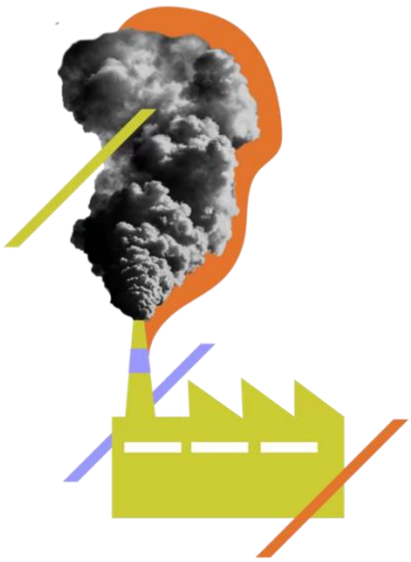
THE ITALIAN CLIMATE CHANGE THINK TANK

THE NATIONAL ENERGY AND CLIMATE PLAN

A plan for action

SECTORAL SCENARIOS

Industry sector



SECTORAL DECARBONISATION SCENARIOS

The new version of the NECP must update national and sectoral targets on the basis of a more ambitious EU- wide greenhouse gas (GHG) reduction target of **-55% by 2030 compared to 1990 levels,** as redefined with the approval of the *"Fit for 55"* package, i.e. the set of directives and regulations that sets climate and energy objectives for Member States aligned with the climate neutrality objective in 2050.

This objective translates into the achievement of the objectives set out in the following table:

	Unit of measure	Data 2021	Fit for 55 target
Greenhouse gas reduction targets			
ETS reduction target (compared to 2005)	%	-47	-62
Effort Sharing reduction target (compared to 2005)	%	-17	-43,7
Absorption Increase Target (LULUCF)	$MtCO_{2eq}$	-27,5	-35,8
Renewable Targets			
Share of RES in gross final energy consumption	%	19	38,4%-39%
Share of RES in gross final energy consumption in transport	%	8	29%
RES share in gross final consumption for heating and cooling	%	20	29,6%-39,1%
Share of hydrogen from RES on the total used in industry	%	0	42%
Energy efficiency targets			
Primary energy consumption	Mtep	145	115 (±2.5%)
Final energy consumption	Mtep	113	94,4 (±2,5%)
Annual savings in final consumption	Mtep	1,4	73,4

Table 1 – *Objectives of the National Integrated Energy and Climate plans as identified by the Fit for 55 Package. The ETS objective is intended at EU level, while other targetsare to be seen at national level. (Source NECP 2023)*

Without considering the emissions under EU ETS which have a EU-wide reduction target[1], in line with the new objectives, national emissions by 2030 relating to the sectors included under the *Effort sharing Regulation* should fall from the current 284$MtCO_{2eq}$ to **194 $MtCO_2eq$[2],** meaning more than 30% compared to 2021 levels. It is important to underline that the reduction target is only the end point of a reduction trajectory with **binding annual targets,** so that any non-compliance in each of the years cumulates over the period 2021-2030.

[1] Equal to -62% compared to 2005, and also includes emissions from the maritime and aviation sectors.

[2] Estimated by applying a reduction of -43.7% compared to the 2005 level of 343.8 MtCO2e and as also indicated in the 2023 NECP proposal https://commission.europa.eu/system/files/2023-07/ITALY%20-%20DRAFT%20UPDATED%20NECP%202021%202030%20%281%29.pdf

In addition, **under current policies,** and taking into account the effects of measures adopted up to 2021, including those defined in the NRRP (National Recovery and Resilience Plan), an emissions gap of more than 10 $MtCO_{2eq}$ already appears in 2021. As shown in the table below, this gap, continues to grow to 52.5 $MtCO_{2eq}$ by 2030 in the absence of further measures.

	1990	2005	2021 MtCO2 eq.	2025	2030
Greenhouse gas emissions (excluding LULUCF), of which:	**523**	**594**	**418**	**373**	**350**
ETS Sectors		248	132	124	110
Effort Sharing Industries (ESR)		344	284	263	246
Effort Sharing Objectives (*)			273	241	194
Distance to ESR targets			***10,9***	***22***	***52***

Table 2 ***–*** *Historical greenhouse gas emissions and projections under current policy baseline for the ETS and non-ETS sectors. Source: ISPRA - NECP 2023*

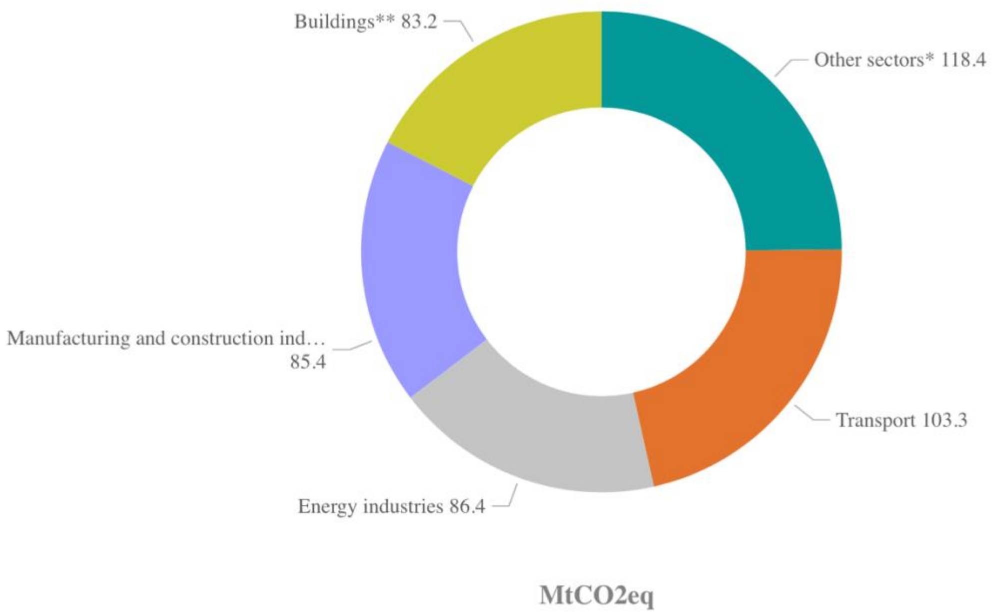


Figure 1 ***–*** *Contribution of individual sectors to total GHG emissions in 2021. Consistent with the NECP scenarios and the greenhouse gas inventory, the building sector includes emissions from Agriculture 'energy'; Other sectors include the remaining fugitive and non-energy emissions (Industrial Processes, Agriculture and Waste).*

The Effort sharing sectors, for which it is necessary to achieve annual and binding reduction targets for Italy, include the building and transport sectors, both of which are very significant in terms of emissions, accounting respectively for about 29% and 36% of the total ESR[3] sectors and the industrial sector with installed capacity of less than 20MWt (14% of the total ESR including emissions deriving from industrial processes and the use of products (IPPU)). Agriculture (only non-energy, i.e. livestock and crops, 11%) and waste (7%) are also included (Figure 1).

[3] Source: Table 5.5 https://www.isprambiente.gov.it/files2023/pubblicazioni/rapporti/rapporto_384_2023_le-emissioni-di-gas-serra-in-italia.pdf, 2021 data

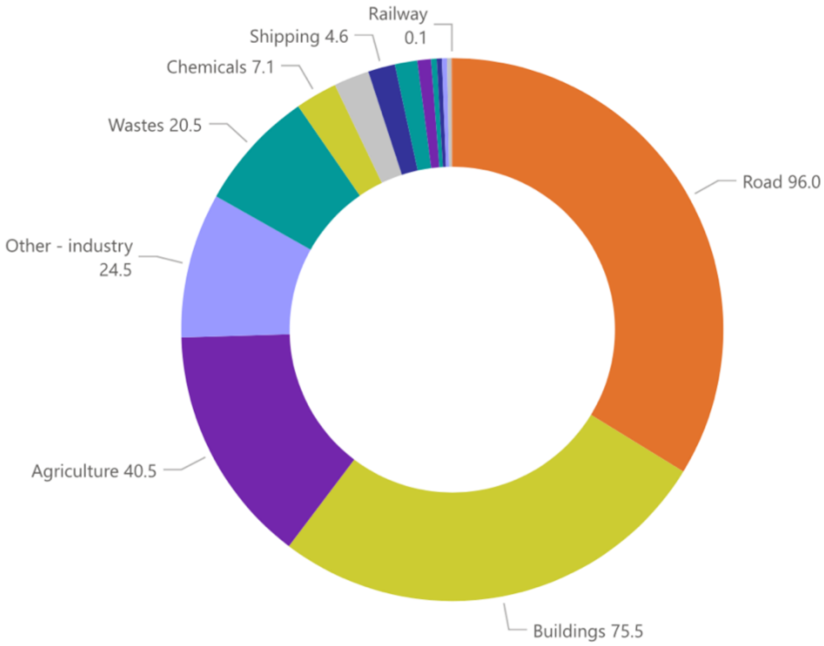


***Figure 2** – Emission contribution of the individual sectors compared to the total included in Effort Sharing. Date 2021. ECCO elaboration on ISPRA2021 data.*

In order to be able to analyse and make alternative or complementary proposals to those currently present in the NECP, a *bottom-up* 2021-2030 emissions scenario has been developed, i.e. **starting from the policies and their expected effect,** in order to highlight their risks and opportunities. The scenario, called ECCO-FF55, has been developed for the four main macro-sectors of energy production and use: power, buildings, industry and transport. These account for 76% of emissions and are the sectors with the greatest abatement potential by 2030. The work is not based on the use of a model, strictly speaking, but on a simplified **bottom-up evaluation methodology developed to associate emission reductions with the policies and measures framework, providing information on their priorities and effectiveness, investment needs and the reform framework needed to enable the transformation.**

For each sector, the following chapters will show:

1. The main characteristics of the sector, the emission share, the historical trends and the main drivers of these trends.
2. The main differences compared to the NECP2023 scenario.
3. The policies underpinning the ECCO scenario, highlighting priorities and, where possible, integrating cross-cutting dimensions, in particular the financing of measures.

Attached to the document, a table is provided with concrete examples of 'flagship measures' for each sector, which shows the information that would be necessary to be able to **accompany each measure from its design to its implementation.** Where possible, indicators for monitoring the measures have also been indicated.

The paper does not assume scenarios for process emissions from industry (7%), the LULUCF sector (Land Use, Land-Use Change and Forestry) (6% as removals), agriculture (9.6% energy and non-energy): for these sectors the scenario data have been taken as they are from NECP2023. Similarly, the production potentials of biofuels were assumed to be equal to those of the NECP and a sensitivity analysis was carried out.

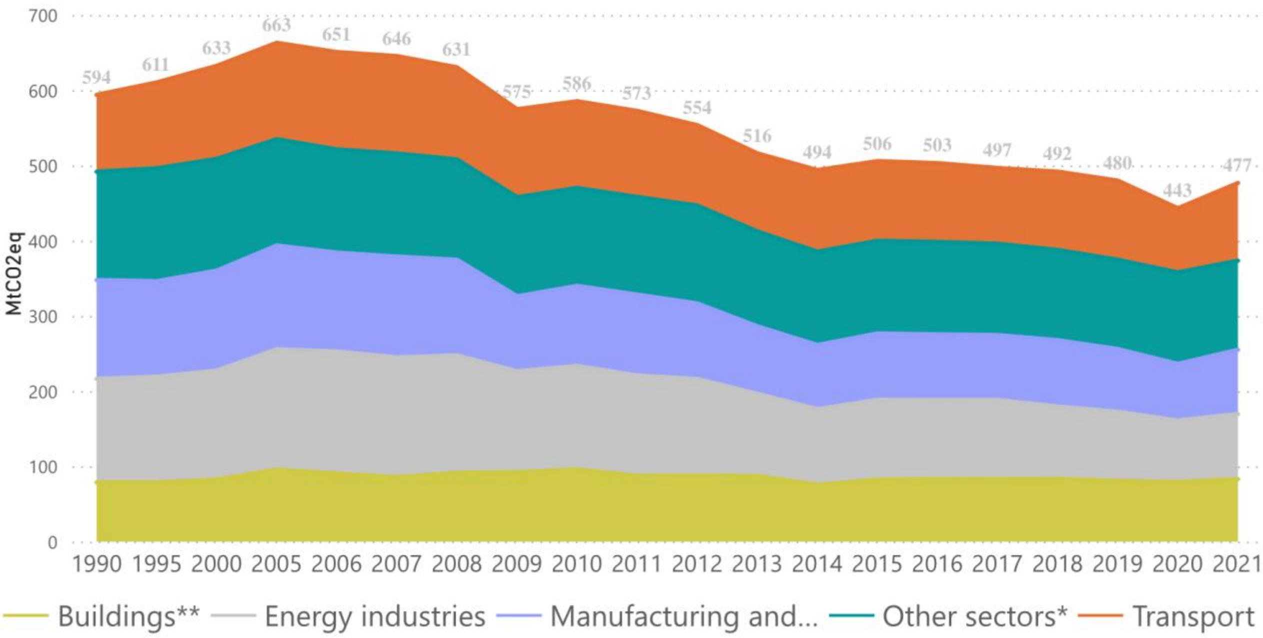


Figure 3 *– Historical evolution of GHG emissions by sector, excluding LULUCF. Other sectors* includes emissions from other energy and fugitive uses, agriculture (livestock and crops) and waste - Source: ECCO elaboration on UNFCCC data [MtCO2eq]*

The ECCO-FF55 scenario considers **Italy's commitment at the G7 towards a substantially decarbonised power system by 2035[4],** enhancing the results obtained from the dedicated modelling exercise. In addition to adhering to the commitments Italy made at the international level, this methodological choice is based on the need to **facilitate the transition across all economic sectors.** In general terms, within the energy consumption sectors, the main *drivers* of reduction are energy efficiency, the electrification of energy consumption, and the production and use of green hydrogen in hard to abate industries.

Only a competitive and decarbonised power system that guarantees stability and energy security for households and businesses can concretely enable the decarbonisation of the country 's energy consumption sectors and economic system. The ability to envision a new power system, able to effectively support the rapid uptake of renewables with appropriate and innovative solutions for stability and supply security forms, represents the foundation of a plan capable of achieving the objectives and aligning the country with the committed decarbonisation pathway.

Given the strategic relevance of the decarbonisation of the power sector, the ECCO-FF55 scenario is based on a modelling analysis explicitly developed for the power sector and fully integrates its results into the overall reduction scenario (i.e the ECCO-Artelys scenario).

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[4] Comuniqué 2023 https://www.whitehouse.gov/briefing-room/statements-releases/2023/05/20/g7-hiroshima-Leaders-communique/#:~:text=We%20reaffirm%20our%20commitment%20to,temperature%20rise%20within%20reach%20and, which recalls the communiqué of the previous year https://www.bmuv.de/fileadmin/Daten_BMU/Download_PDF/Europa_International/g7_climate_energy_environment_ministers_communique_bf.pdf

In the period 2021-2030, the ECCO-'*Fit For 55' (*ECCO-FF55) scenario envisages an overall reduction of **-54.5%** in GHG emissions **compared to 2005[5],** reaching a value of **270 MtCO2eq by 2030,** compared to **312 $MtCO_{2eq}$** in the NECP (cf. Table 84 of the NECP 2023), achieving the reduction targets set out in the 'Fit for 55' package for Italy.

According to the results of the ECCO-FF55 scenario:

- The sector contributing most significantly to the reduction is the **power sector**, which, accounts for 37% of total reductions. Here, the primary *drivers* include the robust penetration of renewables in the power system, as assumed in the ECCO- Artelys scenario.
- As far as energy emissions from the **manufacturing industry** are concerned, they contribute to the reduction by 22%[6]: the primary *drivers* considered for this sector include leveraging the **electrification** potential for medium to low-temperature process heat, targeting the use of biomethane in energy-intensive sectors, exploiting **green hydrogen** generated through the decarbonisation of the power system, and initiating the decarbonisation process of the **former ILVA of Taranto plant[7].**
- The **transport** sector contributes for 20% of the reductions. The envisaged measures primarily focus on **reducing the demand for private transport** through the *implementation* of policies outlined in the NRRP (National Recovery and Resilience Plan) and various planning tools for sustainable mobility. In this context, certain proposed amendments to the NRRP (National Recovery and Resilience Plan) regarding mobility measures are critically highlighted alongside the emphasised need for highly effective *governance* of the Plan in coordination with local government levels to ensure the successful implementation of these measures. The expected **increase in the number of Battery Electric Vehicle (BEVs)** in the fleet to 3.5 million cars is lower than the NECP's projection of 4.3 millions, despite policies being more focused towards fleet electrification. Regarding the **shipping sector,** reductions are anticipated due to the implementation of the NRRP (National Recovery and Resilience Plan) investments in electrifying national port docks (i.e. cold ironing) and partially replacing the ferry fleet for shipping people and vehicles to and from the islands[8].
- In the **building sector[9],** the contribution to the overall reduction amounts to approximately 16%. The principal drivers are the **enhanced electrification** of final consumption, achieved through the accelerated replacement of traditional heating systems with (exclusively) electric heat pumps, and an increase in the rate of **renovations up to 2030** from the current value of 0.37% to 4% by 2030. This represents a significant increase compared to the rate of 1.9%

[5] Reference year for EU climate and energy policies. This translates to 48% compared to 1990 emission levels, the basis for communicating the EU's commitment to the Paris Agreement. This is Italy's contribution to the Union's total contribution, which amounts to -55% compared to 1990 levels.

[6] On the basis of ECCO calculations, it is estimated that the push for electrification contributes to a reduction in particularly in the ESR sectors, which saw emissions reduced by 38% compared to 2005.

[7] In order to be consistent and to make comparisons, in line with the emission scenarios of the NECP, the emissions relating to the former ILVA of Taranto are counted partly in the energy industries sector (for the share relating to the production of coke) and, in part, in the industrial sector (for the production of steel from blast furnaces).

[8] This last contribution, considered in ESR, will have to be quantified as an ETS following the inclusion of the sector in the EU ETS, as provided for in the last revision of the Directive.

[9] It should be noted that, with regard to the 'energy' emissions of the agricultural sector which, following the classification of the inventory, are 'merged' with the civil sector, no specific measures have been envisaged, although the potential for reduction is quite significant (the sector emits about 7MtCO2eq). While respecting the objectives of the RED Directive, it could be envisaged to allocate at least part of the potential biofuels for heating and traction of agricultural machinery, moving the current SADs for the promotion of alternative fuels.

assumed in the NECP for the period 2021 to 2030. The measures supporting this scenario include targeted incentives for deep renovations and replacement of heating systems, based on a reform hypothesis for the current eco and superbonus mechanisms promoting energy efficiency.

The scenario accounts for the emission trends and the historical inertia observed within individual sectors, whilst identifying a framework of priority measures. These measures are distinctly aimed at bridging the emissions *gap* identified in the NECP, especially for the *Effort sharing* sectors, notably in transport, building and industry.

	2005	2030	
		NECP	ECCO-FF55
	MtCO2eq		
From ENERGY USES, of which:	**488**	**232**	**189**
Energy Industries	160	51	41
Industry (including manufacturing other comb.)	92	41	34
Transport	128	77	64
Building sector	96	56	43
Of which agriculture*	9,2	7	7
Other energetic and fugitive uses	12	7	7
From OTHER SOURCES, of which:	**106**	**81**	**81**
Industrial Processes	46	33	33
Agriculture (cultivation and livestock)	35	32	32
Waste	24	16	16
Total (excluding LULUCF)	**594**	**312**	**270**
LULUCF	-36	-35	-35
Of which ESR	**344**	**216-223**	**193**
Distance to ESR targets		**22-29,1**	**-1**

Table 3 – *Historical evolution of GHG emissions by sector (source: ISPRA) and emission scenario for 2021-2030 (source: ECCO elaboration)*

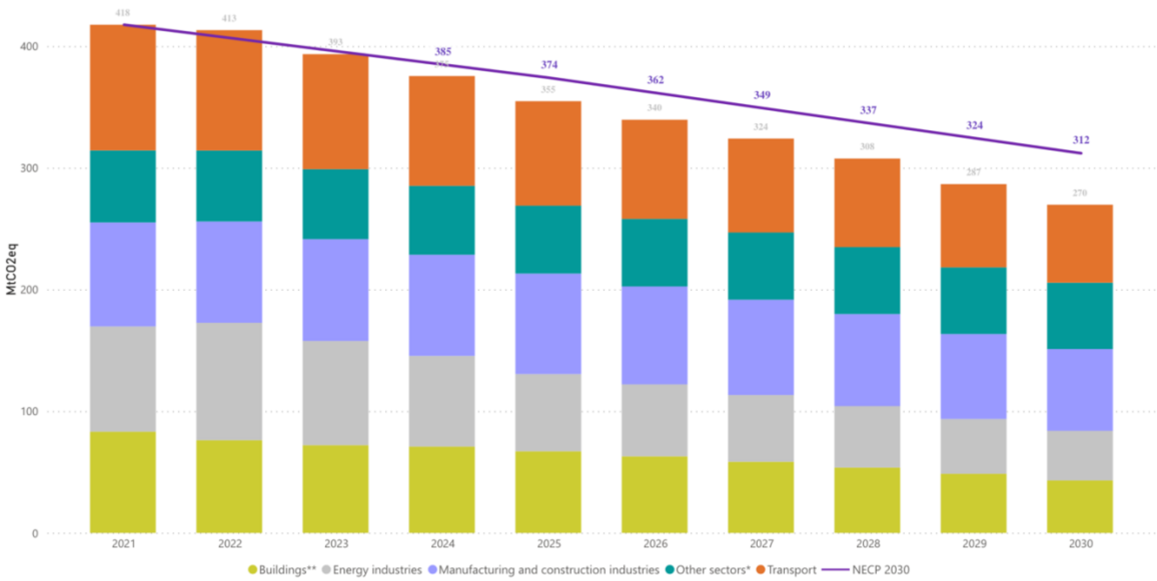


Figure 4 – *ECCO-FF55 emission scenario for 2021-2030, excluding LULUCF, and comparison with NECP scenario - Source: ECCO elaboration [MtCO2eq]*

INDUSTRY SECTOR

The main characteristics of the industrial sector

- Net of emissions from energy industries, the Italian manufacturing sector contributes 22% of national greenhouse gas emissions[10] in 2021.
- In the period from 1990 to 2021 greenhouse gas emissions from Italian industry decreased by 35% both as a result of the implementation of climate policies, such as the EU ETS, and due to a reduction in production and the number of active companies, particularly after the economic crisis of the years 2008-2009.
- About 57% of emissions from the manufacturing sector fall within the EU ETS sectors, with the remainder in the ESR sectors, for which the national reduction target is in force [11]. This means that about 36 Mt CO_{2eq} fall within the national competence under Effort Sharing Regulation.

The greenhouse gas emissions reduction scenario

- The NECP scenario envisages a 24% reduction in energy emissions from the industrial sector by 2030 compared to 2021 levels, while the ECCO-FF55 scenario predicts a 37% reduction.
- The NECP scenario shows a final energy consumption by industry of 24.3 Mtoe by 2030, while in the ECCO-FF55 scenario a final energy consumption of 22.2 Mtoe is reached.
- To achieve this result, the proposed scenario assumes a progressive and constant improvement in the energy efficiency of production processes, the partial electrification of low and medium temperature heat, the use of green hydrogen, the allocation of a significant share of biomethane to industry and the conversion of the Ilva plant in Taranto with the DRI (Direct Reduced Iron) technology[12]. In contrast to the draft NECP, by 2030, in the ECCO-FF55 scenario it has also been assumed that CCS (Carbon Capture and Storage) technologies will not be used up to 2030.

Which policies by objective

- The NECP should include strategies for reducing emissions from the manufacturing sector in a dedicated chapter that address in an integrated way both production processes direct decarbonization and adequately support the demand for 'green' products.
- Specifically for the 2030 targets, it is considered necessary that the NECP includes:
  - Policies to support innovation and technologies for decarbonisation, also in *hard- to-abate* sectors
  - Policies for selectively stimulating the demand for low-carbon products.

[10] ECCO processing based on ISPRA data. In this document, the term industry refers to the manufacturing and construction sectors.
[11] ECCO elaborations starting from data "EU Emissions Trading System (ETS) data viewer", European Environment Agency, 27 July 2023 and "Italian Greenhouse Gas Inventory 1990-2021", ISPRA, 2023.
[12] Based on the updated assumptions of the scenario already published in the Taranto study, primary steel production, 2021.

Priority Enabling Policies

- In the case of industry, sectoral analyses that are able to capture the specificities of individual supply chains appear necessary to identify a framework of coherent policies aimed at decarbonisation, while safeguarding the competitiveness of companies, with targeted financial instruments and adequate social policies.
- Specific measures dedicated to SMEs appear to be a priority, in the light of the national industrial ecosystem.
- In the industrial sector, the time component plays a particularly significant role, with policies that must aim to take advantage of short-term reduction opportunities and set up the new decarbonisation solutions of the future.

The Italian industrial sector contributes to 22% of national greenhouse gas emissions[13]. In the period from 1990 to 2021 greenhouse gas emissions from Italian industry decreased by 35%[14]; there are multiple factors that contribute to this reduction:

- the adoption of the European Union's emissions trading system (EU ETS[15]) from 2005
- the adoption of energy efficiency measures at the European and national level
- the shift from higher emitting fossil fuels (coal and oil) to natural gas and renewables.

The decrease in production and in the number of active companies, in particular following the economic crisis of the years 2008-2009.

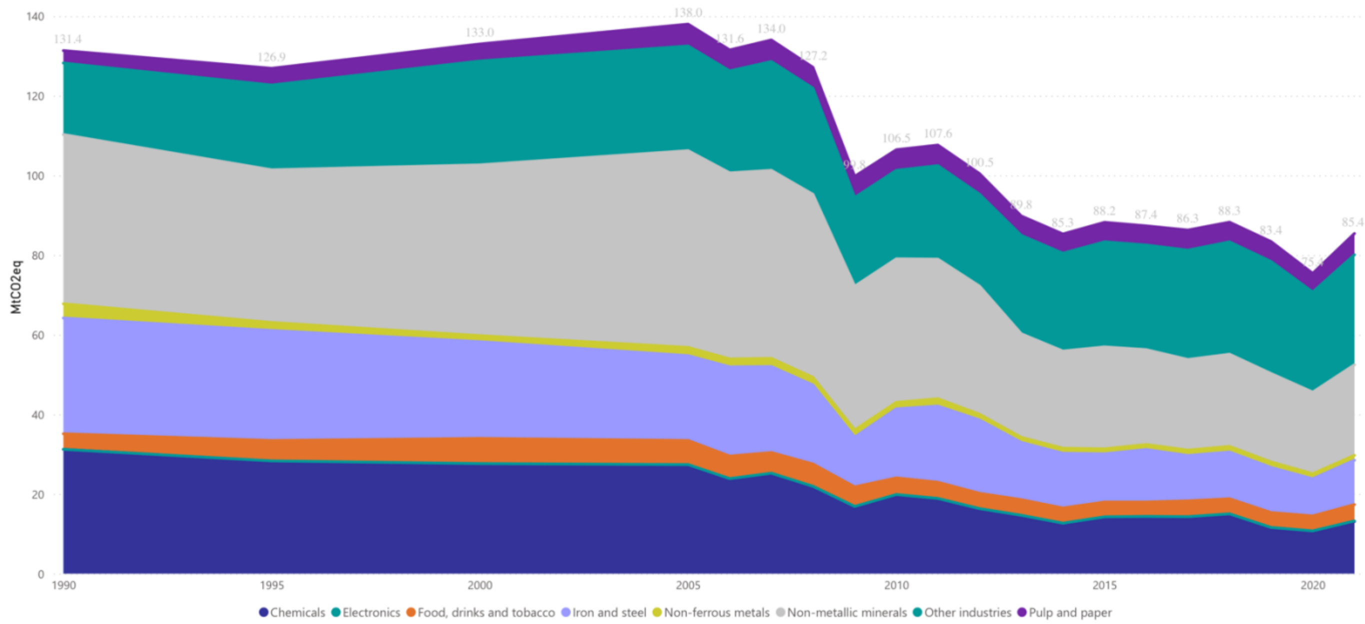


***Figure 5** – Trends in emissions from the industrial sector (MtCO2eq)*

National production plants can be distinguished between those subjects to the EU ETS Directive, i.e. electricity production plants and energy-intensive sectors (steel, chemical, paper, glass, bricks, cement, lime, etc.) and plants with installed power exceeding 20MW, for which, therefore, the

[13] ECCO elaboration based on ISPRA data.
[14] ECCO elaboration based on ISPRA data.
[15] "EU Emissions Trading System", European Commission. https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets_en

component of energy production is relevant. The other plants fall under the Effort Sharing Regulation.

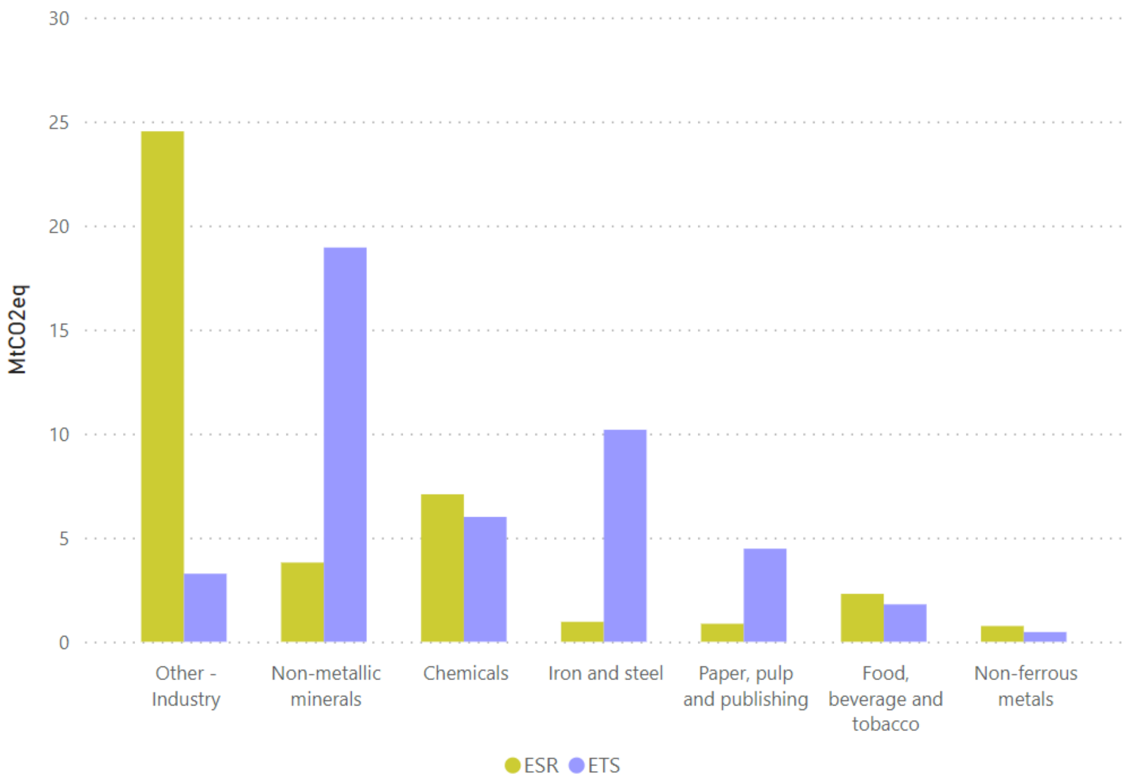


Figure 6 – *Greenhouse gas emissions from industry between sectors subject to the ETS and ESR regulations. The emissions of the individual sub-sectors are reported in absolute values in millions of tons of CO2eq and refer to the year 2021 – Source: ECCO elaboration based on ISPRA data.*

The national economy has been historically characterized by high levels of energy efficiency[16]. With the introduction of the EU ETS in 2005, industry began to reduce final consumption, which showed a more marked trend than value added, leading to a reduction in energy intensity, with an average annual rate from 2005 to 2019 of -2.7%. This reduction was also accompanied by a reduction in value added in the period 2007-2014 of 21% and +8.6% from 2014 to 2019.

Looking at historical data, moreover, the industry shows a rate of electrification of final consumption that in constant growth since 1990, with an acceleration since 2005. In this sector, electricity consumption accounts for 41.8% of final consumption in 2019[17].

[16] The International Energy Efficiency Scorecard still ranks Italy 5th in the world for performance of Energy efficiency of the economic system
[17] https://www.isprambiente.gov.it/files2021/pubblicazioni/rapporti/r343-2021.pdf

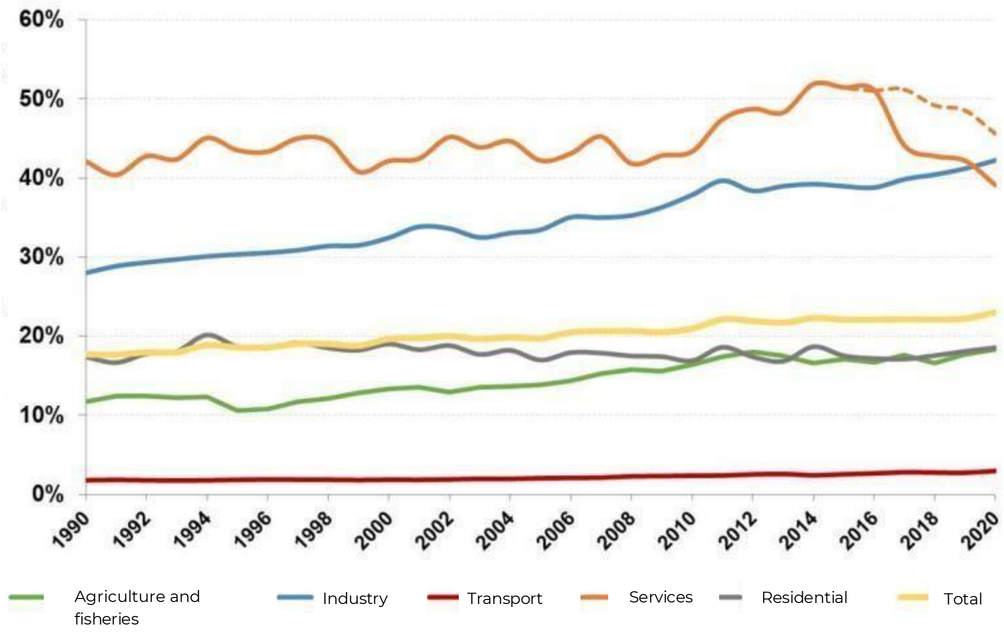


Figure 7 *– Trend in the share of electricity consumption in final energy consumption by sector. For services, the share net of final consumption for ambient heat from heat pumps is also reported (dotted line from 2017). Source ISPRA, 2022.*

The energy crisis that began at the end of 2021 had a direct impact on final energy consumption, that, in the industrial sector, recorded a decrease of 8% in 2022[18]. A significant part of the industry's savings can be explained by the change in the production mix in response to high energy prices. In industry, the share of companies with energy costs above 10% of turnover rose from just over 22% to almost 42%. However, the results of a survey by MBS Consulting Innovation Team and ECCO shows that some of the numerous interventions implemented in emergency will lead to reductions in structural consumption, especially for smaller companies. **The survey also shows that 70% of companies see further margins for reduction and 55% of them would be ready to face new investments to this end.**

For this reason, in the development of the ECCO-FF55 scenario, it was intended to specifically investigate the efficiency and electrification potentials that can be exploited for the achievement of the 2030 targets and which policies should be used for this purpose.

DESCRIPTION OF THE ECCO-FF55 SCENARIO

The ECCO-FF55 scenario, like the NECP scenario, was developed from data from 2021, the year in which the industrial sector emitted 85.4 $MtCO_{2eq}$, of which:

- 53.9 $MtCO_{2eq}$ are “energy" emissions, resulting from the combustion of fossil fuels
- 31.8 $MtCO_{2eq}$ are "non-energy" emissions, linked to chemical reactions in industrial processes.

[18] “Crisi energetica ed efficienza”, Osservatorio Energia. https://eccoclimate.org/wp-content/uploads/2023/10/Crisi-energetica-ed-efficienza-alcune-evidenze_articolo-MBS-ECCO.pdf

In 2021, the final energy consumption of the Italian industrial sector was 29.3 Mtoe (Figure 7 – Figure 8), divided into:

- 11.4 Mtoe of natural gas
- 6.8 Mtoe of other fuels (solid fuels, liquid fuels, renewable energy, biofuels, non-renewable waste)
- 10.3 Mtoe of electricity.

The consumption of natural gas and other fuels was calculated from UNFCCC (United Nations Framework Convention on Climate Change) inventories, net of the share of fuels used to produce electricity with cogeneration plants and the related losses. The data on electricity consumption were obtained from the National Energy Balance[19].

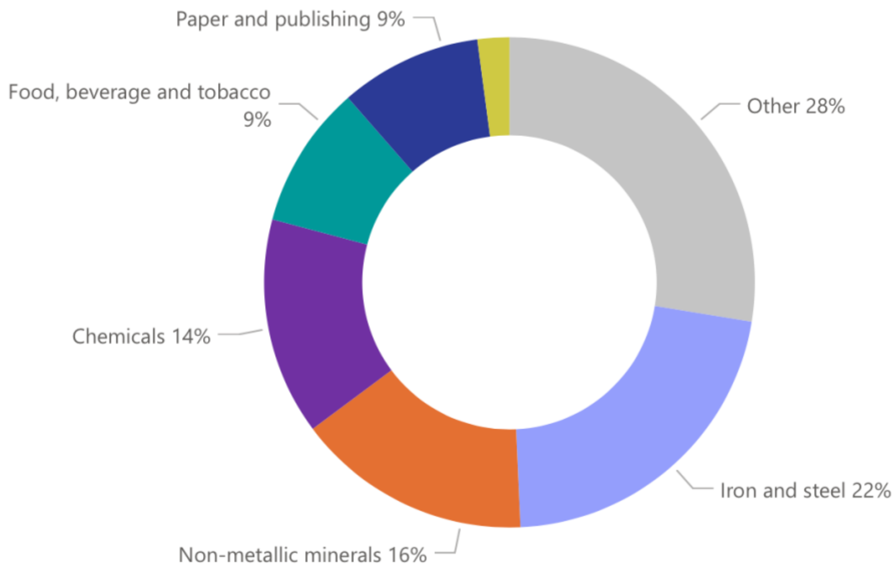


***Figure 8** – Energy consumption of Italian industry in 2021 by sector.*

Sector	% SME[20]	EE Consumption [Mtoe]	ET consumption for fuels [Mtoe]		ET consumption per temperature [Mtoe]			
			Natural gas	Other fuels[21]	T<100° C	100°C<T<150° C	150°C<T<500° C	T>500° C
Chemistry	98.5 %	1.2	1.7	1.3	0.5	0.2	0.9	1.4
Feed Beverages & Tobacco	99.8 %	1.3	0.8	0.7	0.8	0.5	0.1	0.06
Iron & Steel	96%	1.6	2.0	2.8	0.5	0.2	0.2	3.8

[19] "Simplified energy balances", *EUROSTAT*.
[20] "Local Units and Employees: Class of Employees, Economic Sectors (Ateco 3 Digits)", ISTAT.
[21] Consumption of liquid fuels, solid fuels, biofuels and biomass and waste has been grouped under "Other fuels".

Sector	% SME [20]	EE Consumption [Mtoe]	ET consumption for fuels [Mtoe]		ET consumption per temperature [Mtoe]			
			Natural gas	Other fuels[21]	T<100° C	100°C<T<150° C	150°C<T<500° C	T>500° C
Non-Ferrous metals	98.8 %	0.2	0.4	0.02	0.03	0.01	0.02	0.3
Non-metallic Minerals	99.8 %	0.8	2.4	1.3	0.3	0.5	0.2	2.8
Paper & press	99.8 %	0.8	1.9	0.01	0.8	0.2	1.0	0.02
Other	99.7 %	5.0	2.4	0.7	2.3	0.4	0.2	0.2

Tabella 4 *– Consumi di energia elettrica (EE) e termica (ET) dei settori dell'industria italiana nel 2021. I consumi di energia termica sono suddivisi in funzione della tipologia di combustibile utilizzato e del livello di temperatura alla quale è richiesto il calore. Elaborazione ECCO a partire da dati BEN e UNFCCC.*

As evident from Table 4, the electrification potential appears to be concentrated in the food, paper and "other" sectors, which encompasses several sub-sectors of industry, highly represented also in the population of non-ETS installations (Figure 5). Considering this data, therefore, policies aimed at exploiting this potential could contribute to the reduction of national emissions, minimizing to the reduction of the gap identified in the NECP proposal.

In the proposed scenario, a progressive and constant improvement in the energy efficiency of production processes has been assumed, with an average rate of improvement in emissions performance of 2.5% per year. This value was established on the basis of the rate of improvement of the sectoral *benchmark* values, developed by the Commission based on data reported by companies and developed to consider the technological improvement for the fourth phase of the EU ETS[22].

In the past, Italian industries have focused on basic measures that allowed for immediate results in terms of reducing energy costs, but there are opportunities for improvement through more advanced solutions with long-term returns[23]. These interventions mainly concern energy recovery and auxiliary systems for industrial application. Energy efficiency is also fostered by the adoption of monitoring and automation systems, such as Internet of Things (IoT) technologies, an integral part of Industry 4.0 transformation.

In addition to the energy efficiency measures integrated in the reference scenario, further actions are planned in the ECCO-FF55 scenario, namely:

- Electrification of part of the heat required at medium-low temperatures. In 2021, the industry consumed a total of 18.3 Mtoe of heat, of which an estimated 7 Mtoe at temperatures below 150°C. In the proposed scenario, it is expected that 50% of the industrial thermal demand at a temperature below 150°C, equal to 3.5 Mtoe, can be electrified with appropriate guidance and

[22] "Update of benchmark values for the years 2021-2025 of phase 4 of the EU ETS", European Commission, 12 ottobre 2021.
[23] Gianluigi Torchiani, "Italia già avanti nell'efficienza energetica nell'industria: ecco cosa si può ancora fare", Lumi, 28 gennaio 2020. https://www.lumi4innovation.it/about-us/

support policies. It is assumed that only direct heat will be electrified, while no intervention is made on heat from cogeneration. The cogeneration systems used in industry are, typically, highly efficient plants with high heat recovery, for which it is probable that there will be no substantial intervention by 2030. With this measure, it is possible to reduce 8.3 MtCO2eq by 2030 across all industrial sectors, considering the natural gas emission factor.

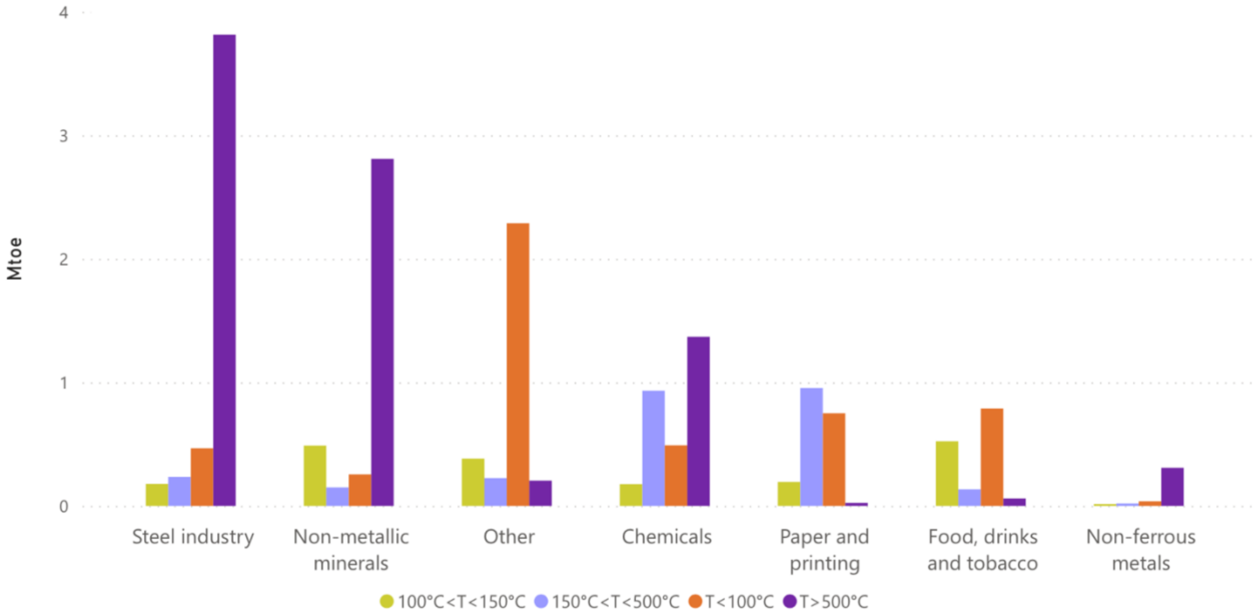


Figure 9 *– Thermal energy consumption of the Italian industrial sectors divided by temperature levels in the 2021*[24].

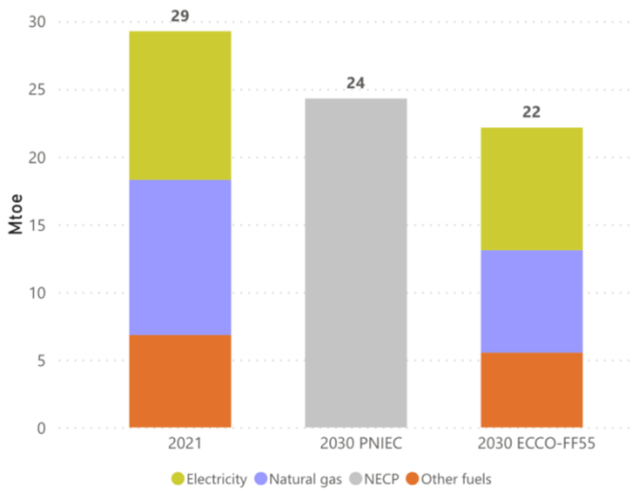
- Use of biomethane. In substitution of natural gas, an increasing consumption of biomethane is assumed, equal to 1.5 billion cubic meters by 2025 and 3.3 billion cubic meters by 2030. The NECP estimates an availability of biomethane from renewable biomass at 5.7 billion m3 by 2030; 57% of this has been allocated, hypothetically, to the industrial sector. This measure reduces emissions by 6.5 MtCO2eq by 2030 across all sub-sectors[25].
- An increasing consumption of green hydrogen. It is assumed that the green hydrogen produced by electricity generation will be used for steel, chemical and petrochemical industries and the refining, for a total of 8 TWh by 2030[26] and a reduction in emissions of 1.6 MtCO2eq, considering the emission factor of natural gas.
- The conversion of the ILVA plant in Taranto to the DRI technology. In this scenario, the conversion of the former Ilva plant in Taranto to DRI technology is envisaged. This conversion, based on the sectoral scenarios developed by ECCO[27], implies the initial use of natural gas,

[24] Processing of ECCO data from the NFCCC, National Energy Balance and Kosmadakis, Georg; «Estimating the potential of industrial (high-temperature) heat pumps for exploiting waste heat in EU industries", Applied Thermal Engineering, 20 April 2019.
[25] That figure is based on two fundamental assumptions, namely the assumption of the biomethane potential equal to that of the NECP (for which reference should be made to the considerations expressed in the box on biofuels) and an allocation of the quantities of biomethane to industry which, in the case of biomethane being fed into the network, should be verified.
[26] This figure is one of the results reported in the study "Development of a transition pathway towards a close to net-zero electricity sector in Italy by 2035", Artelys in collaboration with ECCO, June 2023. https://eccoclimate.org/wp-content/uploads/2023/06/Development-of-a-transition-pathway-towards-a-close-to-net-zero-electricity-sector-in-Italy-by-2035_19giugno.pdf
[27] "A green steel strategy", ECCO, August 2022.

possibly blended with hydrogen, to power DRI plants, with a gradual transition to the exclusive use of green hydrogen. By 2030, it is estimated that 6 Mt of steel will be produced using the DRI technology, with a blend of 90% - 10% natural gas and green hydrogen. By 2030, this measure will result in a reduction of 2 MtCO2eq in total[28].

Under these assumptions, in the ECCO-FF55 scenario, natural gas consumption decreases from 11.5 Mtoe in 2021 to 7.6 Mtoe in 2030 (Figure 10). Energy efficiency and electrification measures account for a large part of the reductions in gas consumption and emissions, as well as the consumption of biomethane and green hydrogen. On the other hand, the conversion of the ILVA steel mill in Taranto to the DRI technology, partly fueled by natural gas, leads to an increase in gas consumption in the medium term. In the long term (post-2030) it is expected that the natural gas used to power the DRI plants will be completely replaced by green hydrogen, leading to the elimination of both natural gas consumption and greenhouse gas emissions.

In the proposed scenario, the electricity consumption of the industrial sector decreases from 11 Mtoe in 2021 to 9.1 Mtoe in 2030. This reduction is the result of a combination of energy efficiency measures, which reduce electricity consumption, and an increased electrification of production processes.



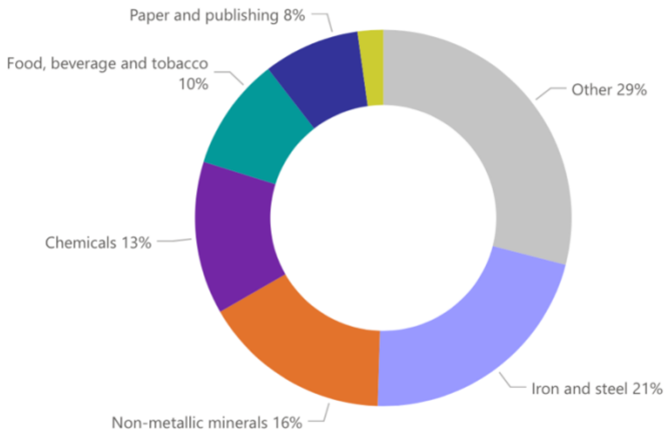


Figure 10 *– Comparison between the CO2eq emissions of the Italian industrial sectors and % contributions to 2030 in the scenario ECCO- FF55.*

In the ECCO-FF55 scenario, the greenhouse gas emissions of Italian industry are equal to 82.6 $MtCO_{2eq}$ in 2025 and 67.2 Mt in 2030 (Figure 11). This value shows a 37% decrease compared to 2021 (-49% compared to 1990).

[28] It is noted that part of the emissions related to ILVA's industrial complex and, in particular, those arising from the production of coke, are accounted for in the energy industries.

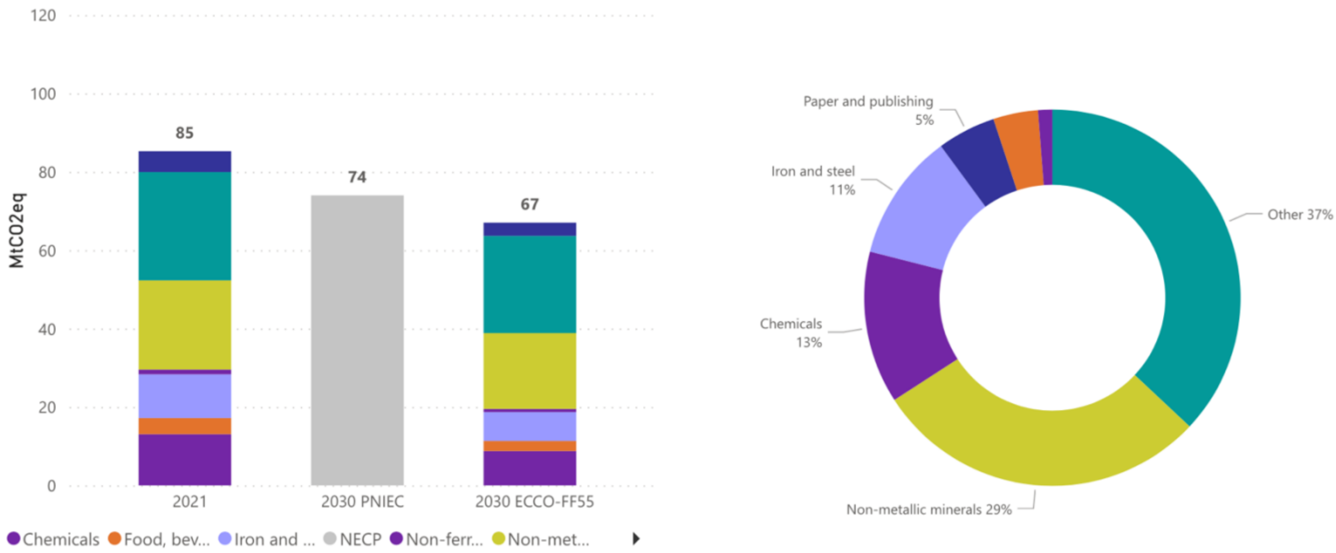


Figure 11 – *Comparison between the CO2eq emissions of the Italian industrial sectors and % contributions to 2030 in the scenario ECCO- FF55.*

POLICIES AND MEASURES UNDERPINNING THE ECCO-FF55 SCENARIO

As mentioned in the chapter 'The Plan and the manufacturing industry', due to the importance of the industrial sector, the policies for its decarbonisation should be part of a dedicated chapter in the Plan andgrouped by macro-objectives.

The necessary policies for transition should take maximum account sectoral specificities and, at the same time, identify cross-cutting measures that can accelerate technological innovation and support companies in making necessary investments.

A NECP for industry should include measures to reduce greenhouse gas emissions, but also to preserve the competitiveness of industry and jobs. A chapter dedicated to the decarbonisation of industry should identify the analytical tools and policies for the management of industrial transformation related to decarbonisation according to two main guidelines, namely:

- Policies to support innovation and decarbonisation technologies, **including for hard-to-abate sectors.**
- Policies to **selectively support the demand for decarbonised products** in synergy with the policies to promote the circular economy.

The Plan should also identify possible tools to analyse the **links between innovative production chains,** highlighting the opportunities and risks arising from the acceleration towards the uptake of zero/low emission technologies, to encourage the adoption of **policies for the management of industrial transformation,** including in terms of employment.

SUPPORT FOR INNOVATION AND TECHNOLOGIES TO REDUCE EMISSIONS

Promotion of energy efficiency and electrification of consumption

There is need for clear guidance and support for companies to invest in innovative technologies to reduce emissions, which are often characterized by high risks and investment costs. In the same way, it is necessary to better address existing policies which, in addition to the 'energy efficiency' component, can enhance that of reducing emissions. This is important especially to accelerate the decarbonisation of industrial plants falling under the Effort sharing Regulation, but not only that, contributing substantially to the achievement of national objectives.

The instruments listed below and referred to in the NECP have multiple destinations or objectives and do not always explicitly combine energy efficiency requirements with decarbonisation requirements. In the NECP, it would be necessary to organize and prioritize these schemes, as well as make changes based on the effectiveness of already implemented measures to improve efficiency or electricity consumption **prioritise and possibly modify these schemes in relation to the effectiveness.** The modalities of access to funds should be simplified and, as far as possible, linked to a single instrument and implementing body, rather than being fragmented. In this context it is necessary to recognize the peculiarities of SMEs and to give them easier access to funding. In addition, the energy price signal induced by the presence or absence of the EU ETS scheme should be adequately considered in policy-making.

1. White Certificates[29]

The White Certificates Mechanism promotes energy efficiency in sectors such as industry, infrastructure and services. It consists of issuing certificates, known as TEE (Energy Efficiency Certificates – Titoli di Efficienza Energetica), after the implementation of significant energy saving interventions. One TEE corresponds to the saving of one ton of oil equivalent (toe). Electricity and gas distributors with more than 50,000 end customers (obliged entities) must comply with primary energy savings obligations and achieve annual targets. This can be done through energy efficiency projects or the purchase of TEEs from third parties, in particular energy service companies (ESCOs).

Since its introduction, the mechanism has certified energy savings of 29.1 Mtoe and released 57.7 million TEE[30]. In recent years, there has been a sharp decline in TEE recognized and certified savings[31]. The 2019 NECP provided *for the continuation of the process of updating and strengthening the White Certificates Mechanism with the aim to simplifying and optimising the methodologies for quantifying and recognizing energy* savings, reducing the time for the approval, issuing and offering of TEE on the market[32].

In line with that purpose, the NECP 2023 could include a relaunch of this scheme that provides a reward for those interventions that, in addition to increasing energy efficiency, allow a reduction in direct greenhouse gas emissions. In this way, the mechanism of White Certificates would be functional not only to improve efficiency, but also to achieve objectives for both ETS and ESR companies.

2. Industrial Trasition Fund[33]

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[29] "White Certificates", ESM. https://www.gse.it/servizi-per-te/efficienza-energetica/certificati-bianchi
[30] Annual Report on White Certificates 2022, *GSE*.
[31] Annual Report on White Certificates 2022, *GSE*.
[32] "Piano Nazionale Integrato per l'Energia e il Clima", Ministry of Economic Development, December 2019.
[33] Industrial Transition Fund, Invitalia. https://www.invitalia.it/cosa-facciamo/sosteniamo-grandi-investimenti/fondo-transizione-industriale

The objective of this fund is to help the Italian production system to adapt to EU policies for combating climate change. The Fund has a budget of 300 million €, half of which is reserved for energy-intensive companies. The subsidies are granted in the form of a non-repayable contribution to companies that carry out interventions to improve energy efficiency in the execution of their activities and/or efficiency in the use of resources, through reducing the use of the same also through reuse, recycling and use of recycled raw materials. The Fund also encourages the installation of plants for the self-production of energy from RES, hydrogen and high-efficiency cogeneration plants. However, interventions that lead to an increase in the production capacity of the plant are not permitted. The Fund has a wide range of actions and is clearly focused on the financing low-risk interventions. The fund's focus on electrification and measures to reduce the sector's direct emissions could create a favorable environment for the decarbonisation of industry.

3. Green 5.0 transition

This is an intervention of more than €4 billion introduced in the revision of the National Plan of Recovery and Resilience of July 2023. Transition 5.0 is a digital innovation scheme to support the green transition in the production system. It will be implemented via a tax credit mechanism and will cover a wide range of economic sectors, including tourism. The objectives are the acceleration of the transformation of instrumental assets and the production processes of companies and the promotion of the creation of new plants and the expansion of those already in place for the production of energy from renewable sources. Projects that aim to reduce energy consumption in production processes, replace the use of fossil fuels, reduce emissions into the atmosphere, promote the recovery of critical raw materials and promote circularity in production processes through a more efficient use of resources are encouraged. The decisive direction of these resources towards interventions in line with the DNSH (Do No Significant Harm) principle, with precise indications of induced and direct emission reductions, could have significant impacts, considering the propensity of companies towards this type of intervention[34].

4. National Energy Efficiency Fund[35]

This instrument promotes the interventions necessary to achieve the national energy efficiency objectives achieved by companies and the Public Administration. The Fund has a budget of 310 million € and is divided into two sections: the granting of guarantees on individual financing projects (30%) and the provision of loans at subsidized rates (70%). Invitalia is in charge of managing the Fund. The reduction of energy consumption in industrial processes is one of the supported interventions. As far as companies are concerned, the Fund appears to be complementary and partially overlapping with other listed measures, for which its contribution should be weighed against the results achieved and the greater or lesser efficiency compared to the other instruments presented here.

5. Thermal Account

The Thermal Account incentivizes interventions to increase energy efficiency and the production of thermal energy from renewable sources for small-scale plants. The beneficiaries are mainly public

[34] According to the results of the survey referred to in the preamble, according to which as many as 70% of companies see room for a reduction in gas demand and with or without incentive policies, 55% are ready to invest in this direction.

[35] "Fondo Nazionale Efficienza Energetica", Ministry of Environment and Energy Security. https://www.mase.gov.it/energia/efficienza-energetica/fondo-nazionale-efficienza-energetica

administrations, but also companies and individuals, who will be able to access funds for 900 million euros per year. In order to optimize dedicated tools for efficiency in enterprises, the instrument based on performance indicators should be revised to this end.

6. Sustainable Growth Fund

The Sustainable Growth Fund (FCS – Fondo per la Crescita Sostenibile) is intended to finance programmes and interventions with a significant impact at national level on the competitiveness of the production system with multiple purposes:

- Promotion of research, development and innovation projects
- strengthening the production structure and re-launching areas of national importance that are in complex crisis through the signing of program agreements
- the promotion of the international presence of companies and the attraction of investments from abroad.

Such a very articulated fund should see a close correlation between the measures and interventions promoted and the policies envisaged in the NECP.

7. Sabatini green

The Sabatini green measure is an incentive offered by the Ministry of Enterprise and Made in Italy aimed at simplifying the obtaining of finance by companies, with the aim of enhancing the competitiveness of the national production sector. Part of the financial allocation of this measure is earmarked for investments with a reduced environmental impact for micro, small and medium-sized enterprises. This provision concerns "green investments" related to the purchase of machinery and plants with "low environmental impact" that improve the eco-sustainability of products and production processes. These measures could be expanded and made more targeted, favoring efficiency and electrification projects.

8. Support for electrification in plants that are under to the EU ETS Directive

The latest revision of the EU ETS Directive provides that Member States (Art. paragraph 1), in the transposition of the directive, may allow installations that fall below the thresholds for inclusion in the emissions trading system, due to electrification interventions, to remain subject to the rule and, therefore, ensure that the investment pays off through the free allocation of CO_2 emission allowances. It is hoped that in the transposition of the law, the Government will decide to allow this possibility, favoring companies that electrify process heat and reduce their emissions.

Support for innovation in Hard to Abate sectors

1. Financing instruments for innovative technological solutions

In interventions that involve the adoption of particularly innovative solutions, it is necessary to establish a form of risk-sharing between private and public investors and to support, in addition to CapEx, OpEX[36]. Una form of support can be Carbon Contracts for Difference (CCfD). CCfDs make it

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[36] See chapter 'Finance and investments in the Plan'.

possible to ensure investments in decarbonisation technologies and the associated economic return, absorbing the risk of eventual failure. A Carbon Contract involves an agreement between the Government or an institution and a private producer to set a carbon price (strike price) for a specific period. If the market price is lower than the agreed price, the government pays the difference to the producer; if the market price is higher, the private sector returns the surplus to the government. These contracts balance the price volatility of CO2 emissions and reduce the risk associated with investments.

This form of investment support is suitable to cover both CapEX and OpEX and, for this reason, it has also been accepted as a financing methodology for Innovation Fund's projects, since the last revision of the EU ETS Directive. By extending the scope of this fund, this methodology can finance particularly risky investments and support private investment through public guarantees.

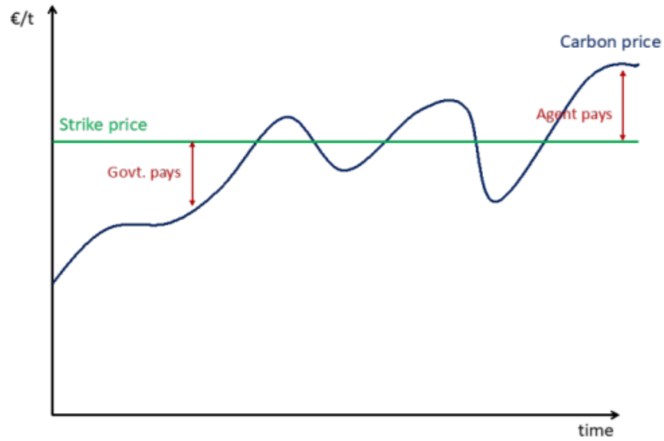

***Figure 12 –** Schematization of the operating principle of Carbon Contracts for Differences* [37].

Conversion of the former ILVA in Taranto

The NECP mentions the conversion of the ILVA plant but apart from this it does not reflect which strategy will be pursued to this end. Although the NECP claims to have taken this conversion into account, it does not explicitly outline the steps and expected effects. In the investment chapter, the financial requirements for the conversion are not specified, nor are its timelines, expected social consequences (to be considered in the estimation of the Plan's socioeconomic impacts), or the just transition measures to be undertaken, aside from mentioning the Just Transition Plan. In previous studies[38], ECCO has analysed the technological, economic and social feasibility of the conversion, identifying DRI technology as a possible mature technological solution for a full conversion of the production process.

The establishment of the company DRI d'Italia seemed to be moving towards implementing the conversion of the production site from blast furnaces to DRI, using funding from the NRRP (National Recovery and Resilience Plan). However, with the July 2023 revision, the € 1 billion allocated to DRI d'Italia for initiating the conversion process has been removed from the Recovery and Resilience Plan

[37] "Carbon Contracts for Differences: their role in European industrial decarbonization", Climate Friendly Materials Platform, September 2020.
[38] "A green steel strategy", ECCO, August 2022. https://eccoclimate.org/wp-content/uploads/2022/09/REPORT-ACCIAIO-Una-strategia-per-lacciaio-verde-en.pdf
e "Taranto, primary steel production in the challenge of decarbonisation", ECCO, November 2021. https://eccoclimate.org/wp-content/uploads/2021/11/Taranto-eng-1.pdf

and, currently, there is no certainty about the fate of these resources and which alternative funds will be used. The revision of the NECP could provide an opportunity to plan conversion interventions that can combine the economic and social sustainability of investments with the environmental sustainability of the project.

The role of hydrogen in industry

Regarding the role of hydrogen, the results of the study carried out by ECCO in collaboration with Artelys were considered as input for the elaboration of the ECCO-FF55 scenario, where the assumptions and the simulations' result of a substantially decarbonised electricity system by 2035 are presented[39]. This report shows a production of 8 TWh of green hydrogen by 2030 due to overproduction of electricity from renewable sources. In the ECCO-FF55 scenario, it is assumed that all this hydrogen will be destined to the steel, chemical, petrochemical and refinery sectors. In this regard, it is evident how the decarbonisation of the electricity sector enables that of other sectors, specifically, industry. The policies referred to in chapter 6.1.2 relating to renewable energy production also enable the transformation of industry. Complementary to these policies are those related to the promotion of green hydrogen from the NRRP (National Recovery and Resilience Plan) and REPowerEU (EU Communication COM).

BOX – THE NECP AND THE ROLE OF CCUS TECHNOLOGIES

Carbon Capture and Storage (CCS) involves a series of processes that encompass the separation of CO_2 from energy sources or emitted gas streams and its transport to a storage location for long-term confinement. Alternatively, CO_2 can also be employed in industrial processes for the production of chemicals, construction materials, or fuels, which is referred to as Carbon Capture and Use (CCU).

Internationally, there are 40 operational commercial facilities applying CCUS to industrial processes, fuel treatment, and energy generation, with a combined capture capacity of 45 million metric tons of CO_2 annually[40]. Announcements have been made for over 50 new capture facilities expected to be operational by 2030, capturing an additional 125MtCO_2 annually. However, as of June 2022, final investment decisions had been made for only 10 of these projects.

Additionally, the International Energy Agency states that even if all 50 announced new facilities were to be built, the use of CCUS would remain a marginal technology for achieving net-zero carbon emissions by 2050. In the NECP proposal, these technologies are associated with different uses, such as the decarbonisation of the electricity system, hydrogen production, and the reduction of emissions in hard-to-abate industrial sectors, in particular, cement, chemicals and steel. The Plan indicates that targets for CO_2 capture and storage will be established based on available storage capacity, without providing quantification of the captured emissions by 2030, the planned capture methods and the related CO_2 management (geological storage or use in industrial processes).

[39] "Development of a transition pathway towards a close to net-zero electricity sector Italy by 2035", ECCO e Artelys. https://eccoclimate.org/programme/energy/
[40] "Carbon Capture, Utilisation and Storage", IEA. https://www.iea.org/energy-system/carbon-capture-utilisation-and-storage#tracking

CCUS technologies are characterized by high investment and operational costs (in particular energy costs) which, at the moment, are limiting their large-scale adoption, as also emerged from a series of interviews with various large industrial entities conducted by ECCO last year. Furthermore, CCS does not contribute to secondary targets for the reduction of emissions, which characterise, for example, thermal power plants and integral cycle plants for steel production. The transition to renewable energy sources and production processes that do not require the use of coal allows to achieve results in terms of reduction of greenhouse gas and pollutant emissions, with positive local effects.

Given the multiple uncertainties related to these technologies, in the development of the ECCO-FF55 scenario ECCO has decided not to consider their application by 2030.

With a broader horizon, it is considered that a priority group of sectors entitled to use the available carbon storage capacity should be identified– such as, for example, the cement and lime industrial sectors –and these solutions should be used where no alternatives are available. More cost- effective technologies are available for the decarbonisation of the electricity system and to produce hydrogen, as highlighted in the previously illustrated scenarios. In these areas, focusing on CO_2 capture and storage, rather than aiming for a drastic reduction in emissions at source, requires the implementation of a complex management and control system both from a technological and governance point of view.

REDUCING PRODUCT DEMAND AND SELECTIVELY SUPPORT PRODUCTS WITH LOW CARBON FOOTPRINT

The decarbonisation of materials requires the reduction of emissions during production processes and the creation of a market for low-carbon products.

As far as the reduction of the demand for raw material products is concerned, the reference of the NECP to the Circular Economy Strategy is a good starting point. However, there is a lack of specific policies aimed at reducing and selectively encouraging demand for such products.

For example, the introduction of a **deposit return system** (DRS) would significantly improve the recycling of plastics, glass and metal, while meeting Europe's circular economy objectives. Some countries that have already implemented DRS have achieved positive results; for example, the PET collection rate in DRS countries is 90%, while in Italy it is 46%[41]. The DRS not only increases the collection rate, but it also allows waste streams to be effectively separated while promoting high-quality recycling.

With regards to selective support for '*low-carbon'* products, the intervention of the public sector through the Green Public Procurement is essential to stimulate the creation of a *low-carbon* market and the market uptake of these products. However, at the moment the **Minimum Environmental Criteria** (MECs) do not include specific requirements for products with a low carbon footprint. The introduction of constraints in MEC for the use of "*low carbon*" products makes it possible to stimulate demand and maintain the competitiveness of companies. It is also necessary to establish shared European standards and certifications to define when a product can be considered "*low carbon*".

[41] "PET collection rates across Europe", Unesda.

Currently, these criteria do not include the carbon variable in a systematic way, so a revision is needed in this regard, starting from the ongoing review processes at MASE.

ESTIMATION OF INVESTMENT NEEDS

Estimating the overall amount of investments required for decarbonization in the industry is a complex exercise, primarily from a conceptual point of view. What we commonly call the "industrial sector" is, in fact, a heterogeneous set of production sectors, each with very different processes and technologies and interconnected through articulated supply chains.

The assessment of the investments necessary to decarbonise the economy is subject to considerable variability, also in relation to the methodologies used. On the latter, the IPCC (Intergovernmental Panel on Climate Change) distinguishes between a "*broad*" and a "narrow" definition of investment. The term 'broad' refers to investments in technologies that can be adopted and purchased directly by end-users, such as cars or heating and air conditioning systems. The "narrow" definition, on the other hand, focuses on the specific components or subsystems incorporated into the broader applications available to end users, such as compressors, vehicle engines and heat generators. These two definitions do not directly align and generally produce incomparable results. The order of magnitude of investments under the "broad" definition is significantly higher (a multiple of 6 – 10 times) compared to that derived from the "narrow" definition. It is therefore not surprising that efforts to calculate investments using a *bottom-up approach* (based on the collection and analysis of specific technologies) are often inconsistent with *top-down* estimates obtained from integrated macroeconomic-climate models, which instead refer to aggregated economic and sectoral categories. In the industrial context, the challenge becomes even more complex as the need to reduce greenhouse gas emissions must be balanced with the need to preserve the productivity and competitiveness of companies. These targets are heavily influenced by many factors, including environmental constraints, costs, and energy price volatility.

As part of the assessment related to the ECCO-FF55 scenario, three components have been considered to calculate the investments necessary to reduce greenhouse gas emissions in industry by 2030:

1. Investments in energy efficiency
2. Electrification of final energy consumption
3. Initiation of the conversion to DRI technology of the former Ilva plant in Taranto

ENERGY EFFICIENCY MEASURES

The estimations of investments required for energy efficiency interventions, are made according to the "Energy Efficiency Report" by Politecnico di Milano [42]. The report forecasts an investment of 23.1 billion euros between 2021 and 2030 leading to a reduction in final energy consumption in the industrial sector of 5,367 ktoe, thanks to energy efficiency measures. This results in a specific investment of €4.3 million per ktep of reduced energy consumption through energy efficiency measures.

[42] "Energy efficiency report 2023", Politecnico di Milano.

In the ECCO-FF55 scenario, a reduction in energy consumption of 4,830 ktoe is achieved between 2023 and 2030 thanks to energy efficiency measures, resulting in a cumulative investment of € 16.2 billion.

ELECTRIFICATION OF FINAL ENERGY CONSUMPTION

In the ECCO-FF55 scenario, it is projected that between 2023 and 2030, 3.5 Mtep of heat required at temperatures below 150°C will be electrified. Considering an investment cost of electrification technologies of between € 0.1 and € 0.3 million per MW of thermal[43] and an operation of 6,000 hours per year, the necessary investment will range between € 0.5 and € 2.3 billion, depending on the solution adopted (electric boilers, solar thermal, electric industrial heat pumps).

As of now, the emission comparison between, for example, a gas boiler and a heat pump of equal performance is clearly in favor of the latter technology. The replacement of a 30MW gas boiler with a heat pump can decrease carbon emissions from about 40kCO_2/year down to 15.6kCO_2/year. It is evident that with the advancement of renewable sources in the electricity sector, there is a progressive decarbonisation of other sectors of the economy, including industry.

CONVERSION OF THE FORMER ILVA PLANT TO DRI TECHNOLOGY

To estimate the investments required for the conversion of the Taranto steel production plant from coal-fired blast furnace to DRI technology, the following costs were considered:

1. DRI plant: An estimated investment of 2.5 billion euros is estimated for the construction of the DRI plant, which by 2050 will produce 8 million tons of steel per year, including the construction of direct reduction units, electric arc furnaces and pelletizers. This does not include the costs of decommissioning existing blast furnaces and layout changes.
2. Hydrogen storage systems: To ensure safety and continuity of operation, it is necessary to store an amount of hydrogen sufficient to power five working days, i.e. 6.8kt of hydrogen. An investment of € 4.4 to € 5.9 billion is estimated for hydrogen storage systems.

The sum of these cost items leads to a total investment of between 6.9 and 8.4 billion euros for the complete conversion of the former Ilva steel plant in Taranto to DRI technology powered by green hydrogen. The cost of electrolysers has been allocated to the electricity sector as it is assumed that the hydrogen needed to power the steel mill will come from renewable overgeneration.

By 2030, a production of 6 Mt is estimated using DRI technology with a mixture of natural gas and 90% - 10% green hydrogen.

Therefore, to start the conversion and produce by 2030 6Mt of steel/year using DRI technology with a natural gas-hydrogen blend at 90%-10% respectively, a total investment of € 2.8 - 2.9 billion is estimated.

It should be noted that initially the National Recovery and Resilience Plan (NRRP) envisaged an investment of 1 billion euros for the implementation of projects for the production of pre-reduced iron through the DRI process powered by green hydrogen. However, after an amendment in July

[43] "Long term projections of techno-economic performance of large-scale heating and cooling in the EU", *European Commission*.

2023, these resources were removed from the plan, and it is currently unclear whether they will be maintained and allocated in what ways and timeframes.

In conclusion, considering also the investments needed for energy efficiency and electrification, the total estimated investment to achieve the industry's targets ranges between 18.9 and 20.8 billion euros, equal to an average of 2.7 – 3 billion euros per year, simplifying basic assumptions as much as possible. It should be noted that the draft revision of the NECP reports a cumulative investment for industry of € 12.6 billion for the period 2023 – 2030, which is about half of the estimated investment in the ECCO-FF55 scenario. No details are provided regarding the methodology used for the estimation and the cost items considered. It is not clear, for example, how such a modest investment can be sufficient despite the extensive use of CCUS technologies, systems characterized by very high investment costs.

BOX – THE ASSESSMENT OF SOCIOECONOMIC IMPACTS OF THE TRANSITION – THE EMPLOYMENT IMPACT OF THE CONVERSION OF THE FORMER ILVA IN TARANTO

Within the socioeconomic impact assessment of the of the Plan, the evaluations related to industrial transformation should have a specific focus. In the 2030 Plan, there should be greater consideration of the impacts of the conversion of the Taranto site, which is included among the proposed interventions by 2030.

In previous studies[44], ECCO has analysed the employment repercussions associated with to the conversion to green hydrogen-based DRI (Direct Reduced Iron) technology of the former Ilva steel plant in Taranto, where steel is currently produced using the integrated coal cycle.

Currently, there are 8,200 employees working at the Acciaierie d'Italia plant in Taranto, of which 5,000 work in the hot area [45]. The adoption of DRI technology results in a reduction in the level of employment as it requires fewer plants for steel production, and consequently, fewer workers are needed to operate them. The current workforce exceeds the actual need of the plant, if it was to be converted to DRI and achieve a production level of 8 million tons of steel per year.

Literature suggests that a DRI plant requires between 227 and 400 employees to produce one million tons of steel per year[46], resulting in a total workforce ranging from 1,816 to 3,200 people, with a surplus of 1,800 to 3,184 employees.

Producing the necessary hydrogen on-site opens up the possibility of developing a hydrogen supply chain. According to the Preliminary Guidelines of the National Hydrogen Strategy, the Italian government plans to install approximately 5 GW of electrolysis capacity by 2030, double what is necessary for the conversion of the Taranto steel plant. Based on these guidelines, the impact on employment in Taranto, linked exclusively to hydrogen production, could result in the creation of about 100,000 temporary jobs during the construction phase and 50,000 permanent

[44] "A green steel strategy", ECCO, August 2022. https://eccoclimate.org/wp-content/uploads/2022/09/REPORT-ACCIAIO-Una-strategia-per-lacciaio-verde-en.pdf
e "Taranto, primary steel production in the challenge of decarbonisation", ECCO, November 2021. https://eccoclimate.org/wp-content/uploads/2021/11/Taranto-eng-1.pdf
[45] "Proposta di soluzione tecnica per il rilancio dello stabilimento di Taranto", Federmanager, May 2020.
[46] "Proposta di soluzione tecnica per il rilancio dello stabilimento di Taranto", Federmanager, May 2020.

jobs. The significant investment required for hydrogen-based DRI technology is therefore justified by various advantages, including the reduction of greenhouse gas and pollutant emissions, as well as the establishment of a local hydrogen supply chain with positive impacts on employment.

The analysis described shows the implications of the different technological choices with respect to the production and employment reconfiguration of the site. Although such analysis may not be included in the Plan, it should at least refer to analyses addressed in other programming documents, such as, for example, the measures regarding the phase out of coal, mentioned in the Plan.

THE ITALIAN CLIMATE CHANGE THINK TANK

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