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Taranto 2030: a model for sustainable transition between industrial innovation and participatory governance

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Abstract

What happens when the largest steel plant in Europe becomes the epicentre of an environmental, social and economic crisis? This thesis starts from the case of the former ILVA in Taranto to analyse the necessary conditions for a sustainable and just industrial transition in territorial contexts with high production dependency. The paper adopts an integrated approach, combining historical analysis, economic evaluation and the study of public policies, to understand the fractures generated by a development model based on the centrality of a large polluting industry.

The first part of the thesis reconstructs the dynamics that led Taranto to become a critical node in Italian industrial policy, highlighting the long-term health, environmental and social impacts. By quantifying the external costs - including health damage, property devaluation, loss of productivity and increased healthcare expenditure - it demonstrates how the absence of effective environmental governance and the failure to internalise externalities compromised the sustainability of the economic model.

Subsequently, the thesis analyses the main European transition instruments - Green Deal, Clean Industrial Deal, Emission Trading System - with a specific focus on the Just Transition Fund (JTF), which operational declination for Taranto was approved by the Italian government on 11 February 2025. The JTF is examined not only as a source of funding, but as an opportunity for structural transformation, provided it is accompanied by project selection criteria based on employment impact, environmental quality and social inclusion.

Special attention is paid to technological solutions for decarbonisation (EAF/DRI furnaces), the role of the circular economy in the steel industry and the resilience of local supply chains. The comparison with industrial reconversion experiences in cities such as Gelsenkirchen and Pittsburgh offers practical insights into a place-based approach to transition.

The transversal element that runs through the entire work is the importance of participatory governance as a necessary condition for successful transition. Involving local communities, community foundations, and civic stakeholders is not only an ethical issue, but a strategic lever to build trust, legitimacy and lasting impact.

The conclusions highlight how Taranto can become a European benchmark for industrial transition, provided that technological innovation, social equity and civic participation are integrated into a shared and coherent vision. Finally, the thesis proposes operational recommendations to orient JTF calls towards maximising economic and social value, promoting a sustainable, inclusive and replicable transformation.

Introduction

> *"The urgent challenge of protecting our common home includes the purpose of uniting the entire human family in the quest for sustainable and integral development."*
> Pope Francis Laudato Sì, 2015, paragraph 13

Growing up in an era of environmental and social crisis means asking new questions about development models that we have inherited without choosing them.

This thesis stems from a simple but radical question: under what conditions, and through what instruments, is it possible for Taranto to achieve a development model in which economic growth, social welfare and respect for the environment coexist in a sustainable manner?

Looking at Taranto and the history of ILVA means confronting a challenge that is still open, one that questions our very idea of progress. The need to rethink development models imposes itself as one of the most urgent and complex challenges. It is no longer a question of choosing between economic growth or environmental protection, but of building development paths that hold both together in an integrated and sustainable perspective.

Even from a secular perspective, the concept of 'sustainable and integral development' today represents an indispensable reference for those who wish to imagine a future in which progress, social justice and environmental protection coexist harmoniously.

Starting from this awareness, this thesis sets out to examine the case of ILVA in Taranto as a paradigmatic example of the tensions between industrial growth and environmental and social sustainability, with the aim of identifying fair transition paths.

On the other hand, this thesis focuses on Taranto's industrial and environmental crisis by integrating it with international experiences of cities with a strong steel industrial vocation, particularly in Europe and North America. In the final chapter 5, models of *sustainable industrial reconversion*[1] (European Commission, 2018) adopted in similar contexts will be examined, trying to provide guidance for imagining Taranto as a potential model of industrial transition towards 2030.

The objective of this thesis is, therefore, twofold: to understand how the territorial, social and productive fabric of Taranto has been shaped around the large steel industry and, at the same time, to

[1] Sustainable industrial reconversion is the process of transforming traditional productive sectors, aimed at reducing environmental impact, improving energy efficiency and promoting more resilient economic models. It involves technological and social innovations, requiring the active involvement of territories and local communities.

question which conditions and strategies can today make possible a *just transition*[3] (United Nations Framework Convention on Climate Change, 2015), capable of safeguarding together the right to work, health and the environment.

The ILVA case, already the subject of European attention, highlights the challenges of transition in contexts heavily dependent on a single industry. Conceived as a project for the modernisation and redemption of the Mezzogiorno, which became a symbol of Italy's economic miracle, the largest steel plant in Europe has, over time, turned into one of the main areas of conflict between economic growth and environmental and social sustainability.

The ILVA affair forcefully poses a universal question: is it really possible to reconcile industrial development and environmental protection? Must employment and economic prosperity necessarily oppose the health of citizens and the protection of the territory?

Taranto thus becomes an open-air laboratory to reflect on how to manage the reconversion of energy-intensive and polluting production models in an era of climate crisis and growing inequalities.

In recent years, the Ilva case has also been studied at the European level as an emblematic example of the challenges and contradictions accompanying the processes of decarbonisation and industrial reconversion, highlighting how complex it is to combine the right to work, environmental sustainability and social cohesion in territories highly dependent on a single large company.

By analysing the historical fractures that have marked the relationship between industry, the environment and the local community, this thesis will attempt to grasp the lessons that the 'Taranto case' can offer not only to Italy, but also to the European debate on just transition.

It is not just about recounting a crisis: it is about understanding if, how and under what conditions it is possible to imagine a future where economic growth, social inclusion and sustainability are not alternatives, but complementary elements of a new development paradigm.

[3] The Just Transition has been defined by the International Labour Organisation (ILO) as that pathway of transformation towards a low-emission and sustainable economy, while ensuring worker protection, social protection and the inclusion of the most vulnerable communities. Introduced by the trade union movement, it is now a pillar of international and European climate policies (ILO, 2015).

Chapter 1. ILVA and the industrial context: from the past to the current crisis

1.1 Italian industrial policy in the 1950s and the choice of Taranto

"I beg you to take an interest in the land issue. We must not break our promises, our social directives. We must work to lift the backward regions of the South, lift the conditions of the farm labourers, provide for the transformation of the land and the formation of small property".
(Segni[4], 1947)

With these words addressed to Prime Minister Alcide De Gasperi, Antonio Segni summarised the spirit of a part of the post-war Italian ruling class: the development of Southern Italy (the "Mezzogiorno") was not only an economic objective, but also a political and moral mission. In the 1950s, the theme of Southern growth became closely intertwined with national industrial policy, giving impetus to a season of public investment led by IRI[5], the state body set up in the 1930s to relaunch Italy's strategic enterprises.

Within IRI, a fundamental role was played by Finsider, a steel holding company created in 1937 to coordinate and strengthen the steel sector, considered essential for the economic modernisation of the country (Ninni & Silva, 2005).

It was in this context that the project to build a new large full-cycle steel centre took shape[6] - the fourth after Cornigliano, Piombino and Bagnoli - destined not only to strengthen national production but also to act as a development engine for the South.

The choice of Taranto as the final location, formalised between 1958 and 1959, responded to multiple factors:

- **Politicians.** The Mezzogiorno needed a major strategic investment to reduce the territorial imbalances accentuated by the industrialisation of the North. The establishment of a strategic industry would have offered employment opportunities and boosted local economic growth, also responding to the social pressure resulting from the post-war peasant struggles (Barca, 1999).

[4] Antonio Segni (1891-1972), Minister of Agriculture in 1947 and President of the Republic from 1962 to 1964, was a staunch supporter of public intervention in the Mezzogiorno, helping to define the policies of agrarian reform and development of the South after World War II.
[5] The IRI (Institute for Industrial Reconstruction) was created in 1933 to rescue failing companies during the Great Depression and remained a key player in Italian public industry for much of the 20th century.
[6] This is an industrial complex that produces steel starting directly from iron ore, through a continuous production process encompassing all stages: from the preparation of raw materials, to reduction in furnaces, to the casting and final rolling of the steel product.

- **Geographical and logistical.** Taranto offered particularly favourable conditions: vast flat areas available, a strategic natural harbour for international trade in raw materials (iron ore, coal), good rail and road connections, presence of local labour, abundance of limestone.
- **Industrial and cultural.** The historical presence of the Maritime Military Arsenal and the Tosi Shipyards had already introduced into the area technical-industrial skills useful for the start-up and operation of the new iron and steel industry.
- **European and strategic.** With the birth of the ECSC[7], Italy entered a liberalised European market for coal and steel. In order to close the competitive gap with France and West Germany, the so-called Sinigaglia Plan[8] was drawn up, which foresaw a strong strengthening of national steel production through the creation of new large state-owned plants (Sinigaglia, 1946).
- **Economic and urban planning.** The logic of the industrial policy of the Development Poles (Cerrito, 2010), inspired by François Perroux's key industry theory[9], urged the establishment of large industrial enterprises in depressed areas, in the hope that an industrial and infrastructural spin-off would arise around them thanks to a network of complementary services, generating a multiplier effect on the local economy.

The decision to invest in Taranto was therefore the result of an organic vision of development, which intertwined national industrial policy, European modernisation requirements and the desire for internal social cohesion. The aim was to build a 'mother factory' capable of radically transforming the area's economy and reducing the North-South divide.

The laying of the foundation stone took place on 10 July 1960, while the inauguration of the complete plant was celebrated in November 1964 in the presence of the highest political authorities, including Aldo Moro[10] and Emilio Colombo[11]. The Taranto steel plant - destined to become the largest in

[7] The ECSC (European Coal and Steel Community), established by the Treaty of Paris in 1951, was the first experiment in European economic integration. For Italy, it represented a strong incentive to modernise the steel sector and strengthen national production capacity, prompting the State to plan new public investments and to develop industrial poles that were competitive at European level.
[8] The Plan is named after Oscar Sinigaglia, an engineer and chairman of Ilva in the 1930s and later manager of Finsider, a proponent of the expansion strategy of the Italian state-owned steel industry after World War II.
[9] François Perroux (1903-1987), a French economist, theorised that economic growth stems from 'propeller centres' - strategic enterprises or sectors - capable of generating development in the surrounding area through phenomena of attraction and productive specialisation. His model influenced many European regional industrialisation policies after World War II.
[10] Aldo Moro (1916-1978), Prime Minister in 1964, the year of the inauguration of the ILVA plant in Taranto, promoted a vision of development centred on the balance between industrial modernisation and social cohesion, with particular attention to the role of the Mezzogiorno.
[11] Emilio Colombo (1920-2013), Minister of the Treasury in 1964, the year of the inauguration of the ILVA plant in Taranto, was one of the protagonists of the centre-left's economic policies, supporting the industrial development of Southern Italy as a lever for the modernisation of the country.

Europe - was welcomed as a symbol of progress and national pride, in a season dominated by the optimism of the 'Italian economic miracle' (Toniolo, 2013).

The birth of the great Taranto steel plant represented the crowning achievement of an ambitious vision of industrial development, the child of the economic miracle and European integration policies. However, this vision, although projected into the future, concealed within it the first tensions between industrial progress and local welfare, which would give rise to economic, environmental and social fractures. These fractures, which still mark the city's destiny today, began to emerge strongly, highlighting the limits of a development model that had not fully taken into account the needs of the territory and its community.

1.2 Taranto and ILVA: a triple fracture

The construction of the steelworks was accompanied by urban and industrial planning that, at least in its intentions, should have guaranteed an orderly development of the territory. Law No. 634 of 1957 instituted the Consortia for Industrial Development Areas (ASI), instruments designed to foster local planning and the construction of the infrastructures necessary for production settlements, also with the support of Cassa per il Mezzogiorno resources (Felice & Lepore, 2013). Within this framework was the Tekne Plan, approved in 1961 by the local ASI, which outlined balanced growth along an East-West axis, with the creation of three industrial poles between Taranto, Massafra and Grottaglie, supported by additional smaller areas in Palagiano and Palagianello.

However, the size and very nature of the steel plant quickly overwhelmed the original forecasts. The expansion of Italsider[12] imposed a forced reorganisation of the territory: urbanisation was concentrated mainly north of the Mar Piccolo, but the process was marked by recurring conflicts between the municipality of Taranto, the Navy and the State administration, culminating only in 1964 with the approval of the master plan. The situation became even more complicated in the following years, when IRI's decision to double steel production necessitated further expansion towards the coast, through the new Carbonara Plan, which envisaged an 800-hectare sea fill. These events highlighted an initial, profound urban and political fracture, that between industry and territory.

Strategic decisions, taken centrally without any real involvement of the local community, shaped Taranto's urban planning according to the needs of the steelworks, sacrificing any autonomous vision of the city's development.

[12] Major company of the ILVA steel group.

At the same time, a second fracture of an ecological and social nature opened up. Already between 1965 and 1967, the first reports of marine and air pollution emerged, while a study conducted by Aldo Stante[13] in 1970-71 highlighted critical levels of sulphur dioxide, ammonia and particulate matter, especially in the residential areas north of the Mar Piccolo, in the new Paolo VI district. The lack of monitoring systems and the delay in implementing environmental legislation contributed to underestimating the impact of the early evidence.

Meanwhile, the relationship between Italsider and the city was consolidated around a logic of automatic identification between industrial development and collective interest. For a long time, an attitude prevailed that was summed up in the phrase 'what's good for Italsider is good for Taranto', an expression that reflected the widespread perception of the steelworks as an indispensable source of income, employment and progress.

This conviction also conditioned local political choices for a long time, often oriented towards guaranteeing the plant's continuity of production, even at the cost of sacrificing territorial autonomy and environmental quality.

The third and most painful fracture manifested itself forcefully with the privatisation of Ilva and the handover to the Riva group (1995).

The privatisation of ILVA marked the beginning of a new phase for Taranto, characterised by strong company profits, but also by a growing disregard for environmental safety. In 2008, the 'poisoned cheese case', in which dangerous levels of dioxin were detected in dairy products produced near the industrial site, became a symbol of the devastating impact that pollution was having on public health. This event, along with other episodes, fuelled the conflict between the right to work, which increasingly linked the community to the factory, and the right to health, which challenged the industrial model itself.

From that moment, the conflict between the right to work and the right to health emerged in all its rawness. The former Italsider, which in the years of the economic boom had been experienced as an engine of social emancipation, was now transformed into a symbol of painful compromise. Economic dependence on a single large industry made citizens vulnerable to real occupational blackmail: the possibility of maintaining secure employment seemed to demand, as a price, the acceptance of a compromised living environment and serious health risks.

[13] Aldo Stante was an external consultant entrusted by the Taranto municipal administration with the first air quality survey. This 'lasted from the spring of 1970 to 1971; it was conducted through 10 control units located in different parts of the city, and mainly concerned two kinds of pollutants: gaseous substances (ammonia, nitrogen oxides and sulphur dioxide) and particulate matter' (Romeo, 2017, p. 75).

Lacerations that resulted in social divisions, in the weakening of trust in institutions and in the difficulty of building a consensus around policies of real change. The polarisation between those who saw the factory as an indispensable resource and those who denounced its damage, created a climate of distrust that still hinders the process of transition towards a sustainable model for the city.

The "Environment Sellout" (“Ambiente Svenduto”) trial, our Constitution with its reformed Articles 9 and 41, and the condemnation of the EU Court of Justice in 2024 have definitively sanctioned the illegitimacy of the extensions granted to the plant in the absence of environmental adjustments (EU Court of Justice, 2024).

Today Taranto finds itself suspended between a cumbersome industrial past and the need to build a different future. To do so, the historical fractures left by the previous development model must be addressed.

Chapter 2. Pollution and sustainability: the crux of the energy transition

2.1 The social cost of pollution in Taranto

As discussed in Chapter 1, the development model adopted in Taranto has generated deep rifts between production needs, environmental quality and social cohesion. In this section, the long-term effects of the model are explored, with particular attention to the social cost of industrial pollution.

The decision to locate the steel plant close to the Tamburi district - already urbanised and densely populated - amplified the health effects of air pollution. In the 1970s, ILVA in Taranto employed more than 22,000 direct workers and produced more than 10 million tonnes of steel per year, marking a peak of expansion that strengthened the economic dependence on the industrial pole.

The privatisation process in 1995, which led to the sale to the Riva Group for around 1,400 billion lire (≈ 723 million EUR), was a critical turning point. Many analysts spoke of a 'sell-off' of the plant, which was actually valued by IRI at around 4,000 billion lire (≈ 2,07 billion EUR), also considering the latent environmental costs. The Riva management, focused on cost containment, aggravated the structural criticalities, reducing the environmental and social investments necessary to make the production activity sustainable.

As early as the 1970s, anomalies in air, soil and water quality were recorded, but it was not until the 2000s that the seriousness of the situation emerged with systematic epidemiological evidence.

The Sentieri study[14], conducted by the Italian National Institute of Health (ISS) and the Associazione Italiana Registri Tumori (Italian Association of Cancer Registries), documented a significant increase in mortality and the incidence of various diseases in the population living in areas adjacent to ILVA (Passetto & Marsili, 2023).

The study compared to the regional average recorded a:

- 10% excess mortality;
- 30% increase in lung cancer deaths in men;
- 20% increase in respiratory diseases in children under 14 years.

According to the medical-epidemiological report commissioned by the Taranto Court, in the period 1998-2010, ILVA's emissions were associated with 386 deaths, or around 30 per year, mainly from heart causes (Biggeri, Triassi & Forastiere, 2012).

[14] Sentieri is a national study coordinated by the Italian National Institute of Health since 2006, assessing health outcomes in populations near major contaminated sites in Italy. It highlights environmental and health inequalities to inform policies promoting environmental justice.

The main health effects attributed to the plant's emissions, according to the same expert report, are summarised in Table 1:

Table 1 - Health effects attributed to ILVA emissions in Taranto (1998-2010)

Health Indicator	Total Cases (1998-2010)	Annual Average	Notes
Deaths attributed to industrial emissions	386	30	Mainly due cardiac causes
Malignant tumors (hospital admission diagnosis)	237	18	Hospital data
Coronary events requiring hospitalization	247	19	Hospital data
Respiratory disease hospitalitations	937	74	Predominantly among pediatric population

Source: Author's elaboration based on data from Biggeri, A., Triassi, M., & Forastiere, F. (2012). *Medico-epidemiological report on the health effects of pollution caused by the ILVA Taranto plant*. Data reference year: 2012.

The data presented in the 2012 medical-epidemiological report document a direct health impact of ILVA emissions, with 386 deaths attributable to industrial pollution between 1998 and 2010. This evidence places Taranto among the Sites of National Interest (SIN) with the highest levels of health damage, consistent with the findings of the Sentieri study, promoted by the ISS, which had highlighted serious health problems in the resident population.

However, the recorded impact is not limited to the health dimension. Still, it translates into significant economic and social costs: according to regional estimates and independent studies, the sum of environmental damage, property losses (such as the devaluation of real estate in the Tamburi district), incremental health costs and reduced productivity can be estimated in billions of euros. Despite the absence of an official, unambiguous estimate, these elements constitute, to all intents and purposes, 'external costs' that are systematically not accounted for in the plant's economic balance sheet.

This case is emblematic of the failure of a production approach without prior assessment of environmental and social impacts. In the light of the principles of environmental justice and European law (Art. 191 TFEU - "polluter pays" principle) as well as of the dictates of the "just transition" promoted by the European Union and ILO, there emerges the urgency of integrating tools into industrial governance that internalise negative externalities, provide forms of compensation for affected communities, and ensure inclusiveness in decision-making processes.

In addition, a study conducted by the ISS in collaboration with the Taranto ASL (Azienda Sanitaria Locale [Local Health Authority]), found elevated levels of dioxins and PCBs in the breast milk of women living in the area, with an average increase of 28% compared to control areas, signalling a worrying environmental exposure due to industrial activity (De Felip et al., 2019).

In addition to direct health costs, there were wider social costs:

- **Economic.** The property devaluation of the Tamburi district, whose average property value was 40-50% lower than in equivalent areas of Taranto.
- **Employment.** The increasing precariousness of youth employment, with fixed-term contracts and forms of employment blackmail.
- **Welfare.** The increase in regional health expenditure, estimated in tens of millions of euros annually for the management of pathologies - direct and indirect - related to pollution.

The relationship between industry and the local community became increasingly asymmetrical: access to work was a strong constraint on the possibility of social criticism. Those who worked at ILVA were economically dependent on an industry that compromised their own health and that of their families, generating employment blackmail.

From a regulatory point of view, the situation showed a serious delay in complying with European directives. Directive 96/61/EC (IPPC) and then Directive 2008/1/EC required compliance with Best Available Techniques (BAT) and the granting of Integrated Environmental Authorisations (AIA). However, as highlighted in the European Court of Justice's ruling of 31 March 2011 (C-50/10), Italy had not properly surveyed the plants at risk and ILVA was operating without the necessary authorisations.

The regulatory failure contributed to aggravating the social and environmental costs. Moreover, from an economic point of view, the environmental failure weakened the plant's competitiveness, increasing its exposure to legal proceedings, fines and clean-up costs, until the State extraordinary administration in 2012.

In subsequent years, attempts at industrial revitalisation - from the entry of ArcelorMittal to the current State management through Invitalia - have shown the difficulty of reconciling production needs with reducing environmental impact. Despite the announced decarbonisation plans, reality has shown the persistence of very serious structural and environmental problems.

The ILVA case shows how underestimating social and environmental costs can undermine the very economic sustainability of a large industrial plant. The failure to internalise negative externalities in the economic calculation has produced irreversible damage, underlining the urgency of integrating the environmental dimension into industrial and energy transition policies.

Pollution has not only compromised the physical health of the Taranto community but has also undermined the collective confidence in the future.

In light of these considerations, it clearly emerges that environmental justice is a fundamental principle to ensure fairness in the distribution of environmental risks and inclusiveness in the decision-

making processes that regulate them. However, the analysis of Italian contaminated sites shows that these principles are often disregarded, with profound repercussions on the communities involved.

The case of Taranto exemplifies a classic instance of environmental market failure, where the health and social costs of pollution were not incorporated into the economic accounting of industrial activity. From a just transition perspective, it is essential to internalize these externalities through economic instruments that assess avoidable damages and guide public policy. Epidemiological estimates suggest health-related and productivity losses amounting to hundreds of millions annually, indicating that investments in mitigation and industrial reconversion may yield high social returns. Such assessments are necessary to ensure the allocative efficiency of planned interventions, in line with the "polluter pays" principle (Article 191 TFEU).

2.2 Environmental justice in the transition

Reflections on environmental justice found one of its first systematic applications in the study of contaminated sites, as documented by the Sentieri project—specifically in the Sixth Sentieri Report by Zona et al. (2023), which analyses the profiles of health risk and inequality in Sites of National Interest (SIN). In this context, a fundamental distinction was established between two dimensions of environmental justice: distributive justice and procedural justice.

Distributive justice refers to equity in the distribution of environmental risks and benefits associated with a healthy environment. It requires that no social group or territory be exposed to a disproportionate burden of pollution or deprived of the benefits of environmental interventions, regardless of conditions such as ethnicity, income or geographical location.

Procedural justice, on the other hand, concerns the quality of decision-making processes and inclusiveness in environmental policies. It implies the active, fair and informed involvement of all communities, particularly the most vulnerable, in the processes that determine choices about environmental management. This principle is crucial in an energy transition phase, where decisions must consider the rights and needs of all, and avoid new ecological solutions reproducing existing inequalities.

Analyses conducted on the main Italian contaminated sites have shown how, in the territories of the South and the Islands, there is a combination of environmental pressures, socioeconomic deprivation and increased health risks. The Sentieri project has thus brought to light a picture of systemic environmental injustice, which manifests itself at both the distributional and procedural levels.

This experience today constitutes a crucial lesson for governing the transformations required by the ecological transition. The transition towards low-emission and lower environmental impact

production models entails, in fact, significant changes that, if not accompanied by adequate guarantees of equity, may reproduce or even accentuate existing inequalities.

New forms of distributive injustice could emerge if the benefits of transition - access to clean energy, green jobs, environmental quality - are not redistributed fairly, or if the environmental and social costs of new sustainable infrastructure are disproportionately burdensome on territories or groups. Similarly, a lack of procedural justice would risk excluding vulnerable communities from participating in decision-making processes that will shape the environmental and economic future of their territories.

This is the context of the concept of 'just transition', promoted by the ILO and referred to in the Paris Agreement, which emphasises the need to integrate environmental policies with the protection of social rights, labour protection and support for the most fragile communities.

Experience with Sentieri offers valuable operational insights: integrated approaches combining epidemiology, social analysis and community participation can guide the transition in a more equitable manner. It is necessary to develop surveillance tools that weave together environmental, health and social data, to foster community empowerment processes and to adopt participatory communication practices. Furthermore, it is essential to consider communities as dynamic realities, capable of resilience and self-organisation, but also exposed to new risks of marginalisation if not adequately supported.

Finally, reflection on environmental justice in transition implies an acknowledgement of the negative legacies left by past industrial models, which have deeply affected territories and communities. In this sense, the analysis of the European Court of Justice ruling on the ILVA case offers an emblematic example of the tension between industrial development, environmental protection and fundamental rights.

2.3 The 2024 EU Court of Justice ruling and the European legislative context

In the European debate on environmental justice, the case of the former ILVA in Taranto has become increasingly important, also following the decision that emerged in 2024 following the preliminary reference of the Court of Milan (Case C-626/22). Concerns raised by citizens and local administrations about the health and environmental impact of industrial activities prompted the national judiciary to ask for clarifications on the application of Directive 2010/75/EU on industrial emissions.

The European ruling highlighted how the absence of an integrated prior assessment of environmental and health impacts, combined with the failure to consider all pollutants scientifically recognised as harmful, led to systemic criticalities in the management of the authorisation of industrial activities. In the presence of serious dangers to health and the environment, the continuation of production

activities was incompatible with the existing regulatory framework, and raised questions about economic and social, as well as regulatory, responsibilities.

This episode revived the importance of the principle of operator responsibility, according to which the costs of pollution cannot be borne by the community but must be borne by those who generate it, as stated in the Treaty on the Functioning of the European Union. However, analyses by the European Court of Auditors (2021) show that the application of this principle is still uneven, particularly in the areas of remediation and waste management, raising problems of allocative efficiency and territorial equity.

Over the years, a series of legislative and jurisprudential developments have consolidated the link between environmental protection and fundamental rights. The introduction at EU level of criminal liability for environmental offences (2008), the recognition of the right to a healthy environment in the EU Charter of Fundamental Rights (2012), and judgments strengthening access to environmental justice and health protection (2018, 2020), show a path of increasing integration between ecological dimensions and social sustainability.

A further acceleration came in 2024 with a decision of the European Court of Human Rights (Case No. 53600/20), which gave member states the responsibility to protect their citizens from the negative effects of climate change, including in terms of health and safety. This interpretation broadens the scope of climate policies, emphasising positive obligations to protect, with direct implications for economic and industrial planning.

Overall, regulatory developments strengthen the integration of environmental justice, health protection and economic sustainability, outlining a context in which territories and businesses can no longer ignore the social and environmental costs associated with industrial production. The ecological transition therefore requires new development models capable of internalising these externalities, with instruments that favour a fair distribution of benefits and costs, as well as the active participation of local communities in decision-making processes.

Chapter 3. Sustainability and the challenges of transition: solutions and perspectives

3.1 The transition to green steel production and the role of electric arc furnaces

In recent decades, the growing awareness of the critical environmental issues related to steel production has placed the issue of decarbonising steel at the centre of global industrial and energy strategies. The need to reduce CO_2 emissions and the overall environmental impact of heavy industries is now a priority challenge in the ecological transition. This challenge translates, in the steel sector, into a profound technological and organisational transformation, with the emergence of innovative solutions such as Electric Arc Furnaces (EAF) and Direct Reduced Iron (DRI).

The Taranto plant, the largest in Europe, is a paradigmatic case of this transition (Cardellicchio & Trifirò, 2024). According to the most recent analysis, to date only one of the five blast furnaces is operational, with an annual production of less than 1.7 million tonnes of steel, compared to 9.0 in the early 2010s. The remaining blast furnaces have been closed for environmental or structural reasons. The future of the plant revolves around an ambitious reconversion plan based on the introduction of two modules to produce pre-burnt iron by DRI, fuelled by natural gas and then by green hydrogen, and two new EAF.

This reconversion is part of a broader European decarbonisation strategy for the steel industry, accelerated by the Green Deal (European Commission, 2019) and the European Climate Act (European Parliament & Council of the European Union, 2021), which set binding climate neutrality targets to 2050. The decarbonisation process for steel involves two main paths: increasing the efficiency of existing blast furnaces through emission-reducing technologies and, more radically, switching to the EAF-DRI model.

According to the report 'EU Steel towards a Zero Emission Future' (Tosini, 2023), the share of steel production by electric furnaces in the European Union will increase from 43.5% in 2022 to almost 70% in 2030. This will entail, up to the study forecasts, construction of at least 17 new DRI plants in Europe by 2030, with a total capacity of 33.6 million tonnes. At the same time, full-cycle production (blast furnace-converter BOF) will decrease from 56.5% to 30.6%.

Table 2 illustrates the estimated growth in steel production using electric arc furnaces (EAF) across selected EU countries between 2023 and 2030, replacing traditional blast furnace production.

Table 2 - Steel production with electric furnace as replacement for blast furnace production 2023-2030 (thousand tonnes)

Paese	2023	2024	2025	2026	2027	2028	2029	20230
Austria					2.500	2.500	2.500	2.500
Belgio							2.500	2.500
Francia					4.000	4.000	4.000	4.000
Germania				3.400	7.400	7.400	7.400	7.400
Italia					2.500	2.500	2.500	2.500
Paesi Bassi								2.500
Rep. Ceca								3.500
Romania				1.500	1.500	1.500	1.500	3.000
Spagna				1.100	1.100	1.100	1.100	1.100
Slovacchia				3.000	3.000	3.000	3.000	3.000
Svezia		2.500	2.500	4.000	4.000	4.000	4.000	8.600
Ungheria								1.500
Totale		**2.500**	**2.500**	**13.000**	**26.000**	**26.000**	**28.500**	**42.100**

Source: Data from Siderweb Research Office (2023), updated November 2023.

Of the additional 42.1 million tonnes produced with new EAF furnaces, about 28.1 will come from DRI/HBI and 14.0 from ferrous scrap.

However, the green steel revolution also presents new economic and material complexities. The use of pre-doped steel requires very high-quality iron ore (Fe content above 67%), a resource that is not abundant on a global scale. This potential scarcity raises concerns about the long-term sustainability of this resource, especially considering that the global steel industry, even in traditional BF-BOF processes, is increasingly moving towards the use of high-purity ores to reduce emissions. This trend risks intensifying competition for mineral resources and increasing the price of raw materials, with significant impacts on the competitiveness of the steel industry.

Moreover, the demand for ferrous scrap is expected to grow significantly. According to projections by the consulting firm "Arthur D. Little" total scrap consumption in the EU will rise from 59.0 million tonnes in 2022 to approximately 82.9 by 2030. The top five European scrap-consuming countries currently account for 68% of the total, and this share is expected to increase by about 0.5% by 2030. Italy is projected to remain the leading scrap consumer in Europe, with 21.5 million tonnes in 2030, followed by Germany (17.4), Spain (9.6), France (6.0), and Poland (5.4) (see Table 3).

Table 3 - Main European Countries by Scrap Consumption (thousand tonnes)

Paesi	2022		2030		Variazioni 2030/2022	
	.000 ton	%	.000 ton	%	.000 ton	%
Italia	18.764	24,1	21.527	24,6	2.763	14,7
Germania	15.672	20,1	17.393	19,9	1.721	11,0
Spagna	8.465	10,9	9.591	11,0	1.126	13,3
Francia	5.449	7,0	6.020	6,9	571	10,5
Polonia	4.640	5,9	5.377	6,2	737	15,9

Source: Data from Siderweb Research Office (2023), November 2023 forecast.

The growing demand for scrap also implies quality problems: the increase in the share of post-consumer scrap (from 53.2% to 56.4%) will reduce the average quality level, necessitating more sophisticated purification technologies.

At the same time, the costs of green steel are now 20-45% higher than those of conventional steel (Tosini, 2024), mainly due to:

- the high cost of green hydrogen;
- the higher costs of electricity from renewable sources;
- the investment needed for new production infrastructure (DRI/EAF).

It is estimated that the decarbonisation of the global steel industry will require investments of around 1.3 trillion EUR by 2050. In Europe, the actual competitiveness of green steel will depend on CO_2 pricing policies and incentives to lower energy costs, as envisaged in the recent European Action Plan for Affordable Energy (European Commission, 2025a).

In conclusion, the move towards a steel industry based on electric arc furnaces and pre-fired iron is an essential step in Europe's energy and industrial transition. However, the real challenge is not only technological but also related to the overall sustainability of the system. This is where the concept of the circular economy comes in, which can play a crucial role in supporting decarbonisation and addressing resource availability and recycling issues.

The adoption of low-carbon technologies in the steel industry, such as EAF furnaces and DRI processes powered by green hydrogen, requires significant capital investment. Within a just transition framework, these choices must also be evaluated in terms of economic sustainability and allocative efficiency. Public and private investments should aim not only at emissions reduction but also at generating long-term economic and social value.

Economic literature proposes the use of Social Return on Investment (SROI) to assess the environmental, employment, and health benefits of green technologies relative to their upfront costs. In the case of Taranto, a plant based on DRI and green hydrogen may not be immediately competitive but could produce net social benefits through qualified job creation, public health improvements, and industrial attractiveness—provided it is supported by targeted public policies, an appropriate carbon pricing system, and complementary investments.

The economic and regulatory implications of this technological reconversion will be explored in Chapter 4, with reference to the Clean Industrial Deal and European instruments to support the transition.

3.2 The circular economy: a practical solution and a development perspective

The economic development model based on the linearity of the production process - extraction, production, consumption and disposal - has characterised much of the last 150 years of industrialisation. However, growing signs of environmental crisis, resource scarcity and economic instability have highlighted the urgency of transforming production and consumption patterns.

The circular economy today represents one of the most concrete and innovative responses to this systemic crisis. Based on the idea of maintaining the value of materials, products and resources within the economic cycle for as long as possible, it aims to reduce dependence on virgin raw materials, minimise waste and favour a regenerative model inspired by the principles of natural systems.

At the European level, the Green Deal (European Commission, 2019) and the Action Plan for the Circular Economy (European Commission, 2020) set out a clear path: to achieve a climate-neutral, resource-efficient and competitive economy by 2050. The goals are ambitious: decoupling economic growth from natural resource use and environmental degradation by promoting waste prevention strategies, eco-design, product life extension, and the development of new business models such as 'product as a service'.

Despite the strong political and entrepreneurial drive, it is necessary to point out that not all practices that call themselves 'circular' reflect the founding principles of the model. In many sectors, there is a risk of 'circularity window-dressing' (greenwashing), in which seemingly circular practices continue to maintain traditional extractive logics, masking them under an ecological guise without an actual reduction in environmental impact. This phenomenon not only nullifies the potential benefits of circularity but may even exacerbate the situation by promoting unsustainable practices as part of a green rhetoric. As Heather Rogers has observed, the recycling narrative has often been used to shift the focus from producers to consumers' responsibilities, without substantially changing the dominant production patterns (Rogers, 2010).

In the context of the steel industry and of the transition process of the former ILVA in Taranto towards more sustainable production models, it is crucial to distinguish between truly circular practices and cosmetic strategies.

Table 4 below compares the characteristics of a genuine circular economy with those of so-called circular greenwashing, highlighting the associated economic impacts. This comparison helps assess the coherence and effectiveness of industrial strategies, and aims to prevent the adoption of seemingly sustainable solutions from delaying the transition or eroding public trust.

Table 4 - Authentic Circular Economy vs. Greenwashing

Element	Authentic Circular Economy	Circular Greenwashing	Economics
Product design	Eco-design, durability, reparability	No substantive changes	Long-term savings on materials a repairs
Material management	Reduction, reuse, efficient recycling	Limited or ineffective recycling	Greater efficiency vs hidden disposal costs
Business model	Product as a service, industrial symbiosis	Disguised traditional selling	Recurring revenues vs market saturation
Goal	Systemic regeneration, zero impact	Superficial environment marketing	Solid reputation vs reputational risk
Resources pact	Reduced extraction and consumption	Continuity of extractive flows	Reduced dependency on raw materials

Source: Author's elaboration, 2025.

A true circular economy, therefore, requires a systemic redefinition of the entire product life cycle, from design to end-of-life, with a view to continuous regeneration of materials and reduction of ecological impact along the entire value chain.

The iron and steel industry is one of the industrial sectors where the circular economy can find concrete and impactful application. Steel, a symbolic material of modern industry, is entirely recyclable without loss of its mechanical properties: a characteristic that makes it one of the most virtuous examples of 'circular material'.

In Europe, the recycling rate of steel has reached about 60% in overall production, with peaks of more than 90% for the re-use of scrap metal in production cycles (World Steel Association, 2023).

This saves energy, reduces CO_2 emissions and limits the consumption of virgin natural resources. In parallel, the EU Critical Raw Materials Act (European Parliament &Council of the European Union, 2024), which will enter into force in 2026, fits into this context as a key instrument to ensure the security of supply of critical raw materials. The act aims to increase the extraction, processing and recycling capacity of strategic minerals in Europe, including lithium, cobalt, graphite and rare earths, which are essential to produce clean technologies and for the green steel industry. The adoption of this measure strengthens the resilience of the circular economy, reducing dependence on imports of these materials and stimulating the search for more sustainable and circular alternatives.

Sustainable management of steel by-products, such as slag, is another key dimension of the circular economy in the sector. According to the most recent data, some 19.9 million tonnes of blast furnace slag and 15.9 million tonnes of steel mill slag were produced in Europe and the UK in 2023. Of this, 99% of blast furnace slag was reused mainly in cement production and as aggregate, while about 84% of steelworks slag was recovered in various applications, including road construction, hydraulic engineering, fertilisers and metallurgy. According to the report *Ferrous Slag-Based Products Replace*

44 million Tons of Natural *Rock* (EUROslag - Institut, 2024), the utilisation of these by-products avoided the extraction of 44 million tonnes of natural rock and the emission of approximately 12 million tonnes of CO_2.

To better understand the economic and strategic value of steel slag reuse, it is useful to compare what is stated in the Sustainability Report 2022 of Acciaierie d'Italia (ADI) with the results of academic studies analysing consolidated industrial cases in Italy.

Table 5 highlights the main differences between the declared strategies and the actual practices observed, providing a useful basis for assessing the extent to which circular economy principles have been effectively integrated in the case of the former ILVA plant in Taranto.

Table 5 - Steel Slag Reutilisation: ADI vs. Academic Studies[16]

Entry	ADI Sustainability report 2022	Academic studies (2022)
Context analysed	ADI Taranto factory	Italian steel industrial cluster (e.g. Brescia)
Quantitative indication on slag reuse	Not specified	85% for road layers, 15% for concrete/asphalts
Explicit economic valorisation	General mention of environmental savings	Analysis of economic benefits: savings on aggregates and raw materials
Declared initiatives	Recovery and valorisation of production residues	Study of flows and synergies between companies (industrial symbiosis)
Reference to the circular economy	Yes, as a strategic corporate pillar	Yes, with quantitative indicators and meso-scale evaluation

Source: Author's elaboration based on data from Acciaierie d'Italia (2022) and academic studies (Piemonti et al., 2023; Falsafi & Fornasiero, 2022).

Against this background, several European projects aim to systematise the valorisation of steel by-products. For example, REUSteel, a project co-funded by the European Commission, has shown how through industrial symbiosis[17] and the efficient use of residues it is possible to bring the sector closer to the 'zero waste' objective, fostering synergies between different industrial supply chains and reducing the need to resort to new natural resources (Branca et al., 2020).

However, achieving a fully circular steel industry requires further progress, in particular in the adoption of advanced technologies for slag treatment, such as energy recovery and slag purification processes to create new materials with high added value (Branca et al., 2020). It is also essential to harmonise European regulations that, in some cases, hinder the reuse of by-products, such as the

[16] Data derived from a qualitative comparison of Acciaierie d'Italia's 2022 Sustainability Report and studies by Piemonti et al. (2023) and Falsafi & Fornasiero (2022) on steel slag reuse in Italy.
[17] Industrial symbiosis refers to a circular economy strategy in which different companies cooperate by exchanging resources, by-products or energy, turning waste from one production into input for another, in order to reduce environmental impact and improve economic efficiency.

Waste Directive 2008/98/EC (European Parliament and Council, 2008), and to develop stable and profitable secondary markets for recycled materials, promoting innovation in these areas.

Carl de Maré, Head of Technology Strategy at ArcelorMittal, emphasised how steel can play a crucial role in building a low-carbon circular economy. According to de Maré, steel is crucial not only for its infinite recyclability but also for its support of the economic and social development of modern societies. However, he warns that the current global availability of recycled steel is not yet sufficient to completely replace primary production: it will take decades to reach a full recycling economy, especially in developing countries (de Maré, 2020).

De Maré also points out that primary steel production still contributes around 7-8% of global CO_2 emissions, but also that alternative technologies such as green hydrogen are advancing, albeit with significant scalability and cost challenges. Synergies between the steel industry and sectors such as cement - through the reuse of by-products such as slag - are already concrete examples of advanced industrial circularity.

In the Italian context, the former ILVA di Taranto - now Acciaierie d'Italia - represents an emblematic case of how the circular economy can offer a concrete perspective of sustainable industrial transition.

Recently, the Iren Group signed an agreement to supply the former ILVA with 50,000 tonnes per year of Bluair®, an innovative technopolymer obtained from the mechanical treatment of non-recyclable plastic waste. The use of Bluair® as a partial replacement of coal dust in blast furnaces allows a reduction of CO_2 emissions by up to 30% (Iren Group, 2023).

This intervention has a twofold value: on the one hand, it allows for the valorisation of plastics otherwise destined for landfill, closing the material cycle according to the principles of the circular economy; on the other hand, it favours the decarbonisation of the steel industry, reducing dependence on fossil fuels.

The agreement represents just one piece of a broader circular transition strategy: Acciaierie d'Italia is planning to convert part of its production to electric arc furnaces, fuelled by ferrous scrap, with a further reduction in emissions and greater integration of circular economy principles into its production processes.

However, as recent studies point out, a genuine transition requires structural interventions throughout the supply chain: eco-design, efficient management of by-products, development of secondary markets for recycled materials, investment in technological innovation and sustainability-oriented industrial governance (European Environment Agency, 2024)[18].

[18] The EEA paper offers an in-depth analysis of the state of transition to a circular economy in the European Union, highlighting the need for structural interventions throughout the supply chain for a genuine transition.

Today, the circular economy is an indispensable perspective for combining industrial competitiveness, reduced environmental impact and resource regeneration. The steel industry, with its high potential for recycling and innovation, represents a strategic sector for driving this transformation. The case of the former ILVA plant in Taranto shows how the transition to more sustainable production models is not only desirable but also feasible through the adoption of circular solutions and low-emission technologies.

However, to make this transition effective and systemic, we must avoid the risk of a circularity of façade and promote a true regeneration of production and economic models. To this end, the European Green Deal and strategies such as the Clean Industrial Deal chart the course for a zero-impact future, promoting tools for support, innovation and social inclusion.

Chapter 4. European policies and instruments for a just transition: the role of Taranto

After outlining the technologies for decarbonising the steel industry in Chapter 3, this section analyses the economic conditions and policy levers needed to make the transition to green steel in Europe sustainable.

4.1 The Green Deal and the Clean Industrial Deal: European strategies for zero impact

After outlining the technologies for decarbonising the steel industry in Chapter 3, this section analyses the economic conditions and policy levers needed to make the transition to green steel in Europe sustainable.

The European Green Deal, announced in 2019, constitutes the Union's overall strategy to achieve climate neutrality by 2050 by profoundly transforming the economic and production system. However, the implementation of this strategy has proved more complex than expected, so much so that, according to the European Commission (European Commission, Joint Research Centre, 2025), only 21% of the original 154 targets are actually within reach today. This difficulty in implementation led to the adoption in 2025 of the Clean Industrial Deal, a specific action plan for energy-intensive industrial sectors, such as steel, aimed at closing the gap, accelerating the transition and ensuring European industrial competitiveness (European Commission, 2025b).

The Clean Industrial Deal envisages a package of measures in six strategic areas: a) energy security, b) stimulation of demand for clean products, c) financial instruments to support the transition, d) promotion of the circular economy, e) secure supply of critical raw materials and f) strengthening of professional skills. For the steel industry, it is about creating the economic conditions that make the transition to low-emission steel production feasible, despite the current 'price premium' for green products. According to Tosini (2024), the production cost of green steel is today between 20% and 45% higher than conventional steel, due to the high price of green hydrogen, electricity from renewable sources and new plants. However, this cost gap is significantly overestimated if one considers that the price of conventional steel does not reflect its negative environmental and health externalities. A proper internalization of these costs — in accordance with the 'polluter pays' principle enshrined in Article 191 of the TFEU — would substantially reduce the perceived economic advantage of non-green steel.

To address this competitiveness gap, the European Union has deployed a series of integrated political-economic levers. The Emission Trading System (ETS), reinforced in the new Fit-for-55 package, aims to make polluting production more expensive, thereby internalizing externalities, by gradually raising

the price of CO_2 emissions. The Carbon Border Adjustment Mechanism (CBAM) extends this logic to imported products as well, applying an environmental cost to non-EU steel with lower emission standards, to avoid production delocalisation (carbon leakage), protect European companies in transition and encourage non-EU countries to adopt form of carbon pricing.

Next to these rebalancing instruments, the Clean Industrial Deal introduces targeted incentives for the promotion of green steel. Green public procurement policies aim to increase public demand for decarbonised industrial products, while Contracts for Difference (CfD) are an innovative financial instrument to reduce the economic risk for companies: the State guarantees compensation between the market price and the actual cost of clean production. These measures are accompanied by administrative simplifications for plant conversion and fiscal measures to stimulate investment in low-carbon technologies.

Overall, the sustainability of the transition will depend on the ability of European and national institutions to effectively coordinate these instruments, promoting multi-level governance and a balance between industrial competitiveness and social cohesion. The green steel challenge, to be met, therefore requires not only technological innovation, but also a structural transformation of European economic rules and industrial policies.

4.2 Emission Trading Systems (ETS) as a tool for decarbonisation

The European greenhouse gas emission allowance trading system, known as the EU Emissions Trading System (EU ETS), was introduced in 2005 as one of the main instruments of EU climate policy. This system aims to progressively reduce greenhouse gas emissions by setting a cap on emissions for each sector and reducing it annually, incentivising companies to reduce their carbon footprint. Companies that emit more greenhouse gases than their allowances must buy additional allowances, while those that emit less can sell the excess allowances. In recent years, the ETS has been expanded to include new sectors, such as aviation and maritime transport, and from 2025 it will be further extended to the buildings and road transport sectors through the introduction of the 'EU ETS 2' (Ministero dell'Ambiente e della Sicurezza Energe-tica, 2025).

In 2023, the reform of the system introduced more ambitious measures, including the strengthening of emission reduction targets, the broadening of the scope, and the introduction of the CBAM to avoid carbon leakage, i.e. the risk of companies moving production to countries with less stringent regulations. The reform also set a target to reduce net emissions by 61% by 2030 compared to 2005 levels, thus contributing to the goal of climate neutrality by 2050 (Lorenzini, 2023).

However, the analysis of revenues from emission allowance auctions raises concerns. According to the ECCO[19] Think Tank's analysis, based on official data from the Italian Ministry of Environment & Energy Security (MASE) and the Italian Ministry of Economy & Finance (MEF), between 2012 and 2024 Italy generated around 15.6 billion EUR from EU ETS auctions; however, only 9% was documented to be allocated to climate change measures, well below the forecast of 50% of revenues for environmental policies.

The inability to effectively manage the funds has raised concerns about the risk of these revenues being used in emergency measures, such as those for expensive energy, rather than being reinvested in the energy transition (Bellisai & Scano, 2025). According to projections in Bellisai and Scano's report, which are based on scenarios of carbon prices and future emission volumes, the expected revenues from ETS auctions for the period 2025-2030 could range between 27 and 33 billion EUR. This forecast highlights the urgency of more transparent and structured planning on the use of these resources to avoid allocation distortions and ensure that they are allocated to measures that foster effective decarbonisation, as also emphasised by Turco (2025).

The recommendations in the ECCO report and echoed by Turco (2025) highlight the need for better planning of the spending of auction revenues. It is suggested that the country's socioeconomic development strategies be aligned with the climate objectives set out in the National Energy and Climate Plan (NECP)[20], ensuring that funds are used in a timely and effective manner. In addition, transparency and traceability of funds was proposed, with the creation of a public monitoring system that would allow detailed reporting on the use of proceeds, to avoid opacity and inefficiencies.

A crucial aspect of the 2023 reform concerns the gradual reduction of free quotas for heavy industries, such as steel, and the introduction of the CBAM, which applies a carbon price to imports of carbon-intensive products from countries not subject to equivalent regulations. This mechanism aims to prevent European producers from being disadvantaged by international competitors that do not adhere to the same environmental standards (Ministero dell'Ambiente e della Sicurezza Energetica, 2025). In the case of steel, the reform — as outlined in EU policy documents and on the Italian Ministry of the Environment's website (2025) — foresees, inter alia, a complete phase-out of free quotas by 2034. This represents a significant shift that may considerably affect production costs and the competitiveness of key sectors, while contributing to the restoration of fair market conditions. This transformation should therefore drive industries to adopt low-emission technologies not merely in response to state

[19] ECCO is an independent Italian climate think tank, established in 2021. It promotes science-based and systemic solutions to accelerate climate action in Italy and internationally, using research, advocacy, and strategic communication to shape climate and energy policy.

[20] The Integrated National Energy and Climate Plan (NECP) is Italy's strategic document setting energy and climate targets and policies to 2030, in line with Regulation (EU) 2018/1999.

subsidies, but as an essential requirement for production aligned with climate objectives, public health protection, and pollution reduction. In this perspective, green production can no longer be considered an optional feature or a market-dependent luxury, but rather a necessary condition for ensuring long-term economic and social sustainability.

While the ETS is an effective market-based instrument for reducing emissions, the allocation of its revenues often lacks efficiency from a just transition perspective. In Italy, only a limited share is reinvested in environmental or decarbonization projects, with most revenues absorbed into the general budget. This contradicts the principle of targeted reinvestment to support the sectors and regions most affected by the transition.

An efficient allocative approach would require directing ETS revenues based on maximized environmental and social returns, using indicators such as avoided emissions, jobs created, or reduced inequality. This would align with the just transition framework, where fiscal and market instruments are designed not only for efficiency, but also for equity and territorial cohesion.

Impact of ETS on the Taranto Steel Industry

The ETS has a direct and significant impact on the steel industry and on *Acciaierie d'Italia* (formerly ILVA) in Taranto, which is one of the largest steel plan in Europe. The steel sector is indeed a "hard-to-abate" field, where traditional processes generate high CO_2 emissions and the adoption of low-carbon technologies is complex. Within the ETS framework, companies are required to internalize the costs of their environmental externalities, since the system establishes a maximum emissions cap, which cannot be exceeded, and mandates the purchase of additional allowances if emissions go beyond this limit.

The analysis of data from the EU ETS Union Registry for the period 2020-2024 reveals a substantial discrepancy between the ETS allowances allocated to Acciaierie d'Italia and the emissions recorded. Table 6 summarizes the key figures:

Table 6 - Allocated ETS Allowances, Verified CO_2 Emissions, Steel Production, and Emissions Intensity for Acciaierie d'Italia (2020–2024)

Year	Allocated ETS Allowances (t CO_2)	Verified CO_2 Emissions (t)	Steel Production (t)	Emissions Intensity (t CO_2 / t steel)
2020	11,661,315	4,834,123	3,400,000	1.42
2021	6,509,173	5,246,390	4,050,000	1.30
2022	6,372,829	4,703,125	3,470,000	1.36
2023	6,372,829	4,351,958	≈ 3,000,000	1.45
2024	6,372,829	3,312,018	≈ 2,000,000	1.66

Source: Author's elaboration based on data from EU ETS Union Registry – Verified Emissions and Free Allocation Data 2024 (European Commission, 2025c), BuildNews (2025; steel production 2020–2022), and Kolisnichenko (2025; steel production 2023–2024).

From these data, it can be observed that, while the allocated allowances stabilized around 6.37 million tonnes of CO_2 beginning in 2022, actual emissions steadily declined from 4.83 million tonnes in 2020 to 3.31 million tonnes in 2024. This trend is closely linked to the reduction in steel production, which fell from 3.4 million tonnes in 2020 to 2 million tonnes in 2024. However, the contraction in production volumes led to a deterioration in plant efficiency, as evidenced by the rise in emissions intensity: the ratio of CO_2 emissions to tonnes of steel produced increased from 1.42 t CO_2/t steel in 2020 to 1.66 t CO_2/t steel in 2024, indicating that the facilities operated under suboptimal conditions and consumed more energy per unit of output.

Acciaierie d'Italia aimed to reverse this production decline in 2025 by bringing blast furnace 1 (BF1) back online in October 2024 and commissioning blast furnace 2 (BF2) in 2025. With three operational blast furnaces (BF1, BF2, and BF4), the company anticipated producing approximately 3.5 million tonnes of steel in 2025. However, those estimates were revised downward to only 2 million tonnes following the incident on 7 May 2025, when a fire in BF1 forced its prolonged shutdown and left only BF4 in operation (originally scheduled for maintenance stoppage during 2025).

This event highlighted critical structural and operational vulnerabilities: frequent furnace shutdowns, alternating between routine maintenance and unexpected failures, not only impact production volume but also diminish the commercial value of the plant in the event of a potential sale to foreign investors (for example, from Azerbaijan) and have repercussions on employment, triggering further implementation of the national wage guarantee fund (cassa integrazione guadagni) procedures.

Under these circumstances, while the economic burden of ETS allowances represents a significant cost, it is secondary to the plant's infrastructural and managerial challenges: the top priority is to modernize the infrastructure and production processes to restore adequate efficiency levels. To that end, it is essential to concentrate investments on the technological upgrade of blast furnaces and other production units, thereby recovering operational performance and, simultaneously, reducing emissions intensity. Strategic interventions include the adoption of electric arc furnaces powered by green hydrogen, the implementation of carbon capture and storage systems, and overall improvements in process energy efficiency. Only through these measures can the Taranto facility reconcile production continuity with emissions reduction targets and maintain a competitive position in the global market.

European policies, such as the Green Deal and the measures contained in the Clean Industrial Deal, are fundamental to supporting Acciaierie d'Italia's transition. However, the funds generated by the EU ETS must be used more effectively to finance the steel sector's decarbonization and prevent rising production costs from undermining global competitiveness. According to ECCO's recommendations, greater transparency in managing revenues from ETS auctions is needed, ensuring that funds are

allocated to support technological transition and plant modernization so that steelworks like Taranto can face the decarbonization challenge in a fair and competitive manner (Turco, 2025).

In summary, the steel industry in Taranto represents one of the most significant examples of how the EU ETS, together with other European policies, can be both a challenge and an opportunity for industrial decarbonization. Although the system imposes high costs, it also provides incentives to adopt sustainable technologies that can reduce emissions and improve long-term competitiveness. However, as systematically highlighted in the ECCO report (Bellisai & Scano, 2025), the effectiveness of the EU ETS in Italy is heavily conditioned by weak national governance mechanisms. The study emphasizes the absence of a binding regulatory framework to guarantee that revenues are allocated to decarbonization activities, the lack of full traceability of collected resources, and insufficient integration between financial flows and the PNIEC's strategies. Implementing a public monitoring system, as recommended, is crucial to strengthen the legitimacy and redistributive effectiveness of the ETS, promoting an equitable, transparent use of funds generated by the carbon market.

Beyond market-based regulatory tools like the ETS, the ecological transition also requires redistributive instruments such as the Just Transition Fund, designed to ensure territorial equity and support the most affected communities.

4.3 The Just Transition Fund (JTF): the operational plan for Taranto

The Just Transition Fund (JTF), as an integral part of the European Green Deal, is a crucial instrument to address the socio-economic challenges resulting from the transition to a climate-neutral economy. In Italy, the JTF was mainly targeted at the territories most affected by the transition, including the province of Taranto, an area traditionally associated with carbon-intensive industries, such as steel, which is facing the necessary decarbonisation of its industrial sector.

The Executive Plan for the province of Taranto, approved on 13 February 2025, establishes the use of 803,6 million EUR - including the technical assistance and flexibility amount - from the JTF, aimed at supporting an economic, social and environmental transformation of the region (Presidenza del Consiglio dei Ministri – Dipartimento per le Politiche di Coesione e Mezzogiorno, 2025). The plan has three main strands: environment, economic diversification and capacity building for transition, with a strong focus on social inclusion.

As discussed in Chapter 2, the principles of environmental justice - distributive and procedural - form the foundation of a sustainable and equitable transition. The Just Transition Fund (JTF), envisaged in the European Green Deal, represents the main operationalisation of these principles. The Fund aims to support the communities most exposed to employment risks and environmental risks through

concrete actions of industrial requalification, economic diversification and social inclusion (European Parliament & Council of the European Union, 2021). The case of Taranto represents a significant test case, with a total investment of more than EUR 800 million intended to promote a multi-sectoral and participatory transformation of the territory.

A key aspect of the JTF is its inclusive and participatory approach. According to the European Code of Conduct, local and regional authorities, NGOs and civil society representatives must be involved at all stages of the design and implementation of initiatives financed by the fund (European Commission, 2014). This approach is crucial to ensure that policies are responsive to the real needs of local communities, preventing the transition from becoming an elitist and not very inclusive process (Mira Network, 2025).

Here are the three main thrusts of the JTF Executive Plan for Taranto, prepared by the Intermediate Body of the Regione Puglia.

1. Environment and sustainability

The operational plan includes significant investments in renewable energy infrastructure, in the production and storage of green hydrogen, which is one of the most promising solutions for reducing the environmental impact of heavy industries. Projects such as the construction of 'Hydrogen Valleys' and the expansion of Renewable Energy Communities (RECs) are at the heart of this strategy, with funding of around EUR 40 million. In addition, environmental regeneration projects, such as the Green Belt and the Sea Hub, aim to rehabilitate and improve the usability of the territory, with a focus on the regeneration of the coasts of the Mar Grande and Mar Piccolo, areas particularly vulnerable to industrial pressure (Presidenza del Consiglio dei Ministri - Dipartimento per le Politiche di Coesione e il Mezzogiorno, 2025).

2. Economic diversification and innovation

The diversification of the local economic fabric is another strategic objective of the plan. Taranto, historically dependent on the steel industry, must move towards new sectors, such as renewable energy, sustainable agriculture, and the enhancement of cultural heritage and tourism. The plan provides EUR 78 million for investments in local production chains, including mussel farming and sectors related to the blue economy, and technological innovation, with a focus on the creation of new business models oriented towards the circular economy (Greco, 2024).

3. Skills enhancement and social inclusion

The third pillar of the plan concerns the training and retraining of workers, especially those at risk of unemployment due to industrial reconversion. Here, the plan envisages significant investments in continuous training and the acquisition of new skills to prepare workers for the challenges of the

energy transition (Greco & Cacciapaglia, 2023). Targeted actions include specialised training courses in areas such as green hydrogen, renewable energy and the circular economy, with a total investment of more than EUR 160 million.

A critical aspect that emerges from analyses of the situation in Taranto concerns the need to ensure that the benefits of transition are not distributed unequally, but that vulnerable groups, such as women, young people and the unemployed, have access to new job opportunities (Greco & Cacciapaglia, 2023). The participation of civil society, as emphasised by criticism from some local associations, must be ensured at all stages of the plan implementation process to prevent the transition from remaining an elitist and not very inclusive process (Mira Network, 2024).

Actions such as the creation of business incubators and support for start-ups are crucial to ensure that young people and new generations can enter a sustainable and high-skill labour market. These initiatives must be accompanied by industrial policies that promote balanced growth, avoiding the risk of funds being concentrated only on a few large companies, to the detriment of Small- and Medium-sized Enterprises (SMEs) (Leone, 2025).

An interesting example is the Sulcis Iglesiente area in Sardinia, also a JTF recipient. Like Taranto, Sulcis has a strong coal-related industrial legacy and has similar socio-economic criticalities. However, the operational plan envisages a greater emphasis on energy reconversion and regenerative agriculture projects, offering useful comparison points to diversify the Taranto transition model.

From an economic point of view, the effectiveness of the JTF should also be measured in terms of return on public investment. The allocation of the EUR 803 million in the Taranto area can generate a significant multiplier effect, conservatively estimated at around 1.6 in terms of additional Gross Domestic Product (GDP), or around EUR 1.280 million. This estimate is based on economic literature that attributes multipliers of between 1.5 and 2.0 to public investment, depending on the economic context and the quality of expenditure[21]. However, to ensure efficiency and accountability, it is crucial to set up ex-ante, in itinere and ex-post evaluation systems that measure impacts on key economic and employment indicators.

[21] The estimate of the impact on GDP is based on a multiplier of 1.6, applied to the EUR 803 million envisaged by the JTF for Taranto. This value is derived from estimates of multiplier effects of public investment reported in studies by the Bank of Italy and the MEF, which indicate a typical range between 1.5 and 2.0 depending on the structural conditions and absorption capacity of the territories.

Chapter 5. The future of Taranto: a sustainable development model

What should be the starting point for revitalising Taranto? Several recent industrial initiatives and agreements outline a path for the decarbonisation of the steel site, including significant investments in innovative technologies for low-emission steel production. A central step in this direction is the Memorandum of Understanding (MoU) signed in 2024 between Acciaierie d'Italia Spa (the Italian national steelworks), ILVA in extraordinary administration and DRI d'Italia Spa[22], aimed at the construction of a 2.5 million tonne direct reduction (DRI) plant at the Taranto site (Acciaierie d'Italia, 2024). At the same time, at the company workshop in November 2023, investments of over EUR 2 billion and a ten-year time horizon were presented for the decarbonisation of the plant, through the introduction of electric arc furnaces, the electrification of the hot area and the future use of green hydrogen.

In this context, the Just Transition Fund Italy 2021-2027 assumes a conditional role: the disbursement of resources is conditional on compliance with these technical milestones, accompanied by employment protection tools and staff training programmes for the adoption of new green technologies. The plan is also coordinated with national and European investments to avoid overlaps and maximise effectiveness through the involvement of local institutions, communities and stakeholders (Radiocor, 2025).

However, the current negotiation phase for the sale of Acciaierie d'Italia to an Azerbaijani consortium led by Baku Steel Company - which started in March 2025 with an exclusive agreement with the Italian Ministry of Enterprises and Made in Italy (Reuters, 2025) - introduces elements of strong uncertainty on the continuity of environmental and employment commitments, prompting the trade unions to ask for formal guarantees before the final signature (*The Labour Diary*, 2025).

Within this framework, Chapter 5 translates the perspectives emerging from recent industrial developments into a just and sustainable transition model, integrating participatory governance clauses and JTF investment instruments.

5.1 Sustainability and the creation of a green industrial hub

Transforming the Taranto steel area into a true green industrial hub[23] requires a systemic approach that goes beyond mere technological reconversion and involves the entire territorial ecosystem.

[22] DRI d'Italia S.p.A. is a state-owned company established by Invitalia in 2022 to design and operate direct reduced iron (DRI) plants as part of Italy's national decarbonisation strategy.
[23] An industrial hub is an integrated centre that combines production, logistics, research, and training, with the aim of fostering innovation, efficiency, and collaboration among local and international stakeholders.

Firstly, the integration of the plant with a local supply chain of small and medium-sized enterprises is crucial: the production and maintenance of components and modules for hydrogen generation can create more resilient supply networks and new opportunities for skilled jobs (Ministero della Transizione Ecologica, 2022; Edison S.p.A., 2025).

Secondly, it is necessary to create an innovation pole that unites the universities of Bari and Taranto, research centres and Acciaierie d'Italia, equipped with laboratories on low environmental impact materials, electrolysis processes and training courses dedicated to green technologies, linked to scholarships and internships in the company; this will encourage both the transfer of skills and the establishment of new talents in the area, reducing the flight of young people away from the area (Acciaierie d'Italia, 2022).

5.1.1 ILVA, towards green technologies

To make the Taranto steelworks truly 'green', a gradual path is needed that integrates tried and tested solutions and emerging technologies, thus concretising the roadmap outlined by Acciaierie d'Italia (Acciaierie d'Italia, 2022).

Firstly, DRI[24] partially replaces the traditional blast furnace with a process that uses natural gas - or, even better, green hydrogen - to transform iron ore into a solid semi-finished product. This process requires less heat and produces about 30-40% less CO_2 than the classic integral cycle, thus representing a significant first step towards decarbonisation.

Next, EAFs make it possible to melt mainly steel scrap instead of raw ore, using electrical energy. If this energy comes from renewable sources, such as wind or photovoltaics, CO_2 emissions can be reduced by up to 90% compared to conventional plants. This approach makes it possible to produce 'green steel' from recovered materials, drastically reducing the carbon footprint of the entire production cycle (Wired Italia, 2024).

To complete the process, the use of green hydrogen, obtained by electrolysis of water using renewable electricity, replaces the *coke*[25] in the blast furnaces, almost eliminating direct CO_2 emissions. According to estimates based on data from the Politecnico di Milano (Polytechnic University of Milan), the Taranto plant would need around 500,000 tonnes of green hydrogen per year to produce 8 million tonnes of steel, with significant infrastructure investments for the production, transport and storage of this clean gas (Leonardi & Novati, 2021).

[24] Please refer to section 3.1 for a detailed technical description of the DRI.
[25] Coke is a solid fuel derived from the distillation of coal, traditionally used in blast furnaces as a reducing agent to transform iron ore into metal. Its combustion is highly emissive in terms of CO_2.

Finally, Carbon Capture, Utilisation & Storage (CCUS) technology is recognised as a potential solution to capture residual emissions in industrial processes, but there are currently no concrete plans for its adoption in Taranto. The updated National Energy and Climate Plan does not foresee the use of CCUS in the Italian steel industry before 2030, favouring instead already available technologies such as DRI and EAF (Di Mambro, Leonardi, Gasperin, Novati & Cassetti, 2023).

Together, these three steps outline a coherent technological path that could guide the former ILVA towards a sustainable steelmaking model.

5.1.2 Economic and social impacts of sustainable transition in the industrial sector

The conversion of the Taranto steel plant to low-emission processes is not just a technical intervention, but a real driver of socio-economic development for the entire region.

The retraining of human resources is a central element in the transition to low-emission production processes. The adoption of technologies such as electrolysis, the operation of electric furnaces and the running of hydrogen plants will require the acquisition of new skills by personnel currently employed at the plant (International Energy Agency, 2024; Cedefop & UNESCO-UNEVOC, 2025)[26].

According to the International Energy Agency (2024), global investments in clean energy technologies reached 1.4 trillion USD in 2022, driving rapid growth in employment across the sector. Meeting the industrial transition goals will require not only technical innovation, but also a highly skilled workforce, particularly in sectors such as hydrogen, electrification, and materials production.

This significant investment in human capital reduces the risk of structural unemployment and creates career paths in green technologies.

Simultaneously, developing a local supply chain represents a strategic opportunity to strengthen Taranto's productive fabric. The involvement of small and medium-sized enterprises in plant support services, maintenance, logistics and environmental sectors can stimulate specialisation processes and strengthen territorial economic resilience. In addition, the production of low-emission steel in line with European decarbonisation strategies, such as the Fit-for-55 package, can strengthen competitiveness in domestic and foreign markets, opening new opportunities in industrial sectors sensitive to environmental performance.

Finally, the improvement in air quality in neighbouring districts, such as the Tamburi district, is associated with a significant reduction in health risk, with estimates indicating a 30% decrease in overall

[26] The International Energy Agency (IEA) is an intergovernmental body providing data and policy advice on global energy and decarbonisation. The European Centre for the Development of Vocational Training (CEDEFOP) is the EU agency for vocational education and training (VET), supporting skills development for labour market needs.

risk for the Taranto area and 39% for the Tamburi district, according to the most recent Health Impact Assessments (ANSA, 2024).

Although there is currently no specific fund to allocate energy savings from the steel industry to social purposes in the territory, the principle of redistribution of transition benefits is central in European programming documents, such as the Just Transition Fund. From this perspective, initiatives that combine industrial sustainability and investments in services for local communities would be a strategic option to strengthen social cohesion and the acceptance of environmental innovations in industrial-intensive territories. These results lay the groundwork for a Green Steel Hub in Taranto, based on cutting-edge technologies, skilled labour and community involvement - fully in line with the objectives of the Just Transition Fund and the EU directives for climate neutrality.

5.2 Sustainable tourism and enhancement of the territory

Taranto's challenge is to transform the image of the 'steel city' into that of a destination capable of offering authentic and environmentally friendly tourist experiences, integrating the urban regeneration and economic diversification policies promoted by the Just Transition Fund. Although the JTF does not directly finance territorial marketing interventions, its actions aim to create the conditions for a sustainable development of the territory, fostering the birth of new enterprises, the redevelopment of disused areas and the promotion of alternative economic activities, which can indirectly contribute to enhancing the local tourist offer, moving away from the 'hit and run' tourism model linked to cruises (Benetti & Gamba, 2022)[27].

5.2.1 Development of ecological and industrial tourism

Despite the critical environmental issues still present and an international reputation compromised by the prolonged industrial crisis, Taranto possesses a largely untapped ecotourism potential. Its natural heritage, from the Gravine to the wetlands of the Mar Piccolo, and the new resources activated by the Just Transition Fund offer a solid foundation for launching regeneration initiatives in a sustainable manner. From this perspective, it is beneficial to consider already established European experiences not as models to be mechanically imitated, but as reference points for gradual and contextualised development. The cases of Cres and Mali Lošinj (Croatia), Hiiumaa (Estonia), and Pantelleria (Italy), included in the Green Destinations *Top 100 Stories* (Green Destinations, 2024), demonstrate how peripheral territories, by focusing on soft mobility, environmental protection, and community governance, have managed to become destinations for responsible tourism. Similarly, cities like Tallinn

[27] For an operational guide on territorial marketing in projects co-financed by cohesion funds, see European Commission. 2021. *Guidelines on Territorial Marketing for the Cohesion Funds*. Brussels: EU.

and Valencia, which were awarded the title of European Green Capital (European Commission, 2024), underscore the importance of an integrated vision encompassing environment, culture, and civic participation. These examples do not negate the distance that still separates Taranto from similar goals, but they provide operational and cultural elements from which to develop a tourist offering based on identity, inclusion, and genuine sustainability.

The Just Transition Fund, through Action 2.3 of the Executive Plan for Taranto, finances light infrastructural interventions aimed at improving the use of the territory, such as the creation of urban parks, green paths, cycle paths and sustainable infrastructure along the Mar Piccolo and the Gravine. In parallel, Action 2.7 supports training and professional requalification programmes for eco-hospitality operators and environmental guides, laying the foundations for community-led initiatives of responsible and inclusive tourism (Regione Puglia, 2025).

The participatory tourism model, based on the direct involvement of local communities in the design of slow routes and experiential activities, is one of the most promising trajectories for Taranto. Trekking in the Gravine, birdwatching itineraries in the Mar Piccolo, or guided kayak tours can be developed thanks to the opportunities offered by the JTF. Action 2.7 provides funding for specialised courses, environmental certification and services for access to skilled labour, while Action 2.3 includes interventions for light infrastructure and sustainable land use. These instruments favour the creation of sustainable tourism micro-enterprises and community-led[28], with direct effects on the economic well-being of local populations (Regione Puglia, 2025).

Eco-tourism in Taranto is then based on the creation of immersive, low-environmental impact routes, enhancing natural areas such as the Parco delle Gravine, the salt pans of Margherita di Savoia and the wetlands of the Mar Piccolo. Thanks to JTF investments, it is now possible to explore these landscapes with zero-emission travel, linking rural and coastal junctions in a single green network (ARET Pugliapromozione, 2024).

In this way, ecological tourism in Taranto not only enhances a natural heritage often unknown to the public but also integrates with the JTF Operational Plan. Lastly, the article *Quale turismo per il futuro di Taranto (Which tourism for the future of Taranto*) emphasises how certified agritourisms, recovered masserie (traditional farmhouses) and short-chain food and wine itineraries can create a virtuous circuit, transforming local traditions into true participatory experiences in which tourists learn the secrets of wheat harvesting or oil production, becoming 'ambassadors' of local traditions and directly supporting the inhabitants of small villages (Benetti & Gamba, 2022).

[28] By December 2024, the JTF Taranto Operational Plan had approved 15 "community-led" projects for slow routes and light structures, with a total funding of 7.2 million Euro (Regione Puglia, 2024).

The result is a replicable model that integrates specialised training, environmental certification and participatory governance processes: communities identify the potential of their areas, receive support to develop sustainable tourism micro-enterprises and connect to networks of green destinations, ensuring uniform quality standards and responsible visitor flows. This approach multiplies the economic benefits for rural and coastal areas, creates new opportunities for qualified employment and consolidates a shared culture of environmental protection and promotion.

At the same time, the development of industrial tourism in Taranto can benefit greatly from European experiences of enhancing post-industrial sites, transformed into cultural attractions and centres of narrative innovation. A particularly significant model is represented by the *European Route of Industrial Heritage* (ERIH), a network that unites over 2,000 sites in 29 European countries, organised around 16 Thematic Itineraries - including 'Iron & Steel' and 'Industrial Landscapes' - and that identifies as *Anchor Points*[29] places of historical relevance and exhibition quality.

In this scenario, the former ILVA in Taranto is a credible candidate to become Anchor Point: not only for the exceptional historical importance of the steel plant in the European context of the 20th century, but also for the symbolic power it represents today, between the environmental crisis and prospects for green transition. Its candidacy, to be articulated through a dossier that includes a historical narrative, a plan for its use and sustainable management, could make a decisive contribution to the civic re-appropriation of the area, reconverting it into a cultural and educational hub on the right industrial transition.

Joining the ERIH network would guarantee Taranto international visibility, access to specialised tourism circuits and the possibility of developing integrated routes with other European sites, within the 'Iron & Steel' itinerary, alongside iconic sites such as the *Völklingen Ironworks*[30] or the *Zollverein Coal Mine Industrial Complex*[31] (Council of Europe, 2005). Furthermore, participation in training and exchange programmes - such as the *Summer Schools* of the *European Academy of Industrial Heritage* - would provide the city with advanced skills in heritage interpretation, cultural marketing and sustainable management of tourist flows.

Another key element for the success of industrial tourism is the inclusion of local communities and stakeholders in the enhancement processes. In this perspective, the participation of universities, SMEs and citizens can foster innovative models of cultural regeneration. Benetti and Gamba (2022)

[29] For data on visitor numbers, exhibition features, and multimedia elements at Anchor Points, see: European Route of Industrial Heritage. (2023). *Industrial Heritage Barometer 2022/23*. Retrieved May 25, 2025 from https://www.erih.net/projects/erih-industrial-heritage-barometer.

[30] Völklingen Ironworks (Germany), a UNESCO World Heritage Site, where guided tours of the historic furnaces are complemented by multimedia exhibitions on smelting processes and working life.

[31] Zollverein Coal Mine Industrial Complex in Essen (Germany), famous for its modernist architecture and transformed into a cultural centre with museums, exhibition spaces and cycle paths along the old railway tracks.

emphasise the importance of building sustainable and participatory tourism routes for Taranto, oriented towards the identity enhancement of places and the reactivation of the social fabric. In parallel, Boboc et al. (2022) highlight how augmented reality apps deliver digital storytelling through interactive overlays—combining geolocated multimedia, chapter-style narratives and AR markers—to amplify the visitor experience in industrial heritage sites. The integration of these interactive narratives and civic engagement tools can thus transform former industrial spaces into immersive and accessible environments, contributing to a more conscious and inclusive cultural enjoyment.

European experiences such as the Urban Ecomuseum in Turin or the Landschaftspark Duisburg-Nord in Germany (Simone, 2010; Bauernschmidt, 2021) show how former industrial facilities can be converted into multifunctional spaces combining culture, education and leisure. These projects, born from participatory processes, have integrated the memory of work with interactive installations, narrative paths and workshop activities for schools, tourists and residents. Applying similar approaches in Taranto - for example, transforming disused areas of the former ILVA into spaces for multimedia exhibitions, educational workshops on energy or narrative paths on the 'steel past and sustainable future' - would represent a concrete implementation of the strategic lines supported by the Just Transition Fund.

5.2.2 Enhancing the natural, cultural and historical resources of Taranto

Taranto's transition towards a more sustainable and diversified development model is already underway and finds in the enhancement of its cultural and landscape heritage one of its most promising directions. The Operational Plan of the Just Transition Fund for the Province of Taranto is part of this trajectory, offering an opportunity to strengthen and systematise actions already started thanks to various financing instruments. Although the JTF has not, to date, directly financed restoration work on specific historical-artistic heritage, measure 2.6.6 of the programme provides for an allocation of 12 million EUR to support private cultural institutions, creative enterprises and third sector entities active in artistic-cultural innovation, technological experimentation and the redesign of cultural venues (Regione Puglia, 2025).

These measures are in synergy with projects already underway: the restoration and conservation of the Aragonese Castle, financed by the Italian Ministry of Culture with EUR 2.75 million, and the initiatives of the National Archaeological Museum of Taranto (MArTA) to improve accessibility and the visitor experience through multilingual audioguides, tactile routes and digital technologies, are concrete examples of a cultural transition already underway (Museo Archeologico Nazionale di Taranto, 2022; Museo Archeologico Nazionale di Taranto, 2024). These interventions, supported by national and European funds, have been identified in the *PON Cultura e Sviluppo 2014–2020 – Linee guida per i Beneficiari alla chiusura delle operazioni dell'Asse 1* (Ministero della Cultura – Autorità

di Gestione del PON Cultura e Sviluppo, 2024) as key pillars for evaluating the contribution of cultural investments to programme objectives and for structuring future synergies with the Just Transition Fund (JTF). The lack of formally approved JTF projects for sites such as the Tombs of the Knights or for the technological enhancement of museum routes does not, therefore, limit the strategic relevance of such initiatives, which may find space and support within the operational framework of the Fund through future synergic projects. The experiences gained with the 'Permanent Laboratories 2022' and with the creation of the Destination Management Organisation (DMO) 'Ecosistema Taranto – Taranto Ecosystem', activated on the city's candidature as Italian Capital of Culture 2022, also represent valuable resources. These initiatives have made it possible to experiment with forms of participatory planning and integrated governance between public institutions, universities, cultural operators and citizens. The co-design approach and multi-level governance adopted in that context now constitute a replicable model to be integrated in future JTF-funded interventions, not only as virtuous local experiences but as permanent structures of strategic accompaniment for a sustainable and shared cultural transition (Comune di Taranto, 2024).

In parallel, the 'Ecosistema Taranto – Taranto Ecosystem' DMO represents a consolidated model of integrated governance, already active in the coordination of cultural and tourism policies through communication campaigns, flow monitoring systems and international relations. Bringing together the municipality, MArTA, universities, third sector operators and private actors, this organisation has demonstrated the effectiveness of a collaborative management oriented towards territorial enhancement. In this perspective, the JTF can not only enhance this structure as an operational tool for the integration of digital technologies in cultural routes (e.g. multilingual apps, audio guides, interactive totems), but also strengthen its strategic role as a platform for co-design and shared management of interventions. This approach is particularly relevant in the light of the historical fractures analysed in Chapter 1, where the industrial policy linked to ILVA was marked by decisions from above, a lack of transparency and the systematic exclusion of the local community from decision-making processes (Barca, 1999). The promotion of participatory governance is therefore not only a good practice, but a historical necessity to avoid the repetition of past mistakes and to give citizens back an active role in defining the city's future.

A particularly significant occasion in this renewal process are the 20th Mediterranean Games, which Taranto will host in 2026. With a state budget of around 350 million EUR (CIJM/ANSA, 2025), the event represents much more than a sporting event: it is a driver for territorial attractiveness and an accelerator of urban transition. The new infrastructures - including the World Rowing homologated regatta course, the Olympic swimming pool and the Erasmo Iacovone stadium - are designed according to standards of accessibility and sustainability, making them usable even after the event in a logic

of legacy for international sports tourism. These interventions are integrated with the sustainable mobility promoted by the JTF, through cycle paths, electric shuttles and ecological connections between the competition sites, archaeological areas and nature trails in the area. In this way, the event contributes to the construction of a new image of Taranto: no longer just an industrial pole marked by environmental crises, but a dynamic city, capable of enhancing its cultural, natural and sporting capitals in a synergic way. The ferment generated by the Games thus complements the cultural and tourism initiatives, reinforcing the narrative of a city reborn through the plurality of its resources and vocations.

5.3 Training and retraining of human capital

The ADI's Sustainability Report 2022 provides an in-depth overview of environmental and technological measures but devotes little space to up-skilling and workforce retraining initiatives, limiting itself to mandatory health and safety courses (Acciaierie d'Italia S.p.A., 2022).

This shortage becomes even more critical in a sector that, at the European level, directly employs around 300,000 people and supports a further 2.3 million indirect and induced jobs, requiring a rapid transition to skills related to green hydrogen, electrification and circularity (E3G & Beyond Fossil Fuels, 2025)[32]. Without a comprehensive training plan, there is a risk of technical unemployment and 'lock-in'[33] of existing skills, undermining the social justice inherent in the Just Transition Fund for Taranto.

5.3.1 Training projects in green skills and sustainable industry

The training of personnel in Taranto must be inspired by effective European models that integrate theoretical instruction with practical, workplace-based learning. Such approaches have proven effective in aligning vocational education and training with the evolving demands of the green economy, thereby reducing skill mismatches and preparing workers for emerging technologies (Cedefop & UNESCO-UNEVOC, 2025). This model, however, offers useful indications on how to integrate theoretical and practical training to prepare workers for new green technologies.

At the same time, the *Steel Skills Agenda* promotes structured partnerships between companies, technical education centres and social partners, while the European Commission's *Blueprint on Steel* defines training modules on emerging topics - such as electrolysis for green hydrogen production,

[32] The Third Generation Environmentalism (E3G) is an independent climate think tank based in London, focused on accelerating the global transition to climate safety through policy, diplomacy, and finance.
[33] The 'lock-in' of existing skills refers to a situation where workers' expertise remains confined to traditional processes, limiting their adaptability to new technologies. Without upskilling, for instance, a steelworker trained only on blast furnaces may struggle to shift to green sectors like electrolysis or hydrogen management, increasing the risk of technical unemployment.

circular economy and carbon capture - conceived in modular form and easily upgradable according to regulatory and technological developments (European Commission, 2021; Eurofer, 2020).

Including RPL as part of modular programmes allows adults to focus only on skill gaps and to benefit from personalised learning pathways. In addition, RPL is an essential instrument to improve the employability of adults by shortening the duration of training and granting training credits based on previously acquired competences (OECD, 2023)[34].

Experiences in Spain and Poland show how top-down training initiatives, lacking real co-design with workers, have often generated low participation and delays in the recognition of certifications, also due to complex bureaucratic procedures and fragmented and short-term funding (E3G & Beyond Fossil Fuels, 2025).

For the Taranto context, it is proposed to organise *capacity building* workshops structured as *communities of practice*[35], where operators, trainers and managers co-design content and teaching methods, ensuring adherence to the specific needs of the production department. An example of a successful application of this approach can be observed in the 'Steel2Green' project implemented in the North Rhine-Westphalia region, where steel companies and technical institutes collaborate on training design in real work contexts. Concerning *micro-credentials*, the 'GreenSkillCert' programme in Sweden has shown how digital modular certifications in areas such as renewable energy and industrial waste management promote rapid integration into new green roles.

To measure and sustain training progress, it is essential to define shared indicators - e.g. number of *micro-credentials* issued and insertion rates in green roles - to ensure multi-year allocations instead of 'spot' funds, and to maintain transparent communication between companies, trade unions and training institutions. Only in this way can the green roadmap be translated into truly spendable skills, achieving a fair, inclusive and lasting transition for Taranto's workers.

In the implementation phase, it will be crucial to oversee three aspects: firstly, the constant coordination between ITS (Higher education institute for technical and professional training), universities and industry to prevent pathways from remaining 'on paper'; secondly, the active involvement of workers through *communities of practice* to ensure that the training content reflects the production reality; finally, the continuous updating of curricula through school-enterprise co-design workshops and real-time analysis of employment trends - e.g. through big data on job offers - to adapt *micro-credentials* to regulatory and technological changes promptly.

[34] It is about the recognition of informal knowledge, incorporating recognition of prior learning (RPL) mechanisms for senior practitioners, in order not to exclude valuable skills and to reduce the sense of 'lock-in' on old skills.

[35] 'Communities of practice' are peer learning groups that promote the development and sharing of effective professional practices. 'Micro-credentials' are short-term digital certifications attesting to specific skills relevant to rapidly evolving sectors.

These indications align with Action 2.7 of the Executive Plan of the Just Transition Fund for the Province of Taranto, which allocates over 160 million EUR to retraining pathways for workers at risk or already affected by industrial transition. Activities include the creation of vocational courses, training infrastructures and job placement services, particularly for young people, and represent a key resource to support the transition to sustainable and resilient employment.

5.3.2 New opportunities for young people

In the context of the Just Transition Fund for Taranto, unprecedented scenarios for young people are emerging, oriented towards the development of skills and the creation of new professionalism in the field of ecological transition. The opening of the Mediterranean Technopole for Sustainable Development in Taranto in 2025 is a strong signal in this direction: it is a research and innovation hub promoting projects related to decarbonisation, circular economy and digitisation of production processes (AISEC, 2025)[36].

Alongside this infrastructure, it is proposed to adopt the PlanGreenSkills model (Plan International, 2022), which starts by analysing the aspirations and training gaps of young people. A European survey shows that 54% of young people consider renewable energy a priority, but less than 30% feel adequately prepared to face the professional challenges of the sector. The model suggests alternating school-work and dual apprenticeships, complemented by modular courses with the issuing of *micro-credentials* - flexible and upgradeable certificates on key skills such as electrolysis, waste management, teamwork and digital skills[37].

In this context, it is also useful to promote the organisation of green hackathons, already experimented in other Italian realities (Università di Parma, 2025; Etifor, 2025), as intensive co-design events on topics such as sustainable mobility, smart grids and urban waste recycling. Such collaborative marathons encourage the activation of multidisciplinary teams, offer symbolic prizes and can represent a springboard towards the incubation of the most promising ideas.

To translate these insights into effective policies, CEDEFOP's policy brief *Tracking the Green Transition in Labour Markets* (2024) emphasises the strategic importance of using *big data* from job advertisements to monitor the most in-demand skills in real time. Terms such as 'environmental engineering' or 'resource efficiency' are useful indicators to orient training offerings and build effective partnerships between universities, Italian Higher Technical Institutes (ITS) and centres of excellence.

[36] The Italian Association for the Development of the Circular Economy (AISEC) is a non-profit organization promoting the transition towards a circular economic model in Italy. It supports research, policy advocacy, and the implementation of sustainable practices across industries, with a particular focus on innovation, education, and territorial development.
[37] Micro-credentials are short formal certificates documenting specific skills acquired, recognised by educational institutions and companies. They are cumulative, upgradeable and adaptable to the needs of the labour market.

In Italy, this could materialise with the strengthening of ITS in the green sector and the creation of 'green centres of excellence' at the universities of Bari and Taranto.

Finally, there is also a strong demand for green skills from the Excelsior Information System analysis, which confirms an acceleration in the renewable energy, energy efficiency and circular economy sectors (Unioncamere & ANPAL, 2023). However, the mismatch between training demand and supply requires structured interventions, such as those envisaged by the Just Transition Fund guidelines for the Province of Taranto (Regione Puglia, 2025), which include retraining, entrepreneurial incubation and youth employability promotion paths.

Thanks to the integration of local infrastructures such as the Technopole (AISEC, 2025), training models geared to the real needs of young people such as PlanGreenSkills (Plan International, 2022), and advanced analytical tools such as those promoted by Cedefop (Cedefop, 2024), Taranto can launch an educational and entrepreneurial ecosystem capable of offering under-30s concrete professional paths in the field of sustainability. The activation of thematic hackathons (Università di Parma, 2025; Etifor, 2025), the promotion of micro-credentials and cooperation between universities and businesses represent strategic levers for retaining young talents in the area, fuelling innovation and social cohesion within the ecological transition.

5.4 Taranto community involvement and participatory governance models in the transition

The Just Transition Fund for Taranto cannot be based solely on technical or industrial strategies but must be based on inclusive processes of participatory governance. In this sense, the JTF 2021-2027 explicitly emphasises the creation of an 'enabling urban ecosystem' in which citizenship is an active player in the care of common goods and the definition of local development trajectories.

This approach recalls the principles of Elinor Ostrom[38] (1990), according to which the sustainable management of common goods - such as the air, the sea and the urban landscape of Taranto - requires polycentric governance structures, community monitoring mechanisms, shared rules and a legitimacy built through the direct involvement of the communities concerned.

In line with these principles, the municipal administration launched the 'Ecosistema Taranto' (Taranto Ecosystem) programme in 2020, an integrated strategy of ecological, energy, economic and cultural transition. This project has seen the involvement of a heterogeneous network of actors: the Municipality of Taranto, the Italian Ministry of Culture, the State Property Agency (Agenzia del Demanio), the public company Kyma Ambiente, universities and research centres, together with civic

[38] Elinor Ostrom (1933–2012), Nobel laureate in Economic Sciences, explored forms of collective action and reciprocity that resonate with the theory of the gift, highlighting how shared resources can be sustainably managed through cooperation, trust, and non-market exchanges.

committees and local associations. The objective is the sustainable reconversion of the urban and productive model through articulated interventions, from soft mobility to the redevelopment of public spaces, from the enhancement of the historical heritage to renewable energy.

At the same time, several urban regeneration measures have been implemented. Among the most relevant: (1) the redevelopment of the Old Town through the recovery of historic buildings and the construction of the 'Waterfront via Garibaldi'; (2) the enhancement of the Torre D'Ayala area, with the creation of an archaeological park, cultural spaces and sports facilities; (3) the regeneration of the Tamburi district, particularly affected by industrial pollution, through projects to improve public spaces, infrastructures and services.

However, despite the recognised centrality of civic participation, recent experiences still show structural criticalities. A survey conducted by Ippolito, Macaione and La Gioia (2017) in the Tamburi district found that most residents had never been involved in participatory activities (65%), with only 9% declaring regular participation in institutional meetings. Trust in local institutions was also low (mean 2.7 out of 5), especially among the most vulnerable groups and in areas most exposed to environmental risks.

These findings are summarised in Table 7, which provides an overview of civic participation levels among residents of the Tamburi district.

Table 7 - Civic participation in the Tamburi district (n = 125)

Category	Percentage
Never participated in public meetings	65%
Occasional participation	26%
Regular participation	9%

Source: Author's elaboration based on Ippolito, A., Macaione, S., & La Gioia, R. (2017). *A divided community: The case of Taranto*.

These data, even though on a limited sample, are indicative of the socio-cultural barriers that hinder the effective implementation of tools such as participatory budgets, digital consultation platforms, or Local Action Groups envisaged by the JTF. The risk is that participation is limited to formal practices lacking impact, without being able to generate true civic empowerment.

For participatory governance to be effective, it is therefore necessary to strengthen local social capital, recognise inequalities in levels of competence and access, and build a shared culture of territorial care. Only in this way will it be possible to transform participation from a consultative tool to a transformative lever for a truly just transition.

5.4.1 From stakeholder to community holder: the active involvement of the local community, community foundations and non-profit associations

So far in Taranto, the role of non-profit organisations - from Legambiente to WWF, passing through informal committees formed around the issues of the Mar Piccolo and the reclamation of the SIN areas[39] - has mainly translated into environmental monitoring and public denunciations, but rarely into real participation in project choices. Legambiente Taranto has repeatedly denounced the administrative delays in the JTF calls and the absence of effective consultation tables (Scannavini, 2024), while the WWF has reported the lack of dialogue with local communities on the regeneration priorities of the industrial area (WWF Italy, 2024a). These realities, although recognised for their competence and roots in the area, were not involved in the preliminary stages of defining the operational plan, remaining relegated to merely consultative or reactive roles.

To overcome this marginalisation, the Just Transition Fund 2021-2027 implements the principle of horizontal subsidiarity[40] and establishes Local Action Groups (LAGs)[41], bodies co-managed by community foundations, the third sector and local authorities, endowed with an autonomous budget to finance micro-projects of urban regeneration and social services (Regione Puglia, 2025). Each LAG is assisted by a Community Liaison Officer (CLO)[42], a civic facilitator in charge of accompanying citizens in their dialogue with implementing bodies and translating technical language into comprehensible terms.

However, there is a real barrier to citizen participation: the technical language of these tools. Specialised terms such as Local Action Group and Community Liaison Officer - although taken from Regulation (EU) 2021/1056 on JTF - risk transforming powerful inclusive tools into mere 'bureaucratic signposts', remaining abstract if not accompanied by simplified glossaries and civic training sessions (Regione Puglia, 2025).

The establishment of LAGs then prompted the creation of community foundations, provided for in Italy by Law 118/2005 and inspired by the cooperative community model (Mori, 2015). These foundations operate as non-profit bodies with a mixed board (representatives of the third sector, institutions and citizens), dedicated assets and local development purposes ranging from proximity welfare to landscape protection and the support of social innovation micro-projects (Fondazione Compagnia di San Paolo & AICCON, 2023). In Taranto, the 'Futuro in Terra Jonica' (Future in Jonian Land)

[39] SIN areas: Sites of National Interest, highly contaminated wide areas deserving soil and land reclamation by State intervention.
[40] Horizontal subsidiarity principle: Art. 5, Regulation (EU) 2021/1056 on the Just Transition Fund.
[41] Local Action Groups are co-managed local bodies with an autonomous budget for the allocation of JTF resources (Regione Puglia, 2025).
[42] Community Liaison Officers perform civic facilitation and civic audit functions to translate the technical terms of the JTF into accessible language (Regione Puglia, 2025).

promoter committee has already begun to apply a bottom-up 'spiral model', starting from the concrete needs of small groups and gradually extending involvement to new actors.

Only by equipping citizenship with truly accessible tools and structures, and by transforming each participant from a mere stakeholder into a true community holder - i.e. an actor who does not merely observe but engages in co-planning, resource allocation, monitoring and verification of results - will we be able to guarantee genuine and lasting participatory governance.

5.4.2 Towards participatory and inclusive governance

The previous section illustrated the instruments provided by the Just Transition Fund to strengthen civic protagonism. This section analyses how, to date, non-profit organisations and civic committees in Taranto have experienced marginal involvement in key decision-making processes, particularly in the definition of the SISUS project variants and within the 'Ecosistema Taranto' platform.

Since 2019, Legambiente Taranto has drawn up detailed observations on the waterfront redevelopment projects and interventions in SIN areas, raising critical issues related to the absence of adequate environmental assessment and the lack of transparency in the criteria for selecting project solutions. However, these contributions were not systematically considered in the decision-making stages. In a public note, Legambiente highlighted how the consultation of territorial subjects active in the environmental field was often formal, with no real possibility of co-designing or influencing technical choices (Legambiente, 2025).

Similarly, the Tamburi District committees have carried out autonomous civic monitoring initiatives and put forward environmental mitigation proposals, such as the creation of shared vegetable gardens, to reduce the impact of the construction site on the built-up area. However, institutional responses have been limited and have not yet led to an effective integration of these experiences into urban policies.

The mismatch between input from the territory and public decision-making has progressively undermined the trust of local communities, generating resistance towards construction sites and distrust towards institutions. This misalignment underlines the risk of perpetuating a vertical governance model, in contrast with the objectives of the JTF 2021-2027, which instead aims to "strengthen processes of civic involvement and territorial cohesion through the recognition of the active role of local communities" (Regione Puglia, 2025).

In this perspective, the need emerges to flank technical tools with structured moments of civic and environmental literacy, aimed at making participatory processes accessible and comprehensible to all. This step is crucial to overcome information asymmetries and build an authentic enabling urban ecosystem, based on the principles of subsidiarity, transparency and socio-environmental justice.

Italy's Forum PA (Forum for Public Administration) Annual Report 2024 emphasises the importance of a public administration that leverages technology, people, and communities to drive a strong transformation and remain a key actor in shaping the country's future.It highlights how the active participation of citizens and third sector organisations is fundamental for effective and inclusive governance (Forum PA, 2024).

At the same time, the WWF Italy report *"Green Steel: where are we in Italy?"* highlights how the transition to a low-emission steel industry requires a long-term vision, targeted investments and a more integrated and traceable supply chain (WWF Italy, 2025). Furthermore, the dossier on industrial decarbonisation recalls the need to actively involve local communities to ensure that strategies are not only environmentally effective, but also fair and participatory (WWF Italy, 2024b).

5.4.3 What spaces for citizens' participation in transition planning?

To make the transition from mere consultation to real co-design effective, the Taranto JTF promoted a more structured involvement of Non-Governmental Organizations (NGO), citizens committees, and Community Foundations, which are already in the early stages of defining interventions. This approach aims to overcome the 'one-off' logic of public meetings, focusing instead on continuous and integrated paths with the local civic fabric (Regione Puglia, 2025).

A growing role is assumed by local civic groups that provide spaces for interaction between institutions, civil society and local stakeholders. The formal recognition of informal committees combined with *capacity building*[43] in project management and digital engagement aims to transform spontaneous mobilisation into structured citizenship, overcoming the 'tragedy of the commons' (Ostrom, 1990).

Digital platforms such as Decidim[44], adopted in Barcelona, and PRI-SMA, developed and tested in Italian cities such as Catania and Siracusa, have demonstrated the potential of civic technologies in improving the quality of debate and widening participation. PRI-SMA is based on an interoperable and open-source cloud infrastructure designed to facilitate interaction between public administrations, citizens and urban stakeholders by integrating consultation, reporting and co-designing tools (Reforgiato Recupero et al., 2016). More recently, the Regione Puglia has launched its own portal, Puglia Partecipa, established under LR 28/2017 and LR 18/2017, which allows users to inform themselves about ongoing consultations, submit and support proposals, and monitor decision-making events (Regione Puglia, n.d.). However, the digital divide remains a significant barrier: for example, at the conclusion of the Just Transition Fund consultation on Puglia Partecipa, only three project

[43] Capacity building includes technical and organisational training activities for civil society actors.
[44] Decidim is the open-source e-participation platform of the Barcelona City Council, used to structure public debates, consultations, and online voting processes (Ajuntament de Barcelona, n.d.).

proposals were submitted by non-profit organizations, highlighting limited access and engagement among civil-society actors (Regione Puglia, n.d.).

A useful term of comparison is the experience of Local Action Groups (LAGs) - known at European level - also active in the Taranto area. These groups, created under the Common Agricultural Policy's LEADER (Liaison Entre Actions de Développement de l'Économie Rurale - Links between actions for the development of the rural economy) programme, have been working for decades in rural areas to promote participatory local development strategies. The 'Terre del Primitivo' Local Action Group has consolidated multi-level governance practices based on territorial forums, public deliberative processes, civic monitoring tools, and transparent financial reporting (GAL Terre del Primitivo, Internal Regulations, 2018). Although substantially different from the urban and industrial context of the JTF, such experiences offer valuable insights for building new models of territorial co-design in urban settings. The OECD (2022) provides a set of operational tools to support inclusive and effective citizen participation[45].

Only by enhancing and strengthening these spaces, through transparency, training and continuity, will it be possible to consolidate trust and stimulate a citizenry that is a protagonist in the transition. Indeed, the construction of an enabling urban ecosystem, based on subsidiarity, equity and sustainable development, depends on the ability to include citizens' voices at all stages of the decision-making process.

5.4.4 Best practices in Taranto: the 'Futuro in Terra Jonica' Community Foundation Committee

The 'Futuro in Terra Jonica' (Future in Jonian Land) promoter committee was born with an ambitious vision: to bring together heterogeneous realities - from the "Cantiere di Comunità" Association (Community Innovation Hub Association) to the San Marzano Cooperative Credit Bank, from the CISL (Italian Confederation of Workers' Trade Union) trade union to Coldiretti, from social cooperatives such as ISBEM (Euro-Mediterranean Biomedical Research Institute) - to lay the foundations of the first Community Foundation in the province of Taranto (Vita, 2021).

In March 2023, the Regione Puglia formally recognised the value of this experience, allocating 200,000 EUR for the establishment of the Community Foundation. However, as of 2025, notarial registration procedures are still pending, leaving the Committee still during its activities. To transform itself into an operational and sustainable entity, 'Futuro in Terra Jonica' will have to consolidate three

[45] These include deliberative processes (e.g. citizens' assemblies), participatory budgeting, civic monitoring tools (including open data dashboards), stakeholder mapping and inclusion plans, and digital platforms for engagement. Such tools are particularly relevant in ensuring transparency, responsiveness, and legitimacy in the allocation and governance of JTF resources (OECD, 2022).

strategic directions - legal, financial and technological - and a fourth fundamental area, which provides its cultural framework: the Paradigm of Giving[46].

The 'Paradigm of Giving', which guides the future Foundation's vision, combines three key elements in a single flow: an overall vision that participatively maps the territory's needs and potential; civic-tech, project management and mentorship paths to enhance citizens' civic and professional skills; and finally, a reciprocal restitution mechanism, whereby those who benefit from micro-grants or services give back time, resources or know-how to the community, triggering a virtuous circle of social innovation and collective cohesion.

In this sense, the Committee's approach is in line with what Mori (2025) observed, according to which Community Foundations represent instruments of 'structured subsidiarity', capable of generating social capital and fostering endogenous local development processes. Such experiences, when rooted in the territory and supported by a solid relational ecosystem, can become true agents of transformation, overcoming the logic of welfare intervention to promote active and co-responsible citizenship.

The experience of the 'Future in Jonic Land' Committee thus appears as a laboratory of social innovation that combines inclusion, participation and sustainability. Despite its still transitional phase, it shows how, even in territories marked by deep environmental and economic fractures, it is possible to activate dynamics of collective empowerment. The real challenge will be to consolidate this path into a stable legal and management form, capable of intercepting resources, creating alliances and making the community the protagonist of its future.

5.4.5 Foreign best practices of community participation

Over the past two decades, numerous areas formerly dominated by heavy industry - from England to the US Rust Belt and the German Ruhr - have initiated reconversion processes that succeed only if local communities are truly put at the centre (City of Youngstown, 2005). With a view to a just transition, the active participation of citizens is not only an element of democratic legitimacy, but also an enabling factor to make paths of economic and social transformation sustainable and rooted in the territory. Among the most recurrent success factors are the creation of permanent civic learning networks, co-design spaces in brownfield sites and digital platforms for real-time feedback. These tools, when well-integrated, not only gather ideas but translate them into concrete projects that can be monitored and adapted according to the results obtained.

[46] The 'Giving Paradigm' is a relational model that frames gift-giving not as unilateral charity, but as an exchange fostering reciprocity, trust, and social cohesion. In community contexts, it encourages non-monetary restitution (e.g. time, skills, participation), strengthening social capital and belonging (Caillé, 2020).

At the same time, common criticalities emerge for the excessively bureaucratic processes that slow down the start-up of construction sites, scarce multi-year funding for the maintenance of regenerated infrastructure, and difficulties in including marginal segments of the population, especially migrants and young people. Without a constant balance between widespread participation and institutional structuring - e.g. through participatory budgets or Local Action Groups - projects risk remaining on paper or being captured by local elites.

In order to delve deeper into these dynamics and understand the conditions for their effectiveness, in the following paragraphs we will examine two emblematic and different cases: Gelsenkirchen, where the 'learning city' model[47] transformed an industrial landscape into a green laboratory, and Pittsburgh, which built a participatory innovation hub also thanks to the use of digital tools such as Social Pinpoint.

5.4.5.1 Gelsenkirchen: citizen participation process for sustainable transition and the creation of a green ecosystem

Gelsenkirchen, once a coal and steel town with over 250,000 inhabitants, has transformed its brownfield sites into a 450 km² Emscher Landscape Park and 'green laboratories'[48] such as the Hugo Biomassepark. These spaces function as real bottom-up laboratories, run jointly by citizens, schools and NGOs to test solutions for adaptation to climate change and promote Education for Sustainable Development (ESD). Since 1997, the Agenda 21 Office has been coordinating training courses and citizen science courses, adopting the motto 'Think global - act local' and involving associations, businesses and administration in workshops and public events. These initiatives align with the principles outlined in the Smart City Charter, which advocates for sustainable digital transformation through civic engagement and education (Federal Institute for Research on Building, Urban Affairs and Spatial Development [BBSR], 2017). This approach is exemplified in the city's transformation from a coal and steel hub to a green city, as detailed in the case study *Gelsenkirchen: From coal and steel to a green city* (Oppla.eu, n.d.).

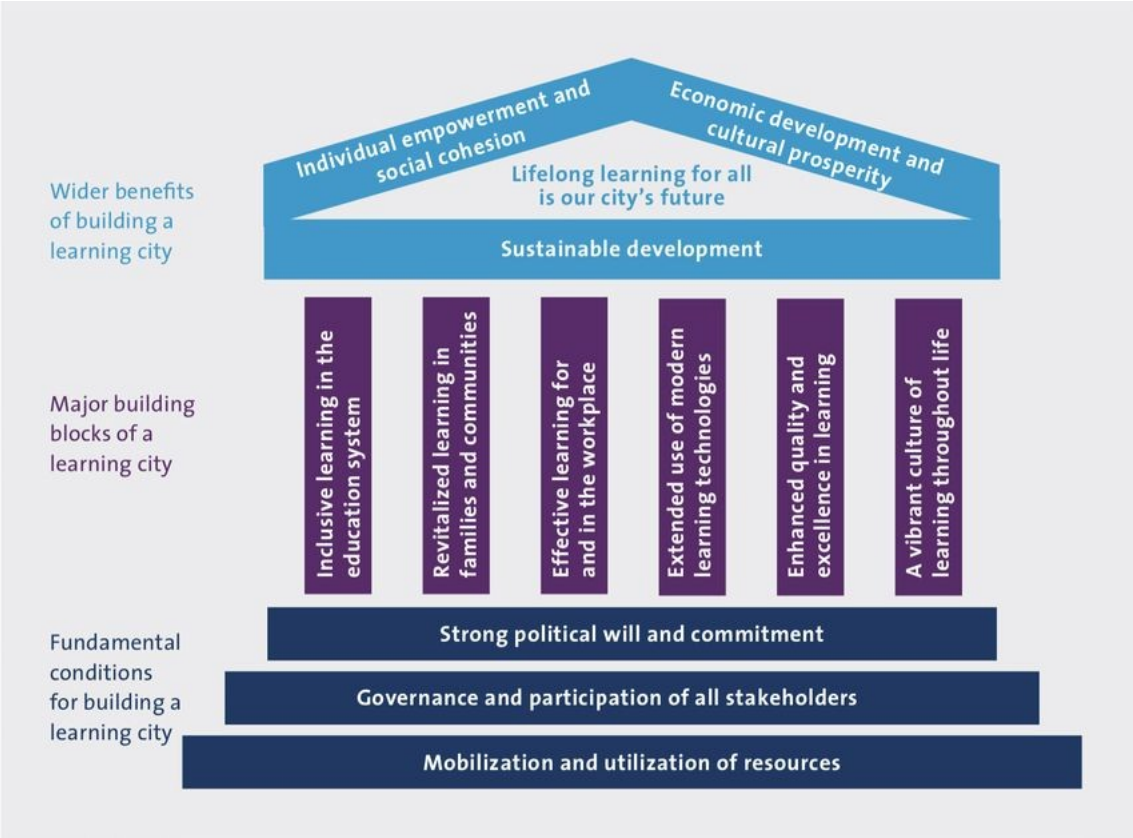
The 'learning city' concept is materialised through a lifelong learning network based on the Adult Education Centre (Volkshochschule - VHS), which has been offering ESD courses and mentorship to both young people and adults since 2013; on the setting up of 'open building sites' in the Emscher Park, where technicians, associations and residents collaborate to define the materials and functions of the new green laboratories; and on a transparent digital infrastructure, with the BNE-Portal and an

[47] The ‘learning city’ is an urban model that promotes lifelong learning by integrating formal education, vocational training, and civic participation. In Gelsenkirchen, for instance, the Volkshochschule (VHS) offers Sustainable Development Education for all age groups.

[48] ‘Green laboratories’ are experimental spaces for environmental and urban regeneration that engage citizens in practices such as climate adaptation, urban agriculture, and participatory green management (e.g. Biomassepark Hugo, Gelsenkirchen).

online monitoring system that makes data on biodiversity, ecosystem services and participation public (UNESCO Institute for Lifelong Learning, 2023; Intelligent Cities Challenge, 2023).

Image 1 - Model of a 'learning city'



Source: UNESCO Institute for Lifelong Learning (2015). *The Framework of the Key Features of Learning Cities*.

The framework developed by UNESCO Institute for Lifelong Learning, illustrated in the Image 1, provides a useful lens to interpret Gelsenkirchen's approach to lifelong learning and its implementation of the 'learning city' model.

Among the most significant initiatives is the 'Learning Places' project that transformed urban public spaces into experiential educational contexts, enhancing the spatial and participatory dimensions of sustainable education. This approach helped consolidate Gelsenkirchen's identity as a diffuse urban laboratory based on knowledge co-production, ecological adaptation and social inclusion (IAU – International Association of Universities, 2023).

To complete the picture, the experience of the Internationale Bauausstellung Emscher Park (IBA), conducted between 1989 and 1999, showed the importance of a holistic approach to spatial regeneration: the reconstruction of the landscape, the ecological restoration of the Emscher water system and the valorisation of the industrial heritage as a cultural resource required integrated actions over several decades, supported by European funds and the cooperation between regional authorities and municipalities (Internationale Bauausstellung Emscher Park, n.d.).

Despite successes, including the 2017 UNESCO Learning City Award, Gelsenkirchen faced significant obstacles: administrative complexities in coordinating more than 20 municipalities, shortcomings in the long-term financing of green space maintenance, and difficulties in integrating migrant communities, called upon to dialogue in multilingual and multicultural contexts. These critical issues highlight how even a structured plan can falter if it lacks constant resources and adequate inclusion strategies.

The comparison with Taranto's JTF highlights two main risks: on the one hand, the need to guarantee multi-year programmes for the maintenance and updating of the financed green infrastructures; on the other, the urgency of setting up linguistic-cultural involvement mechanisms for authentic participation drivers, avoiding that entire segments of the population remain excluded due to technical-bureaucratic barriers. Only by integrating financial continuity, supra-municipal coordination and multi-level civic training paths - as in the German example - can the JTF model be translated into a truly enabling urban ecosystem also in the Taranto context.

5.4.5.2 Pittsburgh: urban regeneration and the creation of a green innovation hub through the active involvement of the local community

Pittsburgh, a former steel capital now converted into a technology and research hub, has adopted a Public Engagement Guide that structures citizen engagement at all stages of urban planning (City of Pittsburgh, 2022). During the pandemic, the city engaged more than 20,000 citizens in digital workshops through the EngagePGH platform, based on Social Pinpoint, which allows them to post comments and geolocalised proposals on interactive maps, vote on planning alternatives and report critical issues in real time (Social Pinpoint, 2023). This amount of feedback has allowed regeneration plans to be continuously refined, increasing the sense of ownership and reducing site conflicts.

Pittsburgh's hybrid approach, combining digital tools and traditional methods, resulted in the launch of 227 projects on the EngagePGH platform, engaging nearly 300,000 residents and collecting over 37,000 online contributions. This model received the 2023 IAP2 USA Core Values Award for Organisation of the Year, highlighting the effectiveness of innovation in public engagement (Social Pinpoint, 2023).

Table 8 summarises the key performance indicators of the EngagePGH platform between 2020 and 2023. The data highlight the widespread adoption of digital engagement among the Pittsburgh population and the City's ability to structure large-scale participatory processes by integrating interactive tools that are accessible to all citizens.

Table 8 - Civic participation indicators through the EngagePGH platform (Pittsburgh, 2020-2023)

Indicator	Value	Description	Relevance for the right transition
Citizens involved	~300.000	Total participants in EngagePGH	Process democratisation Decision-making
Participative projects activated	227	Initiatives supported by the platform	Continuity and transparency of Governance
Contributions received	37.000+	Active feedback in digital form	Institutional accountability and adaptation of projects
Awards received	IAP2 USA	National recognition for civic engagement	External validation of good replicable practices
Most Participated Themes	Urban planning, green spaces	Areas of high relevance public	Reconnecting the urban environment, well-being and social cohesion

Source: Social Pinpoint (2023). *Pittsburgh's Excellence in Public Participation.*

In the operational context, organisations such as Uptown Partners have co-designed communication plans with residents for urban greening sites and projects, using territorial storytelling tools to encourage participation (Uptown Partners, 2020). At the same time, the Western Pennsylvania Conservancy coordinates about 10,000 volunteers each year in over 130 urban gardens and region-wide forestation programmes, with over 41,000 trees planted since 2008 through the TreeVitalize Pittsburgh initiative, improving air quality and strengthening community ties in vulnerable neighbourhoods (Western Pennsylvania Conservancy, n.d.).

The biggest challenge for Pittsburgh has been to keep civic engagement going beyond the initial phase of enthusiasm, preventing projects from starting as "events" and then fizzling out. To this end, it has introduced tax incentives for social enterprises, ongoing training programmes for volunteers, and "give-back economy" mechanisms, whereby those who benefit from space or funding—citizens, businesses or associations—are invited to "give back" time, skills or resources to the community, acting as mentors for new volunteers. Similar mechanisms aimed at promoting hybrid forms of voluntarism, blending civic engagement and organisational support, have proven effective also in European urban regeneration experiences (Jensen & Agger, 2022).

These experiences in Pittsburgh offer important lessons for Taranto on how to transform initial civic enthusiasm into structured and lasting involvement. First, the EngagePGH model demonstrates that digital platforms, when coupled with computer literacy courses aimed at all segments of the population, can broaden participation well beyond the "commonly engaged groups". However, without adequate technological training, only a part of the population can use these tools profitably, creating inequalities in the decision-making process.

Moreover, the Pittsburgh approach of linking incentives—fiscal or educational—to the “economics of giving back” ensures that those who benefit from space, funds or expertise return to contribute to the community, becoming mentors for new participants. Without this dynamic of reciprocity, there is a risk that projects will remain episodic events, unable to effect change in the long run. Similar mechanisms have also proven effective in European contexts, where hybrid forms of voluntarism and structured “give-back” approaches have been studied as key factors in long-term engagement (see Jensen & Agger, 2022).

For Taranto, therefore, it becomes crucial to supplement the technical measures of the JTF with a continuous training plan aimed at both third sector operators and citizens: e-participation workshops, tutorials on the key terms of the JTF mechanism (Local Action Group, Community Liaison Officer, participatory budgets) and support sessions on the use of apps. In parallel, recognition mechanisms - such as volunteer credits or micro-grants - should be envisaged for those who 'give back' their time and skills, to transform beneficiaries into active subjects and consolidate a culture of permanent participation.

Only in this way, by merging the digital and mutual accountability best practices of Pittsburgh with the governance tools of the JTF, will Taranto be able to avoid the risks of disaffection and build a transition process that does not end once the spotlight is turned off on the inauguration of the projects, but becomes a true 'daily practice' of active citizenship.

Conclusions. Towards an integrated development model for Taranto

The central question guiding this thesis - whether Taranto can envision a future in which economic growth, social well-being, and environmental protection can coexist - has been addressed through a critical analysis demonstrating that such a scenario is not only desirable, but concretely attainable, provided that clear structural conditions and coherent political choices are established.

Firstly, the conditions for a structured coexistence of economic development, social equity, and environmental protection do exist, but they require explicit political will and long-term strategic coherence. The data examined throughout this work confirm that the industrial system in Taranto can evolve towards a new development model, on the condition that this path is supported by realistic decarbonisation, entailing at least 3-4 TWh of renewable energy for local industry, by a comprehensive economic evaluation of environmental and health-related damages justifying long-term remediation investments, and by inclusive governance capable of activating social capital, knowledge, and grassroots innovation.

Within this framework, three project proposals are advanced, grounded in the measures set out in the Just Transition Fund (JTF) for Taranto. The 2025 Executive Plan, which allocates over 750 million EUR across three macro-areas (environment, economic diversification, skills and inclusion), provides an operational basis for the implementation of three priority interventions. The first involves the creation of a Circular Steel and Slag District, aimed at valorising steelmaking by-products (slag, dust, sludge) through integrated recovery and reintegration into local production cycles. This initiative, aligned with JTF Measure B on economic diversification and circular economy, targets a recovery rate of at least 95% by 2030, with expected impacts in terms of emission reduction and the activation of green-tech enterprises.

The second proposal concerns the establishment of a Green Industrial Hub with social conditionality. Anchored in Measures A and B of the JTF, this initiative aims to attract sustainable industrial investment contingent on measurable environmental and employment benefits. Mechanisms would include incentives tied to enhanced environmental permits (AIA - Integrated Environmental Permit) and development contracts linked to social impact indicators.

The third proposal introduces an Educational and Professional Pact for Taranto 2030, under Measure C of the JTF. This initiative seeks to train 5,000 young people and workers in strategic areas such as green steel, circular economy, renewable energy, and sustainable tourism. Tools include technical institutes (ITS), vocational university courses, corporate academies, and EQF-certified pathways.

For these projects to yield effective results, clear guidelines must be defined for both the structure of public calls and the overall governance of the JTF. It is recommended that environmental and social

conditionalities be embedded in tender criteria, awarding projects that demonstrate co-benefits such as increased female employment, emission reductions, and inclusive governance. Furthermore, transparency and accountability should be ensured through the publication of project fiches, ex-ante, in itinere and ex-post evaluations, and community involvement in project selection. Evaluation must rely on measurable indicators - e.g., CO_2 avoided per euro spent, number of completed vocational retraining programmes, percentage of local stakeholders engaged - and be supported by a multi-sectoral territorial steering committee composed of local authorities, universities, community foundations, and civic representatives. Integration with other funding streams (PNRR, ERDF, Horizon Europe) will be essential to increase the critical mass of investments.

Within this scenario, Taranto can aspire to become a European paradigm of just transition. The case study demonstrates that ecological transition, to be sustainable, must also be social and democratic. If available resources are invested in building integrated supply chains, promoting responsible innovation, and strengthening community cohesion, the city can emerge as a reference laboratory for Europe.

In conclusion, the coexistence of economic development, social justice, and ecological integrity is not a spontaneous equilibrium but the outcome of deliberate political and institutional construction. In Taranto, today, such construction is not only possible but perhaps necessary to prevent the fractures of the past from becoming the failures of the future.

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