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POLICY BRIEF

Implementation and transposition of hydrogen regulations in the EU Member States

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1. Context

This paper will examine how EU Member States are implementing and transposing EU hydrogen (H2) regulations and directives into their national framework. Ten Member States have been selected for this study.

This paper includes key insights gathered from two consultations with stakeholders that involved hydrogen experts from the relevant ministries responsible for implementation and transposition of hydrogen regulations and directives.

2. Introduction

The implementation and transposition of hydrogen policies across EU Member States play a key role in achieving the bloc's decarbonization goals and fostering a competitive hydrogen economy. While the EU has established a comprehensive regulatory framework for renewable hydrogen, national approaches to translating these policies into action vary significantly, influenced by domestic priorities, industrial strategies, and infrastructure readiness.

In light of the emergence of new technologies, such as artificial intelligence, and the political shift in the United States, EU Member States may reassess their priorities, potentially leading to changes in the hydrogen policy landscape outlined in this paper.

3. EU Framework

3.1 Overview of EU hydrogen framework and Role of the EU Member States in implementing and transposing EU policies

The EU has a complex hydrogen regulatory framework as hydrogen provisions are scattered across different directives and regulations. The EU Hydrogen Strategy set an intermediate 2030 objective of up to 10 million tonnes of renewable hydrogen produced in the EU to reach carbon neutrality by 2050. The **Recast of the Renewable Energy Directive (RED III)** establishes renewable fuels targets for EU Member States in the industry and transport sectors.

- Industry: RED III introduces a specific hydrogen target. It mandates that at least 42% of hydrogen used in industry must come from RFNBOs by 2030, increasing to 60% by 2035. This applies to both energy and non-energy uses.
- Transport: No separate specific hydrogen target exists. Hydrogen is included under the broader RFNBO category within a combined 5.5% target for advanced biofuels and RFNBOs by 2030, with a minimum of 1% from RFNBOs. This allows hydrogen to contribute flexibly (e.g., in fuel cell vehicles or synthetic fuels) but without a separate mandate.)[1].

The **ReFuelEU Aviation Regulation** introduces progressively higher requirements for the share of sustainable aviation fuels (SAF) available at EU airports, with dedicated targets for hydrogen-based e-kerosene, reaching 1.2% by 2030 and 35% by 2050[2]. Similarly, the **FuelEU Maritime Regulation** obliges large vessels docking at European ports to steadily decrease their carbon intensity while also ensuring that at least 2% of their energy consumption comes from renewable fuels by 2030[3]. The **Alternative fuels infrastructure regulation (AFIR)** establishes mandatory deployment targets for hydrogen refuelling infrastructure for road vehicles[4] and the **Decarbonized and gas market package** aims to facilitate the establishment of hydrogen infrastructure and, in the upcoming months, plans to

[1] https://eur-lex.europa.eu/eli/dir/2023/2413/oj
[2] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32023R2405&qid=1716547448481
[3] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32023R1805
[4] https://eur-lex.europa.eu/eli/reg/2023/1804/oj

introduce a system of terminology and certification for low-carbon hydrogen[5]. The **Carbon Border Adjustment Mechanism (CBAM)** currently covers hydrogen as a good but does not account for indirect emissions, such as the electricity used in electrolysis for its production. Additionally, hydrogen 'self-produced' by some key sectors is not included in CBAM[6]. Under the revised **EU Emissions Trading System Directive** (EU ETS), the criteria for receiving free EU allowances (EUAs) have been broadened to include hydrogen production methods beyond fossil-based processes, such as electrolysis[7]. Finally, the **Net Zero Industry Act** recognizes electrolyzers and fuel cells as net-zero technologies[8] and the **Critical Raw Materials Act** covers raw materials such as nickel and platinum that are used to produce electrolyzers, fuel cells and hydrogen storage technologies[9]

The role of the **Member States** is key in putting into practice this complex framework and reaching the EU targets. While EU regulations are directly applicable in the EU Member States, directives need to be transposed at the national level, which means that it is up to individual countries to adopt measures to incorporate them into national law to reach the goals set in the directive.

The **Regulation on the Governance of the Energy Union and Climate Action (EU) 2018/1999**[10] mandates EU Member States to submit their **National Energy and Climate Plans (NECPs)** to the EU Commission. In these plans, each Member State outlines how it intends to address the five dimensions of the Energy Union (decarbonisation, energy efficiency, energy security, the internal energy market, and research, innovation, and competitiveness) and thereby contribute to the implementation of EU energy and climate objectives[11]. The process of drafting, submitting, and updating National Energy and Climate Plans (NECPs) followed a structured timeline under the EU's governance regulation:

- **Initial Drafting** (2018-2019): Member States were required to submit their draft NECPs for the 2021-2030 period by the end of 2018. The EU Commission reviewed these drafts and provided an overall assessment along with country-specific recommendations in June 2019. Based on this feedback, Member States finalized and submitted their initial NECPs by December 2019[12].
- **Monitoring and Progress Reporting** (2020-Onwards): to ensure continuous progress, the Commission published an EU-wide assessment of the final NECPs in September 2020. Individual country assessments were included in the 2020 Energy Union Report. Every two years, Member States must submit progress reports, which contribute to the Commission's broader monitoring of EU energy and climate goals. By early 2020, Member States were also required to submit national long-term strategies looking ahead to 2050.
- **Updating the NECPs** (2023-2024): as part of the ongoing evolution of NECPs, a revision process was set for 2023. Member States were expected to submit draft updates to their NECPs by June 30, 2023, in line with the Governance Regulation. The Commission provided guidance on these updates and assessed progress towards EU climate and energy objectives. In October 2023, the Commission released a technical assessment of NECP progress reports as part of the State of the Energy Union Report[13].
- **Evaluation and Finalization** (2023-2024): by December 2023, the Commission published an EU-wide evaluation of the draft updated NECPs. Individual country assessments and recommendations

[5] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2021%3A804%3AFIN&qid=1640001545187 The final version of the Delegated act on the methodology for calculating GHG emissions savings from low carbon H2 and fuels will be published in the upcoming months.
[6] https://eur-lex.europa.eu/eli/reg/2023/956/oj
[7] Marcu, A., et al. (2023) "2023 State of the EU ETS Report." ERCST, BloombergNEF, Ecoact, and Wegener Center.
[8] these technologies will have access to further support and shorter permitting deadlines ttps://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52023PC0161
[9] https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52023PC0160
[10] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02018R1999-20231120
[11] https://commission.europa.eu/energy-climate-change-environment/implementation-eu-countries/energy-and-climate-governance-and-reporting/national-energy-and-climate-plans_en
[12] https://commission.europa.eu/energy-climate-change-environment/implementation-eu-countries/energy-and-climate-governance-and-reporting/national-energy-and-climate-plans_en
[13] https://energy.ec.europa.eu/strategy/eighth-report-state-energy-union_en

were provided after Member States that submitted their plans. The final step in this cycle required Member States to submit their fully updated NECPs, incorporating the Commission's recommendations, by June 30, 2024[14].

3.2 Financing mechanisms and tools at Member State level to support hydrogen

Financing mechanisms and tools at the EU Member State level to support hydrogen vary significantly depending on national strategies, industrial priorities, and budget allocations. State Aid can be obtained in various ways, and the EU foresees specific guidelines to avoid market distortions (Figure 1).

State aid	**Regulation**
Important Project of Common European Interest (IPCEIs)	IPCEI State aid Guidelines
Hydrogen Bank "Auctions-as-a-Service" scheme	Guidelines on State aid for Climate, Environmental Protection and Energy (CEEAG)
Contracts for Difference (CfDs) and Carbon Contracts for Difference (CCfD)	
State aid for Climate, Environmental Protection and Energy (CEEAG)	
State aid for research and development and innovation (RDIF)	State aid for research and development and innovation (RDIF)
State aid for energy infrastructure, R&D, environmental protection, energy efficiency, renewable electricity for new installation waste recycling/re-utilization	General Block Exemption Regulation (GBER)
State aid - national plans	Recovery and resilience facility (RRF) guiding templates
MS State aid schemes to tackle energy crisis, foster energy security, support the transition to a net-zero economy	State aid Temporary Crisis and Transition Framework

Figure 1: State Aid and regulations to avoid market distortions. Source EU Commission (link)

Additionally, Member States can use other instruments eg. Tax incentives and grants to finance hydrogen projects.

[14] https://commission.europa.eu/energy-climate-change-environment/implementation-eu-countries/energy-and-climate-governance-and-reporting/national-energy-and-climate-plans_en

3.3 Financing mechanisms and tools at EU level to support hydrogen

Projects Co-Funded by the EU: The EU provides financing and co-financing for hydrogen projects through various funding programs (Figure 2)

Fund	Support specifics	EU wide	MFF Financing
Innovation Fund • Hydrogen Bank	Grants Fixed premium	YES YES	NO
Development and Cohesion (ERDF, REACT-EU, CF)	Grants	YES	YES
Connecting Europe Facility – Transport	Grants – guarantees – bonds	YES	YES
Horizon Europe • Clean Hydrogen Partnership	Grants Grants	YES YES	YES
Modernisation Fund	The Modernisation Fund leaves the beneficiary EU countries the freedom to decide on the form of support	NO	YES
Just Transition Fund	Grants	YES	YES
Connecting Europe Facility – Energy	Grants – guarantees – bonds	YES	YES
Invest-EU	Guarantees	YES	YES
LIFE	Grants	YES	YES

Figure 2: EU funds supporting hydrogen, 2021-2027, by category. Source: ERCST 2024 State of the EU Hydrogen Market Report

4. Country studies

Ten EU Member States have been selected as case study.

4.1 Germany

4.1.1 Germany and EU Regulations/Directives implementation and transposition

Ambition: 10 GW of electrolysis capacity by 2030[15]

Strategy

Germany aims to achieve GHG neutrality by 2045. Germany's National Hydrogen Strategy was first introduced in 2020 and set a green hydrogen capacity target of 5 GW by 2030. In 2023, the strategy was updated, and the electrolysis capacity target was raised to 10 GW by 2030. The strategy aims to establish renewable hydrogen as a key element in the energy transition, creating a domestic hydrogen market by developing production capacity and demand-side technologies as well as devising a regulatory framework for hydrogen transport and distribution infrastructure.

At the same time, it seeks to bolster the competitiveness of German companies by promoting research and innovation in hydrogen technologies, encouraging industrial use, and expanding export opportunities, while securing future hydrogen supply via international partnerships, prioritizing European cooperation while also engaging non-EU countries[16]. Germany's updated National Hydrogen Strategy primarily focuses on renewable hydrogen. Consequently, direct financial support for hydrogen production is limited to green hydrogen. However, in the market ramp-up phase, low-carbon blue, turquoise (methane pyrolysis), and orange (produced from waste and residual materials) hydrogen can also play a role. Compliance with strict CO_2 emission limits is a necessary requirement for these low-carbon hydrogen categories (the strategy mentions 25 g CO2 eq./MJ H_2 as a reference). However, if the EU enforces stricter sustainability requirements, Germany will align with them.

The Hydrogen Strategy is intended to lay the foundation for private investment in the hydrogen sector and sets out actions across eight key areas[17]:

- In hydrogen production, the strategy focuses on expanding electrolyzer capacity and increasing the availability of renewable energy. The goal is to reduce production costs and support demand in key industries such as steel and chemicals, where hydrogen can play a crucial role in decarbonization.
- In the transport sector, the strategy promotes the use of hydrogen in heavy transport, aviation, and maritime applications. This includes investment in research and development, as well as support for vehicle deployment and fuel production to facilitate adoption.
- For the industrial sector, hydrogen is positioned as a key solution for replacing fossil fuels. Funding instruments, including 'carbon contracts for difference,' are intended to provide incentives for low-carbon industrial processes and help bridge the cost gap for businesses.
- When it comes to heat applications, the strategy evaluates the continued support for fuel cell heating technologies. Future backing will depend on cost reductions and efficiency improvements to ensure economic viability.
- The development of infrastructure and supply chains is another priority, with efforts focused on ensuring a secure and efficient hydrogen network. This includes repurposing existing gas infrastructure, developing a hydrogen core network, and expanding refueling stations to support market expansion.
- In the area of research, education, and innovation, the strategy aims to advance technological progress through flagship projects and regulatory sandboxes. These initiatives are intended to accelerate the industrial-scale deployment of hydrogen solutions.

[15] https://www.bmwk.de/Redaktion/EN/Publikationen/Energie/national-hydrogen-strategy-update.pdf?__blob=publicationFile&v=2
[16] ibidem
[17] ibidem

- At the European level, the strategy supports EU-wide hydrogen initiatives, working towards the harmonization of sustainability and certification standards. Participation in Important Projects of Common European Interest (IPCEI) will also play a key role in fostering cooperation across member states.
- In the international market and partnerships, the strategy seeks to strengthen global cooperation to secure hydrogen imports, expand the export of German hydrogen technologies, and contribute to energy development in partner countries.

In the medium and long terms, imports will account for a large portion of Germany's demand for hydrogen. The Federal Government expects its national demand for hydrogen and hydrogen derivatives to reach between 95 to 130 TWh by 2030 and foresees that around 50 to 70% (45 to 90 TWh) of the hydrogen products will have to be imported from abroad[18]. The German hydrogen Strategy is therefore complemented by an 'Import strategy for hydrogen and hydrogen derivatives' to ensure resilient and diversified supply of hydrogen[19].

Governance

Germany's hydrogen strategy is governed by the State Secretaries' Committee on Hydrogen. The National Hydrogen Council advises and supports this committee with proposals and recommendations. On behalf of the Federal Government, the Hydrogen Coordination Office supports the ministries in the implementation of the National Hydrogen Strategy. Ultimate decisions and responsibility are with the Federal Ministry for Economic Affairs and Climate Action (BMWK). Aside from the measures taken at federal level, the Länders have also been planning and implementing their own hydrogen-related measures[20].

NECP overview

According to the German NECP, Germany's primary energy consumption is expected to decrease by 39.3 % by 2030 compared to 2008 and final energy-consumption by at least 26.5 % by 2030 compared to 2008. The share of renewable energy in gross final energy consumption in Germany is expected to be 42.5 % in 2030[21].

The 'draft transposition of RED III' into national law is currently under parliamentary procedure. According to the German NECP, The Federal Government will establish the necessary conditions to support the development and large-scale expansion of electrolysis and PtX for e-fuels production[22]. This will facilitate the use of climate-friendly fuels, especially in industry, chemicals, aviation, heavy-duty transport, and shipping, as well as in specialized applications, including the military sector[23].

Germany aims to build an integrated hydrogen infrastructure called 'Hydrogen Core Network' to connect Germany's major hydrogen consumption and supply regions by 2032. The gas transmission system operators are in charge of developing this network and they submitted their application on 22 July 2024 and amended it on 26 September 2024. The Bundesnetzagentur granted approval to the application on 22 October 2024 incorporating certain modifications. The approved plans for the hydrogen core network are for a total of 9,040 kilometres of pipelines, with approximately 60% consisting of repurposed natural gas pipelines. The total investment costs are expected to be €18.9bn[24]. The development of the hydrogen Core Network will contribute to the objectives of the Hydrogen and decarbonised gas market package[25].

[18] https://www.bmwk.de/Redaktion/EN/Publikationen/Energie/importstrategy-hydrogen.pdf?__blob=publicationFile&v=7
[19] ibidem
[20] https://www.bmwk.de/Redaktion/EN/Hydrogen/Dossiers/national-hydrogen-strategy.html
[21] https://commission.europa.eu/publications/germany-final-updated-necp-2021-2030-submitted-2024_en
[22] ibidem
[23] ibidem
[24] https://www.bundesnetzagentur.de/EN/Areas/Energy/HydrogenCoreNetwork/start.html
[25] https://commission.europa.eu/publications/germany-final-updated-necp-2021-2030-submitted-2024_en

Additionally, the Federal Government is expanding public hydrogen refuelling infrastructure in line with AFIR targets. By 2025, an initial network of hydrogen refuelling stations will be in place to support the deployment of fuel cell vehicles, with further expansion planned for 2027 and 2030.

Projects

Regarding some key hydrogen projects in Germany, on July 25, 2024, Shell approved the Refhyne II project, a 100 MW proton-exchange membrane (PEM) electrolyzer to be installed at the Shell Energy and Chemicals Park Rheinland. This facility is slated to produce up to 44,000 kilograms of renewable hydrogen daily, starting operations in 2027[26]. The project received funding from the EU's Horizon 2020 program[27]. Earlier in the same month, EWE AG advanced its Clean Hydrogen Coastline project by making FIDs for two electrolysis plants. Notably, the Emden facility, with a capacity of 280 MW, has the potential to become Europe's largest plant to have reached FID. The project received the IPCEI status[28]. This plant is expected to start operations in 2027[29]. Additionally, RWE's GET H2 Nukleus project in Lingen achieved a milestone in September 2024. The project secured funding from the German federal government and the states of Lower Saxony and North Rhine-Westphalia and received the IPCEI status [30]. The company also commissioned Sunfire and Bilfinger to build the third electrolyzer plant, a 100 MW alkaline electrolyzer, bringing the project's total capacity to 300 MW. This phase is scheduled for commissioning in 2027[31]. Finally, in 2024, Air Liquide inaugurated a 20 MW electrolyzer in Oberhausen, supplying green hydrogen for industry and transport in the Rhine and Ruhr regions [32]. The project received funding from the German Ministry of Economics and Technology within the framework of the National Hydrogen Strategy (NWS)[33].

4.1.2 Financing

Program	Description	Technology	EUR in Billion
H2 Global	Government-backed funding mechanism designed to support the international market ramp-up of green H2 and its derivatives. It operates through two distinct auction phases. The initial phase identifies the exporter with the most competitive price for green H2 deliveries. In the second phase, the acquired volume is auctioned to potential buyers, with the highest bidders securing the	H2 and derivates	5.0[34]

[26] https://hydrogeneurope.eu/shell-takes-fid-on-100mw-renewable-hydrogen-scheme/#:~:text=Shell%20has%20taken%20a%20Final,Chemicals%20Park%20Rheinland%20in%20Germany.
[27] https://www.refhyne.eu/final-investment-decision-taken-by-shell-for-refhyne-2/
[28] https://www.ewe.com/en/media-center/press-releases/2024/02/green-light-from-brussels-for-the-foundation-of-the-european-hydrogen-infrastructure-ewe-ag#:~:text=Green%20light%20from%20Brussels%20for%20the%20foundation%20of%20the%20European%20hydrogen%20infrastructure,-%E2%80%A2%20EU%20Commission&text=Oldenburg%2C%2015.,EWE's%20%E2%80%9CClean%20Hydrogen%20Coastline%E2%80%9D.
[29] https://www.argusmedia.com/en/news-and-insights/latest-market-news/2592874-europe-sees-record-hydrogen-fids
[30] https://www.rwe.com/en/press/rwe-ag/2024-07-15-german-and-state-governments-grant-funding-for-large-hydrogen-projects-by-rwe/
[31] https://www.rwe.com/en/press/rwe-generation/2024-09-11-rwe-commissions-sunfire-and-bilfinger-to-build-third-electrolyzerplant-for-geth2-nukleus/
[32] https://fuelcellsworks.com/news/air-liquide-inaugurates-20-mw-electrolyzer-trailblazer-in-oberhausen
[33] https://fuelcellsworks.com/news/air-liquide-receives-10-9-million-euros-in-funding-for-green-hydrogen-project-trailblazer
[34] As of February 2025, H2Global has secured over €4.7 billion in funding to support the import of renewable hydrogen and its derivatives into the European Union. This includes an initial €900 million allocated in June 2023, an additional €3.53 billion granted by Germany's Federal Ministry for Economic Affairs and Climate Action in February 2024, and a €600 million joint investment from the German and Dutch governments in November 2024

	deliveries. The gap between the higher purchase price and the lower sales price is covered by the intermediary HINT.CO GmbH. Over time, the cost difference is expected to shrink, leading to a reduction in the necessary compensation, which will eventually be phased out		
Climate Protection Contracts (KSV) - (CCfDs)	CCfDs in Germany cover the additional costs of climate-friendly production compared to conventional methods, providing financial security for companies investing in low-carbon technologies like H2. They function as risk-hedging instruments. Producers bid for contracts through auctions, with the government setting a benchmark price. If the market price is lower than the agreed strike price, the government compensates the producer; if it's higher, the producer repays the difference. This mechanism helps offset early-stage production costs and encourages investment[35]	H2 and others	4 (for H2)
Hydrogen Core Network (HCN)	The HCN will serve as the core infrastructure for long-distance hydrogen transport pipelines in Germany, as well as a key segment of the European hydrogen network linking various Member States. The support will be provided through a State guarantee, enabling the TSOs to secure more favorable loans to offset initial losses during the early stages of the HCN's implementation[36].	H2	3
H2B Auctions-as-a-Service			0.35

4.2 France

4.2.1 France and EU Regulations/Directives implementation and transposition

Ambition: 6.5 GW of electrolysis capacity by 2030[37]

Strategy

In 2020, France adopted a National strategy for the development of decarbonised and renewable hydrogen[38] setting a target of 6.5 GW of electrolysis capacity by 2030[39]. The Strategy sets three objectives:

- Installing enough electrolysers to make a significant contribution to the decarbonisation of the economy.
- Developing clean mobility, in particular for heavy-duty vehicles with an objective of reducing CO_2 emissions by over 6 million tons by 2030.
- Building an industrial sector that creates job with the goal of generating 50,000 and 150,000 direct and indirect jobs in France.

[35] https://www.isi.fraunhofer.de/en/competence-center/energiepolitik-energiemaerkte/projekte/ksv.html
[36] https://ec.europa.eu/commission/presscorner/detail/en/ip_24_3405
[37] https://www.iphe.net/_files/ugd/45185a_eb89c38fe1b1418db4b36ee110ac8e32.pdf
[38] https://www.entreprises.gouv.fr/priorites-et-actions/autonomie-strategique/soutenir-linnovation-dans-les-secteurs-strategiques-13
[39] https://www.iphe.net/_files/ugd/45185a_eb89c38fe1b1418db4b36ee110ac8e32.pdf

Additionally, it establishes three priority actions[40]:

- Decarbonising industry by developing a strong French electrolysis sector
- Developing the use of hydrogen for heavy-duty mobility
- Supporting hydrogen research, innovation and skills development to promote the 'uses of tomorrow'

The national strategy is under revision to realign the objectives with the market development.

Governance

A National Hydrogen Council (CNH) has been established to oversee the implementation of France's national hydrogen strategy and to facilitate the dialogue with stakeholders. The council includes representatives from the Ministry of Ecological Transition, the Ministry of Economy, Finance, and Recovery, and the Ministry of Higher Education, Research, and Innovation as well as industry representatives (e.g. France Hydrogène[41]).

NECP overview

The NECP mentions France's energy consumption goal, which is to reduce it by 30% by 2030 compared to 2012 levels. To achieve this, the country has established specific consumption targets, aiming for 1,243 TWh (106.9 Mtoe) of final energy consumption and 1,844 TWh (158.6 Mtoe) of primary energy consumption by the end of the decade[42].

Regarding the implementation of the Renewable energy directive France differentiates its approach to hydrogen for the transport and industry sectors:

- For the transport sector, France is adapting its existing TIRUERT[43] tax incentive to align with RED III, in order to provide visibility for stakeholders to make final investment decisions in hydrogen technologies[44].
- For the industry sector, France is introducing a CFD scheme focused on hydrogen production. The aim is to establish large, mutualized electrolyzers in industrial hubs, supporting various sectors based on geographic and economic factors through competitive auctions[45]. The support will mostly be on OPEX.

To meet the objectives of RefuelEUAviation and FuelEUMaritime, the government will support the first advanced fuel production facilities (including synthetic fuels made from hydrogen). The aviation sector will increase the use of SAFs, in line with the EU mandates. In the maritime sector, France has set a 12% reduction target in the carbon intensity of onboard energy use by 2030, surpassing the 6% target set by FuelEU Maritime[46].

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[40] https://www.ecologie.gouv.fr/sites/default/files/documents/DP%20-%20Strat%C3%A9gie%20nationale%20pour%20le%20d%C3%A9veloppement%20de%20l%27hydrog%C3%A8ne%20d%C3%A9carbon%C3%A9%20en%20France.pdf

[41] Association bringing toghether around 450 stakeholders of the French hydrogen sector across the whole value chain.

[42] https://commission.europa.eu/publications/france-final-updated-necp-2021-2030-submitted-2024_en

[43] The incentive tax on the use of renewable energy in transport (TIRUERT) sets a target for integrating renewable energy into fuels. By incorporating renewable energy, taxpayers can reduce their tax liability, with the tax amount decreasing to zero once the target incorporation rate is reached.
In order to enhance the value of alternative fuels with the best environmental impact, the TIRUERT mechanism will be revised to set greenhouse gas emission reduction targets for 2030, in the form of a reduction in the carbon content of each unit of energy used in the transport sector, considering the whole life-cycle of alternative fuels, in addition to a rate of incorporation of renewable energy, in accordance with the Renewable Energy Directive.

[44] https://commission.europa.eu/publications/france-final-updated-necp-2021-2030-submitted-2024_en

[45] https://www.hydrogeninsight.com/production/france-opens-its-first-contracts-for-difference-tender-for-green-and-nuclear-hydrogen/2-1-1757909

[46] https://commission.europa.eu/publications/france-final-updated-necp-2021-2030-submitted-2024_en

When it comes to the Hydrogen and Decarbonized Gas Market Package, France envisions the first network development to occur in industrial hubs before they could extend when it is relevant to inter-hub connections. Regarding the repurposing of gas pipelines, France recognizes that the majority of its natural gas transport network will still be crucial for managing seasonal and regional supply-demand variations, which restricts the extent to which pipelines can be converted for hydrogen transport[47].

Overall, France set ambitious hydrogen targets. However, in light of the recent economic, geopolitical shifts and the development of new flagship technologies such as AI, France is planning to revise its program 'France 2030' which was launched in 2021 by President Emmanuel Macron to support post-pandemic recovery and green technologies and would have mobilized €54 billion. The reassessment led by the Secrétariat Général pour l'Investissement and the Ministry of the Economy[48]. One of the adjustments under consideration is scaling back subsidies for hydrogen, as demand has not met expectations, and viable applications remain limited. Additionally, the energy crisis triggered by the war in Ukraine has increased production costs, making hydrogen less economically viable despite subsidies. In the mobility sector, electric trucks have gained market share faster than anticipated, reducing the relevance of hydrogen-powered heavy transport. However, hydrogen will remain crucial for industrial decarbonization, particularly in sectors such as cement, chemicals, and steel, meaning some level of support will be maintained[49].

Projects

A project that recently reached FID in France is the Lhyfe's new green hydrogen production site in Northern France. In January 2025, Lhyfe confirmed the construction of its fifth production facility, located in Croixrault (Hauts-de-France). The project obtained financial support from the French Government in the form of a grant of up to €149 million and has been approved by the EU Commission as part of the third wave of IPCEI[50]. Once operational in 2026, the site will produce up to two tonnes of green hydrogen per day (5MW), catering to both industrial and mobility sectors[51]. France is also developing Hydrogen Valleys and regional initiatives aimed at integrating hydrogen into industrial processes, mobility, and energy systems. One of the most ambitious projects is the Regional Hydrogen Roadmap of the Bourgogne-Franche-Comté region. The roadmap foresees a fully integrated hydrogen ecosystem with local production, refuelling infrastructure, and applications in public transport and logistics[52]. Another key regional strategy is Normandy Hydrogen, launched in 2018, which capitalizes on the region's strong industrial and maritime infrastructure. Normandy aims to integrate hydrogen into heavy industry and transport while leveraging existing assets, such as its ports and large-scale industrial consumers, to scale up hydrogen production and distribution[53]. There, Air Liquide is leading the Normand'Hy project which aims to install a 200 MW PEM electrolyzer, which will produce 28,000 tons of green hydrogen annually[54]. The project received funding from France Relance Plan (see section 5.2.2) and qualified as IPCEI[55]. Finally, The Zero Emission Valley (ZEV) project, in the Auvergne-Rhône-Alpes region, represents a major push toward hydrogen mobility[56].

[47] ibidem
[48] https://www.lesechos.fr/industrie-services/energie-environnement/hydrogene-solaire-ia-la-france-va-corriger-sa-strategie-industrielle-2148255#utm_medium=Reseaux%20sociaux&utm_campaign=CM_News_Linkedin
[49] https://www.lesechos.fr/industrie-services/energie-environnement/hydrogene-solaire-ia-la-france-va-corriger-sa-strategie-industrielle-2148255#utm_medium=Reseaux%20sociaux&utm_campaign=CM_News_Linkedin
[50] https://www.lhyfe.com/press/lhyfe-receives-from-the-french-government-a-grant-of-up-to-149m-for-large-scale-production-of-green-and-renewable-hydrogen-near-le-havre-in-france/
[51] https://www.lhyfe.com/press/lhyfe-announces-the-construction-of-a-5th-green-hydrogen-production-site-in-france-the-1st-in-northern-france/
[52] https://mcphy.com/en/achievements/hydrogen-mobility-en/dijon-metropole-smart-energhy-dmse/
[53] https://www.normandie.fr/sites/default/files/2020-11/exe_plaquette_normandie_hydro_gb_web2.pdf
[54] https://www.choosenormandy.com/air-liquide-normand-hy/#:~:text=The%20Normand'Hy%20project%20in,Projects%20of%20Common%20European%20Interest).
[55] https://www.choosenormandy.com/air-liquide-normand-hy/#:~:text=Normand'Hy%20is%20an%20investment,of%20the%20France%202030%20campaign.
[56] https://mcphy.com/en/achievements/hydrogen-mobility-en/zero-emission-valley-zev/

4.1.3 Financing

Program	Description	Technology	EUR in Billion
France Relance	Economic recovery plan that focuses on ecological transition, competitiveness and social and territorial cohesion. The fund supports hydrogen projects related to decarbonization in heavy industry, transport, and energy storage[57]	H2 and others	0.72 allocated to H2
Plan France 2030	Investment plan. Out of the 10 objectives listed in the plan, the second one is to become a decarbonised hydrogen leader. The plan aims at establishing two giga factories on the French soil by 2030 and use hydrogen to reduce industry emissions with 35% by 2030. • The Plan France 2030 set a decarbonised H2 production target of 700,000 tonnes of renewable or low carbon hydrogen per annum by 2030. • According to the measures in Plan France 2030, the H2 price target is set at $1.6 per kg by 2030 . However, this might be revised and the support to H2 reduced.	H2 and others	1.9 allocated to develop green hydrogen projects[58]
State aid Temporary Crisis and Transition Framework	Scheme that will support the production of energy and fuels from biomass and renewable hydrogen to foster the transition to a net-zero economy in line with the Green Deal Industrial Plan[59].	H2 and others	0.9
CfD (not implemented yet)	Programme to support green and nuclear hydrogen production by 2026[60]. The CfDs will last 15 years, aiming to bridge the cost gap between green and grey H2[61].	H2	4

[57] https://fuelcellsworks.com/news/french-economic-recovery-package-to-include-7-billion-euros-for-hydrogen-industry
[58] https://www.iea.org/policies/14279-france-2030-investment-plan
[59] https://ec.europa.eu/commission/presscorner/detail/en/ip_24_1549
[60] https://www.hydrogeninsight.com/policy/-4bn-allocation-france-to-subsidise-1gw-of-green-and-nuclear-hydrogen-production-by-2026/2-1-1521041
[61] https://www.hydrogeninsight.com/policy/france-to-launch-4bn-contracts-for-difference-programme-to-support-clean-hydrogen-production-reports/2-1-1508431

4.3 Spain

4.3.1 Spain and EU Regulations/Directives implementation and transposition

Ambition: 12 GW of electrolysis capacity by 2030[62]

Strategy

In 2020, the Ministry for Ecological Transition and the Demographic Challenge (MITECO) published the Hydrogen Roadmap, country's strategy for developing a renewable hydrogen economy. The Roadmap set a target of 4 GW of electrolysis capacity by 2030[63] and establishes key measures along different blocks:

- Regulatory instruments: simplification of administrative procedures, dedicated regulatory measures to allow for the direct use of renewable electricity in hydrogen production, development of a Guarantees of Origin (GoO) system to track renewable hydrogen production and provide price signals for consumers, establishment of green taxation measures to favor renewable hydrogen over fossil-based hydrogen.
- Sectoral instruments for the adoption of green hydrogen in industry and transport:
  - Industry: minimum renewable hydrogen use quotas for hard-to-electrify sectors, measures to foster the development of hydrogen clusters ("Hydrogen Valleys") in key industrial zones (objective At least 25% renewable hydrogen used in industry by 2030).
  - Transport: targets for heavy-duty vehicles and hydrogen-powered rail, measures to boost hydrogen adoption in aviation and maritime transport, including support for hydrogen-based synthetic fuels (e-fuels) for aviation, expansion of hydrogen based port operations (e.g., H2Ports initiative in Valencia), expansion of the national hydrogen refuelling network from 4 stations (in 2020) to 100-150 by 2030 (2030 Objectives of 5,000–7,500 fuel cell vehicles, 100–150 hydrogen refuelling stations, 150–200 hydrogen-powered buses)
- Cross-sectoral instruments: establishment of a Hydrogen Industry Forum to coordinate efforts among government, industry, and research institutions, Green hydrogen funding under the Strategic Project for Economic Recovery and Transformation (PERTE).
- International Collaboration: Spain aims to position itself as a European hydrogen hub and be a global leader by 2050.

Governance

The Ministry for Ecological Transition and the Demographic Challenge (MITECO) is responsible for implementing Spain's hydrogen strategy, with support from other ministries, including the Ministry of Science and Innovation, which represents Spain in the Clean Hydrogen Partnership. Spain's Autonomous Communities have the authority to authorize hydrogen injection into the natural gas distribution grid (up to 5%), under the oversight of the System Technical Operator (TSO). The main coordination body between the Central Government and the Autonomous Communities is the 'Sectorial Energy Conference'.

NECP overview

In 2024, Spain updated its National Energy and Climate Plan (NECP) for the 2023-2030 period, rising its ambitions. Spain aims to reduce greenhouse gas (GHG) emissions by 32% by 2030 compared to 1990 levels, enhance energy efficiency by 43%, and achieve 50% energy independence[64]. Other targets

[62] https://www.miteco.gob.es/content/dam/miteco/es/ministerio/planes-estrategias/hidrogeno/h2executivesummary_tcm30-513831.pdf
[63] ibidem
[64] https://www.enerdata.net/publications/daily-energy-news/spain-target-2030-power-renewable.html#:~:text=The%20new%202023%2D2030%20roadmap,up%20from%2039%25%20previously).

include the installation of 105GW of new renewable energy by 2030 and a new electrolysis capacity target of 12GW by 2030[65].

The Spanish National Integrated Energy and Climate Plan 2023-2030 considers a scenario of 74% of the hydrogen used by industry to be green by 2030. This is far higher than the 42% figure agreed by EU member states last year in the Renewable Energy Directive[66]. In the transport sector Order TED/728/2024[67] of 15 July introduced clear definitions, a specific framework and rules for certification and accounting of biofuels and other renewable gases in the transport sector. Starting from the 2024 financial year, Spain will start counting sustainable aviation fuels (SAFs) and marine fuels towards its renewable energy for transport targets[68].

In the framework of the implementation of the Hydrogen and Decarbonized Gas Market Package Spain started to develop the national transposition with a public participation process in October 2024. Regarding hydrogen network Enagas Infraestructuras de Hidrógeno was authorized by the Council of Ministers to develop the Spanish hydrogen backbone declared as a Project of Common Interest (PCI) by the European Commission. Approximately 3,000 km of hydrogen pipelines will be deployed by 2030 . Enagás, Spain's gas grid operator, committed to allocate €3.13 billion to the development of hydrogen infrastructure[69]. Spain is also planning to become a key hydrogen exporter[70] boosting its interconnections with EU MS and third countries (PCI projects will be discussed in section 5).

Projects

Spain accounts for around 20 % of the renewable hydrogen projects announced in the world in 2022, only behind the United States[71]. In July 2024, BP, in partnership with Iberdrola, approved the construction of a 25 MW green hydrogen plant at BP's Castellón refinery. This facility, expected to be operational by the second half of 2026, will utilize renewable energy supplied by Iberdrola to produce approximately 2,800 tonnes of green hydrogen annually. The produced hydrogen will replace a portion of the grey hydrogen currently used in the refinery, potentially reducing carbon dioxide emissions by 23,000 tonnes each year[72]. The project has secured 15 million euros in funding through the Spanish Recovery, Transformation, and Resilience Plan, with funding allocated by NextGenerationEU[73]. Spain's commitment to advancing its hydrogen economy is further exemplified by the development of several Hydrogen Valleys. The Basque Hydrogen Corridor (BH2C) is a prominent initiative aiming to create a green hydrogen value chain in the Basque Country. BH2C brings together multiple stakeholders, including energy companies, research institutions, and local governments, to foster industrial decarbonization and technological innovation[74]. Green Hysland, located in Mallorca, is a pioneering project funded by the EU's Horizon 2020 program and aims to create a comprehensive hydrogen ecosystem on the island, encompassing production, distribution, and utilization of green hydrogen

[65] https://www.hydrogeninsight.com/policy/spain-trebles-2030-green-hydrogen-target-to-12gw-in-updated-national-climate-plan/2-1-1714491

[66] https://www.hydrogeninsight.com/policy/spain-trebles-2030-green-hydrogen-target-to-12gw-in-updated-national-climate-plan/2-1-1714491

[67] https://www.boe.es/eli/es/o/2024/07/15/ted728/dof/spa/pdf The Order supports the adoption of hydrogen-based maritime fuels and SAFs in aviation. It also encourages the production of synthetic kerosene from green hydrogen.

[68] https://www.argusmedia.com/en/news-and-insights/latest-market-news/2588499-spain-includes-saf-marine-fuels-in-renewables-targets

[69] https://www.reuters.com/business/energy/spains-enagas-plans-multibillion-euro-investment-hydrogen-infrastructure-2025-02-18/

[70] https://www.hydrogeninsight.com/production/spain-to-become-major-green-hydrogen-exporter-to-europe-with-domestic-production-double-that-of-local-demand-by-2030/2-1-1591337

[71] https://www.worldenergy.org/assets/downloads/Issues_Monitor_2024_Spain_commentary.pdf?v=1730913782

[72] https://www.iberdrola.com/press-room/news/detail/joint-venture-bp-iberdrola-starts-construction-work-spain-largest-green-hydrogen-plant#:~:text=Spain%20and%20Portugal.-,Spain's%20largest%20green%20hydrogen%20plant,the%20second%20half%20of%202026.

[73] https://www.bp.com/en/global/corporate/news-and-insights/press-releases/bp-and-iberdrola-announce-final-investment-decision-for-largest-green-hydrogen-plant-in-spain.html

[74] https://parke.eus/en/the-basque-hydrogen-corridor-recognised-as-one-of-the-worlds-main-h2-valleys/

across various sectors, including transportation and industry. This initiative serves as a model for integrating renewable energy sources into local economies, promoting sustainability and energy independence[75].

4.3.2 Financing

Program	Description	Technology	EUR in Billion
IDAE investment plan	Investment strategy supporting innovative energy transition projects from 2024 to 2026. to back innovative energy transition projects between 2024 and 2026. The plan encourages proposals for public-private partnerships in sectors like sustainable transportation, renewable energy solutions, hydrogen, infrastructure, energy storage, and the circular economy[76].	H2 and other	0.1
PERTE ERHA	It provides funding for all renewable energy sources, including renewable hydrogen (H2), through a combination of public grants and financial incentives. These funds are allocated to projects that align with the goals of energy transition, innovation, and sustainability. Regarding Hydrogen four national mechanism has been developed under the PERTE ERHA: Pioneer Projects, H2 Value Chain, IPCEI H2 State Aids and Clusters/Valleys (this last one with the biggest budget, 1.2 bEUR under the TCTF EU Framework).	H2 and other	3 (for H2)

4.4 The Netherlands

4.4.1 The Netherlands and EU Regulations/Directives implementation and transposition

Ambition: 4 GW of electrolysis capacity by 2030[77]

Strategy

The Netherlands published its National Hydrogen Strategy in March 2020, setting an electrolyzer capacity target of 500 MW by 2025 and 4 GW by 2030[78]. The strategy focuses on 4 areas:

- Legislation & Regulation: The strategy envisages repurposing parts of the existing gas grid for hydrogen transport, with a particular emphasis on cross-border connections, especially with Germany. Clear market regulations are needed to define the role of various stakeholders, particularly network operators. The Netherlands ensures hydrogen transparency through Guarantees of Origin (GOs) issued by VertiCer (formerly Vertogas)[79] and RED III RNFBO criteria compliance thanks to RFNBO certification schemes verified by designated auditors[80].
- Cost Reduction & Scaling Up Hydrogen: The strategy explores the possibility of linking hydrogen production to offshore wind energy, capitalizing on the country's expanding renewable power

[75] https://greenhysland.eu/european-h2-valley-2022-award-a-triple-valley-success/
[76] https://www.idae.es/sites/default/files/general_content/News_on_energy_policies_and_programmes_in_Spain_from_march_to_august_2024.pdf
[77] https://www.government.nl/documents/publications/2020/04/06/government-strategy-on-hydrogen
[78] https://1fa05528-d4e5-4e84-97c1-ab5587d4aabf.filesusr.com/ugd/45185a_f22f45f329cf4841b7604f0c4e6d9c0b.pdf
[79] https://verticer.eu/en/guarantees-of-origin/
[80] https://www.rvo.nl/sites/default/files/2025-01/Report-How-to-become-RFNBO-certified.pdf

capacity. The Government has reserved around €4 billion for targeted support for renewable hydrogen projects on top of existing subsidy schemes for innovation and decarbonsiation.

- Sustainability of Final Consumption: hydrogen will be integrated across key sectors. Industrial clusters and ports, particularly Rotterdam, are central to this transition, with large-scale projects like H-Vision and Porthos supporting early adoption. In transport, hydrogen is key to decarbonizing heavy-duty vehicles, shipping, and aviation, and there are plans to expand refueling infrastructure and promote synthetic fuels. In other sectors the Government will mainly facilitate pilot projects.
- Supporting and Flanking Policy: the government will promote international collaboration and, as a key player in the North Sea region, the country aims to position itself as a hydrogen hub, leveraging on its ports and gas infrastructure for imports and exports.

Additionally, in 2022, the National hydrogen programme was launched. This public-private programme focuses on unlocking the supply of renewable hydrogen, developing the necessary transport, storage and import infrastructure, working with various sectoral programmes, and facilitating ongoing initiatives and projects. Moreover, despite not being a policy itself, the 2022 Hydrogen Roadmap[81]sets plans and actions until and after 2030.

However, higher-than-expected hydrogen production costs, advances in electrification and greater than anticipated electricity and hydrogen infrastructure costs due to inflation and other factors might require a reassessment of the targets for production and use of renewable hydrogen. Electrification is expected to play a larger role in decarbonizing industry than previously thought. Hydrogen will still play a role, but it must be integrated into areas where it will be cost-effective.

Governance

The Ministry responsible for the Strategy is the Ministry of Climate Policy and Green Growth (KGG). Moreover, the Hydrogen Coalition (Waterstofcoalitie), a public-private partnership, brings together stakeholders from various sectors to promote hydrogen in the Netherlands. According to the Netherlands Environmental Assessment Agency, the body that assesses the country's progress toward its climate and energy objectives, final energy consumption is expected to range from 1.566 to 1.818 petajoules in 2030[82].

NECP overview

When it comes to the implementation of hydrogen targets, the Netherlands adopts a dual approach of supply-side subsidies and demand-side quotas, particularly in sectors like aviation and mobility, where there is a higher willingness to pay. Quotas aim to force industrial off-takers to commit, ensuring that subsidies are not misused by large companies that could walk away from contracts. In the long run, quotas should target the end market (e.g., green steel, green fertilizers), as the costs of switching from fossil fuels to renewable hydrogen are more manageable at this stage compared to switching from grey to green hydrogen.

In the framework of the transposition of the RED, The Dutch National Energy and Climate Plan (NECP) includes targets for renewable (biological and synthetic) fuels in aviation, specifying a 14% share by 2030 and 100% by 2050. Additionally, the plan explores the introduction of a purchase obligation for renewable hydrogen in industry, set to begin in 2027[83].

Regarding RefuelEUAviation and Fuel EU Maritime:

- The ‘Aviation in Transition’ program, launched in 2023, is a collaborative effort involving over 60 partners from government, research institutions, and industry aiming to achieve climate-neutral

[81] https://nationaalwaterstofprogramma.nl/documenten/handlerdownloadfiles.ashx?idnv=2379389
[82] https://energy.ec.europa.eu/system/files/2020-03/nl_final_necp_main_en_0.pdf
[83] https://energy.ec.europa.eu/system/files/2020-03/nl_final_necp_main_en_0.pdf

aviation by 2050. Key projects include the development of hydrogen-powered demonstration aircraft[84].

- The Maritime Master Plan aims to develop approximately 40 climate-neutral demonstration ships powered by alternative fuels such as hydrogen, methanol, or LNG combined with carbon capture technology. This initiative focuses on various maritime sectors, including coastal and inland shipping, hydraulic engineering, offshore wind, and maritime safety[85].

Projects

In the Netherlands, several significant hydrogen projects have reached Final Investment Decisions (FIDs). One notable project is Holland Hydrogen I, developed by Shell Nederland and Shell Overseas Investments. This facility, located in Rotterdam, is set to become Europe's largest renewable hydrogen plant upon its completion in 2025. The plant will feature a 200 MW electrolyzer, producing up to 60,000 kilograms of renewable hydrogen daily. The hydrogen generated will supply Shell's Energy and Chemicals Park Rotterdam, facilitating the decarbonization of energy products like petrol, diesel, and jet fuel[86]. Another significant initiative is the Eemshydrogen project by RWE Generation SE. Planned for the Eemshavencentrale site in the northern Netherlands, this project aims to construct a 50 MW electrolyzer powered by RWE's Westereems wind farm. The green hydrogen produced will serve various sectors, including transportation and chemical industries, contributing to the reduction of carbon emissions in North-Western Europe[87]. Additionally, Gasunie, through its subsidiary Hynetwork Services, has taken an FID to develop the first section of a national hydrogen network. This initial segment, exceeding €100 million in investment, will connect major industrial regions in the Netherlands and neighboring countries, such as Germany and Belgium. The network will utilize existing natural gas pipelines, with the first section running over 30 kilometers from the Tweede Maasvlakte to Pernis in Rotterdam, expected to be operational by 2025. Gasunie is also exploring hydrogen storage solutions, particularly utilizing underground salt caverns[88]. Finally, TotalEnergies and Air Liquide signed two agreements. The first is to build and operate a 250 MW electrolyzer near the Zeeland refinery. The second is the Air Liquide ELYgator Project in Maasvlakte, which features a 200 MW electrolyzer and will supply 130 MW of green hydrogen to the TotalEnergies platform in Antwerp[89]. The ELYgator project received support from the EU's Innovation Fund[90].

4.4.2 Financing

Program	Description	Technology	EUR in Billion
OWE	Offers a 7- to 15-year CfD for renewable hydrogen production. This subsidy is being put out to tender. It is a subsidy scheme for large-scale hydrogen production (electrolyzer with a production capacity of at least 0.5 MW)[91].	H2	1

[84] https://luchtvaartintransitie.nl/en/about-us/
[85] https://nlplatform.com/articles/maritime-masterplan-boosted-growth-fund#:~:text=The%20masterplan%20sets%20out%20a,in%20the%20maritime%20sector%20significantly.&text=In%20the%20plan%2C%2040%20climate,Dutch%20government%20as%20launching%20customer.
[86] https://www.offshore-energy.biz/shell-takes-fid-to-build-large-renewable-hydrogen-facility/
[87] https://www.rwe.com/en/press/rwe-generation/2024-04-29-rwe-receives-grant-for-eemshydrogen-project-to-build-50-mw-electrolyzer/
[88] https://www.tno.nl/en/sustainable/industry/clean-hydrogen-production/storage-transport-hydrogen/
[89] https://totalenergies.com/news/press-releases/totalenergies-joins-forces-air-liquide-decarbonize-its-refineries-northern
[90] https://www.airliquide.com/group/press-releases-news/2025-02-18/air-liquide-announces-major-investments-support-european-decarbonization-collaboration-totalenergies
[91] https://english.rvo.nl/subsidies-financing/owe

SDE++ (CfD)	The scheme supports a wide range of initiatives including projects based on renewable electricity and heat, low carbon and renewable gas, including hydrogen, and transport fuels[92]	H2 and other	Total scheme is 42 billion
DEI+	grant intended to reduce CO2 emissions by supporting innovative technologies.	H2 and other	The grant rate is usually between 25 and 50% of project costs.

4.5 Sweden

4.5.1 Sweden and EU Regulations/Directives implementation and transposition

Ambition: 5 GW of electrolysis capacity by 2030[93]

Strategy

The Swedish Energy Agency[94] put forward a hydrogen strategy[95] in 2021 but since then it is in a draft stage. The document mentions a hydrogen target of 5 GW electrolyzer capacity by 2030 and 15 GW by 2045[96].

- In the first phase (2022–2030) pilot and demonstration projects will be launched, local hydrogen hubs and clusters will emerge and will be developed as well as infrastructure for transport and storage of hydrogen.
- In the second phase (2031–2045) provided that sufficient fossil-free electricity supply and grid capacity are established, new value chains for fossil-free hydrogen, electrofuels, and ammonia can be developed. The draft strategy emphasize that hydrogen should be used where is most cost-effective and delivers the highest system benefits [97].

Currently, the governing document is the Government's Energy Policy Proposal[98] (Prop. 2023/24:105 Energipolitikens långsiktiga inriktning)[99]. The government assessed that fossil-free[100] hydrogen can play a crucial role in Sweden's future energy system reducing energy dependency by replacing fossil fuels in industry and reduce emissions in other sectors such as heavy transport. However, expanding Sweden's production of fossil-free hydrogen will require a substantial increase in renewable electricity generation. The Prop. 2023/24:105 recalls the Swedish draft hydrogen strategy and the fact that hydrogen should be prioritized when it's the most cost-effective solution.

Governance

The Swedish Energy Agency is responsible for hydrogen strategy coordination in Sweden. Additionally, the Energy Market Inspectorate is working on implementing the EU Gas Market Package, which includes hydrogen market rules.

[92] https://english.rvo.nl/subsidies-financiering/sde
[93] https://www.energimyndigheten.se/nyhetsarkiv/2021/forslag-till-nationell-strategi-for-fossilfri-vatgas/
[94] Body in charge of coordinating the work on hydrogen in Sweden
[95] https://www.energimyndigheten.se/nyhetsarkiv/2021/forslag-till-nationell-strategi-for-fossilfri-vatgas/
[96] ibidem
[97] ibidem
[98] https://www.regeringen.se/contentassets/2fd0739890d8484b8129d3c0e678f24d/energipolitikens-langsiktiga-inriktning-prop.-202324105.pdf

[100] Translated from swedish

NECP overview

According to the Swedish NECP, Sweden does not have a national target for the share of renewable energy by 2030. According to the Swedish Energy Agency's latest scenario analysis from 2023, Sweden will achieve a 67 % share of renewable energy in 2030[101].

Regarding the transposition of the Renewable Energy Directive (RED), the Prop. 2023/24:105 highlights that Sweden offers favourable conditions for RFNBO production via electrolysis, particularly in the northern regions. Southern Sweden can also contribute to RFNBO generation by utilizing nuclear power[102]. While the use of RNFBO hydrogen in industry is emphasized, no specific RNFBO hydrogen targets are specified in the NECP.

When it comes to the implementation of the Hydrogen and decarbonised gas market package, the government assigned to the Energy Market Inspectorate[103] the task to draft a report and a proposal for new natural gas and hydrogen legislation. Hydrogen infrastructure should be expanded in a way that facilitates the transition and safeguards Sweden's competitive energy prices[104]. Plans for hydrogen infrastructure include the development of national and cross-border pipelines, such as the Baltic Sea Hydrogen Collector and the Nordic Hydrogen Route[105], both of which have been granted PCI status. The goal of these projects is to establish a robust and integrated hydrogen network that enhances energy security, supports industrial decarbonization, and strengthens Sweden's position in the emerging European hydrogen market.

Projects

The most notable investments are in the steel sector, particularly in the transition to fossil-free steel production. Key projects include H2 Green Steel and HYBRIT[106], both of which aim to replace fossil fuels with hydrogen in steelmaking, significantly reducing carbon emissions and advancing the decarbonization of heavy industry. In particular, H2 Green Steel ordered more than 700MW of alkaline electrolyzers from German manufacturer Thyssenkrupp Nucera for its flagship green steel facility[107]and received financing from the EU's InvestEU programme[108]. In 2023, Ovako inaugurated a 20 MW electrolyzer in Hofors. Ovako's hydrogen plant is the world's first facility for producing fossil-free hydrogen to heat steel before rolling[109]. The Swedish Energy Agency provided financing to this project through the program Industrial Leap (see 4.5.2)[110].

[101] https://commission.europa.eu/publications/sweden-final-updated-necp-2021-2030-submitted-2024_en?prefLang=pt

[102] https://www.energimyndigheten.se/remissvar-ochuppdrag/Download/?documentName=F%C3%B6rslag%20till%20nationell%20strategi%2025%20nov.pdf&id=1793

[103] Sweden's regulatory authority responsible for overseeing electricity, natural gas, and district heating markets, ensuring fair competition, efficiency, and consumer protection.

[104] ibidem

[105] For additional info see section 6 'Cooperation Among Member States'

[106] The Hybrit project has secured funding from both the EU's Innovation Fund and the Industrial Leap (see 4.5.2). https://www.highnorthnews.com/en/fossil-free-steel-production-northern-sweden-hybrit-project-goes-industrial#:~:text=With%20the%20help%20of%20HYBRIT,the%20Swedish%20funding%20program%20Industriklivet.

[107] https://www.hydrogeninsight.com/industrial/worlds-first-commercial-scale-green-steel-plant-on-track-for-fid-after-ordering-700mw-of-hydrogen-electrolyzers/2-1-1454069

[108] https://www.eib.org/en/press/all/2024-015-eib-and-nib-to-provide-eur371-million-with-investeu-backing-for-h2-green-steel-s-large-scale-production-of-steel-with-minimal-carbon-footprint#:~:text=The%20EIB%20and%20NIB%20financing,steel%20plant%20in%20Boden%2C%20Sweden.

[109] https://www.ovako.com/en/about-ovako/worlds-first-fossil-free-hydrogen-plant-for-steel-heating/

[110] https://www.ovako.com/en/newsevents/stories/hydrogen-plant-ramping-up/#:~:text=Sweden's%20Energy%20Agency%2C%20provided%20funding,a%20more%20environmentally%20friendly%20EU.

4.5.2 Financing

Program	Description	Technology	EUR in Billion
Industrial Leap	Through grants and loans, this program finances industrial decarbonization projects, among which H2 projects. It was launched in 2017. Initially focused on direct emission reductions, its scope was expanded in 2019 to support projects that achieve negative emissions. In 2021, it was further extended to include key sectors such as biofuels, hydrogen production, plastic recycling, and battery manufacturing. The initiative now also funds measures that indirectly cut industrial emissions, covering everything from research to full-scale deployment. It will finance projects through 2031[111].	H2 and others	0.1
Recovery and Resilience Facility	In June 2024 the EU Commission approved €265 million Swedish State aid measure partly funded under Recovery and Resilience Facility to support H2GS's green steel plant. The measure will support H2GS's project aimed to set up a large-scale green steel plant in Boden, Sweden. The steel plant includes the construction of: (i) one of the largest electrolyzers in the world with a capacity of 690 MW; (ii) a direct reduction plant operating with renewable hydrogen; (iii) two electric arc furnaces; and (iv) cold rolling and finishing facilities[112]	Support for green industry transformation using H2	0.3

4.6 Austria

4.6.1 Austria and EU Regulations/Directives implementation and transposition

Ambition: 1 GW of electrolyzer capacity by 2030[113]

Austria's Hydrogen Strategy was launched in 2022. The Strategy outlines the country's approach to integrating hydrogen into its energy system to achieve climate neutrality by 2040.

Austria aims to replace 80% of fossil-based hydrogen with climate-neutral hydrogen in energy-intensive industries by 2030 and the country set a target of 1 GW of installed electrolyzer capacity by 2030.

Guiding principles of the hydrogen strategy for Austria:

- Climate-neutral hydrogen: renewable hydrogen is the priority. However, according to the Strategy, climate-neutral hydrogen also includes hydrogen which is produced from fossil gas through complete CO2-separation ("blue hydrogen") or through pyrolysis ("turquoise hydrogen"). Nuclear-derived hydrogen and hydrogen from fossil gas without full CO_2 capture are not considered sustainable.

[111] https://www.industriklivet.se/en/#:~:text=The%20Industrial%20Leap%20will%20facilitate,sector%20which%20needs%20to%20transform
[112] https://ec.europa.eu/commission/presscorner/detail/en/ip_24_3468
[113] bmk_wasserstoff_executive-summary_EN_UA.pdf

- Efficient and focused use of hydrogen in sectors where electrification is not a viable option: Key sectors include the steel and chemical industries, and transportation (long-haul trucking, shipping, aviation). The role of hydrogen in peak load balance and as storage and flexibility option is also emphasized.
- Infrastructure development: Existing natural gas networks will be repurposed for hydrogen, ensuring direct hydrogen transport rather than blending with natural gas. Strategic hydrogen infrastructure will be deployed at industrial hubs and integrated with European networks.
- International cooperation: Given that Austria's renewable hydrogen demand will surpass domestic production potential, the strategy emphasizes European and global partnerships to secure imports and position Austria as a hydrogen hub. Austria has initiated a strategic partnership with Italy and Germany to develop the Southern Hydrogen Corridor connecting the MENA Region with Europe for imports via direct pipeline.

Governance

The "Hydrogen Strategy for Austria" was jointly developed by the Federal Ministry of Climate Action, Environment, Energy, Mobility, Innovation and Technology and the Federal Ministry of Labour and Economy. To ensure the implementation of the Hydrogen Strategy and a regular dialogue between stakeholders and decision-makers, the Hydrogen Platform 'Hydrogen Partnership Austria' (HyPA) was established by the two Ministries, with management support by the Austrian Energy Agency and the Business Promotion Agency of Tyrol[114].

NECP Overview

Austria aims to reach at least 57% of renewable energy in gross final energy consumption by 2030[115].

Regarding the implementation of RED III

- In the industry sector: the NECP reiterates the ambition of replacing 80% of fossil-derived hydrogen with climate-neutral hydrogen by 2030 in particular industry sectors such as steel and chemicals.
- In the transport sector: Austria aims to ensure a comprehensive implementation of RED III targets and achieve higher shares of renewables than the RED III minimum requirements.

Additionally, a Renewable Gas Act (EGG) that was under consideration under the last government but failed to secure the necessary parliamentary support has been stipulated as a renewed priority by the incoming government, setting a target of a total renewable gas production of at least 6.5 TWh by 2030 through the support instrument of market premiums.

Austria aims to implement the hydrogen and decarbonized gas market package by the end of the year leveraging on its already well-developed gas infrastructure. Consequently, Austria is working on establishing the necessary legal framework to enable the development of this

[114] https://www.bmaw.gv.at/en/Topics/International/Hydrogen-Strategy-for-Austria.html
[115] https://commission.europa.eu/document/download/368783a6-2986-46e3-8a93-38beefc3872f_en?filename=AT%20%E2%80%93%20FINAL%20UPDATED%20NECP%202021-2030%20%28English%29.pdf&prefLang=nl

hydrogen infrastructure, including the repurposing of existing gas pipelines for regional hydrogen transport[116].

Regarding RefuelEU Aviation, Austria developed a 'Roadmap for Sustainable Aviation Fuels' (SAF), defining measures to ensure the availability, sustainability, and competitiveness of SAF[117].

When it comes to FuelEU Maritime Austria will invest in alternative fuels infrastructure for inland waterway transport[118].

Projects

In May 2023, Austria's first green hydrogen production site has commenced operations in Styria. This facility, which began operations with a 1 MW electrolyzer powered by a nearby solar park, is poised to expand to over 150 MW in the coming years[119]. Additionally, the oil and gas company OMV will commission its first electrolysis plant at the Schwechat refinery in 2025. The plant will have a 10 MW capacity. Looking ahead, OMV is planning a much larger electrolysis plant with a capacity of up to 200 MW, which is expected to begin operations in 2027, subject to a final investment decision[120]. Additionally, VERBUND, leading energy company is investing in green hydrogen as part of its strategy to support industrial decarbonization. Its subsidiary, VERBUND Green Hydrogen GmbH, is dedicated to producing and distributing hydrogen. In 2024, VERBUND and Westfalen Group have signed a declaration of intent for the supply of green hydrogen from Austria starting in 2026. VERBUND, will produce hydrogen at multiple sites, while Westfalen will distribute it mainly to medium-sized businesses in Austria and southern Germany[121].

4.6.2 Financing

Program	Description	Technology	EUR in Billion
Decarbonization of industrial production processes, CfDs ("Transformation of Industry")	The instrument support projects for the reduction of greenhouse gas emissions from industrial installations. The aid will take the form of direct grants, covering either investment costs only ('investment grants'), or both investment and operating costs ('transformation grants') [122]	H2 and others	Total scheme is 2.7 billion EUR until 2030.
H2B Auction as a service– H2 Production Support Act	Granting of a fixed premium per kg Hydrogen, over a period of 10 years. Participation via the EU Hydrogen Bank (EU Innovation Fund).	H2	0,82 until 2026

[116] https://commission.europa.eu/publications/austria-final-updated-necp-2021-2030-submitted-2024_en?prefLang=nl
[117] https://www.bmk.gv.at/en/topics/transport/aviation/aviation-strategy/saf-roadmap.html
[118] https://commission.europa.eu/publications/austria-final-updated-necp-2021-2030-submitted-2024_en?prefLang=nl
[119] https://hydrogeneurope.eu/austrias-first-green-h2-production-plant-goes-live/#:~:text=Austria's%20first%20green%20hydrogen%20production,MW%20in%20an%20initial%20push.
[120] https://www.omv.com/en/expertise/fuels-and-feedstock/green-hydrogen
[121] https://www.verbund.com/en-at/about-verbund/news-press/press-releases/2024/04/15/westfalen-gruppe-wasserstoff
[122] https://ec.europa.eu/commission/presscorner/detail/en/ip_24_4746

4.7 Czech Republic

4.7.1 Czech Republic and EU Regulations/Directives implementation and transposition

Ambition: produce around 20,000 tons of renewable hydrogen per year by 2030 (installed electrolyzers capacity = 400 Mwe)

Strategy

The Czech hydrogen strategy, launched in 2021, sets the framework for the development of the hydrogen sector from 2021 until 2050. The strategy was updated in 2024. The updated Strategy is structured into three phases[123]:

- "Local Island" (2023-2030): This initial phase aims to create self-sufficient hydrogen production and consumption hubs/hydrogen valleys across the country. By 2030, the goal is to produce approximately 20,000 tons of renewable hydrogen per year, for which it is necessary to build new electrolyzers with a capacity of 400 MWe. These 'islands' will integrate renewable and nuclear energy sources to ensure a stable hydrogen supply, irrespective of seasonal variations. A key objective is to establish a foundation that can later scale up with more cost-effective imported renewable hydrogen. During this period, hydrogen will primarily be used in mobility and the chemical industry.
- "Global Bridges" (2030-2045): This second phase aims to expand hydrogen supply chains by importing renewable hydrogen from regions with abundant and cost-efficient renewable energy resources leveraging on the Czech repurposed natural gas network. The development of EU hydrogen projects such as the Central European Hydrogen Corridor and the Czech German Hydrogen Interconnector will enable the Czech Republic to become part of the European hydrogen ecosystem. Investments in hydrogen transport infrastructure, such as repurposed pipelines and hydrogen distribution networks, will be crucial during this phase. Importing renewable hydrogen from abroad will help drive down its cost.
- "New Technologies" (2045-2060): In the final phase, the focus will shift to advanced hydrogen production methods, such as high-temperature electrolysis and renewable electricity from geothermal energy. These innovations are expected to drive down production costs and bolster the Czech Republic's energy independence. studies estimate that the price of hydrogen could drop as low as 2 Euro/kg.

Governance

The Czech Hydrogen Strategy was developed by the Ministry of Industry and Trade. This Ministry worked with other ministries such as the Ministry of the Environment and the Ministry of Transport as well as with other stakeholders on the Strategy update. The Plenipotentiary of the Minister of Industry and Trade for Hydrogen Technologies oversees the advancement and practical application of hydrogen technologies. He manages a Hydrogen Coordination Group and Coordination Group of Hydrogen Valleys.

NECP Overview

Czech Republic is updating its national legislation to align with the targets and provisions set by EU law.

On the transposition of the Renewable Energy Directive, to meet the hydrogen demand from the industry and transport sectors, the country plans to install 400 MWe of electrolyzer capacity, assuming

[123] https://mpo.gov.cz/en/guidepost/for-the-media/press-releases/government-approved-the-update-of-the-hydrogen-strategy-of-the-czech-republic--282178/

a 30% utilization rate. According to preliminary calculations, meeting the RED III industry target would require around 8000 tonnes per year of RFNBO hydrogen in Czech Republic. To meet the transport target 13600 tonnes RFNBO H2 per year are needed[124].

When it comes to the Hydrogen and Decarbonized Gas Market Package, the Czech Republic is planning to repurpose two existing gas pipelines for hydrogen transport: one from Lanžhot to Brandov to facilitate imports from North Africa, Ukraine, and Southeast Europe, and another from Brandov to Waidhaus to import hydrogen from Scandinavia, the Baltic, and the North Seas. Each pipeline will have an initial capacity of 1.5 Mt of hydrogen per year (50 TWh/year).[125] Additionally, a significant regulatory milestone was reached with the amendment of the Czech Energy Act (Act No. 458/2000 Coll.), which came into effect on January 1, 2024. This amendment officially includes hydrogen among the gases that can be distributed via the pipeline network, meaning it is now governed by the same legal framework as natural gas[126].

Regarding the EU Alternative Fuels Infrastructure Regulation (AFIR), the NECP mentions the National Action Plan on Clean Mobility (NAP CM), which outlines a gradual hydrogen infrastructure rollout. By 2025, five hydrogen refueling stations are planned, with further expansion depending on an assessment of hydrogen mobility potential. By 2030, the country expects to deploy 4,000 hydrogen passenger cars, 1,200 light commercial hydrogen vehicles, and 600 hydrogen-powered trucks. However, battery-electric vehicles have seen faster adoption than hydrogen-powered passenger cars.

Projects

The first commercial green hydrogen electrolyzer in the Czech Republic, producing green hydrogen using electricity from its own rooftop solar power plant, was developed by Solar Global in Napajedla and started operation in October 2023. The electrolyzer has a capacity of 230 kW and can produce up to 82 kilograms of hydrogen per day. It has been supplemented with hydrogen storage and its own compressor unit, with a capacity of approximately 400 kg of compressed hydrogen gas[127]. The project received approximately CZK 40 million in funding from the Czech Ministry of Transport[128]. Additionally, Unigranit, a Czech building materials company, has ordered an AEM Nexus 1000 electrolyzer with an initial capacity of 500 kW, expandable to 1 MW to lower the carbon footprint of their production processes[129]. Finally, other Czech companies such as CEZ are working on developing hydrogen projects aimed at advancing green hydrogen production and infrastructure[130].

[124] https://commission.europa.eu/document/download/3164cc75-45db-4898-bc63-d5f7d989c9c9_en?filename=CZ%20%E2%80%93%20FINAL%20UPDATED%20NECP%202021-2030%20%28English%29.pdf
[125] https://commission.europa.eu/document/download/3164cc75-45db-4898-bc63-d5f7d989c9c9_en?filename=CZ%20%E2%80%93%20FINAL%20UPDATED%20NECP%202021-2030%20%28English%29.pdf
[126] https://cms.law/en/int/expert-guides/cms-expert-guide-to-hydrogen/czech-republic
[127]https://www.solarglobal.cz/en/vodik#:~:text=SG%20Hydrogen%20is%20the%20first,decarbonise%20energy%2C%20industry%20and%20mobility.
[128] https://www.solarglobal.cz/en/tiskova-zprava/zlinsky-kraj-centrem-zelene-revoluce-spolecnost-solar-global-v-napajedlech-vybuduje-jednu-z-prvnich-plnicich-stanic-na-zeleny-vodik
[129] https://www.enapter.com/enapter-news/back-into-action-with-our-next-aem-nexus-delivery-and-autumn-events/
[130] https://www.cez.cz/webpublic/file/edee/ospol/fileexport/investori/half-year-financial-report-2024_en.pdf

4.7.2 Financing

The majority of funds available for hydrogen in Czech Republic are included within the Modernisation Fund. Key programmes are:

Program	Description	Technology	EUR in Billion
GREENGAS Programme	supports electrolyzers for renewable hydrogen production and investments in hydrogen t storage[131]	H2 and others	0.12
Programme ENERG ETS	subsidy program focused on supporting decarbonization and energy efficiency in industrial processes, The program is designed for entities operating facilities under the EU Emissions Trading System (EU ETS) in the Czech Republic, including energy-intensive industries[132]	H2 and others	The funding covers 30–80% of eligible project costs[133]
Just Transition Fund	Dedicated projects, including hydrogen ones, for transformation of coal region (Ústí nad Labem, Karlovy Vary and Moravia-Silesia Regions)	H2 and others	
Interreg programs	Support for crossborder cooperation and sharing of information and best practices.	H2 and others	

4.8 Ireland

4.8.1 Ireland and EU Regulations/Directives implementation and transposition

Ambition: 2 GW of offshore wind capacity for renewable hydrogen production by 2030

Strategy

Ireland published its hydrogen strategy in summer 2023. The strategy sets a target of 2 GW of offshore wind capacity for renewable hydrogen production, to be developed by 2030, which will enhance investors' confidence and help generating the necessary volumes required to scale up the sector. The Strategy is driven by three key policy objectives[134]:

- Decarbonisation: hydrogen has the potential to become a zero-carbon substitute for fossil fuels in hard-to-decarbonise sectors where electrification is not feasible. Priority is given to green hydrogen and blue hydrogen is considered acceptable only with full carbon capture and storage (CCS).
- Energy Security: Ireland aims to leverage on its vast offshore renewable sources to produce hydrogen, reducing dependence[135] on fossil fuel imports and enhancing energy resilience. Hydrogen can also enable large-scale seasonal energy storage and help balancing variable renewables.
- Industrial and export opportunities: Ireland has the potential to produce more renewable hydrogen than it needs, positioning itself as a supplier for European markets. Exporting hydrogen could drive economies of scale, lower costs, attract investment in infrastructure, and create high-skilled jobs in the renewable energy sector.

To make the vision outlined in the strategy a reality, 21 key actions are defined. They include mapping Ireland's renewable energy surplus, creating an early innovation fund to support early-stage hydrogen projects, adopting EU standards for renewable and low carbon hydrogen and developing a national

[131] https://cms.law/en/int/expert-guides/cms-expert-guide-to-hydrogen/czech-republic
[132] https://danovky.cz/en/news/detail/1479
[133] https://www.sfzp.cz/files/documents/storage/2021/06/29/1624956268_ModF_Vyzva_1_2021_ENERG_cistopis.pdf
[134] https://assets.gov.ie/263248/f982c10f-eca6-4092-a305-90000e5213ed.pdf
[135] Ireland imported 77% of its energy in 2021.

certification scheme to provide clarity to end users as to the origin and sustainability of their hydrogen. The actions also focus on developing business models that foster the growth and expansion of renewable hydrogen. They emphasize utilizing surplus renewable grid electricity before 2030 and aiming for an initial 2 GW of offshore wind capacity starting in 2030. Additional steps include publishing a draft National Policy Framework on Alternative Fuels Infrastructure and creating a plan for transitioning the gas network to hydrogen over time, as well as developing safety standards, identifying and addressing gaps, engaging with the EU and other Member States to bolster cooperation in the hydrogen field. Given the current state of play, the development of a hydrogen market will most likely happen after 2030[136].

Governance

The Department of the Environment, Climate and Communications developed the text for the consultation on the Irish Hydrogen Strategy. Currently, Ireland is in the process of finalizing/operationalizing a task force, the Interdepartmental Hydrogen Working Group, which will overview the delivery of the 21 actions and identify further measures to support future actions needed as the sector develops[137].

NECP overview

The 21 key actions align with the goal of implementing and transposing hydrogen regulations and directives into the national framework. Regarding the Renewable Energy Directive (RED), the NECP targets 70% renewable electricity by 2030. However, there will be periods when the electrical grid cannot absorb all the renewable energy produced. In such cases, the option to produce green hydrogen and creating an integrated energy system could help maximize the use of renewable resources. Hydrogen produced from underutilized renewable electricity could be stored in the local gas grid and used in the heating and transport sectors. The NECP also mentions the possibility of reconfiguring current CCGTs (Combined Cycle Gas Turbines) for hydrogen. Additionally, hydrogen turbines could be developed as backups for intermittent renewables. Regarding RED III, Ireland will mainly focus on transposing the transport targets as the demand for hydrogen at industry level is currently low[138][139]. A renewable transport fuel obligation scheme that includes multipliers for renewable hydrogen is already in place[140].

In the framework of the Hydrogen and Decarbonized Gas Market Package, the NECP mentions the possibility of hydrogen blending with natural gas but the package still needs to be fully implemented[141].

Overall, heavy-duty transport sectors, which are subject to binding EU targets for 2030, are expected to be the first end use sectors to develop, with industry and flexible power generation following closely behind. Aviation and maritime will emerge as key end-users, but the development of the use of hydrogen in these sectors is likely to take a longer time frame[142].

Projects

In September 2024, Microsoft partnered with the Electricity Supply Board (ESB) on a project to power Microsoft's data center and administration building in Dublin using green hydrogen. This pilot project,

[136] https://assets.gov.ie/263248/f982c10f-eca6-4092-a305-90000e5213ed.pdf
[137] https://energy.ec.europa.eu/system/files/2020-08/ie_final_necp_main_en_0.pdf
[138] https://assets.gov.ie/263248/f982c10f-eca6-4092-a305-90000e5213ed.pdf
[139] Ireland has one refinery - Whitegate refinery. The refinery must comply with RED III.
[140] https://energy.ec.europa.eu/system/files/2020-08/ie_final_necp_main_en_0.pdf
[141] ibidem
[142] https://assets.gov.ie/263248/f982c10f-eca6-4092-a305-90000e5213ed.pdf

the first of its kind for a Microsoft data center in Europe, will supply up to 250 KW of clean energy over an eight-week period[143].

Ireland is planning to establish a Hydrogen valley (SH2AMROCK project) and a multi-modal hydrogen transport hub in Galway. This initiative seeks to integrate renewable hydrogen into Ireland's energy system, facilitating decarbonization across multiple applications[144].

4.8.2 Financing

Program	Description	Technology	EUR in Billion
Zero Emissions Heavy Duty Vehicle Purchase Grant Scheme	In February 2024, the Irish government launched a subsidy program to encourage the adoption of hydrogen-powered heavy-duty vehicles. The program offers grants covering up to 60% of the cost difference between zero-emission vehicles and their diesel counterparts, promoting the transition to cleaner transportation options[145].	H2 and others	The grants cover up to 60% of the cost difference between ZEVs[146] and diesel equivalents

4.9 Hungary

4.9.1 Hungary and EU Regulations/Directives implementation and transposition

Ambition: 240 MW of electrolysis capacity by 2030

Strategy

Hungary's National Hydrogen Strategy was adopted in May 2021. The Strategy sees low carbon hydrogen as an opportunity to match demand and scale up production in the short-term. In the long-term priority is given to renewable hydrogen. The Strategy established key 2030 objectives and measures:

- Hydrogen production: Hungary aims to establish a competitive and scalable hydrogen market by developing low-carbon and renewable hydrogen production. By 2030, the country targets an annual production of 36,000 tons, (20,000 tons from low-carbon sources and 16,000 tons of green hydrogen). The 2030 electrolyzer capacity target is 240 MW. Although calculation restarted after the release of RED III and 1.6 GW of capacity would be required for hydrogen supply if production for consumption target would be exclusively domestic, which Hungary does not see as a realistic option for 2030.
- Industrial Decarbonization: Hungary aims to gradually replace grey hydrogen with green and low-carbon hydrogen in ammonia production, refining, chemical, cement and steel industry. By 2030, the Strategy aims for 24,000 tons of hydrogen to be used in industrial applications (20,000 tons low-carbon and 4,000 tons green hydrogen), resulting in an annual reduction of 95,000 tons of CO_2 emissions. To accelerate this transition, Hungary plans to develop two hydrogen valleys in Transdanubia and Northeast Hungary, creating regional hubs for hydrogen production, distribution, and industrial consumption.
- Green Transportation: Hungary aims to integrate 10,000 tons of green and other carbon-free hydrogen in the transport sector by 2030. This will support the operation of 4,800 hydrogen-

[143] https://news.microsoft.com/source/emea/2024/09/microsoft-announces-pioneering-green-hydrogen-pilot-project-with-esb/
[144] https://www.clean-hydrogen.europa.eu/projects-dashboard/projects-repository/sh2amrock_en
[145] https://www.hydrogeninsight.com/transport/-100-000s-off-fcevs-irish-government-opens-subsidy-programme-for-hydrogen-powered-heavy-duty-vehicles/2-1-1602634
[146] zero-emissions vehicles

powered vehicles, including trucks, buses, and municipal waste collection fleets. The strategy also prioritizes the development of a national hydrogen refueling infrastructure strategically placed along key transport corridors. These efforts will contribute to reducing transport-related CO_2 emissions by 130,000 tons annually.

- Energy and natural gas infrastructure: Hungary will invest in Power-to-Gas (P2G) technologies, to convert excess renewable electricity into hydrogen. By 2030, the country plans to establish an average down-regulation capacity of 60 MW, enabling more efficient integration of renewables. Additionally, the strategy includes blending hydrogen into the natural gas network, with an initial target of 2% hydrogen content, subject to further technical assessments. Hungary is also working towards regional integration with the European Hydrogen Backbone, ensuring cross-border trade and infrastructure development. The Hungarian Gas Transmission Operator FGSZ is highly committed to build the Hungarian section of the Central European Hydrogen Corridor by 2030. The corridor will contribute to supply hydrogen in south-east direction from the Near and Middle East to Germany and along its rout included Hungary. The FGSZ also prepares hydrogen connection from SoutH2 Corridor to the Central European Hydrogen Corridor by 2035.
- Supply chain: the strategy promotes the development of domestic manufacturing capabilities for hydrogen-related technologies.
- Regulation and international cooperation: Hungary aims to align national policies with EU hydrogen regulations, ensuring clear definitions, certification schemes, and incentives for hydrogen production and use. The strategy also emphasizes international partnerships, particularly through IPCEI projects, Visegrád Group cooperation, and participation in EU-wide hydrogen corridor initiatives.
- R&D and Education: the strategy mentions the establishment of a National Hydrogen Technology Laboratory, dedicated to research, pilot projects, and technology validation. An innovation support scheme will be launched in 2025.

Implementation Timeline:

- 2021-2023: Establishment of regulatory and operational frameworks, initiating pilot projects.
- 2024-2025: Launch of major industrial and mobility initiatives, expansion of hydrogen infrastructure.
- 2026-2030: Scale up hydrogen applications, integration of Hungary's hydrogen economy into the European market.

Governance

The Ministry of Energy is in charge of implementing the national hydrogen Strategy.

NECP Overview

Regarding the transposition of RED III targets:

- In the industry sector the NECP identifies hydrogen as a key decarbonization tool for energy-intensive industries and mentions that imports will be needed to meet RFNBOs targets
- In the transport sector Hungary aims for a 25% renewable share of transport fuels by 2030. To reach this target, Hungary will increase the share of advanced biofuels and renewable fuels of non-biological origin (RFNBO) in final energy consumption in transport to 1% by 2025 and 5.5% by 2030.

Hungary is currently working on a legislative reform in line with the transposition of RED III and gas decarbonisation package, aimed at incentivizing investment in these renewable gases, primarily by streamlining licensing and authorization procedures.

In the framework of the Hydrogen and Decarbonized Gas Market Package, Hungary plans to invest in hydrogen-compatible pipelines and underground storage. Additionally, FGSZ (Hungary's gas transmission system operator) is already part of the European Hydrogen Backbone (discussed in Section 5).

Projects

In April 2024, MOL Group inaugurated a 10 MW green hydrogen plant at its Danube Refinery in Százhalombatta. This facility is the largest of its kind in Central and Eastern Europe. The facility is designed to produce approximately 1,600 tonnes of green hydrogen annually, using electricity from renewable sources. The electrolyzer is expected to reduce the refinery's carbon dioxide emissions by over 25,000 tonnes per year, equivalent to removing roughly 5,400 cars from the road. The €22 million investment aligns with MOL Group's 'SHAPE TOMORROW' strategy, aiming to enhance sustainability and energy self-sufficiency in the region. The green hydrogen produced will primarily be used within MOL's network for fuel production[147].

Akvamarin project started in 2021 under the management of MFGT (Hungarian gas storage operator). The test operation of the 2.5 MW of electrolyzer already started last year. The project primarily provides a pilot opportunity for hydrogen industrial developments, such as the research and development of LOHC (Liquid Organic Hydrogen Carriers) storage technology. Five universities are participating in the project[148].

The 'Bükkábrány' project started in 2021 in the Bükkábrány Energy Park. The main aim was to develop and test innovative energy storage and control system technology, which can continuously regulate the operation of the electrolyzer in real time, depending on surplus electricity available from the solar park's production. The project utilizes the renewable electricity production of the energy park's 19.9 MW capacity solar power plant. The 1 MW capacity electrolyzer test mode had begun in 2024[149].

4.9.2 Financing

Program	Description	Technology	EUR in Billion
Funding scheme for sectors strategic for the net-zero economy	Provides financing the form of direct grants and/or tax advantages to different sectors eg. batteries, solar panels, wind turbines, heat-pumps, electrolyzers, and equipment for carbon capture usage and storage [150]	H2 and others	Total scheme is 2.36 billion EUR

[147] https://molgroup.info/en/media-centre/press-releases/mol-started-production-in-the-largest-capacity-green-hydrogen-plant-of-the-region
[148] https://mfgt.hu/en/Akvamarin
[149] https://hungarytoday.hu/first-green-hydrogen-plant-starts-trial-operation/
[150] https://ec.europa.eu/commission/presscorner/detail/it/ip_23_3851

4.10 Poland

4.10.1 Poland and EU Regulations/Directives implementation and transposition

Ambition: 2 GW of electrolysis capacity by 2030[151]

Strategy

In 2021 the Polish Government published the 'Polish Hydrogen Strategy until 2030 with an outlook until 2040'[152] - strategic document setting out the main objectives and actions needed for the development of the hydrogen economy in Poland. Poland is currently one of the largest producers and consumers of hydrogen in Europe[153]. However, most of the hydrogen production in Poland relies on fossil fuels. The strategy aims to change this by building a full hydrogen value chain, expanding renewable energy use, and creating the necessary legislative and financial frameworks to support the transition. The strategy is structured around six main objectives:

- Integrating hydrogen into the energy and heating sector: over the next five years from the publication of the strategy, efforts will be directed toward research and development in fuel cell systems, Power-to-Gas (P2G), and Gas-to-Power (G2P) technologies. These advancements will help integrate hydrogen into residential and commercial energy systems, allowing for better cooperation between gas and electricity networks and enabling energy storage solutions.
- hydrogen as an alternative fuel for transport: hydrogen is seen as a key solution for decarbonizing sectors where direct electrification is challenging or economically unfeasible. In the short term, Poland plans to introduce between 100 and 250 hydrogen-powered buses by 2025, along with the construction of at least 32 refueling stations. By 2030, this number is expected to increase to around 800–1000 buses. The strategy also envisions the development of hydrogen-powered trains, ships, and even applications in aviation.
- decarbonization of industry: Poland's industrial sector is one of the largest consumers of hydrogen, particularly in chemicals, petrochemicals, and refining. Shifting to low-carbon hydrogen will significantly reduce emissions, especially in energy-intensive industries such as steel production. To accelerate this transition, the government plans to establish at least five hydrogen valleys by 2030, which will serve as innovation hubs, fostering collaboration between industry, research institutions, and infrastructure developers.
- Hydrogen production from low-carbon sources: over the next five years, the goal is to launch at least 50 MW of hydrogen production capacity from renewable or low-emission sources. By 2030, this figure is expected to reach 2 GW. Unlike some other hydrogen policies that focus on specific technologies, the Polish approach is technology-neutral, prioritizing emissions reduction rather than prescribing a particular production method. However, support for hydrogen from fossil fuels will only be granted if effective carbon capture and storage (CCS) or utilization (CCU) technologies are applied.
- Efficient and safe hydrogen transmission, distribution, and storage: in the early stages, hydrogen will mainly be transported by road and rail. However, as demand grows, Poland plans to adapt its existing natural gas networks for hydrogen transport and eventually build dedicated hydrogen pipelines. For large-scale storage, salt caverns have been identified as the most viable option.
- Establishing a stable regulatory environment: removing legal and administrative barriers to hydrogen market development is essential to ensure long-term investment and encourage the adoption of renewable hydrogen technologies. The government also plans to promote research and development and formally concluding a Hydrogen Economy Sector Deal.

Governance

[151] https://www.trade.gov.pl/en/extended-topics/polands-hydrogen-strategy-a-green-future/
[152] https://www.trade.gov.pl/en/extended-topics/polands-hydrogen-strategy-a-green-future/
[153] including self-production for fertilizers

The Strategy was drafted by the Ministry of Climate and Environment. To effectively manage the aforementioned Sector Deal, the Hydrogen Economy Coordination Council was created, bringing together 45 members from various sectors. The Council has formed seven working groups to develop solutions and set priorities for Poland's hydrogen economy.

NECP Overview

The implementation of EU hydrogen objectives will create the demand for 260,000 tons of renewable hydrogen in 2030 and 514,500 tons in 2035 in Poland. The country will require an additional 13.4 terawatt-hours (TWh) of renewable electricity by 2030 and 25.5 TWh by 2035[154].

As of the publication of this report only the draft updated NECP 2021-2030 is available. The final version is not available yet[155].

Regarding the transposition of RED III targets, the Ministry of Climate and Environment has estimated that, to meet the expected hydrogen demand from industry and transport, Poland will need more than 300,000 tonnes of RFNBO hydrogen by 2030. Therefore, Poland plans to update its 'Hydrogen Strategy for 2030 with an outlook for 2040', to align it with current needs and define the development pathways for the RFNBO hydrogen market. Additionally, a comprehensive legislative package is under development to establish the regulatory framework for the hydrogen market[156].

In the framework Hydrogen and Decarbonized Gas Market Package, Poland's draft NECP outlines plans to establish a legal framework for hydrogen transmission and distribution, including cross-border infrastructure and technical standards for hydrogen storage[157].

Notably, in November 2024, Poland enacted legislation introducing key definitions such as low-emission hydrogen and renewable hydrogen. The act also established guidelines for collaboration between operators and the procedures for designating these operators. Consequently, Poland designated a Transmission System Operator (TSO) to prepare plans for developing the country's hydrogen infrastructure. This role has been assigned to GAZ-SYSTEM, the current natural gas system operator, facilitating the integration of natural gas and hydrogen sectors[158].

Regarding ReFuelEU Aviation, currently, Poland lacks sufficient domestic SAF production capacity to meet its aviation fuel demands. This shortfall necessitates the development of new supply chains and the construction of appropriate storage infrastructure to accommodate SAF imports. Most Polish airports do not have dedicated storage facilities for SAF, and existing logistics rely on current supply bases. Poland is working on regulatory system for Sustainable Aviation Fuels (SAFs)[159]. A draft of the regulation has been prepared and is currently under consultation.

[154] https://fuelcellsworks.com/news/the-demand-for-renewable-hydrogen-in-poland-will-amount-to-514-5-thousand-tons-in-2035

[155] https://commission.europa.eu/energy-climate-change-environment/implementation-eu-countries/energy-and-climate-governance-and-reporting/national-energy-and-climate-plans_en

[156] https://commission.europa.eu/publications/poland-draft-updated-necp-2021-2030_en

[157] Poland has one of the largest hydrogen storage potentials in Europe, estimated at up to 10,000 TWh in salt caverns

[158] https://www.gaz-system.pl/en/hydrogen-market/news/19-12-2024-gaz-system-published-survey-results-on-the-hydrogen-map-of-poland.html The company conducted a comprehensive survey, resulting in the 'Hydrogen Map of Poland', which identified 178 hydrogen production, consumption, distribution, and storage projects nationwide. The findings indicate a projected increase in hydrogen production post-2030, stabilizing at approximately 1.11 million tons annually after 2040, with the highest concentration in North-West Poland. Conversely, hydrogen consumption is expected to rise from 1.27 million tons in 2030 to 2.62 million tons in 2040, primarily in the central and south-west regions. This data underscores a potential shortfall in domestic production relative to demand, suggesting the necessity for increased production or imports.

[159] https://commission.europa.eu/publications/poland-draft-updated-necp-2021-2030_en

Financial mechanisms such as Contracts for Difference (CfD) will also be introduced to support hydrogen production. However, in order to meet the total estimated hydrogen demand, the draft NECP recognizes that imports will also be necessary.

Projects

Poland is actively developing Hydrogen Valleys, including the Greater Polish Hydrogen Valley, which was initiated in July 2021. This initiative focuses on producing green hydrogen and integrating local technological solutions into the global hydrogen value chain. Key stakeholders include regional authorities, major cities such as Poznań and Konin, universities, and companies like Solaris Bus & Coach and ZE PAK[160]. Similarly, the Pomeranian Hydrogen Valley, established in 2019, aims to build a hydrogen ecosystem in the Pomeranian region. Its projects focus on land and sea transportation, with initiatives supporting the development of hydrogen-powered buses, trains, and ships[161].In addition to these two major hydrogen valleys, several others have been established across Poland. The Mazovian Hydrogen Valley, Silesian Hydrogen Valley, Lower Silesian Hydrogen Valley, and Podkarpackie (Subcarpathian) Hydrogen Valley are also playing a crucial role in advancing hydrogen production and applications, particularly in industrial decarbonization, mobility, and energy storage[162].

Finally, PKN ORLEN is leading several hydrogen projects, including the HYDROGEN EAGLE program, which plans to develop an international network of hydrogen hubs powered by renewable energy across Poland, the Czech Republic, and Slovakia. The program includes constructing over 100 hydrogen refueling stations and achieving an annual hydrogen production capacity of approximately 50,000 tonnes by 2030[163] and qualified as IPCEI[164].

4.10.2 Financing

Program	Description	Technology	EUR in Billion
New Technologies in the Field of Energy "	Program launched by the National Centre for Research and Development (NCBR) for the period 2021-2029. The programme aims to support Poland's transition to climate neutrality by implementing solutions that enhance energy security and competitiveness. It focuses on six technological areas, including hydrogen technologies[165].	H2 and others	0.8

[160] https://h2poland.eu/en/categories/hydrogen-valleys/public-perception/doliny-wodorowe-w-polsce/
[161] ibidem
[162] ibidem
[163] https://www.orlen.pl/en/about-the-company/media/press-releases/2021/june/orlen-group-to-launch-international-hydrogen-program
[164] https://www.orlen.pl/en/about-the-company/media/press-releases/2021/june/orlen-group-to-launch-international-hydrogen-program
[165] https://www.gov.pl/web/ncbr-en/new-technologies-in-the-field-of-energy

5. Cooperation among Member States

The development of a competitive and integrated hydrogen market in the European Union relies on a combination of financial instruments and strategic cooperation frameworks. These mechanisms help mobilize investments, de-risk projects, and enhance cross-border coordination to scale up hydrogen production, infrastructure, and applications. Several EU-level initiatives play a crucial role in supporting hydrogen deployment.

5.1 Important Projects of Common European Interest (IPCEIs)

IPCEIs are large-scale, cross-border projects that involve multiple EU Member States and aim to address significant market failures by supporting innovation and industrial leadership in strategic sectors. They allow for targeted state aid to fund projects that might not be viable under normal EU competition rules[15].

Hydrogen-Related approved IPCEIs[166]:

IPCEI	Description	Countries	Amounts
Hy2Tech (Hydrogen Technology)	The IPCEI focuses on advancing hydrogen technologies across the value chain, including production, fuel cells, storage, transportation, distribution, and mobility applications. Aims to achieve technological breakthroughs such as efficient electrode materials, high-performance fuel cells, and innovative transport technologies. Expected to create approximately 20,000 direct jobs.	Austria, Belgium, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Italy, Netherlands, Poland, Portugal, Slovakia, and Spain	Up to €5.4 billion in public funding, anticipated to unlock an additional €9 billion in private investments.
Hy2Use (Hydrogen Industry)	The IPCEI supports the development of hydrogen infrastructure and its integration into industrial processes, particularly in sectors that are challenging to decarbonize, such as steel, cement, and glass. Projects include constructing large-scale electrolyzers and transport infrastructure to bolster renewable and low-carbon hydrogen production, storage, and distribution.	Austria, Belgium, Denmark, Finland, France, Greece, Italy, Netherlands, Poland, Portugal, Slovakia, Spain, Sweden, and Norway.	Up to €5.2 billion in public funding, expected to stimulate an additional €7 billion in private investments
Hy2Infra (Hydrogen Infrastructure)	The IPCEI aims to establish a comprehensive hydrogen infrastructure by deploying 3.2 GW of large-scale electrolyzers, approximately 2,700 km of hydrogen transmission and distribution pipelines, large-scale storage facilities with at least 370 GWh capacity, and port infrastructure to handle liquid organic	France, Germany, Italy, Netherlands, Poland, Portugal, and Slovakia	Up to €6.9 billion in public funding, anticipated to attract an additional €5.4 billion in private investments

[166] IPCEIs – example of electrolyzer projects with a capacity > 100MW that reached FID: Shell's Refhyne 2, EWE Clean H2 Coastline (Emden), RWE's GET H2 Nukleus Project, Green H2 Los Barrios, Asturias H2 Valley, 'Bilbao Large Scale electrolyzer' of the Basque Hydrogen Corridor (BH2C)

	hydrogen carriers. Facilitates the emergence of an EU-wide hydrogen network by connecting regional clusters.		
IPCEI Hy2Move (Hydrogen Mobility)	The IPCEI focuses on integrating hydrogen technologies into various transport modes, including road, maritime, and aviation. Projects involve developing fuel cell vehicle platforms for buses and trucks, high-performance fuel cells for ships and locomotives, advanced on-board hydrogen storage solutions for aircraft, and technologies for on-site hydrogen production at refueling stations.	Estonia, France, Germany, Italy, Netherlands, Slovakia, and Spain	Up to €1.4 billion in public funding, expected to leverage an additional €3.3 billion in private investments

Source: EU Commission (link)

5.2 Projects of Common Interest (PCIs)

PCIs are trans-European energy infrastructure projects that support the EU's energy policy goals, particularly market integration, security of supply, and decarbonization. They receive regulatory and financial support under the Connecting Europe Facility (CEF) and benefit from streamlined permitting procedures[16]. Hydrogen-related PCIs were first included in the European Union's 6th PCI list, adopted on November 28, 2023. 65 hydrogen related projects feature in the list[17].

Main Hydrogen-Related approved PCIs:

PCI	Description	Countries
H2Med Project	H2Med is designed to transport up to 2 million tonnes of renewable hydrogen annually, accounting for 10% of Europe's projected consumption by 2030. The project comprises two main components: the CelZa pipeline connecting Portugal and Spain (Celorico de Beira to Zamora) and the BarMar maritime pipeline linking Spain and France (Barcelona to Marseille).	Portugal, Spain, France, with support from Germany.
Baltic Sea Hydrogen Collector (BHC)	The BHC aims to establish a large-scale, cross-border infrastructure for collecting and transporting green hydrogen across the Baltic Sea region, thereby supporting the creation of an efficient and reliable European hydrogen market.	Finland, Sweden, with involvement from Denmark
SoutH2 Corridor	The SoutH2 Corridor is a hydrogen pipeline network spanning approximately 3,300 km, facilitating the transportation of hydrogen from North Africa to Europe. It aims to import up to 4 million tonnes per annum (Mtpa) of hydrogen, delivering over 40% of the EU's import target set by the REPowerEU Plan.	Italy, Austria, Germany, potential extensions to North African countries
Czech-German Hydrogen Interconnector (CGHI)	The CGHI aims to create a hydrogen interconnector linking high-potential hydrogen supply areas in Northern Germany and the Baltics with anticipated high-demand clusters in the EU, particularly in Southern Germany and Northern Bohemia. The project also plans to connect local suppliers and consumers along the corridor.	Czech Republic, Germany
Central European Hydrogen Corridor (CEHC)	The CEHC explores the feasibility of establishing a hydrogen pipeline corridor in Central Europe to transport hydrogen from major supply areas in Ukraine through Slovakia and the Czech Republic to demand regions in Germany. This corridor will also facilitate hydrogen transport between production facilities and consumers within the Czech Republic and Slovakia.	Czech Republic, Slovakia, Germany, + potential extensions to Ukraine

Northern Hydrogen Backbone (NHB)	The NHB aims to develop a hydrogen pipeline network connecting hydrogen production sites in Northern Europe with major consumption centers across the continent. This project is part of the broader European Hydrogen Backbone initiative, which envisions a pan-European hydrogen transport network.	Netherlands, Germany, Denmark
Hydrogen Baltic Pipeline (HBP)	The HBP aims to establish a hydrogen pipeline connecting the Baltic States with Central Europe, facilitating the integration of hydrogen markets and enhancing energy security in the region.	Estonia, Latvia, Lithuania, Poland

Source: EU Commission (link). 65 hydrogen projects out of the 179 submitted under the 6th list of PCIs were accepted by the EU Commission.

5.3 Bilateral or Multilateral Cooperation Among Member States

Bilateral or Multilateral Cooperation Among Member States are mechanisms that allow countries to collaborate on regional hydrogen infrastructure, cross-border trade, and industrial hubs. They help pool resources and ensure alignment on regulatory frameworks.

Initiative	Description	Countries
North Seas Energy Cooperation (NSEC)	Established in 2016, the NSEC is a regional, non-binding cooperation framework aimed at facilitating the cost-effective deployment of offshore renewable energy, particularly wind energy, in the North Seas region. It promotes the development of an integrated offshore energy grid, linking renewable energy sources across the northern seas of Europe. The cooperation supports the EU's climate and energy objectives for 2030 and 2050[167].	Belgium, Denmark, France, Germany, Ireland, Luxembourg, the Netherlands, Norway, Sweden, and the EU Commission.
European Hydrogen Backbone (EHB) Initiative	Launched in 2020, the EHB initiative brings toghether European gas TSOs to develop a dedicated hydrogen transport infrastructure across Europe. The initiative aims to repurpose existing natural gas pipelines and construct new hydrogen pipelines to create a pan-European hydrogen network, facilitating the development of a competitive, liquid, and cross-border hydrogen market[168]	33 energy infrastructure operators from 22 countries

5.4 Memoranda of Understanding (MoUs)

MoUs are non-binding agreements that set the groundwork for policy coordination, infrastructure development, and hydrogen trade between countries. They can be stipulated both between EU Member States and/or with third countries to foster cross-border collaboration.

Hydrogen-related MoUs

MoU	Description
MoU NSEC - UK	The United Kingdom was previously a NSEC member but left following Brexit on 31 January 2020. A MoUs between NSEC and the UK was signed in December 2022, establishing a cooperation framework[169].
EU Commission - France, Portugal and Spain	The MoU will strengthen cooperation on cross-border energy infrastructure in South-West Europe[170]

[167] https://energy.ec.europa.eu/topics/infrastructure/high-level-groups/north-seas-energy-cooperation_en
[168] https://ehb.eu/
[169] https://energy.ec.europa.eu/news/north-seas-energy-cooperation-and-uk-establish-cooperation-framework-facilitate-development-offshore-2022-12-18_en
[170] https://energy.ec.europa.eu/news/european-commission-and-energy-ministers-france-portugal-and-spain-strengthen-cooperation-cross-2023-12-19_en

6. Conclusions/Recommendations

- Hydrogen should be a means to enable decarbonization, not an end in itself. The regulatory framework, including financial incentives, should be designed in a technologically neutral manner to maximize efficiency and allow for the most effective decarbonization pathways.
- A rapid and consistent implementation of the EU hydrogen framework is crucial to provide the necessary regulatory certainty for investors and industry stakeholders. Delays in transposition at the national level create uncertainty, slowing down project development and capital allocation. A clear and predictable regulatory environment will encourage long-term investments in hydrogen production, infrastructure, and end-use applications. Member States should prioritize swift and consistent implementation while ensuring that administrative and permitting processes are streamlined to avoid bottlenecks.
- EU Member States have adopted different approaches to support hydrogen, reflecting their unique energy landscapes and industrial priorities. This diversity reflects the need for a degree of flexibility in transposing and adapting the EU hydrogen framework at the national level. While localized approaches are necessary, excessive divergence in national policies risks creating fragmentation in the EU hydrogen market. Coordinated efforts to harmonize key aspect will be essential to ensure a level playing field in Europe.
- The cost of green hydrogen remains significantly higher than fossil-based alternatives, making it difficult to achieve large-scale market adoption. Mechanisms[171] at the EU and Member State level can play a key role in closing the price gap, ensuring competitiveness, and facilitating market development.
- The EU Hydrogen Bank is seen as an opportunity for supporting the EU hydrogen market uptake. However, the current structure of the European Hydrogen Bank may disadvantage smaller Member States. Establishing regional windows within the Hydrogen Bank could promote a more balanced distribution of funding.
- Global policy shifts, particularly in the United States, along with the rapid advancement of emerging technologies like artificial intelligence, may lead to a reassessment of EU Member States strategic priorities. However, the publication of the EU Clean Industrial Deal reinforces Europe's commitment to promoting the uptake of renewable and low-carbon hydrogen as a pillar of industrial decarbonization. The Industrial Decarbonisation Accelerator Act, by developing a label on the carbon intensity of industrial products and their certification, should enable consumers to make informed decisions and boost the development of the EU hydrogen economy. The challenge lies in ensuring that hydrogen development remains aligned with broader industrial competitiveness goals.

[171] Such as CfDs, CCfDs, H2Global.