Italy's Energy-Intensive Industries amid Competitiveness and Decarbonisation

by **Pier Paolo Raimondi**

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Summary of key messages

• European climate policy and ambition have increasingly been enhanced. After having expanded renewables mainly in the power sectors, now it's the time for European countries to expand their decarbonisation efforts in other sectors, such as agriculture, transport, residential and industry in order to reach climate neutrality by 2050. Inevitably, these efforts will impact the livelihood of consumers and companies requiring a solid social and industrial strategy.

• *The European Green Deal is entering into a new, critical phase*, where competitiveness and economic security are more relevant. Over the past years, the interplay of industrial policy, competitiveness and decarbonisation has become the priority for the new European Commission. Geopolitical competition, energy and climate crises have induced governments to consider measures to accelerate transformation of existing industries in compliance with net-zero targets, preserving competitiveness and ensuring economic security through manufacturing capacity. Such commitment brings back debates regarding fiscal discipline and common European funds.

• This conundrum is particularly visible for *energy-intensive industries* (EIIs) and addressed by the Clean Industrial Deal. Their transformation will be essential for decarbonisation to be achieved (they represent around 22 per cent of EU GHG emissions), but governments are struggling to ensure also their competitiveness vis-à-vis international competitors because of higher energy and carbon prices.

• Transformation of EIIs can be pursued through different solutions: electrification, hydrogen and CCS:

- *Electrification* covers already a relevant share of Italy's industry energy consumption. In 2022, electricity was the main source for the industrial sector, accounting for 44 per cent, followed by natural gas (33 per cent). Indeed, the final energy and carbon intensities per unit of value-added show that the Italian industry has one of the lowest rankings among the EU-27 with the highest levels of electrification among the biggest countries. Electrification can decarbonise also low and medium temperature heat. To further seize environmental benefits, Italy needs to accelerate renewable installations by removing permitting delays and providing a clear and consistent regulatory framework.
- Addressing *methane emissions*, especially from the international suppliers, is crucial to further mitigate emissions. The reconfiguration of flow and growing relevance on MENA countries provides an opportunity to address the pressing environmental issue. Natural gas accounts for 40 per cent of energy consumption and 50 per cent of power consumption. Its role is expected to remain relevant based on the 2024 NECP and geopolitical ambition. Since the bulk of the industrial sector's emissions comes from the combustion part, requiring an assessment of the role of energy supply and in particular of natural gas.
- In the long term, Italy needs to decarbonise molecules and prioritise the ramp up the use of *clean hydrogen* where more efficient electrification is not feasible. Italy recently adopted its first national hydrogen strategy, which envisages different trajectories given the uncertainty over its development and potential improved performances from other technologies. Concurrently, alongside the wider environmental and socio-economic risks associated with hydrogen systems (including in third countries), Italy will need to address the climate impacts of these systems. This requires limiting not only carbon dioxide and methane emissions but also hydrogen emissions, as hydrogen itself is an indirect greenhouse gas effects with potent warming impacts. To incentivise the ramp up of decarbonised products, Italy should use public procurement. Some hydrogen-powered EIIs will be relocated to other regions; Italy needs to work with its partners to ensure environmental and economic benefits are integral to the build out of these industries.

• *CCS* regained a newfound political relevance because governments aim at accelerating the energy transition while preserving existing industrial

capabilities. Italy is eager to reduce the gap in terms of CCs developments compared to the North Sea. The Ravenna project should capture hard-to-abate sectors' emissions as acknowledged by the NECP.

Ways forward

• Italy will need to a *combination of measures* that favours the transformation of existing EIIs within the European and national borders, and concurrently orderly manage some production outsourcing to regions with cheaper energy costs. Selected subsidies to shield domestic producers may be allocated but they will need to be carefully evaluated based on clear criteria, such as economic relevance (cluster effects) and economic resilience (avoiding new dependencies on critical sectors/products).

• In finding the new equilibrium, *Italy needs to work with the EU in setting priorities, standards and creating new tools*, including related to investments. A coordinated approach would avoid market fragmentation and inefficiency. Italy needs to work in building criteria and standards for protecting domestic producers and outsourcing some of the production. Positive developments and efforts in terms of reducing CO_2 intensity should be acknowledged and recognised while designing features for green markets. Given different fiscal spaces and the investment needed to reach decarbonisation, common and stable funds at the EU level will be needed – especially for Italy. Nonetheless, Italy will need to prove its ability to spend properly and adequately the existing funds.

Introduction

The interplay of industrial policy, competitiveness and decarbonisation has come prominently back to the fore over the past years. The worsening of geopolitical, along the energy and climate crises, has induced governments to reconsider and design adequate industrial policies to find an equilibrium between reaching climate targets, preserve industrial competitiveness – especially for energy-intensive industries (EIIs)[1] – and fostering clean tech manufacturing. Achieving this equilibrium will entail investments and resources both from the private sector, but also from the public sector leading to considerations on cost-efficiency and fiscal discipline. This conundrum is particularly acute in the EU, acknowledged also by the new European legislative cycle.[2] Indeed, the European Green Deal is entering into a new phase, characterised by higher geopolitical tensions and focus on competitiveness and economic security. The new focus drives the new Commission as represented by the Clean Industrial Deal. In this context, Italy is an interesting case study. Indeed, it is the second largest manufacturing producer in Europe and the eighth largest in the world. Furthermore, its energy system is heavily reliant on natural gas and gas imports, making it exposed to high and volatile prices. Additionally, the country faces some chronic challenges, which may undermine its ability to find an equilibrium in the new trilemma.

Structure of the report. – After having outlined the importance of the EIIs in the European (Section 1) and Italian context (Section 2), the report aims to analyse different options for decarbonising existing Italian EIIs in order to contribute to European and national climate objectives. EIIs are particularly exposed to high energy prices given natural gas' relevant role both for EIIs and for the country's power sector (around 50 per cent). Within this aim, the report seeks also to spotlight the relevance of addressing methane emission from natural gas and the role hydrogen can play in fostering decarbonisation (Section 3). Furthermore, the report highlights the need of investing in decarbonisation

1 In this report, the term EIIs refers to iron and steel, chemicals, paper, glass.

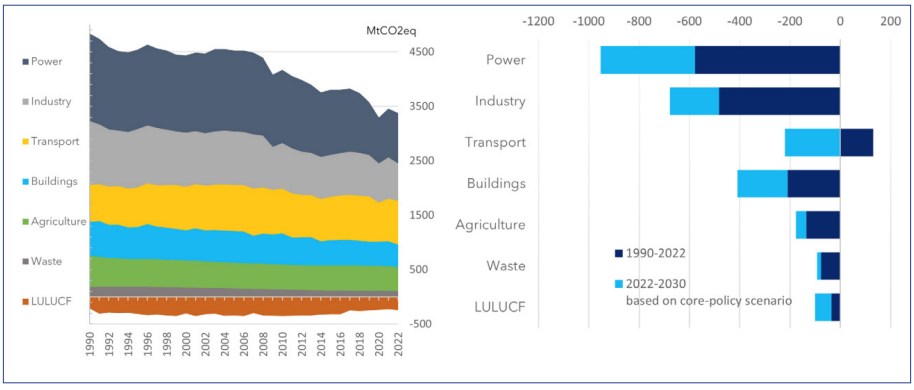
2 Ursula von der Leyen, *Europe's Choice. Political Guidelines for the Next European Commission 2024-2029*, 18 July 2024, https://commission.europa.eu/media/58570_en; Mario Draghi, *The Future of European Competitiveness*, September 2024, https://commission.europa.eu/topics/eu-competitiveness/draghi-report_en.

solutions for the industry sector, while ensuring investments for new clean technologies in order to seize economic opportunities (Section 4). Given specific features (high energy prices and macroeconomic barriers outlined in Section 5), the analysis highlights potential trade-offs offs between maintaining EIIs production and importing decarbonised products from abroad – especially from neighbouring countries (Section 6).

1. EU general context

The EU has set ambitious climate targets, included in the European legislation through the European Climate Law in July 2021. While in the past years the power sector has been at the centre of the national mitigation strategies, governments and decisionmakers need to take important decisions for the decarbonisation of other sectors as well, notably transport, agriculture and industry, in order to reach climate neutrality by 2050 (figure 1).

Figure 1 | EU GHG emissions and removals by sector, past trends and required reductions



Source: European Commission, *Climate Action Progress Report 2023*, 2024, p. 9, https://climate.ec.europa.eu/document/download/60a04592-cf1f-4e31-865b-2b5b51b9d09f_en.

Among sectors, decarbonising the industrial sectors is gaining particularly political relevance given both opportunities and challenges due to the role of industry in the socioeconomic landscape as well as its contribution to national environmental footprints. Over the past decades, EU industrial emissions have

generally come down thanks to a mix of policies (e.g., European carbon pricing), improvements in the energy efficiency, fuel switching as well as economic headwinds and some delocalisation of industries outside Europe. Within the broader decarbonisation of the industrial sector, it is noteworthy to focus on the EIIs as they are crucial parts of the industrial landscape. The industries of the entire EIIs ecosystem employ 7.8 million people in Europe and provide a value added of 549 billion euros (equal to 4.5 per cent of the EU total).[3] From an energy and environmental standpoint, they are responsible for around 22 per cent of the greenhouse gas (GHG) emissions of the entire industry at the European level[4] and they are some of the main consumers of EU industrial gas: chemical and petrochemical production consumes 32 per cent of EU industrial gas; non-metallic minerals[5] 13 per cent, alongside the food and beverage industry with 13 per cent.[6]

At the same time, these industries are increasingly under pressure due to energy, economic and industrial challenges. Indeed, their competitiveness has been heavily undermined by high energy prices since mid-2021. Moreover, they need to adapt and adjust in order to contribute to national mitigation strategies by better integrating cleaner production routes and technologies. Despite historical improvements, accelerated and deep decarbonisation is required to achieve climate neutrality by 2050.[7] To do so, industries can pursue different technological solutions (i.e., renewables and electrification, hydrogen, and carbon capture, use and storage, CCUS). However, achieving deep emission reductions in the industrial sectors, especially in the short-term means overcoming multiple barriers, in particular difficulties in finding alternative technological solutions, competitiveness concerns over the cost of mitigation technologies, incompatibility of existing business models with climate-friendly models, as well as regulatory inertia in standard setting.[8] Given

3 European Commission, *For a Resilient, Innovative, Sustainable and Digital Energy-Intensive Industries Ecosystem: Scenarios for a Transition Pathway* (SWD/2021/277), 27 September 2021, p. 3, https://ec.europa.eu/docsroom/documents/47059.

4 Ibid.

5 Includes cement, glass, and ceramics manufacturers.

6 Akos Losz and Anne-Sophie Corbeau, "Anatomy of the European Industrial Gas Demand Drop", in *SIPA CGEP Commentaries*, 18 March 2024, https://www.energypolicy.columbia.edu/?p=19758.

7 European Commission, *For a Resilient, Innovative, Sustainable and Digital Energy-Intensive Industries Ecosystem*, cit.

8 Tomas Wyns and Gauri Khandekar, "Energy-intensive Industries in the EU: Overcoming Barriers to Transition?", in Tim Rayner et al. (eds), *Handbook on European Union Climate Change Policy and Politics*,

the risk for EU competitiveness, the newly re-elected European Commission President Ursula von der Leyen promised to present in her first 100 days in office a new Clean Industrial Plan aimed at combining decarbonisation and competitiveness especially for EIIs. The new Plan will be based and enriched by the recent report on competitiveness written by former Italian Prime Minister Mario Draghi and the recent Competitiveness Compass.

The Clean Industrial Deal (CID), presented on 26 February 2025, seeks to sustain an industrial transformation in two sectors: the EIIs and the clean-tech sector.[9] The CID ambition is to overcome the traditional silo approach and promote a comprehensive approach through the entire value chain. Therefore, it addresses six crucial aspects for business: i) affordable energy, ii) lead markets, iii) financing, iv) circularity and access to materials, v) global markets and international partnerships and vi) skills. All of these should be followed by cutting red tape and exploiting fully the Single Market. Clean electrification is proposed as an economic strategy to ensure affordable prices, which are addressed in the Action Plan for Affordable Energy adopted the same day. To do so, the CID identifies contracts for difference (CCfD) and power purchase agreements (PPA) as key measures to make clean energy more attractive for industries. Lead markets are another tool to build demand for decarbonised products through non-price criteria in public procurement and incentives for private purchases – although reforms in these field are unlikely to produce tangible results before the end of the decade.[10]

Regarding the clean-tech sector, the CID comes after the Green Deal Industrial Plan (GDIP), issued by the Commission in 2023,[11] whose goal is to accelerate the green transition, promote economic growth while enhancing economic security through domestic manufacturing capacities in clean energy technologies (i.e., wind turbines, solar PV, batteries, electrolysers and heat

Cheltenham/Northampton, Edward Elgar, 2023, p. 289-304, https://doi.org/10.4337/9781789906981.00034.

9 European Commission, *The Clean Industrial Deal: A Joint Roadmap for Competitiveness and Decarbonisation* (COM/2025/85), 26 February 2025, https://eur-lex.europa.eu/legal-content/en/TXT/?uri=celex:52025DC0085.

10 Francesco Nicoli, "Mapping the Road ahead for EU Public Procurement Reform", in *Bruegel First Glance*, 31 March 2025, https://www.bruegel.org/node/10778.

11 European Commission, *A Green Deal Industrial Plan for the Net-Zero Age* (COM/2023/62), 1 February 2023, https://eur-lex.europa.eu/legal-content/en/TXT/?uri=celex:52023DC0062.

pumps). A key component of the GDIP was the Net-Zero Industry Act. This marked the explicit return of industrial policy at the EU level in response to China dominant role and the US Inflation Reduction Act (IRA). Indeed, global competition and multiple crises (e.g., Covid-19, energy crisis and Russia's war to Ukraine) has elevated economic security and resilience as a top political priority, reconsidering interdependence and economic efficiency. The creation of new clean tech manufacturing capacity can satisfy multiple needs: job creation, economic growth and economic security while accelerating the clean transition. By doing so, governments can also obtain and enhance political support to the energy transition, otherwise the risk would be the derailment of the decarbonisation process and a loss of competitiveness at the domestic and European level. The ambition to reach all of these goals (competitiveness, decarbonisation, security) has generated a debate at the European level regarding the financial capabilities and needs to reach the net-zero targets, while preserving competitiveness and strengthening clean tech manufacturing.[12] Lastly, the growing creation and adjustment of the European legislative response to both domestic and external challenges demand a strong improvement in the governance and alignment between different measures and initiatives. For example, the CID failed to mention the 'Competitiveness coordination tool' proposed in the Competitiveness Compass.

2. Italian energy-intensive industries: Energy trends and the role of natural gas

The main energy-intensive sectors (steel, chemical, non-metallic minerals, and paper) are particularly relevant from the energy, environmental and socioeconomic perspective for Italy. Indeed, these sectors employ around 1.25 million people in Italy[13] while generating 88 billion euros of gross value added (equals to 5 per cent of country's total).[14] At the same time, EIIs in Italy

12 Claudio Baccianti and Christian Odendahl, "How to Make EU Fiscal Rules Compatible with Net Zero", in *CER Policy Briefs*, May 2022, https://www.cer.eu/node/9711.

13 Alberto Carriero et al., "Decarbonizzare l'industria italiana: quale ruolo per l'idrogeno verde?", in *CDP Briefs*, 13 February 2024, https://www.cdp.it/sitointernet/page/en/decarbonising_italian_industry_is_there_a_role_for_green_hydrogen_?contentId=TNK46988.

14 Industrial Decarbonization Pact and Boston Consulting Group, *Industrial Decarbonization Pact: un'alleanza per la piena decarbonizzazione dei settori hard to abate*, February 2022, https://www.bcg.

are responsible for 67.5 million tonnes CO_2 per year (Mt CO_2/year) in 2022 (of which 78 per cent from fossil fuel emissions and 22 per cent from industrial process) (table 1).[15]

Table 1 | CO_2 emissions industrial sectors hard-to-abate (Mt, 2022)

	Combustion	Process	Total
Cement and non-metallic minerals	11.4	10.2	21.6
Refining and petrochemicals	19.0	0.8	19.9
Steel* and other metals	13.9	1.6	15.5
Chemical and fertilisers	10.1	0.5	10.6
Total	54.4	13.1	67.5

Notes: * including coke production; paper industry's emissions were 4.6 Mt with very limited from process.
Source: Author's elaboration on MASE, *Piano nazionale integrato per l'energia e il clima*, cit.

Nonetheless, the Italian industry has experienced a positive development in terms of emission reduction as a general downward trend is observed from 1990 to 2021 according to the estimates provided by the National Energy and Climate Plan (NECP). Within the general trends, there are differences at the sub-sectoral level. For example, some sub sectors (iron and steel, non-metallic minerals) reduced sharply their emissions, while other sub sectors (non-ferrous metals, pulp and paper) increased their emissions over the same period. Despite some specificities, the general downward trend was driven by both regulatory and economic factors. While the introduction of the EU Emission Trading System (EU ETS) in 2005 contributed to spur emission reduction and efficiency improvements, emissions' reductions were mostly spurred by macroeconomic challenges – in particular the 2008 financial crisis. Indeed, in 2009 an overall reduction of emissions occurred due to the effects of the economic recession. In 2010 production levels restored for iron and steel, but a further significant drop is noted in 2013 due to environmental constraints of the main integrated iron and steel plant in Italy, located in Taranto, which had to reduce its steel production level. Emission intensity of the steel industry in Italy had fallen by 60.4 per cent over the 1990-2020 period.[16] Non-metallic minerals emission

com/publications/2022/industrial-decarbonization-pact.

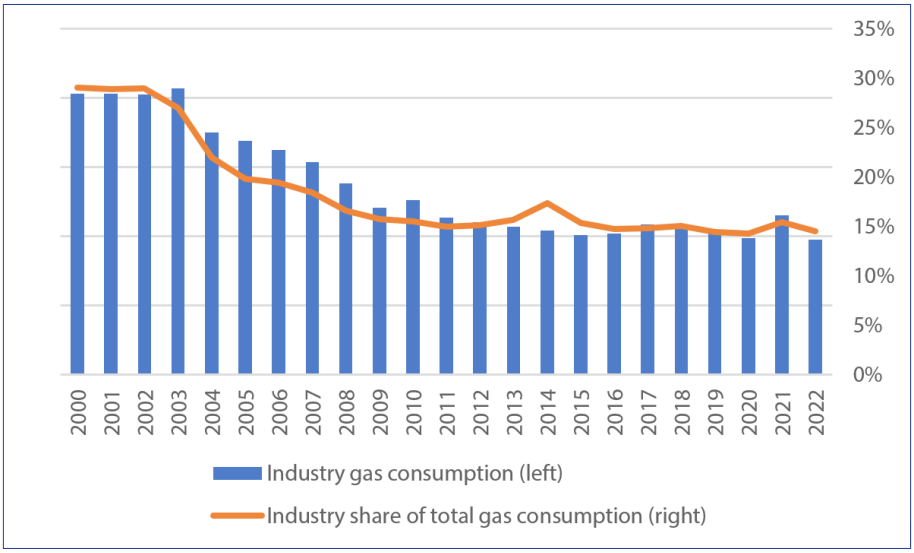
15 Italian Ministry of the Environment and Energy Security (MASE), *Piano nazionale integrato per l'energia e il clima*, June 2024, https://commission.europa.eu/node/32214_en.

16 Italian Institute for Environmental Protection and Research (ISPRA), *Intensità di emissione di*

trend is driven by the cement industry which strongly reduced its production levels in 2009 and further in 2013, in relation to the economic recession and the crisis of building construction sector; a further decrease of this sector is observed in 2016 and 2017.[17] Emissions related to the production of cement and non-metallics minerals are strictly related to the production volumes hence their reduction yields a direct emissions reduction. Lastly, emissions from the industrial processes comes primarily from the production of cement, lime and steel as well as from F-gas use.

Nonetheless, *the bulk of the industrial sector's emissions comes from the combustion part, requiring an assessment of the role of energy supply and in particular of natural gas*.

Figure 2 | Industrial gas consumption (bcm) and its share of Italy's total gas consumption (%), 2000-2022



Source: Author's elaboration.

anidride carbonica nell'industria siderurgica, updated 31 December 2023, https://indicatoriambientali.isprambiente.it/it/industria/intensita-di-emissione-di-anidride-carbonica-nellindustria-siderurgica.

17 ISPRA, *Efficiency and Decarbonization Indicators in Italy and in the Biggest European Countries. Edition 2023*, https://www.isprambiente.gov.it/en/publications/reports/efficiency-and-decarbonization-indicators-in-italy-and-in-the-biggest-european-countries-2013-edition-2023.

In 2022, the industrial sector's gas consumption stood at 9.7 billion cubic metres (bcm) accounting for 14 per cent of Italy's total gas consumption. Italy's natural gas consumption in the industry has fallen since 2003, when it peaked (20.7 bcm). This downward trend is easily explained by the mix of economic challenges, technological developments and efficiency improvements of the following years. Consequently, the industry's share of total gas consumption dropped from 30 per cent in 2000 to 14 per cent in 2022 (figure 2).

Despite the declining consumption, EIIs remain key consumers of gas. This is due to specific industrial processes and requirements in the selected industries. Natural gas is particularly important as both a feedstock and fuel. Moreover, its contribution is crucial not only to direct energy supply to the industry sector, but also indirectly through its contribution in the power sector. This is the case for example of the steel industry. Italy is the second largest producer in the EU with a production of 21 Mt (accounting for 16 per cent of the EU's steel production in 2023) behind Germany.[18] However, Italy's steel production benefits of a comparative advantage vis-à-vis the world average: world's lowest CO_2 intensity rate. Indeed, there are two production routes for making steel: primary steelmaking relies on blast furnaces (BF), fuelled by coal or coke, and basic oxygen furnaces (BF-BOF) to turn iron ore into steel. This is the main production route use in the EU (around 60 per cent) and in Germany (almost 70 per cent of national production). By contrast, Italy relies heavily on secondary steelmaking, which uses electric arc furnaces (EAF) to produce steel thanks to steel scrap, increasing also circularity and security of supply. The expansion of EAF in Italy was driven mainly by resource scarcity and private companies. This solution accounts for over 80 per cent of Italy's steel production, compared to 44 per cent in the EU and only 28 per cent at the global level.[19] *The high degree of EAF allows Italy's steelmaking to have the lowest carbon intensity in the world* (figure 3).

18 Eurofer, *European Steel in Figures 2024*, June 2024, p. 15, https://www.eurofer.eu/publications/brochures-booklets-and-factsheets/european-steel-in-figures-2024; World Steel Association, *World Steel in Figures 2024*, May 2024, https://worldsteel.org/?p=56174.

19 Federacciai, *Rapporto di sostenibilità 2023*, 13 June 2024, p. 77, https://federacciai.it/?p=5920.

Figure 3 | The CO_2 intensity of the steel production in selected countries and regions in 2019

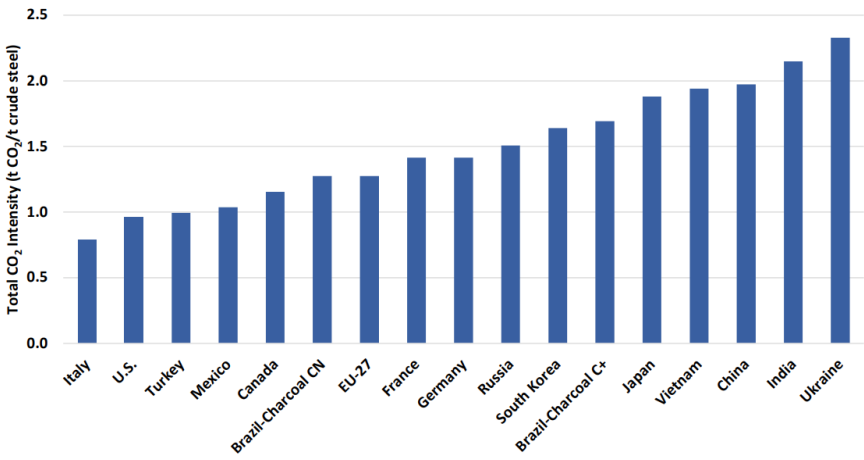


Figure ES1. The CO_2 intensity of the steel production in the studied countries/region in 2019
Note: Brazil-Charcoal CN refers to when charcoal is considered carbon neutral. Brazil-Charcoal C+ refers to when charcoal is not considered carbon neutral because of questions and concerns regarding the sustainability of biomass used in the steel industry in Brazil. See methodology in Appendix for more information.

Source: Ali Hasanbeigi, *Steel Climate Impact. An International Benchmarking of Energy and CO_2 Intensities*, Global Efficiency Intelligence, April 2022, p. 3, https://www.globalefficiencyintel.com/steel-climate-impact-international-benchmarking-energy-co2-intensities.

Along the rise of secondary steelmaking production mainly located in the Northern regions, the country has experienced a drop in primary steelmaking from the only BF-BOF facility in the national territory: the former Ilva facility in Taranto. Due to chronic challenges, the production dropped from 9 Mt in 2012 to 3 Mt in 2023. Electricity is also used in the aluminium production. Indeed, while the primary aluminium production in 2013 has stopped, there has been a rise of secondary aluminium production, which uses electricity as the primary energy source hence emissions, due to the direct use of fossil fuels, are limited.[20] According to the final version of the 2024 Italian NECP, industrial emissions are expected to experience a more modest drop (-14 per cent

20 ISPRA, *Italian Emission Inventory 1990-2022. Informative Inventory Report 2024*, https://www.isprambiente.gov.it/en/publications/reports/italian-emission-inventory-1990-2022-informative-inventory-report-2024.

between 2021 and 2030) by 2030 compared to its historical record (-39 per cent between 2005 and 2021) as well as other sectors' expected reductions.[21] This is the result of the reconfiguration of Taranto's steel facility and, at a lower extend, the use of CCS and decarbonised gases. All these solutions are extensively considered by existing EIIs in order to transform their processes in order to produce decarbonised products, such as green steel,[22] aluminium, glass. The next section addresses these potential pathways.

3. Selected solutions for emissions' abatements in the EIIs

EIIs can pursue different decarbonisation strategies depending on their industrial process, economic competitiveness and availability of alternative technologies. Particularly, the three different solutions are: electrification (powered by renewables), hydrogen and CCS. This section outlines the opportunities, practical application and challenges of each of them.

3.1 Electrification

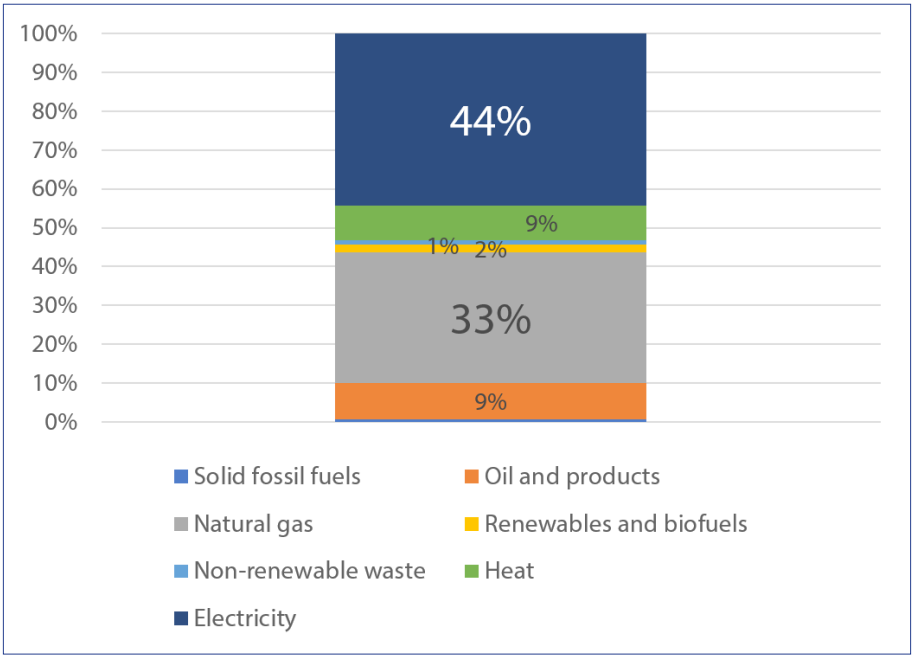
A crucial step for reducing emissions is expanding electrification where possible as also acknowledged in the Clean Industrial Deal. In general, electrification covers already a relevant share of Italy's industry energy consumption. In 2022, electricity was the main source for the industrial sector, accounting for 44 per cent, followed by natural gas (33 per cent) (figure 4). Indeed, the final energy and carbon intensities per unit of value-added show that the Italian industry has one of the lowest rankings among the EU-27 with the highest levels of electrification among the biggest countries.[23]

21 MASE, *Piano nazionale integrato per l'energia e il clima*, cit.

22 Agora Industry, Wuppertal Institute and Lund University, *Global Steel at a Crossroads. Why the Global Steel Sector Needs to Invest in Climate-Neutral Technologies in the 2020s*, November 2021, https://www.agora-energiewende.org/publications/global-steel-at-a-crossroads.

23 ISPRA, *Efficiency and Decarbonization Indicators in Italy and in the Biggest European Countries*, cit.

Figure 4 | Share of energy solutions of Italy's industry energy consumption in 2022



Source: Author's elaboration.

As already mentioned, some sectors, such as aluminium and steel, already represent positive examples of electrification in the industry sector. Clean energy could also decarbonise steam, which plays a vital role in various sectors, particularly in the paper, chemicals and food industries. Steam generation using electric boilers and heat pumps offers great potential for the early direct electrification of low- to medium-temperature applications (below 600 degrees Celsius),[24] with heat pumps entailing considerable efficiency advantages over gas-fired boilers. To further increase environmental benefits of electrification, Italy will need to accelerate renewable installations in order to decarbonise its power sector, reduce its overdependence on natural gas and provide clean electricity at competitive costs. The 2024 NECP envisages 131 GW by 2030,

24 Joris van Niel and Ken Somers, "Net-zero Electrical Heat: A Turning Point in Feasibility", in *McKinsey Articles*, 16 July 2024, https://www.mckinsey.com/capabilities/sustainability/our-insights/net-zero-electrical-heat-a-turning-point-in-feasibility.

which corresponds to 74 GW of additional capacity on to the 2021 level. The 2030 target will cover 63.4 per cent of electricity. However, the expansion of renewables faces some headwinds. Historical data related to annual installation shows that traditionally Italy's annual renewable installation rates are heavily based on subsidies. In response to the energy crisis, the Italian government has worked on reducing permitting procedures to ramp up renewable installations with some positive outcomes.[25] Yet, Italy has not developed a clear and consistent regulatory framework – in some case the regulatory developments seem to be contradictory. For example, some political and local opposition have furthermore resulted in complicating the authorisation procedures in certain cases. At the same time, in July 2024 the Italian Ministry of the Environment and Energy Security (MASE) published a decree law which envisages a new mechanism for the development of renewable capacity by EIIs.[26] Moreover, the mass deployment of renewables requires a national strategy on electricity grids in order to balance the power sector and ensure power supply. Last but not least, another barrier is represented by the gap between natural gas and electricity prices, with the former much cheaper than the latter.[27] This gap simply discourages any operator that is eager to shift from traditional solutions to alternatives. With the expected gas glut due to the liquefied natural gas (LNG) expansion by 2026, global gas prices are expected to decrease which may lead to higher costs for the support to renewables. To promote electrification in industry sectors, Italy will need to continue in the expansion of renewable energy capacity through clearer regulatory framework. Political commitment and social acceptance towards the role of renewables will be crucial.

25 Pier Paolo Raimondi, *Reconciliation of Energy Security and Climate Objectives: The Case of Italy*, Rome, IAI, January 2024, https://www.iai.it/en/node/17983.

26 MASE, Decree No. 256 of 10 July 2024: *Decreto del Ministro dell'Ambiente e della Sicurezza Energetica del 10 luglio 2024 n. 256 recante la disciplina delle modalità e dei criteri per il soddisfacimento delle condizioni di cui all'articolo 3, commi 5, 6 e 8, del decreto-legge 131 del 2023*, https://www.mase.gov.it/bandi/decreto-del-ministro-dellambiente-e-della-sicurezza-energetica-del-10-luglio-2024-n-256.

27 Chiara Di Mambro, Giulia Novati and Simone Gasperin, "Industry and Electrification: Strategic Opportunities for the National Energy and Climate Plan", in *ECCO Policy Briefings*, February 2024, https://eccoclimate.org/?p=7674.

3.2 Cleaner molecules

While electrification is a valuable solution for some sectors, other sectors, where high temperatures are required, will need (clean) molecules. In the short term, natural gas is expected to continue to play a role, while in the long-term decarbonised gases, such as hydrogen – though itself an indirect greenhouse gas –, will need to emerge in order to provide secure and sustainable energy supply for some hard to abate sectors in line with the EU climate targets. Either way, it is important for Italian policymakers to address their environmental impact domestically and internationally.

3.2.1 Methane emissions

Given the dominant role of natural gas in supplying directly and indirectly EIIs, it is necessary to address its environmental impact caused by methane emissions. Natural gas accounts for 40 per cent of energy consumption and 50 per cent of power consumption. Since the 2024 NECP does not foresee a clear phase out plan for natural gas – still considered to be a transitional fuel and essential for selected sectors, addressing methane emissions gains of importance. Therefore, a holistic strategy related to industrial emissions and its energy supply would be very much welcome. By addressing methane emissions both domestically and internationally, Italian industries will expand their mitigation strategy while building alternatives to natural gas.

Domestically, since 1990, there have been positive developments in the reduction of methane emissions from the national gas value chain, which represented 5.7 per cent of national methane emission and 80 per cent of fugitive emission in 2022, according to estimated emission data provided in the NECP.[28] The vast majority of methane emission from the national value chain comes from the distribution segment (almost 82 per cent), while transport, storage and LNG terminals (almost 18 per cent), while the domestic production is responsible for less than 1 per cent. As mentioned, the domestic value chain has taken several initiatives to reduce its emissions in line with growing domestic and international policies but also voluntarily. As result, between

28 MASE, *Piano nazionale integrato per l'energia e il clima*, cit.

1990 and 2022, methane emissions from the value chain have dropped by 71.9 per cent (from 9.3 Mt CO_2eq to 2.6 Mt CO_2eq) even though the volume of gas flows in the network has increased according to the estimates included in the NECP.[29]

Despite the limited role and the positive steps undertaken on methane emissions, Italy needs also to consider methane emissions given its overreliance on gas and more specifically on gas imports – around 95 per cent of its total gas consumption in 2023. The international dimension is expected to gain further importance in light of the Italian ambition to become an energy hub in the Mediterranean – a concept included in the Mattei Plan for Africa;[30] something that would allow Italy to seize the opportunity generated by the reconfiguration of energy flows following Russia's war in Ukraine. The combination of high dependence on imports and (geo)political ambition requires an external strategy to reduce methane emissions. As a consequence of the conflict, Italy has adjusted its import portfolio with a greater contribution from North African countries and LNG.[31] However, Italy needs to carefully assess methane emissions from these sources as, for example, the topic has been largely overlooked in the Mediterranean basin.[32] Addressing methane emissions from its external suppliers in its mitigation strategy is motivated also by the developments of European legislation. Indeed, in May 2024 the new EU Methane Regulation became legislation and entered into force in August.[33] The Regulation is the first of its kind to explicitly address methane emissions from imports given Europe's overdependence on imports. The Regulation envisages a temporary period (2025-2027), which is focused on data collection and creation of a global monitoring tool. The Regulation introduces three types of obligations on the importers: i) information provisions; ii) demonstrating equivalence of measurement, reporting and verification (MRV) from January 2027; iii) report

29 Ibid.

30 The Mattei Plan is the new Italian strategy for Africa, launched in October 2022 by Prime Minister Giorgia Meloni. It aims at building a new type of partnership, which can be a win-win solution to the multiple challenges faced by Africa. For more, see: Daniele Fattibene and Stefano Manservisi, "The Mattei Plan for Africa: A Turning Point for Italy's Development Cooperation Policy?, in *IAI Commentaries*, No. 24|10 (March 2024), https://www.iai.it/en/node/18219.

31 Pier Paolo Raimondi, *Natural Gas in Italy: Features and Perspectives in Light of Russia's War in Ukraine*, Rome, IAI, September 2022, https://www.iai.it/en/node/15987.

32 Pier Paolo Raimondi, *Reconciliation of Energy Security and Climate Objectives*, cit.

33 European Commission DG Energy, *New EU Methane Regulation to Reduce Harmful Emissions from Fossil Fuels in Europe and Abroad*, 27 May 2024, https://energy.ec.europa.eu/node/6102_en.

on methane intensity from 2028 and from 2030 demonstrate that imports remain below the maximum methane intensity values, which will be set later by the Commission.[34] The aim is to extend very similar MRV standards of EU producers to imported natural gas.

Italy will need to include into its climate and energy diplomacy in the Euro-Mediterranean area the issue of methane, promoting similar MRV standards and joint actions to tackle the issue. To do so, Italy, and its energy companies, will need to engage and leverage on joint ventures with national oil companies in the area. Furthermore, gas value chain in Middle East and North Africa (MENA) countries is far less fragmentated compared to other gas suppliers, notably the US, because of the presence of a single or few companies overseeing the entire supply chain (i.e., the national oil companies). Therefore, vertically integrated companies and MENA countries will be facilitated to meet the equivalence provision. In doing so, Italy would ensure to reduce environmental footprint of its gas supplies – also for its EIIs.

3.2.2 Hydrogen

Along with cleaner natural gas, companies could further decarbonise thanks to the development of hydrogen – especially for those sectors where electrification is not a feasible option due to high temperature needs. At the same time, policymakers need to carefully take into consideration its indirect warming effect. Building on scientific consensus, government need to set policies that enable more precise quantification of emissions in the hydrogen value chain.

In terms of potential demand, hydrogen could generally contribute to the decarbonisation of primary steelmaking and some segments in the downstream production. However, regarding the primary steelmaking, Italy could decarbonise its only BF-BOF facility thanks to a hydrogen direct iron reduction (H-DRI) plant. Germany's larger reliance on BF-BOF facilities, fuelled by coal, explains higher political interests in favouring hydrogen in the steel industry.

34 Maria Olczak, Andris Piebalgs and Jonathan Stern, "Analysing the EU Methane Regulation: What Is Changing, for Whom and by When?", in *OIES Energy Insights*, No. 153 (June 2024), https://www.oxfordenergy.org/?p=47426.

As previously outlined, hydrogen could also contribute to decarbonisation by replacing natural gas as a fuel for high temperature industrial heating processes in EIIs sectors such as glass, cement and paper. However, this solution doesn't seem to be the best option compared to electrification and CCS, that may prove more competitive.[35] To ignite the development of hydrogen economy, a first, crucial step would be to decarbonise the existing national hydrogen consumption, before moving to the other sectors. As of today, Italy consumes about 400,000 tH2/year of grey hydrogen almost entirely in the chemical and refining industry. This production is estimated to be the source of about 4 $MtCO_2$.

Back in 2020, Italy presented its Preliminary Guidelines for a National Hydrogen Strategy, which expected hydrogen to cover 2 per cent of total final energy consumption by 2030 (corresponding to 700,000 tH2) and aiming at a 20 per cent share by 2050. The document foresaw also the establishment of 'hydrogen valleys' as for promoting innovation and development. To meet half of the 2030 target, the Preliminary Guidelines envisaged the contribution of 5 GW of electrolyser capacity, leaving room for the role of blue hydrogen. Meanwhile, the EU has adopted key legislation pieces to favour the ramp up of hydrogen in the industry sector.[36] In 2023, the EU adopted its Renewable Energy Directive 3 (RED III) which envisages that the use of hydrogen in the industry should come from RFNBOs by 42 per cent by 2030 and 60 per cent by 2035). Italy has included a hydrogen target for the industry sector, foreseeing 0.115 Mt by 2030, in its final 2024 NECP.[37] This target would correspond to a 54 per cent share of green hydrogen in the industry sector by 2030 – way above the 42 per cent binding target set by the RED. The Plan envisages that around 70 per cent of total hydrogen demand by 2030 (0.25 Mt/year) will be supplied by domestic production, which would require 3 GW of electrolyser capacity (lower than the Preliminary Guidelines' electrolyser target). While the NECP considers mainly the role of green hydrogen, it also takes into consideration the contribution of blue hydrogen. More specifically, the latter is evaluated for facilitating the decarbonisation of existing demand of grey hydrogen in the country and the

35 Marco Giuli, *Italy in the International Hydrogen Economy*, Rome, IAI, February 2022, https://www.iai.it/en/node/14708.

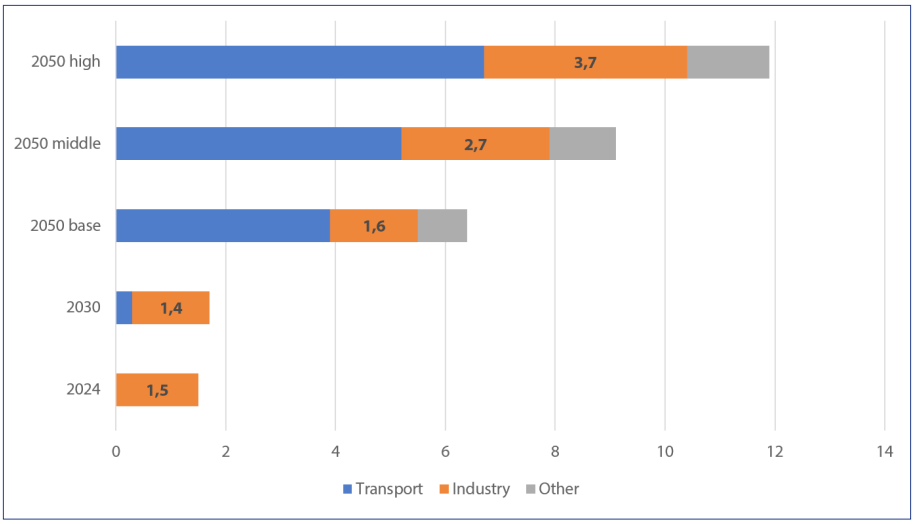
36 Other policies, which however favour the development of hydrogen in other sectors like transport, have been adopted at the EU level. The case of AFIR, FuelEU Maritime Regulation, and ReFuelEU Aviation Regulation.

37 To sum with 0.137 Mt in the transport sector.

creation of a hydrogen economy.

In November 2024, Italy finally joined other major EU countries like Germany, Spain, the Netherlands, and France, and published its first official hydrogen strategy.[38] The strategy provides different measures and developments depending on different time horizons (2030, 2040 and 2050) and different contributions of alternative technologies (electrification, biomethane, biofuels, CCS) (figure 5).

Figure 5 | Hydrogen demand scenario by sector by 2050 (Mtoe)



Source: Author's elaboration.

By 2030, it foresees only a slight increase in hydrogen demand from the current level (from 1.5 Mtoe to 1.7 Mtoe) mainly due to its advent in the transport sector. According to the national strategy, this phase will be characterised by ecosystems of production and consumption located in selected areas, the so-called Hydrogen Valleys, in order to create synergies between different sectors. Between 2030 and 2040, hydrogen developments will be driven by measures to follow up European targets and National Recovery and Resilience Plan (NRRP). By 2050, net zero targets should be reached and hydrogen could

38 MASE, *Strategia nazionale idrogeno*, November 2024, https://www.mase.gov.it/sites/default/files/Strategia%20Nazionale%20Idrogeno.pdf.

ideally be a key contributor to such achievement covering 18 per cent final energy consumption of hard-to-abate industry in Italy (table 2) identifying steel, chemicals and glass as the sectors with the highest potential for future hydrogen development in the industry (table 3). In the high scenario, the final consumption in the industry sector (3.71 Mtoe) corresponds to 70 per cent of the total gas consumption in the hard-to-abate industrial sectors. Nonetheless, industry is expected to play a more limited role in absolute terms in the rise of hydrogen by 2050 compared to the transport sector.

Table 2 | Comparison between hydrogen consumption in the high scenario and total final consumption by 2050

	Final H_2 consumption 2050 (Mtoe)	**Total final consumption by 2050 (Mtoe)**	**% H_2 in total final consumption by 2050**
Hard-to-abate industry	3,71	20,93	17,7
Steel	1,11	7,22	16,8
Foundry	0,1		
Ceramics	0,31	3,48	32
Cement	0,2	5,73	12
Glass	0,49		
Refining - feedstock	0,34	0,34	100
Chemicals - feedstock	1,16	1,5	77,3

Table 3 | Hydrogen consumption by 2050 according three scenarios for hydrogen penetration (Mtoe)

	Base	**Middle**	**High**
Final consumption	5,54	7,97	10,57
Industry	1,57	2,68	3,71
- Steel	0,8	0,92	1,11
- Foundry	-	0,05	0,1
- Ceramics	0,03	0,17	0,31
- Cement	-	0,1	0,2
- Glass	0,12	0,3	0,49
- Refining - feedstock	0,34	0,34	0,34
- Chemicals - feedstock	0,28	0,8	1,16

Source: *MASE, Strategia nazionale idrogeno*, cit.

The Strategy outlines two scenarios based on different contributions from domestic production and imports (table 4). Scenario 1 prioritises the domestic production over imports, requiring higher electrolysers capacity, related investments and dedicated renewable capacity (45-90 GW). *Given chronic barriers to investments and renewable installations in Italy, deploying additional RES capacity dedicated to hydrogen may be quite challenging*.[39] To put into context, in 2022 Italy's renewable capacity was 60 GW and Italy had an average yearly addition of 1.2 GW between 2015 and 2020.

Table 4 | Key features and measures required for hydrogen

		Scenario 1 (70% domestic production; 30% import)		**Scenario 2** (20% domestic production; 80% import)	
	National demand	**Domestic production**	**Import**	**Domestic production**	**Import**
Scenario of H_2 diffusion (base-high)	6-12 Mtoe 75-140 TWh	4-8 Mtoe 52-97 TWh	2-4 Mtoe 22-42 TWh	1-2 Mtoe 15-28 TWh	5-9 Mtoe 60-110 TWh
Electrolysers capacity (i.f. 40%)		15-30 GW		4-9 GW	
Investments for electrolysers (euros)		8-16 bn		2-5 bn	
RES capacity for electrolysers		45-90 GW		13-26 GW	
Investments for RES (euros)		37-70 bn		10-20 bn	

Source: MASE, *Strategia nazionale H2*, 26 November 2024, https://energiaoltre.it/wp-content/uploads/2024/11/Strategia-Nazionale-Idrogeno-1.pdf.

As result, the official strategy prioritises green hydrogen (covering half of 2030 consumption) in line with the European legislation, but it also envisages a role for blue hydrogen, mainly due to lower costs, as well as pink (nuclear-based) hydrogen given the renewed political support to nuclear generation outlined also in the NECP. Despite the potential, the expansion of clean hydrogen as a solution in EIIs is currently hindered by several factors. The main challenge is higher costs compared to conventional sources. Countries are evaluating

39 Pier Paolo Raimondi, *Reconciliation of Energy Security and Climate Objectives*, cit.

ways to reduce the green premium. For example, Germany announced the use of carbon contracts for difference (CCfD) which are expected to facilitate investments in low-carbon technologies.[40] In its Energy Release Decree Law, Italy envisages the use of contracts for difference, but it could also explore the use of CCfD to further encourage the hydrogen ramp up. In 2025, it will be crucial to define all the legislative and regulatory frameworks, which would enable the implementation of the national strategy. For example, in 2025 the government is expected to present a law on hydrogen tariffs aimed at improving the economic argument for both green and low carbon hydrogen.[41] Furthermore, Italy could work on favouring the demand of decarbonised products, such as green steel, also through public procurement and by setting clear standards for decarbonised products.[42] This would align with the proposed measures in the Clean Industrial Deal, which include the establishment of a low-carbon product label and the revision of the EU public procurement directives. The Strategy considers the establishment of a 'competition based' mechanism for importing hydrogen, which resembles the H_2 Global mechanism.

Regarding imports, the Strategy gives high importance to infrastructure although it does not address adequately hydrogen emissions in order to avoid replication of past experience with methane emissions.[43] Italy has one of the largest gas networks in Europe, which will need to be adjusted taking into account environmental consequences although retrofitting may entail some issues.[44] Adjusting the pipeline would not be limited only to the domestic market; indeed, Italy is linked to some non-EU countries in the broader Mediterranean

40 Chetna Hareesh Kumar, Hanna Fekete and Imogen Outlaw, *Assessing Safeguards for Hydrogen Sustainability in Germany's Carbon Contracts for Difference*, NewClimate Institute, February 2025, https://newclimate.org/node/15366.

41 Assolombarda website: *Agevolazioni idrogeno in Italia ed in Europa – Stato dell'arte*, https://www.assolombarda.it/servizi/energia/informazioni/agevolazioni-idrogeno-in-italia-ed-in-europa-2013-stato-dell-arte; "Dossi all'assemblea di H2IT: 'Il 2025 sarà un anno decisivo per i progetti del settore idrogeno'", in *HydroNews*, 6 December 2024, https://hydronews.it/?p=14869.

42 Pier Paolo Raimondi, "Industrial Decarbonisation Strategies in Italy and Germany: The Case for Cooperation in Green Steel", in *IAI Commentaries*, No. 24|40 (July 2024), https://www.iai.it/en/node/18748.

43 Abdurahman Alsulaiman, "Review of Hydrogen Leakage Along the Supply Chain: Environmental Impact, Mitigation, and Recommendations for Sustainable Deployment", in *OIES Papers*, No. ET 41 (November 2024), https://www.oxfordenergy.org/?p=47887.

44 Paul Martin et al., "A Review of Challenges with Using the Natural Gas System for Hydrogen", in *Energy Science & Engineering*, Vol. 12, No. 10 (October 2024), p. 3995-4009, https://doi.org/10.1002/ese3.1861.

region through international pipelines and it is eager to leverage on them to import cheap hydrogen from the southern shore of the Mediterranean. These imports would be beneficial also for other European countries reinforcing the ambition to become an energy hub between Africa and Europe. For example, Italy, Austria and Germany support the establishment of the SouthH2 Corridor, which will transport up to 4 Mt/year from Algeria. To further support the project, Italy has cooperated with Austria and Germany. It is particularly welcomed the expansion of the technical cooperation and political support to the project to Tunisia and Algeria. The Strategy also envisages a positive role of ports in fostering hydrogen development.

While hydrogen could contribute to reduce emissions, it is of paramount important to design, measure and reduce its environmental footprint for a real contribution to mitigation strategies.[45] In this sense, the collaboration with external hydrogen suppliers is essential to design sustainable and secure international trade schemes. Indeed, North African countries' power sectors still rely heavily on fossil fuels, limited renewable generation capacity as well as severe water-scarcity.[46]

3.3 CCS

Carbon capture and storage (CCS) could be another possible option for reducing emissions in EIIs – especially by dropping emissions from the combustion process. The choice of this solution can be motivated by several factors, such as the lack of other competitive alternatives and feasible solutions; the high concentration of CO_2 emissions; the emission volume of the single industrial hubs and their geographical location nearby potential CCS plants.

Compared to the North Sea, the Mediterranean Sea is lagging behind in terms of CCS projects. However, the Southern European countries have started looking to this option. Italy could benefit from its depleted gas fields. Italy envisaged

45 Tianyi Sun et al., "Climate Impacts of Hydrogen and Methane Emissions Can Considerably Reduce the Climate Benefits across Key Hydrogen Use Cases and Time Scales", in *Environmental Sciences Technologies*, Vol. 58, No. 12 (2024), p. 5299-5309, https://pubs.acs.org/doi/10.1021/acs.est.3c09030.
46 Manfred Hafner, Pier Paolo Raimondi and Benedetta Bonometti, *The Energy Sector and Energy Geopolitics in the MENA Region at a Crossroad. Towards a Great Transformation?*, Cham, Springer, 2023, https://doi.org/10.1007/978-3-031-30705-8.

the role of CCS in its Long-Term Strategy, which estimated a reduction of 20-40 million tonnes CO_2 by 2050 thanks to CCS.[47] The 2024 NECP estimates Italy's CCS potential to be 750 Mt distributed mainly in two offshore sites: the Ravenna Hub (515 Mt) and Jono Hub (130 Mt). The Ravenna Hub, which is expected to be one of the largest CCS projects in the Mediterranean, would contribute to national mitigation strategy especially for the industrial capacities located in the Northern regions. While Phase 1 will consist of storing 25,000 tCO_2/year emitted by Eni's gas power plant, the industrial phase will start from 2027 and capture hard-to-abate sectors' emissions. The NECP foresees around 4 Mt of CO_2 from hard-to-abate sectors and other sources to be captured and stored in Ravenna. In the next steps, the project could store up to 16 Mt of CO_2. Additionally, Ravenna CCs is part of the Callisto Mediterranean Project, which is in the EU projects of common interest (PCI) list.

CCS regained a newfound political relevance because governments aim at accelerating the energy transition while preserving existing industrial capabilities. This newfound relevance has been also reaffirmed by the European Net Zero Industry Act, which includes CCS among the strategic net-zero technologies. Although the technology has been used for many years from the oil and gas industry (due to the practice of enhanced oil recovery), CCS faces several challenges in terms of economics and acceptability. The economic barrier is represented by the high cost of the capture itself. According to some stakeholders, CCS faces still high costs (130-150 euro/Mt) and regulatory uncertainty. The creation of a national CCS strategy is very much needed as well as measures that can de-risk project financially.[48]

47 MASE et al., *Strategia italiana di lungo termine sulla riduzione delle emissioni dei gas a effetto serra*, January 2021, https://www.mase.gov.it/sites/default/files/lts_gennaio_2021.pdf.

48 James Burgess, "European CCS Industry Continues to Face Delays as Challenges Stack up", in *S&P Global News*, 26 June 2024, https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/energy-transition/062624-european-ccs-industry-continues-to-face-delays-as-challenges-stack-up.

4. Challenges for EIIs' adaptation between high energy prices and fiscal constraints

In adapting to the new context, both the Italian decisionmakers and the private sector face two different challenges: high energy prices as well as macroeconomic and fiscal challenges.

a) Economics: high energy prices and carbon prices

The major challenge and concerns for sectors like non-metallic minerals, chemicals, paper, iron and steel, is related to energy price and competitiveness. At the European level, the share of energy costs has dropped to 1.7 per cent of production costs in 2019 (down from 2.3 per cent in 2010) due to higher energy efficiency and – at a smaller extend – fuel switching.[49] However, energy remains an essential component, accounting for larger shares in production costs, in the EIIs. In certain cases, the share of energy in production costs can reach very high levels. For example, energy accounts for 71 per cent of fertilisers' production costs, 38 per cent of ferro-alloys and silicon, 37 per cent for ceramics, 34 per cent primary aluminium, 23 per cent of container glass and 22 per cent in the case of zinc.[50] This is a direct consequence of the 2021/22 energy crisis, exacerbated by Russia's war to Ukraine that has led to an energy shock and to a spike of energy prices – both natural gas and electricity. For the abovementioned sectors, it is estimated that average energy costs share could have increased between 20 and 55 per cent between 2021 and the first quarter of 2022. Price volatility directly undermines competitiveness of existing industries.[51] Within this context, European industries face an existential conundrum to either raise their prices to safeguard margins or reduce production due to the high share of energy consumption.

49 European Commission, *Report on Energy Prices and Costs in Europe* (COM/2024/136), 22 March 2024, https://eur-lex.europa.eu/legal-content/en/TXT/?uri=celex:52024DC0136.
50 Ibid.
51 David Pinkus et al., "Coordination for EU Competitiveness", in *European Parliament Studies*, March 2024, https://www.europarl.europa.eu/thinktank/en/document/IPOL_STU(2024)747838.

Following the loss of Russian piped gas, the European gas markets have been substantially shaken leading to higher reliance on LNG and exposure to higher and more volatile prices. European natural gas prices are between three to five times higher than those in the US. Since natural gas still sets the price in the power sector despite the rise of renewables, electricity prices have increased as well expanding the gap with the US and China. Indeed, electricity retail prices are currently two to three times those in the US and China. This new paradigm may also encourage industries moving production to regions with cheaper energy prices with European countries becoming more dependent on imports and losing industrial capacity.

In terms of price, Italy entered into the crisis from an already disadvantage position as it traditionally displayed higher wholesale electricity prices compared to the EU due to the heavy presence of gas in their power mix and due to a relatively high reliance on imports.[52] A condition that quickly got worse in 2022 widening the gap also with other member states. Italian prices were consistently on the upper bound of electricity prices in Europe during the crisis, between 30 euro/MWh and 60 euro/MWh above the EU average.[53] Electricity prices paid by Italian companies increased by about 73 per cent in 2022 (compared to the EU-27 average of about 41 per cent), while gas prices recorded a growth of 163 per cent (against EU-27 average of 96.5 per cent).[54] Such challenging economic context has led to a reduction of gas and power consumption in the industry sector in 2022 as companies were struggling to preserve their output in such challenging environment.[55] Furthermore, given the fear of supply shortages, the use of gas in the industry sector competed with other sectors, namely power and heating, hence experienced higher degree of demand reduction.

52 Andrea Gasparella, Derck Koolen and Andreas Zucker, "The Merit Order and Price-Setting Dynamics in European Markets. A 2022 and 2030 Investigation using METIS", in *JRC Science for Policy Briefs*, August 2023, https://publications.jrc.ec.europa.eu/repository/handle/JRC134300.

53 Miguel Gil Tertre et al., "Electricity Price Differentials in the EU: Impacts on Intra-EU Competitiveness", in *SSRN*, December 2023, https://ssrn.com/abstract=4652494.

54 MASE, *La situazione energetica nazionale nel 2022*, July 2023, https://www.mase.gov.it/sites/default/files/Archivio_Energia/LA%20RELAZIONE%20SULLA%20SITUAZIONE%20ENERGETICA%20NAZIONALE%20NEL%202022_MASE%20Luglio%202023.pdf.

55 Confindustria, *The Italian Economy Between Rising Rates and High Inflation - Spring 2023*, March 2023, https://www.confindustria.it/home/centro-studi/prodotti/previsioni/rapporto/congiuntura+e+previsioni/rapporto-previsione-economia-italiana-primavera-2023.

Even in the case of lower energy prices, European EIIs face additional costs set by CO_2 prices which reached their record level in 2023. Although some uncertainty on the future trajectory, tighter and more ambitious targets at the European level are expected to drive upward carbon prices affecting industry competitiveness. While emitting CO_2 would entail higher costs for producers inducing them in investing in alternative solutions, these desirable alternatives come with higher capital and operating costs. To address this risk along with the one of carbon leakage, the EU adopted the Carbon Boarder Adjustment Mechanism (CBAM) which applies a carbon levy based on the emission embedded in certain imported goods (cement, iron and steel, aluminium, fertilisers, electricity and hydrogen). As the CBAM is in its transitional phase, the EU still needs to finalise several aspects regarding the methodology and the acceptability of the Mechanism with several trading partners. Moreover, the EU decided to avoid any export rebates in order to comply with World Trade Organisation's rules. The implications of CBAM cannot be addressed in this paper given the complexity of the Mechanism and the paper's scope.

b) Macroeconomic and fiscal challenges

Given the high energy prices, countries earmarked public money to shield consumers and firms. Between September 2021 and January 2023, Italy allocated 92.7 billion euros (equal to 5.2 per cent of GDP) to curb the problem, behind only Germany (157 billion euros), and ahead France (92.1 billion euros) among the member states.[56] Nonetheless, such approach needs to be revised and a more targeted approach towards the most vulnerable groups would be more useful given fiscal unsustainability and regressive effects.[57] At the same, even targeted subsidies may prove insufficient to preserve and support some sectors' competitiveness. For example, Italy is among those European countries that provided meaningful subsidies to gas-consuming industries.[58] However, industrial production has decreased despite these measures due to import

56 Giovanni Sgaravatti et al., "National Policies to Shield Consumers from Rising Energy Prices", in *Bruegel Datasets*, updated 26 June 2023, https://www.bruegel.org/node/7844.

57 Pier Paolo Raimondi, *Reconciliation of Energy Security and Climate Objectives*, cit.

58 Giovanni Sgaravatti et al., "National Policies to Shield Consumers from Rising Energy Prices", cit.; Akos Losz and Anne-Sophie Corbeau, "Anatomy of the European Industrial Gas Demand Drop", cit.

substitution and economic headwinds among other variables.[59]

Meanwhile, countries have expanded the use of state aids under the Temporary Crisis and Transition Framework (TCTF).[60] Between March 2022 and end of June 2023, the Commission approved a total of 729.72 billion euros of State aid measures. 7.8 per cent of the total was approved for Italy, which ranks third after Germany (48.8 per cent) and France (23 per cent).[61] In absolute terms, Italy was the second largest spender, having granted 39.2 billion euros, after only Germany (72.8 billion euros) and before Spain (12.1 billion euros), while in relative terms (as percentage of national GDP), Italy ranks second (1.32 per cent of its GDP) after Hungary (1.35 percentage) and before Germany (1.23 per cent of GDP). However, the country has smaller fiscal manoeuvre compared to other European peers given its large deficit. Additionally, the country is expected to face tighter scrutiny on its policies by the European institutions[62] given the new European Union's fiscal rules. The new fiscal context requires a reconsideration of the fiscal and economic support to the existing industries in order to accelerate their transformations in line with the national and European climate objectives.

5. Investments for enabling decarbonisation

Given fiscal and macroeconomic hurdles, Italy may face difficult trade-offs between supporting existing industries while investing in new technologies in order to position itself in the new low-carbon industrial map.

59 Philipp Jäger, "Rustbelt Relics or Future Keystone? EU Policy for Energy-Intensive Industries", in *Hertie School Policy Papers*, 20 December 2023, https://www.delorscentre.eu/en/publications/energy-intensive-industries; Akos Losz and Anne-Sophie Corbeau, "Anatomy of the European Industrial Gas Demand Drop", cit.

60 European Commission website: *Temporary Crisis and Transition Framework*, https://competition-policy.ec.europa.eu/node/712_en.

61 Sara Ferraro, Giuseppina Cannas, Koen van de Casteele, *Competition State Aid Brief*, No. 1/2024 (February 2024), https://competition-policy.ec.europa.eu/document/download/22938d94-beaa-44bf-97ca-8a1785ca1a1c_en.

62 "European Council Approves Italy Deficit Procedure", in *Ansa*, 26 July 2024, https://www.ansa.it/english/news/politics/2024/07/26/european-council-approves-italy-deficit-procedure_7c6731cf-d99d-48b5-b79e-43793359aeab.html.

On one side, the country needs to allocate funds to decarbonise existing EIIs, alongside other industries, which require a variety of technologies and solutions. At the national level, the 2024 NECP foresees around 824 billion (cumulated for the period 20224-2030), an additional 174 billion euros compared to the existing policies. For the industry sector alone, Italy envisages 13.1 billion of euros of cumulative costs between 2024 and 2030. By contrast, according to a recent study conducted by the Politecnico of Milan, the hard-to-abate sectors in the country would require between 30 and 80 billion euros.[63] Italy has already different financial avenues, such as the National Recovery and Resilience Plan (NRRP) and Piano Transizione 5.0.[64] Within the NRRP, Italy has 3.64 billion euros of investment for the development hydrogen. Among these funds, 2 billion are dedicated to incentivising decarbonisation in hard-to-abate sectors, through the development and use of green and renewable hydrogen. Moreover, Piano Transizione 5.0 envisages the use of tax credit up to 6.3 billion of euros, financed by the REPowerEU, for facilitating the reduction of energy consumption through renewables.[65] All these financial avenues however face time constraints. Indeed, the NRRP ends at the end of 2026, while Piano Transizione 5.0 covers only the 2024-25 period. At the European level, it is estimated that around 340 billion euros for the four largest EIIs together to transform them between 2031 and 2040.[66]

On the other hand, it would need to invest in favouring new manufacturing capacity in the clean energy technologies. This element represents an additional industrial and socioeconomic opportunity, but it could also contribute for the decarbonisation of existing sectors. Particularly, this will be the case for large heat pumps for industrial sector, batteries and hydrogen-related technologies. For example, the expansion of batteries could reduce the costs, balancing the system and reducing the need for grid expansions. The European Commission' estimated accumulated investment needs to boost EU's manufacturing capacity

63 Energy & Strategy, *Zero Carbon Technology Pathways Report 2023*.
64 Italian Ministry of Enterprises and Made in Italy, *DL PNRR: al via Transizione 5.0, 6.3 miliardi per la sfida green e digitale delle imprese*, 26 February 2024, https://www.mimit.gov.it/it/notizie-stampa/mimit-dl-pnrr-al-via-transizione-5-0-6-3-miliardi-per-la-sfida-green-e-digitale-delle-imprese.
65 Ibid.
66 See "Part B. In-depth Analysis and Recommendations", in Mario Draghi, *The Future of European Competitiveness*, cit.

in net-zero technologies to be around 92 billion euros from 2023 until 2030 and up to 119 billion euros in the scenario with no dependence on imports.[67] Besides being an additional industrial and socioeconomic opportunity, net-zero technologies could also contribute for the decarbonisation of existing sectors. Particularly, this will be the case for large heat pumps for industrial sector, batteries and hydrogen-related technologies. For example, the expansion of batteries could reduce the costs, balancing the system and reducing the need for grid expansions. However, the EU has failed to create a dedicated fund and preferred to relax its state aid rules. In 2022, the Commission also presented the guidelines on State aid for climate, environmental protection and energy.[68] In response to the IRA in early March 2023, the Commission modified the TCTF, which allows "aid for accelerated investments in sectors strategic for the transition towards a net-zero economy".[69] For example, the Commission approved several State aid schemes proposed by Italy. In November 2023, it approved a 5.7 billion euros State aid scheme to support res communities and self-consumers,[70] followed by a 17.7 billion euros State aid scheme to support development of centralised electricity storage system in December 2023.[71] In 2024, the Commission approved 550 million euros State aid scheme to support investments for the use of hydrogen in industrial processes.[72] However, the extensive use of State aid rules could undermine the single European market as member states have different fiscal spaces causing a disadvantage for those with limited space such as Italy. At the same time, easing fiscal rules will not

67 European Commission, *Investment Needs and Funding Availabilities to Strengthen EU's Net-Zero Technology Manufacturing Capacity* (SWD/2023/68), 23 March 2023, https://single-market-economy.ec.europa.eu/node/2064_en.

68 European Commission, *Guidelines on State Aid for Climate, Environmental Protection and Energy 2022* (C/2022/481), 18 February 2022, https://eur-lex.europa.eu/legal-content/en/TXT/?uri=celex:52022XC0218(03).

69 Batteries, solar panels, wind turbines, heat-pumps, electrolysers and CCUS, as well as the production and recycling of priority components and CRMs. See European Commission, *Temporary Crisis and Transition Framework for State Aid Measures to Support the Economy following the Aggression against Ukraine by Russia*, 2 May 2024, point 85, https://eur-lex.europa.eu/legal-content/en/TXT/?uri=celex:02023XC0317(01)-20240502.

70 European Commission, *Commission Approves €5.7 billion Italian State Aid Scheme under the Recovery and Resilience Facility to Support Renewable Energy Communities and Self-consumers*, 22 November 2023, https://ec.europa.eu/commission/presscorner/detail/en/ip_23_5787.

71 European Commission, *Commission Approves €17.7 billion Italian State Aid Scheme to Support Development of Centralised Electricity Storage System*, 21 December 2023, https://ec.europa.eu/commission/presscorner/detail/en/ip_23_6758.

72 European Commission, *Commission Approves €550 million Italian State Aid Scheme to Support Investments for the Use of Hydrogen in Industrial Processes to Foster the Transition to a Net-Zero Economy*, 30 January 2024, https://ec.europa.eu/commission/presscorner/detail/en/ip_24_507.

imply a direct help for countries with structural low fiscal space. In this regard, an increase in EU solidarity and common funds would be a better option.[73] In expanding net-zero technologies, it would be necessary to keep in mind comparative disadvantages in some of them (e.g., solar) vis-à-vis key producers, mainly China, and focusing on cutting-edge technologies and in those where the EU has a better advantage (e.g., wind, electrolysers and heat pumps). This would imply leaving space for imports from cheaper producers; otherwise, EU climate targets will be not reached.

Such an approach would be ideal in light of fiscal sustainability and constraints. Investments for manufacturing capacity in net-zero technologies would be additional to those required to reach climate targets, set by the European Green Deal. According to the estimates made by the Commission, to deliver on the European Green Deal objectives annual investments will need to increase by around 520 billion euros between 2021 and 2030, with 390 billion euros per year for decarbonising the economy and in particular the energy sector.[74] However, the EU is estimated to have also a significant investment gap. A recent analysis conducted by I4CE estimates that the EU faces a climate investment deficit (that is, the difference between the level of climate investments happening today in the EU and the total investment needs required annually by 2030 to achieve the EU 2030 targets) at least 406 billion euros per year or 2.6 per cent of the EU GDP.[75]

What is clear is that Europe cannot reach its net-zero targets, maintaining industrial competitiveness and developing clean tech manufacturing with fiscal discipline.[76] At the same time, Italy will need to adjust its regulatory

73 Matthias Buck, *Ensuring Resilience in Europe's Energy Transition: The Role of EU Clean-Tech Manufacturing*, Berlin, Agora Energiewende, September 2023, https://www.agora-energiewende.org/publications/ensuring-resilience-in-europes-energy-transition.

74 European Commission, *Towards a Green, Digital and Resilient Economy: Our European Growth Model* (COM/2022/83), 2 March 2022, https://eur-lex.europa.eu/legal-content/en/TXT/?uri=celex:52022DC0083; Stefan Speck et al., "Investments in the Sustainability Transition: Leveraging Green Industrial Policy against Emerging Constraints", in *EEA Briefings*, 7 November 2023, https://www.eea.europa.eu/publications/investments-into-the-sustainability-transition.

75 Clara Calipel, Antoine Bizien and Thomas Pellerin-Carlin, *European Climate Investment Deficit Report. An Investment Pathway for Europe's Future*, Paris, I4CE, February 2024, p. 9, https://www.i4ce.org/en/?p=67744.

76 Jean Pisani-Ferry, "Europe's Climate Quandary", in *Project Syndicate*, 1 June 2023, https://prosyn.org/9OO97ML.

framework and address its chronical challenges to attract and unleash both public and private investments in the field of clean energy technologies given the end of relevant public investment initiatives.

6. Dilemma and trade-offs between domestic and imported products

Compared to 2019 when the European Green Deal was launched, Europe, hence Italy too, faces an entirely different international and energy landscape. Global competition, subsidies race, high energy prices urge the EU to find a balance between energy security, climate objectives and economic competitiveness. In this regard, Europeans (including Italy) will need to decide a combination of measures that favours the transformation of existing EIIs within the European and national borders and the reallocation of production to the regions with cheaper energy.[77] Selected subsidies to shield domestic producers may be allocated but they will need to be carefully evaluated based on clear criteria, such as economic relevance (cluster effects) and economic resilience (avoiding new dependencies on critical sectors/products).[78]

Natural gas plays a crucial role in Italy's energy system and it is expected to remain so for the short to medium term. Higher and more volatile prices deeply affected industries' competitiveness. Following the two years of tight market, the market is expected to return to be well supplied and become a buyers' market in the next couple of years due to the expansion of export projects (mainly in Qatar and the US) coupled with lower demand in Europe due to higher renewables and demand reductions. The expected gas glut could bring down gas prices and encourage higher industrial production to a certain extent. However, the main issue will be if EIIs gas demand will be able to enjoy lower prices. Furthermore, natural gas should decline faster to reach 2030 and

77 Sascha Samadi, Andreas Fischer and Stefan Lechtenböhmer, "The Renewables Pull Effect: How Regional Differences in Renewable Energy Costs Could Influence Where Industrial Production Is Located in the Future", in *Energy Research & Social Science*, Vol. 104 (October 2023), Article 103257, https://doi.org/10.1016/j.erss.2023.103257.

78 Giovanni Sgaravatti, Simone Tagliapietra and Georg Zachmann, "Adjusting to the Energy Shock: The Right Policies for European Industry", in *Bruegel Policy Briefs*, No. 11/23 (May 2023), https://www.bruegel.org/node/9072; Philipp Jäger, "Rustbelt Relics or Future Keystone?", cit.

2050 climate targets compared to what envisaged in the NECP.[79]

Nonetheless, the climate targets, enshrined into EU law, require the transformation of these industries. While designing the EU and national decarbonisation strategies, including those related to hydrogen, governments will need to take into account several trade-offs between importing hydrogen for domestic consumption or importing decarbonised products. Until now, the EU and Italy have generally favoured strategies that promotes hydrogen imports, which are perceived as essential in keeping and decarbonising European industries as well as avoiding major socioeconomic backslashes. However, international hydrogen trade is yet to come and faces several technological, regulatory and economic barriers. Furthermore, the European non-binding import targets, set at 10 Mt/y by 2030 by the REPowerEU Plan, seems to be unrealistic to be reached.[80] Additionally, the new energy and economic scenario favours countries with higher renewable potential, many in the so-called Global South, to attract industries and seize economic opportunities.

In light of this context, Italy and Europe should work with non-EU countries, starting from neighbouring countries in North Africa and the Middle East, to build up decarbonised EIIs through the use of clean hydrogen domestically.[81] Doing so with the right intention has the potential to spur the development of local economies, accelerate decarbonisation at a lower cost, and strengthen their climate and energy diplomacy at a time of greater geopolitical confrontation. However only through high environmental standards and coordination and transparency on MRV system on hydrogen emissions and sustainability will it be possible to achieve both climate and economic objectives. These elements should be included in the design of the new Clean Trade and Investment Partnerships, proposed in the CID.

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79 Charlotte Liebrecht and Raphael Hanoteaux, "National Energy Climate Plan Analysis: Italy", in *E3G Briefing Papers*, March 2024, https://www.e3g.org/wp-content/uploads/E3G-Briefing-NECP-gas-analysis-Italy.pdf.

80 European Court of Auditors (ECA), "The EU's Industrial Policy on Renewable Hydrogen. Legal Framework Has Been Mostly Adopted – Time for a Reality Check", in *ECA Special Reports*, No. 11/2024, https://www.eca.europa.eu/en/publications?ref=sr-2024-11.

81 UNIDO, IRENA and IDOS, *Green Hydrogen for Sustainable Industrial Development. A Policy Toolkit for Developing Countries*, February 2024, https://www.unido.org/node/9662885.

7. Policy recommendation for the EU and Italy

Both European and Italian EIIs face existential challenges caused by the high energy price context and the urgency to transform and adapt themselves in line with climate targets. EIIs have different options to adapt their production by mitigating emissions: electrification, cleaner molecules and CCS. Each technology can provide positive outcomes although still needs to overcome several barriers, notably higher costs, infrastructure developments and investments. In light of these challenges, *Italy could see the increase of imports while losing industrial capacity*. Based on the previous sections, the paper seeks to provide some policy recommendations on the following issues:

More clean energy supply: Italian industries' competitiveness is deeply undermined by high energy prices. To partially restore its energy competitiveness, Italy needs to increase the availability of (clean) energy supply to lower energy prices. The 2024 NECP sets ambitious renewables targets, but the country needs to address its chronic issues on renewable deployment and political commitment. It still needs to design a proper strategy to expand its grids and battery industry. Renewables will not be the only solution for industrial decarbonisation, demanding to ensure enough energy supply coming from several sources, including clean molecules. A first step will be to remove all the unnecessary permitting procedures to accelerate the deployment and attract enough investments along the entire value chain, notably in infrastructure to increase generation, distribution, transport capacities and storage.

Comprehensive strategy: Decarbonising EIIs will be able through a variety of different solutions (electrification, hydrogen and CCS). However, their contribution depends on policy, economics and technological potential in order to avoid inefficiency and loss of time. Italy should promote electrification for low and medium temperature heat also revising its electricity prices, while CCS for abating CO_2 process emissions for example in cement industry. For hydrogen, a crucial first step would be to prioritise the use of hydrogen in the existing hydrogen-consuming sectors in order to ignite hydrogen demand. To do so, Italy needs also to streamline and design coherent policies and strategies

as a better governance is a prerequisite for a successful decarbonisation. The new hydrogen strategy goes in this direction. Nonetheless, it should address more explicitly environmental risks related to the hydrogen economy, namely hydrogen leakage, as it is crucial to avoid policy changes and inefficiencies. Despite its preference for hydrogen trade through pipeline, the strategy rightly envisages a positive and relevant role for its ports, leveraging also its geographical position. By building a clearer and more coherent governance, the country needs also to address important factors: demand, prices and environmental footprint.

- *Demand*: While building enough energy supply, Italy will need to ensure to incentivise demand for clean energy and decarbonised products. To do so, the country will need to use public procurements aimed at favouring the ramp up of cleaner products, also acknowledging good practices.
- *Price*: As of today, cleaner solutions face mostly an economic barrier as they entail higher capital and operational costs compared to the fossil fuels-based solutions. Italy should favour policies and measures aimed at fostering industrial decarbonisation through stable prices, such as CCfD or PPA.
- *Environmental footprint*: By developing the use of different solutions, it is important to promote a comprehensive approach to emissions reduction by also addressing emissions along the value chain of natural gas and hydrogen, as outlined by the EU Methane Regulation and Hydrogen Package.

International dimension and trade-offs: Lower competitiveness and specific barrier may induce Italy to reconsider the international dimension of mitigation strategies of its industry. Addressing methane emission requires an international outreach given Italy's dependence on gas imports, in line with the EU Methane Regulation. However, Italy needs to engage proactively with its energy partners – especially in the Mediterranean – in order to ensure robust MRV systems, the use of existing technologies and funds as well as data transparency. In the long-term, Italy leaves room for some hydrogen imports for decarbonising its industries and gaining relevance in the European supply architecture. However, the existing challenges to the international hydrogen trade, including related to hydrogen emissions and leakage, and the high energy price environment in Europe suggest that other regions could attract EIIs and decarbonise their final products thanks to the domestic use of hydrogen. Italy will need to include this

approach into its energy and foreign policy – especially in the MENA region and Africa. Selected subsidies to shield domestic producers may be allocated but they will need to be carefully evaluated based on clear criteria, such as economic relevance (cluster effects) and economic resilience (avoiding new dependencies on critical sectors/products),[82] while accepting some relocation of industrial productions which will be driven towards more favourable regions by market forces.

European solutions: Italy cannot design its industrial decarbonisation without taking into account the European level. European coordination is essential in setting priorities and tools, including funds. On the priorities, Italy should cooperate with European institutions in building criteria and standards for protecting domestic producers and outsourcing orderly some of the production. It will need to make sure that positive developments in terms of decarbonisation efforts are acknowledged properly, such as in the case of steel production, while designing features for green markets. Regarding financial tools, Italy faces serious economic and fiscal hurdles that could further hinder its ability to protect its industries' competitiveness, while investing in new technologies. Without a more coordinated and stable funding source at the European level, the risk will be market fragmentation and inefficiency. Therefore, common financial strategies are encouraged and needed and Italy would need to engage with European institutions and other member states to shape industrial strategy as well as enhance and streamline adequate investment tools. At the same time, Italy will need to prove its ability to spend properly and adequately the existing funds.

82 Giovanni Sgaravatti, Simone Tagliapietra and Georg Zachmann, "Adjusting to the Energy Shock", cit.; Philipp Jäger, "Rustbelt Relics or Future Keystone?", cit.

List of acronyms

Bcm	Billion cubic metres
BF	Blast furnaces
BOF	Basic oxygen furnaces
CBAM	Carbon Boarder Adjustment Mechanism
CCS	Carbon capture and storage
CCUS	Carbon capture, use and storage
CCfD	Carbon contracts for difference
CID	Clean Industrial Deal
EAF	Electric arc furnaces
EIIs	Energy-intensive industries
EU ETS	European Emission Trading System
GDIP	Green Deal Industrial Plan
GDP	Gross domestic product
GHG	Greenhouse gas
GW	Gigawatt
H-DRI	Hydrogen direct iron reduction
IRA	Inflation Reduction Act
LNG	Liquefied natural gas
LULUCF	Land use, land-use change and forestry
MRV	Measurement, reporting and verification
MASE	Italian Ministry of the Environment and Energy Security
MENA	Middle East and North Africa
Mt	Million tonnes
Mtoe	Million tonnes of oil equivalent
MWh	Megawatt hours
NECP	National Energy and Climate Plan
NRRP	National Recovery and Resilience Plan
PCI	Projects of common interest
PPA	Power purchase agreement
PV	Photovoltaic
RED	Renewable Energy Directive
RES	Renewable energy sources
TCTF	Temporary Crisis and Transition Framework
TWh	Terawatt hours

Italy's Energy-Intensive Industries amid Competitiveness and Decarbonisation

The European Green Deal has entered into a new, critical phase, where competitiveness and economic security are more relevant. The Clean Industrial Deal aims to create a business case for European green industrialisation by focusing not only on clean tech but also on the existing energy-intensive industries. Their transformation will be essential for decarbonisation to be achieved. A combination of solutions is required to mitigate emissions in EIIs: electrification; addressing methane emissions, especially from the international suppliers, given the relevance of natural gas in Italy's energy mix; the ramp up of clean hydrogen where more efficient electrification is not feasible; and CCS. Along the industrial transformation, Italy is called to pursue different industrial and energy measures to address multiple challenges. To do so, Italy needs to work with the EU in setting priorities, standards and creating new tools, including related to investments, that will enable industrial transformation.

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