602
Investments ⁽⁸⁾	157,881	112,705	205,715	241,472
TOTAL	3,720,279	4,041,122	4,538,442	4,087,876

⁽¹⁾ All orders from suppliers during the year are analysed and the emissions related to each type of goods and services purchased were estimated using the emission factors used in previous years of the "Quantis Scope 3 Evaluator" tool of the GHG Protocol.

⁽²⁾ Emissions are calculated using Well-to-Tank (WTT) UK Government GHG Conversion Factors for Company Reporting, which quantify the emissions associated with the extraction, processing, and transportation of purchased fuels and electricity. Emission factors are kept constant and equal to the base year 2020 for the purposes of comparability over the years and monitoring of the target validated by SBTi.

⁽³⁾ The emissions generated by the disposal of waste produced by the Group have been estimated, using emission factors from the Ecoinvent 3.7.1 database reprocessed using Simapro software.

⁽⁴⁾ Emissions from business travel are calculated through the Group's travel agency (which handles all employee travel), which performs the environmental impact analysis. For the calculation of CO_{2e} emissions, all services booked through the travel agency portal (plane, train, rentals, hotel) are considered.

⁽⁵⁾ Data estimated on the basis of the average number of employees (range over 10,000) used as in previous years by the "Quantis Scope 3 Evaluator" tool of the GHG Protocol.

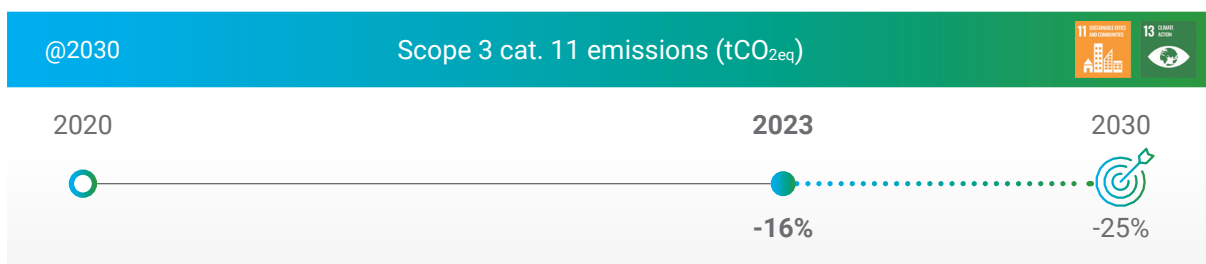
⁽⁶⁾ Volumes of gas distributed to end customers multiplied by the emission factor related to the combustion of the gas are considered.

⁽⁷⁾ Data calculated on the basis of the value of income from rentals and rental income and through the emission factors used in previous years of the "Quantis Scope 3 Evaluator" tool of the GHG Protocol.

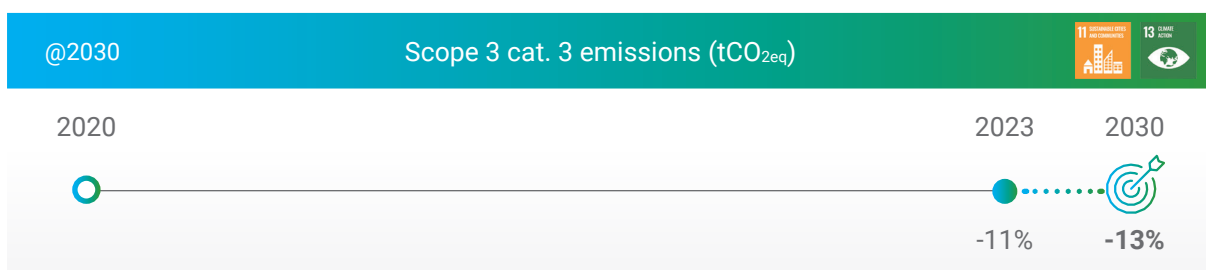
⁽⁸⁾ Data estimated for investee companies not consolidated with the line-by-line method using the emission factors used in previous years of the "Quantis Scope 3 Evaluator" tool of the GHG Protocol. The estimate is based on the annual revenues of the companies and the proportional share of Iren Group's investment in each company.

The Business Plan targets include a 25% reduction in scope 3 emissions related to the use of products sold (category 11) and a 13% reduction in scope 3 emissions related to fuel and energy use (category 3), not included in scope 1 or 2 emissions.

Emissions related to the use of products sold refer to those due to combustion, by the end user, of the natural gas distributed in the Group's networks. The reduction, foreseen by 2030, takes into account scenario analyses that consider aspects such as: the progressive electrification of consumption, the reduction in demand for natural gas for heating due to the rise in average temperatures, the market penetration of hydrogen and renewable gases. In 2023, there was a significant drop in this category of emissions, due to the contraction in the volumes of natural gas distributed, linked to both the warm heating season and the trend in the cost of raw materials, which has led to a reduction in demand.



The item related to the purchase of fuels and electricity quantifies the emissions produced to extract, process and transport the fuels and electricity purchased by the Group. This type of emission is also expected to decrease as a result of both a reduction in the Group’s consumption, thanks to activities planned to minimise the carbon intensity of energy production, and changes in emission factors.



Other atmospheric emissions from production plants concern sulphur oxides (SO_x), nitrogen oxides (NO_x), and particulates.

Atmospheric emissions (t)	2023	2022	2021
SO _x ⁽¹⁾	56	25	43
NO _x	951	746	969
Powders ⁽¹⁾	3	9	10

⁽¹⁾ The data is calculated from the flue gas volume at the stack and the concentration measured by the emission analysis performed by an accredited external laboratory. The determined parameter, which describes the condition of a short period, is then extended to the whole year. This method of calculation may lead to significant differences from one year to the next.

Control and reduction of emissions

Consistent with the strategy outlined in the 2030 Business Plan, the Group has continued to develop renewable assets (» SEE PAGE 113), which constitutes one of the key levers for reducing emissions, just as the predominantly cogenerative set-up (production of electricity and thermal energy that feeds district heating networks) of the Group's thermoelectric park contributes significantly to containing specific greenhouse gas emissions.

Energy production plants fuelled by waste or natural gas adopt combustion technologies that aim to minimise emissions. In particular, larger plants use specific catalysts for the reduction of carbon monoxide (CO) and nitrogen oxides (NO_x). In addition, the plants are equipped with continuous emission monitoring systems that allow the real-time detection of the main pollutants that are periodically monitored through specific indicators and that concern the main species emitted into the atmosphere, in relation to the energy produced. The monitoring of these indicators is also provided for in the Integrated Environmental Authorisations of major installations and in the Environmental Statements of EMAS-registered sites pursuant to Annex IV of Regulation (EC) no. 1221/2009. This makes it possible to improve the efficiency of the combustion process in thermal power plants, including cogeneration plants, larger thermal power plants serving district heating networks, and waste-to-energy plants. These plants are also required, pursuant to the relevant Integrated Environmental Authorisations (IEA), to comply with stricter emission limits than those contained in national legislation. Pursuant to the I.P.P.C. environmental legislation and relevant IEAs, it is mandatory for power plants with a capacity exceeding 50 MW to continually improve environmental services, by updating to the best available technology in order to continually reduce the pollution for the different environmental compartments, including atmospheric emissions. In addition, all thermal and thermoelectric plants, including cogeneration, with a capacity above 20 MW are subject to the system called "European Union Emission Trading Scheme" (EU-ETS). During the year, around 2,834,290 CO₂ allowances (EU Allowances) were purchased to meet the obligations provided for in the Emissions Trading System (ETS) legislation related to emissions generated by Iren Group's plants.

Through the annual monitoring and reporting of greenhouse gas emission data, the aim of this system is to support a more cost-effective reduction of emissions over time at European level and to promote low-carbon investments, to achieve the objectives

defined under the Kyoto Protocol and the Paris Agreement.

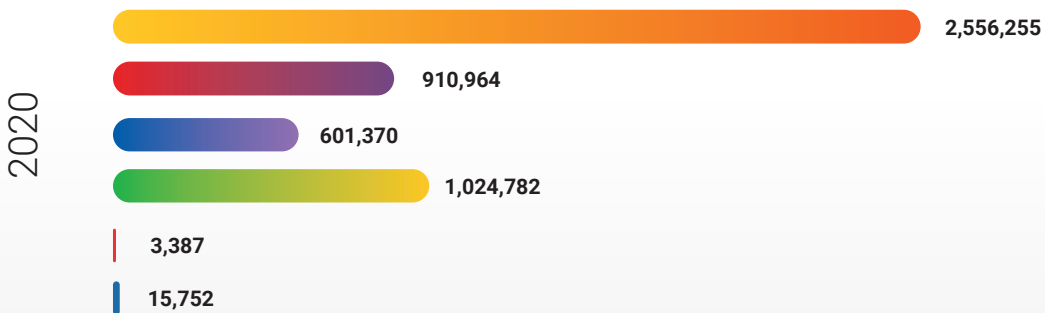
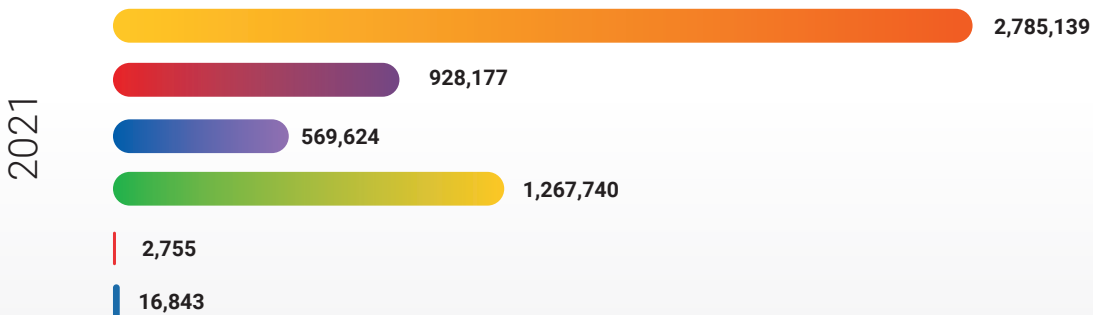
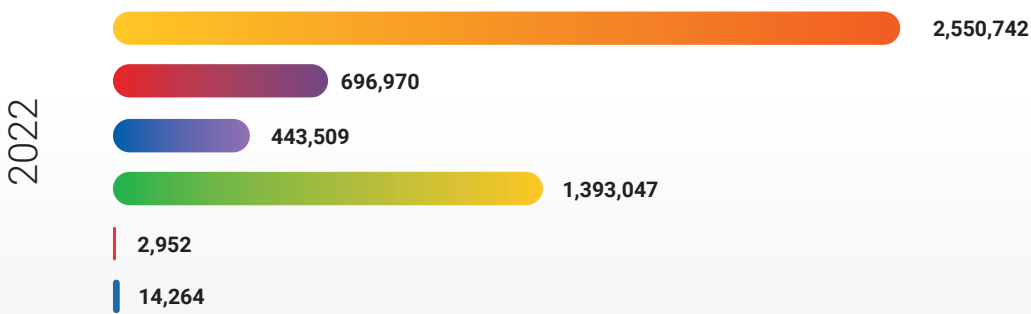
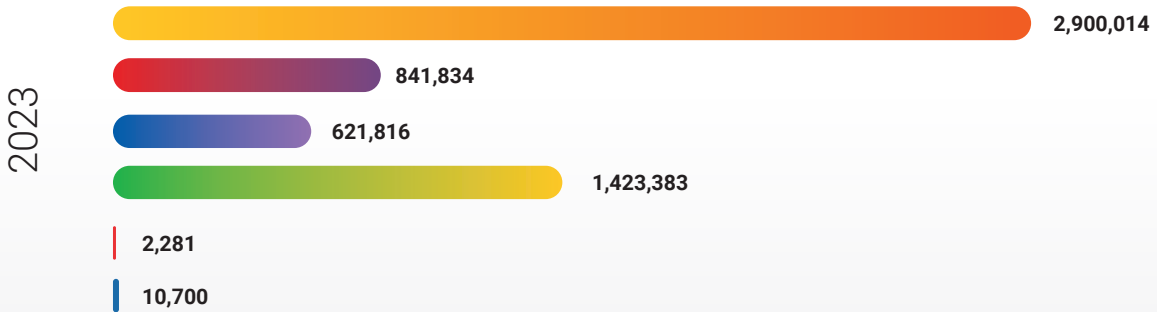
The combustion of the biogas produced in landfills produces the maximum reduction of methane and other greenhouse gas emissions, although its conversion into CO₂ has a potential greenhouse effect 28 times lower than natural gas.

In addition to monitoring and limiting emissions of power plants, Iren Group is contributing to reducing CO₂ emissions also through specific investments and initiatives, such as:

- **district heating** that uses heat produced in cogeneration, replacing traditional condominium boilers and reducing the natural gas consumption;
- **heat accumulators** that store the thermal energy produced by cogeneration plants when the demand for heat is lower, in order to release it during peak load hours of the district heating network, thus reducing the use of integration boilers and allowing a reduction in fuel consumption and related emissions of pollutants into the atmosphere;
- **electric accumulators** that can store or deliver electricity, providing flexibility to the electricity grid and strong support for the development of renewable generation;
- **sorted waste collection and recovery of materials from waste** that allow avoiding both emissions for the production of new materials and emissions that materials would have produced if sent for disposal and generate a positive impact on the environment, for example, through the reuse of plastics, including as a substitute for fossil fuels, and the production of compost and biomethane from organic waste;
- **sustainable mobility** and reduction of employee travel through smart working and agile ways of working.

Total emissions avoided in 2023 by adopting the listed initiatives are summarized in the graph below:

CO₂ emissions avoided (t)



- Total
- From cogeneration, thermoelectric and district heating ⁽¹⁾
- From hydroelectric and photovoltaic plants ⁽²⁾
- From waste ⁽³⁾
- Wastewater plants with biogas production ⁽⁴⁾
- Internal projects ⁽⁵⁾

⁽¹⁾ The calculation considers as a benchmark the emissions of the national thermoelectric system equal to 462.692 kgCO₂/MWh in 2023, 443.510 kgCO₂/MWh in 2022, 452.268 kgCO₂/MWh in 2021 and 457.059 kgCO₂/MWh in 2020 (Terna and PNA figures). The figures also include emission reductions from heat and electricity storage systems.

⁽²⁾ The calculation considers emission reductions from hydroelectric and photovoltaic plants, compared with the conventional thermoelectric mix.

⁽³⁾ CO₂ avoided from waste takes into account: - production from biogenic sources: electricity produced from biogas (landfills and biodigesters), electricity and heat produced by WTE, assuming 51% of the total production of WTE as a renewable source (Source: GSE) and, in the event that there is also production of thermal energy, converting thermal energy into electrical energy according to specific factors (for PAI = 1/6.88, for TRM = 1/4.5, for Piacenza = 1/6) and applying the national reference parameter (see note 1); - sorted waste collection: correlation between the most significant tonnes of recycled waste (paper and cardboard, plastic, organic and green, wood, iron, glass) and the tonnes of CO₂ equivalent saved (source: Waste management options and climate change EC-AEA 2001); - material recovery: the emissions avoided by the primary materials recovered in Group plants and diverted from incineration (iron and metals, plastic, durable goods, other materials) or by the secondary raw material produced by their recovery (compost, blunair) or by the recovery of sewage sludge.

⁽⁴⁾ The calculation takes into account the amount of biogas from the treatment plants from which electricity was produced.

⁽⁵⁾ Internal Group initiatives are considered (e.g. energy efficiency of plants/processes, electrical storage, electric mobility).



2.9 million tonnes of CO_{2eq} avoided by eco-friendly energy production, sorted waste collection, material recovery and numerous other initiatives

In the Business Plan to 2030, the Group expects to avoid almost 2.3 million tonnes of CO₂ emissions thanks to sorted waste collection and recovery of materials and energy from waste.



Emissions of NO _x and SO _x avoided ⁽¹⁾ (t)	2023	2022	2021
Nitrogen oxides (NO _x)	132	594	546
Sulphur oxides (SO _x)	94	182	229

⁽¹⁾ The calculation considers emissions that, for the same amount of energy produced, would have been generated by domestic heating systems and the national electricity production network, subtracting the emissions effectively produced by the Group's plants.

OTHER INITIATIVES TO REDUCE EMISSIONS

In order to reduce **fugitive emissions** related to the dispersion of methane gas into the atmosphere in the gas distribution service, the Group adopts distributed monitoring systems (remote control), anti-intrusion systems, the continuous planned search for leaks and the ordinary and extraordinary maintenance of networks, measuring and reduction units. In addition, at the Group's main thermoelectric power plants (Moncalieri, Torino Nord and Turbigo), annual monitoring campaigns of fugitive methane emissions released by plant lines and equipment are carried out by specialised companies in order to contain and reduce diffuse non-ducted emissions.

In 2023, a new catalyst module for the abatement of **nitrogen oxides (NO_x)** was allocated at the Turin waste-to-energy plant.

For the containment of the biogas emissions from **landfills**, cycles of internal control are carried out for the regulation of the valves at the top of the biogas collector wells with measurement of the capturing efficiency of the plant.