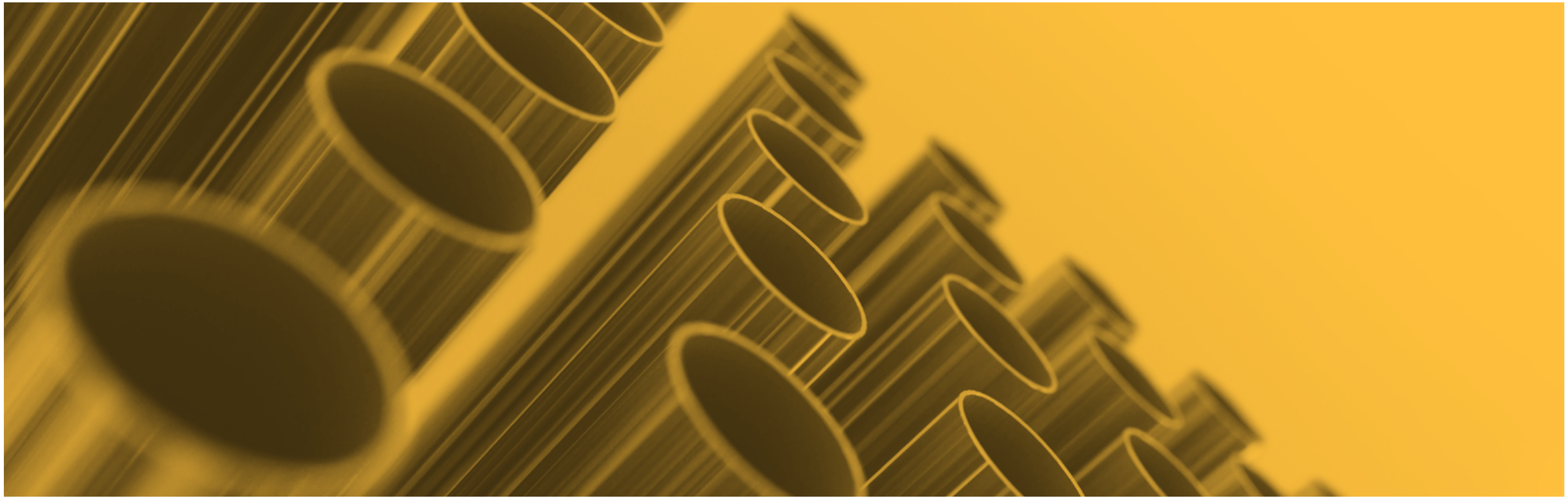


BONELLIEREDE
BREDIN PRAT
DE BRAUW BLACKSTONE WESTBROEK
HENGELER MUELLER
SLAUGHTER AND MAY
URÍA MENÉNDEZ

JUNE 2022

THE POTENTIAL OF HYDROGEN: A GUIDE TO KEY EUROPEAN MARKETS

CONTENTS
FOREWORD
KEY TAKEAWAYS
INTRODUCTION
POLICY OVERVIEW
EXISTING REGULATION
PRODUCTION
STANDARDS
INFRASTRUCTURE
END USES
GLOSSARY
CONTACTS
COUNTRY ANNEX

CONTENTS

FOREWORD

Momentum is building for the development of a low carbon hydrogen economy in Europe, driven by decarbonisation and energy security considerations.

As developments and ventures proliferate, investors are increasingly looking to commit substantial capital in the context of significant regulatory flux.

This guide considers the regulatory landscape across the hydrogen value chain in 7 key jurisdictions:

- France
- Germany
- Italy
- The Netherlands
- Portugal
- Spain
- The United Kingdom

This guide is intended to assist developers, investors and other market participants to navigate:

- the changing regulatory framework for hydrogen across the value-chain
- the emerging standards for low carbon hydrogen

If you would like to discuss this guide or would like further information on any aspect of it, please get in touch with your usual contact.

21 June 2022

This guide is a collaboration between our Best Friends firms, consisting of BonelliErede in Italy, Bredin Prat in France, De Brauw Blackstone Westbroek in the Netherlands, Hengeler Mueller in Germany, Slaughter and May in the United Kingdom, and Uría Menéndez in Portugal and Spain. Each is a market leader in its respective jurisdiction, each has a formidable international reputation in its own right, and all are authorities in cross-jurisdictional best practice.

We regularly work together on energy and infrastructure instructions, and are actively engaged on hydrogen mandates in all the jurisdictions mentioned in this guide.

KEY TAKEAWAYS

- Whilst at a high level countries share common objectives, at a national level, approaches differ in relation to production capacity ambition, production method, and maturity of policy and regulation.
- Steps are underway to streamline and conform national regulatory frameworks in some areas, particularly as EU policy influences national frameworks of EU member states. The EU has adopted a strategic approach for the development of a low carbon hydrogen economy described in the EU Hydrogen Strategy and supplemented by the EU Energy System and Integration Strategy, each focusing predominantly on green hydrogen.
- The UK's policy is distinct from that of the EU and adopts a technology neutral approach to low carbon hydrogen production. However, the UK market will inevitably be influenced by decisions in the EU due to the UK's close connection with European energy markets and supply chains, as well as its significant trading relationships with EU member states.
- The emergence of a regional or international hydrogen standard will be needed to support the development of a coherent hydrogen economy. In the meantime national standards and eligibility requirements for accessing support are emerging, creating a patchwork of different requirements for organisations to comply with. For first movers, making early investments following these national requirements, there may be a risk if more stringent regional or international standards are introduced without appropriate transition or grandfathering provisions.

Production	All jurisdictions under review have set out their hydrogen production ambitions, but differ in relation to the level of ambition and production method, which is of course influenced by the size and focus of the economy of each country (e.g. the size of its industrial sector) as well as its underlying energy mix. As national strategies bed-down, distinct import and export markets are beginning to emerge. All countries have established grant funding schemes to support hydrogen production projects in their jurisdictions, with funding also available at the EU level. Some jurisdictions such as the Netherlands and the UK have already taken steps to introduce operating support schemes seeking to incentivise low carbon hydrogen production by increasing its competitiveness compared with high carbon fuels.
Transport and storage	The development of hydrogen transport networks and storage is generally less well advanced in all jurisdictions. However this is expected to rise up the policy priorities once production volumes and market demand increase.
End uses	All jurisdictions reviewed are prioritising the use of hydrogen in the industrial and transport sectors. The focus on other sectors varies, with some jurisdictions attributing higher potential to heat and power than others.

INTRODUCTION: WHY THE HYPE ABOUT HYDROGEN?

Net zero pledges have resulted in a raft of policies and proposals for regulation focused on developing production and demand for low carbon hydrogen. The attraction of clean hydrogen for EU and UK policy makers is particularly driven by its potential to reduce emission in sectors which can't be readily electrified.

Low carbon hydrogen may also help solve the issue of the variability in renewable power generation. Production of electrolytic hydrogen, using electricity generated by intermittent renewable sources such as wind and solar, means the resulting hydrogen molecules can be stored and subsequently reconverted into electricity or used outside of the electricity sector (such as in transport or industry), although not without losses in conversion.

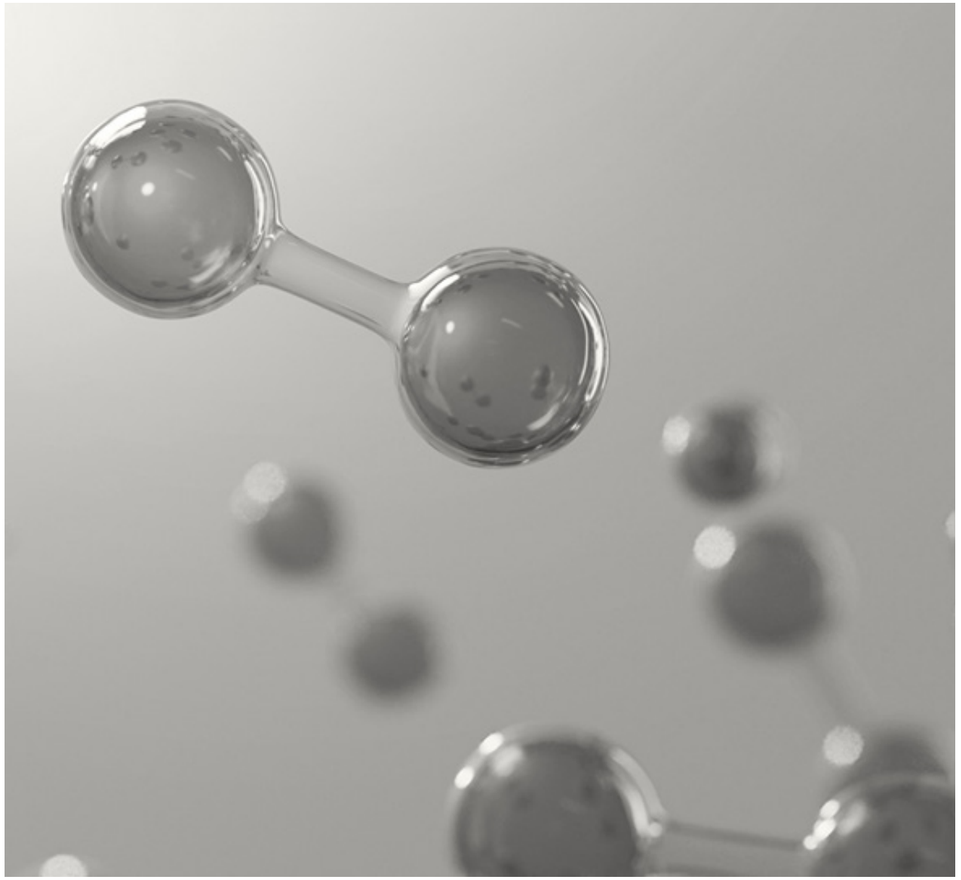
Finally, as a result of the conflict in Ukraine, ambition for low carbon hydrogen in the EU and in the UK has increased sharply. Low carbon hydrogen has the potential in due course to reduce reliance on fossil fuel imports, including reliance on Russian gas imports, and to address security of supply concerns.

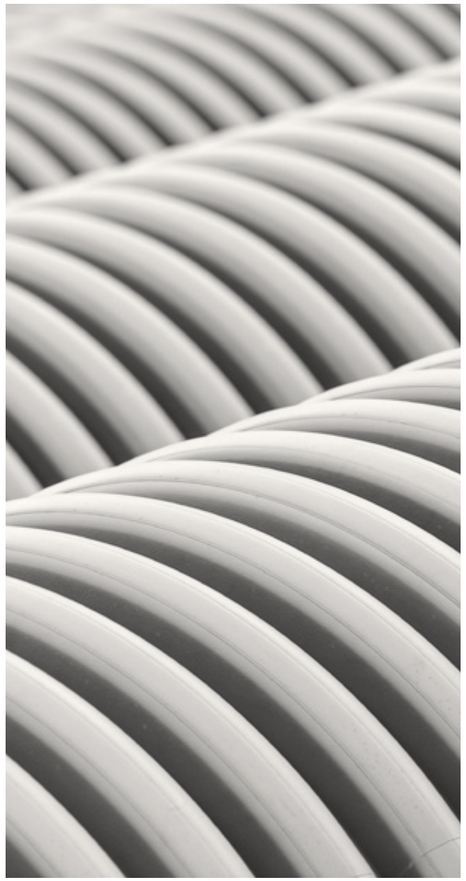
The emergence of a global low carbon hydrogen economy

Hydrogen is one of the most abundant elements on earth, but there are no hydrogen deposits to exploit, it has to be produced.

According to the International Energy Agency (IEA), in its Hydrogen Tracking Report (November 2021), today's hydrogen production is reported to be produced mainly from fossil fuels, resulting in close to 900Mt of CO_2 emissions per year. It is, for example, currently used to process oil in refineries and in industry.

However, low carbon hydrogen is seen as a potentially important energy carrier for the energy transition. Unlike electricity, which is hard to store and transport over distance, hydrogen could be more similar to fossil fuels, enabling a global market in low carbon fuel to develop.





Forecasts for the potential of hydrogen in the future energy mix vary. However all agree that there is a role for low carbon hydrogen in the energy transition. The role that low carbon hydrogen plays varies by country and by region.

In its Global Hydrogen Review 2021, the IEA noted that to deliver its estimates by 2050 requires US$1 200 billion of investment in low carbon hydrogen supply and use through to 2030. As well as the emergence of national markets, the IEA envisages the development of global trade in hydrogen in its net zero scenario, with large volumes exported from gas and renewables-rich areas in the Middle East, Central and South America, and Australia to demand centres in Asia and Europe.

This scale of low carbon hydrogen production poses significant technical, economic and regulatory challenges including:

- developing sufficient electrolyser manufacturing capacity
- ensuring the availability of sufficient renewable and low carbon electricity generation capacity and the grid capacity to transport the electricity produced
- the deployment of carbon capture and storage capacity
- the development of demand for low carbon hydrogen
- the development of hydrogen storage and distribution capacity, including dedicated hydrogen pipelines or non-pipeline distribution capacity
- promoting the adoption of low carbon hydrogen and addressing the price differential between existing grey hydrogen and low carbon hydrogen production methods. In its Global Hydrogen Review 2021, the IEA reported that the levelised cost of production of hydrogen from natural gas ranges from US$0.5 to US$1.7/kg, compared US$1 to US$2/kg for blue hydrogen and US$3 to US$8/kg for green hydrogen.

As a result of these challenges, electrification is, in many cases, the preferred decarbonisation option. However, where this is not possible, policy and regulatory intervention is required to overcome these challenges, and to develop appropriate frameworks and regulation to support low carbon hydrogen across the hydrogen value chain.

The colours of hydrogen

It has become common practice to colour-code hydrogen. The "colour" depends on how it's produced, and whether residual emissions are captured. This colour-coding system is still not universally accepted and is not used in many jurisdictions. However, for the purposes of this guide, we will use the colours below to refer to the different production methods.

GREY
Produced by stripping hydrogen from methane using steam methane reformation (SMR). This is the prevailing, existing hydrogen production method.

BLUE
Produced in a similar fashion to black or grey hydrogen but uses CCS to capture up to 95% of emissions (but not a zero emissions process).

BLACK
Produced from other fossil fuels such as coal or oil.

PINK
Produced from electrolysing water using nuclear power.

GREEN
Produced by using renewable electricity to electrolyse water. It can also be produced by SMR, converting biogas or biomass, with carbon capture and storage (CCS).

TURQUOISE
Produced from natural gas, but by bubbling it through a molten metal in a process called 'pyrolysis' with no CO_2 gas emissions.

POLICY OVERVIEW: EXPANDING THE ROLE OF HYDROGEN IN EUROPE

Hydrogen policy in Europe varies by jurisdiction, presenting a challenge for international investors. However, despite sometimes fragmented and divergent policy, steps are underway towards harmonisation in some areas, particularly as EU policy influences national frameworks. Nevertheless, there remain significant differences in the scope and ambition of each country's hydrogen strategy.

European ambition influences national policy

National policies adopted in EU member states need to be considered against the backdrop of the wider EU strategy. The EU has adopted a strategic approach for the development of a low carbon hydrogen economy described in the EU Hydrogen Strategy and supplemented by the EU Energy System Integration Strategy. Focused on green hydrogen, the plan envisages the following milestones:

Present –2024:

At least 6GW of electrolyser installed capacity and production of up to 1M tonnes of green hydrogen.

2025 - 2030:

At least 40GW of electrolyser installed capacity and production of up to 10M tonnes of green hydrogen.

2030 - onwards:

Green hydrogen technologies will be fully implemented in all hard-to-decarbonise sectors.

The EU Hydrogen Strategy milestones were further supplemented by the European Commission's REPowerEU Plan published in May 2022, which envisages 10M tonnes of domestic green hydrogen production and 10M tonnes of green hydrogen imports by 2030 (subject to its adoption by the EU institutions).

The UK's policy, although distinct from that of the EU due to its technology neutral approach, will inevitably be influenced by decisions in the EU due to the UK's close connection with European energy markets and supply chains, as well as its significant trading relationships with EU member states.

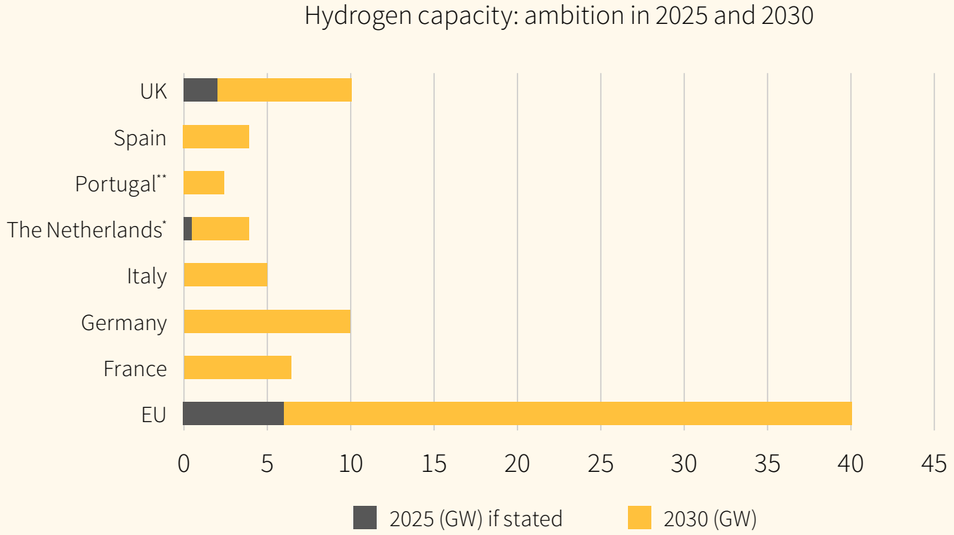
Significant differences exist in national approaches

At a national level, approaches differ in relation to production capacity ambition, production method, and maturity of policy and regulation.

Figure 1 highlights the stated hydrogen production ambitions of each country, with the UK and Germany having the highest goals for 2030 of the countries reviewed. However, the level of ambition cannot be viewed in absolute terms, but must be considered in the context of the economy of each country (e.g. the size of its industrial sector). None of the countries reviewed had a stated policy goal beyond 2030, although many had published forecasts of the potential of the sector beyond this date.

In order to avoid giving rise to any legitimate expectations, which may increase the risk of administrative review in the event of a change of policy, all countries reviewed have not fixed legally binding targets but rather expressed their 2030 goals as ambitions.

FIGURE 1: PRODUCTION CAPACITY AMBITION TO 2030



*The Netherlands's aim is 3-4 GW by 2030. In addition the Netherlands is aiming for 1.5-1.8 Mton of blue hydrogen production by 2030.

** Portugal's aim is 2 GW to 2.5 GW by 2030.

Countries also differ as to the production method, or colour of hydrogen, they are seeking to promote. For example, the Netherlands and Italy are focusing on both blue and green hydrogen. Germany, Portugal and Spain are focused primarily on promoting green hydrogen, whilst France is promoting the deployment of electrolytic hydrogen. The UK is adopting a technology neutral approach. The difference in approach can also be partly explained by differences in each country's available energy resources (e.g. renewable resources, nuclear fleet) and its CCS policy.

TABLE 1: TYPE OF HYDROGEN BY COUNTRY

	Colour of hydrogen*
EU	Green
France	Green and pink
Germany	Green
Italy	Green and blue
The Netherlands	Green and blue
Portugal	Green
Spain	Green and blue (in specific cases)
UK	Green (including biomass gasification with CCUS), blue and pink

* Note: not all jurisdictions refer to the colours of hydrogen within their policies and, in these cases, the appropriate colour has been assigned for ease of comparison but this does not necessarily reflect published policy.

Finally, the pace of policy adoption and development of regulation differs according to jurisdiction. For example, France has adopted a national strategy which is supported by an underlying ordinance to provide the necessary regulatory framework and is underpinned by a funding commitment of around €9 billion by 2030. Germany has adopted a national strategy but is taking a step-by-step approach, focused initially on establishing an R&D strategy to encourage investment in the sector, whereas the Netherlands and the UK have already taken steps to introduce operating support schemes seeking to incentivise low carbon hydrogen production by increasing its competitiveness compared with the high carbon fuels. Italy has adopted Preliminary Guidelines on the National Strategy for the Development and Use of Hydrogen but is yet to set a national hydrogen strategy although one is expected soon.

Further details of policy and regulation is found in the relevant country annex to this guide.

EXISTING REGULATION: REFORMS TO THE REGULATORY LANDSCAPE FOR HYDROGEN

Scaling up the hydrogen economy requires an appropriate legal framework, which provides legal certainty for large and long-term investments. The existing regulatory framework for hydrogen is often fragmented and comprised within a diverse mix of law, regulation and codes ranging from environmental and health and safety laws to gas quality requirements. In many jurisdictions, law-makers are seeking to review and streamline existing rules applicable to hydrogen to facilitate the deployment of low carbon hydrogen. However, despite a proactive approach, regulatory reform is inevitably a slow process. As a result, developers and investors are bringing forward initiatives in the context of a changing legal environment.

Policy co-ordination will influence market development

In the EU, developments in many member states will be linked to harmonisation initiatives at the EU level. The European Commission's proposals of December 2021 for a Hydrogen and Decarbonised Gas Package, recasting (amongst other things) the Third Energy Package on natural gas, includes proposals relating to:

- the regulatory framework for hydrogen, with a special focus on hydrogen facilities (e.g. hydrogen pipelines, storage facilities and terminals) and activities (e.g. production, transport, supply and storage of hydrogen)
- integration and access of renewable and low carbon gases (including green hydrogen) to the existing gas network and
- creation of a new governance structure, the European Network of Network Operators for Hydrogen, to establish technical rules and promote the international coordination and interconnection among EU countries.

But local rules are developing in the interim

All jurisdictions are considering incentives for hydrogen production and the implementation of standards for low carbon hydrogen. For detailed analysis of related policy and regulation, please see the sections relating to production and standards of this guide.

In addition, reviews and reforms to the existing regulatory framework are underway in every market. For example:

- France, Italy, the Netherlands, Spain and the UK are considering or have passed changes to the **development and planning framework** for hydrogen production, distribution, transport or storage, to better accommodate electrolytic and low carbon hydrogen
- Italy, the Netherlands, Portugal, Spain and the UK are reviewing **technical standards** including limits on blending of hydrogen into existing natural gas networks
- France, Germany, the Netherlands and Portugal are considering **network access rules**, including unbundling of pure hydrogen gas grids and
- Germany and the Netherlands are considering market interventions to **stimulate hydrogen demand** in key use sectors such as industry (including the steel and chemical sectors) and transport.

Further details are found in the relevant country annex to this guide.

PRODUCTION: SCALING UP HYDROGEN PRODUCTION

Low carbon hydrogen production is a priority for all the jurisdictions reviewed in this guide. One of the key challenges, however, is the problem of growing hydrogen production capacity and demand simultaneously. On the one hand, the business case for producing low carbon hydrogen is limited by its comparatively higher production costs which means, without support, it cannot compete with the market prices offered for conventional, high carbon hydrogen or fuels. On the other, hydrogen users face limited volumes and higher prices for low carbon hydrogen, restricting demand development.

A supportive regulatory environment is essential for project development

Support for hydrogen production may take the form of financial or non-financial support. In addition to financial support (described further below), the importance of the policy and regulatory frameworks cannot be underestimated. Projects are underway in a number of the jurisdictions reviewed to ensure that the regulatory environment for hydrogen production is capable of delivering national targets, and does not pose a barrier to project or market development. New measures must integrate with the existing regulatory framework for hydrogen, which is also subject to review in a number of respects.

In the matrix below, we provide an overview of the regulatory environment for hydrogen production projects as at the date of publication. However, as noted in the section on existing regulation, the current regulatory framework is under review and reforms are proposed in many jurisdictions.

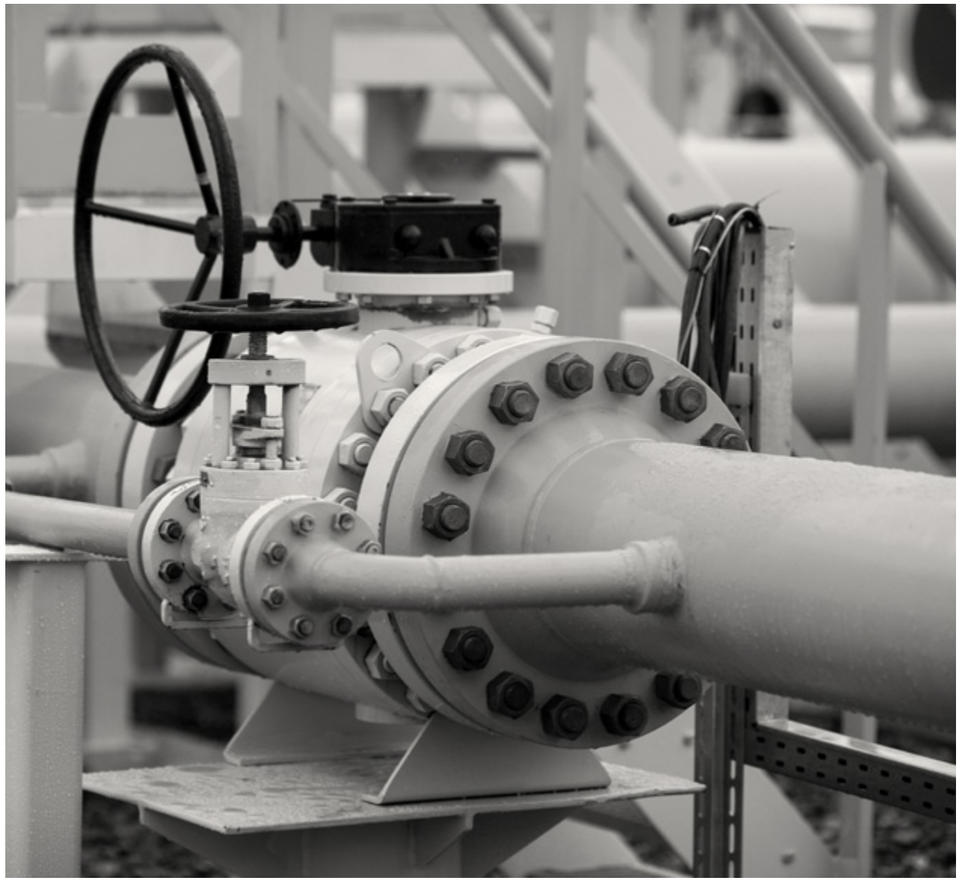


TABLE 2: HYDROGEN PRODUCTION: A REGULATORY OVERVIEW

	Production ambitions	Import target	Colour/s	Emissions intensity limit	Hydrogen Standard?	Development and planning regime	Production licence required?	Development support (e.g. grants)	Operating support - revenue	Operating support - other	Demand-side measures	Mitigation of project on project risk
France	6.5 GW of electrolytic hydrogen by 2030	(✗)	🟢🟣	(✓)	(✓)	✓	✗	✓	✓	✗	✗	✗
Germany	10 GW by 2030	(✗) No, but funding for non-EU projects available	🟢	✓ Zero	✓ Zero	✓ Onshore (✗) Offshore	✓	✓	✗	(✓)	✓	(✗)
Italy	5 GW by 2030	(✗)	🔵🟢	✓ Zero	✓ Zero	✓	✓	(✓)	(✓)	(✓)	✓	(✗)
The Netherlands	Green hydrogen: 500 MW by 2025; 3-4 GW by 2030; Blue hydrogen: 1.5-1.8 Mton by 2030	Until 2025: 0,1 – 0,2 Mton Until 2035: 1,5 - 3 Mton H_2 equivalent	🔵🟢	✗ in favour of EU regulation	✗ in favour of EU standard	✓ offshore & onshore	✗	✓	✓	✓	✓	✗
Portugal	2.5 GW by 2030	✗	🟢	✗	✗ will use EU standard	✓	✓	✓	(✗)	✗	✗	(✗)
Spain	4 GW of green hydrogen by 2030	✗	🟢	✓ Zero	✗ will use EU standard	(✓)	(✓)	✓	✗	(✓)	✗	✗
United Kingdom	10 GW by 2030 50% to be electrolytic	✗	🔵🟢🟣🔵	(✓)	✓	✓	✗	✓	(✓)	✗	✓	(✓)

Key

✗ No with regard to status quo ✓ Yes with regard to status quo ( ) means that measures are proposed or under development but are not yet in force

Frameworks for financial support for hydrogen production are crystallising

Governments have widely acknowledged the need for financial support for hydrogen production to overcome barriers to market development. Public funding, ranging from grants and tax exemptions, to operating support is available. However, the type of support available, the eligibility criteria and conditions of the support vary by jurisdiction. In addition, depending on the nature of the support, state aid or subsidy control approvals may be required. A summary of measures is found below, with more detailed information available in the country annex.

A. France

France's National Hydrogen Strategy aims for 6.5 GW of new-build, near zero hydrogen produced through electrolysis by 2030. This is to be supported by:

- a public support system for the production of electrolytic hydrogen that meets the required emissions threshold (still to be defined pending the adoption of a specific decree) in the form of operating support or a mix of operating support and "contracts for difference" to support investment, established under the Hydrogen Ordinance and
- Hydrogen IPCEI funding. France has selected 15 projects in the industrial sector, including a significant number aimed at the mass production of low carbon hydrogen, as well as electrolyser manufacturing (amongst other projects).

B. Germany

Support in Germany is focused on green hydrogen through electrolysis, aiming for 10 GW by 2030. Funding is available:

- for German projects under the Hydrogen IPCEI which alone is expected to contribute more than 2 GW towards the 2030 target
- under an additional grant funding programme, Hydrogen Technologies 2030, which aims at accelerating research activities regarding the mass manufacturing of electrolysers (H2Giga) as well as the offshore production of hydrogen (H2Mare)
- of approximately €900 million for non-EU production projects for import into Germany under H2 Global. At least for an interim phase, these funds will also be available to offset the difference between the prices for foreign production and the domestic sale price, each price being established based on an auction mechanism and
- under an exemption for producers of green hydrogen from the obligation to pay the renewable energy levy, a general surcharge to the electricity price.

C. Italy

According to the Preliminary Guidelines, in order to implement the low-carbon hydrogen strategy in Italy, around €5-7 billion will be specifically allocated to hydrogen production investments.

Currently, support is available under the National Recovery and Resilience Plan, which provides for:

- €500 million for the redevelopment of brownfield sites for the production of hydrogen to be used for local transportation and industry
- €450 million for the start-up of a large industrial plant for the production of electrolysers with approximately 1 GW of electrolysis capacity by 2026 and the development of further technologies needed to support hydrogen end-use and
- €160 million of support for research and necessary legislative reforms to facilitate the production (as well as use, transport and distribution) of hydrogen.

D. The Netherlands

By 2030 the Netherlands is aiming for 3-4 GW of green hydrogen installed capacity and 1.5-1.8 Mton of blue hydrogen production. To achieve this support

schemes are in place and being extended for research into, scaling up and rolling out of hydrogen including:

- applied research and innovative pilot projects via subsidies under the MOOI (Mission-oriented Research, Development and Innovation), DEI+ (Energy Innovation Demonstration Scheme), and HER+ (renewable energy subsidy module)
- the extension of state aid under the Hydrogen IPCEI is being considered
- operating support for green hydrogen production is in place (open as of June 2022) via the SDE ++
- operating support scheme for blue hydrogen is in place via SDE++ (subsidies of CCS)
- a temporary extra support scheme is under consideration for construction of electrolyser capacity with a reserved budget of €250 million (in addition to the current SDE++, DEI+ and HER+) and
- other support is also under consideration such as linking the development of offshore wind energy and hydrogen and introducing a blending obligation.

E. Portugal

The National Hydrogen Plan (Plan) sets out various incentive and funding measures applicable to production projects. Support includes:

- an initial partial or total exemption from payment of the tariff for hydrogen projects to access the distribution or transmission gas grid
- operating support aimed at funding the difference between the energy source which will be replaced – i.e. natural gas – and the initial production cost of green hydrogen via a variable premium on top of the price of natural gas to reflect the additional cost of green hydrogen, so that the additional cost of green hydrogen production is not reflected in the price paid by users
- preferential tax treatment of hydrogen production plant operators and
- proposals for grants or incentives for hydrogen production, such as creation of a financial mechanism to support hydrogen selling prices.

In addition, the Portuguese Recovery and Resilience Plan (PRRP) approved by the European Commission provides for investment of €185 million in the hydrogen and renewable gases sector, available for a variety of projects, including projects for the production of green hydrogen using electrolysis.

F. Spain

Public support will be available under the PERTE ERHA scheme, with up to €1.5 billion of funding available, a significant proportion of which is for green hydrogen projects. The PERTE ERHA funds will be awarded from 2023 to 2026 through incentive programmes including the following (note applications to these closed 7 June 2022):

- Incentive Program 1 – €30 million in grants and public subsidies for innovation in the hydrogen value chain, with a special focus on the development of manufacture capacity of hydrogen equipment
- Incentive Program 3 - €100 million in grants and public subsidies for large-scale hydrogen production through electrolysis (open to projects with electrolysis capacity higher than 20MW) and
- Incentive Program 4 - €40 million in grants and public subsidies for innovation in the hydrogen value chain, with a special focus on research, development and innovation activities.

G. UK

The UK is aiming for 10 GW of hydrogen production capacity by 2030, with at least half of this to be from electrolytic hydrogen. Existing and proposed support for hydrogen production has been summarised in the Hydrogen Investor Roadmap and comprises:

- grant funding of up to £240 million under the Net Zero Hydrogen Fund
- operating support under a new hydrogen business model, part of the Industrial Decarbonisation and Hydrogen Revenue Support (IDHRS) scheme. Bilateral contracts for difference are proposed for:
  - new build blue hydrogen production facilities
  - the retrofitting of existing, grey hydrogen production capacity with carbon capture capability and
  - new build electrolytic hydrogen production facilities.
- the Renewable Transport Fuel Obligation (RTFO), a quota scheme with tradable certificates aimed at reducing emissions in the transport sector and
- a range of innovation funding is being made available under a number of schemes forming part of the Net Zero Innovation Portfolio and the Industrial Energy Transformation Fund.

H. EU

Support will also be available from the EU from different sources and programmes included in the Hydrogen Public Funding Compass (e.g. NextGenerationEU, Horizon Europe, Innovation Fund, InvestEU, etc.) to support the development of green and low carbon hydrogen projects across the hydrogen value chain within the EU.

In addition, the proposal for the revision of the Energy Taxation Directive 2003/96/EC (currently in the process of approval) aims to promote the production and consumption of green and other low carbon hydrogen by establishing a minimum tax rate of €0.15/GJ which will be applicable both to green hydrogen and, for a 10 year transitional period, to other low carbon hydrogen used in motor fuels. This is a more favourable tax rate than that applicable to conventional fossil fuels which, by way of comparison, are proposed to be subject to the highest minimum rate of €10.75/GJ when used as a motor fuel.

What is the Hydrogen IPCEI?

Important Projects of Common European Interest (or IPCEIs) address market failures or other important systematic failures in the EU. Projects spanning the entire low carbon hydrogen value chain (production, storage, transmission, distribution and industrial applications) may become Hydrogen IPCEIs. A project must ordinarily involve at least four EU member states and its benefits must extend to a wider part of the EU. Projects declared as IPCEIs are more likely to receive state aid and may be subject to a simplified notification process as common requirements for the grant of state aid (such as the existence of a market failure) will have already been recognised in relation to these projects.

To date, EU member states have selected national projects and these are currently subject to a matchmaking process to develop a coherent overall package that will then be notified to the European Commission. Assessment of the first Hydrogen IPCEIs will be completed in summer 2022.

A comparison of existing and proposed financial support measures to stimulate low carbon hydrogen production in the key markets reviewed is found to the right.

TABLE 3: HYDROGEN PRODUCTION FINANCIAL SUPPORT OVERVIEW

	France	Germany	Italy	The Netherlands	Portugal	Spain	UK
Nature of existing support (open to applications)	IPCEI funding	Grant funding for domestic and international projects IPCEI funding Tax/levy exemptions	Grants IPCEI funding	Grants Operating support for blue H_2 under SDE ++ (CCS) Operating support for green hydrogen under SDE++ IPCEI funding	Grants	Grants IPCEI funding	Grants Quota scheme under the RTFO Operating support for blue hydrogen
Proposed support (not yet open to applications)	Operating support and "contracts for difference"	Operating support for domestic projects	Operating support for domestic projects	A temporary additional support scheme aimed at increasing hydrogen production from new-build electrolysers (*Tijdelijke opschalingsregeling Waterstof via Elektrolyse*) Extension of IPCEI funding Tax/levy exemptions	Full or partial exemption from gas grid connection fees Operating support Tax incentives Grants	Tax/levy incentives	Operating support for electrolytic hydrogen
Production methods supported	Mainly electrolytic hydrogen	Green electrolytic hydrogen	All low carbon hydrogen production methods	Green electrolytic hydrogen Blue hydrogen (CCS)	Under development, but with a special focus on electrolysis	Under development, but with a special focus on green electrolytic hydrogen	All low carbon hydrogen production methods
New-build or retro-fit?	New-build	New-build	New-build and retro-fit	New-build and retro-fit	New-build	New-build	New-build and retro-fit

STANDARDS: NAVIGATING EMERGING HYDROGEN STANDARDS

Whilst there are a number of voluntary hydrogen standards (e.g. CertifHy and TÜV SÜD), there is growing recognition that an international standard for low carbon hydrogen is required. However, this will take time to develop and for consensus to form. In the interim, we are seeing national and regional standards develop. Whilst policy-makers recognise the value of harmonisation, it is essential that this proliferation of standards does not create a barrier to the development of a global low carbon hydrogen economy. In this section, we consider proposals for low carbon hydrogen standards both nationally and at the EU level.

Initially national approaches are being developed

With many EU member states actively engaged in developing both national and international hydrogen markets – for example, the Netherlands is setting up a HyXchange, and Germany is developing the H2Global initiative – the need for clear standards is widely recognised.

However, whilst EU-wide standards are under development (see further below), most countries are requiring evidence of the low carbon quality of hydrogen in order for hydrogen projects to be eligible for public grants or public funding. Two main approaches may be discerned (used separately or in combination):

1. Reference to the carbon emissions intensity of the hydrogen produced; and/or
2. Reference to the production methods and the source of energy used.

These requirements may be imposed either in a national hydrogen standard or as part of the eligibility criteria within the application process for a public support regime.

For example, the Spanish RTR Plan includes a requirement that the electricity used by a hydrogen producer must be of renewable origin, and that the supply of electricity to the hydrogen producer must be carried out through direct lines or through long-term PPAs with electricity sourced from newly commissioned generation projects.

By contrast, in France a CO_2 emissions threshold is proposed rather than the qualification of product as low carbon being based on the source of electricity used. It should be noted, however, that the threshold is expected to be met by production using grid electricity, as the generation mix in France is dominated by nuclear power. Similarly, the UK Low Carbon Hydrogen Standard requires that hydrogen production meets an emissions threshold of 20gCO_2e/MJ(Lower Heating Value) in order to be considered low carbon.

Where a national standard is proposed, the purpose of the standard, production methods permitted and application differs by jurisdiction. A summary of approaches used or under development is found below.

TABLE 4: EMERGING HYDROGEN STANDARDS IN FRANCE, GERMANY, SPAIN AND THE UK

	Purpose	Technology restrictions?	When applied?	Applicable to imports?	In use?
France	Eligibility requirement for public support or government grants	Technology neutral	At point of production	Yes, guarantees of origin issued by EU countries will be recognised provided they comply with RED II requirements and are equivalent to the French framework	No Details awaited pending the adoption of specific decrees
Germany	Eligibility requirement for the exemption from payment of the renewable energy levy on electricity used for electrolysis (although the levy will be repealed on 1 July 2022)	Electrolysis using renewable energy	At point of production	No	Yes, but de facto expiry as of 1 July 2022
Spain	Fuel mix disclosure to demonstrate to final consumers the proportion of renewable-sourced gases	Electrolysis using renewable energy	At point of production	Yes, guarantees of origin issued by EU countries will be recognised provided they comply with RED II requirements	No Details awaited pending adoption of specific decrees
UK	Eligibility requirement for public grants or revenue support	Technology neutral	At point of production	Not currently but guarantee of origin scheme to be established by 2025	Yes, draft already in use for grant eligibility

Whilst the emergence of standards and eligibility requirements are necessary to ensure that public funds are channelled towards projects and businesses which will support carbon reduction commitments, policy-makers need to ensure that the multiplicity of standards and requirements do not jeopardise the emergence of global trade in hydrogen.

The EU will play an important role in the longer term in establishing a regional standard

Currently, there are no clear rules in force at the EU level specifying which standards and requirements must be met by hydrogen producers in order for their hydrogen output to qualify as "renewable" or "low-carbon". However, work is underway to define the qualities of both low carbon and green hydrogen.

The proposal for an EU directive on common rules for the internal markets in renewable and natural gases and in hydrogen (COM/2021/803 final) of 15 December 2021, part of the Hydrogen and Decarbonised Gas Package, defines low-carbon hydrogen as "hydrogen the energy content of which is derived from non-renewable sources, which meets a greenhouse gas emission reduction threshold of 70%". This is intended to apply both to hydrogen produced in the EU and to imports.

In relation to green hydrogen, article 27 of RED II currently outlines the requirements for renewable fuels of non-biological origin to count towards the target for a minimum share of renewable energy within the transport sector. RED II provides that only electricity obtained from direct connection to a renewable generation plant may count as renewable transport fuel unless it can be demonstrated that the grid-derived electricity is from purely renewable sources and is claimed only once and only in one end use sector. The European Commission is currently consulting on a delegated act to clarify and further develop these rules (see box to the right). Although under the proposals many of the requirements would not come into force until 2027, some industry players consider these requirements as controversial, highlighting the risk that they may inhibit the development of a green hydrogen market in the EU.

Focus on the draft delegated act relating to article 27 RED II

Key points which industry will need to engage on in relation to the European Commission consultation include whether the renewable electricity used by the hydrogen production facility must be generated by a generation facility commissioned no earlier than 36 months before the hydrogen production plant (the additionality principle). Also, where a hydrogen production facility is using renewable electricity via the grid, whether the requirement for a temporal and geographical correlation between the electricity generated and the hydrogen produced is appropriate. By contrast, it is notable that the UK Low Carbon Hydrogen Standard does not include any equivalent additionality requirement.

In July 2021, in the context of the Fit for 55 Package to update the EU's commitments to align with the EU's climate target for 2030, the European Commission proposed amendments to RED II (COM (2021) 557 final). Although these are still undergoing the approval process, if adopted, the changes would mean the provisions on the calculation of renewable fuels of non-biological origin produced from electricity apply regardless of the sector in which such fuels are consumed. Adoption is expected by the end of 2022, and the proposals may be seen as paving the way for an EU green hydrogen standard.

Article 19 of RED II also includes provisions regarding the establishment of a guarantee of origin scheme for the purposes of demonstrating to end consumers the share or energy from renewable sources in a supplier's energy mix. Guarantees of origin with respect to renewable electricity have been established in many countries (including the UK) for a number of years. As mentioned above, some EU member states, such as France and Spain, are however now extending these rules to cover renewable gases, including green hydrogen. RED II also provides for mutual recognition of guarantees of origin, as between EU member states.

Separately, the Climate Delegated Act (2021/2139 of 4 June 2021) approved by the European Commission in the context of the EU Taxonomy Regulation – intended to provide investors with tools to assess which economic activities should be deemed as "sustainable" – provides greenhouse gas thresholds in connection with hydrogen production and other hydrogen-related activities.

It is expected that further work will be undertaken to align and streamline the different definitions of low carbon and green hydrogen amongst EU member states. In the meantime, industry must navigate the patchwork of requirements applicable in the relevant jurisdiction. For first movers making early investments according to national requirements, there may be a risk if more stringent regional standards are introduced without appropriate transition or grandfathering provisions.

INFRASTRUCTURE: THE NEED FOR HYDROGEN INFRASTRUCTURE

Scale up of production and demand for low carbon hydrogen is required prior to the roll out of significant hydrogen infrastructure. As a result, policy and regulatory progress towards hydrogen storage and transport networks is generally less well developed in all jurisdictions. However strategic network planning is underway in all jurisdictions.

At the national level, the development of hydrogen transport networks and storage is expected to rise up in the policy priorities at a later stage, once production volumes increase. However, security of supply concerns have re-focused efforts to consider national infrastructure requirements and to coordinate cross-border hydrogen infrastructure in order to meet revised targets.

A summary of measures to stimulate low carbon hydrogen storage and distribution in key markets is found below. Please see the country annex for further details.

France	**Goal? No** The Government is authorized to make an ordinance relating to the regulation of the underground storage of hydrogen and to organise tenders relating to the development of hydrogen storage. France has adopted a framework for the injection of hydrogen in the existing gas grid, and has made government grants available in the context of the Hydrogen IPCEI.
Germany	**Goal? Under consideration** Projects identified under the Hydrogen IPCEI include establishing a pure hydrogen grid network of approximately 1,200 km (a so called “starter network”). In addition, government funded research is exploring different hydrogen transport options as part of the TransHyDE project including high-pressure vessels, existing gas pipelines, ammonia-bound transport and liquid organic hydrogen carriers. A new regulatory framework for the development of pure hydrogen grids has been adopted.
Italy	**Goal? Under consideration** To date, the NRRP provides for a €300 million investment in the railway sector, which includes the development of high capacity storage systems with the possibility of using metal hydrides or liquids, and a €160 million investment to improve knowledge of hydrogen-related technology for the production, storage and distribution.

The Netherlands	**Goal? Yes – four caverns for hydrogen storage to be developed before 2030 (the first as early as 2026)** In addition to hydrogen storage, the Government is also reviewing together with the Dutch transmission system operators Gasunie (gas) and TenneT (electricity), whether and under what conditions part of the gas network might be used for the transport and distribution of hydrogen. Preparations for the national hydrogen backbone have started and a budget of €750 million has been reserved. However, pilot projects will require a temporary amendment of the Gas Act as currently hydrogen is not defined as a gas regulated by the Act, and so system operators are not entitled to transport hydrogen using the current gas networks. The Netherlands has the ambition of becoming a hydrogen hub. A national hydrogen backbone is planned to connect regional backbones with large clusters of industrial consumers, port facilities, storage facilities and grids, both within and also outside the Netherlands. International co-operation will be intensified.
Portugal	**Goal? Yes – for gas grid blending:** • 2025: 1% - 5% • 2030: 10% - 15% • 2040: 40% - 50% • 2050: 75% - 80% The PT H2 Plan includes a tentative plan for auctions of production rights to inject hydrogen into the existing gas grids. The new Gas Distribution Grids' Regulation provides a regulatory framework for the operation of gas grids using 100% natural gas or 100% renewable-source or low carbon gases (such as biomethane and low carbon hydrogen). Support is available under the Environmental Fund (which supports projects that contribute to environmental public policies) and the Supporting Innovation Fund (which supports technological development and investments into renewable energy and efficient energy use) may cover storage and distribution costs. Where storage and distribution costs are necessary for the production of green hydrogen, these costs are covered by the Scheme of Incentives to Support the Production of Green Hydrogen and Other Renewable Gases.
Spain	**Goal? No** The Spanish Government is considering development and innovation in relation to hydrogen storage (both liquid and gas), distribution and direct supply to consumers or other users (such as road transport vehicles) through hydrogen re-fuelling stations. The Spanish Hydrogen Roadmap also aims to review the technical rules applicable to natural gas infrastructure to allow a higher blending of hydrogen within the gas system. Support will be initially focused on low-scale storage and distribution facilities as green hydrogen production will be primarily located within areas with industry or transport.

UK	**Goal? Under consideration** A number of pilot projects are underway to explore hydrogen infrastructure requirements (e.g. Project Union, H21 and Future Grid). The cost of small scale hydrogen transport and storage infrastructure may be recovered by production projects under the operating support regime proposed. Large-scale hydrogen storage requirements are also under review. New business models for hydrogen transportation and storage will be developed by 2025, to be in place by 2030. Decisions on blending up to 20 per cent hydrogen into the natural gas grid will be taken by the end of 2023.
EU	**Goal? No** The revision of the TEN-E regulation, which sets guidelines for cross border energy networks, includes a new focus on hydrogen networks (new and repurposed) and ensures that these are included in ENTSO-G's ten-year network development plans. The revision also includes hydrogen infrastructure within the categories eligible for support, principally through PCIs that are eligible for financing from the Connecting Europe Facility for 2021-2027. As part of the REPowerEU Plan, the European Commission announced plans to support the development of three major hydrogen import corridors via the Mediterranean, the North Sea area and, as soon as conditions allow, with Ukraine. The Iberian Peninsula was also highlighted as having potential in the long term as a production hub and import point from North Africa. An infrastructure needs assessment is expected to conclude by March 2023.

END USES: HYDROGEN USES ACROSS ALL SECTORS OF THE EUROPEAN ECONOMY

Most countries have focused on using hydrogen across a number of sectors, most commonly industry, transport, heat and power. Despite the high level similarities, the strategies of each country diverge in terms of specific industries and the level of maturity that is expected to be achieved from the hydrogen infrastructure by 2030.

FIGURE 2: CURRENT PRIMARY SECTORAL FOCUS FOR LOW CARBON HYDROGEN USAGE BY JURISDICTION

France	Germany	Italy	The Netherlands	Portugal	Spain	UK
Industry	Industry	Industry	Industry	Industry	Industry	Industry
Transport	Transport	Transport	Transport	Transport	Transport	Transport
		Heat	Ports		Power	Heat

The focus on particular sectors is driven largely by each country's economy. For example: Germany has a strong focus on road transport as well as the chemicals and steel industries, the Netherlands is developing hydrogen hubs, France and Italy are researching the use of hydrogen in rail transport that has not been electrified, and the UK is considering plans to blend hydrogen into its already extensive gas network. Each of these sectors present their own challenges in relation to incorporating hydrogen and countries are adopting various levels of ambition (whether that be demonstration projects or a full-scale rollout).

Below, we highlight some of the commonalities and areas of divergence in national approaches to hydrogen use cases in the jurisdictions reviewed. Further details of measures applicable in each country may be found in the country annex.

Industry

Italy, the Netherlands, Portugal, Spain and the UK are promoting the development of industrial clusters, siting low carbon hydrogen production close to end users. Both the Netherlands and the UK are also supporting blue hydrogen production, and so these industrial clusters will also be connected to a CO_2 transport and storage network. The number of industrial clusters may increase following the adoption and implementation of the European Commission's REPowerEU Plan, which envisages funding to double the number of so called 'hydrogen valleys'.

Stimulation of demand in industry is particularly supported via the Hydrogen IPCEI. In France, sites such as an ArcelorMittal steel factory in Dunkerque or a Vicat cement site, will be used to trial the adoption of low carbon hydrogen. Similarly in Germany, 16 of the German projects under the Hydrogen IPCEI are focused on low carbon steel production and hydrogen transformation in the chemical industry.

The REPowerEU Plan and the EU Hydrogen Strategy envisage innovation funding and the roll-out of carbon contracts for difference to support hydrogen fuel-switching in industrial processes. The carbon CfD would pay the difference between the CO_2 strike price and the actual CO_2 price under the EU Emissions Trading System, bridging the cost gap compared to conventional hydrogen production.

Germany and Portugal are currently considering specific industrial sub-sector support and market intervention. For example, in Germany the introduction of a demand quota for green steel is being discussed.

Transport

Due to the target of 14% of renewable transport fuels in consumption by 2030 under RED II, all countries (including the UK due to historic EU membership) are stimulating the adoption of renewable transport fuels, with many having adopted a sub-target for renewable transport fuels of non-biological origin (including electrolytic green hydrogen). As noted in the section on standards, an EU delegated act is currently subject to consultation to establish the criteria for electricity used in green hydrogen production in order for the hydrogen to be classified as a 'renewable transport fuel' and counted towards these targets by EU member states.

In July 2021, as part of the FiT for 55 Package, the European Commission published a proposal (COM(2021) 557 final) amending article 25 of RED II to provide

for a greenhouse gas intensity reduction target of at least 13 % by 2030 compared to a baseline. Fuel suppliers will demonstrate compliance with this obligation by the surrender of tradable credits. Some jurisdictions propose to exceed the RED II requirements. For example, Germany and France have set their national targets at the higher level of 25% by 2030 and 28% by 2030 respectively. As part of the REPowerEU Plan and the EU Hydrogen Strategy, the European Commission is currently consulting on a delegated act to establish a methodology for assessing greenhouse gas emissions savings from renewable liquid and gaseous transport fuels of non-biological origin and savings from recycled carbon fuels.

The use of low carbon hydrogen is envisaged in all jurisdictions in road transport, particularly for heavy goods vehicles, with measures focused on the development of fuel cell technology, vehicles and re-fuelling stations underway. Support for projects is expected to be available via the Hydrogen IPCEI as well as via certificate trading, which is already in place in the UK and may be established pursuant to RED II proposals (as noted above).

Hydrogen will play a role in other transport sub-sectors, although the extent of that role is overall less clear. Initiatives are underway in many countries to trial hydrogen in aviation, maritime and rail. For example, the Netherlands has negotiated an aviation sector commitment to reach 14% blending of sustainable fuels in the sector by 2030 and 100% by 2050 (although this is still in draft form), whilst France and Italy have launched initiatives focused on using low carbon hydrogen in the rail sector, where electrification is not feasible.

Heat in buildings

The Netherlands and the UK have the greatest focus on hydrogen in the heating sector of the countries reviewed. However, the ambition here is longer-term, and the focus in the next decade will be on understanding the viability of hydrogen as a heating fuel through a variety of demonstration projects.

Power

The potential role of low carbon hydrogen in the power sector has been acknowledged within the hydrogen strategies of the Netherlands, Spain and the UK. It has potential to provide valuable system flexibility services either as firm, dispatchable generation or by acting as long-duration storage. However, the contribution of hydrogen in the power sector is still being explored. As a result, many jurisdictions will be trialling power-related pilot schemes during the 2020s and exploring the implications of hydrogen blending. This use case is likely to scale up however in the 2030s.

Agriculture

Despite the potential for hydrogen to contribute to low carbon ammonia production and agricultural transport vehicles, agriculture is a sector omitted from many countries' strategies. The use of low carbon hydrogen in agriculture forms part of the Netherlands' Hydrogen strategy, and support schemes for pilot projects have been launched for the sector, however no concrete targets are set out in the NWP. For information regarding fuel switching in transport (including agricultural vehicles), please refer to the transport section above.

GLOSSARY

BEIS	The UK Government Department for Business, Energy & Industrial Strategy
CCS	Carbon Capture and Storage
CCUS	Carbon Capture, Usage and Storage
CfD	Contract for Difference
Directive 2009/73/EC	Directive 2009/73/EC of the European Parliament and of the Council of 13 July 2009 concerning common rules for the internal market in natural gas and repealing Directive 2003/55/EC
EC Regulation 715/2009	Regulation (EC) No 715/2009 of the European Parliament and of the Council of 13 July 2009 on conditions for access to the natural gas transmission networks and repealing Regulation (EC) No 1775/2005
Energy Taxation Directive	Council Directive 2003/96/EC of 27 October 2003 restructuring the Union framework for the taxation of energy products and electricity
ERSE	Portuguese Energy Services Regulator
EU	European Union
EU Hydrogen and Decarbonised Gas Package	The European Commission's proposals of December 2021 for recasting (amongst other things) the Third Energy Package on natural gas
EU Hydrogen Strategy	Communication from the European Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: A hydrogen strategy for a climate-neutral Europe (COM/2020/301 final), 8 July 2020

EU Energy System Integration Strategy	Communication from the European Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: Powering a climate-neutral economy: An EU Strategy for Energy System Integration (COM/2020/299 final), 8 July 2020
Fit for 55 Package	Communication from the European Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions 'Fit for 55': delivering the EU's 2030 Climate Target on the way to climate neutrality (COM(2021) 550 final)
Hydrogen IPCEI	Important projects of common European interest for hydrogen, being projects which may represent a very important contribution to economic growth, jobs and competitiveness for the EU industry and economy
NWP	The Dutch National Hydrogen Program (*Nationaal Waterstof Programma*)
REPowerEU	REPowerEU Plan European Commission (COM(2022) 230 final), Brussels, 18 May 2022

PERTE ERHA	Strategic Projects for the Recovery and Economic Transformation of Renewable Energies, Renewable Hydrogen and Storage (*Proyectos Estratégicos para la Recuperación y Transformación Económica de Energías Renovables, Hidrógeno Renovable y Almacenamiento*), approved by the Spanish Government on 14 December 2021
PNEC	The Portuguese National Plan for Energy and Climate 2020-2030
PRRP	Portuguese National Recovery and Resilience Plan (*Plano de Recuperação e Resiliência*) approved by the Portuguese Government
PT H2 Plan	The Portuguese National Hydrogen Plan, enacted by Council of Ministers' Resolution 63/2020, of 14 August 2020
SDE++	Dutch support scheme for renewable energy (*Subsidieregeling Duurzame Energie++*)
SMR	Steam Methane Reformation

Spanish Hydrogen Roadmap	The Spanish Hydrogen Roadmap: a commitment to renewable hydrogen (*Hoja de Ruta del Hidrógeno: una apuesta por el hidrógeno emovable*), published in October 2020
Spanish RTR Plan	The Recovery, Transformation and Resilience Plan (*Plan de Recuperación, Transformación y Resiliencia*) approved by the Spanish Government in the context of Regulation (EU) 2021/241 of the European Parliament and of the Council of 12 February 2021 establishing the Recovery and Resilience Facility
RED II	Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources
Regulation 715/2009	Regulation (EC) No 715/2009 of the European Parliament and of the Council of 13 July 2009 on conditions for access to the natural gas transmission networks and repealing Regulation (EC) No 1775/2005

RTFO	The UK Renewable Transport Fuel Obligation established pursuant to the Renewable Transport Fuel Obligations Order 2007, as amended, a quota scheme coupled with tradable certificates for renewable transport fuels
TEN-E	The Trans-European Network for Energy Regulation (EU) No 347/2013 of the European Parliament and of the Council of 17 April 2013 on guidelines for trans-European energy infrastructure
Third Energy Package	Directive 2009/73/EC and EC Regulation 715/2009
T&S	Transport and Storage

CONTACTS

BonelliErede

GIORGIO FRASCA
Partner
Rome
+39 06 845511
giorgio.frasca@belex.com

GIOVANNA ZAGARIA
Senior Counsel
Rome
+39 06 845511
giovanna.zagaria@belex.com

LORENZO TRINGALI
Associate
Rome
+39 06 845511
lorenzo.tringali@belex.com

Bredin Prat

BARTHÉLÉMY COURTEAULT
Partner
Paris
+33 1 44 35 35 35
barthelemycourteault@bredinprat.com

YANN AGUILA
Partner
Paris
+33 1 44 35 35 35
yannaguila@bredinprat.com

GUILLAUME FROGER
Counsel
Paris
+33 1 44 35 35 35
guillaumefroger@bredinprat.com

De Brauw Blackstone Westbroek

ARJAN KLEINHOUT
Partner
Amsterdam
+31 20 577 13 48
arjan.kleinhout@debrauw.com

MENNO STOFFER
Partner
Amsterdam
+31 20 577 1601
menno.stoffer@debrauw.com

DIEDERIK MAESSEN
Counsel
Amsterdam
+31 20 577 1329
diederik.maessen@debrauw.com

Hengeler Mueller

JAN D. BONHAGE
Partner
Berlin
+49 30 20374 173
jan.bonhage@hengeler.com

SEBASTIAN SCHNEIDER
Partner
Frankfurt am Main
+49 69 17095 120
sebastian.schneider@hengeler.com

MORITZ RADEMACHER
Counsel
Dusseldorf
+49 211 8304 789
moritz.rademacher@hengeler.com

Slaughter and May

MIKE CORBETT
Partner
London
+44 (0)20 7090 3431
michael.corbett@slaughterandmay.com

OLIVER MOIR
Partner
London
+44 (0)20 7090 3307
oliver.moir@slaughterandmay.com

KATHRYN EMMETT
PSL Counsel
London
+44 (0)20 7090 4640
kathryn.emmett@slaughterandmay.com

Uria Menéndez - Portugal

BERNARDO AYALA
Partner
Lisbon
+351 210 308 613
bernardo.ayala@uria.com

JOÃO LOURO E COSTA
Counsel
Lisbon
+351 210 308 613
joao.lourocosta@uria.com

JILL DE SOET PALMEIRO
Junior Associate
Lisbon
+351 210 920 171
jill.soetpalmeiro@uria.com

Uria Menéndez - Spain

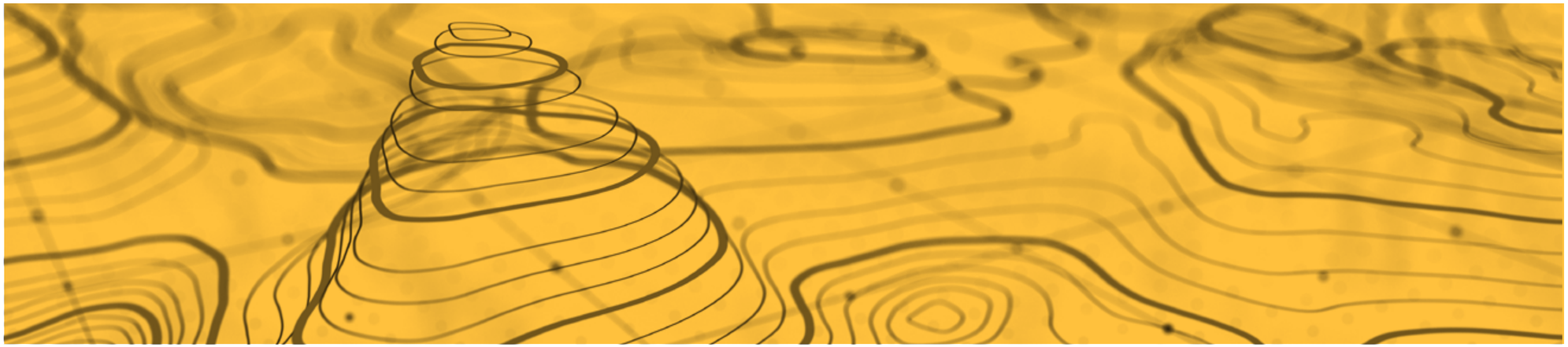
JUAN IGNACIO GONZÁLEZ RUIZ
Partner
Madrid
+34 91 586 03 81
juan.gonzalezruiz@uria.com

IGNACIO ÁLVAREZ COUSO
Partner
Madrid
+34 91 586 05 48
ignacio.alvarez@uria.com

JOSÉ MIGUEL EGEA ADÁN
Senior Associate
Madrid
+34 91 586 07 91
josemiguel.egea@uria.com

CONTENTS
FOREWORD
KEY TAKEAWAYS
INTRODUCTION
POLICY OVERVIEW
EXISTING REGULATION
PRODUCTION
STANDARDS
INFRASTRUCTURE
END USES
GLOSSARY
CONTACTS
COUNTRY ANNEX

COUNTRY ANNEX



EU

EU Hydrogen Strategy and policy overview

The EU is aiming to develop its hydrogen industry in a step-by-step strategic approach as described in the EU Hydrogen Strategy. This plan establishes the following timeline for green hydrogen targets:

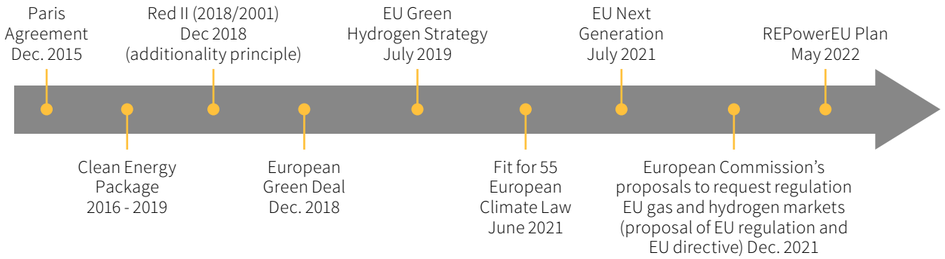
- Present – 2024: At least 6GW of installed capacity in electrolysers and production of up to 1M tonnes of green hydrogen.
- 2025 – 2030: At least 40GW of installed capacity in electrolysers and production of up to 10M tonnes of green hydrogen.
- 2030 – onwards: green hydrogen technologies will be fully implemented in all hard-to-decarbonise sectors.

The EU Hydrogen Strategy is one of the measures approved in connection with the European Green Deal, with the objective of delivering the EU climate targets:

- to reduce its net greenhouse gas emissions by 55% in 2030 (with regards to 1990 levels) and
- to achieve climate neutrality by 2050.

In December 2021, the European Commission adopted two legislative proposals (a proposed directive and a proposed regulation) that, when approved, will recast the Third Energy Package on natural gas to, among other objectives, support the development and integration of green hydrogen projects. In particular, they will provide a regulation for the decarbonisation of the gas and hydrogen markets and establish an internal market for hydrogen on similar terms to those applicable to the natural gas internal market.

The EU Hydrogen Strategy was further supplemented by the European Commission's REPowerEU Plan, which envisages 10M tonnes of domestic green hydrogen production and 10M tonnes of green hydrogen imports. The measures within the REPowerEU Plan are expected by to be fully implemented by 2030 in order to accelerate the EU's energy transition and energy independence from Russia.



Hydrogen support

As anticipated, support will be available under different programmes included in the Hydrogen Public Funding Compass (e.g. NextGeneration EU, Horizon Europe, Innovation Fund, InvestEU, etc.) to promote the development of green and low-carbon hydrogen projects at different stages of the value chain across the EU. In addition, financing support may also be obtained from the EU country funds, which are funding programmes available to each EU country where the relevant hydrogen project may be deployed.

Renewable hydrogen projects may also fall within the scope of Important Projects of Common European Interest, which address market failures or other important systematic failures. Production of green hydrogen, and storage and distribution projects have both been declared as IPCEIs.

The REPowerEU Plan and the EU Hydrogen Strategy envisage innovation funding and the roll-out of carbon contracts for difference to support hydrogen fuel-switching in industrial processes. The carbon CfD would pay the difference between the CO_2 strike price and the actual CO_2 price under the EU Emissions Trading System, bridging the cost gap compared to conventional hydrogen production.

Storage and transport

The revision of the TEN-E regulation was proposed by the European Commission on 15 December 2020. The TEN-E regulation sets guidelines for cross border energy networks. In relation to hydrogen, the revision includes a new focus on hydrogen networks (new and repurposed) and ensures that these are included in ENTSO-G's ten-year network development plans. The revision also includes hydrogen infrastructure within the categories eligible

for support, principally through PCIs that are eligible for financing from the Connecting Europe Facility for 2021-2027. Provisional agreement was reached by EU institutions in December 2021, paving the way for the regulation to be in place by 2023, providing a framework for greater coordination of hydrogen infrastructure between EU member states.

As part of the REPowerEU Plan, the European Commission announced plans to facilitate the import of up to 10M tonnes of renewable hydrogen, by supporting the development of three major hydrogen import corridors via the Mediterranean, the North Sea area and, as soon as conditions allow, with Ukraine. The Iberian Peninsula was also highlighted as having potential in the long term as a production hub and import point from North Africa. An infrastructure needs assessment is expected to conclude by March 2023.

Sector specific measures

The EU Hydrogen Strategy and the EU Strategy for Energy System Integration aim to promote the use of green hydrogen to decarbonise sectors that are hard to electrify (such as the transport sector and heavy industries) and as an alternative to electricity storage in the provision of flexibility services to electricity markets.

In particular, RED II includes an obligation for transport fuel suppliers to ensure that the quota of renewable energy consumed is at least equal to 14% of the total energy consumed in the transport sector by 2030. There is also a mandate for member states to ensure that greenhouse gas emissions savings due to the use of renewable liquids and gaseous fuels of non-biological origin in the transport sector are at least of 70% from 1 January 2021 (a revised version of RED II is in the process of being approved and such targets are expected to be updated and increased). Green hydrogen is expected to have a key role in the process of decarbonising the transport sector and so enabling the EU to achieve this goal.

FRANCE

Policy overview

The law n°2019-1147 dated 8 November 2019 relating to energy and climate (the **Energy-Climate Law**) aims for Renewable and Low-carbon Hydrogen (as defined below) to reach 20% to 40% of the total hydrogen and industrial hydrogen consumption by 2030.

The National Strategy for the development of carbon-free hydrogen in France (the **Hydrogen National Strategy**) published in September 2020 is aiming for 6.5GW of carbon-free hydrogen produced through water electrolysis by 2030. According to the Hydrogen National Strategy, €7 billion will be invested to meet these objectives by 2030. In November 2021, an additional €1.9 billion of financing for the Hydrogen National Strategy was announced in the context of the France 2030 investment plan.

The ordinance n°2021-167 dated 17 February 2021 relating to hydrogen (the **Hydrogen Ordinance**) established:

- a new and clarified hydrogen taxonomy
- a public support system for the production of Renewable and Low-carbon Hydrogen by water electrolysis in the form of financial operating support or a mix of operating support and financial support for investment
- guarantees of origin to certify the renewable or low-carbon nature of hydrogen and
- the framework within which the operators of natural gas grid must operate in the event of the injection of renewable energy into these systems.

Key regulatory reforms

The main areas of focus for regulatory reforms are electrolysis sector development, industrial decarbonisation, clean mobility development, R&D, skills development, hydrogen taxonomy, guarantees of origin, the use of the natural gas grid, and the public support system for green hydrogen.

Hydrogen standard?

France is developing a hydrogen standard to be applied at the point of production to all production methods that meet the required emissions threshold.

Renewable hydrogen is defined as hydrogen:

- produced exclusively using renewable energy sources
- produced by electrolysis (which most production will be overwhelmingly – if not exclusively – in practice) or using another technology allowing direct recovery (such as pyrogasification or thermolysis of biomass, steam reforming of biogas) and
- where the production process does not emit per kilogram of hydrogen produced a quantity of CO_2 emissions greater than or equal to a certain threshold (still to be defined pending the adoption of a specific decree).

Low-carbon hydrogen is defined as hydrogen where the production process generates emissions less than or equal to the same threshold, but which is not produced solely using renewable energy sources.

Meeting the standard is an eligibility requirement for projects and businesses seeking to benefit from the public support system.

Production

The Hydrogen National Strategy aims for 6.5GW of carbon-free hydrogen produced through water electrolysis by 2030.

The Hydrogen Ordinance established a public support system for the production of renewable and low-carbon hydrogen by water electrolysis in the form of financial operating support or a mix of operating support and financial support for investment. An implementing decree will specify the practical details of this state support, but the Hydrogen National Strategy states that it would take the form of a contract for difference scheme for the sale of hydrogen.

In the context of the Hydrogen IPCEI, France has selected 15 projects in the industrial sector for support. A significant number of these projects focus on the mass production of carbon-free hydrogen. The projects also focus on: the decarbonisation of industrial sites through the use of carbon-free hydrogen, the construction of key equipment gigafactories (such as electrolysers, fuel cells and storage tanks) and R&D.

Storage and transport

A number of regulations and government initiatives focus on storage and distribution.

The law n°2021-1104 dated 22 August 2021 (the **Climate and Resilience Law**) establishes the framework for calls for tenders relating to the development of hydrogen storage (Article 85 of the Climate and Resilience Law).

The Climate and Resilience Law authorised the Government to make an ordinance relating to the regulation of the underground storage of hydrogen (Article 81 of the Climate and Resilience Law).

A call for tenders regarding technological building blocks and hydrogen demonstrators will allocate €350 million until 2023 for projects developing or improving the distribution of hydrogen.

In the context of the Hydrogen IPCEI, projects selected by France focus on the construction of gigafactories to produce key equipment for the storage and distribution of hydrogen, such as fuel cells and storage tanks.

The Hydrogen Ordinance provides a framework for the injection of hydrogen into the existing gas grid, and states that if hydrogen is injected within the existing gas grid, gas grid operators must implement the necessary measures to ensure the proper functioning and balancing of the

grid, the continuity of the natural gas transmission and delivery service, and the safety of people and property (Article 2 of the Hydrogen Ordinance).

Sector specific measures

The Hydrogen National Strategy identifies several priorities:

Electrolysis

As previously mentioned, the Hydrogen National Strategy aims for France to reach 6.5GW of carbon-free hydrogen produced through water electrolysis by 2030. In this context, France wants to develop large capacity projects related to electrolysis technology in order to reach the industrial scale needed to achieve profitability.

As mentioned above, the public support system for the production of hydrogen will only be available for the production of hydrogen through water electrolysis, and several projects selected by France in the context the Hydrogen IPCEI focus on the production of hydrogen through electrolysis and the construction of electrolyser gigafactories.

Industry

The Hydrogen National Strategy also aims to replace carbon-intensive hydrogen by renewable or low-carbon hydrogen in order to decarbonise certain industrial processes and products in high carbon-emitting sectors such as steel, cement and petrochemicals. France supports several projects designed to decarbonise certain industrial sites through the Hydrogen IPCEI, such as an ArcelorMittal steel factory in Dunkerque or a Vicat cement site.

Mobility

The Hydrogen National Strategy made the development of clean mobility through the use of carbon-free hydrogen, in particular for heavy vehicles, one of its priorities. Hydrogen technologies also have the potential to provide an alternative to storage capacity in addition to electric batteries. Hydrogen has application in high engine power or long-distance vehicles, especially for captive fleets that travel long distances in light traffic flows, light commercial vehicles, lorries, buses, waste collection vehicles, and in regional or inter-regional trains in non-electrified areas of track.

The French Government believes that investing in this sector is essential because it is a very dynamic market which needs alternative technological solutions that provide greater autonomy than batteries. It also represents a major economic opportunity with an estimated annual turnover of €100 billion, and supports 225,000 jobs in the automotive manufacturing and equipment supply sectors. The state mainly supports the sector through the Hydrogen IPCEI by selecting projects relating to fuel cells for mobility, hydrogen vehicles or hydrogen trains.

R&D and skill development

The Hydrogen National Plan identified R&D and skills development as one of its three main priorities. R&D is supported through the Hydrogen IPCEI but also through a strong public framework and, in particular, the priority research programme on hydrogen applications that promotes upstream research and prepares the next generation of hydrogen technologies (batteries, tanks and electrolysers) with} a budget of €65 million. Skill development is also encouraged in order to support the development of hydrogen uses within French territory through the creation and conversion of jobs, as well as training courses.

GERMANY

Policy overview

Initially, Germany aimed for 5GW of electrolyser capacity by 2030 as outlined in the National Hydrogen Strategy adopted by the Federal Government on 10 June 2020. Following the general federal elections in September 2021, the political parties forming the new Federal Government agreed to raise the target to 10GW by 2030. However, none of these targets have legally binding effect.

Germany's hydrogen policy is based on direct funding of research and of specific projects, and shaping supportive market conditions by establishing a regulatory framework for hydrogen. A major part of the available funding (€8 billion) was awarded to 62 IPCEI projects covering the entire hydrogen value chain, from production to transport and use of hydrogen. All German projects under the Hydrogen IPCEI are still pending approval from the European Commission. With regards to market conditions, the legislative focus to date has been on reducing production costs of green hydrogen as well as implementing pure hydrogen network regulation. Recently, legislators have also started to address the conditions for offshore production of hydrogen.

Currently, an advisory group (**H2 Compass**) is identifying research and development needs, which will culminate in the Federal Government's roadmap for the further development of the German hydrogen market.

Key regulatory reforms

Although the regulatory framework is still fragmented, several basic regulations are already in place: licensing of hydrogen production installations (except for offshore electrolysis), standard requirements for hydrogen to qualify as green hydrogen, partial exemption / reduction of electricity taxes for hydrogen production, and voluntary opt-in

regulation for pure hydrogen grids covering unbundling rules, network access and high return on equity rates (9% for new assets, 7.73% for old assets). The overall framework will be revised in accordance with the EU's upcoming Hydrogen and Decarbonised Gas Package.

Further reforms are under discussion; in particular, a more comprehensive reform of taxes and levies on electricity used for electrolysis as well as market-specific instruments. Currently a CfD scheme to incentivise the carbon to hydrogen transition in industry is currently being prepared at the federal level. A green steel demand quota has also been discussed, but no specific legislative steps have been taken.

Hydrogen Standard?

Germany is developing a hydrogen standard for hydrogen produced by electrolysis from renewable energy. To meet the standard, the following requirements must be met:

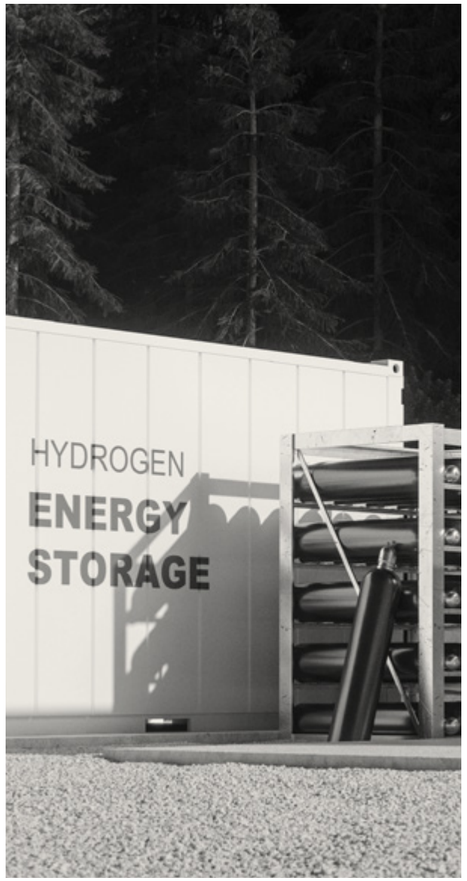
- start of operations prior to 1 January 2030
- connection to the grid via own metering point
- limited to first 5,000 used hours p.a. for electrochemical production of hydrogen and
- production from electricity sourced from renewable energy must not already be supported under another public support scheme.

This standard entitles the producer to an exemption from the payment of the renewable energy levy on electricity used for electrolysis. Although the repeal of this levy will take effect as of 1 July 2022, this may provide a precedent for the exemption/reduction of further levies and charges in respect of the electricity price or other benefits. This standard will eventually have to be aligned with EU requirements, once adopted.

Production

Regarding the production of hydrogen, support in Germany is focused on green hydrogen by way of electrolysis. The German projects under the Hydrogen IPCEI alone aim to contribute more than 2 GW to the overall capacity target of 10GW by 2030. An additional funding programme, known as Hydrogen Technologies 2030, aims at accelerating research activities regarding the mass manufacturing of electrolysers (**H2Giga**) as well as the offshore production of hydrogen (**H2Mare**). Another project, H2 Global, provides funding of approximately €900 million for non-EU production projects importing hydrogen to Germany (Germany will not be able to meet its future hydrogen demand with domestic production alone). At least for an interim phase, these funds will also be available to offset the difference between the price of foreign production and the domestic sale price, each price being established based on an auction mechanism.

The regulatory framework for hydrogen production in Germany consists of permit requirements and operational support. In 2021, the production of green hydrogen was exempted from the obligation to pay the renewable energy levy, which is a general surcharge on the electricity price. However, a comprehensive reform of the various levies on the electricity price to further reduce production costs for green hydrogen is yet been initiated. In addition, the Ordinance on Allocation of Other Energy Production Areas in the German Exclusive Economic Zone allows for assigning offshore areas for the practical testing of offshore hydrogen production, for which tender procedures are envisaged to start in 2022.



Storage and transport

Part of the funded IPCEI projects also cover the establishment of a pure hydrogen grid infrastructure of approximately 1,200 km. In addition, the German Government is funding research activities that explore hydrogen transport with a view to import conditions. The related project, TransHyDE, focuses on hydrogen transport in high-pressure vessels, in existing gas pipelines, bound in ammonia, and by means of liquid organic hydrogen carriers.

Apart from the support schemes, the legislature revised the German Energy Industry Act to provide grid operators with a basic regulatory framework incentivising the development of pure hydrogen grids, which can also include the conversion of former gas pipelines. The legislature chose not to merely extend the existing regulation of natural gas, but to introduce a separate regulation for hydrogen as a third energy category. The regulation is based on a voluntary opt-in and covers certain unbundling rules, network access and network fee regulation, including high returns on equity rates of 9% for new assets and 7.73% for old assets under a new Hydrogen Network Fee Ordinance.

Sector specific measures

Within the industry sector, 16 of the German projects under the Hydrogen IPCEI focus on low carbon steel production or hydrogen transformation in the chemical industry. In addition, the funding programme Decarbonisation of the Industry, which started in January 2021, incentivises the transition to green hydrogen. Another funding programme for climate protection contracts incentivises low greenhouse gas processes based on the concept of CfDs and is planned to start in 2022, with €3 billion available until 2024. This will have a particular focus on the steel industry. In addition, the introduction of a demand quota for green steel is also being discussed.

Interestingly, the German Government has been funding research activities for fuel cell technology since as early as 2006. In addition to multiple smaller initiatives, 12 projects under the Hydrogen IPCEI focus on developing fuel cell technology, hydrogen vehicles and hydrogen refuelling stations. The funding focuses on areas where electrification is not a viable option (such as for buses, trains, air, sea and heavy transport). Besides direct funding, further market incentives can be expected as a result of the EU greenhouse gas reduction ratio for renewable transport fuels. Germany is set at 25% by 2030, thereby exceeding the requirements of RED II.

In contrast to the chemical industry, the steel industry and certain areas of the transport sector, the German Government only sees limited potential for the use of hydrogen in the heating market.

ITALY

Policy overview

In 2021, the Italian Ministry of Economic Development issued the Preliminary Guidelines on the National Strategy for the Development and Use of Hydrogen (**Preliminary Guidelines**), which establish a primary role for hydrogen by calling for a "growth in the energy mix from the current <2% to 13–14% by 2050, with an estimated underlying electrolysis capacity of [500GW]" at the European level. This is because "hydrogen is in an exclusive position to contribute to national environmental objectives … especially if produced from renewable energy sources through electrolysis". As stated in the Preliminary Guidelines, a detailed Italian hydrogen strategy was expected to be published in 2021; however, the detailed Italian hydrogen strategy is still under discussion and has not yet been published (but it is expected soon).

Italy is aiming for 5GW of low carbon hydrogen capacity by 2030 as outlined in the Preliminary Guidelines. Italy plans to support a variety of production methods, including green and blue hydrogen. There is currently no definitive policy goal beyond 2030. However, the Preliminary Guidelines suggest that Italy could require up to 20% of overall energy demand to be met by hydrogen in 2050, and forecast that the long-term Italian strategy, once approved, will also set the Italian targets for 2050.

Key regulatory reforms

The legislative decree no. 199/2021 simplified the authorisation process for the construction and operation of electrolysers for hydrogen production. However, two main reforms are still expected: the first on the technical norms (such as production safety, transport and storage of hydrogen); and the second on measures to incentivise production and consumption.

Hydrogen Standard?

Italy has not (yet) formulated its own standard but is in favour of regulating this at the EU (or even international) level.

Production

According to the Preliminary Guidelines, in order to implement the low-carbon hydrogen strategy in Italy and to meet the hydrogen demand target, it is estimated that up to €10 billion of investment will be required between 2020 and 2030 (net of the investments in renewable projects). This amount includes a specific allocation for hydrogen production investments of around €5-7 billion.

The Italian National Energy and Climate Plan also provides for the promotion of the production and use of hydrogen generated from renewable electricity. At the time of writing, support is available under the National Recovery and Resilience Plan (NRRP), which allocates – among the €23 billion funding to promote and develop the green transition – a dedicated amount to support hydrogen production. In particular, the NRRP allocates:

- €500 million for the redevelopment of brownfield sites for the production of hydrogen to be used for local transportation and industry and
- €450 million for the start-up of a large industrial plant for the production of electrolysers with approximately 1GW of electrolysis capacity by 2026 and the development of further technologies needed to support hydrogen end-use (e.g. fuel cells for trucks).

In addition to the above, the NRRP supports research and promotes all necessary legislative reforms to facilitate the production (as well as use, transport, and distribution) of hydrogen with a dedicated amount of €160 million.

Storage and transport

According to the Preliminary Guidelines, investments in hydrogen distribution and consumption facilities expected are to be around €2-3 billion. To date, the NRRP provides for:

- a €300 million investment in the railway sector, which encompasses the development of high pressure electrolysers as well as high capacity storage systems with the possibility of using metal hydrides or liquids and
- a €160 million investment to improve knowledge of hydrogen-related technology for production, storage and distribution in order to increase competition and to gradually reduce costs.

Sector specific measures

Pending approval of a detailed hydrogen strategy, the Preliminary Guidelines identify sectors where green hydrogen is expected to become competitive in the short term, such as transport (in particular, trucks), rail and industry (specifically where hydrogen is already used as a raw material, e.g. in the chemical and oil refining sectors). Support for specific sectors is currently available under the NRRP as set out below.

Transportation

- The NRRP allocates €230 million to increase the use of hydrogen in road transport, promoting the creation of truck and car hydrogen re-fuelling stations, reaching at least 5-7% of the internal market by 2030. The development of approximately 40 refuelling stations is expected, giving priority to strategic areas for heavy goods vehicles (e.g. along highways, close to ports and near logistics terminals). The introduction of hydrogen as an energy carrier will require two reforms to:
- the technical norms (such as production safety, transport and storage of H_2) and
- measures to incentivize production and consumption.

Rail

The NRRP allocates €300 million for the conversion to hydrogen of non-electrified railway lines in regions characterised by high passenger traffic with high usage of diesel trains. The most advanced projects envisage this being done in an integrated manner, including the production and distribution of hydrogen and the procurement of hydrogen trains.

Hard-to-abate sectors

The NRRP allocates €2 billion for the transition towards zero emission green hydrogen in industries that are energy-intensive and hard-to-abate, such as steel mills and petroleum refining, as well as the chemical, concrete, glass and paper sectors.

Hydrogen valleys

The NRRP allocates €500 million for the redevelopment of brownfield sites for the production of hydrogen to be used for local transportation and industry. In this regard, the NRRP aims to create 10 hydrogen valleys (industrial areas whose economy is based partly on hydrogen) in order to promote, at the local level, the production and use of hydrogen in industry and transport. To minimise costs in the first phase, brownfield sites already connected to the electrical grid will be used to install electrolysers for hydrogen production using excess renewable electricity or dedicated renewable electricity production in the area.

THE NETHERLANDS

Policy overview

The Dutch Government's Hydrogen Strategy (March 2020) aims to scale up electrolysis to approximately 500 MW by 2025 and 3 to 4GW of installed capacity by 2030. As a result of cross-sector cooperation, a National Hydrogen Programme 2022-2025 (NWP) has been developed which provides further detail. The NWP forms part of the National Climate Agreement. For blue hydrogen, the NWP aims for 1.5-1.8 Mton of production by 2030. A goal beyond 2030 has not been specified, but hydrogen is seen as an indispensable part of the gas energy carriers that will be needed to provide at least 30% of Dutch energy consumption in order to achieve a climate-neutral energy supply and economy by 2050.

Key regulatory reforms

A number of general reforms will have implications for the hydrogen market in the Netherlands:

- on 1 January 2023, the Dutch Environment and Planning Act (*Omgevingswet*) is expected to enter into force and
- a draft for a new Energy Act has been prepared (internet consultation took place in 2021, but a formal proposal is yet to be introduced to Parliament). The proposal aims to replace the current Gas Act and Electricity Act 1998, implement new European regulations and give substance to agreements made in the Climate Accord of 2019. However, the provision on hydrogen projects (including the role of system operators) is subject to debate. Improvements to the (new) Energy Act are therefore still under consideration.

In relation to hydrogen specifically:

- a temporary additional support scheme of €250 million (separate from/complementary to support under the Stimulation of Sustainable Energy Production and Climate Transition Subsidy (SDE++) support scheme) is being developed aimed at increasing hydrogen production from new-build electrolysers (*Tijdelijke opschalingsregeling Waterstof via Elektrolyse*) and
- a number of reforms are under consideration but have not yet been enacted including in relation to taxation, a blending obligation for aviation, hydrogen transport infrastructure (a hydrogen backbone), market regulation and further implementation of RED II and III.

Hydrogen standard?

The Netherlands has not (yet) formulated its own standard but is in favour of regulating this at EU (or even international) level. In this respect, the Netherlands is part of the Pentalateral Forum (comprising Benelux, Germany, France, Austria and Switzerland) and, together with Austria, has taken the initiative to develop common approaches to critical issues such as standards, market incentives and market regulations ahead of the discussions at an EU level.

Furthermore, the Netherlands is committed to lobbying within the EU on amended definitions in the RED II that increase the opportunities for green hydrogen, responding to concerns that the current standards are too restrictive for the scaling up of green hydrogen.

However, the Dutch authorities have stipulated that green hydrogen is eligible under SDE++ subject to certain conditions including that the hydrogen is produced by a plant that produces hydrogen by electrolysis with a nominal capacity of at least 500 kW, and has a connection to the electricity grid or has a direct connection to an installation that produces renewable electricity (wind or solar).

Production

Hydrogen production in the Netherlands is focused on green and blue hydrogen, using large-scale electrolysers linked to wind or solar energy facilities or using production plants with CCS in the coastal regions.

The Government's first priority in the coming years is to reduce the production costs of clean hydrogen by upscaling production plants in so-called 'regional hydrogen clusters' (Port of Rotterdam area, Zeeland/Flanders and in the North of the Netherlands). Different support schemes are being introduced to facilitate this development.

Stimulating the production of blue hydrogen (e.g. the Porthos Project in the Port of Rotterdam area) will contribute to the emissions reductions needed by 2030 and also supports the accelerated development of green hydrogen.

The Government announced that the production of hydrogen and operation of electrolyser facilities should be reserved to private/commercial market parties and should not be open to transmission and distribution system operators (TSOs and DSOs) (unless only temporarily and if necessary). Precise locations of electrolysers will be chosen, on the basis of the guidance in the Main Energy Infrastructure Programme (*Programma Energiehoofdinfrastructuur*), by the Government in close consultation with industry. Key factors in determining the location will be the proximity to gas infrastructure, space for the electrolysers and the space for and capacity of electricity infrastructure.

The SDE++ support scheme, with a total budget for 2022 of €13 billion, provides operating support for hydrogen production projects in the Netherlands.

Overview of the SDE ++	SDE++ support scheme subsidizes the 'unprofitable component' in order to render a technology competitive. The 'unprofitable component' is the difference between the 'base rate' and the market value of the output generated by the technology in question (the 'corrective amount'). The base rate is fixed for the entire subsidy period but the corrective amount is set annually. The base rate differs per technology and is calculated by Netherlands Environmental Assessment Agency (Planbureau voor de Leefomgeving, PBL), commissioned by the Ministry of Economic Affairs. The base rate is the cost price of the technology: the calculation is based on a reference installation where the majority of projects are profitable. The unprofitable component decreases when the market value rises, reducing the amount of the subsidy received. Subsidies are granted for periods of 12 or 15 years. The duration of the subsidy depends on the technology used (see below).	
	New build	**Retro-fit**
Electrolytic H_2	As of 2020: supported a minimum of 0.5 MW hydrogen production capacity Subsidy period: 15 years Electrolysis directly linked to the grid or to wind/solar (green hydrogen)	Not applicable.
H_2 production using CCS	As of 2022 the capture of CO_2 emissions originating from the production of hydrogen from industrial waste gases is eligible for subsidy (both new-build and retrofit). Subsidy period: 15 years	

To complement support under the SDE++, there are plans for a temporary scaling-up support scheme for green hydrogen to support electrolyser construction construction (expected to open from autumn 2022). Currently the Netherlands has 2MW of electrolyser capacity but by 2025 is aiming to develop 50 to 100MW of electrolysis capacity with a reserved budget of €250 million. A public consultation was held in early 2022 and the aim is to open this extra support scheme in the second half of 2022.

Apart from support schemes, the fiscal aspects of hydrogen are important to facilitate further development. Currently an energy tax has been levied on the electricity and mineral resources necessary for hydrogen production but not on hydrogen itself. Clarity on future taxation is, however, important for business cases (e.g. double taxation of resource and end product should be avoided).

Storage and transport

The aim of 3 to 4GW of electrolysis requires hydrogen storage of approximately 3-5 caverns according to the NWP. The ambition is to develop four sites before 2030 (the first already in 2026) with a budget of €35 million set aside for this purpose. The possibility of hydrogen storage in depleted gas fields also needs to be researched further.

In addition to hydrogen storage, the Government is also reviewing together with the Dutch transmission system operators Gasunie (gas) and TenneT (electricity), whether and under what conditions part of the gas network might be used for the transport and distribution of hydrogen. It has been decided that the operation of a future hydrogen transport network will be reserved to public operators such as Gasunie. Preparations for the national hydrogen backbone have started and a budget of €750 million reserved.

Network operators will begin collaborating with market participants to launch hydrogen pilot projects, in order to research a workable supply chain. However pilot projects will require a temporary amendment of the Gas Act. Hydrogen is not defined as a gas regulated by the Gas Act, and so TSOs are not entitled to transport hydrogen by using the current gas networks. A proposal was formulated in June 2021 but the Council of State advised against it and it was therefore abandoned.

Sector specific measures

The NWP contains a detailed gaps analysis with specific goals per sector.

Ports and industrial clusters

Currently the industry uses about 0.8Mton/year of hydrogen which is estimated to increase to approximately 2.5kilotonnes by 2030. In the short term (by 2025), the first applications for ‘low carbon’ hydrogen is in ammonia production, methanol production, petrochemicals, refining and steelmaking furnaces. In the longer term, ports and industrial clusters will accelerate their efforts in developing blue hydrogen by means of studies, business cases and investments, with grey hydrogen being replaced by blue hydrogen. Most of these projects will be local either producing hydrogen by capturing CO_2 emissions from existing hydrogen production within the five industrial clusters (as showcased by the Porthos Project and H-Vision in the Port of Rotterdam) or by accelerating offshore wind energy production and new build electrolysers to produce green hydrogen. The availability of a hydrogen infrastructure in the near future, however, will be key for hydrogen to become a success according to the HyWay27 study, published by PricewaterhouseCoopers / Strategy& in June 2021.

Electricity sector

The aim is to convert natural gas plants into hydrogen plants to provide sustainable, flexible generating capacity. Currently the technology necessary for hydrogen fired-generation is being developed but should be commercialised before 2030. Scaling up demonstration projects is feasible. If the supply of zero-carbon hydrogen can be scaled up in time, this would help achieve CO_2 reductions in the electricity sector in the long term. At a local and regional level, initiatives are currently being undertaken to combine local generation with the production, use and storage of hydrogen. Important factors for successful scale up include the availability of CO_2-neutral hydrogen and a sufficient hydrogen network.

Transport

The Netherlands has the ambition to deploy 50 refuelling stations, 15,000 fuel cell vehicles and 3,000 heavy-duty vehicles by 2025, which is expected to increase to 300,000 fuel cell vehicles by 2030. For aviation, the Netherlands is firmly committed to a European blending obligation and will even pursue a national obligation as of 2023 if progress is delayed at the European level. The negotiated (draft) Sustainable Aviation Agreement with the sector included a commitment to reach 14% blending of sustainable fuels by 2030 and 100% by 2050. This consists largely of synthetic fuels requiring the sufficient availability of (blue or green) hydrogen.

Built environment

Unlike the UK, where large-scale projects such as the H21 project have started, the Netherlands is focused on smaller scale pilot projects in the 2020-2025 period (e.g. in Rozenburg, Stad aan‘t Haringvliet and Hoogeveen). In this period, the main focus will be on researching how hydrogen can be an alternative for natural gas. In the period 2025-2030, more and larger-scale projects will follow, taking into account the lessons learned from, for example, H21, and the projects targeted up to 2025. During this first period, hydrogen will be added to the guidelines for municipalities on sustainability and the phasing out of natural gas in the built environment. An amendment of the current Gas Act and Environmental Act is necessary for the phase out of natural gas, with an online consultation held on this subject at the end of 2021/beginning of 2022.

Agricultural sector

As part of the Hydrogen strategy and support schemes, pilot projects using hydrogen have started in the agricultural sector. However, no concrete targets are specified in the NWP. Since many farms are already generating sustainable energy from solar, wind and biomass sources, this locally produced energy can be also be used for hydrogen production for use in heavy transport, such as tractors and other agricultural equipment, and in trucks in the agro-logistics sector.

PORTUGAL

Policy overview

The Portuguese Government's current macro policy for the energy and gas sectors is set out in the National Plan for Energy and Climate 2020-2030 (PNEC 2030). The PNEC 2030 is designed with the goal of achieving carbon neutrality by 2050.

Aligned with the PNEC 2030, the Portuguese Government approved the PT H2 Plan. According to the PT H2 Plan, by 2030 Portugal expects to achieve the following goals:

- 10% to 15% injection of green hydrogen into natural gas networks
- 2% to 5% of green hydrogen in the industrial sector's energy consumption
- 1% to 5% of green hydrogen in the road transport sector's energy consumption
- 3% to 5% green hydrogen in the national shipping sector's energy consumption
- 1.5 % to 2 % of green hydrogen in the energy final consumption
- 2 GW to 2.5 GW of installed capacity in electrolysers
- Setting up 50 to 100 hydrogen refuelling stations.

Key regulatory reforms

Reforms are mainly underway through Decree-Law 62/2020, of 28 August, which approved the new legal framework applicable to the gas sector allowing for the production and grid blending of renewable gases and the new Portuguese Energy Services Regulator (ERSE) Regulation on the Natural Gas Distribution Grid.

The main areas of focus of reforms are the regulatory framework for green hydrogen production, hydrogen blending into gas grids and the extension of guarantees of origin to renewable gases, including green hydrogen.

Hydrogen Standard?

Portugal is not developing its own standard, but will use the EU standard. However, while the EU standard is still pending, the Portuguese authorities have outlined requirements to be met by sponsors of hydrogen production facilities in order to apply for public incentives under the Scheme of Incentives to Support the Production of Green Hydrogen and Other Renewable Gases. These include that the project demonstrates it does "no significant harm".

Production

The PT H2 Plan sets forth various national funding instruments applicable to production projects, amongst others. In particular, the PT H2 Plan foresees incentive measures such as:

- an initial partial or total exemption from payment of the tariff for hydrogen projects to access the distribution or transmission gas grid
- operating support aimed at funding the difference between the energy source which will be replaced – natural gas – and the initial production cost of the hydrogen via a variable premium on the price of natural gas to match the price of green hydrogen, so that the additional cost of green hydrogen production is not reflected in the price paid by users
- implementation of a tax benefit mechanism or positive discrimination regarding the tax treatment of hydrogen production operators and
- guarantees of origin in the hydrogen sector.

The Portuguese Government is in the midst of implementing measures in relation to grants or incentives for hydrogen production. The PRRP approved by the European Commission provides for investment of €185 million into the hydrogen and renewable gas sector available to various projects, including projects for the production of green hydrogen using electrolysis.

Notices of any invitation to tender must comply with the rules set out in Regulation (EU) 2021/241 of the European Parliament and the Council of 12 February 2021 establishing the Recovery and Resilience Facility and will be published at www.fundoambiental.pt.

Storage and transport

The following indicative targets for blending hydrogen in the gas distribution grids are set out in the PT H2 Plan:

- 2025: 1% - 5%
- 2030: 10% - 15%
- 2040: 40% - 50%
- 2050: 75% - 80%

In order to try to achieve these goals, the PT H2 Plan includes a tentative plan for auctions of production rights to be held to inject hydrogen in the existing gas grids. The amount of hydrogen to be auctioned is set so that the share of hydrogen in the gas grids grows steadily until it reaches the 15% target in 2030.

On 19 January 2022 ERSE approved the new Gas Distribution Grids' Regulation, which allows and regulates the operation of gas grids using 100% natural gas or 100% of gases of renewable origin or low carbon content, such as biomethane or hydrogen. A maximum share of hydrogen content in the national gas distribution grid of 20% by volume is permissible, although this limit may alter depending on the place of consumption or the group of users.

Sector specific measures

The PT H2 Plan identifies many specific targets and measures to be implemented by 2030 in sectors such as industry, transport and water.

Industry

The PT H2 Plan establishes a target of 2% to 5% of green hydrogen in the industrial sector's energy consumption by 2030. To achieve this, the PT H2 Plan sets out measures to regulate the installation of hydrogen production, storage and supply in industrial installations, and to implement industrial scale pilot projects for the introduction of hydrogen in the various industry sub-sectors (such as refining, chemicals, metallurgy, cement and glass).

The PT H2 Plan also aims to use hydrogen to decarbonise an industry sub-sector representing a strategic opportunity for Portugal, which will be selected on the basis of its importance in the national economy and its impact in terms of greenhouse gases emission reductions. For example, were the chemical industry to be selected, this would to allow Portugal to become a leading country in green ammonia production, and to substitute imports with national production.

The Sines Project

The PT H2 Plan envisages the implementation of the Sines Project, an industrial-scale project under development for the production of green hydrogen, which is expected to have a total capacity in electrolysers of at least 1 GW by 2030.

The objective is for the project to be a green hydrogen hub for national consumption and, ultimately, hydrogen exports. It is also envisaged that the project will include an manufacturing facility for the production of electrolysers, which, in the first phase, will meet the demand generated by this project, and in the second phase will supply equipment for other national and international projects.

Transport

The PT H2 Plan establishes a target of 1% to 5% of green hydrogen in the transport sector's energy consumption by 2030, with the aim of decarbonizing the transport sector, in particular, road transport (heavy freight, urban logistics and passenger vehicles).

Various measures are set out to achieve this, such as regulation for the roll-out of hydrogen vehicle refuelling stations, green hydrogen supply infrastructure, and the procurement of hydrogen-powered vehicles by the public sector and public transport companies, among others.

Projects like Power-to-Mobility (the production of green hydrogen for the supply of vehicles refuelling stations) and Mobility by Hydrogen (the manufacturing of hydrogen buses) are currently being developed, with the delivery of the first hydrogen refuelling station expected in 2021.

Water

The PT H2 Plan also promotes the implementation of measures to encourage the synergies between the water and energy sectors, in order to incorporate the use of both domestic and industrial wastewater in green hydrogen production. This solution would foster the use and attribute economic value to wastewater, an almost unused resource.

SPAIN

Targets and policy overview

The Spanish Hydrogen Roadmap comprises a list of 60 measures to be adopted across a range of issues, such as the regulatory framework, market integration, and research, development and innovation activities, in order to promote the deployment of green hydrogen activities and infrastructure within Spanish territory. However it does not outline any specific measures in connection with other types of low carbon hydrogen (such as blue hydrogen).

By 2030, Spain expects:

- to deploy 4 GW of electrolysis capacity
- at least 25% of hydrogen used in the industry sector to be renewable
- to deploy 100 to 150 hydrogen refuelling stations and 5,000 to 7,500 road transport vehicles powered by hydrogen and
- to make €8.9 billion in investments for the construction and commissioning of green hydrogen production facilities and related electricity generation projects, for industrial transformation to use hydrogen and for other transport applications (including, amongst other things, trains and heavy transport vehicles powered by hydrogen).

Key regulatory reforms

Reforms are mainly being implemented through Royal Decree-law 6/2022, of 29 March 2022, although these reforms are in principle subject to the final outcome of the review of the Third Energy Package currently ongoing at the EU level.

The main areas of focus of the reforms are:

- the regulatory framework for green hydrogen facilities isolated from the gas network and
- the specific regime applicable to direct connections from green hydrogen production facilities to the gas network.

The Spanish Government has also proposed new rules to integrate renewable gases (including green hydrogen) within the Spanish guarantees of origin scheme, which are expected to come into force during 2022.

Hydrogen Standard?

Spain is not developing its own standard, but will use the EU standard. However, while the EU standard is pending, Spanish authorities have outlined the requirements to be met by sponsors of hydrogen production facilities in order to apply for public subsidies under the Spanish RTR Plan. These include that the electricity used by a hydrogen producer must be of renewable origin, and that the supply of electricity to the hydrogen producer must be through a direct connection or provided under long-term power purchase agreements with the electricity sourced from newly commissioned generation projects.

In addition, implementing article 19 of RED II, the Spanish Government has established the basic legal framework to create a guarantee of origin system in connection with renewable gases (including green hydrogen) produced using renewable power by virtue of Royal Decree 376/2022 of 17 May 2022. However, the actual criteria that the electricity and gases used will need to meet in order to be considered fully renewable have not been defined yet.

Production

Hydrogen production in Spain is currently classified as a chemical industry activity, regardless of the renewable or non-renewable origin of the hydrogen produced. This classification as “chemical industry” entails certain regulatory restrictions (especially in terms of environmental and land use rules), although one of the main targets of the Spanish Hydrogen Roadmap is the development of a less burdensome regulatory framework for green hydrogen production facilities.

Public support will be available under the PERTE ERHA scheme. The PERTE ERHA scheme provides for public support to green hydrogen projects of up to €1.5 billion and, although this scheme will be also applicable to the development of hydrogen storage, distribution and supply activities, it is expected that a large part of these funds will be for green hydrogen production activities. The PERTE ERHA funds will be awarded from 2023 through 2026 through incentive programmes.
The Spanish Government has recently approved the following incentive programmes in relation to green hydrogen production projects and activities:

	Target	Amount	Window for applications
Incentive Program 1	Innovation in the hydrogen value chain, with a special focus on the development of manufacture capacity of hydrogen equipment	€30 million	8 April 2022 – 7 June 2022
Incentive Program 3	Large-scale hydrogen production through electrolysis (i.e., projects with electrolysis capacity higher than 20 MW)	€100 million	
Incentive Program 4	Innovation in the hydrogen value chain, with a special focus on R+D+i activities	€40 million	

Storage and distribution

As described in the PERTE ERHA, support will be focused on lower-scale storage and distribution facilities as green hydrogen production will be primarily located within areas with industry or transport potential to integrate hydrogen consumption in the medium-term. The Spanish Hydrogen Roadmap identifies, amongst other things, the following areas as potential hydrogen clusters: A Coruña, Huelva, Vizcaya, Puertollano, Madrid, Barcelona, Valencia and Asturias.

The Spanish Hydrogen Roadmap also targets the review of the technical rules applicable to natural gas infrastructure in order to allow a higher blending of hydrogen within the gas system (currently limited to 5% blending). An example is Project HIGGS (Hydrogen in Gas Grids) whereby several partners and institutions are analysing the impact of hydrogen blending in existing natural gas infrastructure, as well as the improvements and modifications required in such facilities to allow a higher level of hydrogen blending.

Sector specific measures

Transport

The Spanish Hydrogen Roadmap sets out ambitious goals with regards to the role of green hydrogen within the transport sector (e.g. the development of a fleet of at least 150 to 200 renewable hydrogen fuel cells buses by 2030).

The potential for hydrogen to be used within the transport sector is being developed through different alternatives and technologies:

- Road: Pursuant to data provided by the Directorate General of Traffic (Dirección General de Tráfico), more than a dozen of hydrogen fuel cell vehicles are being developed as part of public and private research projects in Spain. Likewise, with regards to heavy-duty vehicle transport, several projects have been launched to study the feasibility of renewable hydrogen as fuel for industrial vehicles (e.g. buses, trucks). Among such projects, it is worth noting the public tender launched by Transports Metropolitans de Barcelona for the purchase of eight hydrogen fuel cell buses in 2020
- Rail: Renfe (the Spanish railway company) has launched a project to develop locomotives powered by hydrogen fuel cells jointly with Enagás and the National Hydrogen Centre (Centro Nacional de Hidrógeno), with funding support from the EU
- Sea: There are several ongoing initiatives studying the use of green hydrogen in machinery used in ports and cargo terminals. Notably, the H2Ports initiative is dedicated to the development of a pilot project in the port of Valencia to incorporate hydrogen in port logistics operations in order to reduce their environmental impact. H2Ports has received funding from the Fuel Cells and Hydrogen Joint Undertaking.

Industry

According to data provided by the Spanish Government in the Spanish Hydrogen Roadmap, the annual hydrogen consumption in Spain is of around 500,000 tonnes (mostly grey hydrogen), the majority of which is used in the production of industrial products and fertiliser such as ammonia and in refineries for the removal of impurities from crude oil. Iberdrola has developed the largest green hydrogen project in Europe in Puertollano (Ciudad Real) consisting of a 100MW solar photovoltaic plant and a 20MW green hydrogen generation facility which is meant to supply a nearby ammonia production plant.

Power

The Spanish Hydrogen Roadmap highlights the key role of green hydrogen in power generation and as long duration storage – allowing better management of the electricity system by absorbing the renewable electricity that is not consumed at the time it is produced.

Hydrogen clusters

The Green Hysland Project, a green hydrogen project developed in the Balearic Islands, has been selected by the Fuel Cell and Hydrogen Joint Undertaking to be awarded with an EU grant in an amount of €10 million (the second largest grant awarded by that authority to a green hydrogen project). The Green Hysland Project will be the first flagship project in southern Europe and will create a "green hydrogen ecosystem" in the Balearic Islands. The Green Hysland Project will generate, distribute and use at least 300 tonnes of renewable hydrogen per year in Mallorca, produced from solar energy. The green hydrogen produced by the Green Hysland Project will have multiple uses, prioritising the direct consumption of renewable hydrogen, for example, in the generation of heat and power for commercial and public buildings, the supply of auxiliary energy to ferries and port operations and the creation of a refuelling station. In addition, the possibility of injecting part of this green hydrogen into the island's gas pipeline network through a guarantee of origin system will be assessed, which will allow for the decarbonisation of the gas supply.

In addition, jointly with other interested parties Petronor and Repsol have launched a hydrogen cluster in the Basque Country, the so-called "Basque Hydrogen Corridor". This hydrogen ecosystem is intended to "enable progress to be made in the decarbonisation of the energy, industrial, residential and mobility sectors". A range of players from multiple sectors have joined this initiative, which intends to promote the development of essentially renewable hydrogen projects throughout the whole value chain. Petronor and Repsol are expecting investments of up to €1.3 billion until 2026 leading to 20,000 tonnes of renewable hydrogen per year.

Against the above background - and despite the fact that the Spanish Government's policies and all new regulations are strictly focused on green hydrogen projects – arguably as an intermediary step, Petronor is also developing certain blue hydrogen projects with the support of the regional authorities.

UK

Policy overview

The UK is aiming for 10GW of low carbon hydrogen capacity by 2030, with at least half of this coming from electrolytic hydrogen, as set out in the British Energy Security Strategy (published April 2022), doubling the ambition of the UK Hydrogen Strategy (published August 2021). The UK plans to support a variety of production methods including blue and green hydrogen, but perhaps also biomass gasification with CCUS. There is currently no policy goal beyond 2030, however, the Hydrogen Strategy suggests the UK could require between 7-20 GW of production capacity in 2035 and 15-60 GW in 2050.

The Scottish Government also published a Hydrogen Policy Statement in December 2020, aiming for 5GW by 2030 and at least 25GW by 2045 in Scotland alone. It published a draft Hydrogen action plan in November 2021.

Key regulatory reforms

In the UK, a number of proposals are progressing including:

- recognition of hydrogen in the draft overarching National Planning Statement for energy and
- legislative changes to implement the low carbon hydrogen business model.

Wider reforms, for example to gas network and storage rules, may also be required as policy develops.

Hydrogen Standard?

The Department for Business, Energy & Industrial Strategy (BEIS) has proposed a Low Carbon Hydrogen Standard. Low carbon hydrogen projects and businesses seeking government grants or revenue support from the Net Zero Hydrogen Fund or under the hydrogen business model are required to comply with the standard in order to secure that support. The standard will be a single 'low carbon label', applied at the point of production to all production methods that meet the required emissions threshold of 20gCO_2e/MJ(Lower Heating Value). Although the standard will be reviewed periodically, starting in 2023, the level of the standard will be grandfathered so any future changes would not apply retrospectively to contracts for support that had already been awarded.

The standard will apply to UK production pathways only at this stage but the UK Government intends that the standard be developed into a certification/guarantee of origin scheme by 2025. Like the EU, the UK is developing a green taxonomy. The UK Government is also consulting on including the standard in the UK Green Taxonomy to support investment in low carbon hydrogen.

Production

Support will be available under a new Industrial Decarbonisation and Hydrogen Revenue Support (IDHRS) scheme for new build low carbon hydrogen production projects and for the retrofitting of existing hydrogen production capacity with carbon capture capability. The Government will be providing up to £140 million to establish the scheme. In addition, a range of innovation funding and co-funding is being made available.

Although being developed in parallel, the level of support, terms and timing for award under the IDHRS differ, depending on the technology used and whether the project is a new build or retrofit project. A summary of the proposals is set out here:

	New build	Retro-fit
H_2 production using CCS	Bilateral contract for difference (CfD) with a counterparty, under which producers are paid the difference between a reference price and a strike price. Until a hydrogen market benchmark develops, the reference price will be the higher of the natural gas price and the 'achieved sales price' negotiated by the producer. A contractual price discovery mechanism is proposed to incentivise higher sales prices Allocated under the CCUS cluster sequencing programme, expected to be awarded from Q2 2023.	Industrial carbon capture scheme will provide the plant with revenue support to cover capex plus a return, carbon T&S fees, and opex. The capex payment is a negotiated amount per tonne of CO_2, repaid over 5 years (but can be extended). The opex payment is structured as a CfD: the reference price is intended to imitate the avoided costs of carbon and producers are paid the difference per tonne of CO_2 captured to a negotiated strike price, reflecting expected opex (indexed). Allocated under the CCUS cluster sequencing programme, expected to be awarded from Q2 2023.
Electrolytic H_2	Bilateral CfD (as described above) Allocated under electrolytic allocation process. 2022 round applications open in July 2022 for award by December 2023.	Not applicable.

Some production projects will not require business model support, for example due to revenue from the Renewable Transport Fuel Obligation (RTFO) scheme (see below) or displacement of a more expensive fuel such as diesel. Grant funding is also available via the £240 million Net Zero Hydrogen Fund and under other fuel-switching grant schemes.

Storage and transport

A variety of joint government and industry research, development and testing projects are underway, designed to help determine the safety, feasibility, costs and benefits of converting the existing gas grid to carry 100% hydrogen. An example is Project Union whereby National Grid is considering the development of a hydrogen 'backbone' to link industrial clusters in the UK. The Government plans to develop new business models for transportation and storage by 2025, to be in place by 2030.

Work is also underway to consider blending of up to 20% of hydrogen by volume into the existing gas distribution network, and up to 2% into the gas transmission network, with a decision expected by the end of 2023.

The need for large-scale hydrogen storage is also subject to further review by the UK Government, including as part of a Call for Evidence on facilitating the deployment of large-scale and long-duration electricity storage.

Sector specific measures

The UK Government plans to publish a Hydrogen Sector Development Action Plan in 2022.

Transport

A low carbon fuel strategy for transport is expected to be published in 2022.

Existing support for green hydrogen production is available under the RTFO scheme. Under the RTFO, transport fuel suppliers have an obligation to provide a volume of sustainable renewable fuel which is calculated as a proportion of the overall volume of fuel they supply for road transport and non-road mobile machinery. A sub-target was introduced in January 2019 for 'development fuels', including fuels of non-biological origin such as green hydrogen. Compliance is evidenced via a certificate trading regime.

Industry

The UK's Industrial Decarbonisation Strategy aims to create four low carbon industrial clusters by 2030 which will involve a mix of blue and green hydrogen production projects together with the development of carbon capture and storage T&S networks. Two clusters have been identified as part of a CCUS competition: HyNet (in the North West of England) and the North East Cluster (in Humber and Teeside) for delivery by the mid-2020s, with a reserve cluster in Scotland. Hydrogen also features strongly in the Government's policy for industrial fuel switching, alongside electricity and bioenergy.

Heat

As part of the UK Hydrogen Strategy, there are plans for a hydrogen neighbourhood and town this decade. However, a strategic decision on the role of hydrogen for heating is not expected to be taken until 2026.

Power

The potential for hydrogen to be used directly in power generation or as long duration storage (so called power-hydrogen-power projects where the hydrogen is produced by electrolysis) is acknowledged in the UK's Hydrogen Strategy, but remains under investigation.

BONELLIEREDE	www.belex.com Milan, Rome, Genoa, Brussels, London, Cairo*, Addis Ababa*, Dubai *in cooperation with local law firm
BREDIN PRAT	www.bredinprat.com Paris, Brussels
DE BRAUW BLACKSTONE WESTBROEK	www.debrauw.com Amsterdam, Brussels, London, Shanghai, Singapore
HENGELER MUELLER	www.hengeler.com Berlin, Düsseldorf, Frankfurt, Munich, Brussels, London
SLAUGHTER AND MAY	www.slaughterandmay.com London, Brussels, Hong Kong, Beijing
URÍA MENÉNDEZ	www.uria.com Madrid, Barcelona, Valencia, Bilbao, Lisbon, Porto, Brussels, London, New York, Bogota, Lima, Santiago de Chile