The European hydrogen policy landscape

Extensive update of the April 2024 report

January 2025

Disclaimer

The aim of this report is to reflect the situation in the European and national policies, legislations, strategies and codes & standards which impact the deployment of hydrogen technologies and infrastructures, as of July 2024, unless stated otherwise. This report serves as an extensive update to the previous version published in April 2024, which covered data up to August 2023. It incorporates advancements and developments that occurred in the interim period, providing a comprehensive overview of the current landscape. The authors believe that this information comes from reliable sources, but do not guarantee the accuracy or completeness of this information.

The data of the European Hydrogen Observatory will continuously be updated. These updates will take place annually for most datasets, while for some it can also be done on a case by case basis. As a result, the information used as of writing of this report might differ from the updated data that is presented on the European Hydrogen Observatory.

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This report was prepared for the Clean Hydrogen JU as part of the European Hydrogen Observatory. Copies of this document can be downloaded from https://observatory.clean-hydrogen.europa.eu/.

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Clean Hydrogen Partnership

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Executive summary

This report summarises the status of the European hydrogen policy landscape. It is based on the information available at the European Hydrogen Observatory (EHO) platform, the leading source of data and information on hydrogen in Europe (EU27, EFTA and the UK). Building on the previous report published in April 2024, which reflected data as of August 2023, this report provides an extensive update, capturing advancements and developments over the past year. It offers a comprehensive overview of the European and national policies, legislations, strategies and, codes and standards which impact the deployment of hydrogen technologies and infrastructures.

The EHO database now includes 32 EU policies and legislations that directly or indirectly impact the development and deployment of hydrogen technologies, with an addition of 3 new EU policies compared to the previous report, now including the Advanced Materials for Industrial Leadership Strategy, the adopted Electricity Market Design Reform and the Revised Industrial Emission Directive. All of which were released or adopted in 2024. This expansion reflects the growing regulatory attention on the hydrogen sector. The growing number of implemented legislations and policies have an impact on the whole value chain of hydrogen including production, transport, storage and distribution, and end-uses. Other key changes to EU policies relevant to the hydrogen value chain include the final adoption of the Hydrogen and Decarbonized Gas Market Package, Net Zero Industry Act, Critical Raw Material Act, Energy Performance of Buildings Directive and the CO_2 emission performance standards for new heavy-duty vehicles.

At the national level, as of May 2024, 21 out of 32 European countries have successfully published their national strategies in the hydrogen sector, while 3 countries are in the draft stage. Compared to July 2023, Lithuania has now published its first hydrogen strategy, and Romania has progressed from no strategy to the draft stage.

Several European countries have strategically incorporated quantitative indicators within their national strategies outlining their targets and estimates across the hydrogen value chain. This deliberate approach reflects a commitment to providing clear and measurable goals within their hydrogen strategies.

A target often used in national strategies is electrolyser capacity, reflecting efforts to enhance domestic renewable hydrogen production. Germany maintains the highest goal, aiming for 10 GW of electrolyser capacity by 2030, consistent with the previous report. France follows with an unchanged target of 6.5 GW by 2030. Other targets that some of the countries use in their strategies are on the number of hydrogen refuelling stations, fuel cell electric vehicles and total (renewable) hydrogen demand.

A few countries also have targets on renewable hydrogen uptake in industry and hydrogen injection limit in the transmission grid.

To monitor the policies and legislation that are adopted on a national level across the hydrogen value chain, a survey was launched with national experts, which was validated by Hydrogen Europe. In total, 30 European countries have participated to the survey (+2 countries compared to August 2023).

On production, the survey revealed that 20 country specialists (67%) report that their country provides support for capital expenditure (CAPEX) in the development of renewable or low-carbon hydrogen production plants (+3 countries since August 2023). Moreover, 8 countries also provide support for operational expenditure (OPEX). Furthermore, 13 countries have instituted official permitting guidelines for hydrogen production projects (+5 countries since August 2023), while 6 countries have enacted a legal act or established an agency serving as a single point of contact for hydrogen project developers, with no change since August 2023. For transmission, since August 2023 no additional countries have reported support schemes for hydrogen injection into the transmission grid, with the total remaining at two, Ireland and Portugal. Several countries have policies in place that clearly define the hydrogen limit in their transmission grid for now and in the future. Since August 2023, the minimum hydrogen concentration has increased from 0.02% to 0.1%, while the maximum concentration remains unchanged at 15%. A few countries define within their policies the operation of hydrogen storage facilities.

On end-use, the questionnaire zoomed in on the different type of applications for clean hydrogen, i.e. mobility, heating, power and industry. For mobility, the majority of countries, totalling 23, (77%) reported to have implemented support schemes aimed at promoting the adoption of hydrogen (+3 countries since August 2023). Purchase subsidies stand out as the predominant form of support for fuel cell electric vehicles (FCEVs), with implementation observed in 20 countries. Since August 2023, the number of countries adopting support schemes for stationary fuel applications, including heating and power generation, has doubled, rising from 2 to 4. Similarly, six countries now provide support for the deployment of hydrogen-based residential and commercial heating systems, reflecting the same growth since the previous year. For hydrogen end-use in industry, a total of 12 countries reported providing support schemes as of 2024, an increase of 3 countries since August 2023. The chemicals industry has become the primary focus, with support schemes in 11 countries (up from 7), while ammonia production now ranks second with support in 10 countries (up from 8 in 2023). On the topic of technology manufacturing, 7 countries reported having support schemes as of July 2024, the same number as in August 2023. However, there was a notable shift in the composition of countries offering these schemes.

Exploring the latest advancements in European codes and standards relevant to the deployment

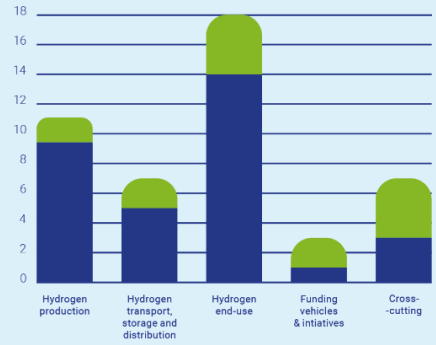
of hydrogen technologies and infrastructures, a total of 16 standards have been revised and developed in 2024 (6 have been already captured in the EHO database). These standards cover various stages of the hydrogen value chain, with 10 standards covering distribution and storage, 7 standards focusing on end-use applications, and 1 standard related to cross-cutting areas. Notably, no standards related to production were reviewed or developed during this period. These standards mainly cover hydrogen fuel cell technologies, road vehicles, hydrogen refuelling stations, and plastics pipes, fittings and valves for the transport of gases.

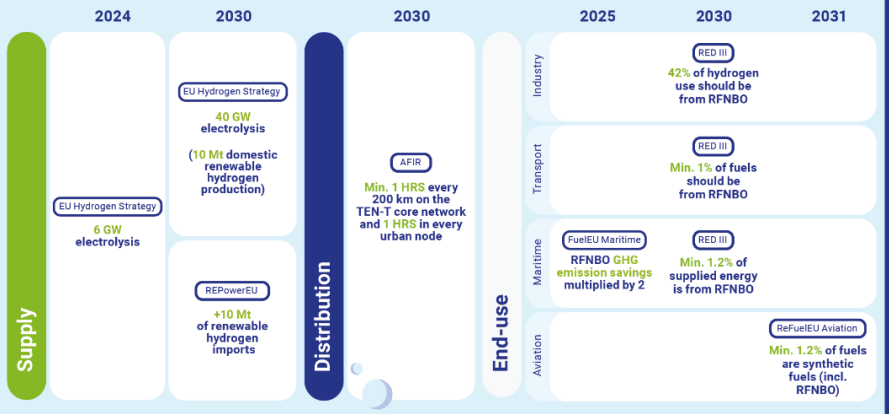
Key insights

EU Policies & Legislation

The EHO database now includes 32 EU policies and legislations, with 3 new additions compared to the previous report, covering various categories across the hydrogen value chain.

The 3 additions specifically address hydrogen production and end-use applications.

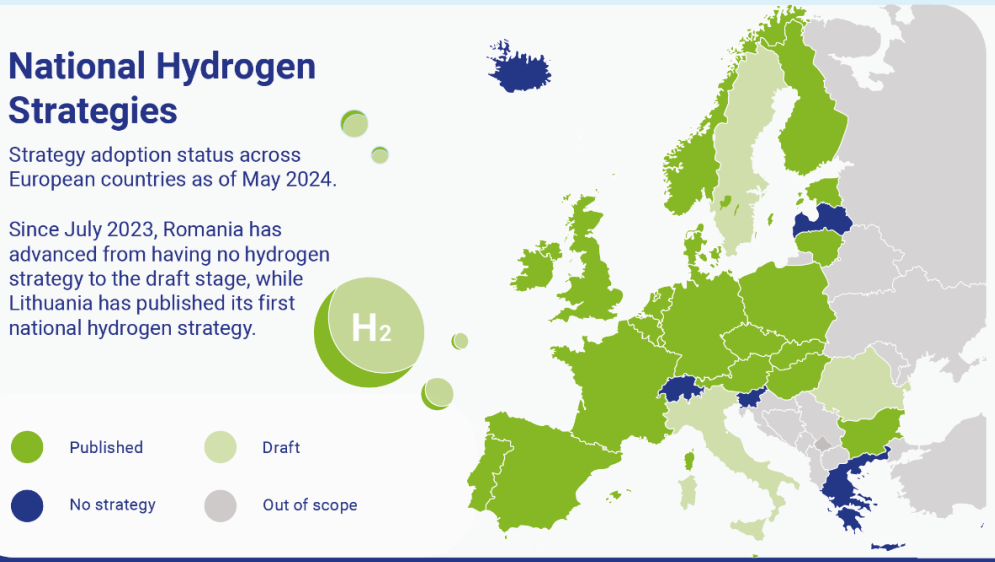




National Hydrogen Strategies

Strategy adoption status across European countries as of May 2024.

Since July 2023, Romania has advanced from having no hydrogen strategy to the draft stage, while Lithuania has published its first national hydrogen strategy.



Production

12 countries have targets on **electrolysis capacity** ranging between **0.1 and 10 GW by 2030**.

Transmission

4 countries have targets on **hydrogen blending limits** in their **natural gas transmission** networks with a **hydrogen concentration of 2 to 15% by 2030**.

End-use

9 countries have estimated their future **hydrogen demand ranging** from **0.16 to 130 TWh by 2030**.

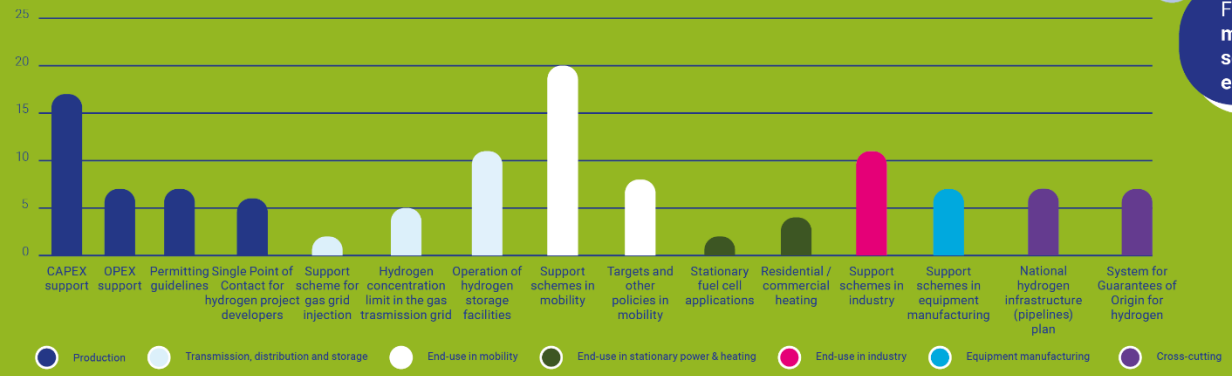
7 countries have targets on the number of **HRS ranging** from **10 to 125 units by 2030.**

6 countries have targets on the number of **FCEV** with a major focus on **road transport**.

Key insights

National Policies & Legislation

Number of countries with national policies and legislation relevant to hydrogen sector by topic in Europe



For **production** and **equipment manufacturing**, **support schemes** have a main focus on **electrolysers.**

Support schemes in **mobility** mainly focus **on road transport**.

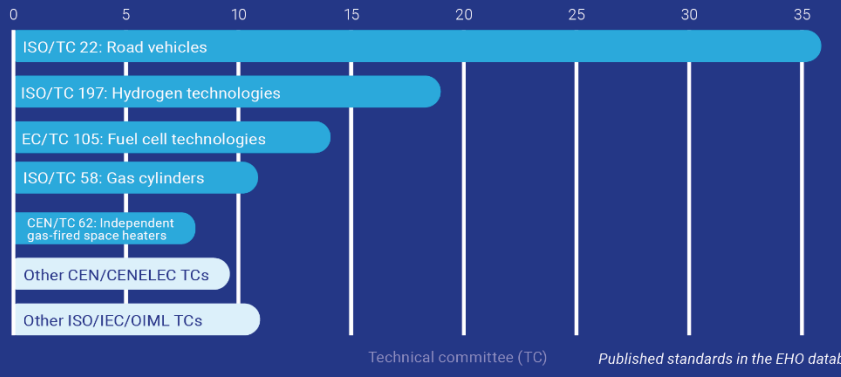
Codes & Standards

107
searchable standards on the EHO database

16
revised or newly developed standards in 2024 (6 already included in the EHO database)

21 **different technical committees of standardisation bodies, of which 5 are responsible for publishing around 80% of the standards.**

Most of the standards in the EHO database have focus on end-use (59%) and distribution & storage (28%).



Overview

A growing number of governments are acknowledging the importance of the hydrogen sector and are implementing policy support measures, which are required to ensure technology readiness, enhance market penetration, and stimulate market growth. Policies collectively shape the landscape for hydrogen technologies and infrastructures. They provide a regulatory framework, financial support, and strategic direction to promote the sustainable deployment of hydrogen across European countries.

This report aims to summarise the status of the European hydrogen policy landscape. It is based on the information available at the European Hydrogen Observatory (EHO) website, the leading source of data on hydrogen in Europe. The data presented in this report is based on research conducted by Hydrogen Europe until the end of July 2024, but also goes beyond this timeline for major policies, legislations or standards implemented recently. This report builds upon the previous version published in April 2024, which reflected data as of August 2023, providing updated insights on European policies and legislation, national strategies, national policies and legislation, and codes and standards. Interactive data dashboards can be accessed on the website: https://observatory.clean-hydrogen.europa.eu/

The EU policies and legislation section provides insights into the main European policies and legislation relevant to the hydrogen sector, which are briefly summarized on content and their potential impact to the sector.

The national hydrogen strategies chapter offers a comprehensive examination of the hydrogen strategies adopted in Europe. It summarizes the quantitative indicators that have been published (targets and estimates) and provides brief summaries of the different national strategies that have been adopted.

The section referring to national policies and legislation focuses on the policy framework, measures, incentives and targets in place that have an impact on the development of the respective national hydrogen markets within Europe.

The codes and standards section provides information on current European standards and initiatives developed by the standardisation bodies, including CEN, CENELEC, ISO, IEC, OIML The standards are categorised according to the different stages of the hydrogen value chain: production, distribution and storage, and end-use applications.

01

EU Policies and legislation

This chapter provides an overview of the current European policies and legislation relevant to the deployment of hydrogen technologies and infrastructure.

It provides a brief description of the policies and the main expected impacts for the sector.

The data on European policies and legislation presented on the European Hydrogen Observatory website are based on content analysis, publicly available information, and expert knowledge from Hydrogen Europe, and reflects the situation as of May 2024.

Interactive data dashboards on EU policies and legislation can be accessed on the European Hydrogen Observatory website.

1.1. Overview

The European Hydrogen Observatory (EHO) now covers a total of 32 policies, both of legislative and non-legislative nature enacted that directly or indirectly affect the development and deployment of hydrogen technologies at the EU level, with an addition of 3 new policies compared to the previous report (i.e. the Advanced Materials for Industrial Leadership Strategy, the Electricity Market Design Reform and the Revised Industrial Emission Directive).

Legislative content typically involves a directive (e.g. Renewable Energy Directive) or a regulation (e.g. Regulation setting CO_2 emission performance standards for new passenger cars and light-duty vehicles). Non-legislative content involves a high-level political strategy, roadmap, or communication (e.g. EU Green Deal communication or the Hydrogen Strategy).

The EHO website provides more information on these policies based on their relevance and impact across various value chain levels of the clean hydrogen industry. The EU policies are broken down into the following categories: (1) cross-cutting, (2) hydrogen production, (3) hydrogen transport, storage and distribution, (4) hydrogen end-uses and (5) funding vehicles and initiatives.

In Figure 1 an analysis is made on the number of EU policies and legislations, that are available in the EHO database, applicable to different categories within the hydrogen value chain. Moreover, Table 1 gives a complete overview of the different policies and legislations that are presented in the EHO website. The content of these policies and legislations are summarized in the following subsections, broken down according to the different steps in the value chain.

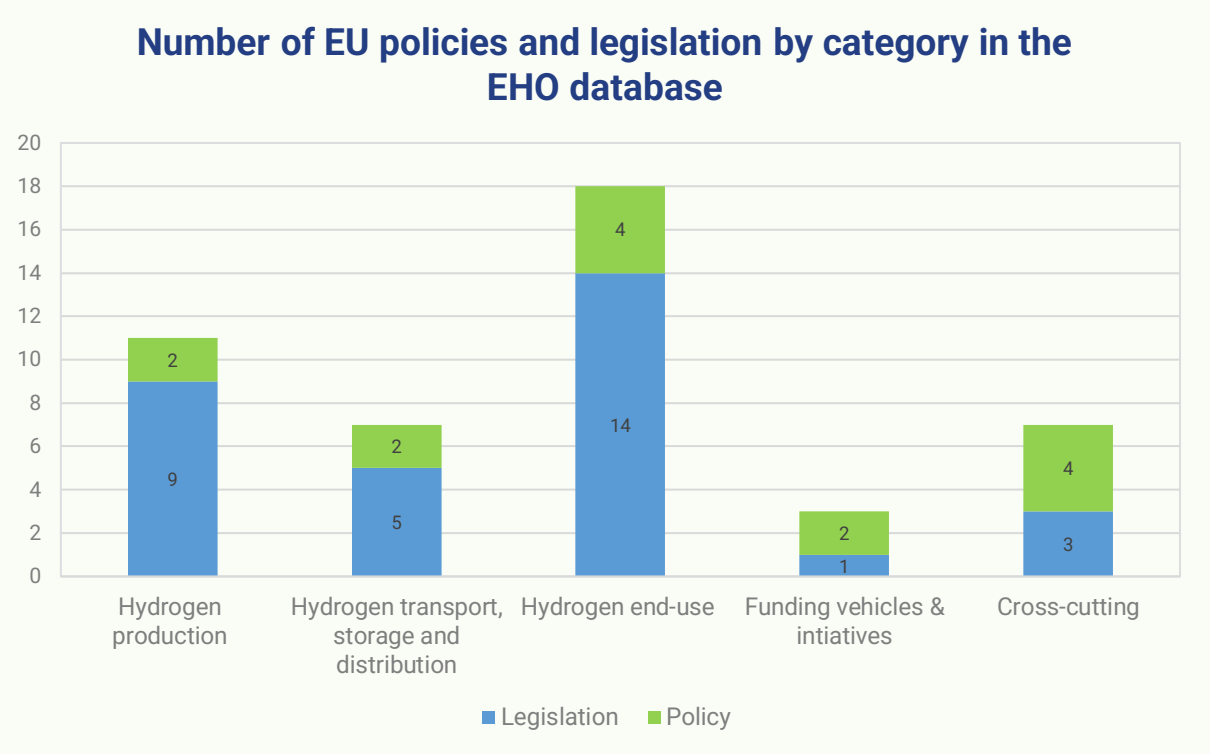


Figure 1. Number of EU policies and legislation in the EHO database by category.

Table 1. EU policies and legislations covered in the EHO database sorted by topic as explained in this report.

Cross-cutting	
EU Green Deal	European Climate Law
EU Energy System Integration Strategy	EU Hydrogen Strategy
Industrial Strategy	Sustainable finance
REPowerEU	
Production	
Energy Efficiency Directive	Renewable Energy Directive
EU Emissions Trading Scheme	Carbon Border Adjustment Mechanism
Hydrogen and Decarbonised Gas Market Package Adopted in 2024	Net Zero Industry Act Adopted in 2024
Critical Raw Materials Act Adopted in 2024	Offshore Renewable Energy Strategy
Advanced Materials for Industrial Leadership Strategy New in 2024	Electricity Market Design Reform Adopted in 2024
Industrial Emissions Directive Adopted in 2024	
Transport, storage and distribution	
Sustainable and Smart Mobility Strategy	TEN-T Regulation Adopted in 2024
Alternative Fuels Infrastructure Regulation Entered into force in 2024	FuelEU Maritime
REFuelEU Aviation	
End-use	
Energy Taxation Directive	Renovation wave
Energy Performance of Buildings Directive Adopted in 2024	CO_2 emission performance standards for passenger cars and light duty vehicles
CO_2 emission performance standards for heavy duty vehicles	Public procurement for clean vehicles
Funding vehicles and initiatives	
State Aid	Innovation Fund
Hydrogen Bank	

Most of the policies and legislations presented in this chapter cover the broader energy transition topic that also directly or indirectly includes the deployment of hydrogen technologies. In some of the policies and legislations clear targets and commitments are set forward, specifically for hydrogen technologies deployment or hydrogen uptake. These targets and commitments are summarized in Figure 2, also broken down according to the different steps in the value chain.

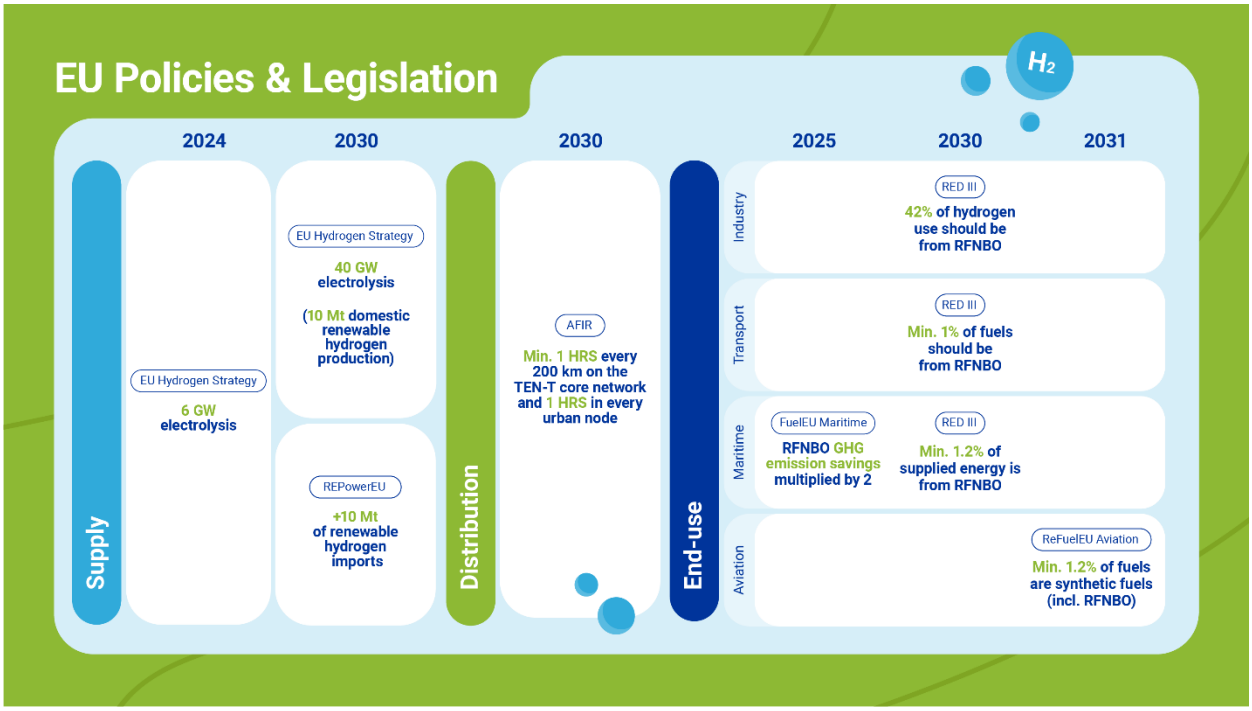


Figure 2. Direct targets and commitments by EU policies and legislations towards hydrogen technologies deployment and hydrogen uptake across the value chain.

1.2.
EU Policies and legislation by category

1.2.1.
Cross-cutting

The European energy and climate policy landscape is undergoing significant changes to create a framework that supports the transition to a climate-neutral economy. The main objectives are to enhance greenhouse gas reductions by encouraging the adoption of clean technologies like hydrogen. This section summarizes these major EU policies and legislations that have been implemented and that have an impact across all sectors, including hydrogen deployment.

European Green Deal [1] and Climate Law [2]

In late 2019, the newly elected European Commission presented its proposal for a European Green Deal. This policy roadmap is meant to be an EU's new growth strategy. It provides significantly stronger emphasis on the decarbonisation dimension of the Energy Union

[1] The European Green Deal-European Commission (europa.eu)
[2] European Climate Law-European Commission (europa.eu)

through a resource-efficient and competitive economy where there are no net emissions of greenhouse gases in 2050 and where economic growth is decoupled from resource use. It also aims to protect, conserve and enhance the EU's natural capital, and protect the health and well-being of citizens from environment-related risks and impacts. The Green Deal objectives are now being executed in many legislative and non-legislative initiatives, aimed at implementing the increased level of ambition. Most importantly, the European Climate Law, was adopted by EU institutions in June 2021 and it sets into EU law the binding target of net zero greenhouse gas emissions by 2050 (so-called 'carbon neutrality' or sometimes 'climate-neutrality') as well as a 55% greenhouse gas reduction target by 2030 for the EU.

Fit for 55 package[3]

The European climate law turns reaching the EU's climate goal of reducing EU emissions by at least 55% by 2030 to a legal obligation. To meet this obligation, the EU countries have been working at new legislations with the Fit for 55 package. The legislations presented in Table 2, that are of relevance to hydrogen, were either adopted or revised as part of the Fit for 55 package. They will be explained in more detail in the following subsections based on their impact on the different steps of the value chain (production, distribution and storage or end-use).

Table 2. Legislative policies that were adopted or revised in the Fit for 55 package and are of relevance to hydrogen.

Hydrogen related legislations in Fit for 55 package	
EU Emissions Trading System (ETS)	Alternative Fuels Infrastructure Regulation (AFIR)
Effort Sharing Regulation	ReFuel EU Aviation Regulation
CO_2 emissions standards for cars and vans	FuelEU Maritime Regulation
Carbon Border Adjustment Mechanism (CBAM)	Energy Performance of Buildings Directive
Renewable Energy Directive	Energy Taxation Directive
Energy Efficiency Directive	Hydrogen and Decarbonised Gas Market Package

Energy System Integration Strategy and the European Hydrogen Strategy[4]

Before the adoption of the new legislations from the Fit for 55 package, in 2020, the European Commission released two new major hydrogen relevant strategies, the Energy System Integration Strategy and the European Hydrogen Strategy, that show the importance of hydrogen in a decarbonised future economy, in applications such as high temperature industry (cement, etc.), feedstock in industry (steel, fertilisers), and heavy and long-haul transport (maritime, aviation, heavy duty vehicles, etc.). In these two strategies, hydrogen is identified as a crucial technology for integrating the components of the energy system. Its versatility and potential for energy storage make it an essential tool for decarbonizing sectors that are

[3] Fit for 55': delivering the EU's 2030 Climate Target on the way to climate neutrality-European Commission (europa.eu)
[4] Powering a climate-neutral economy: An EU Strategy for Energy System Integration-European Commission (europa.eu)

particularly difficult to transition to low-carbon alternatives. In the European Hydrogen Strategy, the Commission sets clean hydrogen production targets: aiming for at least 6 GW of renewable hydrogen production capacity (i.e. electrolysers) by 2024 in the EU (resulting in the production of 1 million tonnes of renewable hydrogen) and for at least 40 GW by 2030. By 2050, the hydrogen strategy estimated a potential ¼ of the EU's renewable electricity production to be used for hydrogen production.

EU Industrial Strategy[5]

In 2020, under its EU Green Deal, the Commission also proposed a brand-new EU Industrial Strategy to deliver on three key priorities: maintaining European industry's global competitiveness and a level playing field, making Europe climate-neutral by 2050 and shaping Europe's digital future. With the European Industrial Strategy as well as the European Hydrogen Strategy of 2020, the Commission acknowledged the potential of hydrogen in contributing to the energy transition and announced the creation of the European Clean Hydrogen Alliance (ECH2A) in July 2020. Its aim is to bring governmental, institutional and industrial partners together with investors, to identify and build up a pipeline of viable investment projects along the hydrogen value chain, in order to deliver the green transition and create a clean hydrogen market which contributes to growth and jobs and reduction of GHG emissions.

Sustainable finance under the EU Green Deal[6]

To achieve the goals set by the European Green Deal, besides implementing legislations, the Commission also strives to channel finance to sustainable investment options, compatible with the climate neutrality objective. Concretely, the Commission wants to direct financial flows to green investment and avoid stranded assets, via increased available funds for sustainable investment and reviewed taxonomy. The Commission has put in place the European Green Deal Investment Plan (EGDIP), also referred to as Sustainable Europe Investment Plan (SEIP), as part of the Green Deal. This includes the Just Transition Mechanism, which focuses on ensuring a fair and just transition to a green economy. It is mobilising significant investments over the period 2021-2027 to support citizens of the regions most impacted by the transition.

REPowerEU[7]

In the more recent years, as a response to the energy market disruptions caused by the invasion of Russia in Ukraine, the Commission also presented the REPowerEU Plan on 18 May 2022. The Plan seeks to rapidly reduce the EU's dependency on Russian fossil fuels and proposed a series of amendments to increase the ambition of several files being revised under the Fit for 55 package. Within the section devoted to the hydrogen sector of the REPowerEU Plan, the Commission sets the key, indicative target to

[5] European industrial strategy - European Commission (europa.eu)
[6] Strategy for Financing the Transition to a Sustainable Economy-European Commission (europa.eu)
[7] REPowerEU-European Commission (europa.eu)

achieve 10 million tonnes of domestic hydrogen production and 10 million tonnes of imported renewable hydrogen by 2030.

The Green Deal Industrial Plan[8]

As a further response to the most recent challenges related to the pandemic, the unjustified aggression of Ukraine and the rapid changes in the global geopolitical order, the European Commission also published in February 2023 its Green Deal Industrial Plan. This plan is updating the EU industrial strategies to enhance the competitiveness of Europe's net-zero industry and is accelerating the transition to climate neutrality. It does so by creating a more supportive environment for scaling up the EU's manufacturing capacity for the net-zero technologies and products required to meet Europe's ambitious climate targets.

Clean Industrial Deal

In 2024, the Antwerp Declaration set the stage for a stronger European industrial policy, calling for actions to enhance competitiveness, protect jobs, and accelerate the transition to climate neutrality. It emphasized simplified regulations, streamlined state aid, and investments in affordable low-carbon energy.

In response, the European Commission committed to a Clean Industrial Deal, to be unveiled within 100 days of the new Commission starting in December 2024. This initiative aims to improve industrial competitiveness while aligning with EU climate goals. It focuses on reducing energy costs, fostering innovation, and accelerating the deployment of clean technologies through targeted investments and partnerships. It promises to strengthen Europe’s position as a global leader in sustainable industries, ensuring regulatory clarity and boosting support for key projects.

This new planned initiative of the EU Commission 2024-2029, together with other planned new initiatives, such as the competitiveness compass and turbo charging investments in the green transition, will also provide extra support for the uptake of hydrogen technologies.

1.2.2. Production

Legislations that fall under the Fit for 55 package that can have an impact on hydrogen production include the Energy Efficiency Directive, the Renewable Energy Directive, the EU Emissions Trading Scheme, the Carbon Border Adjustment Mechanism and the Hydrogen and Gas Market Decarbonisation Package. Moreover, the Green Deal industrial plan will also have an impact on hydrogen production with the Net-Zero Industry Act, Critical Raw Materials Act and Electricity Market Design Reform legislations that entered into force in 2024. Finally, the new Industrial

[8] The Green Deal Industrial Plan-European Commission (europa.eu)

Emissions Directive and the communication on Advanced Materials for Industrial Leadership of 2024 also have a direct impact on hydrogen production. The following sections will briefly summarize these legislations and their potential impacts on the hydrogen sector.

Energy Efficiency Directive[9]

The Energy Efficiency Directive (EED) (EU/2023/1791) helps reduce overall energy consumption and is therefore central to achieving the EU's climate ambition, while enhancing present and future energy security and affordability. A substantial revision ('recast') of the EED came as part of the Fit for 55 legislative package in order to deliver on the increased climate ambition of the EU Green Deal. In the final agreement, member states must collectively ensure a reduction of final energy consumption of at least 11.7% by 2030, compared with the energy consumption forecasts for 2030 made in 2020. This translates into an upper limit to the EU's final energy consumption of 763 million tonnes of oil equivalent. The EED provides a regulatory framework that indirectly influences the hydrogen sector by promoting energy efficiency, sector integration, and building standards, among other measures.

Renewable Energy Directive[10]

The revised version of the Renewable Energy Directive (EU/2023/2413) that has entered into force in November 2023 sets a 42.5% target on the share of renewable energy in the EU's overall energy consumption by 2030, with an additional 2.5% indicative top up to allow the target of 45% to be achieved. All member states will contribute to achieving more ambitious sector-specific targets in transport, industry, buildings and district heating and cooling. These sector-specific targets also include targets directly relevant for hydrogen. In industry, 42% of the hydrogen used should come from renewable fuels of non-biological origin (RFNBOs) by 2030 and 60% by 2035. Moreover, there is also a minimum requirement of 1% of RFNBOs in the share of renewable energies supplied to the transport sector in 2030.

EU's Emission Trading System[11]

The EU's Emission Trading System (EU ETS), in addition to the new CBAM, is the EU's main policy for reducing greenhouse gas emissions. It applies to all EU countries plus Iceland, Liechtenstein and Norway and until now covered energy intensive installations (power stations & industrial plants) and airlines operating between these countries. With the revision that was adopted in 2023, as part of the Fit for 55 package, this list is now extended to the maritime sector. In addition, a separate ETS for buildings and road transport (ETS2) is being introduced, with monitoring and reporting of emissions starting in 2025 and full operation planned for 2027. The system is a cap-and-trade system, where a cap is set on the total amount of CO_2 that can be

[9] Energy Efficiency Directive-European Commission (europa.eu)
[10] Renewable Energy Directive-European Commission (europa.eu)
[11] EU's Emission Trading System-European Commission (europa.eu)

emitted by installations covered by the system. Within the cap, companies receive or buy emission allowances which they can trade with one another as needed. The cap is reduced over time, following a linear reduction factor (LRF). ETS1 will aim for a reduction in emissions of 62% by 2030 (compared to 2005) based on a LRF of 4.3-4.4%. ETS2 aims for a reduction in emissions of 42% by 2030 with a 5.1% LRF initially until 2027. The scope of the EU ETS corresponds in many aspects to GHG-emitting economic activities where hydrogen can act as a clean energy carrier substitute in a cost-effective and purpose-fit manner. With the revision of the system, it is expected that the impact for hydrogen could be even bigger, since the amount of allowances will be progressively reduced, which could raise their price, incentivising decarbonisation efforts. Furthermore, with the revision, the ETS now includes the coverage of all hydrogen production methods exceeding 5 tonnes per day, including electrolysers, making renewable and low-carbon hydrogen facilities eligible for free allowances.

Carbon Border Adjustment Mechanism[12]

The Carbon Border Adjustment Mechanism (CBAM) is part of the European Union's Fit for 55 package and was presented on 14th July 2021 by the European Commission. CBAM aims to establish a mechanism which equalises the price of carbon between domestic products and imports in selected sectors. Under the scheme, EU importers will be subject to a carbon price (via a CBAM certificate) whose price level mirrors that of the ETS (i.e. the carbon price that would have been paid, had the production taken place in the EU). The mechanism will be introduced gradually and first apply to selected products at high risk of carbon leakage: iron, steel, cement, fertiliser, aluminium, electricity generation and (non-renewable) hydrogen production. As for timing, the scheme will kick off with a transition period of around 2 years, from October 2023 to the end of 2025, during which importers will have to report emissions embedded in their goods. From 2026 onwards, a long phase-in of the CBAM will start, whereby it will gradually replace ETS free allowances until the complete phase in of the scheme in 2034. In practical terms, this implies that, by 2030, an EU-based ammonia producer will receive only approx. 50% of the free allowances it would have obtained without CBAM. At the same time, an ammonia importer will be required to cover approx. 50% of the total embedded emissions associated with their ammonia shipment. In general, the mechanism is expected to accelerate decarbonisation efforts both in the EU and abroad, by equalising the carbon price of domestic products and imports. With the progressive phase-out of free allowances under the ETS, the industrial sectors covered by the mechanism will be subject to the full carbon price. This would create a stronger incentive to decarbonise industrial processes. Thus, the role of renewable hydrogen is expected to increase, especially in sectors where there are

[12] Carbon Border Adjustment Mechanism-European Commission (europa.eu)

few other alternatives, such as in steel and fertilisers production.

Hydrogen and Decarbonised Gas Market Package[13] *Adopted in 2024*

The EU adopted the Hydrogen and Decarbonised Gas Market Package in May 2024, comprising Directive EU/2024/1788 and Regulation EU/2024/1789. This package revises the 2009 Gas Directive and Regulation, introducing a new regulatory framework for hydrogen infrastructure. EU member states must transpose these rules by mid-2026 to promote renewable and low-carbon gases, including hydrogen, while ensuring energy security and affordability for citizens. The package sets the common rules for the internal market in natural gas, and now also for renewable natural gas and hydrogen. Thereby aligning the existing legislation with the Clean Energy Package provisions on incentives for clean energy solutions, prosumer behaviour, easier switching of providers and clear certification for low carbon hydrogen. The role of low-carbon hydrogen as an enabler of decarbonization in the short and medium term is foreseen, and this package supports the uptake of renewable fuels such as renewable hydrogen. In general, the internal market rules set by this regulation for hydrogen are similar to the existing ones for the natural gas and electricity sectors. Yet, they also establish a degree of flexibility to ramp-up the development of the hydrogen market.

Net-Zero Industry Act[14] *Adopted in 2024*

The Net-Zero Industry Act that entered into force the 29th of June 2024, jointly with the Critical Raw Materials Act, are complementary pieces of legislation under the first pillar of the Green Deal Industrial Plan. This pillar aims to create a simpler, faster and more predictable regulatory framework, secure the volumes needed for raw materials, and ensure users are able to benefit from the low costs of renewables. The objectives of the NZIA are to provide investment certainty, lower administrative burdens through facilitated permitting and access to information, and facilitate market access through public procurement, auctions, and schemes to support private demand by consumers. Additionally, the development of skills for quality job creation in these technological sectors is also addressed.

Under the NZIA, electrolysers and fuel cells are in the scope of the regulation, making them strategic technologies. Upstream components of electrolysers and fuel cells are also included within its scope. The granting of Net-Zero Strategic Project status can be awarded to those projects that contribute to an increase of production capacity of components or parts related to strategic technologies for which the EU heavily depends on imports, or to projects that provide a systemic benefit towards EU competitiveness, with spill-over effects on manufacturing capacities, sustainability performances, skilling and reskilling.

[13] Hydrogen and Gas Market Decarbonisation Package-European Commission (europa.eu)
[14] Net Zero Industry Act-European Commission (europa.eu)

Critical Raw Materials Act[15] *Adopted in 2024*

The regulation, which entered into force on 23 May 2024, targets several issues related to critical raw materials, such as low diversification of EU supply sources, the untapped potential of local supply, weak monitoring and risk management capacity to anticipate and prevent supply disruptions of critical raw materials, adverse social and environmental impacts of production of CRMs, insufficient support for circularity and insufficient research and innovation. This regulation will also be important to hydrogen technologies, such as electrolysers and fuel cells, since they are dependent on CRMs. Their availability and future prices will be a crucial aspect affecting the speed at which the hydrogen market can grow.

Advanced Materials for Industrial Leadership Strategy[16] *New 2024*

The European Commission's Advanced Materials Strategy, published on 27 February 2024, is the communication that highlights the pivotal role of advanced materials in driving the EU's green and digital transitions. These materials, designed for superior performance and specific functions, are crucial for clean energy technologies, including hydrogen applications such as electrolysers and fuel cells.

Key benefits for the hydrogen sector stem from the strategy's focus on securing the supply of critical advanced materials like catalysts, ionomers, and graphite components, which are essential for hydrogen production and storage. By addressing supply chain challenges, the strategy aims to prevent disruptions and ensure cost stability, critical for scaling the hydrogen market. The establishment of a Technology Council for advanced materials and targeted investments through a €500 million public-private partnership under Horizon Europe will foster innovation and accelerate the development of materials critical for hydrogen technologies. Furthermore, the strategy's emphasis on a value chain approach integrates hydrogen within broader industrial ecosystems, promoting collaboration and efficiency.

In essence, the strategy strengthens the EU's industrial leadership while directly supporting the hydrogen sector's growth by enhancing material availability, innovation, and investment frameworks. These efforts are vital for advancing clean energy solutions and achieving the EU's climate goals.

Electricity Market Design Reform[17] *Adopted in 2024*

The EU's updated Electricity Market Design (EMD), that entered into force in May 2024 focuses on decoupling electricity prices from volatile fossil fuels, enhancing renewable energy integration, and ensuring supply security. These changes have significant implications for

[15] Critical Raw Materials Act-European Commission (europa.eu)
[16] Advanced Materials for Industrial Leadership Strategy
[17] Electricity Market Design Reform

hydrogen as a key enabler of the energy transition.

The reform prioritizes flexibility measures, establishing national targets across different timeframes. Clean hydrogen (particularly dispatchable hydrogen) emerges as a leading solution for seasonal flexibility, supporting congestion management and balancing renewable energy variability. Electrolysis and other hydrogen-based flexibility tools will play an essential role in meeting these objectives.

Non-fossil flexibility support schemes and capacity mechanisms, now integral to the market design, offer financial incentives for hydrogen-powered facilities. These measures strengthen hydrogen's role in energy storage, demand response, and capacity services during periods of low renewable output, such as "Dunkelflaute" events.

By promoting renewable power purchase agreements and integrating hydrogen into a more resilient market framework, the new EMD accelerates clean hydrogen production and use. This positions hydrogen as a cornerstone of Europe's sustainable, flexible, and decarbonized energy system, ensuring affordable and reliable energy for industries and citizens alike.

Revised Industrial Emission Directive[18] *Adopted in 2024*

The updated Industrial Emissions Directive (IED), that entered into force on the 4th of August 2024, introduces measures to align industrial emissions regulations with the EU's Green Deal and zero-pollution goals. Among its broader goals, the revision significantly benefits the hydrogen sector by addressing long-standing permitting challenges. Under the previous IED, hydrogen production from electrolysis and emissions-intensive methods like steam methane reforming were treated equally, subjecting all technologies to the same regulatory burdens. This hindered the deployment of clean hydrogen solutions like electrolysers. The revised IED rectifies this by exempting electrolysers producing under 50 tons/day of hydrogen from its scope. This exemption reduces administrative and permitting obstacles, enabling faster deployment of small to medium electrolysers critical for the EU's clean energy transition.

These changes support the broader roll-out of renewable hydrogen by streamlining compliance and encouraging investment in clean technologies. The updated directive fosters an enabling environment for hydrogen innovation while maintaining robust environmental protections, accelerating the sector's contribution to decarbonization goals.

[18] Revised Industrial Emission Directive

1.2.3.
Transport, storage and distribution

Besides the legislations that already have been mentioned, other legislations that fall under the Fit for 55 package that can have an impact on hydrogen transport, storage and distribution include the FuelEU Maritime, RefuelEU Aviation and the Alternative Fuels Infrastructure Regulation. Before the introduction of these legislations, the European Commission published in December 2020 its Sustainable and Smart Mobility Strategy that provides a vision on the European transport system and transport policies, not least in the perspective of the sector's decarbonisation.

Sustainable and Smart Mobility Strategy[19]

The main message of this 2020 strategy consists in the ambition of making mobility more sustainable, smarter and more resilient by 2030. In a nutshell, the Strategy adopts an integrated approach by looking at demand, supply, infrastructure, and fuels in the transport sector. Specifically for hydrogen, it will have an estimated share of 31-40% in road transport fuels in 2050, and e-fuels will account for 10-17%. In terms of infrastructure, the Strategy will aim to deploy 500 hydrogen refuelling stations by 2025 and 1,000 by 2030. By April 2024, over 90% of the 82 initiatives outlined in the Sustainable and Smart Mobility Strategy had been already addressed at different stages and for some completed.

Trans-European Network for Transport[20]

Adopted in 2024

The Trans-European Transport Network (TEN-T) regulation sets the basis for the European's transport network policy and constitutes a key instrument for the development of coherent, efficient, multimodal, and high-quality transport infrastructure across the EU. First adopted in 2013, the revised regulation regarding EU guidelines for the development of the trans-European transport network (TEN-T) entered into force on 18 July 2024. This regulation will put the transport sector on track to cut its emissions by 90%, as stated in the Green Deal Plan and Smart and Sustainable Mobility Strategy. It aims to increase connectivity in Europe, foster the resilience of the transport system, shift more passengers and freight to sustainable modes of transport and to focus more on sustainable urban mobility. The TEN-T regulation provides the basis for the implementation of other legislations, such as the Alternative Fuels Infrastructure Regulation and FuelEU Maritime. The TEN-T guidelines also determines the eligibility for funding under the CEF Transport programme.

[19] Sustainable and Smart Mobility Strategy-European Commission (europa.eu)
[20] Trans-European Network for Transport-European Commission (europa.eu)

Alternative Fuels Infrastructure Regulation[21]

Entered into force in 2024

The Alternative Fuels Infrastructure Regulation (AFIR), which entered into force on April 13th, 2024, establishes a common framework of measures for the deployment of alternative fuels infrastructure in the Union in order to minimize dependence on oil and to mitigate the environmental impact of transport by supporting the uptake of alternative fuels in the transport sector. By upgrading the previous directive into a regulation., makes its targets binding and directly applicable in all member states. This regulation recognises hydrogen as a key alternative fuel with a potential for long-term oil substitution. It further sets out the legal framework for hydrogen refuelling stations for road transport, the lack of which contributes to the limited penetration of hydrogen-powered vehicles in the EU market – namely the deployment of hydrogen refuelling infrastructure from 2030 onwards in all urban nodes and every 200 km along the TEN-T core network, to serve both cars and lorries. The framework ensures refuelling certainty and, as such, lays the foundation for the scale up of hydrogen powered mobility.

FuelEU Maritime[22]

FuelEU Maritime regulation adopted in July 2023 as part of the Commission's Fit for 55 legislative package, to steer the EU maritime sector towards decarbonisation via limiting the carbon intensity of the energy used on board ships, therefore indirectly supporting the uptake of sustainable maritime fuels. This Regulation establishes limits on the annual average GHG intensity of the energy used on board, increasing from 2% in 2025 to 80% in 2050. The Regulation also includes provisions incentivizing the use of renewable fuels from non-biological origin (RFNBOs) by ships. First, until 2033 a multiplier of 2 can be used on RFNBOs to reward their use by early movers. Additionally, an RFNBO 'sunrise clause' was introduced, which states that if in 2031 the share of RFNBOs in the yearly energy used on-board ships is less than 1%, a mandatory quota of 2% RFNBOs shall apply by 2034. This incentivizes the use of e-fuels and renewable hydrogen to decarbonize shipping as it falls into the scope of RFNBOs and will lead to an uptake of demand for hydrogen-based maritime e-fuels, as ammonia or methanol.

ReFuelEU Aviation[23]

The ReFuelEU Aviation regulation, adopted in October 2023, sets minimum obligations for all fuel suppliers to gradually increase the share of SAFs (sustainable aviation fuels) in the fuel supplied to operators at EU airports. The SAF requirements increase from 2% by 2025 to 70% by 2050. Within this SAF requirements, a sub-obligation is also set for synthetic aviation fuels (RFNBOs complying with the lifecycle emissions saving threshold of 70%, thus including renewable hydrogen), increasing from 1.2% by 2030-2031 to 35% by 2050. This historic

[21] Alternative Fuels Infrastructure Regulation- European Commission (europa.eu)
[22] FuelEU Maritime- European Commission (europa.eu)
[23] ReFuelEU Aviation- European Commission (europa.eu)

agreement, the first-of-a-kind mandate for green aviation fuel, will allow SAFs projects to be deployed at a larger scale, adding certainty on the definition of those fuels for investors and suppliers.

1.2.4. End-use

Besides the legislations that already have been mentioned in the earlier sections, other legislations that fall under the Fit for 55 package that can have an impact on hydrogen end-uses include the Energy Taxation Directive, the Energy Performance of Buildings Directive and CO_2 emissions standards for cars and light duty vehicles.

The Energy Taxation Directive could have an impact on all end-uses and aims to shift the tax burden from labour to pollution. For hydrogen end-use in buildings, the Energy Performance of Buildings Directive is of main importance and is currently being revised with the aim to set out the vision and tools to achieve zero emissions by 2050 in buildings, as a part of the Renovation Wave for Europe strategy. For hydrogen use in transport, in addition to the legislations mentioned in the previous section, the CO_2 emissions standards for cars and light duty vehicles and to the CO_2 emissions standards for heavy-duty vehicles regulations are of relevance. These regulations set ambitious targets for reducing the average emissions of new vehicles that could, together with the public procurement for clean vehicles, result in an increase of the fuel cell electric vehicles fleet. For industry, no additional legislations are covered in this section, as the main relevant legislation were already covered in the section of production, such as the EU emissions trading system, the Carbon Border Adjustment Mechanism and the Renewable Energy Directive.

Energy Taxation Directive[24]

In its EU Green Deal, the European Commission clearly states that the tax burden should shift from labour to pollution. The Energy Taxation Directive sets minimum levels of taxation and lays down the conditions for applying tax exemptions and reductions. The Directive is currently being revised under the Fit for 55 legislative package. In June 2024, the Council reviewed the state of progress on the file once more. However, the Belgian presidency noted that countries' positions were still divided, necessitating additional efforts to achieve a balanced agreement. The main proposed change relates to the move to base taxation of energy products on their energy content (instead of volumes) and rank them with different minimum taxation rates depending on their environmental performance. Moreover, it also proposes to phase-out exemptions for certain products and home heating, and lastly, fuels for intra-EU air,

[24] Energy Taxation Directive--European Commission (europa.eu)

maritime and fishing are no longer fully exempt from taxation.

Energy taxation will be a cornerstone to facilitate a prosperous future for hydrogen. As a sustainable alternative fuel and considering the uptake the Commission wants to provide them under the Fit for 55, hydrogen could benefit from financial incentives. Under the proposed revision of the directive, the switch to renewable and low-carbon fuels is heavily incentivised. Carbon-intensive fuels are to be taxed more, while preferential tax rates for renewable and low-carbon hydrogen will serve to stimulate their use in multiple applications.

Renovation Wave for Europe[25]

The European Commission published its Renovation Wave for Europe strategy in October 2020. The strategy aims to help improve the energy performance of buildings and deliver on the European Green Deal ambitions, as buildings are responsible for about 40% of the EU's energy consumption, and for 36% of greenhouse gas (GHG) emissions in the EU. The Strategy provides a roadmap of EU targets to be achieved by 2030 and is accompanied by a series of policy measures. Some of these policy measures include the revisions of the Renewable Energy Directive, the EU Emissions Trading System Directive and the Energy Performance of Buildings Directive as part of the Fit for 55 package.

Energy Performance of Buildings Directive[26]

Adopted in 2024

The revised Energy Performance of Buildings Directive (EU/2024/1275), which came into effect across all EU countries on 28 May 2024, aims to boost renovation rates in the EU, focusing on the worst-performing buildings, while improving air quality, digitalizing energy systems, and supporting sustainable mobility infrastructure. The directive allows countries to tailor measures to their national context and exempts certain buildings, such as historical sites and holiday homes. The directive aims to cut building sector GHG emissions by at least 60% by 2030 (vs. 2015) and achieve zero-emission buildings by 2050. The revised Energy Performance of Buildings Directive introduces several measures, including minimum energy performance standards for non-residential buildings to encourage upgrades of the least efficient structures. It sets a binding target to improve the average energy performance of residential buildings by 16% by 2030 (compared to 2020) and by 20-22% by 2035. New buildings must meet zero-emission standards, with their whole life-cycle carbon accounted for. National Building Renovation Plans will replace long-term renovation strategies, and Energy Performance Certificates will be improved with standardized criteria, greater reliability, and enhanced digitalization. The Directive will also help the EU to gradually phase out boilers powered by fossil fuels and will also enable hydrogen-based

[25] Renovation Wave for Europe-European Commission (europa.eu)
[26] Energy Performance of Buildings Directive-European Commission (europa.eu)

heating solutions to contribute to this important objective.

CO_2 emissions performance standards for cars and light duty vehicles[27]

The revised regulation for setting CO_2 emission performance standards for new passenger cars and light commercial vehicles was published in April 2023. The regulation incentivises manufacturers to integrate an increasing share of low- and zero-emission vehicles in their fleet to meet their average CO_2 emission reduction targets. The average allowed emissions reduce over time with a final target in January 2035, when all new passenger cars and new light commercial vehicles should have zero emissions.

CO_2 emissions performance standards for heavy-duty vehicles[28] *Adopted in 2024*

This legislation was adopted in May 2024. Similar to the CO_2 emission performance standards for new passenger cars and light commercial vehicles, the regulation sets targets for reducing the average (fleet-wide) emissions from new trucks and other heavy goods vehicles for 2025 and 2030. The updated proposed targets retain the 15% CO2 reduction goal for 2025, increase the 2030 target to 45%, and introduce new reduction targets of 65% for 2035 and 90% for 2040. The revision expands the range of covered vehicles to encompass additional truck types, buses, coaches, trailers, and vocational vehicles, while also modifying the compliance flexibilities available to manufacturers. Due to the many incentives this regulation gives and the characteristics of hydrogen, it is expected that hydrogen fuel cell technology will benefit and expand in HDV fleet.

Public procurement for clean vehicles[29]

Public procurement refers to the process by which public authorities, such as government departments or local authorities, purchase work, goods or services from companies. In the context to a transition to carbon-neutral economy, public procurement is seen as an important tool to stimulate innovation and promote competitiveness and growth of industries, as public procurement accounts for a significant part of national GDP. Through public procurement, demand for sustainable technologies is increased, triggering effects across the product's value-chain, thereby supporting the development of economies of scale and innovation. The Clean Vehicle Directive, that sets public procurement targets for clean vehicles, together with the Green Public Procurement instrument, which is a voluntary instrument to help public authorities use their purchasing power to choose environmentally friendly goods, are expected to boost demand for clean vehicles (including FCEVs) and the deployment of infrastructure for the distribution of clean transport fuels like hydrogen.

[27] CO_2 emissions performance standards for cars and light duty vehicles-European Commission (europa.eu)
[28] CO2 emissions performance standards for heavy-duty vehicles-European Commission (europa.eu)
[29] Public procurement for clean vehicles-European Commission (europa.eu)

1.2.5.
Funding vehicles & initiatives

In 2020, the European Union provided an unprecedented response to the coronavirus crisis that hit Europe and the world. At its heart is a stimulus package worth 2.018 trillion EUR. It consists of the EU's long-term budget for 2021 to 2027 of 1.211 trillion EUR, topped up by 806.9 billion EUR through NextGenerationEU, a temporary instrument to power the recovery. In June 2023, the Commission proposed to reinforce the EU's 2021-2027 long-term budget in a targeted manner, to make sure the EU budget can continue to deliver on the most essential objectives.

Most of the NextGenerationEU budget (723.8 billion EUR) is allocated to the Recovery and Resilience Facility. The additional budget of NextGenerationEU is used to reinforce several existing EU programmes of the Multiannual Financial Framework (MFF). MFF programmes that have an impact on the development and deployment of hydrogen technologies include the cohesion policy and investEU, in addition to programmes managed by CINEA such as Connecting Europe Facility, Innovation Fund, Horizon Europe and Life programme. Many of these programmes make use of the European Investment Bank (EIB), which is the lending arm of the European Union that provides loans and financial support for various sustainable projects, including those related to hydrogen infrastructure and technologies. Next to these EU funded programmes, also the revised state aid rules and Important Projects of Common European Interest (IPCEI) will result in an increased deployment of hydrogen technologies.

Recovery and Resilience Facility [30]

The Recovery and Resilience Facility (RRF) is the centrepiece of the EU's NextGenerationEU recovery plan. Its goal is to make EU economies and societies greener, digital and resilient. The RRF will provide 650 billion EUR to invest in reforms and projects at 2022 prices, of which 359 billion EUR in grants and 291billion EUR in loans. Project financing depends on what each EU country has included in its plan. The funds under the Recovery and Resilience Facility are distributed according to national recovery and resilience plans prepared by each Member State, in cooperation with the European Commission.

InvestEU[31]

The InvestEU programme consists of three components: the InvestEU Fund, the InvestEU Advisory Hub and the InvestEU Portal. The InvestEU Fund is expected to mobilise more than 372 billion EUR of public and private investment through an EU budget guarantee of 26.2 billion EUR that backs the investment of financial partners such as the European Investment Bank (EIB) Group and others. The InvestEU fund

[30] Recovery and Resilience Facility-European Commission (europa.eu)
[31] InvestEU-European Commission (europa.eu)

provides for an EU guarantee to support financing and investment operations, carried out by implementing partners that contribute to objectives of the EU's policies. Implementing partners and other financial intermediaries will provide finance as guarantees, loans, risk-sharing or equity. The EIB Group will have access to 75% of this guarantee and will act as the main implementing partner for the fund. The InvestEU Advisory Hub provides advisory support for the development of investable projects and access to financing. The InvestEU Portal boosts the project's visibility to a large network of international investors.

Cohesion Policy[32]

The EU Cohesion Policy contributes to strengthening economic, social and territorial cohesion in the European Union. The European Regional Development Fund (ERDF), Cohesion Fund (CF) and the Just Transition Fund (JTF) are part of the EU's Cohesion Policy. ERDF and CF support innovation and entrepreneurship in the transition to a climate-neutral economy. Some regions may allocate ERDF funds to hydrogen projects as part of their clean energy strategies. JTF aims to reduce the social and economic impact resulting from the transition to climate neutrality in the most affected regions, given their dependence on fossil fuels or on carbon-intensive industries. The Commission provides grants that are disbursed to the member states in line with their territorial just transition plans. These plans identify the eligible territories, i.e. those expected to be the most negatively impacted by the green transition.

Modernisation Fund[33]

The Modernisation Fund is a fund supporting 10 lower-income EU countries' transition to climate neutrality through the modernisation of their energy systems and improved energy efficiency. It supports investments in the production and use of renewable hydrogen; hydrogen fuelled trains, trucks and cars, high-efficiency hydrogen CHP.

Connecting Europe Facility[34]

The Connecting Europe Facility (CEF) is a key EU funding instrument in delivering the European Green Deal and an important enabler towards the Union's decarbonisation objectives for 2030 and 2050. It supports the development of high performing, sustainable and efficiently interconnected trans-European networks in the fields of transport, energy and digital services. In addition to grants, the CEF offers financial support to projects through innovative financial instruments such as guarantees and project bonds. The Connecting Europe Facility for Energy (CEF-E) is a funding instrument that supports the implementation of the Regulation on Trans-European Networks for Energy (TEN-E), which is focused on linking the energy infrastructure of EU countries. It may fund cross-border hydrogen transmission & distribution projects, storage and large-scale electrolysers (>100 MW of capacity).

[32] Cohesion Policy-European Commission (europa.eu)
[33] Modernisation Fund-European Commission (europa.eu)
[34] Connecting Europe Facility-European Commission (europa.eu)

The Connecting Europe Facility for Transport (CEF-T) contributes to the implementation of the Trans-European Transport Network (TEN-T) and finances projects that upgrade infrastructure and remove bottlenecks while promoting sustainable and innovative mobility solutions. These projects cover all EU countries and all transport modes (road, rail, maritime, inland waterways).

Innovation Fund[35]

Innovation Fund is one of the world's largest funding programmes for the demonstration of innovative low-carbon technologies. The Fund is highly relevant as a tool to deploy clean hydrogen technologies, as its project eligibility scope covers areas where, in each of them, clean hydrogen technologies could have significant potential (energy-intensive industries decarbonisation, energy storage, and innovative renewable energy generation) or be positively impacted (CCS/U). The Fund may amount to 40 billion EUR for the 2020-2030 period (based on a carbon price of 75 EUR/ tonne). The Innovation Fund supports up to 60% of relevant costs of projects in case of regular grants, while it can support up to 100% in case of competitive bidding procedures. Additional support via blending is also possible, with 100 million EUR currently assigned from the Innovation Fund to InvestEU to enable support in the form of financial instruments (i.e., debt or equity-type debt) via the Green Transition Product. Under the umbrella of the European Hydrogen Bank funded by the Innovation Fund, the Commission has launched in November 2023 its first auction (i.e., competitive bid) for supporting the production of renewable hydrogen (budget of 800 million EUR). Funding has been awarded as a fixed premium in the range 0.37 and 0.48 €/kg of verified and certified RFNBO hydrogen, produced by 7 renewable hydrogen production projects, amounting to 1.5 GW of capacity. The second auction of the Hydrogen Bank was launched on December 3, 2024 with a budget of 1.2 billion EUR. Moreover, the mechanism, called Auctions-as-a-Service (AaaS), will continue enabling countries of the EEA to use their national budget resources to support projects located on their territory while relying on an EU-wide auction mechanism to identify the most competitive projects.

Horizon Europe[36]

Horizon Europe 2021-2027 is the EU's key funding programme for research and innovation, with a budget of 95.5 billion EUR. Pillar II and III of Horizon Europe are focused on the deployment of low-carbon industry applications and breakthrough technologies, including hydrogen. It must involve the research and innovation element. The Clean Hydrogen Partnership is a public-private initiative under Horizon Europe that aims to accelerate the development of a clean hydrogen economy in Europe. It may involve funding opportunities and collaboration with industry stakeholders.

[35] Innovation Fund-European Commission (europa.eu)
[36] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32021R0695

LIFE programme [37]

LIFE 2021-2027 is the only EU funding programme entirely dedicated to environment, climate and energy. It includes the Clean Energy Transition sub-programme. It is oriented to projects in early phase demonstration, in governance, and in catalyst projects for large-scale deployment solutions.

The Clean Energy Transition Partnership [38]

The Clean Energy Transition Partnership is an initiative co-funded by the European Union that brings together public and private stakeholders in the research and innovation ecosystems in European Member States and Associated Countries. Its aim is to boost and accelerate the energy transition and to support the implementation of the European Strategic Energy Technology Plan (SET Plan). The Clean Energy Transition Partnership has 7 Transition Initiatives (TRIs) focusing on the R&D challenges described in the Strategic Research and Innovation Agenda (SRIA), which also include R&D challenges for clean hydrogen technologies.

State aid[39]

The Commission has been revising the rules on state aid in a number of priority areas, including climate, energy and environment. Currently, three documents compose the EU framework for state aid, which is pivotal for hydrogen, plus a fourth one that refers to the compatibility of state aid with the Important Projects of Common European Interest (IPCEIs):

- Guidelines on State aid for climate, environmental protection and energy (CEEAG);
- General Block Exemption Regulation (GBER);
- the EU Temporary Crisis and Transition Framework for State Aid;
- the Communication on Criteria for the analysis of the compatibility with the internal market of State aid to promote the execution of important projects of common European interest (2021);

The revision of state aid rules will facilitate public support to the development of key industrial sectors and innovative value chains and can give leverage to the deployment of hydrogen and fuel cell technologies and their role in steering the energy transition, via potential increased funding channels and amounts. This is especially the case under the new GBER, where different categories of state aid measures can directly or indirectly support the hydrogen sector in a wide range of activities, operative costs needs may be considered, and aid intensities may reach 100% in case of competitive bidding processes.

Important Projects of Common European Interest[40]

Where private initiatives supporting breakthrough innovation and infrastructure fail to materialise because of the significant risks such projects

[37] LIFE programme-European Commission (europa.eu)
[38] Clean Energy Transition Partnership (cetpartnership.eu)
[39] State aid-European Commission (europa.eu)
[40] Important Projects of Common European Interest-European Commission (europa.eu)

entail, EU state aid rules enable EU countries to jointly fill the gap to overcome these market failures with an IPCEI. IPCEIs are ambitious, cross-border, integrated projects, important due to their contribution to EU objectives while limiting potential competition distortions and ensuring positive spill-over effects for the internal market and the Union. The Hy2Tech and Hy2Use IPCEI's were specifically focused on hydrogen technologies for which > 10 billion EUR of state aid has been approved. On 15 February 2024, the commission approved the IPCEI Hy2infra, which concerns infrastructure investments not covered by the first two IPCEIs. In May 2024 another important IPCEI was approved, namely the Hy2Move, for which the Member States will provide up to €1.4 billion in public funding, which is expected to unlock additional €3.3 billion in private investments. IPCEI Hy2Move will cover a wide part of the hydrogen technology value chain, by supporting the development of a set of technological innovations, including: the development of mobility and transport applications, the development of high-performance fuel cell technologies, the development of next-generation on -board storage solutions for hydrogen and the development of technologies to produce hydrogen for mobility and transport applications.

02

National hydrogen strategies

Introduction

This chapter provides an overview of the national hydrogen strategies adopted in EU27, UK and EFTA countries. For each strategy, quantitative indicators (i.e. targets or estimates) have been identified. A qualitative summary of the strategy's content is also provided, describing and classifying the main priorities and corresponding measures along the hydrogen value chain. It is important to note that the information is sourced from the European Hydrogen Observatory based on data gathered by Hydrogen Europe until May 2024. Therefore, there may be additional strategies for some countries that are not captured in this report.

Interactive data dashboards on national hydrogen strategies can be accessed on the European Hydrogen Observatory website.

2.1.
Overview

European countries have developed national hydrogen strategies to support the transition to a low-carbon economy and achieve their climate targets. Hydrogen is seen as a key component of this transition, as it can be produced from renewable sources and used as a clean energy carrier in various sectors, such as industry, transport and energy. These strategies aim to scale up renewable hydrogen production and utilization while supporting the development of associated infrastructure and technologies, with targets set for hydrogen deployment across sectors and plans in place to foster innovation and create economic opportunities within the hydrogen sector.

In addition, national hydrogen strategies aim to promote international cooperation and coordination, as hydrogen is a global commodity that requires international collaboration to ensure its safe and efficient production, transport, and use. Overall, national hydrogen strategies are an important tool for countries to achieve their climate targets and support the transition to a low-carbon economy, while also promoting innovation and economic growth.

Some European countries, including Germany, France, Netherlands, Portugal, Spain, and Italy, have developed hydrogen roadmaps in addition to their national hydrogen strategies. These roadmaps are an important tool for countries to provide a more detailed plan for the deployment of hydrogen technologies and infrastructure in the country, including specific targets and timelines, to ensure that they are on track to meet

their national and international climate targets. However, it is important to note that the current focus of the EHO database is primarily on hydrogen strategies rather than specific roadmaps.

Figure 3 gives an overview of the adoption status of national strategies in European countries, relevant to the deployment of hydrogen technologies and infrastructures. As of May 2024, 66% of the European countries (21 out of 32), have already published such strategies, while in 9% of the countries (3 out of 32), national hydrogen strategies are at a draft stage and have not yet been officially adopted. The remaining counties, 25% (8 out of 32), have no official national hydrogen strategy adopted yet.

Compared to the previous report, which included data up until July 2023, the percentage of countries with published strategies has increased by 3%, and the number in draft has also risen by 3%. Conversely, the percentage of countries without an adopted strategy has decreased by 6%. More specifically, in 2024, Lithuania has released its first national hydrogen strategy, marking a significant step forward. Additionally, Romania has made progress by advancing from having no strategy to reaching the draft stage.

These trends indicate a growing commitment among European nations to establish national hydrogen strategies, highlighting their recognition of the importance of hydrogen in achieving climate goals and enhancing energy security.

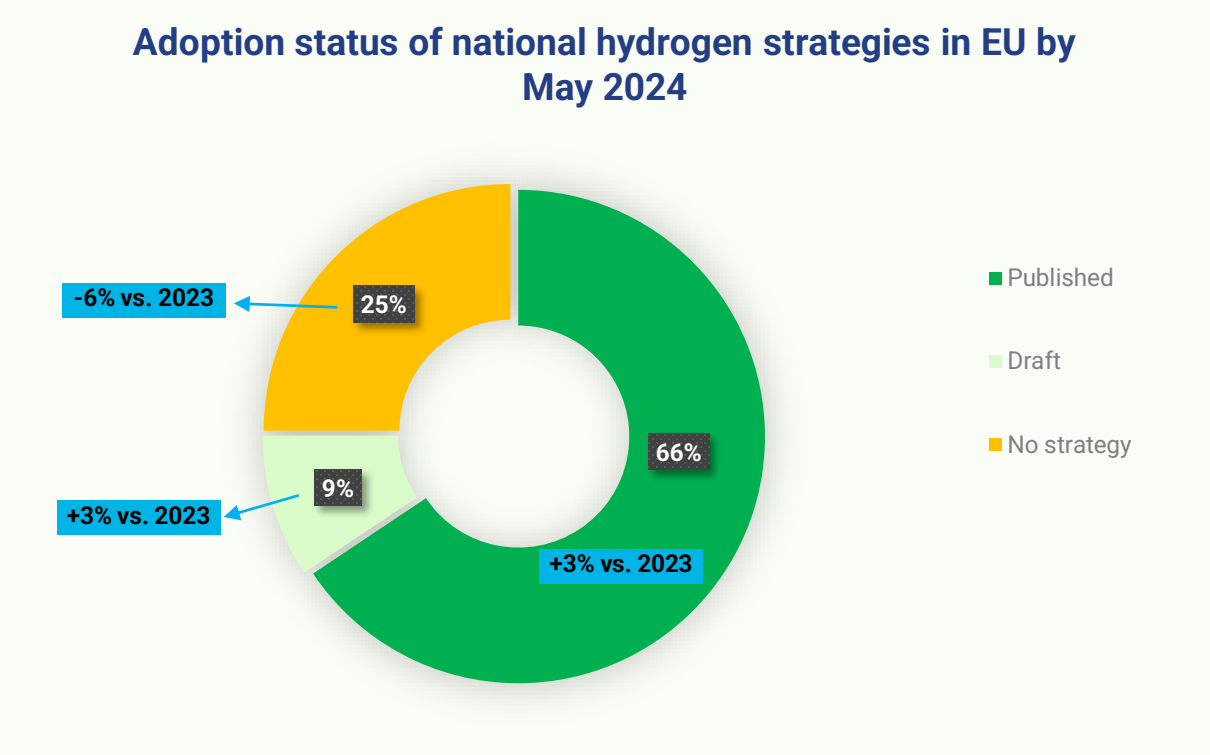


Figure 3. Adoption status of national hydrogen strategies in Europe.

Figure 4 provides a geographical representation of the current adoption status of national hydrogen strategies across European countries. A table is also added in the Appendix A1 providing a comprehensive overview of the national hydrogen strategies published across Europe, categorized by country and year of publication. Additionally, it includes direct links to the respective strategy documents, offering easy access for further reference.

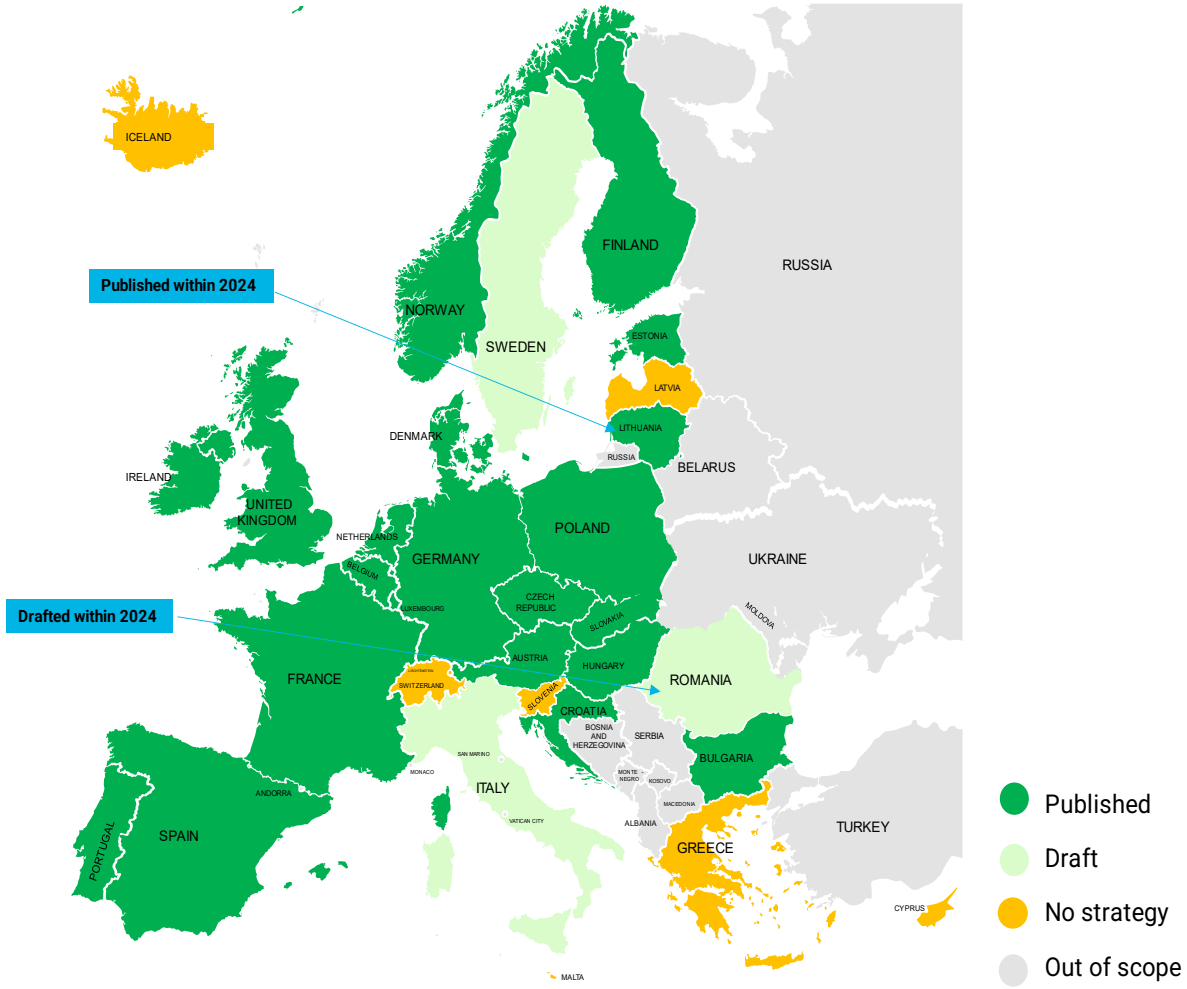


Figure 4. Map of strategies adoption status across European countries.

Figure 5 shows which topics are covered by European national strategies, based on the summaries made on the European Hydrogen Observatory. The figure illustrates the distribution and adoption of hydrogen strategies within distinct stages of the value chain by European nations as of May 2024. Notably, all strategies include hydrogen production, underscoring its foundational role in national plans. Similarly, hydrogen applications in mobility are widely prioritized, with all 20 countries incorporating them, a slight increase from 18

countries in July 2023. Industry applications appear in 17 of the 20 strategies, up from 16 in 2023.

Most countries (18 out of 20) continue to emphasize expanding or establishing hydrogen distribution networks and storage facilities, maintaining the same level of focus as in 2023. Education and research initiatives demonstrate growth, with 15 countries including them in 2024, compared to 12 in 2023.

In contrast, hydrogen applications for heating, energy backup power, and manufacturing remain less frequently addressed, with only 10, 11, and 8 countries, respectively, including these aspects in their strategies. These numbers reflect a slight increase in the focus on energy backup power (11 in 2024 versus 10 in 2023), while other categories remain unchanged. Strategies that focus on hydrogen import and export routes exhibit slightly lower adoption, with 7 countries pursuing these international trade routes in 2024 compared to 8 in 2023.

A table is also added in the Appendix A2 that categorizes and summarizes the main measures (qualitative representation) within the hydrogen value chain for each European country that has published strategies.

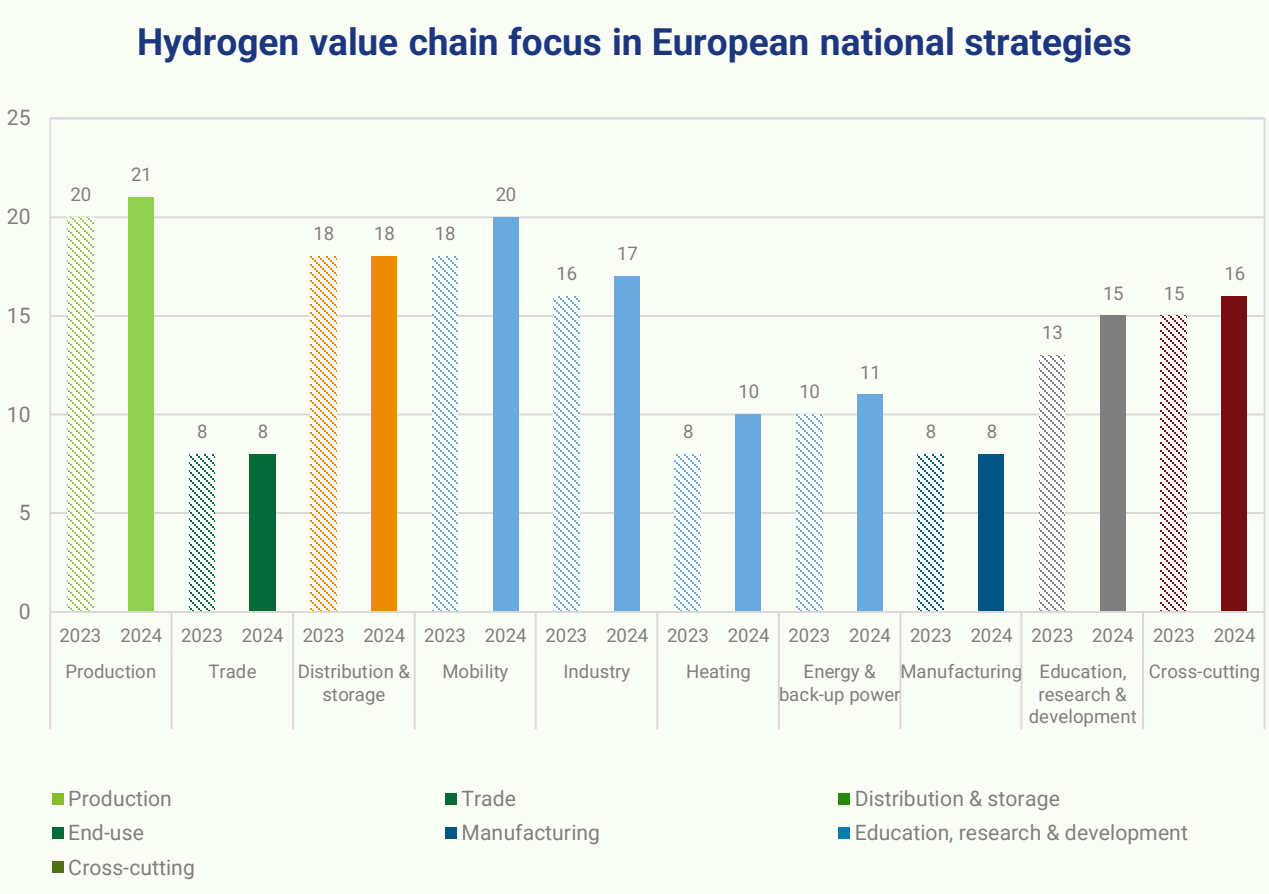


Figure 5. Hydrogen value chain focus across European national strategies.

2.2.

Qualitative summary by country

This section provides a qualitative summary for each European national hydrogen strategy. This summary aims to describe and classify the principal measures undertaken along the hydrogen value chain, offering insights into the diverse approaches and key initiatives adopted by each nation.

Austria

Austria's hydrogen strategy prioritizes renewable hydrogen production, achieved through water electrolysis with renewable energy or sustainably sourced biomass, and climate-neutral hydrogen, produced from methane with carbon capture, utilization, and storage (CCUS) or pyrolysis. This climate-neutral approach requires zero greenhouse gas emissions and excludes nuclear energy. To stimulate production, Austria offers investment subsidies, green electricity allocations, and renewable gas quotas. The strategy also emphasizes building a dedicated hydrogen infrastructure, repurposing existing gas pipelines to transport pure hydrogen, especially to industrial clusters, while hydrogen blending is generally discouraged. For storage, the strategy includes short- and medium-term solutions, with plans for long-term underground storage pending further research and regulatory updates.

In terms of end-use, Austria envisions hydrogen as crucial for sectors like heavy-duty transport (buses, freight) and plans to use it alongside battery-electric trains to decarbonize rail networks. Hydrogen is also seen as essential in aviation and water transport. Industrial applications focus on replacing fossil-based hydrogen in chemical processes, using hydrogen as a reducing agent in steel production, and supporting high-temperature processes in cement and glass industries where electrification isn't viable. Through these targeted applications, Austria's strategy aims to integrate hydrogen across major sectors to support national decarbonization goals.

Belgium

Belgium's hydrogen strategy prioritizes full decarbonization by 2050 through renewable energy, given the nation's limited domestic renewable resources. Recognizing the need for external energy, Belgium aims to establish itself as a European hub for importing and distributing renewable hydrogen and its derivatives. The strategy emphasizes a phased approach to production: while the long-term target is a fully renewable hydrogen mix by 2050, Belgium supports transitional solutions in the short term, including steam methane reforming (SMR) and autothermal reforming (ATR)with carbon capture and storage (CCS), as well as pyrolysis, to bridge the gap as renewable capacity is developed.

To enable this transition, Belgium is focusing on establishing critical import routes and a national

hydrogen transport network, leveraging existing infrastructure and building cross-border connections. Industrial applications, particularly in high-temperature sectors like chemicals and steel, are a key focus, along with aviation, maritime transport, and strategic support for hydrogen research and development to foster local expertise. Conversely, hydrogen use in residential heating and passenger cars is deprioritized in favour of electrification and other renewable solutions.

Bulgaria

Bulgaria's hydrogen strategy focuses on establishing green hydrogen production, with pilot projects funded through the national recovery plan and the development of hydrogen valleys. The country will assess renewable hydrogen production zones and explore opportunities for hydrogen storage. In terms of transmission and distribution, Bulgaria will evaluate its hydrogen export potential, the future role of natural gas infrastructure, and identify potential storage sites. Regulatory frameworks for access to the grid will be adapted to integrate both biogas and hydrogen.

For end-uses, mobility will be prioritized through financial incentives for fuel-switching and the establishment of the first 20 hydrogen refuelling stations (HRS), with the regulatory regime on hydrogen transport and alternative fuels to be updated accordingly. Industry will be encouraged to transition to renewable hydrogen through a quota system aligned with European legislation. The energy sector will also be adjusted by modifying electricity market rules to support the integration of power-to-x (PtX) technologies. Alongside these actions, Bulgaria will strengthen its administrative capacity, raise public awareness, and foster international cooperation through participation in European-funded projects. Research and development will focus on hydrogen's integration across energy systems, mobility, storage, and industry, alongside advancing synthetic fuel technologies.

Croatia

The Croatian hydrogen strategy focuses on renewable hydrogen production to replace fossil fuels and enhance the integration of renewable energy into the electricity system. Initially, hydrogen production will be concentrated in mobility and industry sectors, primarily for refineries and petrochemical plants, with the goal of meeting industrial feedstock needs by 2030. After 2030, the strategy aims to scale up production to meet increasing national demand.

In terms of transmission and distribution, the strategy envisions limited infrastructure in the early stages, with hydrogen production located near demand areas. In the second phase, hydrogen infrastructure will expand to support industrial applications, mobility, heating, and electricity system balancing. For end-uses, hydrogen mobility is a priority, starting with public procurement and the development of a network of hydrogen refuelling stations, with 10 stations planned initially. The industrial sector will focus on replacing fossil fuels with green hydrogen, particularly for high-temperature heating needs.

Hydrogen will also play a role in heating systems once distribution networks are in place, and it is envisioned for use in backup power systems for both civilian and military applications.

Education and research will focus on improving production efficiency, developing new production methods, and integrating hydrogen technologies into educational programmes to build knowledge across society.

Czech Republic

The Czech Republic's hydrogen strategy focuses on diverse production methods, including renewable hydrogen, hydrogen from natural gas with carbon capture, electrolytic hydrogen from nuclear energy, and pyrolysis, addressing limited renewable energy potential and industrial demand.

Transmission will begin with localized production near consumption, transitioning to hydrogen pipelines after 2031 due to the country's role as a net importer of energy. Research and development will target hydrogen-powered vehicles and production technologies, such as electrolysis and pyrolysis.

Mobility is the priority end-use in the early phases, with industrial hydrogen adoption expected to start after 2026, transitioning to commercial use post-2031, and large-scale low-carbon hydrogen production not anticipated until after 2040.

Denmark

The Danish hydrogen strategy puts forward a target of increasing electrolysis capacity. A key emphasis point is that hydrogen must be of renewable electricity origin following EU methodology. The strategy puts focus on using PtX technology, (converts electricity into other forms of energy, such as hydrogen, synthetic fuels, or chemicals), for difficult-to-abate sectors such as shipping, aviation, agriculture, parts of industry and parts of heavy-road transport. The government will initiate dialogue with neighbouring countries on hydrogen infrastructure development and present an energy and supply package with a proposal for regulating ownership, financing, and operation of hydrogen infrastructure.

Estonia

The Estonia's hydrogen strategy focuses on expanding production through EU and national funding, along with establishing legal frameworks and enhancing renewable energy capacity. It aims to secure sustainable water and CO_2 sources for hydrogen production.

Education and R&D efforts center on training specialists and supporting research in hydrogen production technologies, with particular emphasis on solid oxide electrolysers and fuel cells.

The strategy includes setting up a legislative framework for hydrogen transmission and distribution, exploring the integration of hydrogen into the natural gas system. Short-term transport will rely on cylinders, with pipelines considered for longer distances. Hydrogen storage solutions are being explored, including the Incukalns facility in Latvia.

Manufacturing of hydrogen technologies will be strengthened by national investments, supporting both production and deployment of hydrogen technologies.

In mobility, the strategy focuses on developing hydrogen refuelling stations and exploring fuel-cell powered ferries. Additionally, hydrogen will be considered for national energy security, including crisis reserves, while regional cooperation is pursued to leverage renewable energy potential for hydrogen production.

Finland

The Finnish hydrogen strategy emphasizes the promotion of all emission-free hydrogen production technologies, fostering a technology-neutral approach, while also supporting the development of a regulatory framework for CCS/CCU at the EU level.

For transmission and distribution, Finland focuses on the coordinated development of a national hydrogen network, with Gasgrid Finland leading efforts in infrastructure development and international cooperation, along with the establishment of market regulations.

Research and development activities are supported through funding for hydrogen technologies and solutions, including CCS and system integration. The strategy also emphasizes fostering cooperation between authorities and stakeholders.

In terms of end-uses, the strategy focuses on using hydrogen for heavy-duty transport, including road, maritime, and offroad machines. It also promotes the integration of e-fuels into the fuel distribution obligation to meet future renewable energy targets.

France

The French hydrogen strategy is structured around specific goals and actions tailored to its industrial and mobility needs. The strategy prioritises the development of a domestic hydrogen sector that not only drives decarbonisation but also strengthens France's technological autonomy and industrial capacity. This includes a clear focus on heavy-duty mobility, with an emphasis on hydrogen solutions for long-distance operations in sectors such as freight transport, buses, and trains in non-electrified regions. The goal is to make hydrogen a key enabler of clean mobility, particularly for captive fleets engaged in just-in-time operations.

On the production side, France is aiming to develop a significant electrolysis capacity, with an emphasis on large-scale projects that can both meet rising demand and drive the economy of scale necessary for hydrogen production to become commercially viable. The creation of regional hydrogen hubs is a core part of the strategy, enabling synergies between industries and mobility sectors to optimise resources and accelerate the hydrogen economy.

In terms of industrial application, France is particularly focused on hydrogen as a replacement for fossil fuels in processes like fuel desulphurisation in refining and hydrogen use in chemicals such as ammonia and methanol production. The strategy supports the

introduction of mechanisms to ensure the value of decarbonised hydrogen is enhanced, including guarantees of origin and financial incentives to support the transition in high-impact sectors. Additionally, the strategy places a strong emphasis on fostering innovation in hydrogen technologies through research and development, as well as strengthening educational programmes to build a skilled workforce capable of supporting the hydrogen economy's growth.

Germany

The German hydrogen strategy centers on green hydrogen, aiming for a long-term, reliable supply while using other hydrogen types temporarily. The strategy focuses on integrating electrolysis with the energy system, reducing regulatory barriers, and ensuring sustainability in production, especially concerning water usage.

For transmission, Germany plans significant pipeline development and interconnections with neighbouring countries, supporting the European Hydrogen Backbone. Hydrogen infrastructure, including LNG terminals, will be adapted to ensure stability in supply.

The country aims to lead in hydrogen technology manufacturing, with a focus on electrolysers, and develop international partnerships. The strategy targets decarbonization in heavy-duty transport, industry, and energy, with a focus on hydrogen's role in hard-to-abate sectors like steel and chemicals and supports hydrogen-ready power plants.

Germany also plans to use hydrogen in energy production and specific heating applications, particularly in areas not connected to heating networks.

Hungary

The Hungarian hydrogen strategy focuses on low-carbon production capacities for industry and mobility, with a target of increasing electrolysis capacity by 2030, through licensing and international cooperation, with a focus on supporting SMEs and accessing external markets. Domestic automotive manufacturers will also cooperate in the field of hydrogen technologies. Green hydrogen will be produced using solar PV, nuclear energy, and grid electricity, in addition to promoting CCS technologies by establishing a regulatory framework. There is a focus on using natural gas infrastructure for storage, starting with a pilot project, but with the target of hydrogen blending. The strategy promotes heavy-duty vehicles in the mobility sector, low-carbon hydrogen consumption in the petrochemical and chemical industries and meeting industrial heat demand with hydrogen in the cement, iron, and steel industries. The energy sector will pilot co-firing natural gas with hydrogen and introduce hydrogen applications in the electricity market for flexibility services. Cross-cutting measures include the establishment of a National Hydrogen Technology Laboratory and dissemination of information among the general public to increase public acceptance of hydrogen technologies.

Ireland

The Irish hydrogen strategy includes hydrogen production from grid-connected electrolysers during periods of high wind and curtailment. Low-carbon hydrogen production is not expected to have a major role. The main obstacle is the development of a new hydrogen industry. Hydrogen transport will first take place via compressed tanks, with infrastructure development in clusters and an overall plan to transit from natural gas to hydrogen over time. Infrastructure development will be integrated and consider energy systems, networks, storage, and ports. Hydrogen use in mobility focuses on freight, HDV, aviation, and maritime transport. The national policy framework on alternative fuels infrastructure will be updated to include hydrogen considerations. Hydrogen will have a role in medium and high-grade heat applications in industry, and in enabling flexible power generation in the energy sector. Further assessments will be carried out to understand the actual quantities of hydrogen needed in a net-zero integrated energy system. The development of hydrogen clusters will be promoted. Specific attention is paid to safety issues and therefore a safety roadmap will be developed. On standardisation and certification, the establishment of a certification scheme for hydrogen is foreseen, with the integration of electricity guarantees of origin to avoid double counting.

Lithuania

Lithuania's hydrogen strategy focuses on developing a renewable hydrogen ecosystem to reduce energy dependence and emissions, with an emphasis on domestic production. Key production targets include electrolytic capacity expansion and pilot projects for synthetic methane, alongside safety standards and simplified regulations.

Transmission and distribution plans leverage the Finland-Germany pipeline for export and storage, aiming to position Lithuania as a transit hub. Hydrogen blending into natural gas infrastructure will be pursued as a transitional measure, while synthetic methane is explored as a long-term storage solution.

Cross-cutting initiatives prioritize a legal framework for hydrogen infrastructure, the establishment of hydrogen valleys, and public education on hydrogen safety and applications. International cooperation will be directed toward building a robust regional hydrogen network and attracting high-value equipment manufacturers.

For mobility, the strategy promotes hydrogen-powered vehicles and fuelling infrastructure, with plans to introduce hydrogen in public transportation across multiple cities and at key ports. Industrial applications focus on the fertilizer sector, particularly green ammonia, with secondary uses in refining and high-temperature processes like glass and cement production.

In the energy sector, Lithuania aims to use green hydrogen to enhance grid flexibility, creating a framework for power-to-gas and gas-to-power projects and leveraging surplus renewable electricity.

Luxembourg

The hydrogen strategy in Luxembourg targets hydrogen demand by 2050, with limited green hydrogen production and most hydrogen being imported or produced locally with imported renewable electricity, and participation in cross-border mechanisms for renewable hydrogen production. Instruments to guide economic actors, such as quota systems for SAF in aviation, cross-border tenders for hydrogen production support, and obligations for development of refuelling infrastructure for heavy-duty vehicles will be set. There is a focus on participation in European initiatives and development of European rules for hydrogen infrastructure, with priority given to granting projects of common interest status to projects exclusively dedicated to hydrogen and derivatives. The strategy includes measures on decarbonizing mobility with renewable fuels, substitution of grey hydrogen with green in industry, and using hydrogen as an alternative to decarbonize heat networks and in high-efficiency cogeneration plants. Several research priorities in the strategy are special materials used for photoelectrolysis of water, fuel cells, hydrogen storage and optimal use of rare resources. The strategy envisions active participation in the definition of rules at the EU level, focusing on certification of renewable hydrogen.

Netherlands

The updated Dutch hydrogen strategy published in 2021 (NWP), builds on the previous strategy by setting a stronger foundation for scaling up green hydrogen production and infrastructure. Central to the update is the acceleration of production capacity goals, aiming for a robust renewable hydrogen output linked to offshore wind energy. This expanded focus on domestic production is complemented by a decentralized approach, allowing local hydrogen generation to ease grid congestion and support urban and logistics needs. Alongside continued support through DEI+ and SDE++ programmes, the NWP now emphasizes GroenvermogenNL's role in driving research and development to reduce costs and advance electrolysis technology.

Infrastructure efforts are reinforced by prioritizing the integration of the hydrogen system within existing natural gas infrastructure. The programme also highlights the Netherlands' evolving role as an international hydrogen trade hub, establishing frameworks to support imports and exports, including ammonia and other derivatives, within a North-Western European hydrogen market. Safety and public awareness campaigns have been intensified to build societal acceptance of hydrogen, particularly in urban mobility and the transport sectors.

The NWP update enhances goals for hydrogen-powered transport and sustainable aviation fuel (SAF) deployment, extending support for heavy-duty vehicles and hydrogen refuelling infrastructure. The Netherlands also continues to collaborate with European partners on regulatory standards, guarantees of origin, and targeted electrolyser locations. These refinements aim to position the Netherlands as a key player in the hydrogen economy while strengthening infrastructure, enhancing energy security, and

supporting long-term sustainability objectives in alignment with European climate goal.

Norway

The Norwegian hydrogen strategy supports hydrogen production mainly through development and demonstration projects, researching more efficient ways to produce hydrogen. On the topic of hydrogen exports, both pipeline and ship exports to Europe are considered. An alternative to be investigated is the export of natural gas towards Europe, with hydrogen production on site with CCS and import of CO_2. The strategy includes support for equal rules in FCEV and BEV mobility, public procurement, zero emissions solutions in shipping, and funding for hydrogen technology development in industry. Research activities will focus on achieving low-emissions society, but specifically more efficient electrolysis plants are highlighted.

Poland

The Polish hydrogen strategy considers integrating hydrogen production in locations closer to consumption and available energy sources, while also setting the legal regime to produce hydrogen from nuclear energy. The strategy prioritizes safety in transmission, distribution, and storage, adapting energy legislation, conducting a feasibility study for a "Hydrogen Highway," and foresees blending hydrogen in the natural gas system. For mobility, priority is given to construction of refuelling stations in densely populated areas for buses and rail transport, as well as on TEN-T corridors. For the industry, the focus is on the use of low-carbon hydrogen in the petrochemical, chemical and fertiliser industries, through industrial hydrogen valleys. In the heating and power sectors, there is a focus on research and development mainly in co-firing of hydrogen in gas turbines, co-generation and poly-generation systems, and hydrogen storage. The strategy intends to foster the development of manufacturing capacities for the entire hydrogen value-chain. Research, development and commissioning pilot projects will be carried out in relation to co-generation and poly-generation plants where hydrogen is the primary fuel, as well as low-carbon hydrogen production technologies. To implement the strategy, the ministry of energy will conclude a polish hydrogen agreement with industrial interested parties.

Portugal

The Portuguese hydrogen strategy includes legislative changes to allow licensing of hydrogen production plants, promotion of hydrogen production in waste-water treatment plants, and development of a support mechanism for sale of renewable hydrogen. In subsequent stages of development of the sector, Portugal can become an exporter of green energy products through the Sines port or through pipelines connecting the Iberian Peninsula with the rest of Europe. Hydrogen is a way to increase the value of existing pipelines and reduce their amortisation. Consequently, a legal framework for hydrogen blending will be developed. The focus for hydrogen use in mobility is mainly on buses, heavy-duty vehicles, captive fleets, trains,

and maritime transport. In industry, it focuses on cement, glass, ceramics, refining, and chemicals, in addition to power-to-gas technologies for energy. The strategy includes ambitions for legislative changes, support for refuelling stations, production of synthetic fuels, replacement of grey with green hydrogen, development of quality and safety standards, and support for hydrogen pilot projects. Cross-cutting measures focus on international cooperation multilateral and bilateral cooperation, development of guarantees of origin for hydrogen and the promotion of sector-coupling.

Slovakia

The Slovakian hydrogen strategy considers all low-carbon methods to produce hydrogen, including electrolysers using electricity from nuclear power plants, high temperature pyrolysis and gasification of non-recyclable waste. The strategy includes a technical analysis on repurposing natural gas infrastructure, establishment of safety regulations, and expansion and connection of the national grid with neighbouring countries. The focus for hydrogen use in mobility is mainly on public transportation, freight, planes, boats, and machinery in various sectors. For end-use in industry, the strategy targets low-carbon hydrogen in the chemical, petrochemical, and steel industries. A network of hydrogen refuelling stations will be developed, and a study on replacing natural gas with hydrogen will be carried out. The development and production of materials for transport and storage of hydrogen is considered. Emphasis is placed on harmonisation of standards and regulatory measures, specifically on the low-carbon hydrogen value-chain and guarantees of origin. International cooperation will be also fostered.

Spain

The Spanish hydrogen strategy supports the production of renewable hydrogen by establishing a regulatory framework for Power-to-X (PtX) technologies. For infrastructure, the regulatory requirements for hydrogen blending and storage will be revised. Evaluations will be carried for the need to modify end-use equipment both for industrial users and domestic ones. In mobility, there will be hydrogen-specific legislation for green hydrogen production and refuelling stations, plans for vehicle purchase and infrastructure deployment, a study on FCEV locomotives, and measures for hydrogen technologies and refuelling stations in ports. In industry, there will be financial support for the transition to renewable hydrogen. For energy, there will be a change in the regulatory framework to allow PtX facilities in the energy market and promotion of green hydrogen in generation and co-generation plants. Research and development will be supported across the entire value-chain for hydrogen, but focus will be given on hydrogen use in cogeneration, recycling of components, and hydrogen turbines. An analysis will be carried on indirect taxation impact on renewable hydrogen. On certification, the strategy foresees participation in international standardisation bodies and development of a guarantee of origin system within the EU.

United Kingdom

The United Kingdom's hydrogen strategy, updated in December 2023, continues to focus on advancing both electrolytic and low-carbon hydrogen production, providing a comprehensive approach to developing hydrogen as a key energy source. Efforts are directed towards supporting diverse hydrogen production pathways, including those enabled by CCUS, while maintaining alignment with the UK Low Carbon Hydrogen Standard.

For infrastructure, the strategy emphasizes the establishment of large-scale hydrogen transport and storage systems, with a particular focus on geological storage. The government is also enhancing its strategic energy planning through the Future System Operator, which will begin its role in overseeing hydrogen initiatives by 2026. In addition, the blending of hydrogen into existing gas networks is being pursued, creating a transitional approach to hydrogen integration.

In trade, the UK aims to position itself as a key exporter of high-grade hydrogen, particularly to continental Europe, with the development of a certification scheme. Research and development remain a core priority, particularly for hydrogen production, transport applications such as aviation and maritime, and the integration of hydrogen into industrial processes for decarbonization.

The strategy also prioritizes creating a skilled workforce through new initiatives like the Hydrogen Skills Strategy, set to launch in 2024. End-use applications in mobility, aviation, and maritime sectors are being supported through regulatory changes and development projects. The government is also considering the role of hydrogen in the heating sector, with trials underway to explore its viability for residential and industrial heating in the future.

2.3.
Quantitative targets

Several European countries have incorporated quantitative indicators within their national strategies, outlining targets and estimates across the hydrogen value chain. This deliberate approach reflects a commitment to providing clear and measurable goals within their hydrogen strategies. These quantifiable indicators serve as robust tools for assessing the ambitions of each country's hydrogen strategy. By setting specific targets these nations are advancing their commitment to the development and integration of hydrogen within their energy landscapes.

The following sections summarize, the quantitative indicators that were set forward in the national hydrogen strategies of European

countries according to the different steps of the value chain.

2.3.1. Production and trade

One of the key areas of focus for the deployment of hydrogen, is hydrogen production, as this is a critical step in the development of a sustainable hydrogen economy. This section presents the main targets that have been set by various countries for hydrogen production.

One of the strategies employed to enhance domestic renewable hydrogen production involves efforts to increase electrolyser capacity.

Figure 6 illustrates the 2030 targets for electrolyser capacity, established by various European countries. Germany maintains the highest goal, aiming for 10 GW of electrolyser capacity by 2030, consistent with the previous report. France, Denmark and the UK follow with targets of 6.5, 5 and 5 GW by 2030, respectively. The targets of the remaining countries fall below 5 GW of electrolyser capacity.

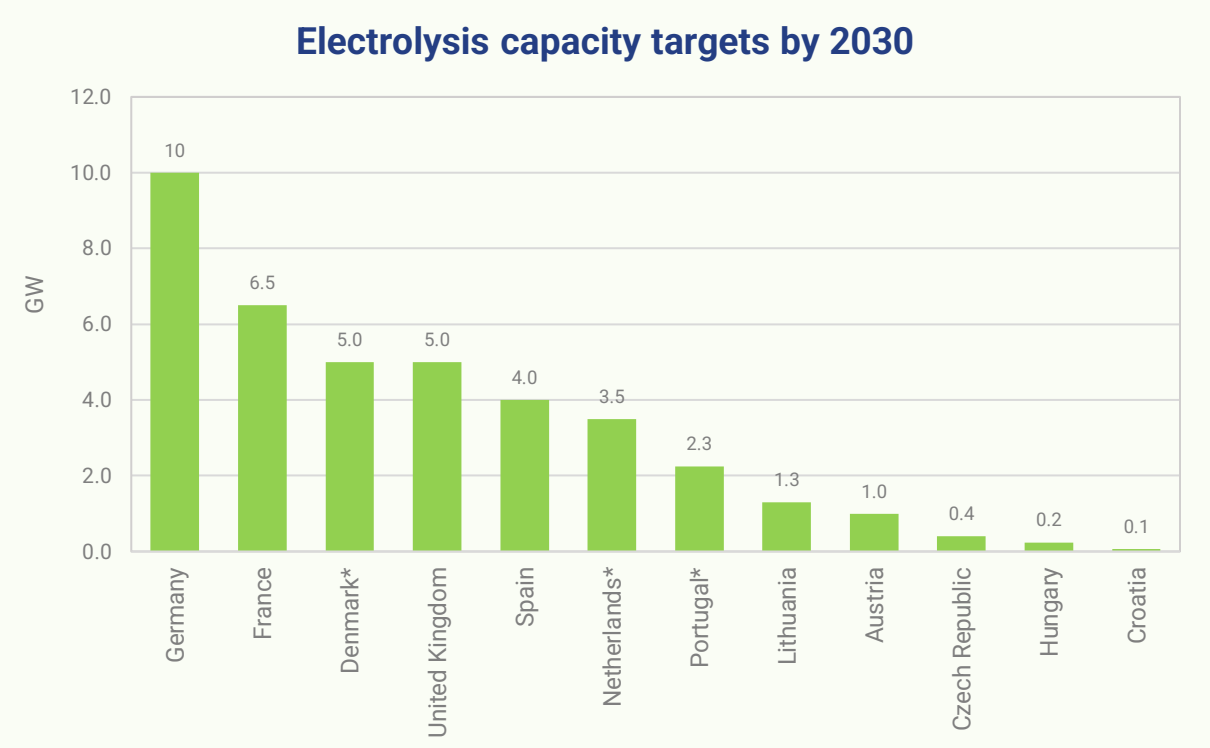


*Figure 6. Targets on electrolysis capacity set by European countries by 2030. *Average values were used for Denmark, the Netherlands and Portugal.*

Not all countries have set targets for the year 2030. Belgium, for example, only has a target for 2026, aiming to have 0.15 GW installed.

Some other European countries have committed to scaling up both renewable and low-carbon hydrogen production as part of their hydrogen

production targets. For example, Czech Republic aims to produce 101 kt/year of low-carbon hydrogen by 2050, while Hungary targets 16 kt/year and 20 kt/year of renewable and low-carbon hydrogen production, respectively. Estonia and Lithuania expect to increase the renewable hydrogen production to 2-40 kt/year and 129 kt/year by 2030, respectively. Additionally, countries such as the United Kingdom aim to increase low-carbon hydrogen production capacity, with a target of 10 GW, at least half of which will be electrolytic, while Poland has set a target of 2 GW of low-carbon hydrogen production capacity, with a focus on integrating production closer to consumption and available energy sources.

The trade of hydrogen is interconnected with production and reflects a combination of economic, environmental, and strategic considerations. The nature of hydrogen trade allows European countries to leverage their strengths, address domestic shortages, and contribute to a more sustainable and diversified hydrogen economy.

Some countries have included into their strategy targets related to trade. As an example, Belgium aims to import 20 TWh of hydrogen and its derivatives by 2030, and 200-350 TWh by 2050, partially intended for transit (mainly to Germany). Hungary is another example, with ambitions to ensure that all new liquefied natural gas (LNG) terminals are equipped to handle hydrogen or its derivatives. Germany focuses on meeting national demand primarily through imports, starting with ship-based ammonia until 2030, followed by other hydrogen derivatives and pipeline-based green hydrogen post-2030, emphasizing diversification to reduce risks.

2.3.2. Transmission

Currently, hydrogen use, mainly as a feedstock, is confined to local industrial clusters, but it is envisaged that it will also become a main energy vector transporting energy over longer distances across Europe and storing it over longer periods of time. Hydrogen, as an energy carrier, could be transported in pipelines across Europe either by blending hydrogen with natural gas and transporting the resulting mixture using the current gas network or transporting hydrogen as such in a dedicated separate network, part of which might be provided by refitted existing infrastructure.

It is clear that the blending strategy, while already contributing to the reduction of carbon dioxide emissions, can only have a transitional role, since full decarbonisation of the EU economy requires a much greater penetration of hydrogen in the EU energy mix than what could be accommodated through blending. The ambition of Germany in their national hydrogen strategy is to establish a hydrogen network spanning approximately 1,800 km by 2030. This network will be constructed

either through new infrastructure or by repurposing existing networks to facilitate the transportation of hydrogen.

Blending of minor shares of hydrogen into natural gas does not create particular technical problems in the transportation and usage of the resulting mixture. At present, European countries impose different limits on hydrogen blending in natural gas networks. Figure 7 gives an overview on the targets set by European countries on limits on hydrogen blending in natural gas networks. In Portugal, a legal framework for hydrogen blending will be developed, setting a target of 10 - 15% hydrogen injection in natural gas grid. Regarding Austria, hydrogen blending is not seen as a viable option, considering the scarcity of renewable hydrogen, although an increase of the current limit of 10% of hydrogen in the natural gas grid will be examined. In Poland, the strategy also foresees 10% blending of hydrogen in the natural gas system. In the case of Hungary, based on the lack of hydrogen storage potential, the strategy focuses on the use of natural gas infrastructure for storage, starting with a pilot project, but with the target of minimum of 2% of blending.

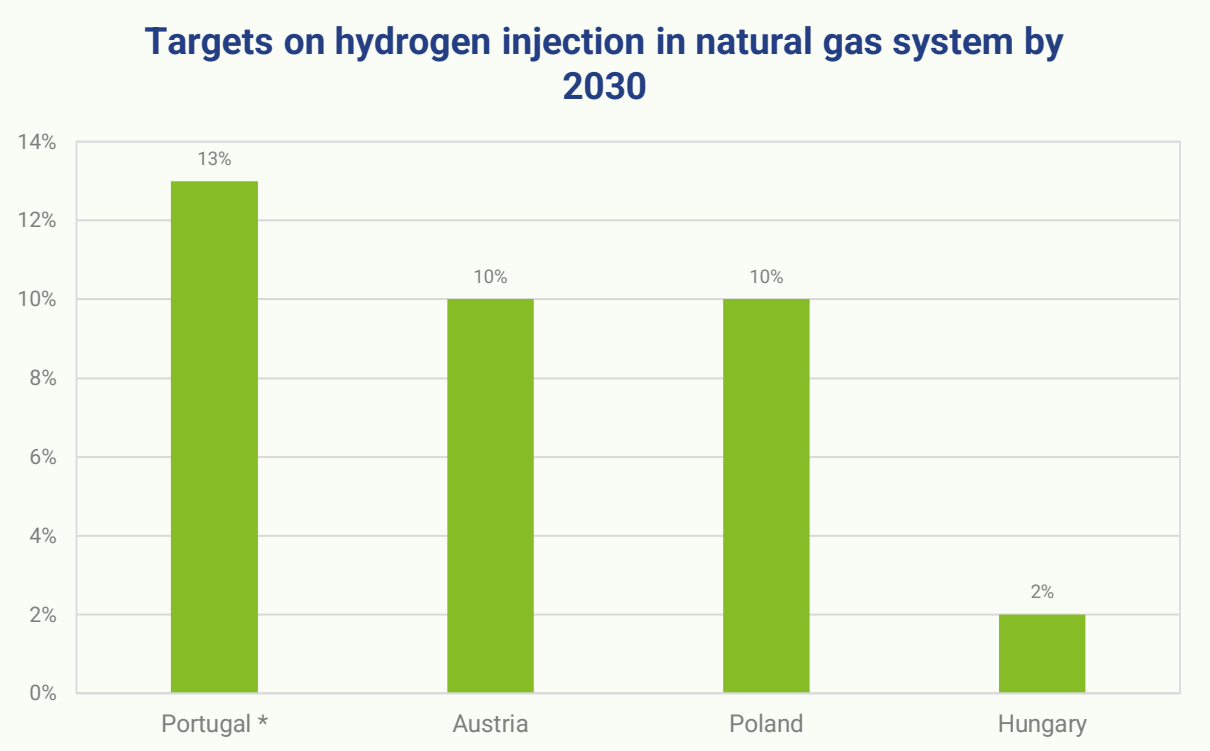


*Figure 7. Targets on hydrogen injection limit (%) in the natural gas network by 2030 set by European countries. *For Portugal, an average value (13%) was used, calculated as the midpoint of the target range of 10%-15%..*

2.3.3.
End-use

Demand

Table 3 gives an overview of the expected total hydrogen demand in the European countries by 2030, 2040 and 2050. In Belgium the use of renewable hydrogen as a feedstock and for high-temperature heating in industry is a priority (chemical, steel industries) with demand for renewable molecules expected to rise to 125-200 TWh by 2050.

A total hydrogen demand of 95 to 130 TWh is forecasted in Germany for the year 2030. This includes the projected demand for hydrogen derivatives such as ammonia, methanol, or synthetic fuels.

The demand for gaseous energy carriers (methane and hydrogen) in relevant sectors in Austria in the year 2040 is estimated to range between 89 and 138 TWh, according to calculations. The range is derived from a scenario analysis, where on the one hand, assuming application-specific efficiency maximization and extensive electrification yields lower the demand value of 89 TWh (energy efficiency). On the other hand, assuming a comparatively higher but less efficient utilization of existing technological infrastructure and processes results in the upper demand value of 138 TWh.

Table 3. Expected total hydrogen demand in European countries. by 2030, 2040 and 2050. [41][42]

Country	Target year	Target value	
		TWh	kton
Austria	2040	89-138	2670-4140
Belgium	2050	125-200	3750-6001
Croatia	2030	0.16	4.8
Czech Republic	2030	3.2	97
Germany	2030	95-130	2850-3900
Ireland	2050	19.8-74.6	594-2238
Luxembourg	2050	4-10	120-300
Portugal	2030	3.3	99
Slovakia	2030	6.7	200
	2050	13.3-20	400-600

[41] Conversion factor: kton=(TWh*1000)/33.33
[42] For Croatia and Portugal, the total demand was estimated, using data from Eurostat

The total estimated hydrogen demand in Ireland for 2050 is 19.8-74.6 TWh, distributed across various sectors as follows: 3.6-13.3 TWh in flexible power generation or integrated energy parks for large energy users, 0-1.5 TWh in commercial and residential, 0-14.9 TWh in industry and processing, 1-9.3 TWh in road and rail transport, 13-26 TWh in aviation, 2.2-2.6 TWh in maritime and 0-7 TWh in other potential non-energy uses.

In Luxembourg the goal of achieving a hydrogen demand of 4-10 TWh by 2050 (1-4 TWh in industry, 2-4 TWh in road, air, water, rail transport, and 1-2 TWh in integrated energy system) would require doubling of the national electricity consumption, therefore renewable hydrogen production will be limited, with most of the hydrogen being imported or produced locally with imported renewable electricity.

Based on the existing utilization of hydrogen, it can be assumed that in Slovakia, the annual consumption of hydrogen will reach 200 kilotons by 2030. Intensive use of hydrogen anticipates a total consumption increase by 2050 to a range of 400 to 600 kilotons.

In Portugal, the projected total demand for 2030 is estimated to be 3.3 TWh, with 2-5% allocated in the industry, 3-5% in road transport, and 3-5% in domestic maritime transport. Meanwhile, in Czech Republic, the estimated total demand for the same period is 3.2 TWh.

Mobility

Hydrogen may be a realistic alternative to gasoline, accelerating the transition to clean modes of transportation. The key to making this shift is the widespread availability of hydrogen refuelling stations (HRS).

Figure 8 gives an overview on the targets set by European countries on the number of hydrogen refuelling stations by 2025 and 2030.

Netherlands has set a target of 50 refuelling stations by 2025, while in Poland the strategy on mobility includes the construction of 25 refuelling stations by 2025 in densely populated areas for buses and rail transport, as well as on TEN-T corridors. Specific actions include the development of hydrogen refuelling and bunkering infrastructure, replacement of diesel locomotives with hydrogen-powered ones and change of applicable legislation to enable construction of HRS and use of hydrogen in transport.

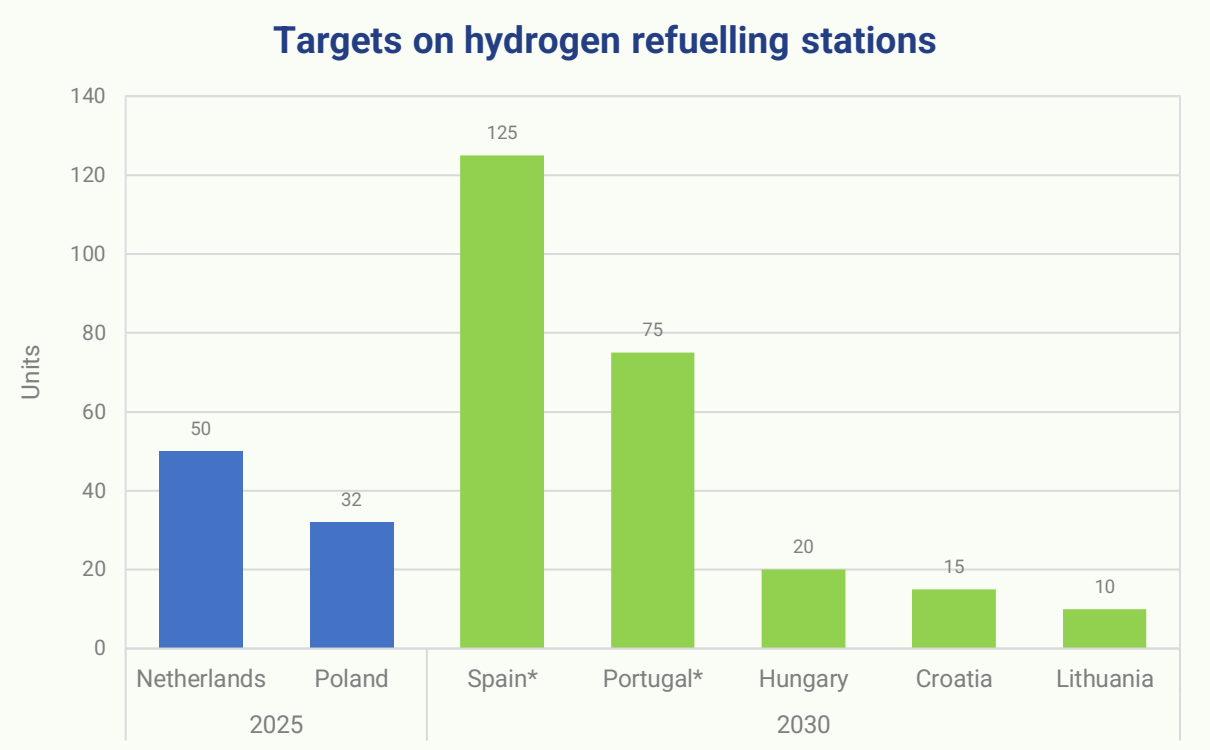


*Figure 8. Targets on the number of hydrogen refuelling stations set by European countries. * Average value was used for Portugal and Spain.*

Spain has set the highest goals for 2030, aiming a network of at least 100-150 publicly accessible hydrogen stations. These should be located in easily accessible places, distributed throughout the territory with a maximum distance of 250 km between each hydrogen station and the nearest one. Following closely behind is Portugal with the objective to create 50 to 100 hydrogen refuelling stations.

In contrast, Hungary and Croatia has set lower targets, with the establishment of at least 20 hydrogen refuelling stations (with two refuelling points per refuelling station) and a network of 10 refuelling stations linked to large city centres, respectively. Lithuania plans to establish a minimum of 10 hydrogen refuelling stations, including at least one dedicated to the maritime sector. The country has already initiated its first green hydrogen production project, which includes setting up a refuelling station for loading equipment and vessels at the Klaipėda State Seaport.

Figure 9 shows the targets set by European countries on the deployment of different types of fuel cell electric vehicles by 2025 and 2030.

In 2025, the Netherlands has established the highest goals in the deployment of fuel cell electric vehicles (FCEVs), targeting 15,000 passenger cars and 3,000 heavy-duty vehicles (HDV) and light-duty vehicles (LDV). Similarly, Portugal aims to deploy 400-500 FCEV passenger cars and 20-50 HDV and LDV. Conversely, Poland's priority lies in increasing the number of FCEV buses to 100-250.

Looking towards the long term, many countries have outlined more comprehensive targets for the deployment of FCEVs by 2030. Specifically, there is a notable emphasis on passenger cars. Czech Republic aspires to reach 45,000 FCEV passenger cars, the Netherlands aims to double its passenger car deployment compared to 2025, targeting 30,000, and Portugal has a more conservative goal of 750-1,000.

Moving on to HDV and LDV, the Czech Republic, Spain, and Portugal aim to deploy 4,000, 5,000-7,000, and 250-400 FCEVs, respectively. Regarding buses, Czech Republic and Poland have set their sights on reaching 900 and 800-1,000 FCEV buses, respectively. In contrast, Hungary has taken a holistic approach, setting a target for the total number of FCEVs across all vehicle types, with a goal of reaching 4,800 units.

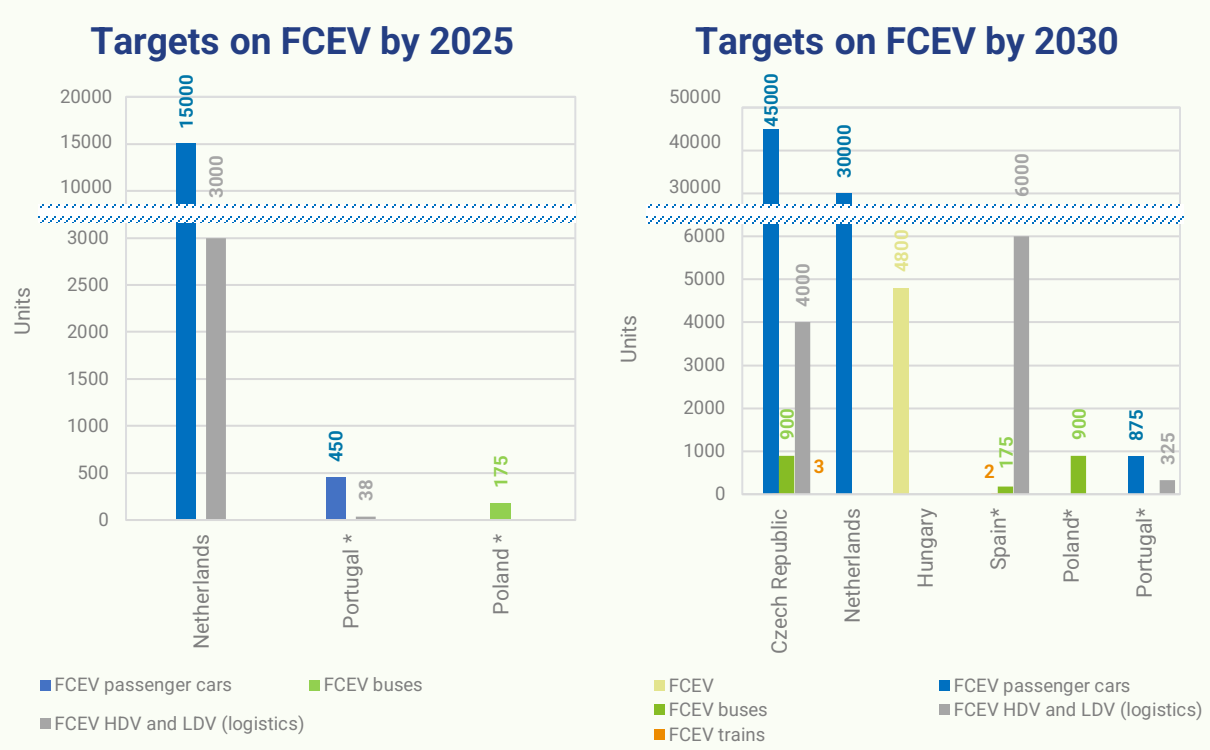


*Figure 9. Targets on the number of hydrogen fuel cell electric vehicles by 2025 and 2030 set by European countries. * Average value was used for Poland, Portugal and Spain.*

Industry

Recognized as a cornerstone of economic activity, industries hold significant potential to drive the transition towards sustainable energy practices. As major consumers of energy, industries have the capacity to both benefit from and contribute to the widespread adoption of hydrogen technologies. This section delves into targets set by European countries on the replacement of fossil-based gases with renewable hydrogen in their industries.

In several European countries, there is a concerted effort for the transition from fossil-based to renewable hydrogen within the industrial sector, with the establishment of specific targets in place. Austria aims to replace

fossil-based hydrogen with climate neutral hydrogen in energy intensive industries by 80 % until 2030.

Regarding Czech Republic, by 2030, only 5% of the grey hydrogen is expected to be replaced in chemical industry by low carbon gases. The same percentage applies for the replacement of natural gas by low carbon gases in chemical industry.

Portugal promotes the hydrogen production near consumption, 75-100% replacement of grey ammonia with green ammonia produced from renewable hydrogen by 2030 and the development of quality and safety standards for hydrogen equipment are priorities in industry. Additionally, support for hydrogen pilot projects in industry will be developed.

Spain targets a minimum contribution of renewable hydrogen of 25% of the total hydrogen consumed in 2030. It is expected to contribute in all industries that consume hydrogen both as a feedstock and as an energy source, such as refineries and the chemical industry

In Lithuania, the primary hydrogen offtake will be from the fertiliser industry, with at least 41% of ammonia needed for fertilizer production to come from green hydrogen by 2030. Following that is refining. Hydrogen could potentially also be used in other industrial processes requiring high and stable temperatures (glass, cement production, etc.) to replace natural gas.

2.3.4. Education, research and development

In the European context, the majority of countries have incorporated hydrogen into their strategic initiatives concerning education and research for the advancement of hydrogen technologies. These strategies emphasize the training of specialists, experts, and engineers to facilitate the development of hydrogen-related technologies. Additionally, they highlight ongoing research and development (R&D) initiatives undertaken by universities and companies, as well as funding and programme activities in this domain.

Croatia shows a good example, having set quantitative targets for research and development in hydrogen technologies. The country aims to attain five patents related to the hydrogen economy by the year 2030 and 50 patents by 2050. This commitment reflects Croatia's dedication to measurable outcomes in the pivotal field of hydrogen technology.

03

National Policies and legislation

Introduction

This chapter provides an overview of the main national policies and legislation relevant to the hydrogen sector in EU Member States, EFTA countries and the UK, excluding Liechtenstein.

The data is collected by means of a comprehensive questionnaire completed by country specialists. The questionnaire focuses on the policy framework, measures, incentives and targets in place that have an impact on the development of the respective national hydrogen markets.

The information reflects the situation as of July 2024.

Interactive data dashboards on national policies and legislation can be accessed on the European Hydrogen Observatory website.

3.1.
Overview

A total of 30 countries participated in the survey, with the addition of two new countries, Finland and Switzerland, compared to the previous report that covered data up to August 2023. Comprehensive questionnaires were completed by country specialists. The responses from each country were evaluated, covering both cross-cutting questions about national policies and legislation, as well as specific questions related to the hydrogen value chain.

Figure 10 summarizes the countries' responses to cross-cutting questions on national policies and legislations. Appendix A3 offers a detailed overview of the responses from each country. The questions included:

- Has a dedicated national roadmap/strategy for the hydrogen sector been adopted?
- If not, is such a document under development?
- Is there a national hydrogen infrastructure (pipelines) plan?
- Is a system for Guarantees of Origin for hydrogen in place in your country?

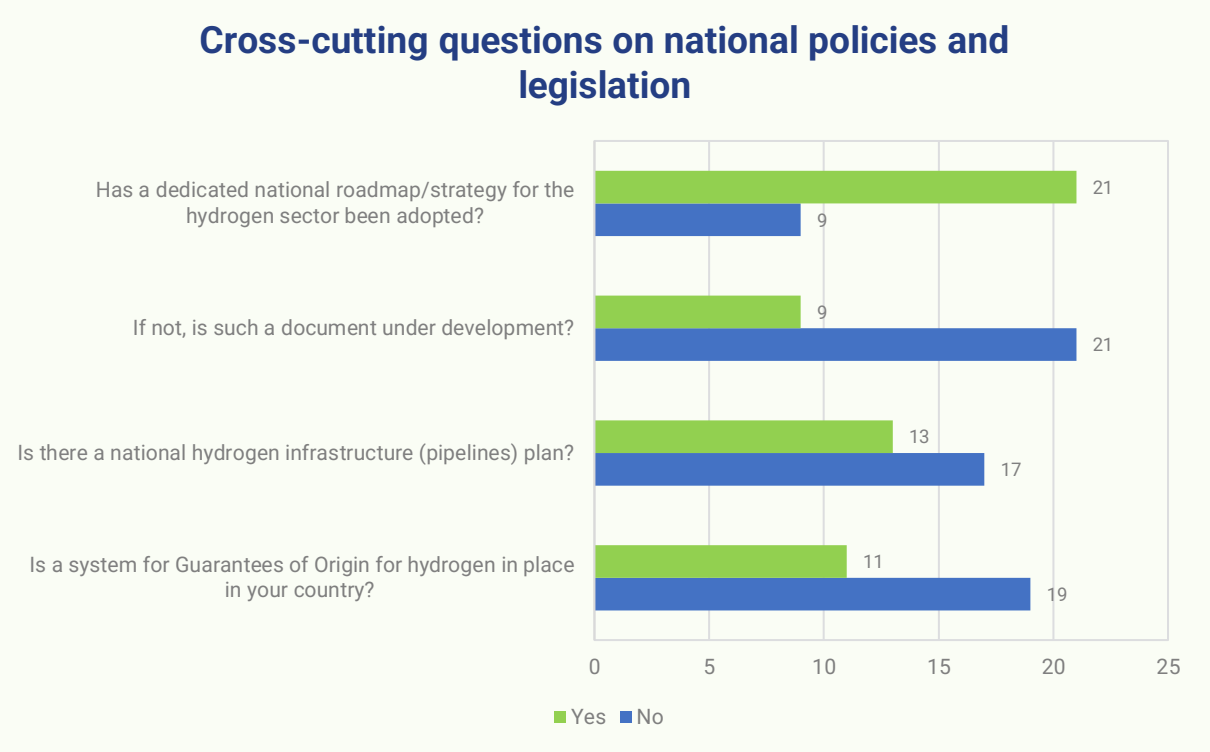


Figure 10. Overview of countries' responses to general questions on national policies and legislation

Figure 11 gives an overview of the total number of European countries that have adopted policies and legislation relevant to the hydrogen sector across various stages of the value chain, including:

- Production
- Transmission, distribution and storage
- End-uses for
  - Mobility
  - Stationary power and heating
  - Industrial use (including as a feedstock)
- Equipment manufacturing.

It is evident, that a significant proportion of European countries have implemented policies and legislation related to various aspects of hydrogen production. More specifically, as of July 2024, 20 country specialists (67%) have indicated that their country has adopted a policy or legislation offering support for capital expenditure (CAPEX) in the development of renewable or low-carbon hydrogen production plants 8 countries (27%) have implemented policies and legislation providing operational expenditure (OPEX) support and 13 countries (43%) official permitting guidelines specifically tailored to hydrogen production projects, while 6 countries (20%) have established policies and legislation designating a Single Point of Contact for hydrogen project developers, streamlining the communication and coordination process.

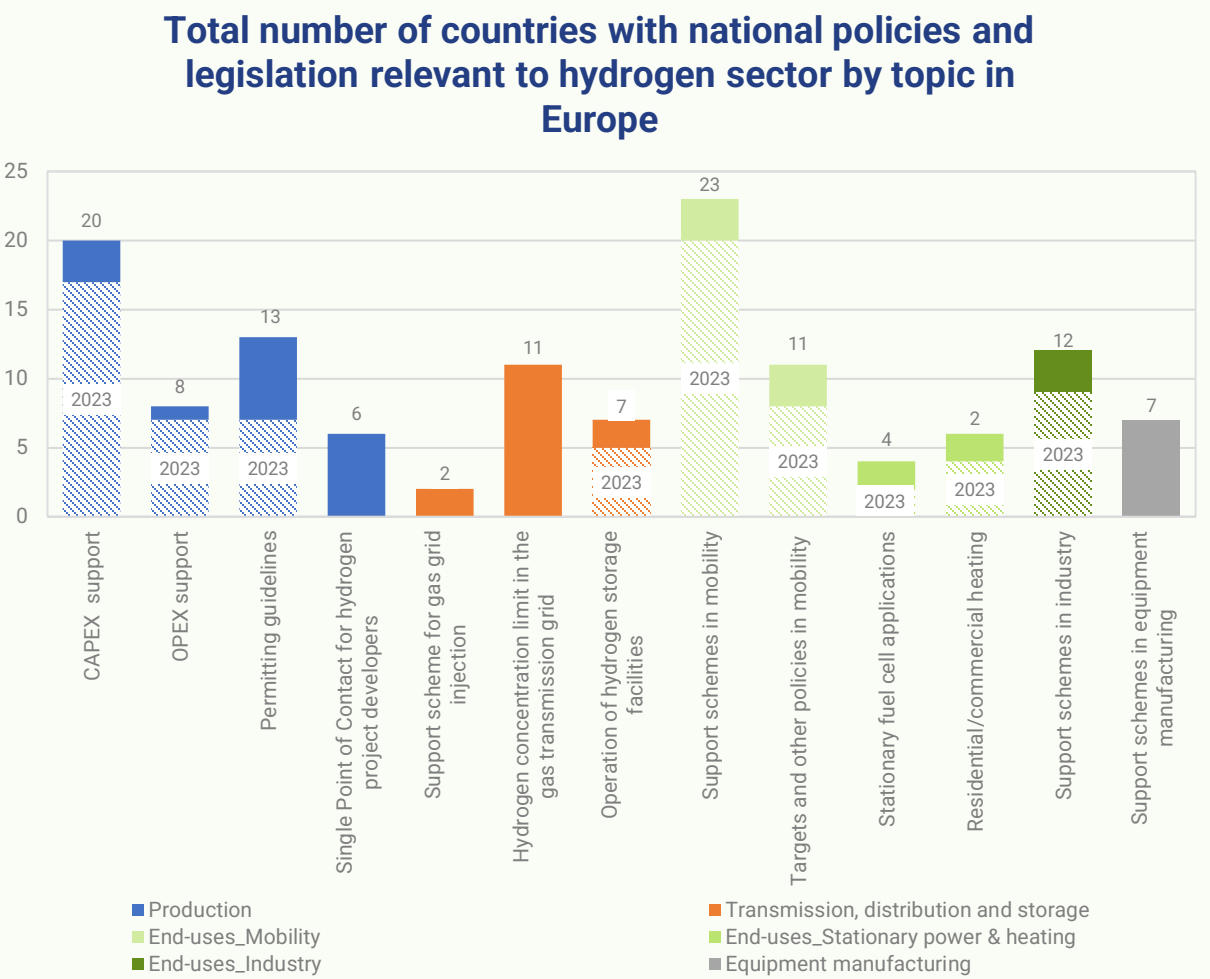


Figure 11. Total number of countries adopted national policies and legislation relevant to the hydrogen sector by topic in Europe.

Based on the questions asking about policies and legislation related to the transmission, distribution, and storage of hydrogen in Europe, 2 countries (7%) were found to have adopted support schemes for gas grid injection. Policies and legislations that have installed a legal hydrogen concentration limit into the gas transmission grid have been adopted by 11 countries (37%), while those addressing the operational aspects of hydrogen storage facilities, have been implemented by 7 countries (23%).

In the context of hydrogen end-use, the questionnaire revealed that the majority of countries, 23 in total (77%), have proactively implemented support schemes to encourage the adoption of hydrogen in the mobility sector. 11 countries (37%) have also established targets and policies to promote the use of hydrogen in the mobility sector. 4 countries (13%) have incorporated applications for stationary fuel cells into their regulatory frameworks. 6 countries (20%) have developed policies offering support for the deployment of hydrogen in residential and commercial heating applications, while 12

countries (40%) have implemented support schemes aimed at promoting the use of renewable or low-carbon hydrogen in industrial processes. Finally, 7 countries (25%) have established support schemes specifically focused on the manufacturing of electrolysers and related components.

These findings underscore the diverse strategies and priorities adopted by countries in promoting the use of hydrogen across various parts of the value chain, reflecting an evolving landscape of national policy initiatives.

3.2.

National policies and legislation by topic

3.2.1. Production

This section covers the questions answered by country specialists related to national policies and legislations on hydrogen production.

The questionnaire sought to answer whether policies are in place, their economic value (in EUR or as % of total investments), their application (electrolysers, low-carbon hydrogen, etc.), and any other relevant details about the policy.

The main questions covered in the questionnaire related to policies and legislation related to hydrogen production included:

- Is there any CAPEX support for renewable/low-carbon hydrogen production plants?
- Is there any OPEX support for renewable/low-carbon hydrogen production plants?
- Are there official permitting guidelines in place for H_2 production projects?
- Is there a Single Point of Contact for hydrogen project developers?

CAPEX support

Figure 13 gives an overview of the countries reported to provide CAPEX support for renewable and low-carbon hydrogen production plants. In total, 20 countries have reported to provide CAPEX support as of July 2024 (+3 countries compared to August 2023). CAPEX support is predominantly allocated to water electrolysis plants, accounting for 90% of the total. The remaining 10% is directed towards green hydrogen production (including biomass-based hydrogen) and general environmental investments (Figure 12). The conditions of the support differ from country to country.

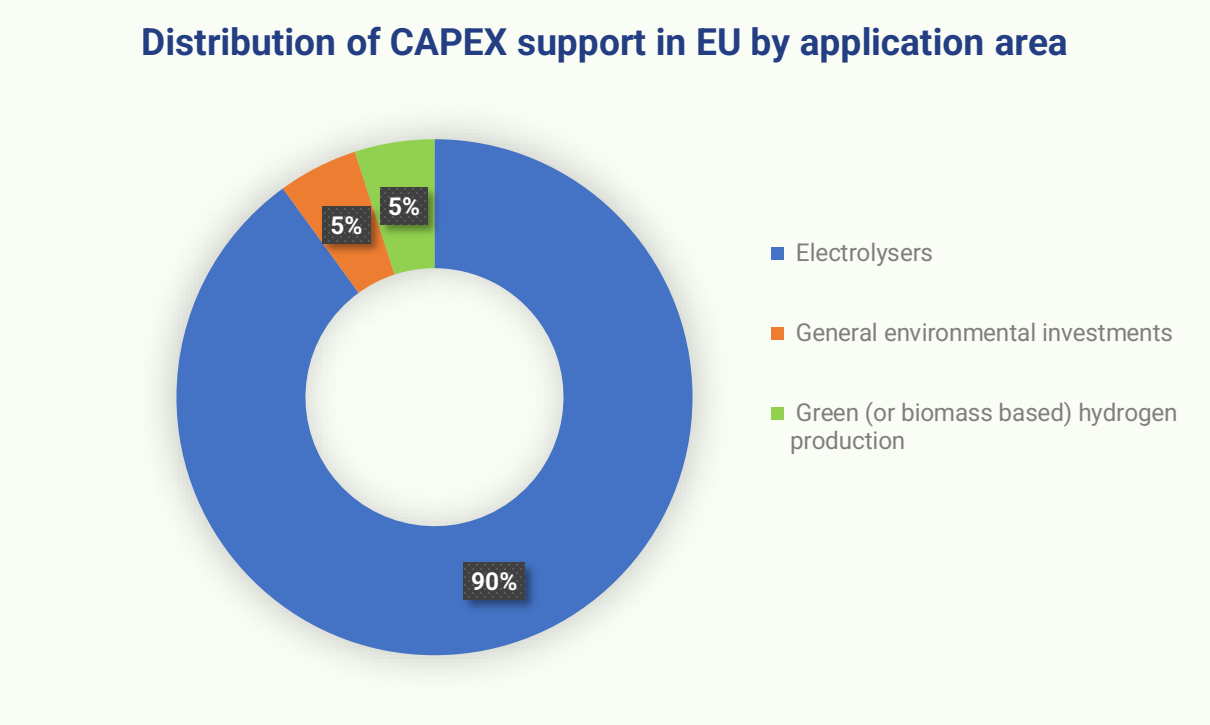


Figure 12. Breakdown of CAPEX support in the EU by application area.

Most countries give a grant in relationship to the investment cost. Austria's Renewable Energy Expansion Act (EAG 2021) provides investment grants for hydrogen production plants using 100% renewable electricity, covering up to 20% of costs for facilities between 0.5-1 MW and up to 45% for those over 1 MW, limited to environmentally relevant additional investment costs. Belgium offers a 15 – 55% subsidy for the extra cost of the investment with the Ecology premium plus instrument. The subsidy percentage depends on the scope of the enterprise and the technology. Czech Republic plans a subsidy of 45-65% of CAPEX, aligned with Article 41 of General Block Exemption Regulation (GBER), which covers investment aid for environmental protection projects. In Germany, electrolysers used for hydrogen production, particularly when the hydrogen is partially allocated for mobility applications, may be eligible for CAPEX funding. The maximum funding rate is 45%, covering the total capital expenditure needed to build the electrolysis plants. Eligible expenses for this funding are defined in accordance with Article 41 of the GBER. As of July 2024, the United Kingdom's Net Zero Hydrogen Fund (NZHF) has closed two CAPEX funding rounds (March and June 2023), offering up to 30% support for low-carbon hydrogen projects. Eligible projects had to meet the UK Low Carbon Hydrogen Standard, with grant requests ranging from £200,000 to £20 million. No future CAPEX rounds are currently planned.

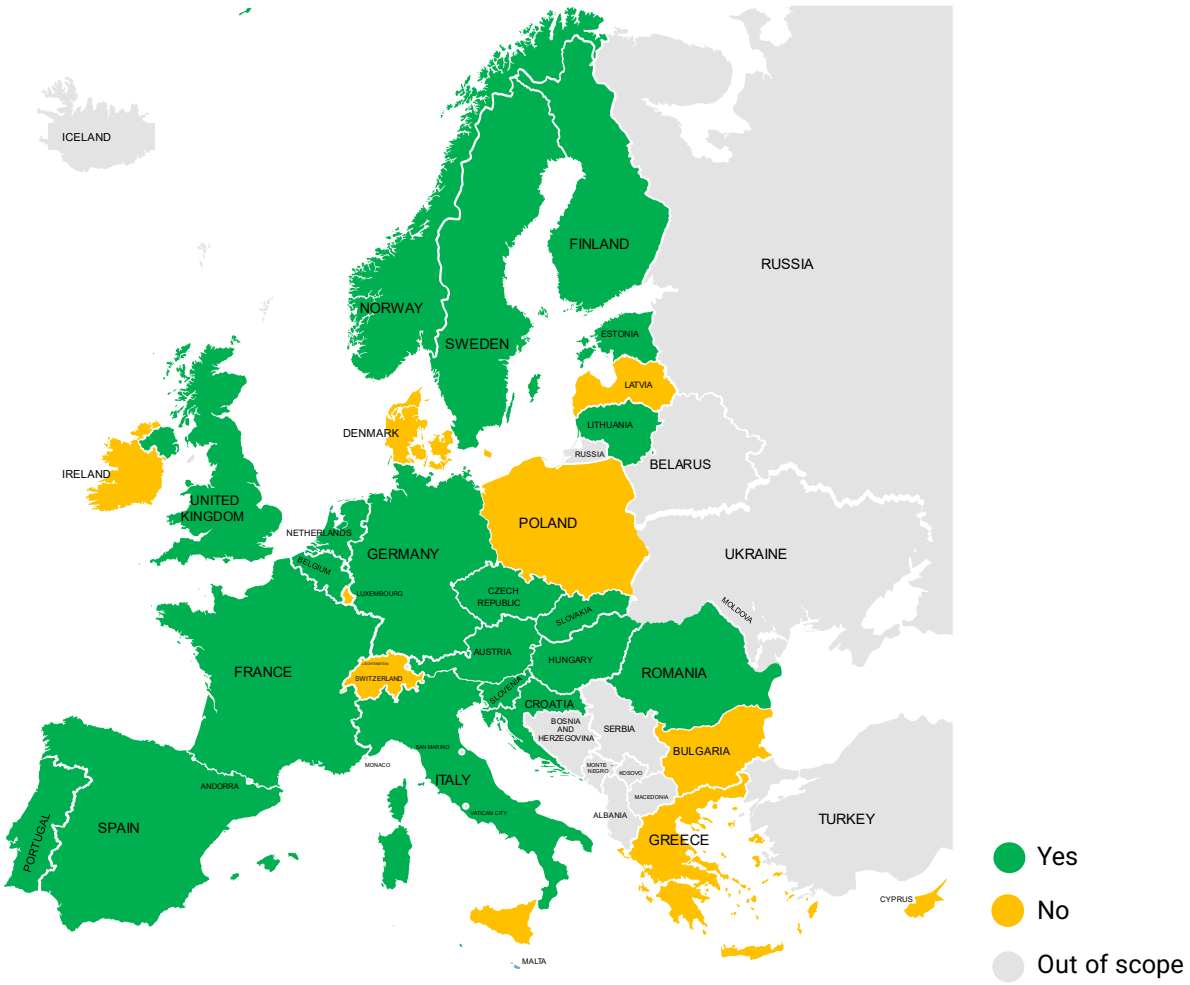


Figure 13. Map of countries reported to provide CAPEX support applications for renewable and low-carbon hydrogen production plants by country.

For many of the countries, the subsidy is part of a programme that has a specific budget which is available for the production of renewable hydrogen and other renewable gases. Of those countries that have reported their budget in the EHO questionnaire, a total investment of approximately 2362.1 million euros (MEUR) was dedicated to CAPEX support schemes for renewable and low-carbon hydrogen production plants in Europe as of July 2024. This represents an increase of 835.2 MEUR compared to August 2023, when the budget was 1526.9 MEUR.

Figure 14 illustrates the distribution of these CAPEX support schemes across European countries. The Netherlands, Italy, France, Spain, Romania, Norway, and Finland stand out with support levels exceeding 100 MEUR.

In the Netherlands, the subsidy scheme supports electrolysers from 0.5 MW onwards, covering both CAPEX and OPEX (excluding SDE++), with a total budget of 998.33 MEUR for the 2024 round.

Italy has allocated 450 MEUR to support the development of green hydrogen production plants on brownfields. To be eligible, projects

must have an electrolyser size between 1 MW and 10 MW and meet location requirements outlined in MITE's Ministerial Notice of 15/12/21.

In France, the scheme offers support ranging from 1.5 MEUR to 15 MEUR per project. Selection criteria include project setup, consortium, financing, innovation, eco-conditionality, replicability, business model relevance, and socio-economic impact. Additionally, the French government plans to publish a 700 MEUR hydrogen support scheme by the end of the year under a 4.2 billion EUR framework.

Spain has allocated 150 MEUR for a second call under the Ministry for Ecological Transition's incentive programme. This funding supports pioneering renewable hydrogen projects with commercial viability in hard-to-decarbonize sectors like industry and heavy transport. Eligible projects must have an electrolysis power between 0.5 MW and 50 MW.

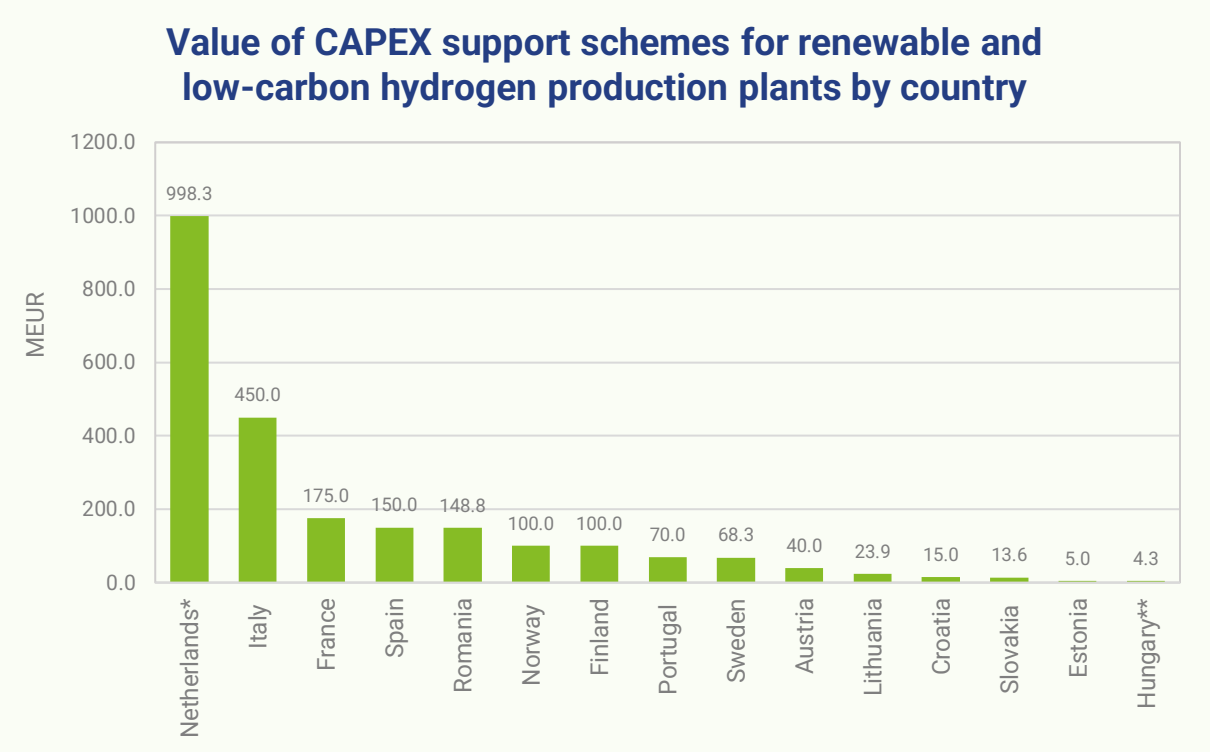


*Figure 14 Value (in MEUR) of reported CAPEX support schemes for renewable and low-carbon hydrogen production plants by country. *In Netherlands the subsidy covers both CAPEX and OPEX **An average of 2,500,000-6,000,000 € was taken for Hungary. Conversion factor for Sweden: 1 SEK ≈ 0.086 EUR*

Romania has allocated a 148.8 MEUR subsidy to support investments in green hydrogen production facilities through electrolysis, as outlined in the State Aid Scheme published in the Official Monitor, Part I, No. 483, on 24 May 2024.

Norway has allocated at least 100 MEUR to support hydrogen production and distribution for the maritime sector through Enova's competitive-bidding auction. Funding will be awarded to at least three projects in different regions.

Finland's Ministry of Economic Affairs and Employment launched a 200 MEUR investment aid scheme in 2023, with 100 MEUR dedicated to hydrogen projects. The scheme targets renewable hydrogen production and new technologies, supporting projects over 5 MEUR that are not otherwise viable.

OPEX support

Figure 15 gives an overview of the European countries reported to provide OPEX support for renewable and low-carbon hydrogen production plants. In total 8 out of the 30 countries (27%) provide OPEX support as of July 2024 (+1 country compared to August 2023). The primary focus of OPEX investments is also directed towards supporting the production of hydrogen with electrolysers.

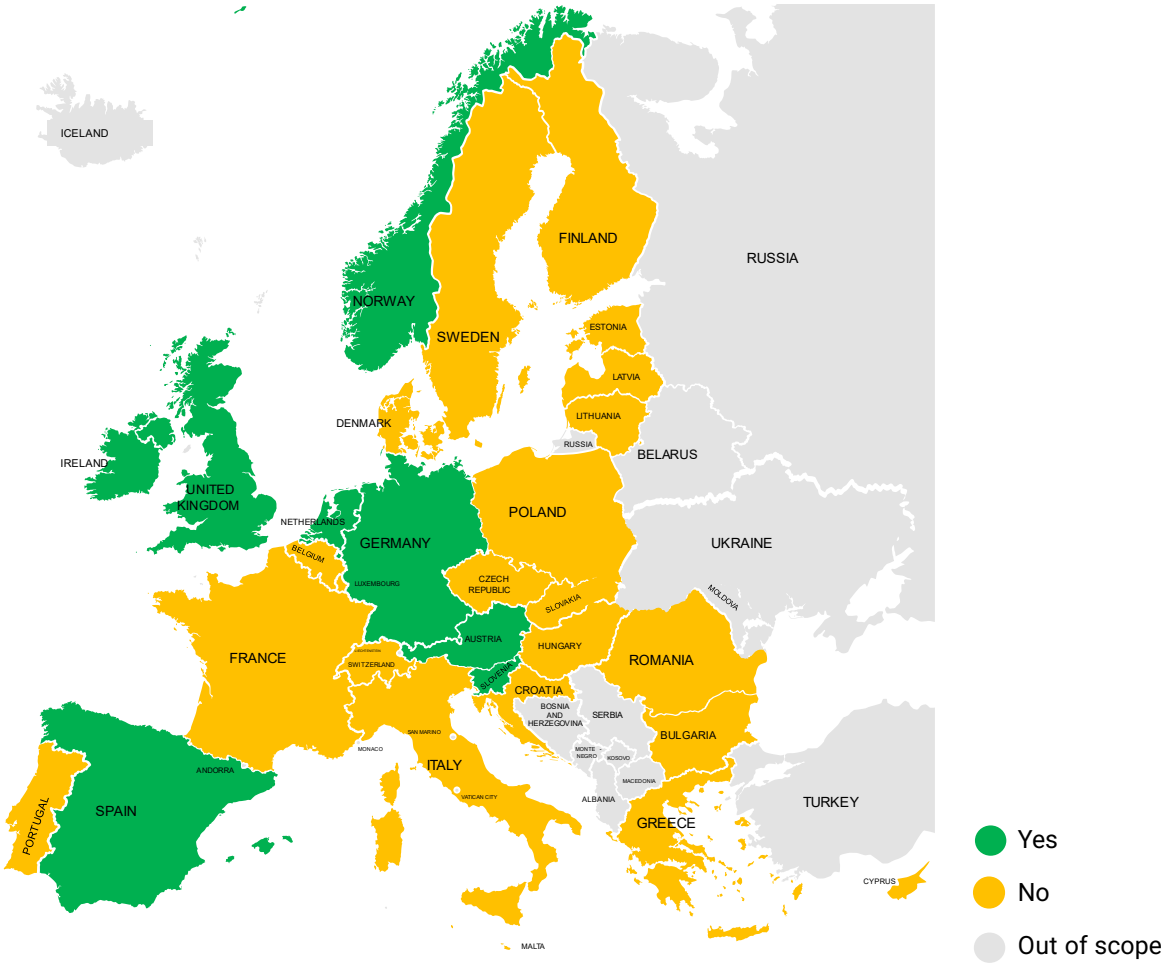


Figure 15. Map of countries reported to provide OPEX support for renewable and low-carbon hydrogen production plants.

Austria's Hydrogen Promotion Act, passed on June 12, 2024, supports the construction and operation of electrolysers for converting electricity into renewable hydrogen (non-biological origin). A total of 820 MEUR is allocated for RFNBO subsidies between 2024 and

2026. Subsidies will be provided through competitive auctions, offering a fixed premium per unit produced for ten years. Auctions may be conducted under the EU Innovation Fund, with award decisions based on bid rankings.

Germany offers OPEX support for electrolysers and reforming with CCS through contracts for difference, based on avoided carbon emissions. A budget of up to 4 billion EUR has been allocated for the initial bidding process, with projects eligible if they achieve at least a 10-kiloton annual CO_2 reduction and meet stringent EU requirements for green or low-carbon hydrogen. Funded projects must reach a 60% greenhouse gas reduction by the third year of the agreement and 90% by its end, ensuring significant climate benefits over the 15-year contract term.

Ireland offers OPEX support through the Renewable Transport Fuel Obligation (RTFO), which requires fuel suppliers to ensure that 21% of motor fuel energy content is renewable. While not a direct subsidy, RTFO account holders receive certificates for renewable fuels, with additional incentives for renewable fuels of non-biological origin (RFNBOs) used in transport sectors. Suppliers earn three extra certificates per megajoule of RFNBOs, and failure to meet the obligation results in a buy-out charge, encouraging compliance and promoting renewable energy adoption.

The Netherlands supports OPEX for electrolysers through the SDE++ and OWE schemes, which subsidize the cost difference between renewable and conventional hydrogen production. SDE++ adjusts subsidies based on market fluctuations, with support lasting 12–15 years and a 2024 budget of 11.5 billion EUR. OWE covers both CAPEX and OPEX, with flexible terms of 7–15 years and a 2024 budget of 998 MEUR.

Norway offers OPEX support for hydrogen production through CO_2 Compensation, providing 7 billion NOK (approximately 619 MEUR) annually to industries impacted by high electricity prices due to the EU Emissions Trading System (ETS). Additionally, Norway participates in European Hydrogen Bank auctions to further support hydrogen initiatives.

Spain supports OPEX for electrolysers through Incentive Programme 3, which funds large-scale electrolysis demonstrators and innovative renewable hydrogen projects. While the subsidy value is undetermined, it includes provisions to partially cover operating costs.

In the United Kingdom, the Hydrogen Production Business Model - Hydrogen Allocation Rounds provides OPEX support for electrolysers, gasification/pyrolysis of biomass/wastes, and methane splitting projects, with the subsidy valued per unit of production. Additionally, the Renewable Transport Fuel Obligation offers OPEX support for electrolysers and biomass projects, with the subsidy determined by market-based certificates.

Permitting guidelines

Figure 16 provides a geographical representation of the European countries reported to have in place official permitting guidelines for hydrogen

production projects. Among the 30 European countries examined, 13 were reported to have established such guidelines as of July 2024 (+5 countries compared to August 2023). These nations include Austria, Denmark, Finland, Greece, Luxembourg, Netherlands, Norway, Portugal, Slovenia, Spain, Sweden, Switzerland and the United Kingdom. Table 4 provides a detailed breakdown of the titles and explanations of the guidelines for each country.

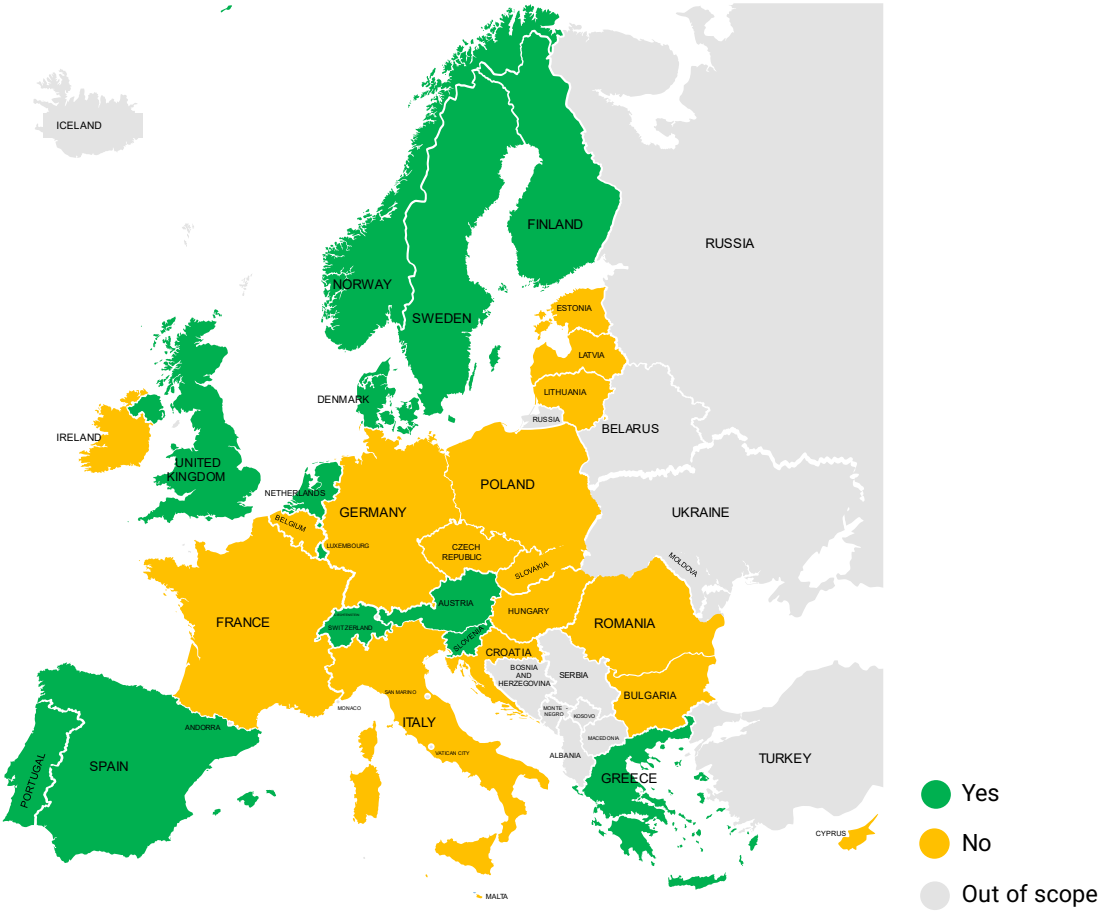


Figure 16. Map of countries reported to have in place official permitting guidelines for hydrogen production projects.

Table 4. Titles and explanation of official permitting guidelines for hydrogen production projects per country.

Country	Title/name	Explanation
Austria	H E100 guideline "Rule of ÖVGW" H_2-production plants	The ÖVGW guideline, put together by industry professionals and reviewed by authorities, covers planning, construction, approval, and initial testing, referencing key national and international norms for gas and water systems.
Denmark	Establishing Power-to-X plants: A Regulatory Guide	The Danish Authority Working Group, under the Danish Energy Agency, provides a step-by-step guideline on permissions and regulatory requirements for new PtX plants on land, covering environmental and safety permissions. The guideline applies to electrolysis and synthesis plants, gas stations, storage (excluding underground), and PtX product pipelines.
Finland	Safety of hydrogen handling and storage	The guideline released by Tukes, the Finnish Safety and Chemicals Agency, provides safety instructions for plant operators on the use and handling of hydrogen across the entire hydrogen value chain, covering key safety practices and summarizing relevant Finnish legislation. Additionally, ELY (Centre for economic development, transport and the environment) is developing comprehensive guidelines for the permitting process related to hydrogen projects
Greece	Ministerial Decision 2647/1998, 3982/2011, 4605/2019 - Official Journal of the Hellenic Republic Government Gazette A' 52/01.04.2019	The official guidelines for hydrogen production projects are detailed in Article 100. They cover licensing requirements for production units and include storage regulations for medical and compressed gases.
Luxembourg	Procedures for permitting request	The "Permitting Procedures" authorize requests related to technology implementation, renewable energies, electricity, hydrogen, heat, cold, and more. Priority is given to renewable hydrogen production, consumption technologies, and construction projects.
Netherlands	Permits specifically needed for Subsidy scaling up green hydrogen production via electrolysers (OWE)	OWE subsidy is granted only if hydrogen production can start within four years and requires an environmental permit under the Wabo or, if applicable, a Water Act permit.
Norway	Hydrogen and ammonia	Companies planning hydrogen facilities under the Major Accident Law must obtain approval from the Norwegian Directorate for Civil Protection (DSB). This applies to those with bunkering plans for hydrogen and ammonia use in ships as well.

Portugal	Guia do promotor "Legislação e regulação para a Economia do Hidrogénio"	The guidelines are regularly updated to outline permitting requirements for hydrogen production, listing relevant standards and legislation. They also offer guidance on submitting permitting requests and outline the overall process
Slovenia	Handbook guide to setting up small power plants for the production of electricity from renewable energy sources and cogeneration of heat and power	The guide is designed for investors in small-scale RES and high-efficiency CHP installations. It provides an overview of installation technologies, procedures for siting, construction, grid connection, and operation, along with methods for integrating installations into the grid. It covers legal, tax, and financial aspects, defines categories for small, self-supplying, and large installations, and includes procedures for refurbishment, financing, sales, and grants.
Spain	Royal Decree 815/2013, of 18 October, approving the Regulation on industrial emissions and implementing Law 16/2002, of 1 July, on integrated pollution prevention and control.	Hydrogen production, whether through chemical processes or renewable energy electrolysis, is currently regulated under industrial chemical activity regulations (RD 815/2013).
Sweden	Guidelines for H_2 production projects	H_2-TSA 2023, by "Energigas Sverige," guides Hydrogen Refuelling Stations (HRS) for vehicles. Aligned with the international standard SS-ISO 19880-1, it addresses design, installation, commissioning, operation, monitoring, and maintenance, with some adjustments.
Switzerland	Energy Law decree (Loi sur l'énergie)	Article 16 outlines authorization procedures for constructing renewable energy plants. Cantons aim for swift approvals, with commissions and agencies under Article 25 overseeing the process. The Federal Council may assign a federal office to coordinate position statements or authorization procedures.
United Kingdom	Hydrogen production by electrolysis of water: emerging techniques and Emerging techniques for hydrogen production with carbon capture	1.Guidance on emerging techniques on how to prevent or minimise the environmental impacts of hydrogen production by electrolysis of water. 2.Guidance on preventing or minimising environmental impacts of industrial hydrogen production from methane or refinery fuel gas with carbon capture for storage.

Single point of contact for hydrogen project developers

Figure 17 provides a geographical representation of the European countries reported to have in place a legal act or agency as a single point of contact for hydrogen project developers. Among the 30 European countries examined, 6 reported to have established such legal acts or agencies

as of July 2024, with no change since August 2023. These nations include Croatia, Denmark, Germany, Portugal, Slovenia and Spain. Table 5 provides a detailed breakdown of the name and explanations of the legal acts or agencies operating as a single point of contact for hydrogen project developers for each country.

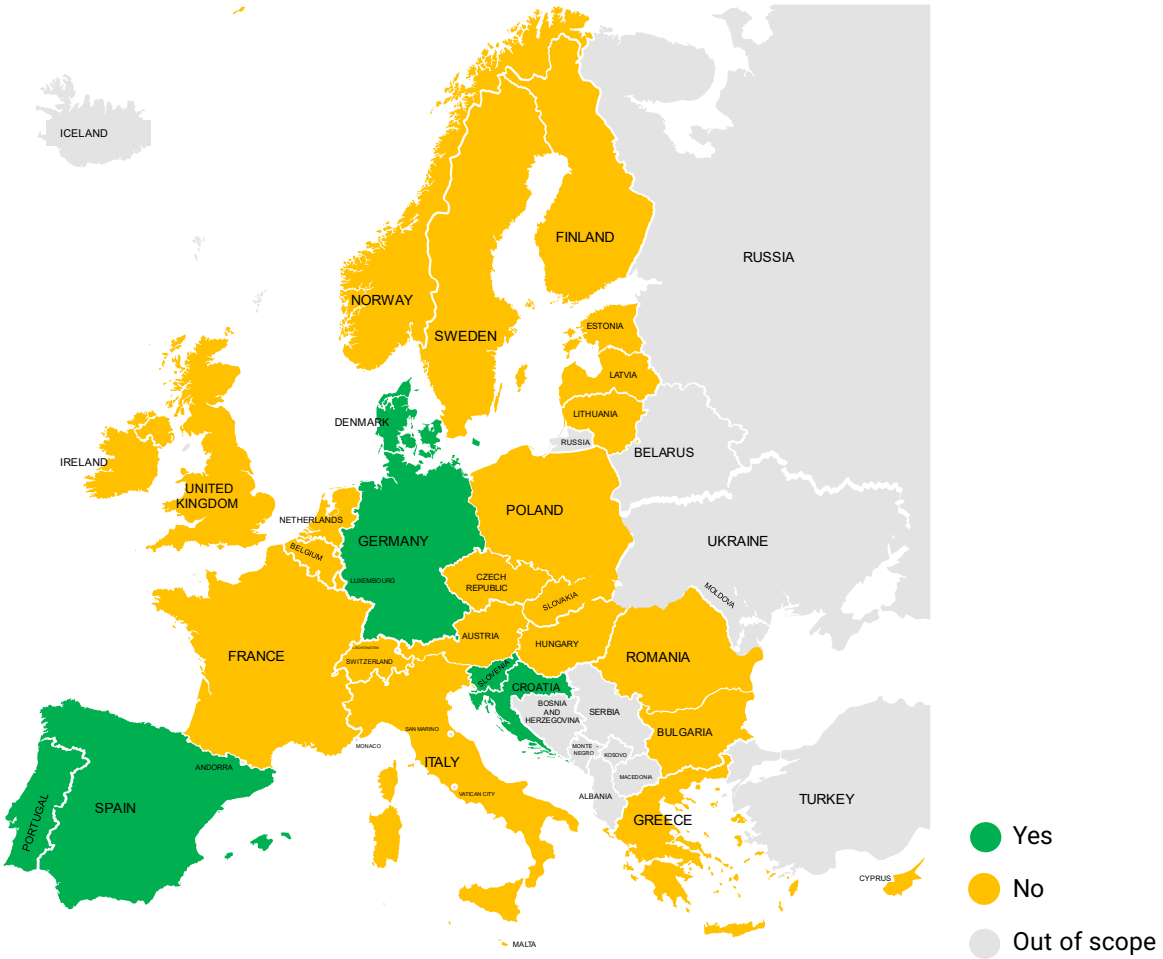


Figure 17. Map of countries reported to have in place a legal act or agency as a Single Point of Contact for hydrogen project developers.

Table 5. Titles and explanation of the legal acts or agencies operating as a single point of contact for hydrogen project developers per country.

Country	Title/name	Explanation
Croatia	Croatian Hydrocarbon Agency	Croatian Hydrocarbon Agency according to RES Law in Croatia become a National Coordinating Body for hydrogen (Article 58.a).
Denmark	The PtX Secretariat	The PtX Secretariat under the Danish Energy Agency provides guidance to PtX stakeholders, municipalities, and other authorities regarding regulation and the interaction of different permission processes for PtX projects.
Germany	Förderberatung – Lotsenstelle Wasserstoff	The federal government has launched a central hydrogen website as a "one-stop shop" offering information on hydrogen, the National Hydrogen Strategy, and funding opportunities to support the adoption of hydrogen technologies at national, European, and international levels.
Portugal	E.Portugal	E.Portugal portal streamlines industrial tasks, including hydrogen production permits. Simulate requirements and submit formal requests on the same platform.
Slovenia	RES Contact Point	The RES Contact Point helps public and private applicants with permits and approvals for constructing and operating generating installations, connecting them to the grid, and accessing support programmes for renewable energy production, biofuels, cogeneration, and excess heat utilization. It operates under BORZEN, a state-owned enterprise.
Spain	Institute for Energy Diversification and Saving	This is the body in charge of managing the IDAE aid within the framework of the recovery, transition and resilience plan (PRTR)

3.2.2.

Transmission, distribution & storage

This section covers the questions answered by country specialists related to national policies and legislations on hydrogen transmission, distribution and storage.

The questionnaire sought to answer whether policies are in place and any other relevant details about the policy.

The main questions covered in the questionnaire concerning policies and legislation related to

hydrogen transmission, distribution and storage included:

- Is there any support scheme for hydrogen when injected into the gas grid?
- Is there a legal hydrogen concentration limit into the transmission gas grid?
- What is the acceptable limit of H_2 into the transmission gas grid?
- Is there a legal framework for the operation of hydrogen storage facilities within national energy law?

Support scheme for gas grid injection

The number of countries reported to provide support schemes for hydrogen injection into the gas grid remained at two, including Ireland and Portugal, as of July 2024, with no change since August 2023.

In Ireland, current legislation allows renewable hydrogen to be eligible for Guarantees of Origin (GOs) when injected into the gas grid. However, the existing registry is currently operational only for biomethane, as no hydrogen production is currently taking place in Ireland. The processes for issuing Guarantees of Origin specifically for renewable hydrogen have not been developed yet. Anticipated revisions to CEN 16325 are expected to provide guidelines on accounting for renewable electricity converted into hydrogen within the framework of Guarantees of Origin.

Portugal supports renewable hydrogen injection into the gas grid through a centralized purchase scheme with a fixed price contract over 10 years. The programme, valued at €14 million annually (€140 million total), allows bids up to €127/MWh for a maximum annual volume of 120 GWh. Producers are exempt from network charges and must provide Guarantees of Origin for the delivered volumes.

Hydrogen concentration limit in the gas transmission grid

Legal hydrogen concentration limits are set in order to ensure the safe and efficient integration of hydrogen into the transmission gas grid, while maintaining the stability and integrity of the existing infrastructure. Of the 30 countries examined, 11 reported to have established legal limits on hydrogen concentrations in their gas grids as of July 2024, with no change since August 2023.

The maximum concentration of hydrogen (as a percentage) allowed in the gas transmission grid per country in Europe is presented in Figure 18.

Ireland, Estonia and United Kingdom, impose the most stringent limits on hydrogen (H_2) integration into the transmission gas grid, with acceptable thresholds set at <0.1 mol%, 0.1 vol%, and 0.1% respectively.

The Netherlands, Lithuania and Italy have set a more progressive approach, allowing 2% of hydrogen (H_2) integration into the transmission gas grid, while Spain follows with a threshold of 5% blending of hydrogen.

Portugal has set one of the highest acceptance limits, with regulation stating that the maximum quota for the blending of other gases in the

national gas transmission network is 5% until 2025 and 10-15% until 2030. Austria also sets one of the highest acceptance limits with a 10% maximum concentration of hydrogen within the natural gas grid.

In Germany, due to the different requirements of end-use components no generally applicable limit value for hydrogen was specified in the current set of rules. The limit values result from the application areas of the gas infrastructure. In Slovenia, the share of hydrogen or any other gas that may be injected into the existing gas network is not nationally regulated. The rules can be found in the Gas Supply Act.

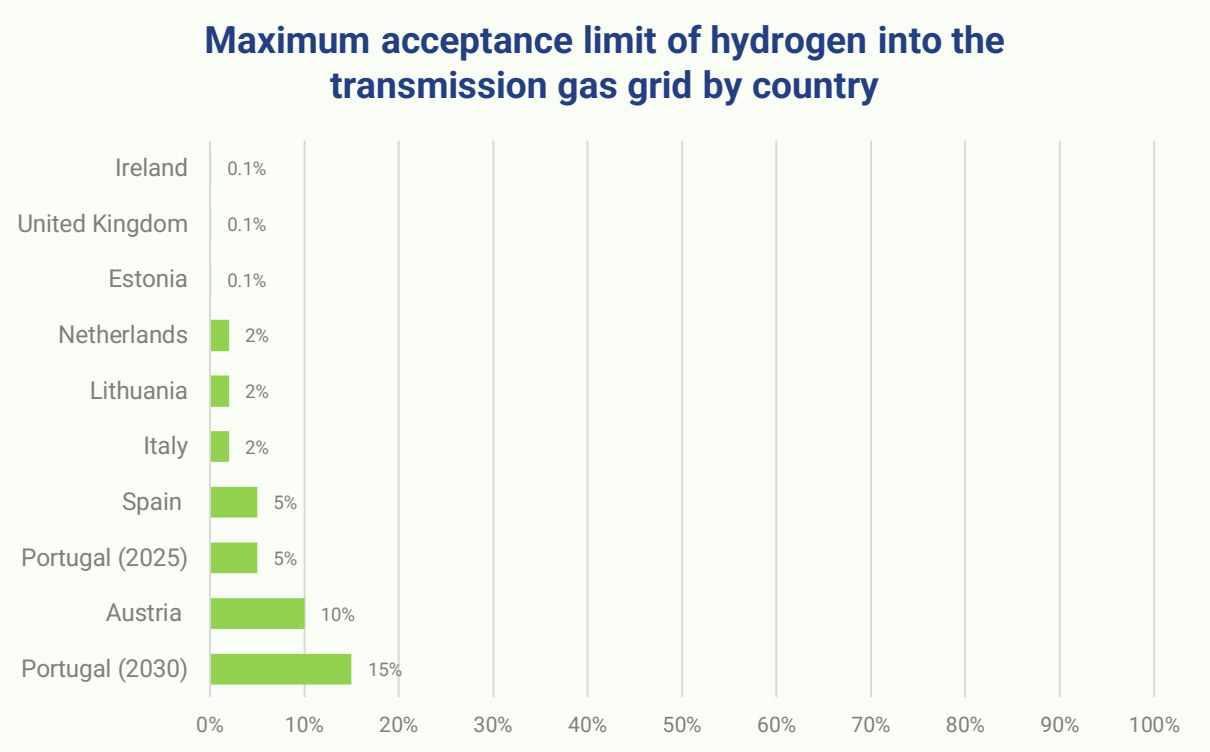


Figure 18. Acceptance limit of hydrogen (%) into the transmission gas grid by country.

Operation of hydrogen storage facilities

The development of policies and legislation for hydrogen storage operations play a pivotal role in ensuring safety, environmental protection, infrastructure development, market confidence, standardization, innovation, and energy integration. By providing a clear regulatory framework, governments create an enabling environment for the growth of the hydrogen economy. 7 European countries have been identified as having established legal frameworks for the operation of hydrogen storage as of July 2024 (+2 countries compared to August 2023). These countries are Finland, France, Greece, Norway, Slovenia, Spain, and Sweden.

Finland has established a legal framework for the operation of hydrogen storage facilities under national energy law. Hydrogen storage is categorized as minor if its capacity is less than two tonnes, in which case it only requires reporting to the local rescue department.

Additionally, all hydrogen storage facilities exceeding a pressure of 0.5 bar are regulated under Finland's pressure equipment and vessel legislation to ensure safety and compliance.

France has incorporated within its national hydrogen policy a regulatory framework concerning underground storage, as outlined in "Article L211-2 of the new Mining Code (Code Minier)," which was modified in April 2022. This legislation describes the specific activities encompassed within the scope of underground storage operations.

Greece has established a legal framework for the operation of hydrogen storage facilities under Ministerial Decision 10451/929/1988, published in the Official Journal of the Hellenic Republic (Government Gazette 370/B/9-6-1988). This framework governs the setup and management of compressed gas bottling plants and acetylene production units. It also specifies requirements for the safe handling, storage, and control of packaging cylinders used in these facilities, ensuring regulatory compliance and safety standards.

Norway has several laws and regulations under the authority of the Norwegian Directorate for Civil Protection (DSB), a leading Standard Norway's committee for hydrogen technology, "SN/K 182 Hydrogenteknologi". Hydrogen and ammonia handling, including its equipment and installations used in the handling, is regulated in the “Law on handling of flammable and reactionary and pressurized substances”. If a company stores minimum 5 tons hydrogen or minimum 50 tons ammonia, the Major Accident Law (Storulykkeforskriften) will apply. This law is based on the EU Seveso III Directive (2012/18/EU). Norway has also implemented the EU ATEX user directive (1999/92/EC) and the EU Pressure Directive (2014/68/EU).

Slovenia's legal framework for the operation of hydrogen storage facilities is addressed under two national laws: The Act on Infrastructure for Alternative Fuels and Promotion of the Transition to Alternative Fuels in Transport and The Act on the Promotion of the Use of Renewable Energy Sources. While these acts include provisions related to alternative fuels and renewable energy, the operation of hydrogen storage facilities or other specific storage facilities is not explicitly detailed within their articles.

In Spain a working group is currently engaged in the development of regulations relating to hydrogen refuelling stations, professional qualifications, hydrogen production, storage and transport, as well as the homologation of hydrogen vehicles, fuel cells and their possible uses.

The Swedish policy law includes a handling regulation for flammable gas and flammable aerosols (MSBFS 2020:1) with requirements for, among other things, tightness, materials, signage, and ventilation, but also requirements for pipelines, loose containers, tanks, etc.

3.2.3.
End-uses: mobility

This section covers the questions answered by country specialists related to national policies and legislations on hydrogen end-use in mobility.

The questionnaire sought to answer whether policies are in place, their economic value (in EUR or as % of the vehicle cost or tax due), the type of support schemes (e.g. purchase subsidy, tax benefits etc.), which modes of transport they apply to (heavy-duty vehicles, passenger cars, boats etc.), and any other relevant details about the policy.

The main questions covered in the questionnaire concerning policies and legislation related to hydrogen end-use in mobility included:

- Are there any support schemes offered to FCEVs?
- Are there any national FCEV deployment targets?
- Is there any support offered for HRS deployment in your country?
- Is hydrogen used as fuel taxed in your country?
- Are there any national HRS deployment targets?
- Are there official guidelines in place that cover permitting of HRS?

FCEV

Figure 19 presents the number of countries reported to offer support schemes for Fuel Cell Electric Vehicles (FCEVs) across various types of support. A total of 23 countries are identified as providing such schemes, representing an increase of 3 countries compared to the previous report, reflecting the situation as of August 2023.

Purchase subsidies are the most widely used support mechanism for FCEVs, with 20 countries implementing this form of assistance. Additionally, tax benefits are provided by 9 countries, while 5 countries offer other financial incentives. Three countries, on the other hand, rely on non-economic benefits as a means of support. An overview of the types of support schemes offered to FCEVs by country is given in Table 6.

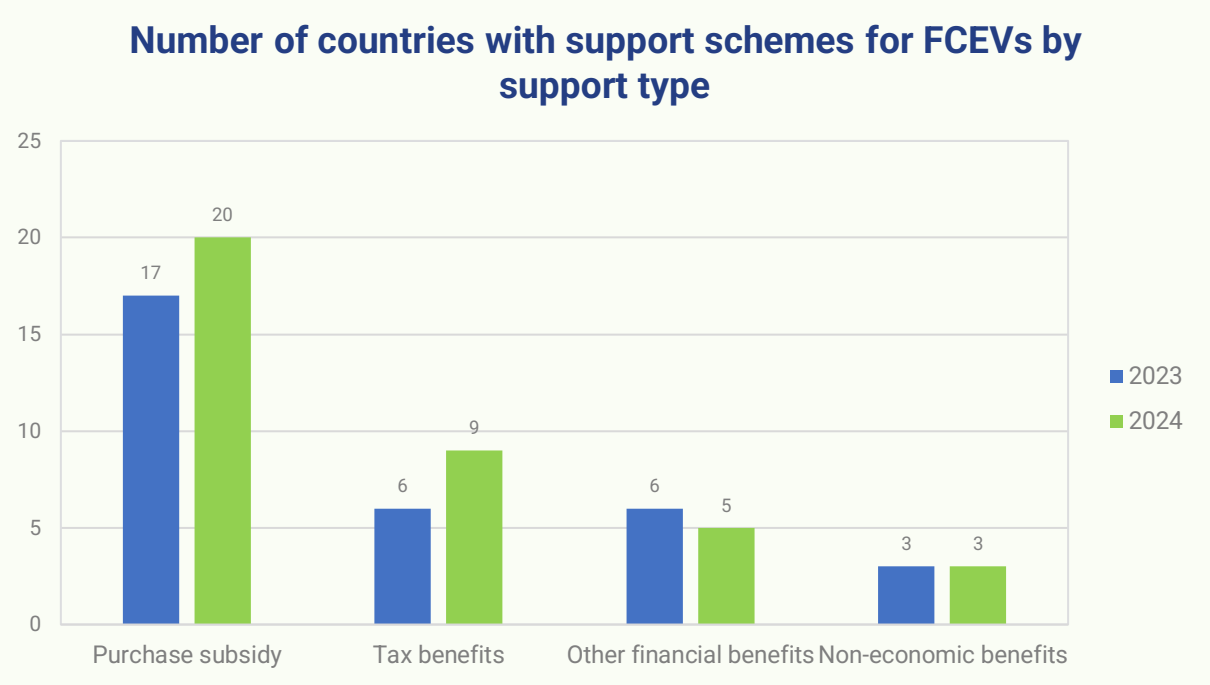


Figure 19. Number of countries reported to provide support schemes offered to FCEVs by support type.

Table 6. Overview of the types of support schemes offered to FCEVs by country.

Country	Purchase subsidy	Tax benefits	Other financial benefits	Non-economic benefits
Austria	√	√		√
Belgium	√	√		√
Croatia	√			
Czech Republic	√		√	
Denmark		√		
Estonia	√			
Finland	√			
France	√		√	
Germany	√			
Hungary	√			
Ireland	√	√	√	
Italy	√			
Lithuania	√			
Luxembourg	√			
Netherlands	√	√`		
Norway	√	√	√	
Poland	√			
Portugal		√		
Slovakia	√			
Slovenia	√		√	
Spain	√	√		√
Switzerland	√	√		
United Kingdom			√	

Figure 20, illustrates the distribution of support schemes for FCEVs across various vehicle types. The data reveals a notable focus on passenger cars/vans (M1/N1), which remain the primary vehicle type covered by the support schemes. Specifically, these schemes are implemented in 21 European countries as of July 2024 (+5% compared to August 2023). Following closely are light-duty vehicles (M2/N2), heavy-duty vehicles (N3), and buses (M3), with support distributed across various countries. Light-duty vehicles (M2/N2) received support in 15 countries, a decrease of 6.3% compared to August 2023. Heavy-duty vehicles (N3) were supported in 16 countries, reflecting an increase of 6.7%, while buses (M3) also saw support in 16 countries, representing a rise of 14.3% over the same period.

Support schemes for boats and ships are observed in 5 countries, while those for non-road mobile machinery are applicable in 4 countries, and schemes for trains and light rail are available in only 2 countries.

Table 7 gives an overview of the different vehicle type applications of support schemes offered to FCEVs by country.

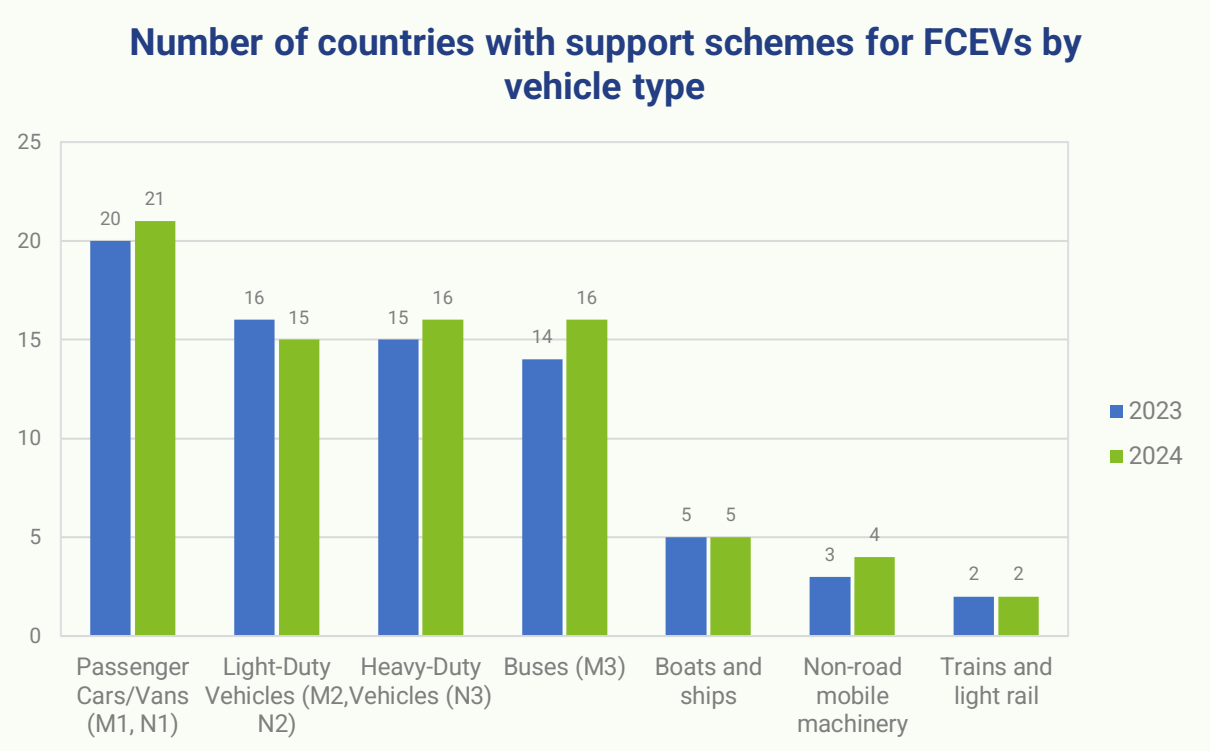


Figure 20. Number of countries with FCEVs support by vehicle type.

Table 7. Overview of the different vehicle type applications of support schemes offered to FCEVs by country.

Country	Passenger Cars/Vans (M1, N1)	Light-Duty Vehicles (M2, N2)	Heavy-Duty Vehicles (N3)	Buses (M3)	Boats and ships	Non-road mobile machinery	Trains and light rail
Austria	√	√	√	√	√	√	
Belgium	√	√	√	√			
Croatia	√	√					
Czech Republic	√						
Denmark	√	√	√	√			
Estonia	√						
Finland	√	√					
France	√	√					
Germany	√	√	√	√	√	√	√
Hungary			√	√			
Ireland	√	√	√	√			
Italy	√	√					
Lithuania	√	√	√	√			
Luxembourg	√	√					
Netherlands	√	√	√	√		√	
Norway	√		√	√	√		
Poland	√	√	√	√			
Portugal	√	√	√	√			
Slovakia			√	√			
Slovenia	√	√	√	√			
Spain	√		√	√	√	√	√
Switzerland	√		√	√			
United Kingdom	√		√	√	√		

HRS

Figure 21 shows the responses from the EU countries regarding policies and legislation for hydrogen refuelling stations (HRS) deployment as of July 2024. 16 countries reported to offer support for HRS deployment, representing an increase of 14.3% compared to August 2023. Additionally, 11 countries have established national targets for HRS deployment, reflecting a decrease of 8.3% over the same period. Meanwhile, 4 countries impose taxes on hydrogen fuel usage, a decline of 20% compared to August 2023, and 12 countries have issued official guidelines for HRS permitting, marking a 50% increase from August 2023.

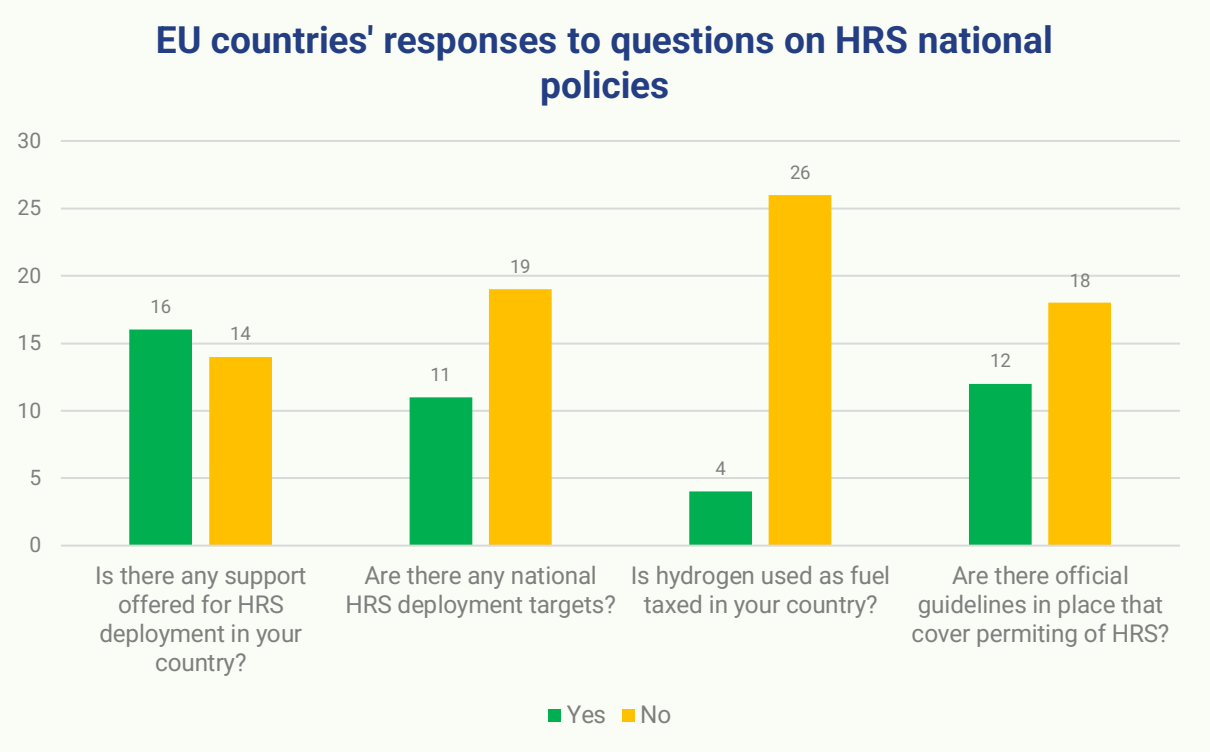


Figure 21. EU countries' responses to key questions on hydrogen refuelling station (HRS) policies.

3.2.4.

End-uses: stationary power & heating

This section covers the questions answered by country specialists related to national policies and legislations support for stationary fuel cells providing electricity and/or heat.

The questionnaire sought to answer whether the policies are in place, their economic value (in EUR or as % of the investment or tax due), and any other relevant details about the policy.

The main questions covered in the questionnaire concerning policies and legislation related to support for stationary fuel cells providing electricity and/or heat included:

- Is there any support offered to stationary fuel cell applications?
- Is there any support offered to deployment of residential/commercial heating with hydrogen?

Stationary fuel cell applications

Figure 22 presents the share of countries reported to provide support for stationary fuel cell applications. Only 4 countries out of 30, Ireland, the Netherlands, Norway and Sweden, reported to offer support to stationary fuel cell applications as of July 2024 (+6% compared to August 2023).

In Ireland the scheme provides grants for projects, up to 3 MEUR per project, following the EXEED standard to enhance energy efficiency, reduce operational costs, and demonstrate sustainability. While prioritizing energy efficiency, it also supports renewable energy and sustainable heating, given compliance with specified conditions in the scheme guidelines.

In the Netherlands, stationary fuel cell applications receive indirect support through state aid under IPCEI Hy2Tech projects and programmes by the Netherlands Enterprise Agency (RVO), such as SH2IPDRIVE and the DEI+ scheme. The level of support varies depending on the system.

In Norway, stationary fuel cell applications receive indirect support through Enova, which has funded projects utilizing hydrogen to achieve zero emissions at construction sites. However, there are no specific programmes exclusively dedicated to stationary fuel cells.

In the case of Sweden, from 1 January 2021, individuals can receive support when investing in renewable technology such as stationary fuel cell applications. The support is a maximum 50% tax reduction for individuals on the cost of labour and materials. The tax reduction is solely for individuals.

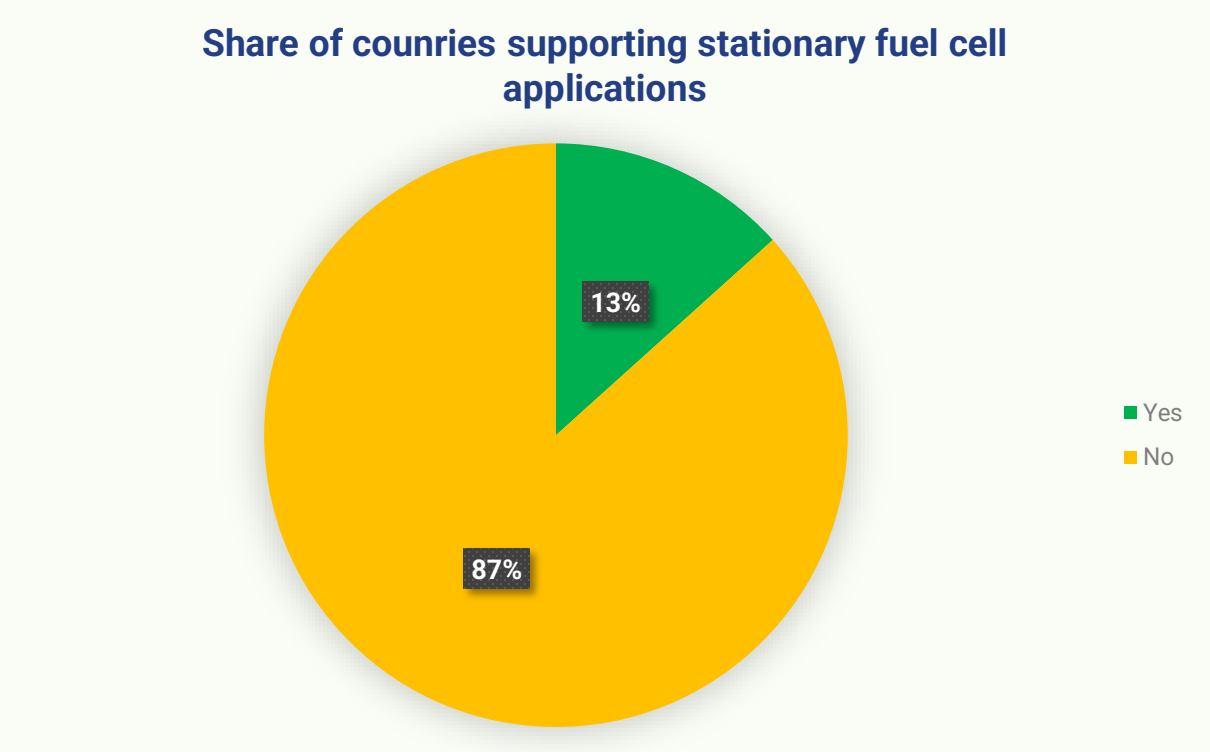


Figure 22. Share of countries reported to offer support for stationary fuel cell applications.

Residential/commercial heating

Figure 23 presents the share of countries reported to offer support for the deployment of residential/commercial heating with hydrogen. As of July 2024, 6 countries reported to provide support for the deployment of residential and commercial hydrogen heating. This includes Germany, Ireland, Italy, and the Netherlands, which already offered support as of August 2023, and two additional countries, Slovenia and Switzerland, which introduced support during the past year.

In Germany, the BEG EM programme provides support for residential and commercial hydrogen heating with grants of up to 30%, which can be combined with bonuses. These include a 20% Climate Speed Bonus for replacing old heating systems and a 30% Income Bonus for households earning up to 40,000 EUR. Total funding can reach up to 70%. Additionally, recipients can apply for loans of up to 120,000 EUR per residential unit, with favourable terms for households earning up to 90,000 EUR.

In Italy, support is provided through the Superbonus scheme. The value of the support is determined on a case-by-case basis. Initially introduced by the Relaunch Decree (Decreto Crescita), the Superbonus offers a subsidy that raises the deduction rate for specific interventions, such as energy efficiency improvements, from 1 July 2020 to 31 December 2021, to 110%. The scheme has since been extended multiple times and now includes additional measures for building restoration, seismic risk reduction (Sismabonus), and energy requalification of buildings.

The Netherlands actively supports the deployment of hydrogen for residential and commercial heating through the Missiegedreven Onderzoek, Ontwikkeling en Innovatie (MOOI): Gebouwde Omgeving programme. This initiative, aimed at fostering innovation in the built environment, provides a total budget of 20.35 MEUR to encourage new approaches that contribute to achieving climate targets. Projects focusing on heating buildings with hydrogen are eligible for funding, with subsidy amounts ranging from 25,000 EUR to a maximum of 4 MEUR per applicant.

In Ireland the support offered to deployment of residential/commercial heating with hydrogen, falls within the same scheme offered to stationary fuel cell applications, described in the section above.

In Slovenia, the "Call for tenders for the co-financing of the restructuring of RES district heating systems" offers subsidies of up to 45% of investment costs for projects involving renewable energy-based heat generators including hydrogen-based heating systems. The funding, totalling 11 MEUR, is provided by the European Union under the "NextGenerationEU" Recovery and Resilience Fund, and is available to companies, sole traders, and cooperatives.

In Switzerland, the Buildings Programme supports residential and commercial hydrogen heating through CO_2 tax revenues and cantonal contributions. Funded by the CO_2 tax (CHF 120

per tonne) and capped at CHF 450 million annually (approx. 450 MEUR), the programme allocates funds to cantons with subsidy programmes for energy-efficient renovations and heating system replacements. Cantonal credits range from CHF 170 million to CHF 200 million per year (approx. 170 to 200 MEUR). The specific support for hydrogen heating remains undetermined.

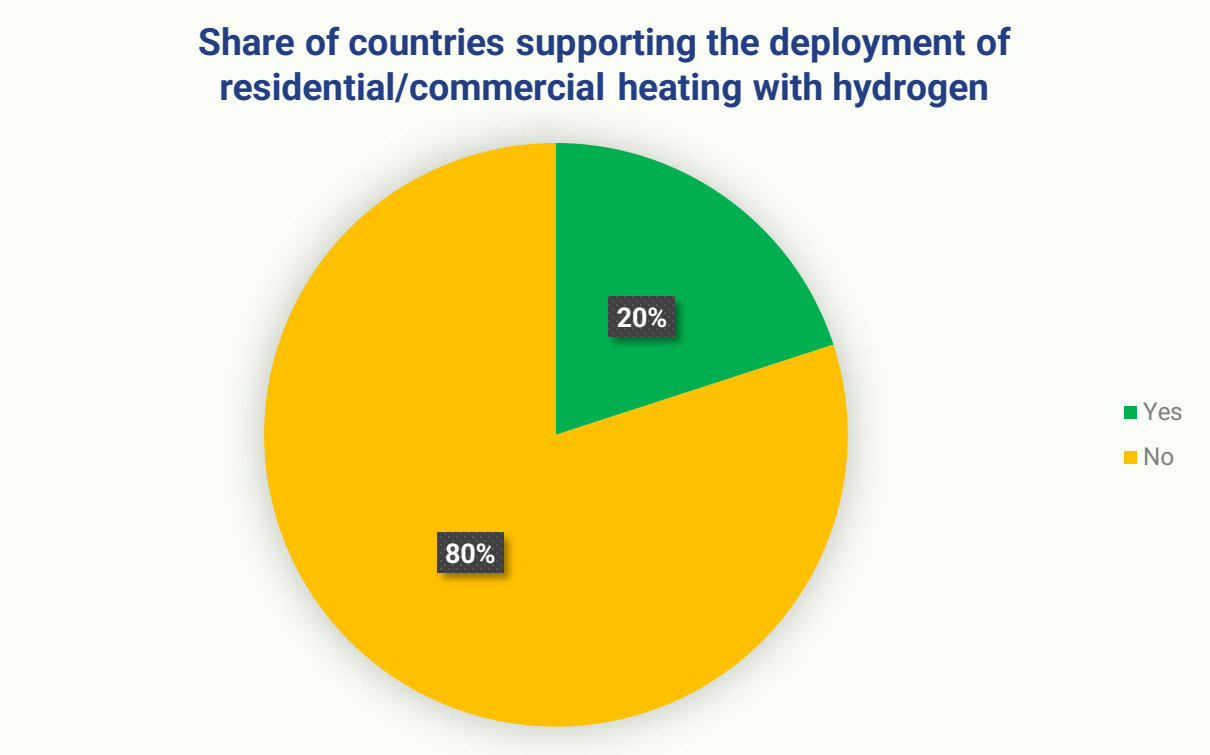


Figure 23. Share of countries reported to support the deployment of residential/commercial heating with hydrogen.

3.2.5.

End-uses: industry

Even though hydrogen has been used in the industry for decades, the future use of renewable or low-carbon hydrogen for heat, as a feedstock, or as a chemical agent are some of its most promising use cases. This section explores policies supporting increased usage of clean hydrogen in industry.

The questionnaire sought to answer whether the policies are in place, what is their economic value, what industries they cover, and any other relevant details about the policy.

The main question covered in the questionnaire concerning policies and legislation related to the hydrogen industry included:

- Are there any deployment support schemes for the use of renewable/low-carbon hydrogen in industry?

Support schemes in Industry

Figure 24 presents the share of countries reported to offer support schemes for the use of renewable/low-carbon hydrogen in industry. As of July 2024, 12 countries (Austria, Croatia, Estonia, Sweden, Ireland, Italy, Netherlands, Norway, Slovakia, Slovenia, Spain, and the United Kingdom) now provide deployment support schemes for the use of renewable/low-carbon hydrogen in industry.

This represents an increase of 3 countries compared to August 2023. The new additions to the list are Croatia, Italy, Norway, and Slovakia, while Lithuania no longer appears among the countries offering these schemes.

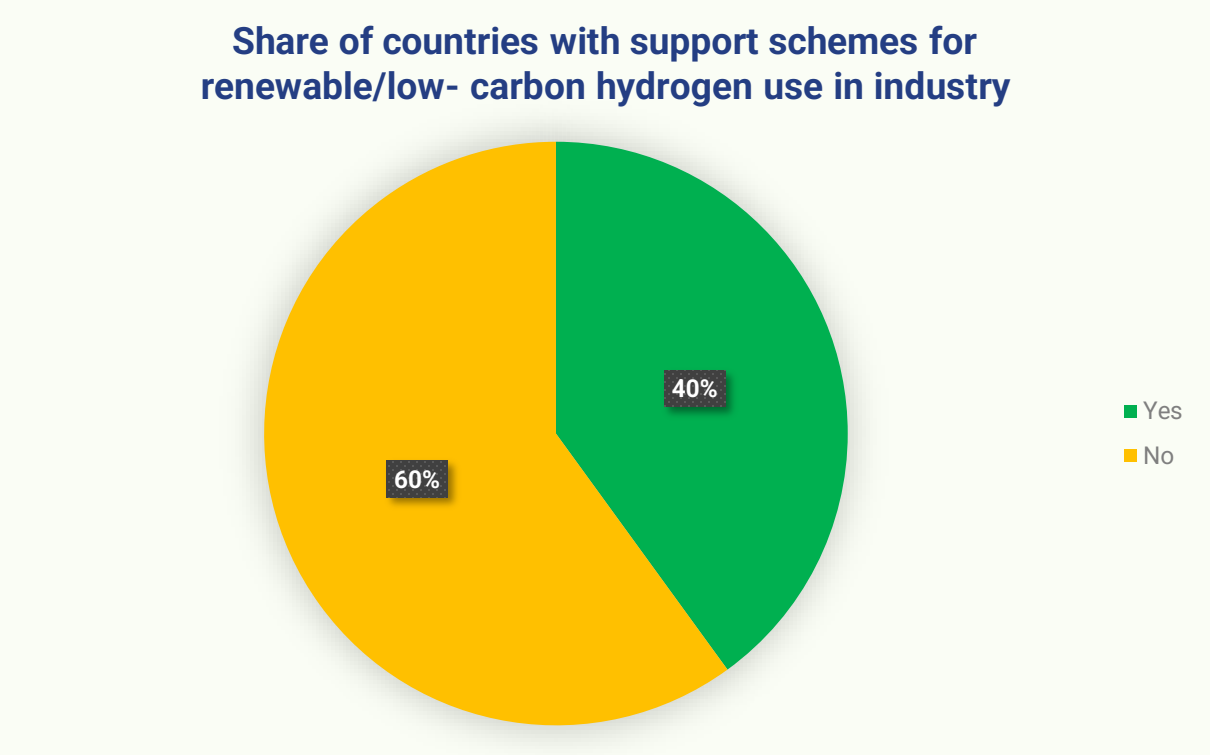


Figure 24. Share of countries reported to provide support schemes for renewable/low-carbon hydrogen use in industry.

Figure 25 illustrates the value (in MEUR) of support mechanisms for the use of renewable/ low-carbon hydrogen in industry by country. The values presented are summing up all the monetary values that were provided in the questionnaire.

Italy leads with a substantial investment of 550 MEUR, funded through the Italian National Recovery and Resilience Plan (PNRR). This funding aims to help companies reduce greenhouse gas emissions by at least 40% or energy consumption by 20% by transitioning from fossil fuels to renewable hydrogen, with a target of 100% hydrogen use by 2036.

Spain follows with 150 MEUR, allocated to adapting or replacing existing equipment to reduce fossil fuel consumption by 30% per equipment. This investment supports the industrial transition to renewable hydrogen across various sectors.

Sweden invests 121.2 MEUR through the Klimatklivet programme, which supports fossil-free technologies and the green transition in Sweden. This funding is available to companies, municipalities, regions, and organizations nationwide.

In contrast, the remaining countries allocate less than 100 MEUR for hydrogen-related projects, with Austria investing 85 MEUR in hydrogen production plants, and Slovakia, Estonia, Netherlands, and Croatia providing smaller amounts ranging from 13.5 MEUR to 50 MEUR. Notably, Ireland provides 1 MEUR per project, indicating that the investment in Ireland is allocated individually for each project rather than as a total amount.

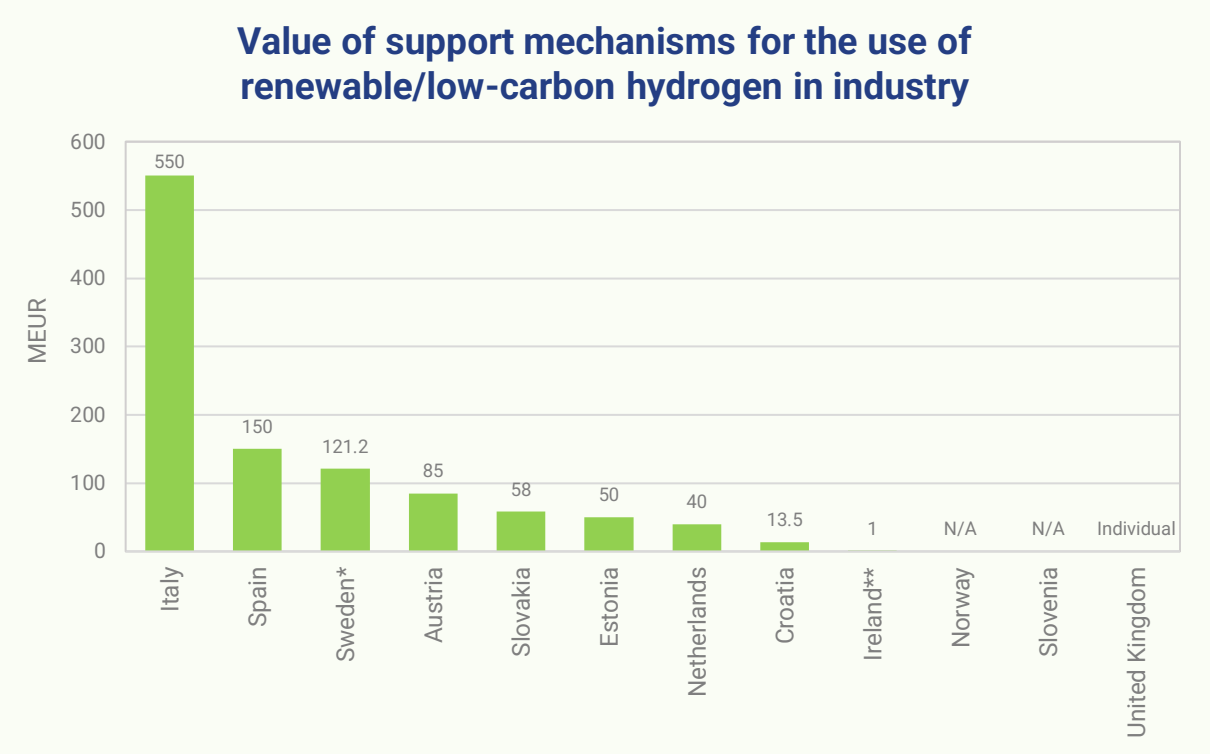


*Figure 25. Value (in M€) of support mechanisms for the use of renewable/ low-carbon hydrogen in industry by country. *Conversion factor for Sweden: 1 SEK ≈ 0.086 EUR ** In the case of Ireland, the value of investment refers to the amount given for each project.*

Figure 26 gives an overview on the number of countries that reported to offer support schemes for the deployment of renewable/low-carbon hydrogen, categorized by the industry they target.

As of July 2024, the deployment of support schemes for renewable/low-carbon hydrogen in various industries shows notable growth compared to August 2023. In 2023, the majority of countries applied these support schemes to ammonia production, followed by the chemicals industry. However, by 2024, the chemicals industry has taken the lead, with support schemes observed in 11 countries, up from 7 in August 2023. In contrast, the number of countries offering support for ammonia production has risen to 10, compared to 8 in 2023, but it now ranks second. Support schemes for refineries

and industrial heating have both increased from 6 countries in 2023 to 9 in 2024. Steel production, still the least-supported sector, has grown from 5 countries in 2023 to 8 in 2024. This shift highlights the growing emphasis on the chemicals industry, while ammonia production continues to receive substantial support, reflecting the broader transition towards renewable/low-carbon hydrogen solutions across multiple industrial sectors.

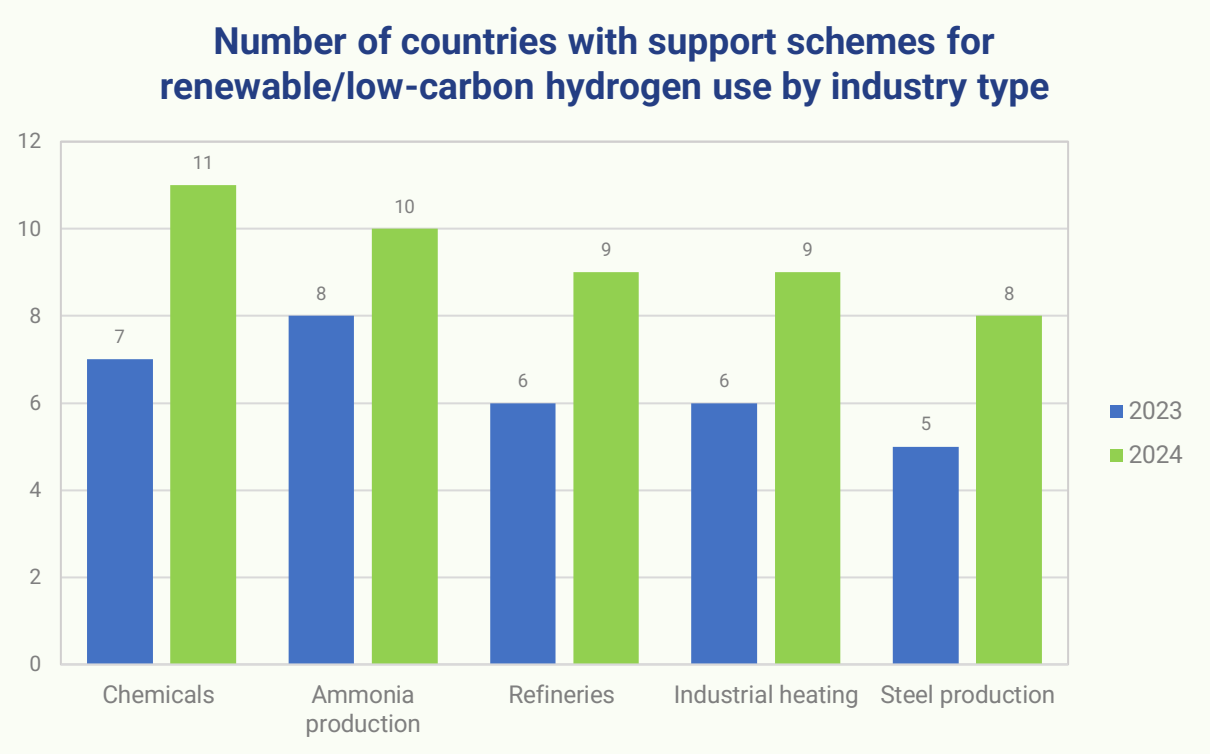


Figure 26 Number of countries with support schemes for the use of renewable/low-carbon hydrogen in industry.

3.2.6. Equipment manufacturing

This section covers the questions answered by country specialists related to national policies and legislations for electrolyser (and components) manufacturing.

The questionnaire sought to answer whether the policies are in place, their economic value (in EUR or as %), the type of support schemes (e.g. grant, tax benefits etc.), and any other relevant details about the policy.

The main question covered in the questionnaire related to policies and legislation supporting electrolyser (and components) manufacturing was:

- Are there any support schemes for electrolyser (and components) manufacturing?

Figure 27 illustrates the share of countries that reported to offer support schemes for electrolyser (and components) manufacturing. By July 2024, the number of countries remained at 7 compared to August 2023, with Belgium, Greece, Italy, the Netherlands, Norway, Spain, and Sweden offering such support. However, compared to 2023, a shift in the countries involved has occurred, with Greece, Italy, the Netherlands, and Norway joining the group, while Czech Republic, Estonia, Germany, and Latvia were no longer included.

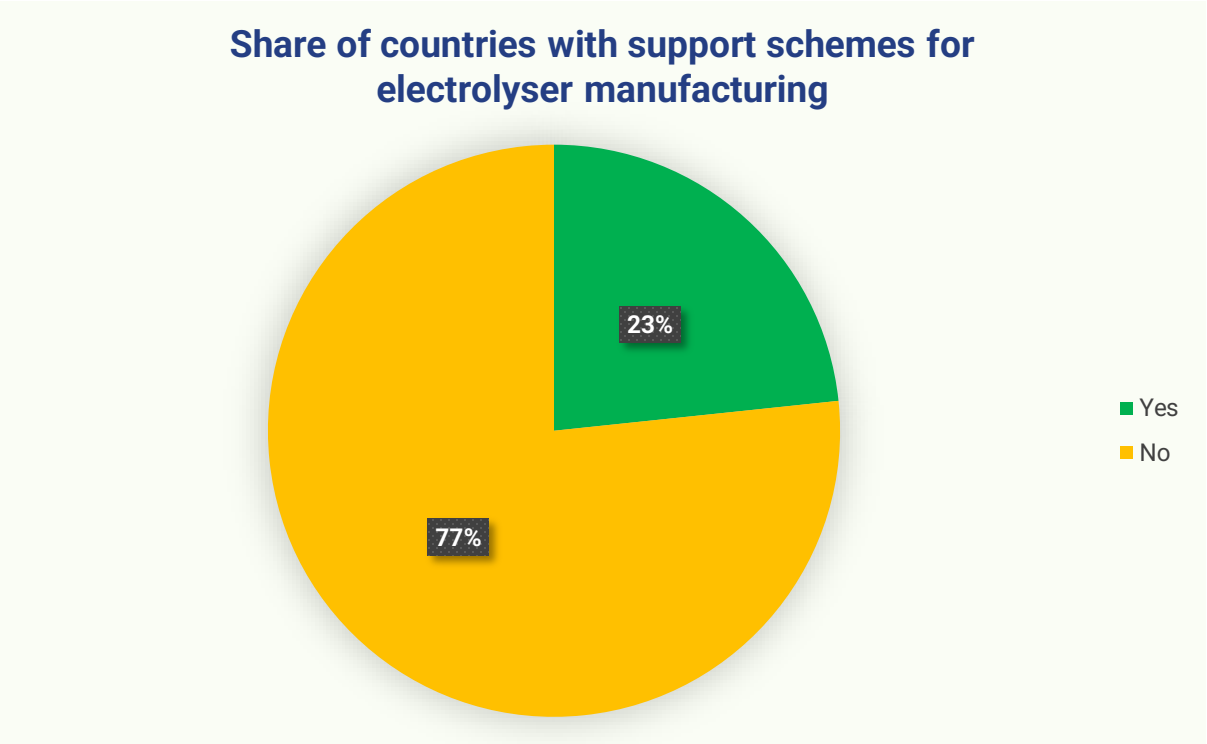


Figure 27. Share of countries with support schemes for electrolyser (and components) manufacturing.

Figure 28 presents the number of support schemes reported for electrolyser (and components) manufacturing in European countries. Belgium and Sweden reported having two support schemes in place for electrolyser manufacturing, while Greece, Italy, the Netherlands, Norway, and Spain, each reported having one support scheme.

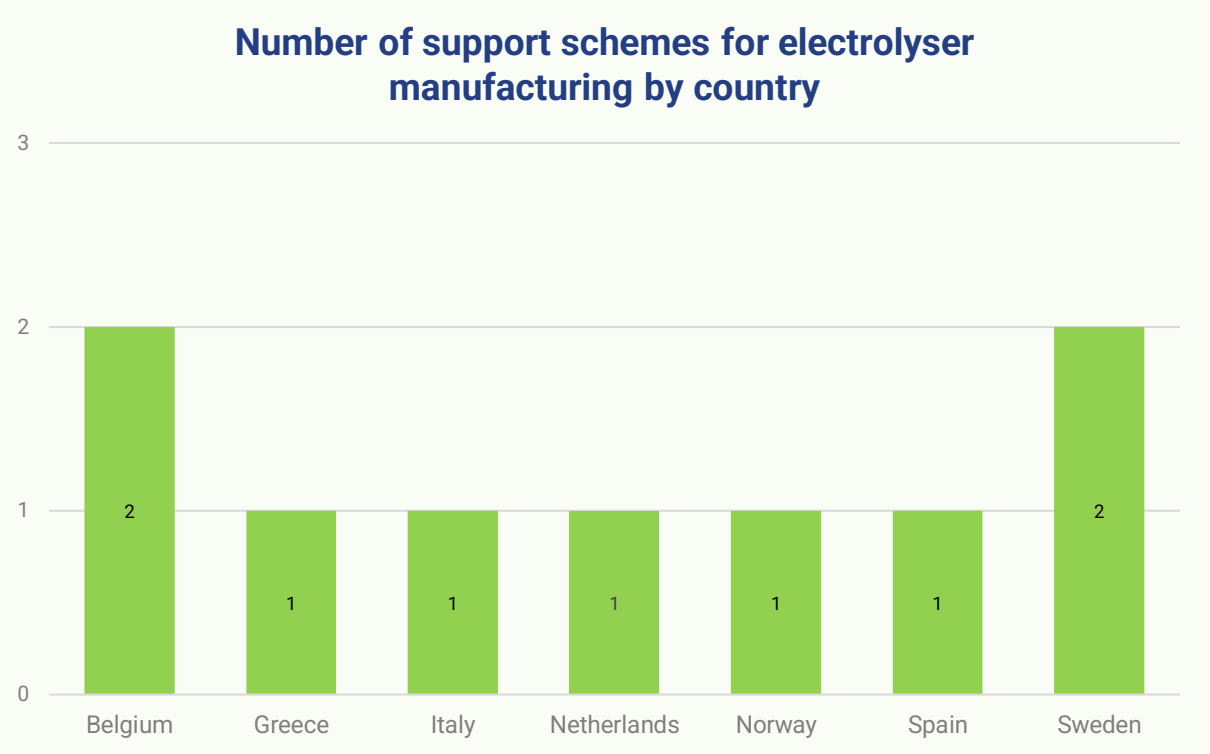


Figure 28. Applications of support schemes.

04 Codes and standards

Introduction

This chapter provides an overview of the key European standards that are relevant for the facilitation of the emerging clean hydrogen market.

The dataset of the European Hydrogen Observatory builds on the data that was included in the previous Fuel Cells and Hydrogen Observatory. This dataset has been updated with new standards that were published between January 2022 and May 2024, which were identified by searching the activities of key standardisation technical committees.

This chapter provides an overview of the standards that are included in the database, how they are categorised, and which new standards have been added in 2024. Moreover, it also gives some context, explaining the importance of standards in facilitating the large-scale deployment of hydrogen and fuel cells.

Interactive data dashboards on codes and standards can be accessed on the European Hydrogen Observatory website.

4.1.
Overview

The EHO includes a searchable database including 107 standards that are relevant to the facilitation of the emerging clean hydrogen sector. This is not a full exhaustive list of relevant standards, but rather an overview of some of the most important and directly relevant standards in place covering key components of the hydrogen value chain. The database includes 6 new or updated standards that were published between January 2024 and March 2024.

The standards included in the database were published by 21 different technical committees of standardisation bodies, which are explained in more detail in the next section. Of these 21 technical committees, 5 are responsible for publishing around 80% of the standards included in the database, as illustrated in Figure 29. These technical committees cover the following topic areas:

- Road vehicles (ISO/TC 22)
- Hydrogen technologies (ISO/TC 197)
- Fuel cell technologies (IEC/TC 105)
- Gas cylinders (ISO/TC 58)
- Independent gas-fired space heaters (CEN/TC 62)

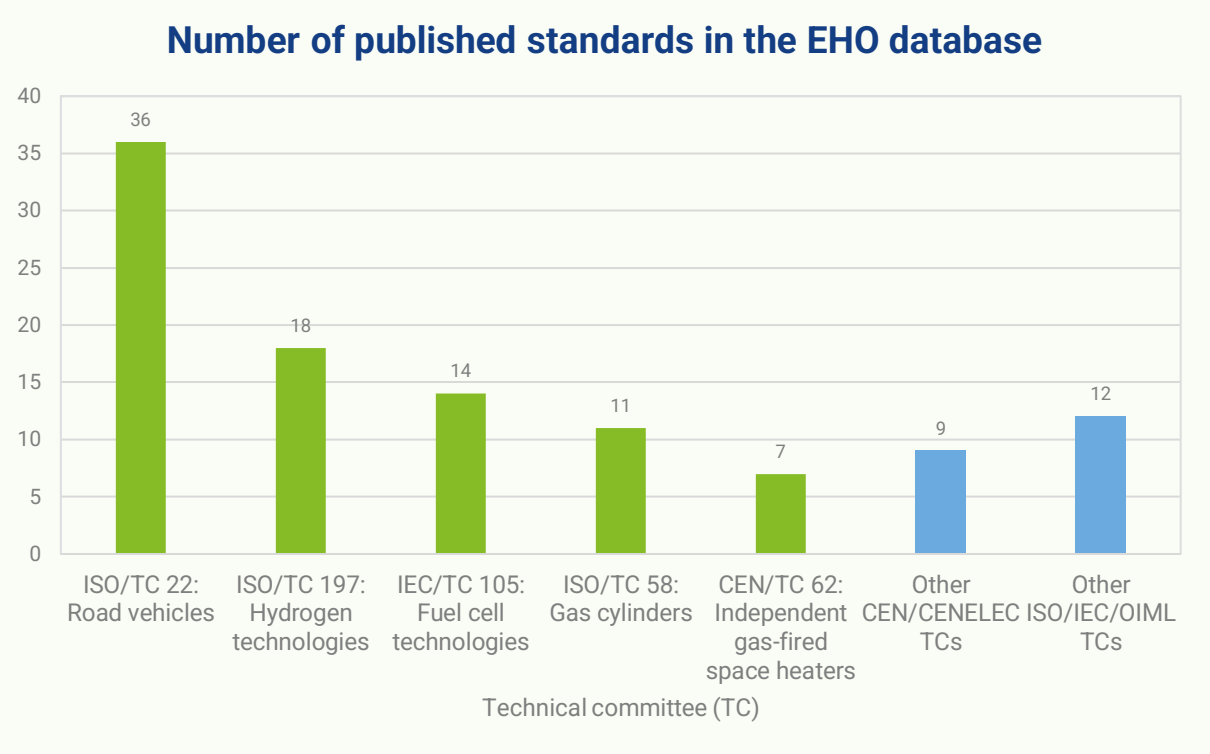


Figure 29. Number of published standards in the EHO per technical committee.

The standards are categorised in the EHO according to the different stages of the hydrogen value chain, as shown in Figure 30. This is a new categorisation structure compared with the previous observatory, which is also aligned with the categories used in other EHO datasets.

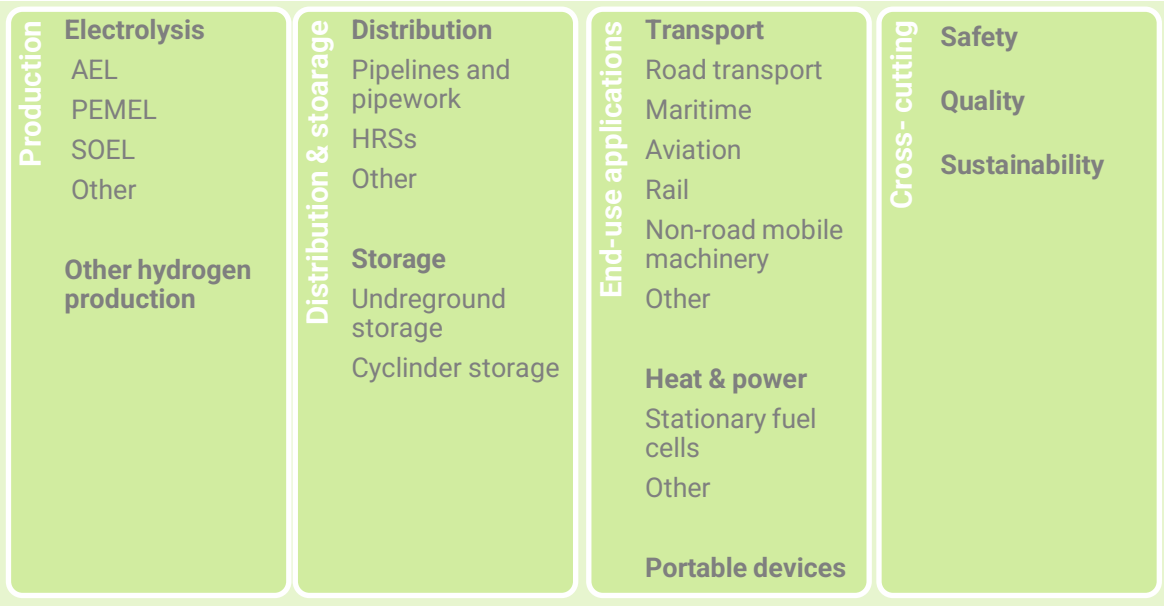


Figure 30 Categorization of standards in the EHO according to the different stages of the hydrogen value chain.

Figure 31 illustrates the number of standards included in the EHO database related to the different stages of the hydrogen value chain (production, distribution & storage, end-use applications, and cross-cutting). It is important to note that only the latest applicable standards are included, and older standards that have been updated are not listed in the database. Additionally, as some standards are relevant to multiple stages, the aggregated total in the figure exceeds 107.

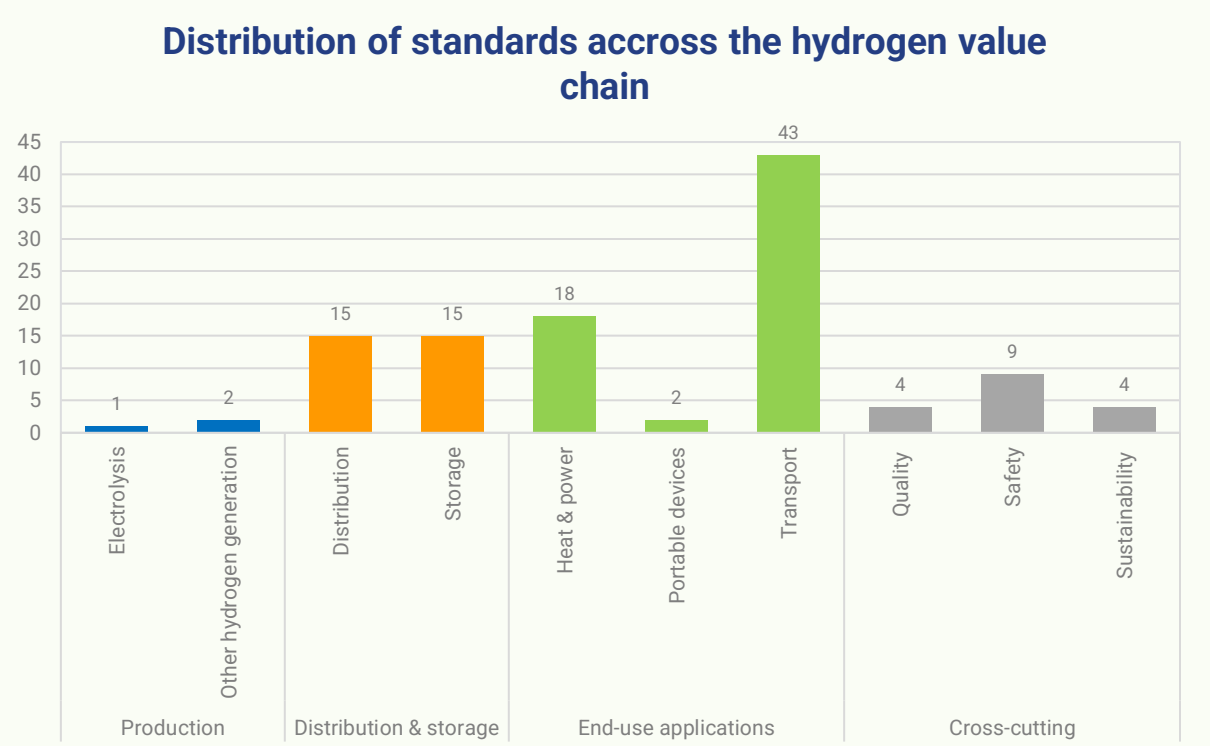


Figure 31. Distribution of standards included in the EHO database across different stages of the hydrogen value chain.

The largest category of standards included in the EHO database is end-use applications, which comprises 63 standards. These standards address the utilization of hydrogen across various sectors, ensuring its effective application in diverse contexts. Within this category, the majority of the standards focus on transport (43), reflecting the critical role hydrogen plays in advancing clean mobility solutions. Additionally, 18 standards are dedicated to heat and power, emphasizing hydrogen's potential in energy systems, while 2 standards are related to portable devices, highlighting niche applications for portable hydrogen-based technology.

The second largest standards category is distribution & storage, with a total of 30 standards. This stage of the hydrogen value chain focuses on the transportation and storage of hydrogen to ensure its safe and efficient delivery to end-users. The standards are equally distributed between distribution (15), which covers pipelines, HRSs, and other methods of transport, and storage (15), which involves

hydrogen containment technologies such as cylinder and underground storage.

Cross-cutting standards, which apply across multiple stages of the hydrogen value chain, account for 17 entries in the database. These are categorized into safety (9), emphasizing critical protocols to mitigate risks; quality (4), ensuring hydrogen purity and consistency; and sustainability (4), addressing environmental and long-term viability considerations.

Lastly, the production stage includes 3 standards, which cover the initial generation of hydrogen. This includes 1 standard for electrolysis, a key technology for producing green hydrogen, and 2 standards for other hydrogen generation methods, such as those based on fossil fuel reforming or biomass.

4.2.

Standardisation in the hydrogen sector

4.2.1.

Context

A 'standard' is a technical document, developed by consensus, that can be used as a rule, guideline or definition. It should define a repeatable way of doing something[43]. Within the European Union, standards are a core component that enable the functioning of the single market. For example, harmonised standards enable companies to demonstrate EU law compliance. Standards also give consumers confidence in relation to safety and quality and enable interoperability and cross-border trade.

Standards have already played an important role in facilitating research and innovation in hydrogen generation and applications. However, standardisation activities will need to be accelerated to facilitate the rapid development of the hydrogen market[44]. This fits into a wider challenge, addressed in the EU's Strategy on Standardisation, to respond to an increasingly rapid innovation pace whilst maintaining quality, and also to ensure that the EU can influence global standardisation.[45.]

The need to keep pace with the constantly developing policy and technological developments is illustrated in Figure 32. This figure shows the expected pace of change of the

[43] European Standards - CEN-CENELEC (cencenelec.eu)
[44] 20230301_ech2a_roadmaphydrogenstandardisation.pdf (cencenelec.eu)
[45] 20230301_ech2a_roadmaphydrogenstandardisation.pdf (cencenelec.eu)

European renewable hydrogen market in the top arrow, with targets to accelerate production over the next decade and to 2050. This will be underpinned by policy and legal frameworks and technological developments, illustrated in the second arrow in the figure. Finally, as illustrated in the bottom arrow, in order for hydrogen technologies to be deployed on the market, standards need to be developed, to facilitate safety, quality and compliance. Standards can then also be used to certify products as safe and fit to be placed on the European market.

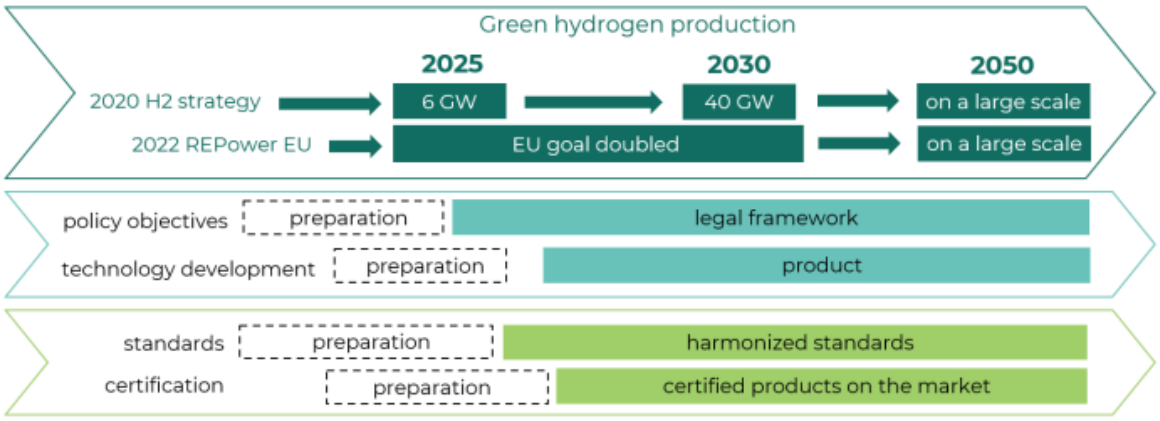


Figure 32. Interlinkages between policy objectives, technology development, standard-setting, and certification[46]

4.2.2.
Standardisation bodies

The codes and standards module covers hydrogen standards developed by the following bodies: ISO, IEC, OIML, CEN, CENELEC. These are described in more detail in this section. Within each organisation, technical committees bring together key stakeholders to develop standards.

Global bodies: ISO, IEC and OIML

ISO (the International Standardisation Organisation) and IEC (the International Electrotechnical Commission) bring together experts from approximately 170 countries globally to develop voluntary, consensus-based standards.

One of the key ISO Technical Committees that deals with Hydrogen is ISO/TC 197: Hydrogen Technologies. The scope of this committee is standardisation in the field of systems and devices for the production, storage, transport, measurement and use of hydrogen. The committee has recently established a sub-committee: (ISO/TC 197/ SC1), focused on standardization of large-scale hydrogen energy systems and applications including aspects of

[46] 20230301_ech2a_roadmaphydrogenstandardisation.pdf (cencenelec.eu)

testing, certification, sustainability and placement, and coordination with other relevant standardisation bodies and stakeholders[47]. This will help to facilitate, for example, applications where overlap or blending with other fuels and energy carriers and systems is considered.

One of the key IEC Technical Committees that deals with Hydrogen is TC 105: Fuel Cell Technologies. The scope of this committee is to prepare international standards regarding fuel cell (FC) technologies for all FC types and various associated applications such as stationary FC power systems for distributed power generators and combined heat and power systems, FCs for transportation such as propulsion systems (excluding road vehicles, coordinated by ISO/TC 22 which have also published several relevant standards, as shown in Figure 28 range extenders, auxiliary power units, portable FC power systems, micro FC power systems, reverse operating FC power systems, and general electrochemical flow systems and processes[48]. This committee is currently developing many standardisation projects, including in the emerging applications of electrically powered industrial trucks, unmanned aircraft systems, and railways.

The EHO also includes some standards from the OIML (International Organisation for Legal Metrology). This is an international standard-setting body linked to the World Trade Organization's Technical Barriers to Trade Agreement. OIML standards should therefore be applied, when appropriate, by all signatories of the WTO Technical Barriers to Trade (TBT) Agreement when developing technical regulations, in application of Article 2.4 of that Agreement.

European bodies: CEN and CENELEC

CEN (The European Committee for Standardization) and CENELEC (European Committee for Electrotechnical Standardization) are two organisations that bring together members from 34 countries to develop European standards and are able to work on standardisation requests issued by the European Commission.

Both organisations have the goal to pursue one standard, one test, accepted everywhere[49]. In support of this, they actively support the activities of ISO and IEC, including through technical cooperation facilitated by the Vienna Agreement (between CEN and ISO) and the Frankfurt Agreement (between CENELEC and IEC).

CEN and CENELEC have recently established the CEN-CENELEC Joint Technical Committee 6: Hydrogen in energy systems, which is looking into standardisation in devices and connections for the production, storage, transport and distribution, measurement and use of hydrogen from renewable energy sources and other sources[50]. In addition, the two organisations have

[47] ISO/TC 197/SC 1 - Hydrogen at scale and horizontal energy systems
[48] IEC - TC 105 Dashboard> Scope
[49] CEN and CENELEC - CEN-CENELEC (cencenelec.eu)
[50] Hydrogen - CEN-CENELEC (cencenelec.eu)

established a Joint Task Force on hydrogen in natural gas systems with the intention to support the timely provision of coherent deliverables in the different CEN and CENELEC Technical Committees, which will allow a safe and reliable use of hydrogen in a decarbonizing energy system[51]. The EHO also includes relevant standards from technical committees that have a broader topic focus. For example, there are 8 standards in the database that were published by CEN/TC 62, which sets standards for independent gas-fired space heaters.

Figure 33 shows an illustration developed for the European Clean Hydrogen Alliance roadmap on standardisation of the known technical committees that are dealing with hydrogen topics across the hydrogen value chain, with global standards in the outer circle and European standards in the inner circle. This includes some committees that have been set up specifically to tackle hydrogen topics, such as the 'ISO/TC 197: Hydrogen Technologies', as well as broader technical committees that cover some standardisation topics that are also relevant to hydrogen deployment, such as 'CEN/TC 15: Inland navigation vessels'. The figure illustrates the fact that many technical committees cover topics across the hydrogen value chain. It is expected that this landscape will continue to develop over coming years, with additional technical committees being set up to tackle specific issues. Against this backdrop, it will be increasingly important to coordinate efforts between standardisation bodies and committees.

[51] Ibid.

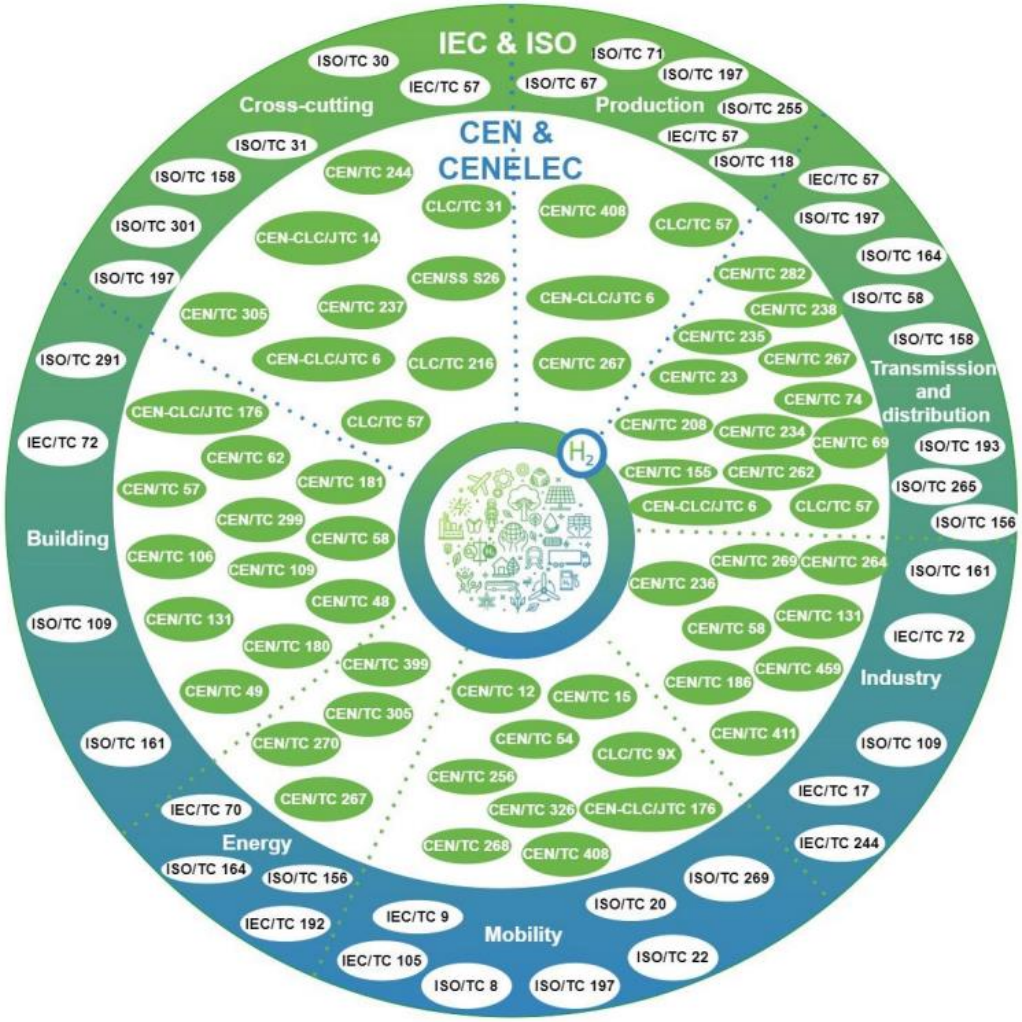


Figure 33. European and International hydrogen standardisation landscape.[52]

4.2.3.

Other standardisation initiatives

There are several standardisation initiatives that have been established to assess the state of standardisation development and recommend priorities going forward. These initiatives will be increasingly important as the development of the hydrogen market, and associated standardisation needs accelerates. This section gives a brief overview of some of the key initiatives that have emerged in recent years.

[52] 20230301_ech2a_roadmaphydrogenstandardisation.pdf (cencenelec.eu)

European Clean Hydrogen Alliance (ECH2A) Standards Roadmap

The ECH2A brings together industry, public authorities, civil society, and other stakeholders with the mission to support the large-scale deployment of clean hydrogen technologies by 2030. In support of this, it established a working group on standardisation in February 2022, which published a 'Roadmap on Hydrogen Standardisation' in March 2023[53]. This roadmap includes a comprehensive analysis of current global and European hydrogen standardisation activities, an analysis of the key gaps that need to be addressed, and recommendations to support the streamlining and consolidation of activities going forwards. This roadmap was – and will continue to be - a key data source for the EHO standards database, given its detailed overview of the key technical committees that are developing relevant standards.

Other organisations assessing standardisation activities

The **Hydrogen Council** is a global CEO-led initiative that was established with the mission to advance the role of hydrogen in the energy transition globally. Regarding the topic of standards, the Hydrogen Council is particularly involved with supporting the development of safety standards. As part of this work, it recently performed a gap analysis, identifying 400 standards gaps that need to be filled. This included technical areas such as a systemic approach to interface design in refuelling stations, as well as 'safety culture' topics. As these topics were all rated as highly critical, the Hydrogen Council has also been tracking progress in each topic.

The **International Partnership for hydrogen and fuel cells in the economy (IPHE)** is an inter-governmental partnership that was established with the mission to facilitate and accelerate the transition to clean and efficient energy and mobility systems using hydrogen and fuel cell technologies across applications and sectors. The IPHE has a working group on regulations, codes, standards, and safety, which assesses progress on standardisation, for example through the high-level regulatory gap analysis that it conducted in 2021[54]. This analysis is helpful to understand the regulatory priorities that will drive future standards development but is not as detailed as the analysis conducted by the ECH2A and Hydrogen Council.

The **International Renewable Energy Agency (IRENA)** – the lead global intergovernmental agency for energy transformation – has conducted projects on hydrogen standardisation, including the following project: "Quality Infrastructure (QI) for Renewable Hydrogen: technical standards and quality control for the production and trade of renewable hydrogen". Projects like this also have the aim of developing roadmaps to be followed by global standard makers in the development of new hydrogen standards.

[53] 20230301_ech2a_roadmaphydrogenstandardisation.pdf (cencenelec.eu)
[54] IPHE RCSSWG Regulatory Areas for Action Compendium A4FINAL (usrfiles.com)

The results from these initiatives were already used to inform the mapping for the current EHO database. The gap analysis and roadmaps will also support the future development of the database, as it shows in which areas standards are likely to be developed.

4.3.
Recent standards (2024)

As set out in the next section, a few standards have been revised and developed in 2024 across different stages of the hydrogen value chain, including distribution & storage, end-use applications, and cross-cutting areas. These standards cover mainly the following areas:

- Road vehicles (ISO/TC 22)
- Hydrogen technologies (ISO/TC 197)
- Fuel cell technologies (IEC/TC 105)
- Cryogenic vessels and specific hydrogen technologies applications (CEN/TC 268)
- Plastics pipes, fittings and valves for the transport of fluids protocols (ISO/TC 138)

4.3.1.
Newly published standards of 2024 included in the EHO database

This section provides an overview of the standards reviewed or developed within 2024, included in the EHO database. The standards are categorized according to the specific stages of the hydrogen value chain they are related to (as shown in Appendix A.4). During this period, the revised and newly developed standards covered distribution and storage, end-use applications, and cross-cutting areas. However, no standards related to production were reviewed or developed during this time frame.

Distribution & storage

- **ISO 19885-1:2024 Gaseous hydrogen -- Fuelling protocols for hydrogen-fuelled vehicles -- Part 1: Design and development process for fuelling protocols**[55]

Publication date: May 2024 (New)

Category: Distribution → HRSs / Storage→ Cylinder storage
Technical Committee: ISO/TC 197: Hydrogen technologies
ICS Code: 27.075 |43.060.40: Hydrogen technologies | Fuel systems

Description: This standard addresses the design and development of fuelling protocols for

[55] ISO 19885-1:2024 Gaseous hydrogen -- Fuelling protocols for hydrogen-fuelled vehicles -- Part 1: Design and development process for fuelling protocols

compressed hydrogen gas dispensing to vehicles with compressed hydrogen storage of fuel. The document does not address dispensing of compressed hydrogen gas to vehicles with hydride-based hydrogen storage systems as well as the dispensing of liquefied or cryo-compressed hydrogen.

End-use applications

- **ISO/TR 11954:2024 - Fuel Cell Road Vehicles: Performance Measurement for Vehicles Fuelled with Compressed Hydrogen**[56]

Publication date: January 2024 (Update)

Category: Transport → Road transport → Light duty vehicles
Technical Committee: ISO/TC 22 (Road Vehicles) – Sub-committee 37: Electrically propelled vehicles
ICS Code: 43.120 - Electric Road Vehicles (Including Their Components and Systems)

Description: This standard – which replaces ISO/TR 11954:2008 - specifies test methods for the measurement of performance, such as acceleration, maximum speed and hill climbing ability, of fuel cell hybrid electric vehicles (FCHEV) as passenger cars and light duty trucks with a maximum authorized total mass of 3 500 kg and fuelled with compressed hydrogen.

- **ISO/TS 5474-5:2024 Electrically propelled road vehicles -- Functional and safety requirements for power transfer between vehicle and external electric circuit -- Part 5: Automatic conductive power transfer** [57]

Publication date: January 2024 (New)

Category: Transport → Road transport → Light duty vehicles, Heavy duty vehicles
Technical Committee: ISO/TC 22 (Road Vehicles) – Sub-committee 37: Electrically propelled vehicles
ICS Code: 43.120 - Electric Road Vehicles (Including Their Components and Systems)

Description: This standard defines requirements for the onboard system (vehicle side) related to the automatic connection for conductive alternating current (AC) and/or direct current (DC) power transfer between electrically propelled road vehicles (EVs) and external electric circuits.

- **IEC 62282-6-101:2024 Fuel cell technologies -- Part 6-101: Micro fuel cell power systems -- Safety -- General requirements**[58]

  Publication date: February 2024 (New)

Category: Portable devices
Technical Committee: IEC/TC 105: Fuel cells technologies
ICS Code: 27.070: Fuel cells

Description: This standard covers micro fuel cell power systems and fuel cartridges that are wearable or easily carried by hand, providing direct current outputs that do not exceed 60 V DC and power outputs that do not exceed 240 VA. Portable fuel cell power systems that provide output levels that exceed these electrical limits are covered by IEC 62282-5-100.

[56] ISO/TR 11954:2024 - Fuel Cell Road Vehicles: Performance Measurement for Vehicles Fuelled with Compressed Hydrogen
[57] ISO/TS 5474-5:2024 Electrically propelled road vehicles -- Functional and safety requirements for power transfer between vehicle and external electric circuit -- Part 5: Automatic conductive power transfer
[58] IEC 62282-6-101:2024 Fuel cell technologies -- Part 6-101: Micro fuel cell power systems -- Safety -- General requirements

- **IEC 62282-6-106:2024 Fuel cell technologies -- Part 6-106: Micro fuel cell power systems -- Safety -- Indirect Class 8 (corrosive) compounds**[59]

Publication date: February 2024 (New)

Category: Portable devices
Technical Committee: IEC/TC 105: Fuel cells technologies
ICS Code: 27.070: Fuel cells

Description: This standard covers micro fuel cell power systems, micro fuel cell power units and fuel cartridges using hydrogen produced from UN Class 8 (corrosive) borohydride formulations as fuel. These systems and units use proton exchange membrane (PEM) fuel cell technologies. The designs include fuel processing subsystems to derive hydrogen gas from the corrosive fuel formulation.

Cross-cutting

- **IEC 62282-6-107:2024 Fuel cell technologies -- Part 6-107: Micro fuel cell power systems -- Safety -- Indirect water-reactive (Division 4.3) compounds**[60]

Publication date: May 2024 (New)

Category: Safety
Technical Committee: IEC/TC 105: Fuel cells technologies
ICS Code: 27.070: Fuel cells

Description: This standard covers micro fuel cell power systems, micro fuel cell power units and fuel cartridges using hydrogen produced from water-reactive (UN Division 4.3) compounds as fuel. These systems and units use proton exchange membrane (PEM) fuel cell technologies. The designs can include fuel processing subsystems to derive hydrogen gas from the water-reactive fuel formulation. This document only applies to water-reactive (UN Division 4.3) solid compounds which solely evolve hydrogen gas upon contact with water (or non-hazardous aqueous solutions).

4.3.2.

Newly published standards of 2024 not yet included in the EHO database

This section includes a summary of standards that have been revised or published within 2024 that have not yet been incorporated into the EHO database. These standards will be included in the next update. The standards are categorized according to the specific stages of the hydrogen value chain they are related to (as shown in Appendix A.4).

Distribution & storage

- **EN 17127:2024 Outdoor hydrogen refuelling points dispensing gaseous**

[59] IEC 62282-6-106:2024 Fuel cell technologies -- Part 6-106: Micro fuel cell power systems -- Safety -- Indirect Class 8 (corrosive) compounds
[60] IEC 62282-6-107:2024 Fuel cell technologies -- Part 6-107: Micro fuel cell power systems -- Safety -- Indirect water-reactive (Division 4.3) compounds

hydrogen and incorporating filling protocols[61]

Publication date: February 2024 (New)

Category: Distribution → HRSs

Technical Committee: CEN/TC 268: Cryogenic vessels and specific hydrogen technologies applications
ICS Code: 75200: Petroleum products and natural gas handling equipment

Description: This standard defines the minimum requirements to ensure the interoperability of hydrogen refuelling points, including refuelling protocols that dispense gaseous hydrogen to road vehicles (e.g. Fuel Cell Electric Vehicles) that comply with legislation applicable to such vehicles.

- **ISO 19880-9:2024 Gaseous hydrogen -- Fuelling stations -- Part 9: Sampling for fuel quality analysis**[62]

Publication date: July 2024 (New)

Category: Distribution → HRSs

Technical Committee: ISO/TC 197: Hydrogen technologies
ICS Code: 43.060.40 |71.100.20: Fuel systems | Gases for industrial application-Including compressed air and hydrogen

Description: This standard outlines requirements for sampling from hydrogen fuelling stations for samples taken at the dispenser. The document defines the best practice for sampling at the nozzle of a hydrogen fuelling station as part of the fuelling station acceptance testing, and ongoing operation.

- **IEC 62282-8-201:2024 Fuel cell technologies - Part 8-201: Energy storage systems using fuel cell modules in reverse mode - Test procedures for the performance of power-to-power systems**[63]

Publication date: July 2024 (Update)

Category: Storage

Technical Committee: IEC/TC 105: Fuel cell technologies
ICS Code: 27070: Fuel cells

Description: This standard – which replaces IEC 62282-8-201:2020- defines the evaluation methods of typical performances for electric energy storage systems using hydrogen. It is applicable to the systems that use electrochemical reaction devices for both power charge and discharge.

- **IEC 62282-8-201:2024 RLV Fuel cell technologies - Part 8-201: Energy storage systems using fuel cell modules in reverse mode - Test procedures for the performance of power-to-power systems**[64]

Publication date: July 2024 (Update)

Category: Storage

Technical Committee: IEC/TC 105: Fuel cell technologies
ICS Code: 27070: Fuel cells

[61] EN 17127:2024 Outdoor hydrogen refuelling points dispensing gaseous hydrogen and incorporating filling protocols
[62] ISO 19880-9:2024 Gaseous hydrogen -- Fuelling stations -- Part 9: Sampling for fuel quality analysis
[63] IEC 62282-8-201:2024 Fuel cell technologies - Part 8-201: Energy storage systems using fuel cell modules in reverse mode - Test procedures for the performance of power-to-power systems
[64] IEC 62282-8-201:2024 RLV Fuel cell technologies - Part 8-201: Energy storage systems using fuel cell modules in reverse mode - Test procedures for the performance of power-to-power systems

Description: This standard – which replaces IEC 62282-8-201:2020 | IEC- contains both the official IEC International Standard and its Redline version. The Redline version is available in English only and provides you with a quick and easy way to compare all the changes between the official IEC Standard and its previous edition.

- **ISO 16486-2:2024 Plastics piping systems for the supply of gaseous fuels — Unplasticized polyamide (PA-U) piping systems with fusion jointing and mechanical jointing - Part 2: Pipes**[65]

Publication date: November 2024 (Update)

Category: Distribution → Pipelines and pipework

Technical Committee: ISO/TC 138 (Plastics pipes, fittings and valves for the transport of fluids) – Sub-committee 5: General properties of pipes, fittings and valves of plastic materials and their accessories -- Test methods and basic specifications
ICS Code: 75200 | 83.140.30: Petroleum products and natural gas handling equipment- Including petroleum and natural gas storage devices, distribution systems, pipelines, petrol stations, dispensing devices, etc. | Plastics pipes and fittings for non-fluid use

Description: This standard – which replaces ISO 16486-2:2020- specifies the physical and mechanical properties of pipes made from unplasticized polyamide (PA-U) in accordance with ISO 16486-1, intended to be buried and used for the supply of gaseous fuels. It also specifies the test parameters for the test methods to which it refers.

- **ISO 4437-1:2024 Plastics piping systems for the supply of gaseous fuels — Polyethylene (PE) - Part 1: General**[66]

Publication date: February 2024 (Update)

Category: Distribution → Pipelines and pipework

Technical Committee: ISO/TC 138 (Plastics pipes, fittings and valves for the transport of fluids) – Sub-committee 4: Plastics pipes and fittings for the supply of gaseous fuels
ICS Code: 75200 | 83.140.30: Petroleum products and natural gas handling equipment- Including petroleum and natural gas storage devices, distribution systems, pipelines, petrol stations, dispensing devices, etc. | Plastics pipes and fittings for non-fluid use

Description: This standard – which replaces ISO 4437-1:2014- specifies materials and the general aspects of polyethylene (PE) piping systems in the field of the supply of gaseous fuels. It also specifies the test parameters for the test methods referred to in this document. In conjunction with ISO 4437-2, ISO 4437-3, ISO 4437-4 and ISO 4437-5, this document is applicable to PE pipes, fittings and valves, their joints, and joints with components of PE and other materials.

- **ISO 4437-2:2024 Plastics piping systems for the supply of gaseous fuels — Polyethylene (PE) - Part 2: Pipes**[67]

Publication date: February 2024 (Update)

Category: Distribution → Pipelines and pipework

Technical Committee: ISO/TC 138 (Plastics pipes, fittings and valves for the transport of fluids) – Sub-committee 4: Plastics pipes and

[65] ISO 16486-2:2024 Plastics piping systems for the supply of gaseous fuels — Unplasticized polyamide (PA-U) piping systems with fusion jointing and mechanical jointing - Part 2: Pipes
[66] ISO 4437-1:2024 Plastics piping systems for the supply of gaseous fuels — Polyethylene (PE) - Part 1: General
[67] ISO 4437-2:2024 Plastics piping systems for the supply of gaseous fuels — Polyethylene (PE) - Part 2: Pipes

fittings for the supply of gaseous fuels
ICS Code: 75200 | 83.140.30: Petroleum products and natural gas handling equipment- Including petroleum and natural gas storage devices, distribution systems, pipelines, petrol stations, dispensing devices, etc. | Plastics pipes and fittings for non-fluid use

Description: This standard – which replaces ISO 4437-2:2014- specifies the characteristics of pipes made from polyethylene (PE) for piping systems in the field of the supply of gaseous fuels. It also specifies the test parameters for the test methods referred to in this document. In conjunction with ISO 4437-1, ISO 4437-3, ISO 4437-4 and ISO 4437-5, this document is applicable to PE pipes, fittings and valves, their joints, and joints with components of PE and other materials.

- **ISO 4437-3:2024 Plastics piping systems for the supply of gaseous fuels — Polyethylene (PE) — Part 3: Fittings**[68]

Publication date: February 2024 (Update)

Category: Distribution → Pipelines and pipework

Technical Committee: ISO/TC 138 (Plastics pipes, fittings and valves for the transport of fluids) – Sub-committee 4: Plastics pipes and fittings for the supply of gaseous fuels
ICS Code: 75200 | 83.140.30: Petroleum products and natural gas handling equipment- Including petroleum and natural gas storage devices, distribution systems, pipelines, petrol stations, dispensing devices, etc. | Plastics pipes and fittings for non-fluid use

Description: This standard – which replaces ISO 4437-3:2014- specifies the characteristics of fusion fittings made from polyethylene (PE) as well as of mechanical fittings for piping systems in the field of the supply of gaseous fuels. It also specifies the test parameters for the test methods referred to in this document. In conjunction with ISO 4437-1, ISO 4437-2, ISO 4437-4 and ISO 4437-5, this document is applicable to PE pipes, fittings and valves, their joints, and joints with components of PE and other materials.

- **ISO 4437-5:2024 Plastics piping systems for the supply of gaseous fuels — Polyethylene (PE)—Part 5: Fitness for purpose of the system**[69]

Publication date: February 2024 (Update)

Category: Distribution → Pipelines and pipework

Technical Committee: ISO/TC 138 (Plastics pipes, fittings and valves for the transport of fluids) – Sub-committee 4: Plastics pipes and fittings for the supply of gaseous fuels
ICS Code: 75200 | 83.140.30: Petroleum products and natural gas handling equipment- Including petroleum and natural gas storage devices, distribution systems, pipelines, petrol stations, dispensing devices, etc. | Plastics pipes and fittings for non-fluid use

Description: This standard – which replaces ISO 4437-3:2014- specifies the requirements of fitness for purpose of assembled polyethylene (PE) piping systems in the field of the supply of gaseous fuels. It specifies the requirements for electrofusion, socket fusion, butt fusion and mechanical joints. It specifies the method of preparation of test piece joints and the tests to be carried out on these joints for assessing the

[68] ISO 4437-3:2024 Plastics piping systems for the supply of gaseous fuels — Polyethylene (PE) — Part 3: Fittings
[69] ISO 4437-5:2024 Plastics piping systems for the supply of gaseous fuels —Polyethylene (PE)—Part 5: Fitness for purpose of the system

fitness for purpose of the system under normal and extreme conditions. It specifies the test parameters for the test methods referred to in this document. This document is intended to be used only by the product manufacturer and test laboratories to assess the performance of components in accordance with ISO 4437-2, ISO 4437-3 and ISO 4437-4 when joined together under normal and extreme conditions in accordance with this document. It is not intended for on-site testing of pipe systems.

End-use applications

It should be noted that IEC 62282-8-201:2024 and IEC 62282-8-201:2024 RLV, which were analysed above, apply not only to hydrogen storage but also to end-use applications in stationary fuel cells.

- **ISO 19887-1:2024 Fuel Gaseous Hydrogen — Fuel system components for hydrogen-fuelled vehicles — Part 1: Land vehicles**[70]

Publication date: October 2024 (New)

Category: Transport → Road transport

Technical Committee: ISO/TC 197: Fuel cell technologies
ICS Code: 27070 | 43.060.40: Hydrogen technologies | Fuel systems

Description: This standard establishes requirements for newly produced compressed hydrogen gas fuel system components, as listed below, that are intended for use on hydrogen gas powered land vehicles.

[70] ISO 19887-1:2024 Fuel Gaseous Hydrogen — Fuel system components for hydrogen-fuelled vehicles — Part 1: Land vehicles

Conclusions

This report provides an overview on the latest advancements of the European hydrogen policies and standards covering the whole value chain of hydrogen.

EU policies and legislation

On the EU level, a large number of EU legislations following the Fit for 55 package, and impacting the hydrogen value chain, were already adopted before 2024, including Renewable Energy Directive, EU Emission Trading System, Alternative Fuels Infrastructure Regulation, FuelEU Maritime, ReFuelEU Aviation and CO2 emissions performance standards for cars and light duty vehicles. Nevertheless, in 2024 the EU policy landscape made significant progress with many other proposals of the Fit for 55 package now being adopted, including the Hydrogen and Decarbonized Gas Market Package, Energy Performance of Buildings Directive and the CO2 emission performance standards for new heavy-duty vehicles. Moreover, all proposals that fell under the Green Deal Industrial Plan are now also adopted. This includes the Net Zero Industrial Act, Critical Raw Material Act and the Electricity Market Design Reform. Finally, the revised Industrial Emissions Directive has also been adopted and the EU commission released an Advanced Materials for Industrial Leadership Strategy. All these policies will play a crucial role in promoting hydrogen use and expanding its infrastructure network across Europe.

Furthermore, two major Important Projects of Common European Interest (IPCEIs) have been approved on the hydrogen topic (Hy2Move and Hy2Infra). In addition, within Innovation Fund a new hydrogen auction round has been launched with a budget of 1.2 billion, following the success of the first round to support the production and uptake of clean hydrogen. These initiatives are reflecting the EU's commitment to fostering innovation and collaboration within the hydrogen sector.

National hydrogen strategies

As of 2024, 21 European countries have adopted national hydrogen strategies, up from 20 in 2023, with Lithuania introducing its first national hydrogen strategy. Additionally, Romania has made progress by advancing from having no strategy to reaching the draft stage.

European national hydrogen strategies continue to incentivize hydrogen production as a core element of their plans, featured in 21 countries, while also placing significant emphasis on end-use applications. Within end-use, mobility (20 countries) and industry (17 countries) are often targeted, underscoring their growing importance in the hydrogen value chain. In contrast, heating and energy backup power gain less attention in 10 and 11 countries, respectively. Most strategies also have a focus on education (15) and cross-cutting (17) initiatives, supporting innovation and broader integration. Meanwhile, the focus on manufacturing remained limited to

8 countries. Hydrogen trade, featured in 7 countries, received slightly less focus, indicating a major focus on domestic value chains.

National policies and legislation

In 2024, an exhaustive survey was completed across 30 European countries (+2 countries compared to August 2023) to collect the key national policies and legislations developed covering both cross-cutting questions and specific questions related to the hydrogen value chain. More than half of the countries questioned have reported to have in place a national hydrogen infrastructure plan and a system for Guarantees of Origin.

The survey highlights varied progress across the hydrogen value chain. Significant advancements are observed in production, with most countries providing CAPEX support for renewable or low-carbon hydrogen plants, and a growing number instituting permitting guidelines and OPEX support. End-use applications, particularly in mobility, show robust support through purchase subsidies for FCEVs, alongside increasing attention to industrial applications such as chemicals and ammonia production. However, progress remains limited in transmission, with only two countries supporting hydrogen injection into transmission grids. There was also no growth in the number of countries providing technology manufacturing support since August 2023.

Codes and standards

The EHO database now includes 107 searchable standards that are relevant to the emerging clean hydrogen sector, categorised according to the different stages of the hydrogen value chain. On a European level, there has been considerable progress, with 6 published standards that were either revised or newly developed between January 2024 and March 2024.

The standards included in the database were published by 21 different technical committees of standardisation bodies. Of these 21 technical committees, 5 are responsible for publishing around 80% of the standards.

Appendix

A.1.

Overview of published national hydrogen strategies in Europe

Country	Publication year	Original text	English translation
Austria	2022	Wasserstoffstrategie für Österreich	Executive summary
Belgium	2022	Update of Belgian Federal Hydrogen Strategy 2022	
Bulgaria	2023	Водородно бъдеще за България	
Croatia	2022	Hrvatska Strategija za Vodik do 2050. godine	Hydrogen Strategy of the Republic of Croatia until 2050
Czech Republic	2021	Vodíkova strategie České republiky	The Czech Republic's Hydrogen Strategy
	2024*	Vodíkova strategie actualizace 2024	
Denmark	2022	Udvikling og fremme af brint og grønne brændstoffer (Power-to-X strategi)	The Government's strategy for Power to X
	2024*	Økonomiske rammevilkår for brintinfrastruktur	
Estonia	2023	Eesti vesiniku teekaart	Estonian Hydrogen Roadmap
Finland	2023	Valtioneuvoston Periaatepäätös Vedystä	
France	2018	Plan de déploiement de l'hydrogène pour la transition énergétique	
	2020	Stratégie nationale pour le développement de l'hydrogène décarboné en France	National strategy for the development of decarbonized and renewable hydrogen in France
	2023*	Stratégie nationale pour le développement de l'hydrogène décarboné en France	
Germany	2020	Die Nationale Wasserstoffstrategie	The National Hydrogen Strategy
	2022	Fortschrittsbericht zur Umsetzung der Nationalen Wasserstoffstrategie	

	2023	Fortschreibung der Nationalen Wasserstoffstrategie	
Hungary	2021	Magyarország Nemzeti Hidrogénstratégiája	Hungary's National Hydrogen Strategy
Ireland	2023	National Hydrogen Strategy	
Lithuania	2024	Vandenilio plėtros Lietuvoje 2024–2050 m. gairės	
Luxembourg	2021	Stratégie hydrogène du Luxembourg	Stratégie hydrogène du Luxembourg (Executive Summary)
Netherlands	2020 2021*	Kamerbrief over Kabinetsvisie waterstof Werkplan Nationaal Waterstof Programma 2022-2025	
Norway	2020	Regjeringens hydrogenstrategi på vei mot lavutslippssamfunnet	The Norwegian Governments hydrogen strategy
Poland	2021	Polska Strategia Wodorowa do Roku 2030 z Perspektywą do Roku 2040	Polish Hydrogen Strategy until 2030 (Summary)
Portugal	2020	Estratégia Nacional para o Hidrogénio (EN-H2)	
Slovakia	2021	Národná vodíková stratégia: Pripravení na budúcnosť	National Hydrogen Strategy: Ready for the Future
Spain	2020	Hoja de Ruta del Hidrógeno: Una apuesta por el Hidrógeno Renovable	
United Kingdom	2022 2023 2023	Hydrogen Strategy update to the market: December 2022 Hydrogen Strategy update to the market: August 2023 Hydrogen Strategy update to the market: December 2023	

**Please note that the targets set on the updated strategies for Czech Republic, Denmark, France and Netherlands will be reviewed in the next versions of this report.*

A.2.

Qualitative summary of national strategies content along the hydrogen value chain

Country	Production	Trade	Distribution and storage	End-use				Manufacturing	Education, research & development	Cross-cutting
				Mobility	Industry	Heating	Energy & back-up power			
Austria	√			√	√					
Belgium	√	√	√	√	√	√		√		
Bulgaria	√		√	√	√		√		√	√
Croatia	√		√	√	√	√	√		√	
Czech Republic	√		√	√	√				√	
Denmark	√		√							
Estonia	√		√	√				√	√	√
Finland	√		√	√					√	√
France	√			√	√				√	√
Germany	√	√	√	√	√	√	√	√	√	√
Hungary	√		√	√	√		√	√		√

Ireland	√	√	√	√	√		√		√	√
Lithuania	√		√	√	√	√	√		√	√
Luxembourg	√	√	√	√	√	√			√	√
Netherlands	√	√	√	√		√				√
Norway	√	√		√	√				√	√
Poland	√		√	√	√	√	√	√	√	√
Portugal	√	√	√	√	√	√	√	√	√	√
Slovakia	√		√	√	√	√	√	√		√
Spain	√		√	√	√		√	√	√	√
United Kingdom	√	√	√	√	√	√	√		√	√

A.3.

Country-specific responses to general questions on national policies and legislation

Country	Has a dedicated national roadmap/strategy for the hydrogen sector been adopted?	If not, is such a document under development?	Is there a national hydrogen infrastructure (pipelines) plan?	Is a system for Guarantees of Origin for hydrogen in place in your country?
Austria	Yes		Yes	Yes
Belgium	Yes		Yes	No
Bulgaria	Yes		No	No
Croatia	Yes		No	No
Cyprus	No	Yes	No	No
Czech Republic	Yes		Yes	Yes
Denmark	Yes		No	No
Estonia	Yes		No	No
Finland	No	Yes	Yes	Yes
France	Yes		No	Yes
Germany	Yes		Yes	Yes
Greece	No	Yes	Yes	No
Hungary	Yes		No	No
Ireland	Yes		No	Yes

Italy	No	Yes	Yes	Yes
Latvia	No	Yes	No	No
Lithuania	Yes		No	No
Luxembourg	Yes		Yes	No
Malta	No	Yes	No	No
Netherlands	Yes		Yes	Yes
Norway	Yes		Yes	No
Poland	Yes		No	No
Portugal	Yes		Yes	Yes
Romania	No	Yes	No	No
Slovakia	Yes		No	Yes
Slovenia	No	Yes	No	No
Spain	Yes		Yes	Yes
Sweden	Yes		No	No
Switzerland	No	Yes	No	No
United Kingdom	Yes		Yes	No

A.4.

Overview of new hydrogen standards in 2024 and their distribution across the value chain

Relevant Standard	Title	Production		Distribution & Storage		End-use applications			Cross-cutting		
		Electrolysis	Other hydrogen generation	Distribution	Storage	Transport	Heat & power	Portable devices	Safety	Quality	Sustainability
ISO 19885-1:2024	Gaseous hydrogen -- Fuelling protocols for hydrogen-fuelled vehicles -- Part 1: Design and development process for fuelling protocols			√	√						
ISO/TS 5474-5:2024	Electrically propelled road vehicles -- Functional and safety requirements for power transfer between vehicle and external electric circuit -- Part 5: Automatic conductive power transfer					√					
ISO/TR 11954:2024	Fuel cell road vehicles -- Performance measurement -- Vehicles fuelled with compressed hydrogen					√					
IEC 62282-6-101:2024	Fuel cell technologies -- Part 6-101: Micro fuel cell power systems -- Safety -- General requirements							√			
IEC 62282-6-106:2024	Fuel cell technologies -- Part 6-106: Micro fuel cell power systems -- Safety -- Indirect Class 8 (corrosive) compounds							√			
IEC 62282-6-107:2024	Fuel cell technologies -- Part 6-107: Micro fuel cell power systems -- Safety -- Indirect water-reactive (Division 4.3) compounds								√		

EN 17127:2024	Outdoor hydrogen refuelling points dispensing gaseous hydrogen and incorporating filling protocols			√							
ISO 19880-9:2024	Gaseous hydrogen -- Fuelling stations -- Part 9: Sampling for fuel quality analysis			√							
IEC 62282-8-201:2024	Fuel cell technologies - Part 8-201: Energy storage systems using fuel cell modules in reverse mode - Test procedures for the performance of power-to-power systems				√						
IEC 62282-8-201:2024 RLV	Fuel cell technologies - Part 8-201: Energy storage systems using fuel cell modules in reverse mode - Test procedures for the performance of power-to-power systems				√						
ISO 16486-2:2024	Plastics piping systems for the supply of gaseous fuels — Unplasticized polyamide (PA-U) piping systems with fusion jointing and mechanical jointing - Part 2: Pipes			√							
ISO 4437-1:2024	Plastics piping systems for the supply of gaseous fuels — Polyethylene (PE) - Part 1: General			√							
ISO 4437-2:2024	Plastics piping systems for the supply of gaseous fuels — Polyethylene (PE) - Part 2: Pipes			√							
ISO 4437-3:2024	Plastics piping systems for the supply of gaseous fuels — Polyethylene (PE) — Part 3: Fittings			√							
ISO 4437-5:2024	Plastics piping systems for the supply of gaseous fuels — Polyethylene (PE)—Part 5: Fitness for purpose of the system			√							
ISO 19887-1:2024	Fuel Gaseous Hydrogen — Fuel system components for hydrogen-fuelled vehicles — Part 1: Land vehicles					√					