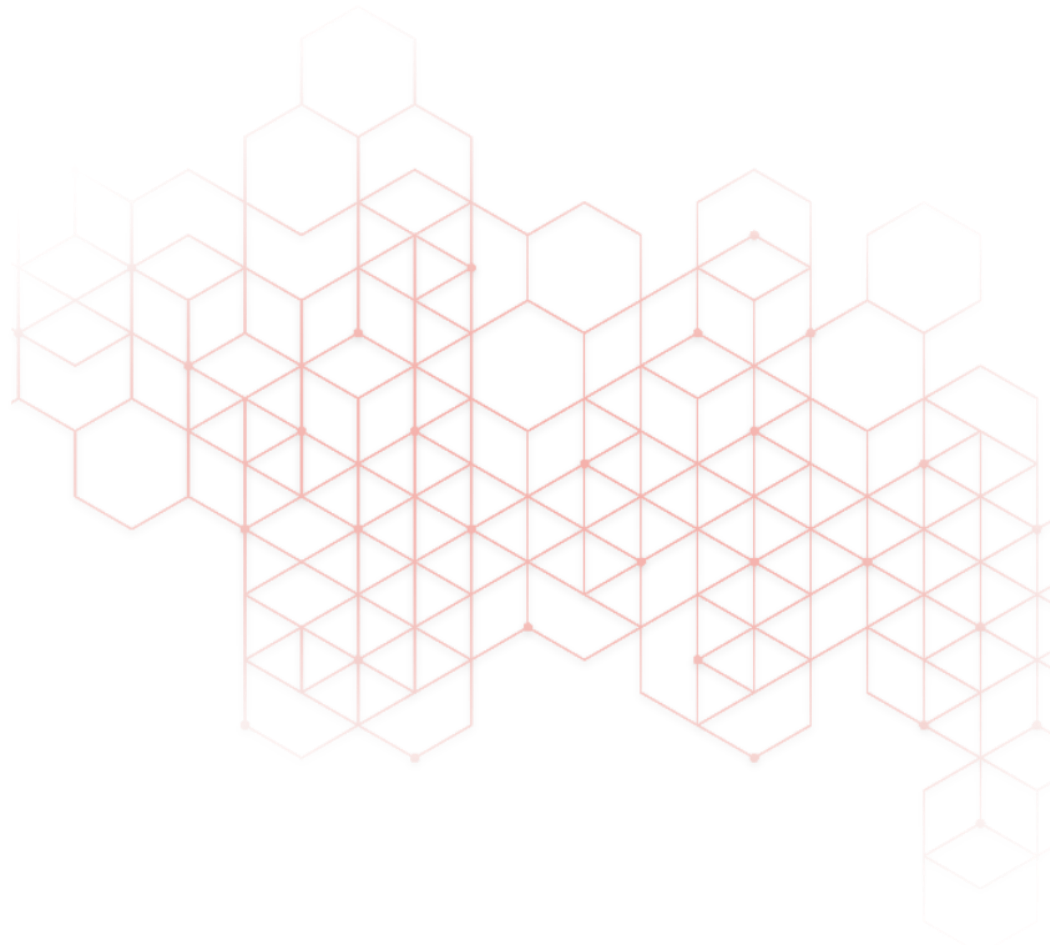


Policy Mapping Document

Francesca Cavezza | European Aluminium

Date: 30 June 2025



Credits

Copyright © 2023 HyInHeat project

Disclaimer

The sole responsibility of this publication lies with the author.
The European Union is not responsible for any use that may be
made of the information contained therein.



This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101091456.

Technical references

Grant Agreement N°	101091456	Acronym	HyInHeat
Full Title	Hydrogen technologies for decarbonization of industrial heating processes		
Work Package (WP)	8		
Authors	Francesca Cavezza		
Leading organisation	European Aluminium		
Date of publication	30 June 2025		
Contributors	Chiara Deffendi, Konstantinos Kollias, Lorraine Schröter, Delphine Snaet, Patrick Lafontaine		
Document Type	Document, report		
Document Title	Policy Mapping document		
Dissemination Level (delete unnecessary options)	PU	Public deliverable	

Document history

Version	Date	Partner	Author
1	24.03.2025	European Aluminium	Francesca Cavezza
2	07.04.2025	EGEN	Thomas Maidonis
3	25.04.2025	European Aluminium	Chiara Deffendi
4	06.05.2025	European Aluminium	Konstantinos Kollias
5	16.05.2025	European Aluminium	Lorraine Schröter
6	11.06.2025	ESTEP	Delphine Snaet, Patrick Lafontaine
Final	30.06.2025	European Aluminium	Chiara Deffendi

Contents

Technical references	3
Document history	3
Contents	4
Tables & Figures	5
List of abbreviations	6
Introduction	7
Evolution from Decarbonisation to Industrial Competitiveness	7
Policies Shaping the Hydrogen Landscape	8
RePower EU Plan.....	8
Net-Zero Industry Act (NZIA)	9
Clean Industrial Deal (CDI) and the Steel and Metals Action Plan	9
Clean Industrial Deal.....	9
Clean Industrial Deal State Aid Framework	10
Steel and Metal Action Plan.....	10
Hydrogen and decarbonised gas market.....	11
Emission Trading System (ETS) and Carbon Border Adjustment Mechanism (CBAM).....	11
Funding mechanisms for hydrogen	12
The European Hydrogen Bank.....	13
Horizon Europe and the Clean Hydrogen Partnership	13
The Innovation Fund.....	13
Important Projects of Common European Interest (IPCEI)	14
National Funding Mechanisms in Key Member States	14
Hydrogen Infrastructure and Transport in Europe	15
Current Infrastructure	16
Thy Hydrogen Valleys	16
European Hydrogen Backbone.....	17
Hydrogen Imports into Europe.....	18
Hydrogen Cost for Industry Adoption	20
Conclusion and next steps	24
Bibliography.....	25
Get in touch.....	32

Tables & Figures

Table	Page
-	-
Figure	Page
Figure 1 Map of hydrogen pipelines by end user and storage facilities (Observatory, The European hydrogen market landscape , 2024)	15
Figure 2 Planned European Hydrogen Backbone (EHB) pipeline network by 2040, illustrating repurposed and new pipelines, storage sites, offshore hydrogen production locations, and hydrogen import terminals (GuideHouse, May 2022)	17
Figure 3 Five supply corridors as envisioned by the European Hydrogen Backbone to be delivered by 2030 (GuideHouse, May 2022)	18

List of abbreviations

Abbreviations	Explanation
CBAM	Carbon Border Adjustment Mechanism
CID	Clean Industrial Deal
CO ₂	Carbon Dioxide
DRI	Direct Reduced Iron
EAF	Electric Arc Furnace
ECA	European Court of Auditors
EHB	European Hydrogen Backbone
ETS	Emission Trading System
EU	European Union
IPCEI	Important Projects of Common European Interest
LOHC	Liquid Organic Hydrogen Carriers
NGO	Non-Governmental Organisation
NZIA	Net-Zero Industry Act
RED	Renewable Energy Directive
RFNBO	Renewable Fuels of Non-Biological Origin
ROI	Return on Investment
TPA	Third-Party Access
TSO	Transmission System Operator

Introduction

Chapter 1 of Deliverable 1.2 provided a comprehensive overview of the EU’s hydrogen policy framework as of July 2023. It covered the main legislative instruments, definitions, funding mechanisms, and strategic goals for hydrogen, with a strong focus on its role in decarbonising energy-intensive industries like steel and aluminium. Since the technical applications and decarbonisation pathways for these sectors were extensively addressed in that chapter, they will not be repeated here.

Instead, this section revisits and updates the policy landscape to reflect the developments that have taken place over the past two years. While the core legislative structure remains largely intact, there has been a clear shift in tone and priorities. Early expectations around hydrogen availability and deployment have been scaled back, prompting the EU to recalibrate its approach—placing greater emphasis on industrial competitiveness and practical implementation.

Key updates include the launch of new strategic frameworks such as the Clean Industrial Deal, published in February 2025, which directly responds to industry concerns and aims to align climate ambition with economic resilience. This chapter presents the most relevant EU-level measures currently in force or under development, highlighting how they work together to support the production, use, and market integration of hydrogen across sectors—particularly in heavy industry.

Evolution from Decarbonisation to Industrial Competitiveness

In 2020, the European Union (EU) introduced its Hydrogen Strategy as a central component of the European Green Deal, emphasizing green hydrogen as a crucial instrument to decarbonize hard-to-abate industries like steel and aluminium by 2030. Ambitious objectives were established—such as producing 10 million tonnes of renewable hydrogen within the EU by 2030 and importing another 10 million tonnes—consistent with the Fit-for-55 climate package and the broader aim of achieving net-zero emissions by 2050 [1]. Green hydrogen was regarded as vital for reducing CO₂ emissions in heavy industrial processes, including steelmaking, to fulfill climate commitments.

However, subsequent evaluations indicated that these initial targets were overly optimistic. In mid-2024, the European Court of Auditors (ECA) cautioned that the EU’s hydrogen targets were driven more by “*political will*” than by robust analysis, concluding the EU was far off track to reach its 2030 objectives. The ECA observed that, despite substantial funding commitments, forecasts for electrolyzer capacity and hydrogen-related projects remained inadequate, thereby calling for a reality check and more pragmatic policies to stimulate hydrogen utilization in industry. This critique highlighted an urgent need to recalibrate hydrogen strategies to ensure not only nominal decarbonisation but also tangible implementation on the ground [2].

By 2024–2025, evolving political and economic conditions prompted European policymakers to balance environmental ambitions with industrial competitiveness. The EU faced geopolitical disruptions, high energy costs, and external industrial incentives—such as the U.S. Inflation Reduction Act (as of March 2025 suspended) that jeopardized Europe’s manufacturing base. European industry leaders grew increasingly concerned that uncoordinated climate targets might impair Europe’s global edge in innovation, skills, and cost structures. According to one assessment, numerous CEOs feared the Green Deal’s stringent measures could cause European industry to fall behind their global competitors, while increasing reliance on foreign clean-tech supply chains [3].

These anxieties intensified political pressure to adjust. EU authorities recognized that if decarbonisation efforts elevated production costs or created market uncertainties for European industries, industry might relocate or downsize, effectively achieving “decarbonisation through deindustrialisation”—an outcome to be avoided. The emerging consensus was that climate policy must cut emissions without undermining the EU’s industrial core. This perspective spurred initiatives designed to integrate economic strategy into the decarbonisation framework.

D8.5 Policy Mapping Document

The European Commission's Clean Industrial Deal (2025) represents this realignment of hydrogen policy. Introduced in February 2025, the Clean Industrial Deal aims to protect the competitiveness of EU industry while advancing decarbonisation objectives [4]. Rather than reducing climate commitments, it reframes them in conjunction with industrial policies—directly responding to the pressures noted above. Hydrogen figures prominently in this plan as both a decarbonisation mechanism and an industrial development opportunity. The Commission reaffirmed hydrogen's "central role" in decarbonizing sectors where electrification is unfeasible. Simultaneously, policymakers acknowledged that the prior emphasis on strictly renewable hydrogen needed to be supplemented with a more pragmatic approach to spur investment.

Equally significant, the EU is deploying new financial and risk-mitigation mechanisms—such as the European Hydrogen Bank [5] and the Hydrogen Mechanism [6]—to bridge the gap between climate targets and actual market conditions. Rather than depending solely on carbon pricing or mandates, these tools will directly support the economic viability of clean hydrogen initiatives in energy-intensive industries.

Overall, the progression of EU hydrogen policy demonstrates a broader effort to reconcile environmental goals with economic competitiveness. This nuanced shift reflects the current political landscape: Europe's commitment to climate leadership endures, but there is now a clear acknowledgment that retaining a strong industrial base and ensuring investment stability are vital for a successful green transition. In summary, the EU's current hydrogen initiatives place equal emphasis on economic resilience and technological advancement alongside emissions reductions, marking a notable change from just a few years ago.

Further details on policies that enable the use and production of hydrogen, as well as the funding mechanisms supporting hydrogen deployment in energy-intensive industries, are presented in the following chapters.

Policies Shaping the Hydrogen Landscape

The following sections detail the regulatory and financial tools that concretely facilitate hydrogen deployment, starting with renewable energy directives.

Renewable Energy Directives (RED II & RED III)

The EU's Renewable Energy Directives set the legal framework for expanding renewables, including hydrogen, across the economy. RED II (2018/2001) [7] established targets for renewable energy and for the first time recognised renewable fuels of non-biological origin (RFNBOs) – essentially green hydrogen and e-fuels – as contributors to these goals. It required EU Member States to collectively ensure at least 32% of final energy comes from renewables by 2030. While RED II mainly spurred renewable use in power and transport (e.g. a 14% renewable energy target in transport by 2030), it laid the groundwork for hydrogen by defining RFNBOs and allowing renewable hydrogen to count towards climate targets in sectors like transport and refining. RED III (2023/2413) [8] is the latest amendment aligned with the European Green Deal, goes much further in integrating hydrogen into industrial policy. It raises the overall 2030 renewables target to 42.5%, and crucially, sets binding hydrogen-specific targets for industry. From 2030 onwards, at least 42% of all hydrogen used in industry must be from RFNBOs rising to 60% by 2035. This mandate directly impacts heavy industries such as steel and chemicals by obliging them to replace a significant portion of "grey" hydrogen (from natural gas) with renewable hydrogen.

Member States must also increase industrial renewable energy use by 1.6% annually, which encourages fuel-switching from fossil fuels to clean hydrogen and electrification. In summary, RED III creates a clear regulatory push for steel, aluminium, and other sectors to adopt hydrogen as part of their decarbonisation pathway, ensuring that a growing fraction of hydrogen consumed is climate-friendly.

RePower EU Plan

In response to the energy crisis and climate imperatives, the EU's RePowerEU Plan [9] acts as a catalyst for hydrogen in hard-to-abate sectors. RePowerEU's headline ambition is a massive scale-up of renewable hydrogen to reduce dependence on imported fossil fuels. It introduced a "Hydrogen Accelerator" program aimed at producing 10 million tonnes of renewable hydrogen within the EU by 2030 and importing an

D8.5 Policy Mapping Document

additional 10 million tonnes. For the steel industry, RePowerEU highlighted the need for urgent infrastructure and fuel switching. The European Commission's communication on RePowerEU underscored swift development of hydrogen pipelines and priority access to hydrogen for industrial users like steel plants. This reflects the fact that green hydrogen is expected to replace coal and natural gas in steelmaking (e.g. using direct reduced iron with hydrogen) to dramatically cut CO₂ emissions. RePowerEU also promotes faster deployment of renewables (solar, wind) which is essential since green hydrogen requires large amounts of clean electricity. In summary, RePowerEU accelerates hydrogen adoption by increasing supply (through ambitious production/import targets) and by focusing on the enabling infrastructure and market conditions needed for heavy industries to transition. Its measures aim to ensure that by 2030, hydrogen is a practical, available option for companies like, in line with EU energy security and climate goals.

Net-Zero Industry Act (NZIA)

The Net-Zero Industry Act (NZIA) (2024/1735) [10] is a recent EU initiative aimed at strengthening domestic manufacturing and accelerating the deployment of clean technologies critical for decarbonisation. The Act explicitly identifies "hydrogen technologies, including electrolysers and fuel cells," as strategic net-zero technologies to be scaled up. It sets a continent-wide goal that by 2030 the EU can domestically manufacture at least 40% of its annual needs for these net-zero technologies.

In practical terms, this means ramping up EU production of electrolysers and related components so that Europe's hydrogen supply chains are secure and able to meet industry demand. Steel and aluminium sectors stand to benefit: a stronger European electrolyser industry can supply the equipment needed for green hydrogen production, which steel plants will use for iron reduction and aluminium smelters or refineries might use for clean energy. Beyond manufacturing targets, the NZIA streamlines regulatory procedures for strategic projects. Hydrogen production facilities and industrial sites that use hydrogen to decarbonise can be designated as "Net-Zero Strategic Projects" to receive priority status and faster permitting. This is especially relevant for heavy industry, as it accelerates the build-out of hydrogen infrastructure (e.g. large electrolysis hubs, hydrogen pipelines to steel mills). The Act also supports energy-intensive industries such as steel, chemicals, and cement in their decarbonisation efforts, provided that the production output is a component included under the scope of the NZIA. Additionally, the NZIA includes provisions for CO₂ storage (50 Mt annual CO₂ storage target by 2030). This complements hydrogen use, in case where hydrogen is produced from fossil fuels with carbon capture. In essence, the NZIA creates a favourable environment for deploying hydrogen in heavy industry by ensuring European-made equipment, simplifying project permits, and linking industrial hydrogen use to the EU's strategic clean-tech goals.

Clean Industrial Deal (CID) and the Steel and Metals Action Plan

The Clean Industrial Deal (CID), the Action Plan for Affordable Energy, and the Steel and Metals Action Plan represent complementary policy measures developed by the European Commission in early 2025 [11]. These two initiatives collectively address the adoption of hydrogen as one of the key strategy to facilitate the transition toward decarbonisation and industrial competitiveness, specifically targeting energy-intensive sectors such as steel and aluminium. While the CID provides overarching regulatory clarity and financial support mechanisms for industrial hydrogen adoption, the Steel and Metals Action Plan offers tailored, sector-specific strategies and supportive infrastructure measures explicitly focused on accelerating hydrogen-based technologies within steel and aluminium industries.

More details for each of these measures and strategies are presents below.

Clean Industrial Deal

In early 2025, the European Commission introduced the **Clean Industrial Deal (CID)** as part of its Green Deal Industrial Plan. This is a broad strategy (not a legislative proposal) aimed at enabling the EU's industrial sectors – especially energy-intensive ones like steel, cement, aluminium, and chemicals – to remain competitive while achieving climate neutrality by 2050 [4]. As mentioned in the consultation document of the Industrial Decarbonisation Accelerator Act, "The Clean Industrial Deal is Europe's new growth strategy to accelerate decarbonisation and competitiveness for European industry. It aims to increase sustainable and resilient industrial production in Europe, while investing in decarbonisation." [12]

D8.5 Policy Mapping Document

The CID highlights the transition of heavy industries towards renewable and low-carbon hydrogen, with a particular focus on establishing “lead markets” for clean technologies, including hydrogen-based solutions. The concept of “lead markets” refers to strategically developing markets within the EU by setting clear regulatory frameworks, targeted financial incentives, and supportive public procurement policies. As part of the broader CID framework, the forthcoming Industrial Decarbonisation Accelerator Act will play a key role in accelerating industrial decarbonisation efforts. According to the consultation document, this initiative also seeks to stimulate demand for low-carbon industrial products, including through the development of a voluntary labelling scheme that discloses the carbon intensity of products. Such measures are intended to support the creation of lead markets by enabling informed purchasing decisions and incentivising the production of lower-carbon alternatives.

This strategy aims to establish Europe as an attractive destination for investments and innovations in emerging clean technologies, thus fostering early market adoption and subsequent global market leadership.

CID outlines set of instruments to support the deployment of hydrogen technologies, including the proposed Industrial Decarbonisation Bank. This initiative is expected to mobilise over €100 billion to scale up clean industrial technologies and foster the market growth. The Bank will primarily draw on existing EU funding mechanisms, including from the Innovation Fund, from InvestEU and other financial instruments, with a significant portion expected to come from voluntary top-ups by Member States. The initiative specifies forthcoming regulatory measures, particularly a delegated act establishing an official EU definition for “low-carbon hydrogen,” intended to provide clarity for investors, industries, and policymakers.

Additionally, the CID reaffirms the European Hydrogen Bank's role. As reported in the next chapter, in 2025, the Commission plans a third hydrogen auction explicitly targeting increased hydrogen production and availability.

Clean Industrial Deal State Aid Framework

The Clean Industrial Deal State Aid Framework (CISAF), published by the European Commission on 25 June 2025 [13], marks a significant step forward for hydrogen in Europe's clean energy transition. Recognising the central role of renewable hydrogen—particularly renewable fuels of non-biological origin (RFNBOs)—CISAF introduces strong support mechanisms to accelerate production and uptake.

These include investment aid up to 100% of eligible costs for RFNBO production through competitive bidding, support for low-carbon hydrogen, and clear eligibility criteria to ensure compliance with EU sustainability standards. CISAF also encourages accelerated depreciation, opens the door for cumulation with other EU funding instruments like the Innovation Fund and IPCEI, and ensures that the entire hydrogen value chain—from electrolyzers to hydrogen-ready industrial uses—is in scope.

In line with the Net-Zero Industry Act and with the EU Hydrogen Strategy, CISAF reinforces Europe's strategic autonomy and supply chain resilience, offering a structured and coherent framework to make hydrogen deployment both economically viable and globally competitive.

Steel and Metal Action Plan

The Steel and Metals Action Plan was published on 19 March 2025 [14].

This Action Plan explicitly recognizes renewable and low-carbon hydrogen as a key technology to reduce emissions significantly, particularly where direct electrification is challenging or not feasible. For steel production, the Plan clearly identifies hydrogen-based Direct Reduced Iron (DRI) technology as a primary route for achieving substantial emission reductions, replacing traditional coal-based blast furnace processes. It sets out targeted actions, including promoting research, innovation, and scaling-up hydrogen-based DRI plants across Europe. In the aluminium and other metal sectors, the Plan highlights hydrogen combustion technologies and hybrid furnaces that can replace fossil fuels, especially for high-temperature processes. Dedicated funding and incentives are explicitly allocated to stimulate innovation and support pilot and demonstration projects focused on these hydrogen-based technologies.

Significantly, the Steel and Metals Action Plan highlights the mobilisation of substantial EU funding—through instruments such as Horizon Europe, the Innovation Fund, and InvestEU—to support innovation and

D8.5 Policy Mapping Document

deployment of hydrogen-based solutions in the sector. In particular, the Innovation Fund, including through pilot auctions like the EU Hydrogen Bank, aims to channel at least €1 billion into breakthrough decarbonisation technologies in energy-intensive industries, with hydrogen-based steelmaking and metals production methods as a key beneficiary.

Additionally, the Plan emphasizes the importance of establishing robust hydrogen infrastructure by expediting permitting procedures, enabling rapid connections between renewable hydrogen production (electrolysers) and industrial plants within the steel and aluminium sectors. Finally, the Plan aims to reinforce economic protection measures through the extension of the EU Carbon Border Adjustment Mechanism (CBAM), explicitly covering additional steel and aluminium products. While the exact impact and benefits of the mechanism remain unclear and, to some extent, questionable, this extension is intended to shield European producers investing in hydrogen-based processes from competition with imports produced using higher-carbon methods (European Commission, 2025d).

Hydrogen and decarbonised gas market

Beyond industrial and climate policy, the EU is also reshaping its gas market regulations to accommodate hydrogen. Traditionally, natural gas has had a well-developed network and market framework, but hydrogen was not part of that system. Recognising this, the European Commission proposed a Hydrogen and Decarbonised Gas Markets Package in late 2021 [15]

This set of reforms (often called the “Gas Package”) updates EU gas laws to remove barriers for hydrogen and other low-carbon gases, facilitating their integration into the energy system. For steel and aluminium plants, which may either purchase hydrogen from external suppliers or produce it on-site and potentially share with nearby facilities, these policies will provide the necessary market and infrastructure rules.

Key elements include:

- **Common Definitions and Certification:** The Gas Package introduces EU-wide definitions for renewable hydrogen and low-carbon hydrogen, aligned with RED III’s criteria (e.g. at least 70% GHG savings). It also establishes certification and training requirement for these gases. (Directive EU/2024/1788) [16]
- **Infrastructure Access (Third-Party Access):** The reforms lay out principles for non-discriminatory third-party access (TPA) to hydrogen networks. It ensures infrastructure owners allow equal and transparent access to pipelines, storage, or terminals, preventing them from favouring specific users or blocking competitors.
- **Unbundling of Hydrogen Networks:** e ensuring hydrogen network operators will be legally and functionally separate from energy production and supply activities, following an ownership unbundling model. This separation is essential to prevent conflicts of interest, ensuring network operators manage the infrastructure independently, thus creating a competitive and transparent hydrogen market.

Furthermore, Article 3(6) of the revised Gas Directive allows the Commission to establish a Hydrogen Priority Sector List, which can be used to ensure that renewable and low-carbon hydrogen is prioritised for end-uses that deliver the highest climate impact. This includes sectors like steel and chemicals, where hydrogen can replace fossil inputs and achieve significant emissions reductions. Such prioritisation also supports the effectiveness of demand-side policies and market incentives.

Emission Trading System (ETS) and Carbon Border Adjustment Mechanism (CBAM)

Europe’s carbon-pricing mechanism, the EU Emissions Trading System (ETS) (Directive (EU) 2018/410) [17] is a cornerstone climate policy affecting steel and aluminium producers. Under the ETS, large emitters (including steel and aluminium producers) must monitor their CO₂ emissions and surrender allowances for each tonne emitted. Historically, these industries received a portion of free allowances to protect against carbon leakage (since global competitors might not face similar costs). However, EU policy is tightening: the ETS cap is reducing over time, raising carbon prices, and free allocations will be phased out for steel and

D8.5 Policy Mapping Document

aluminium between 2026 and 2034 (in parallel with the Carbon Border Adjustment Mechanism) [18]. In recent years, carbon prices have risen to record highs (on the order of €80 per tonne CO₂), which translates into significant added cost for conventional blast furnaces or gas-fired furnaces [19]. In addition, the ETS indirectly supports hydrogen deployment through its revenues. A portion of allowance auction proceeds feeds the Innovation Fund, which has financed flagship industrial projects including electrolyser installations and hydrogen-based steel pilot plants.

To complement the ETS and prevent carbon leakage, the EU is implementing the Carbon Border Adjustment Mechanism (CBAM) (Regulation 2023/956) [20]. CBAM is a trade measure that puts a carbon cost on imported goods such as steel and aluminium, ensuring importers pay an equivalent carbon price as EU producers. Starting in 2023, importers of covered products must report the embedded emissions in their imports; from 2026 onwards, CBAM will gradually require importers to purchase certificates for those emissions, with full enforcement in parallel to the phase-out of free ETS allowances by 2034. Steel and aluminium are among the first sectors covered by CBAM, along with cement, fertilisers, electricity, and certain other precursors.

Steel is a globally traded commodity, and EU steelmakers feared that cutting emissions (and incurring high carbon costs under the ETS) would allow high-carbon imports to undercut them. CBAM addresses this by aiming to level the playing field: foreign steel entering Europe will need to pay for its carbon footprint at the same price as European producers. This policy rewards low-carbon steel production methods worldwide. If a non-EU mill uses clean hydrogen and emits far less CO₂ per tonne of steel, it will pay less (or no) CBAM levy; if it continues to use coal-based production, it will face higher charges. Likewise, EU producers investing in hydrogen-based steelmaking will not only reduce their ETS costs but also face reduced competition from high-carbon steel imports. However, the European Steel Association (EUROFER) highlights that approximately 20% of EU steel consumption currently comes from countries without comparable carbon costs, causing significant competitive disparities. EUROFER advocates for a robust CBAM that includes structural solutions to protect European exports and stringent measures against practices such as circumvention and resource shuffling, arguing these adjustments are essential to achieving CBAM's intended outcomes [21].

For aluminium, CBAM also plays a crucial role. Aluminium production is highly electricity-intensive, with the carbon footprint largely dependent on the energy source used. Under CBAM, imported aluminium will carry a carbon cost linked to its production emissions, making aluminium produced with high-emission power sources or fossil-fuel heat more expensive to import. However, despite many European aluminium smelters consuming relatively cleaner electricity, they are not necessarily shielded from carbon-intensive imports. This is due to the marginal pricing system in European electricity markets, where electricity prices are often set by the most carbon-intensive producers, combined with the globally set price for aluminium that limits European producers' pricing power. The phase-in of CBAM alongside the phase-out of free ETS allocations will raise the cost of all aluminium transactions within the European market—affecting both imported and locally produced aluminium. Similarly to steel, European Aluminium has expressed concerns regarding CBAM's current structure, particularly highlighting indirect carbon costs resulting from the EU ETS and European electricity markets. They argue that the current CBAM design could inadvertently increase carbon leakage risks for the sector and to pause the phase in of the CBAM while keeping existing carbon-leakage protection tools. [22].

Achieving large-scale hydrogen adoption in sectors such as steel and aluminium requires not only valid policies but a significant financial support—both to stimulate market demand and to advance research, innovation, and infrastructure. The EU has developed a comprehensive set of funding mechanisms and investment tools designed to support the full hydrogen value chain, from early-stage research to commercial deployment. These instruments are examined in the following chapter.

Funding mechanisms for hydrogen

Europe supports investment in hydrogen through a structured mix of funding mechanisms, from market deployment to research and development to demonstration and pilot projects. The most relevant of these mechanisms are described below.

The European Hydrogen Bank

As the hydrogen sector matures, the EU is developing novel funding mechanisms to support the market uptake of renewable hydrogen. A prominent new initiative is the so-called European Hydrogen Bank, which is not a bank in the traditional sense, but a funding scheme designed to bridge the cost gap for green hydrogen producers and consumers [23]. The Hydrogen Bank uses an auction-based system (supported by the Innovation Fund) to provide operational subsidies – essentially a form of carbon contract for difference or fixed premium per kilogram of hydrogen – to the most competitive renewable hydrogen projects. The goal is to make green hydrogen financially viable by assuring producers of a certain revenue for their product, thus encouraging investment in production facilities that supply industry. The first pilot auction was launched in late 2023 with a budget of €800 million from the Innovation Fund [24].

Under this scheme, hydrogen producers bid for the minimum subsidy they need per kg of hydrogen produced; the winners receive a 10-year support contract, giving them a guaranteed premium on top of market price. This reduces risk for investors and should stimulate new supply that can then be used by industries like steel and chemicals. Building on the pilot, the European Commission announced plans for a third Hydrogen Bank auction in Q3 2025 with an even larger budget of €1 billion [25]. In parallel, as part of the Clean Industrial Deal, the EU is looking at broader instruments (such as an Industrial Decarbonisation Bank with a potential €100 billion budget by 2026) to support decarbonisation of industrial sectors through measures like carbon contracts for difference [4]. For now, the Hydrogen Bank concept represents an innovative funding mechanism targeting the operational phase: it assures hydrogen offtake and price support, which in turn reassures industrial offtakers that affordable green hydrogen will be available.

Horizon Europe and the Clean Hydrogen Partnership

Horizon Europe is the EU's flagship research and innovation programme (2021–2027), and it allocates significant funding to clean energy research, including hydrogen. Within Horizon Europe, the Clean Hydrogen Partnership (successor to the Fuel Cells and Hydrogen Joint Undertaking) is a public-private partnership that specifically targets hydrogen technologies. This partnership is co-funded by the EU (approximately €1 billion from Horizon Europe) and industry contributors (about €1 billion), combining resources to support research, innovation and demonstration projects [26]

Through competitive calls for proposals, Horizon Europe funds projects that advance hydrogen production, storage, transport, and end-use in sectors like transport and industry. For example, under Horizon Europe's cluster for Climate, Energy and Mobility and partnerships like Processes4Planet, projects have been launched to integrate hydrogen into industrial processes, such as HyInHeat project.

The Innovation Fund

The Innovation Fund is one of the world's largest funding programmes for the demonstration of innovative low-carbon technologies, financed by revenues from the EU Emissions Trading System. It is not a research programme but rather supports commercial-scale demonstrations of breakthrough technologies – essentially bridging the gap between pilot projects and full market rollout. The fund's objective is to create financial incentives **for first-of-a-kind projects** that can dramatically reduce greenhouse gas emissions in industrial sectors [27]. Hydrogen-related projects are a major focus: the Innovation Fund supports projects involving renewable hydrogen production (e.g. large electrolyzers), hydrogen use in industry (such as direct reduced iron processes for steelmaking), energy storage, and even manufacturing of hydrogen technologies

Since its launch in 2020, the Innovation Fund has held multiple competitive calls and has awarded substantial grants to hydrogen projects. By 2024, the Fund had supported 85 innovative projects with a total of €4.8 billion in grants, of which roughly one-third of the projects are hydrogen-focused [28]. This includes several flagship projects in the steel industry: for instance, the HYBRIT green steel project in Sweden (a joint venture of SSAB, LKAB and Vattenfall) was awarded €143 million in the Fund's first call, as a pioneering effort to produce sponge iron using fossil-free hydrogen [29].

sharing the risk with industry, the Innovation Fund accelerates investments in cutting-edge hydrogen applications that can deliver large-scale CO₂ reductions in European aluminium and steel production.

Important Projects of Common European Interest (IPCEI)

To complement EU-wide programmes, Important Projects of Common European Interest (IPCEI) provide a framework for member states to jointly support strategic, cross-border innovation initiatives, including in the hydrogen value chain. IPCEIs allow for coordinated state aid beyond usual limits, recognizing that certain projects are of vital importance for Europe's industrial future and energy transition [30]. In the hydrogen field, the European Commission has approved several waves of IPCEI projects. The IPCEI Hy2Tech (approved July 2022) supports hydrogen technology development (covering production, storage, distribution and mobile applications) with €5.4 billion in public funding from 15 countries [31].

On September 2022, the European Commission approved IPCEI Hy2Use as the second IPCEI in the field of hydrogen. A total of 29 companies from thirteen member states IPCEI Hy2Use will cover a wide part of the hydrogen value chain by supporting the construction of hydrogen-related infrastructure, and the development of innovative and more sustainable technologies for the integration of hydrogen into the industrial processes of multiple sectors such as steel, cement and glass. The IPCEI is expected to boost the supply of renewable and low-carbon hydrogen, thereby reducing dependency on the supply of natural gas. The thirteen Member States will provide up to €5.2 billion in public funding in the coming years, which is expected to unlock an additional €7 billion in private investments [32].

In February 2024, the European Commission approved IPCEI Hy2Infra, the third hydrogen-focused IPCEI. Involving 32 companies across seven member states, it comprises 33 projects covering key hydrogen infrastructure: 3.2 GW of electrolysers, 2,700 km of pipelines, 370 GWh of storage, and port facilities for handling 6,000 tonnes of hydrogen annually. Participants will also work on interoperability and standards. The project will receive up to €6.9 billion in public funding, expected to unlock €5.4 billion in private investments, totalling over €12 billion [33].

Connecting Europe Facility (CEF) – Energy Infrastructure Support

The Connecting Europe Facility (CEF) for Energy plays a strategic role in supporting the deployment of hydrogen by funding cross-border infrastructure essential for an integrated European hydrogen market. Unlike other mechanisms that focus on production or end-use, CEF specifically targets the physical networks—pipelines, storage, and terminals—that enable large-scale, reliable hydrogen transport between industrial regions and member states. [34]

Through targeted grants for construction and preparatory studies, CEF accelerates the development of Projects of Common Interest (PCIs) in the hydrogen sector, with particular emphasis on interoperability and cross-border integration. These investments are crucial for connecting industrial hydrogen clusters, improving security of supply, and supporting the emergence of a pan-European hydrogen backbone.

CEF's emphasis on transnational infrastructure ensures that hydrogen can reach hard-to-abate sectors in multiple regions, regardless of local production levels. By co-financing shared infrastructure, the mechanism reduces the cost burden on individual member states and enables coordinated planning across borders—a critical factor for industries dependent on stable and scalable hydrogen access.

While both CEF and the Important Projects of Common European Interest (IPCEIs) support hydrogen projects, they are distinct mechanisms. CEF funds infrastructure that enables cross-border integration, whereas IPCEIs allow member states to jointly fund innovation and industrial projects by applying more flexible state aid rules; in many cases, the two mechanisms are complementary.

National Funding Mechanisms in Key Member States

The member states complement European programmes with their own funding mechanisms and strategies to promote hydrogen use in industry. Many national governments have adopted hydrogen strategies with dedicated budgets, recognising the potential of hydrogen to decarbonise. Below are only selected and representative examples of national initiatives:

- **Germany:** Germany has one of the most ambitious hydrogen funding programmes in Europe. In 2020, the German government launched its Hydrogen Strategy backed by €9 billion in funding –

€7 billion for domestic hydrogen development and €2 billion for international partnerships [35]. Moreover, steelmakers in Germany have benefited from direct state support: for example, Thyssenkrupp's flagship tkH₂Steel project in Duisburg – a new hydrogen-powered direct reduction iron plant to replace blast furnaces – is receiving around €2 billion in public subsidies (from federal and North Rhine-Westphalia state budgets), approved as state aid in 2023 [36]. This funding covers a substantial portion of the project's cost, with Thyssenkrupp investing nearly €1 billion of its own funds. Additionally, Germany works with the H₂Global scheme – a special auction platform to subsidise the import of green hydrogen and derivatives – which, while focused on hydrogen trade, will indirectly benefit industrial users by securing supply [37].

- **France:** France views hydrogen as integral to industrial competitiveness and decarbonisation, as evident in its national hydrogen strategy and the “France 2030” investment plan. The French government has guaranteed a total of €7 billion for carbon-free hydrogen development by 2030. A portion of these funds is directed toward decarbonising industrial hubs and hard-to-abate sectors. France is deploying a mix of funding instruments, including direct subsidies, calls for projects, and contracts for difference. In 2023, the French government announced it would earmark €4 billion specifically for low-carbon hydrogen projects via public-private contracts [38].
- **Spain:** Spain has leveraged both national funds and EU recovery monies to support hydrogen in industry. Under its Recovery, Transformation and Resilience Plan (Spain's RRF programme), the Spanish government dedicated substantial grants to kick-start green hydrogen production and usage. In 2022, Spain announced €1.2 billion of EU-funded recovery grants for hydrogen projects, including industrial applications in chemicals and refining, and the creation of “hydrogen valleys” across the country [39]. One example is the support for ArcelorMittal's steel plant in Gijón, Asturias. To enable the installation of a 2.3 million-tonne green hydrogen DRI unit and electric arc furnace the Spanish government approved a direct grant of around €460 million from its recovery funds [40].

Hydrogen Infrastructure and Transport in Europe

This section provides an overview of current infrastructure developments and future plans for hydrogen transport in Europe, highlights key industry stakeholders and projects, compares the readiness of EU member states, and outlines the challenges to expanding hydrogen infrastructure.

Current Infrastructure



Figure 1 Map of hydrogen pipelines by end user and storage facilities [41]

As can be seen from Figure 1, hydrogen infrastructure in Europe remains in its early stages despite being crucial for hydrogen growth and distribution. As of 2023, Europe’s hydrogen pipeline network comprised 17 pipelines, covering a total of 1,581 km. The most extensive networks are found in Belgium and Germany, measuring approximately 600 km and 400 km, respectively. Notably, a cross-border network connecting France, Belgium, and the Netherlands spans 964 km.

Currently, these pipelines primarily supply industrial hubs involved in chemical production (e.g., ammonia) and petrochemical processes (e.g., refineries). The majority of the hydrogen pipeline network is concentrated in Belgium, the Netherlands, Germany, and France. However, data accessibility remains limited since these pipelines are privately owned.

In terms of hydrogen storage, four projects utilizing different technologies were operational in 2023. These include two salt cavern storage projects in France and Germany, one hard rock cavern storage project in Sweden, and another utilizing a depleted gas field in Austria [41]. By 2025, additional storage projects have progressed significantly: underground salt cavern storage pilots, such as HyPSTER in France [42] and H2CAST Etzel in Germany [43], are nearing completion.

Overall, as of 2025, Europe’s hydrogen transport and storage infrastructure remains at a nascent stage: a patchwork of pipeline segments, industrial storage vessels, and demonstration projects.

Thy Hydrogen Valleys

Hydrogen Valleys are regional hubs that integrate the entire hydrogen value chain – from production (often using local renewable energy) through storage and distribution to multiple end-use sectors such as transport, industry and power. In essence, a Hydrogen Valley is a defined geographic area (e.g. a city, region, or industrial

D8.5 Policy Mapping Document

cluster) where hydrogen production feeds a variety of local demands, creating an initial “hydrogen economy” at the regional scale [44].

These initiatives typically involve multi-million euro investments and political support, covering all steps needed to deploy hydrogen on the ground (electrolysers, pipelines or tankers, storage tanks, refuelling stations, fuel cells, etc.) and showcasing how hydrogen can decarbonise different sectors in a real-world setting. By linking supply and demand in one area, Hydrogen Valleys act as living labs for hydrogen technology, helping to reduce costs, develop infrastructure, and build know-how that can be scaled up across Europe. They also improve public acceptance of hydrogen by directly engaging local industries and communities in the clean energy transition [45]

Hydrogen Valleys have become a central element of European industrial and energy policy to accelerate hydrogen infrastructure development. The European Commission's Hydrogen Strategy and the Clean Hydrogen Partnership have championed these valleys as flagship projects to kick-start the hydrogen economy. The EU has a goal to have at least 50 Hydrogen Valleys operational by 2030 [46], recognising their importance for decarbonising heavy industries and transport while stimulating regional development. In fact, more than 60 Hydrogen Valleys are already under development across Europe as of the mid-2020s [44].

The majority of all valleys (around 3/4) is still in the early stages, and need support of various nature to mature to the point where they can reach final investment decision and start construction.

REPowerEU, the EU scheme aiming to reduce Europe's dependence on fossil fuels, has topped up the contribution from Horizon Europe to the Clean Hydrogen Joint Undertaking with EUR 200 million to accelerate the roll-out of Hydrogen Valleys across Europe.

European Hydrogen Backbone

The European Hydrogen Backbone (EHB) is an ambitious initiative aimed at creating a comprehensive, interconnected hydrogen transport network across Europe. The backbone is primarily driven by European gas transmission system operators (TSOs) collaborating to repurpose and expand existing gas pipelines for hydrogen transport. This network is critical to establishing a unified European hydrogen market, enhancing energy resilience, and supporting industrial decarbonisation [47].

The current EHB vision includes developing around 40,000 km of hydrogen pipelines by 2040, as illustrated in Figure 2. Approximately two-thirds of this network will utilise repurposed natural gas pipelines, significantly reducing costs and accelerating implementation timelines. Repurposing existing infrastructure allows Europe to leverage established pipeline routes, expertise, and reduce environmental impact, making hydrogen transport both economically and technically feasible [48].

Initially, the backbone will serve to connect various regional hydrogen production and consumption hubs within Europe. The intention is to facilitate efficient distribution of domestically produced renewable hydrogen—especially from regions with abundant renewable energy resources like offshore wind in the North Sea or solar power in southern Europe—to areas with high industrial demand. This approach ensures that hydrogen is accessible at competitive costs where needed most, aiding the EU in meeting its climate and industrial goals.

Furthermore, the EHB will enable cross-border exchanges of hydrogen, creating a flexible and secure European energy system. As Hydrogen Valleys and industrial clusters grow, the backbone will integrate these regional projects, supporting the transition towards larger-scale hydrogen use across sectors, especially in industries such as steel, aluminium, chemicals, and transport.

To sum up, while Hydrogen Valleys are local or regional initiatives that integrate hydrogen production, storage, distribution, and consumption within a defined area. They act as initial building blocks for the hydrogen economy, demonstrating feasibility and stimulating local market development. The EHB complements Hydrogen Valleys by connecting them, thereby enabling efficient hydrogen exchange across Europe. This interconnection ensures Hydrogen Valleys do not remain isolated, instead facilitating larger-

scale hydrogen market development and supporting regional growth by balancing supply and demand across broader geographic areas.

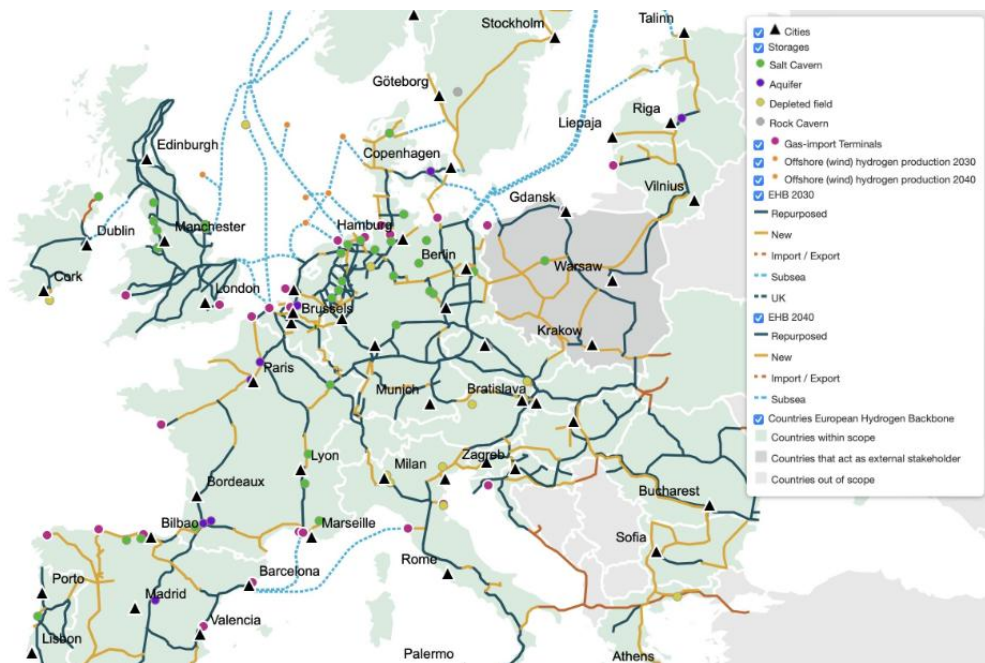


Figure 2 Planned European Hydrogen Backbone (EHB) pipeline network by 2040, illustrating repurposed and new pipelines, storage sites, offshore hydrogen production locations, and hydrogen import terminals [48]

Hydrogen Imports into Europe

Europe’s hydrogen strategy not only boosts domestic production but also relies on substantial imports of clean hydrogen to meet demand. The EU’s REPowerEU plan sets a target to import 10 million tonnes of renewable hydrogen per year by 2030 [49], complementing the one to be produced within the EU. These imports are crucial especially in regions where local production alone cannot meet demand. However, importing hydrogen is a complex challenge, as the molecule must either be converted into carriers or transported via specialized infrastructure [50].



Figure 3 Five supply corridors as envisioned by the European Hydrogen Backbone to be delivered by 2030 [48]

Key aspects of Europe’s hydrogen import plans include:

- Pipeline Import Corridors:** To deliver the 2030 hydrogen demand targets set by the REPowerEU plan, five large-scale pipeline corridors are envisaged. The corridors will initially connect local supply and demand in different parts of Europe, before expanding and connecting Europe with neighbouring regions with export potential. For example, the proposed SouthH2 Corridor [51] is a 3,300 km pipeline network linking North Africa to Italy and further into central Europe. Similarly, the H2Med project [52] will connect the Iberian Peninsula (Spain/Portugal) to France and Germany via pipeline, enabling transport of green hydrogen produced in Spain to the rest of Europe. These planned corridors, illustrated in Figure 3 play a crucial role in achieving Europe's broader energy transition and sustainability objectives.
- Shipping Hydrogen Carriers:** For more distant suppliers, hydrogen is likely to be imported in the form of derivatives such as ammonia (NH₃), methanol, or Liquid Organic Hydrogen Carriers (LOHC), rather than as pure hydrogen gas. Converting hydrogen to ammonia is currently a favoured route because ammonia can be shipped more easily and cheaply using existing infrastructure [50].
- Port Infrastructure and Storage:** Developing robust port infrastructure is crucial to handle the expected inflow of hydrogen and its carriers. This includes building new import terminals, conversion units (for reconverting ammonia to hydrogen), storage tanks (for liquid hydrogen or ammonia), and pipeline connections from ports to the inland hydrogen backbone. The EU can leverage its existing LNG import terminals by retrofitting some to handle hydrogen or ammonia, given that Europe currently has dozens of LNG facilities that could be repurposed for hydrogen service in the future [53].

Hydrogen imports – while reliant on complex infrastructure including specialized carriers, port facilities, pipelines, and reconversion technologies – are of strategic importance in meeting the hydrogen targets set by the EU. The expansion and integration of hydrogen infrastructure through initiatives like the European Hydrogen Backbone, Hydrogen Valleys, and import corridors is crucial to scaling hydrogen adoption in heavy industries such as steel and aluminium. However, infrastructure alone does not guarantee widespread uptake. The economic viability of hydrogen applications is equally essential. Currently, one of the greatest barriers to industry-wide adoption remains the high cost of renewable hydrogen. Therefore, the following section addresses these cost factors in detail, exploring their implications for industries and highlighting the price thresholds necessary for hydrogen to become competitive in industrial processes.

Hydrogen Cost for Industry Adoption

Today's green hydrogen production costs range roughly from \$3.7 to \$11.7 per kilogram, which is far above the price of natural gas on an equivalent energy basis [54].

These elevated costs undermine hydrogen's competitiveness and are forcing a reality check on earlier optimistic market outlooks. In fact, early plans for a rapid scale-up have given way to a more sober assessment: many new hydrogen projects have been delayed or downsized amid cost concerns, marking a shift from hype to pragmatic execution

Recent analyses provide updated cost estimates and regional variations. The EU's first hydrogen production auctions revealed significant differences in green hydrogen costs across Europe [55]

- Southern & Northern Europe: about €5.8–8.8 per kg of green hydrogen (the lowest costs in the EU)
- Germany & France: roughly €12–13 per kg, among the highest in Europe

High hydrogen costs remain a major barrier to adoption in steel and aluminium today. European steelmakers, for instance, have emphasized that using only green hydrogen with current prices would make their products uncompetitive. ArcelorMittal stated in 2024 that it *"cannot operate its European plants using green hydrogen... because the resulting green steel would be unable to compete on international markets."* Even with billions in subsidies for new equipment, the company warned it would effectively price itself out of the market if it relied on expensive green H₂ [56].

Recent techno-economic studies support this view by quantifying the hydrogen price needed for viable green steel production. A 2023 academic study [57] found that using 100% green hydrogen in a Direct Reduced Iron – Electric Arc Furnace (H₂-DRI-EAF) steel process would require hydrogen at about \$1.6–\$1.7 per kg (approximately €1.5/kg) to break even with conventional methods. At that H₂ price, an integrated green-steel plant could cut CO₂ emissions by 76–85% and still be economically viable. This threshold (\$1.7/kg) aligns with other 2024 analyses from TransitionAsia [58]: the study found that without any carbon price, green hydrogen-based steel reaches cost parity with traditional blast furnace steel at roughly \$2.0 per kg H₂. In the EU context, that parity point rises if carbon pricing is considered – at a CO₂ price of \$50/ton, parity is achieved around \$3.3/kg H₂, and with the EU's current carbon price (\$75/ton in 2024), green steel could compete even if hydrogen costs up to ~\$4/kg.

For aluminium producers, the challenge is similar. While hydrogen-fired furnaces have been demonstrating technical feasibility, in project such as HyInHeat and other private initiative from aluminium industry, widespread industrial adoption remains limited by the high cost and uncertain availability of affordable hydrogen. Unless significant cost reductions or additional policy incentives emerge, aluminium producers are likely to delay hydrogen adoption, continuing to rely on cheaper alternatives in the short to medium term.

PESTLE-SWOT Hybrid Analysis: Hydrogen uptake in EU steel & aluminium industries

Despite that hydrogen has emerged as an enabler for the decarbonisation of hard-to-abate sectors (incl. steel and aluminium), real-world deployment is progressing more slowly than policy ambition. The following PESTLE-SWOT hybrid analysis anticipate to reflect a multi-dimensional perspective, spotlighting sector-specific barriers and potential.

Political

The deployment of hydrogen is politically supported through the European Union strategies and a framework of other policy initiatives such as European Green Deal, REPowerEU, the Hydrogen Strategy, the Net-Zero Industry Act and others [59] [60] [61] [62]. However, despite this top-down push, the implementation is incompatible in the member states. Industrial actors often face delays in infrastructure projects, uncertainties in delegated laws, and lack of guaranteed hydrogen availability, making long-term plan risky [63]. State aid rules are sometimes not easy to navigate, especially for medium-sized industrial players. The requirement of more policy focus can be focused on the missing link between hydrogen infrastructure and industrial groups as well as variation for long-term public procurement or contracts (CfDs) [64] [65].

SWOT Link

- Strength: Strong top-down EU commitment and funding program (e.g. Innovation Fund, IPCEI, and others).
- Weakness: fragmented national strategies; Delay of policy instability planning.
- Threat: Regulatory fragmentation may stop further investments or potentially push projects outside the European Union.

Economic

Hydrogen's economic viability remains fragile. Production cost -especially for renewable hydrogen- is still significantly higher than fossil-based options (i.e. natural gas), which locks the industry in high-risk decisions demanding power market volatility, carbon value, and uncertain hydrogen demands [66] [67] [68]. While the European Union has increased public funding (see "Funding mechanisms for hydrogen" session), industrial deployment is dependent on de-risk business models.

SWOT Link:

- Weakness: High Capex/OPEX for hydrogen deployment (incl. retrofits); High input cost; Revenue uncertainty.
- Opportunities: Carbon Border Adjustment Mechanism (CBAM) could possibly reward beginners.
- Threat: International competition from Africa and Asia can transfer price chains abroad.

Social

While public perception of hydrogen is generally positive, social acceptance faces growing challenges—driven in part by increasing public demand for truly low-carbon solutions in various sectors. Potential local resistance to new hydrogen infrastructure, such as pipelines, electrolysers and storage facilities, is an increasing concern, especially in areas where these development can struggle with existing land uses. Additionally, public concerns about the safety of hydrogen technologies also persist and potentially can derail or derail project realization, exposing the importance of transparent communication and strong safety standards. At the same time, the pace of technological change in the hydrogen sector is removing the readiness of the labor force. There is a clear skill difference between engineers and technicians specialized in hydrogen systems, especially between engineers and technicians. Without targeted programs, transition funds and clear mobility routes, both workers and local communities can oppose the industrial change required for hydrogen economy. Ultimately, the successful uptake of hydrogen in the industry will not only depend on technical readiness, but will also depend on the stake trust - through standardisation, the performance social value construction, and inclusive transition system that ensure that no one is left behind [69] [70].

SWOT Link:

D8.5 Policy Mapping Document

- Strength: Hydrogen is considered as "clean" innovation vector by policy makers and civil society.
- Weakness: Skill intervals in engineering and operation.
- Opportunities: Manufacturing, retrofitting, employment creation in hydrogen logistics.
- Threat: Risk if fossil-based jobs are lost without sufficient security nets.

Technological

The technical maturity of hydrogen applications varies between aluminum and steel sectors. In the steel industry, hydrogen-based direct reduced iron (H-DRI) is moving rapidly, already running with large-scale performance and commercial projects [71]. For the aluminium sector, the use of hydrogen is mainly focused on applications in refining and remelting [72] [73]. Many innovation challenges obstruct large-scale hydrogen adoption in both sectors (i.e. hydrogen burners for aluminum, which are still subject to development and are not yet commercially available and expected by 2035 [74], and hydrogen shaft furnaces for DRI). Currently, priority for the European Union is to develop renewable hydrogen. The REPowerEU Strategy of 2022 has determined the purpose of producing 10 million tonnes and importing 10 million tonnes by 2030. However, this level of production is considered very low, which is required to achieve this goal. Complexity related with the integration of renewable energy sources between member states, long lead times for procurement and high costs needs to be addressed. Overall, while steel is paving the route with advanced hydrogen integration routes, aluminum sector will require further innovation efforts to remove existing technical and systemic obstacles combined with further investments and long-term plan.

SWOT Link:

- Weakness: Technology readiness mismatch between H₂ supply and industrial demand.
- Opportunities: EU industrial leadership in electrolysers, fuel cells, and advanced materials.
- Threat: technology lock-in with legacy infrastructure; dependency on imports of critical materials (e.g. iridium, platinum for PEM electrolysers)

Legal

The regulatory framework for hydrogen deployment in Europe remains complex and fragmented, creating significant uncertainty for industry stakeholders (and investors as well). Key definitions—such as what qualifies as renewable hydrogen, when and where it must be produced, and how it will be certified—are still evolving. The design of the EU Hydrogen Bank have provided some direction, but their complexity and perceived restrictiveness continue to delay investment decisions [75]. Permitting procedures for hydrogen projects are often lengthy and vary significantly across Member States, undermining efforts to scale deployment quickly [76]. In parallel, safety and liability frameworks for hydrogen handling—whether related to industrial use, transport, or infrastructure failures—remain unclear and inconsistent, raising concerns for operators and insurers alike. Further challenges arise from the ongoing development of technical standards [77]. The lack of harmonised protocols for hydrogen quality, blending thresholds, and end-use applications complicates market integration and cross-border trade. Until these legal, regulatory, and standardisation issues are resolved in a coordinated manner, the pace of hydrogen deployment is likely to remain slower than policy ambition demands [78].

SWOT Links:

- Strength: CEN-CENELEC and EU regulatory bodies are accelerating technical standards development.
- Weakness: Permitting remains complex and slow, with no fast-track pathways or centralized coordination for industrial developments.
- Threat: Legal uncertainty may delay final investment decisions or disqualify otherwise viable projects.

Environmental

Hydrogen is widely regarded as a promising enabler of industrial decarbonisation, but its true environmental benefit depends heavily on how it is produced and deployed. One of the most critical factors is the source of electricity used for electrolysis. When powered by renewable energy, green hydrogen offers substantial emissions reductions. However, if fossil-based electricity is used—resulting in grey or even blue hydrogen—the overall climate benefit is significantly diminished. Another key consideration is the average water withdrawal and consumption intensities which depend on the hydrogen production technology applied [79] [80] [81]. Moreover, the lifecycle impacts of hydrogen infrastructure—particularly the materials used in

electrolysers and the management of these systems at end-of-life—need closer attention. At the assessment level, Life Cycle Assessment (LCA) methodologies vary significantly across EU Member States, limiting comparability and standardisation. Additionally, emissions accounting frameworks still often fail to fully incorporate upstream and downstream emissions, overlooking the full environmental footprint of hydrogen supply chains. Without addressing these factors, hydrogen risks becoming a partially green solution with blind spots in sustainability and resource efficiency [82].

SWOT Links:

- *Opportunity: Lack of emissions up to 95% vs. fossil fuel in steelmaking via H₂-DRI.*
- *Weakness: The primary process of aluminium depends on electricity rather than hydrogen - limiting substitution potential.*
- *Threat: Public backlash if hydrogen projects are considered greenwashing or resource-intensive.*

PESTLE-SWOT hybrid analysis: key takeaways at a glance

- **High cost and market volatility:** The cost of renewable hydrogen remains high, mainly due to the instability of the electric markets—for especially renewal—and limited maturation of electrolyser manufacturing. Without the economies of scale or stable electricity prices, production costs may not be significantly reduced, making hydrogen less competitive for industrial use.
- **Infrastructure and planning gaps:** Europe currently lacks essential hydrogen infrastructure - such as dedicated pipelines, storage facilities and fuel -filling networks - especially in industrial groups. Additionally, uncertainty in the infrastructure rollout timeline makes it difficult to plan new investments alliances with hydrogen availability for industries.
- **Regulator uncertainty:** The absence of harmonised standards, delay in define "renewable hydrogen", and inadequate clarity on permission and state aid rules hinders investors's trust. Prolonged offttec contracts and support plans are not yet widespread, leaving reluctant to be committed to mass hydrogen use.
- **The readiness of the sector varies:** Steel sector is moving rapidly in the deployment of hydrogen, especially through hydrogen-based direct reduced iron (H-DRI) technologies. In contrast, aluminium sector faces cases of low use where hydrogen can directly change fossil fuels, especially since its thermal processes often favor electrification or hybrid solutions on pure hydrogen.
- **Need policy and market alignment:** To score hydrogen in energy-intensive industries, coordinated European Union-wide policies, aligned financial mechanisms (such as the Carbon Contracts for Difference-CCfDs) are required. Clear signal from both regulator and marks will be crucial for unlocking industrial investment and ensuring hydrogen is deployed where it offers the most value.

Conclusion and next steps

This report has examined the evolving landscape of EU hydrogen policy, specifically highlighting its transition from ambitious decarbonisation targets towards a balanced approach that integrates industrial competitiveness with environmental goals. Over recent years, initial optimistic projections regarding renewable hydrogen production and uptake have faced significant reality checks due to practical limitations, economic pressures, and shifting geopolitical dynamics. Consequently, the EU has recalibrated its strategy, notably through initiatives such as the Clean Industrial Deal, the Net-Zero Industry Act, and dedicated sector-specific actions like the Steel and Metals Action Plan. These measures aim to secure the competitiveness of energy-intensive industries such as steel and aluminium while supporting substantial emissions reductions through hydrogen-based solutions.

To enable hydrogen deployment at scale, the EU has developed comprehensive regulatory frameworks, supportive financial mechanisms such as the European Hydrogen Bank and the Innovation Fund, and strategic infrastructure initiatives including Hydrogen Valleys and the European Hydrogen Backbone. However, despite significant policy advancements and funding commitments, the cost of renewable hydrogen remains a critical barrier. Achieving competitive hydrogen prices is essential for widespread industrial adoption, underscoring the need for ongoing policy adjustments, technological innovation, and robust stakeholder collaboration.

Based on this analysis, the next steps will involve developing a comprehensive questionnaire designed to engage relevant stakeholders from key industrial sectors and associations. This questionnaire developed aims to identify potential policy gaps, barriers, and obstacles that may create unfavourable conditions for the adoption of hydrogen in industrial processes. Once developed, the questionnaire will serve as a tool to gather insights that will directly inform policy recommendations and scenario development in Task 7.5. The findings will be presented in Deliverable 8.9: Policy Recommendations Report.

Bibliography

- [1] E. Commission, "COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS A hydrogen strategy for a climate-neutral Europe," 2020.
- [2] European Court of Auditors , "Special report 11/2024: The EU's industrial policy on renewable hydrogen – Legal framework has been mostly adopted – time for a reality check," 17 07 2024. [Online]. Available: <https://www.eca.europa.eu/en/publications?ref=sr-2024-11>.
- [3] Edelman, "The EU Green Deal at a Crossroads," 3 February 2025. [Online]. Available: <https://www.edelmanglobaladvisory.com/eu-green-deal-crossroads>.
- [4] "Clean Industrial Deal: A plan for EU competitiveness and decarbonisation," 26 02 2025. [Online]. Available: https://commission.europa.eu/topics/eu-competitiveness/clean-industrial-deal_en.
- [5] E. Commission, "European Hydrogen Bank," 2022. [Online]. Available: https://energy.ec.europa.eu/topics/eus-energy-system/hydrogen/european-hydrogen-bank_en.
- [6] European Commission, "Pilot mechanism to support the market development of hydrogen," [Online]. Available: https://energy.ec.europa.eu/topics/eus-energy-system/hydrogen/european-hydrogen-bank/pilot-mechanism-support-market-development-hydrogen_en.
- [7] EUR-Lex, "Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources (recast) (Text with EEA relevance.)," 18 December 2018. [Online]. Available: <https://eur-lex.europa.eu/eli/dir/2018/2001/oj/eng>.
- [8] EUR-Lex, "Directive (EU) 2023/2413," 18 October 2023. [Online]. Available: <https://eur-lex.europa.eu/eli/dir/2023/2413/oj/eng>.
- [9] E. Commission, "COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE EUROPEAN COUNCIL, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS," 18 05 2022. [Online]. Available: <https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52022DC0230>.
- [10] EUR-Lex, "Regulation (EU) 2024/1735 of the European Parliament and of the Council of 13 June 2024 on establishing a framework of measures for strengthening Europe's net-zero technology manufacturing ecosystem and amending Regulation (EU) 2018/1724 (Text with EEA re," 13 June 2024. [Online]. Available: <https://eur-lex.europa.eu/eli/reg/2024/1735/oj/eng>.
- [11] IndustriAll, "Steel and Metals: The European Commission has a Plan!," 19 03 2025. [Online]. Available: <https://news.industriall-europe.eu/Article/1237>.
- [12] E. Commission, "Industrial Decarbonisation Accelerator Act - speeding up decarbonisation," 2025. [Online]. Available: https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/14505-Industrial-Decarbonisation-Accelerator-Act-speeding-up-decarbonisation_en.
- [13] E. Commission, "New State aid framework enables support for clean industry," 25 June 2025. [Online]. Available: https://ec.europa.eu/commission/presscorner/detail/en/ip_25_1598.

D8.5 Policy Mapping Document

- [14] "Commission's Action Plan to secure a competitive and decarbonised steel and metals industry in Europe," 19 March 2025. [Online]. Available: https://ec.europa.eu/commission/presscorner/detail/en/ip_25_805.
- [15] "Hydrogen and decarbonised gas market," [Online]. Available: https://energy.ec.europa.eu/topics/markets-and-consumers/hydrogen-and-decarbonised-gas-market_en.
- [16] European Union law, "EUR-Lex," 13 06 2024. [Online]. Available: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=OJ:L_202401788.
- [17] "Directive (EU) 2018/410 of the European Parliament and of the Council of 14 March 2018 amending Directive 2003/87/EC to enhance cost-effective emission reductions and low-carbon investments, and Decision (EU) 2015/1814 (Text with EEA relevance.)," 14 March 2018. [Online]. Available: <https://eur-lex.europa.eu/eli/dir/2018/410/oj/eng>.
- [18] "Carbon border adjustment mechanism as part of the European Green Deal," 15 01 2024. [Online]. Available: <https://www.europarl.europa.eu/legislative-train/package-fit-for-55/file-carbon-border-adjustment-mechanism>.
- [19] H. Yermolenko, "Carbon price in the EU to be set at €70-80/t in Q4 – analysts," November 2024. [Online]. Available: <https://gmk.center/en/news/carbon-price-in-the-eu-to-be-set-at-e70-80-t-in-q4-analysts/>.
- [20] "REGULATION (EU) 2023/956 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 10 May 2023 establishing a carbon border adjustment mechanism," 10 05 2023. [Online]. Available: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=legisum:4696271>.
- [21] "The CBAM must be fixed and launched urgently," 22 01 2025. [Online]. Available: <https://www.eurofer.eu/publications/position-papers/the-cbam-must-be-fixed-and-launched-urgently>.
- [22] E. Aluminium, "TOWARDS A FAIR & EFFECTIVE CBAM: KEY RECOMMENDATIONS FOR A COMPETITIVE EUROPEAN ALUMINIUM INDUSTRY," 11 2024. [Online]. Available: <://efaidnbmnnnibpcajpcglclefindmkaj/https://european-aluminium.eu/wp-content/uploads/2024/12/2024-11-26-European-Aluminium-position-paper-on-CBAM.pdf>.
- [23] "European Hydrogen Bank," [Online]. Available: https://energy.ec.europa.eu/topics/eus-energy-system/hydrogen/european-hydrogen-bank_en.
- [24] E. Commission, "Commission launches first European Hydrogen Bank auction with €800 million of subsidies for renewable hydrogen production," 23 November 2023. [Online]. Available: https://ec.europa.eu/commission/presscorner/detail/en/ip_23_5982.
- [25] "Third European Hydrogen Bank auction, with a budget of up to €1bn, unveiled as part of new Clean Industrial Deal," 26 February 2025. [Online]. Available: <https://www.hydrogeninsight.com/policy/third-european-hydrogen-bank-auction-with-a-budget-of-up-to-1bn-unveiled-as-part-of-new-clean-industrial-deal/2-1-1784810>.
- [26] "European Partnership for Hydrogen Technologies," [Online]. Available: https://www.clean-hydrogen.europa.eu/index_en.
- [27] European Commission, "What is the Innovation Fund," [Online]. Available: https://climate.ec.europa.eu/eu-action/eu-funding-climate-action/innovation-fund/what-innovation-fund_en.

D8.5 Policy Mapping Document

- [28] H. Europe, "2024 Innovation Fund grants: hydrogen projects account for 30% of total awards," [Online]. Available: <https://hydrogeneurope.eu/2024-innovation-fund-grants-hydrogen-projects-account-for-30-of-total-awards/>.
- [29] SSAB, "HYBRIT receives support from the EU Innovation Fund," 01 04 2022. [Online]. Available: <https://www.ssab.com/en/news/2022/04/hybrit-receives-support-from-the-eu-innovation-fund>.
- [30] E. Commission, "Important Projects of Common European Interest (IPCEI)," [Online]. Available: https://competition-policy.ec.europa.eu/state-aid/ipcei_en.
- [31] "EC green lights €5.4 bn for IPCEI Hy2Tech," July 2022. [Online]. Available: <https://hydrogeneurope.eu/ec-green-lights-e5-4-bn-for-ipcei-hy2tech/>.
- [32] E. Commission, "State Aid: Commission approves up to €5.2 billion of public support by thirteen Member States for the second Important Project of Common European Interest in the hydrogen value chain," September 2022. [Online]. Available: https://ec.europa.eu/commission/presscorner/detail/en/ip_22_5676.
- [33] E. Commission, "Commission approves up to €6.9 billion of State aid by seven Member States for the third Important Project of Common European Interest in the hydrogen value chain," 14 02 2024. [Online]. Available: https://ec.europa.eu/commission/presscorner/detail/en/ip_24_789.
- [34] E. Commission, "CEF Energy Supporting sustainable energy infrastructure projects," [Online]. Available: https://cinea.ec.europa.eu/programmes/connecting-europe-facility/energy-infrastructure-connecting-europe-facility-0_en.
- [35] I. E. Agency, "Package for the future – Hydrogen Strategy," August 2024. [Online].
- [36] R. Becker, "Thyssenkrupp," 20 07 2023. [Online]. Available: <https://www.thyssenkrupp.com/de/newsroom/pressemeldungen/pressedetailseite/eu-commission-approves-german-federal-and-state-government-fund-ing-for-thyssenkrupp-steels-tkh2steel-decarbonization-project-228875>.
- [37] BMWK, "Important step for global hydrogen ramp-up – Germany will work with H2Global to import green hydrogen products on a large scale from 2027," 11 07 2024. [Online]. Available: <https://www.bmwk.de/Redaktion/EN/Pressemitteilungen/2024/07/20240711-h2global.html>.
- [38] A-E. Rubio, "Hydrogen law, regulations & strategy in France," 21 11 2024. [Online]. Available: <https://cms.law/en/int/expert-guides/cms-expert-guide-to-hydrogen/france>.
- [39] F. C. Works, "Rystad: Spain Emerges as Regional Leader in Hydrogen Market, Outpacing Competitors," 09 2024. [Online]. Available: <https://fuelcellsworks.com/2024/09/18/clean-hydrogen/rystad-spain-emerges-as-regional-leader-in-hydrogen-market-outpacing-competitors>.
- [40] E. Commission, "State aid: Commission approves €460 million Spanish measure to support ArcelorMittal decarbonise its steel production," 17 02 2023. [Online]. Available: https://ec.europa.eu/commission/presscorner/detail/en/ip_23_849.
- [41] E. H. Observatory, "The European hydrogen market landscape," 2024.
- [42] Engie, "HyPSTER* Demonstrator paves the way for the Hydrogen industry in Europe," 20 09 2023. [Online]. Available: <https://www.engie.com/en/news/hydrogen-storage>.
- [43] "About the project: H2Cast Etzel," 01 02 2022. [Online]. Available: <https://h2cast.com/>.

D8.5 Policy Mapping Document

- [44] E. U. Press, "Cross-border Hydrogen Valleys," 2023. [Online]. Available: <https://eupublishingblog.com/2023/10/30/hydrogen-valleys/#:~:text=ImageFigure%201%3A%20North,concept>.
- [45] H. E. G. Fr, "Hydrogen Valleys," 2022. [Online]. Available: <https://www.horizon-europe.gouv.fr/hydrogen-valleys-large-scale-29738#:~:text=A%20Hydrogen%20Valley%20is%20a,with%20new%20projects%20emerging%20worldwide>.
- [46] E. Commission, "Repowering the EU with Hydrogen Valleys: Commission presents progress towards a European hydrogen economy," June 2024. [Online]. Available: https://research-and-innovation.ec.europa.eu/news/all-research-and-innovation-news/repowering-eu-hydrogen-valleys-commission-presents-progress-towards-european-hydrogen-economy-2024-06-25_en#:~:text=The%20European%20Union%20has%20made,still%20needs%20to%2.
- [47] "The European Hydrogen Backbone (EHB) initiative," 2023. [Online]. Available: <https://ehb.eu/>.
- [48] GuideHouse, "Five hydrogen supply corridors for Europe in 2030," GuideHouse , May 2022.
- [49] E.- E. Commission, "Hydrogen," 2024. [Online]. Available: https://energy.ec.europa.eu/topics/eus-energy-system/hydrogen_en#:~:text=The%20REPowerEU%20Strategy%20of%202022,processes%20and%20the%20transport%20sector..
- [50] Demaco, "Hydrogen transportation: three well-known energy carriers compared," 2024. [Online]. Available: [https://demaco-cryogenics.com/blog/hydrogen-transportation-three-energy-carriers/#:~:text=Hydrogen%20pipelines%20and%20trucks%20are,and%20liquid%20hydrogen%20\(LH2\)..](https://demaco-cryogenics.com/blog/hydrogen-transportation-three-energy-carriers/#:~:text=Hydrogen%20pipelines%20and%20trucks%20are,and%20liquid%20hydrogen%20(LH2)..)
- [51] T. S. Corridor, "The SouthH2 Corridor," 2024. [Online]. Available: <https://www.south2corridor.net/>.
- [52] T. H. project, "The H2med project," 2024. [Online]. Available: <https://h2medproject.com/the-h2med-project/>.
- [53] C. H. Partnership, "Study on hydrogen in ports and industrial coastal areas," 2023.
- [54] M. Bukowski, "Will Europe's Green Hydrogen Ambitions Be Trumped?," 28 January 2025. [Online]. Available: <https://cepa.org/article/will-europes-green-hydrogen-ambitions-be-trumped/>.
- [55] C. Z. Gerben Hieminga, "Hydrogen: Beyond the hype it is all about execution," 22 January 2025. [Online]. Available: <https://think.ing.com/articles/hydrogen-outlook-beyond-the-hype-it-is-all-about-execution/#:~:text=Here%20are%20our%20top%20three%20calls,to%20oil%20refining%20and%20transportation>.
- [56] R. Parkes, "Green hydrogen is too expensive to use in our EU steel mills, even though we've secured billions in subsidies," 21 February 2024. [Online]. Available: <https://www.hydrogeninsight.com/industrial/green-hydrogen-is-too-expensive-to-use-in-our-eu-steel-mills-even-though-weve-secured-billions-in-subsidies/2-1-1601199>.
- [57] D. P. K. B. K. Y. R. A. T. A. H. B. Fabian Rosner, "Green steel: design and cost analysis of hydrogen-based direct iron reduction," *Energy & Environmental Science*, pp. 4121-4134, 2023.
- [58] T. Asia, "Green Steel Economics – EU Factsheet," July 2024. [Online]. Available: <https://transitionasia.org/green-steel-economics-eu->

D8.5 Policy Mapping Document

factsheet/#:~:text=different%20carbon%20pricing%20scenarios,above%20%2475%20per%20ton%20of.

- [59] E. H. S. u. t. E. G. Deal, 2023. [Online]. Available: <https://observatory.clean-hydrogen.europa.eu/eu-policy/eu-hydrogen-strategy-under-eu-green-deal>.
- [60] E. Commission, "Supporting clean hydrogen," [Online]. Available: https://single-market-economy.ec.europa.eu/industry/strategy/hydrogen_en.
- [61] D. Energy, "Hydrogen," [Online]. Available: https://energy.ec.europa.eu/topics/eus-energy-system/hydrogen_en.
- [62] E. Commission. [Online]. Available: https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en.
- [63] H. Europe, "Hydrogen infrastructure: The recipe for a hydrogen grid plan".
- [64] E. H. Observatory, "Financial Tools and Incentives: EU hydrogen funding programs and initiatives," 2025.
- [65] IDDRI, "Developing hydrogen for decarbonisation in Europe: how relevant are contracts for difference?," 2023.
- [66] EY, "European Hydrogen Index 2025. Bridging the gap between ambition and action," 2025.
- [67] BloombergNEF, "Green Hydrogen to Undercut Gray Sibling by End of Decade," 2023. [Online]. Available: <https://about.bnef.com/blog/green-hydrogen-to-undercut-gray-sibling-by-end-of-decade/>.
- [68] IRENA. [Online]. Available: <https://www.irena.org/Energy-Transition/Technology/Hydrogen>.
- [69] E. D. J. A. M. Geert Vergoossen, "Public Opinion and the Hydrogen Economy: how social resistance may influence hydrogen market dynamics," 2024.
- [70] H. E. Association, "Action plan for Electrolytic Hydrogen," 2024.
- [71] E. I. Bank, "H2 GREEN STEEL," [Online]. Available: <https://www.eib.org/en/projects/all/20200902>.
- [72] Constellium, "World's First Successful Industrial-Scale Production of Aluminium Slab Using Hydrogen Combustion," 2025. [Online]. Available: <https://www.constellium.com/news/worlds-first-industrial-scale-aluminium-slab-using-hydrogen-combustion>.
- [73] Hydro, "World's first batch of recycled aluminium using hydrogen fueled production," [Online]. Available: <https://www.hydro.com/en/global/media/news/2023/worlds-first-batch-of-recycled-aluminium-using-hydrogen-fueled-production/#:~:text=Hydro%20has%20produced%20the%20world's,of%20aluminium%20during%20the%20test..>
- [74] E. Aluminium, "Net-Zero by 2050: Science-based Decarbonisation Pathways for the European Aluminium Industry," 2023.
- [75] C. A. T. Force, "The European Hydrogen Bank – Europe's latest effort to enable the continent's hydrogen revolution," 2023. [Online]. Available: <https://www.catf.us/2023/11/european-hydrogen-bank-europes-latest-effort-enable-continent-hydrogen-revolution/>.

D8.5 Policy Mapping Document

- [76] H. E. e. al., “Join Statement - Reality Check for European Hydrogen Policy to Adjust the Course,” [Online]. Available: <https://hydrogeneurope.eu/wp-content/uploads/2025/02/250203-RFNBO- Informal-Coalition-Joint-Statement.pdf>.
- [77] E. C. H. Alliance, “Roadmap on hydrogen standardisation,” 2023. [Online].
- [78] H. Europe, “A Clean Industrial Deal for the European hydrogen industry,” 2025. [Online]. Available: https://hydrogeneurope.eu/wp-content/uploads/2025/01/HE- paper_CleanIndustrialDeal_final.pdf.
- [79] D. E. B. M. R. G. Y. N. P. G. E. D. P. L. d. S. J. A. B. Rafael L. Germscheidt, “Hydrogen Environmental Benefits Depend on the Way of Production: An Overview of the Main Processes Production and Challenges by 2050”.
- [80] RMI, “Hydrogen Reality Check: Distilling Green Hydrogen’s Water Consumption,” 2023. [Online]. Available: <https://rmi.org/hydrogen-reality-check-distilling-green-hydrogens-water- consumption/>.
- [81] I. a. Bluerisk, “Water for hydrogen production,” 2023.
- [82] H. Europe, “Hydrogen Act: Towards the creation of the European Hydrogen Economy,” 2021. [Online]. Available: https://hydrogeneurope.eu/wp- content/uploads/2021/11/2021.04_HE_Hydrogen-Act_Final.pdf.
- [83] E. H. Observatory, “European Hydrogen Bank,” 28 June 2024. [Online]. Available: [https://observatory.clean-hydrogen.europa.eu/eu-policy/european-hydrogen- bank#:~:text=The%20aim%20of%20the%20international,international%20leg%20of%20the%20 Bank..](https://observatory.clean-hydrogen.europa.eu/eu-policy/european-hydrogen- bank#:~:text=The%20aim%20of%20the%20international,international%20leg%20of%20the%20Bank..)
- [84] C. Gottlieb, “EU introduces new Hydrogen and Decarbonized Gas Market Package,” 09 2024. [Online]. Available: <https://www.clearygottlieb.com/news-and-insights/publication-listing/eu- introduces-new-hydrogen-and-decarbonized-gas-market-package>.
- [85] “About the EU ETS,” [Online]. Available: https://climate.ec.europa.eu/eu-action/eu-emissions- trading-system-eu-ets/about-eu-ets_en.
- [86] Thyssenkrupp, “thyssenkrupp Steel is intensively pushing ahead with developing the hydrogen economy: Call for tenders for supplying hydrogen to the first direct reduction plant at the Duisburg location,” 02 2024. [Online]. Available: <https://www.thyssenkrupp.com/en/newsroom/press- releases/pressdetailpage/thyssenkrupp-steel-is-intensively-pushing-ahead-with-developing-the- hydrogen-economy:-call-for-tenders-for-supplying-hydrogen-to-the-first-direct-reduction-plant- at-the-duisburg-locat>.
- [87] E. H. Backbone, “Our work,” 2025. [Online]. Available: <https://ehb.eu/page/our-work>.
- [88] E. Commission, “Affordable Energy,” 26 February 2025. [Online]. Available: https://energy.ec.europa.eu/strategy/affordable-energy_en.
- [89] H. C. M. & Company, Hydrogen for Net-Zero A critical cost-competitive energy vector, November 2021.
- [90] E. C. H. Alliance, “Roadmap on Hydrogen standardisation,” 2023. [Online]. Available: https://www.cencenelec.eu/media/CEN- CENELEC/News/Press%20Releases/2023/20230301_ech2a_roadmaphydrogenstandardisatio n.pdf.

Get in touch

Website

<http://hyinheat.eu/>

Email address

info@hyinheat.eu

