

Bird & Bird

International Green Hydrogen Report 2022

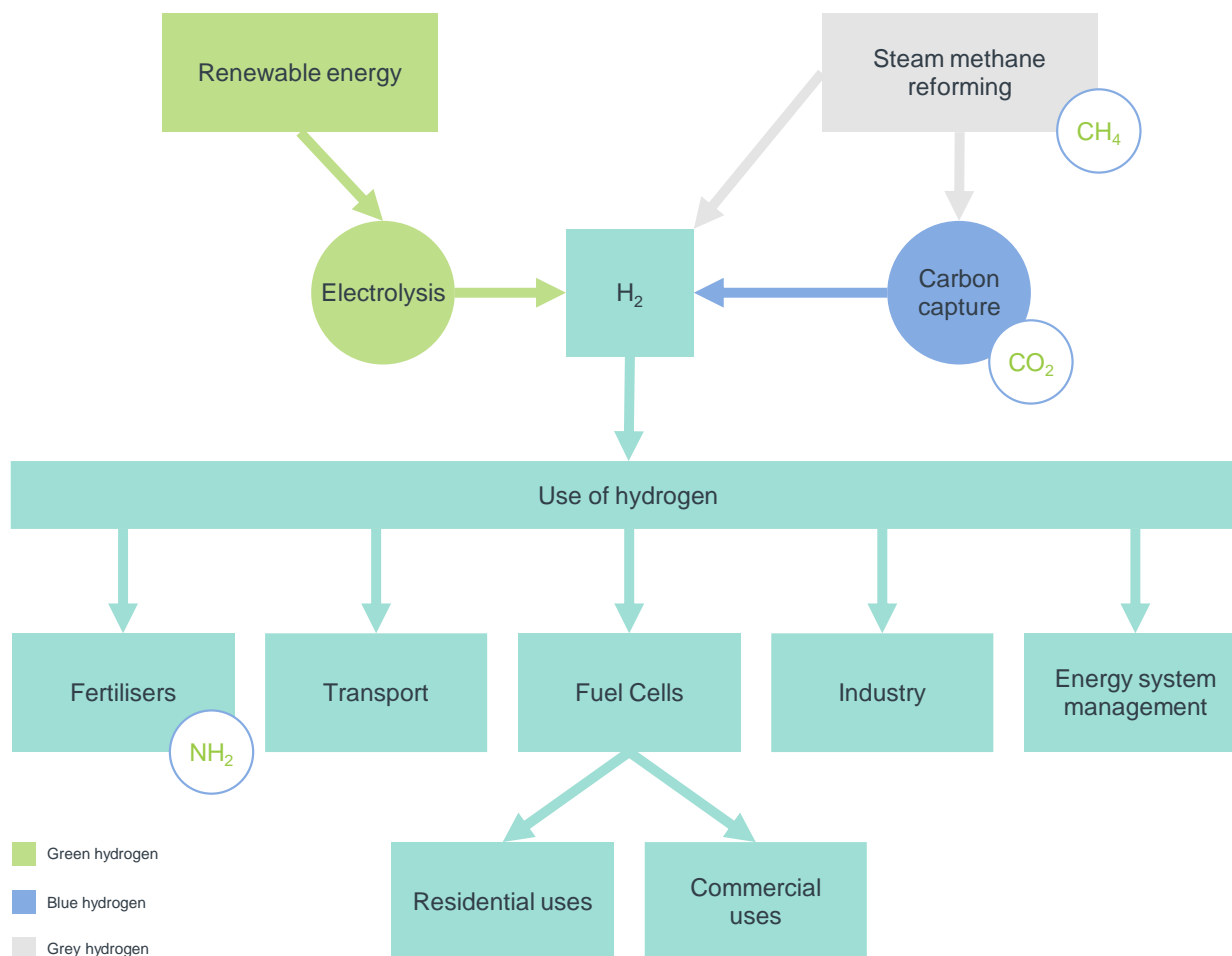
2022



Focus on hydrogen

Hydrogen is clean and versatile

Whether as an energy carrier, as energy storage for renewable energies, as a climate-neutral fuel in transport, as an essential element of sector coupling (dovetailing green electricity with the heat and mobility sectors as well as industry, or as a means of decarbonising CO₂ sources (such as the steel or cement industry).



Accordingly, the desires surrounding the use of hydrogen are growing — and with them the legal questions that arise in this context. For these are as diverse as the usability of hydrogen.

The legal issues

A successful energy transition can only be achieved by combining security of supply, affordability and environmental compatibility with innovative and intelligent climate protection. This requires an alternative option to the fossil fuels that are still predominantly used at present.

Hydrogen has a key role to play in the energy transition. This is because, in addition to numerous other advantages as a renewable energy carrier, it makes it possible to significantly reduce CO₂ emissions.

Our hydrogen-focused team has already successfully supported and strategically advised various projects on the practical use of hydrogen technology.

Green hydrogen is the petroleum of tomorrow

The flexible energy carrier is indispensable for the energy transition and opens up new markets within the framework of the entire value chain: technologies, generation, storage, infrastructure and use including logistics and important aspects of quality infrastructure.

Our hydrogen-focused team has already successfully supported and strategically advised various projects on the practical use of hydrogen technology. We generally work in cross-jurisdictional teams and cooperate with technical consulting specialists where necessary.

Following this approach, we would like to support you as a strong and competent legal advisor in the implementation phase that has now begun and bring about an optimised change in the use of energy sources together with you.



Core legal areas

In the following, we would like to highlight some of the key legal areas surrounding hydrogen.

Hydrogen & Regulation

In the context of the production, transport, distribution and consumption of hydrogen, numerous regulatory provisions must be observed.

A key legal and economic issue is the double burden of certain levies and charges that still applies in the context of energy storage and thus also the use of hydrogen.

Another key issue in terms of regulatory law is the development of a nationwide — or European — hydrogen infrastructure. Without a sufficient infrastructure, it is obvious that the full potential of hydrogen cannot be exploited.

If, in addition, subsidies are granted to develop an innovative technology or to fund a project, it is important to observe the subsidy law requirements for the proper use of the subsidies. In individual cases, this may justify, among other things, strict compliance with all obligations under national public and European procurement law regarding the tendering of contracts. In the event of non-compliance with the subsidy requirements, there is a risk that the subsidies will have to be repaid — plus interest!

In any case — the regulatory framework starts to offer viable business models, but the resulting obligations must be strictly observed! In addition, the regulatory framework is not entirely set and developers and investors have to observe the different national, European and international developments with attention.

We are here to advise you with respect to such regulatory framework.

Hydrogen & Contracts

The implementation of hydrogen production or storage projects (e.g. power-to-gas plants) or infrastructure projects (e.g. the development of a hydrogen infrastructure) require a balanced and solid contractual basis. The complexity of the supply and off-take contracts required for these projects should be considered — also with respect

to investment and financing issues – from the very beginning.

Hydrogen & IP: Protect and defend your intellectual property!

Many promising projects in the field of hydrogen production or transport and distribution start with a pioneering invention. For example, high-performance storage technologies need to be developed in order to be competitive and attractive to consumers. These inventions need to be protected, for example through patent protection at national and international level. Likewise, your patents and trademarks should be effectively enforceable against any imitators.

Conversely, when developing new products and processes around hydrogen, you should consider the increasing density of third-party patents and also design your new product with a view to ensuring your “Freedom to Operate” as far as possible.

The complexity of the supply and off-take contracts required for these projects should be considered – also with respect to investment and financing issues – from the very beginning.

Hydrogen & Cooperation

For the success of your engagement, it is necessary that you place your cooperation with partners on a solid foundation under the respective company law. The establishment of a tailored joint venture or a common project company, to which know-how, industrial property rights, technology or services can be contributed in addition to financial resources, is a typical example. At the heart of this is the joint venture agreement, which must describe the common goal of the cooperation just as clearly as the respective services of the cooperation partners. The possibilities of the partners to influence the development of a

company must also be regulated. In case of a common investment the mutual rights and obligations including lock-up periods, exit scenarios and management incentive packages are to be considered with attention.

All relevant contracts should be drafted clearly, practically and with foresight and take enough account of the special features of the technologies and their change or further development. We accompany and advise you in all necessary strategic decisions and the practical steps of setting up such a joint venture or a common company, whether in connection with research and development, production or distribution or a combination of both.

Do you intend to play a role in the growing market around hydrogen and are you planning to acquire a company, a significant stake or a start-up in this area? We would be happy to support you in these cases with our experienced team, which, in addition to the necessary corporate/ Venture Capital/M&A expertise, knows all the relevant legal interfaces and has a good understanding of the technical background. This includes, for example, questions of intellectual property, financing issues and cooperation agreements as well as the other aspects surrounding hydrogen investments.



Managing contractual and governmental dispute risk

Complex and innovative hydrogen projects, especially those of a cross-border nature, also require participants to identify and mitigate their risk as regards contractual counterparties, and also host governments or other state-entities whose actions have the potential to undermine the value and viability of a project. Our experts can advise on the best contractual structures and dispute resolution options to ensure that the risk of serious disputes is minimised and that when disputes do arise they are resolved with maximum speed and efficiency.

Disputes with joint venture partners, suppliers, customers, and contractors require careful and strategic handling to ensure optimal outcomes. Operators and other stakeholders also need to be alert to the risk of claims from third parties impacted by projects and their operation, and/or claims for environmental damage. Cross-border investment in hydrogen projects also requires a consideration of the availability of investment treaty protections to safeguard cross-border investment from the harmful actions of governments or related bodies. This requires an awareness of the existence of such treaty protections and how they might apply to the proposed investing entities and the host state(s) under consideration.

And beyond that

In addition to the topics highlighted as examples, a wide range of other questions can arise, such as the financing of projects.

Shape your cooperation and your acquisitions and make them solid, forward-looking and resilient!

European Union – latest developments

Last December, the European Commission published its legislative “[Package on Hydrogen and Decarbonized Markets](#)” (“Package”), including new rules aiming to develop a hydrogen market in the EU. It should clarify the legal concepts and role of blue and green hydrogen within the EU’s energy regulatory framework.

The draft Gas Directive includes definitions of renewable and low-carbon hydrogen, in line with the proposed amendments to Renewable Energies Directive II in this respect:

- renewable hydrogen is defined as hydrogen that (i) is produced using renewable sources other than biomass; and (ii) achieves a 70% GHG emission reduction compared to fossil fuels;
- low-carbon hydrogen is defined as hydrogen produced from non-renewable sources, and that meets a GHG emission reduction threshold of 70% compared to fossil-based hydrogen.

The European Parliament and Council must now consider the proposed Regulation and Directive for their adoption and they are entitled to modify the proposals (for example to include further incentives and more flexible rules for low-carbon hydrogen). The legislation is expected to be adopted within the next 18 months.

In the meantime, the Commission is expected to start its preparatory work regarding the methodologies for the certification of renewable and low-carbon hydrogen.

The EU taxonomy policy will also play a significant role in particular with respect to the taxonomy compatibility of certain energy sources such as nuclear power and gas. In its latest delegated act presented 2 February 2022 the European commission foresees that gas plants will have to use renewable energy or hydrogen as of 2035 in order to keep a status as taxonomy aligned projects.



Country profiles

Australia

Australia has potential to become a global leader as a producer and exporter of green hydrogen. Its key strengths include abundant natural resources, extensive renewable energy production capacity and storage resources, a proven track record in building large-scale energy industries and exporting energy, and proximity to high-demand economies, providing ease of access to key opportunities in regional markets.

Legal framework overview

A 2019 preliminary legal review commissioned by the Department of Industry, Innovation and Science identified approximately 730 pieces of legislation and 119 standards across Australia's jurisdictions that are potentially relevant to the hydrogen industry and supply chain development.



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In November 2019, the Hydrogen Working Group, established by the Council of Australian Governments ("COAG") Energy Council, released the Australian National Hydrogen Strategy. The strategy aims to establish a clean, innovative and safe hydrogen industry in Australia, to position Australia as a major global player by 2030. The Strategy sets out 57 coordinated government actions to enable the industry to scale up quickly, including reviewing the existing legal framework as needed to support the industry by removing barriers to development and ensuring safety.

In July 2020, Australia adopted a suite of eight international standards for the safe use, transport and trade of hydrogen across Australia.



The Strategy sets out 57 coordinated government actions to enable the industry to scale up quickly

Current Federal Government initiatives include:

- working with the hydrogen industry to design and develop an internationally consistent Guarantee of Origin scheme for Australia, which will support the industry by informing customers about the emissions associated with the hydrogen they buy and the source and type of technology used in its manufacture; and
- reforming the national gas regulatory framework to bring hydrogen blends, biomethane and other renewable gases within scope. A draft legislative package is to be presented by mid-2022, and draft rules in the second half of 2022. The package is anticipated to require amendments to:
 - the National Gas Law and the National Energy Retail Law and Regulations, which will be led by jurisdictional officials;
 - the National Gas Rules and the National Energy Retail Rules, which will be led by the Australian Energy Market Commission; and
 - Procedures and other AEMO instruments relating to settlement and metering in the facilitated and regulated retail gas markets, which will be led by AEMO.

States and territories are helping to develop the industry by adopting the National Hydrogen Strategy and developing their own hydrogen strategies. They have coordinated with the Federal Government to review the legal and regulatory framework in line with the above.

Funding & Support schemes

The Australian Government is continuing to work with the hydrogen industry in order to overcome barriers to development. Its main focus areas are building demand, achieving low-cost hydrogen at scale, and reducing delivery costs.

In 2018, the CSIRO released the National Hydrogen Roadmap. Its primary objective is to provide a blueprint for the development of the hydrogen industry in Australia, particularly in investments amongst industry, government, research and other stakeholder groups.

From 2015 to 2019, over \$146 million of funding was invested by the Australian Government in hydrogen-related projects. Funds are administered through two key entities: the Australian Renewable Energy Agency (“ARENA”) and the Clean Energy Finance Corporation (“CEFC”).

In April 2020 ARENA launched a \$70 million hydrogen funding round from which seven applicants were shortlisted. The shortlisted applicants have developed projects of 10 MW or larger electrolyzers with various end uses, as inter alia transportation, gas injection or renewable ammonia production. The projects are powered by either on-site renewable generation, purchase of Renewable Energy Certificates or power contracted from a renewable Power Purchase Agreement (“PPA”).

In May 2020, the Australian Government also launched the \$300 million “Advancing Hydrogen Fund”, administered by the CEFC. Through the fund, the CEFC shall provide debt or equity finance to eligible large-scale commercial and industrial projects, typically requiring \$10 million or more.

Between September 2020 and November 2021, the Australian Government committed \$464 million as part of the “Activating a Regional Hydrogen Industry - Clean Hydrogen Industrial Hubs program”, to fund the development of seven clean hydrogen hubs in regional Australia, as well as further studies. The hubs will be in ports, cities and regional areas, where producers, users and exporters of hydrogen could be co-located.

\$1.6 billion

Private sector investment

international partnerships to drive investment in Australian-based projects and accelerate supply chain growth to help deploy low emissions technologies and energy. Such international partnerships include the Australia-Germany Hydrogen Innovation and Technology Incubator (“HyGATE”) Initiative, which opened a funding round in March 2022. HyGATE is administered by ARENA, on behalf of the Department of Industry, Science, Energy and Resources, which has teamed up with Germany’s Federal Ministry of Education and Research, acting through Project Management Jülich (PtJ). In January 2022, the

In 2021 the Australian Government issued the Technology Investment Roadmap to achieve long term Emissions Reductions.

In the 2021-22 Federal Budget, the Government committed \$565.8 million towards developing

Government approved a \$150 million (€95 million) program Australia Japan Clean Hydrogen Trade Program to support the country’s hydrogen export industry and attract overseas investment in its hydrogen supply chains. The first round of the Program will focus on the export of clean hydrogen to Japan under the [Japan-Australia Partnership on Decarbonisation through Technology](#).

Collaborative partnerships have also been announced with Singapore, the UK, the Republic of Korea and India.

Up-coming evolution

The Australian hydrogen industry has gained momentum in the past couple of years. Private sector investment is growing, with over \$1.6 billion committed, and public sector investment reached \$1.27 billion in June 2021. Project announcements indicate that by 2025, over 100 MW green hydrogen could be being produced in Australia.

Australia’s export capacity is advancing, with investment and research being directed to support supply chains, for example, by investing in clean hydrogen hubs.

With regard to key hydrogen industries:

- chemical feedstock is developing quickly, with projects to use clean hydrogen in existing facilities having been announced;
- steel production is developing more slowly, although several steel producers have announced an intention to use clean hydrogen. Clean steel is a priority under the National Hydrogen Roadmap;
- some players in the mining industry are exploring the possibility of hydrogen microgrids, with \$103.6 million in government funding having been allocated to support pilots and deployment;
- the transport industry is slowly advancing, with several refuelling stations and vehicles currently in operation, and additional projects having been announced with targets of operations in 2025. The Australian Government’s Future Fuels Fund includes support for electric vehicle support infrastructure, including hydrogen fuel cell vehicles, and for heavy transport uptake; and
- trials are underway to blend hydrogen into gas networks, with nine projects expected to be operational by 2025.

Some recent examples

The Western Australian Government announced in January 2021 that it has received 65 expressions of interest (“EOI”) from Australia, Japan, Korea, India, Germany, Spain, the UK, France to produce and export commercial quantities of hydrogen from a new hub that may feature up to 270 MW from wind generation and to 1250 MW from solar photovoltaic installations located in the Oakajee Strategic Industrial Area (“SIA”).

In January 2021, an ASX-listed gas exploration company formed a joint venture to focus on the creation of four hydrogen production facilities on Australia’s east coast. It also announced a Memorandum of Understanding to collaborate on the development of an Australian network of hydrogen refuelling points.

In February 2021, a joint venture was announced to develop hydrogen production and export facilities on the southern coast of Victoria.

In February 2021, the Queensland government announced a partnership with a Japanese engineering firm to complete a feasibility study into a green hydrogen production facility.

The National Energy Resources Australia (“NERA”) unveiled in February 2021 a \$1.85 billion investment in 13 regional hydrogen technology clusters over the 6 Australian States.

In November 2021 the Moolawatana Renewable Hydrogen Project was announced. It will combine wind and solar with electrolyzers, a desalination plant, and a dedicated H₂ pipeline to a local port, where the hydrogen will be used to produce green ammonia for export.

In 2023-24, the Tallawarra B project will be Australia’s first net-zero emissions dual-fuel, gas-hydrogen power plant, and will provide over 300 MW of dispatchable capacity in New South Wales, coinciding with the retirement of the Liddell coal-fired power plant in the Hunter Valley.

Finland

Finland's target, to become carbon neutral by 2035 and carbon negative by 2050, is some of the most ambitious targets in the world. Although Finland does not have a separate hydrogen strategy, hydrogen is considered to be an integral part of the national energy and climate strategy. Business Finland (the Finnish government organization for innovation funding and trade, travel, and investment promotion) published in November 2020 a national hydrogen roadmap that analyses Finland's strengths and opportunities in the hydrogen field. The roadmap serves as a basis for developing the hydrogen policy and determining the role of hydrogen in the national energy and climate strategy. Furthermore, investments in power-to-X technologies play a key role in Finland's Recovery and Resilience Plan, published in May 2021.

Legal framework overview

As the main context is to view Finland as a member state in the European Union the development of sector integration and the hydrogen economy in the EU is strongly reflected on a national level. However, as for many other countries, Finland does currently not have a comprehensive legislative framework for the use of hydrogen as an energy carrier as provided for in the proposals generated by EU's "Fit for 55" climate package of July 2021. At present, the legislation in place solely governs hydrogen's use for industrial purposes i.e., production, storage, safety. Hydrogen compliant and future-proof legislative planning is fortunately on the national agenda.

In order to contribute to the national climate targets and to further facilitate and stimulate the hydrogen economy and advancement of new technologies pursuant to the EU Hydrogen and Sector Integration Strategies, the Ministry of Economic Affairs and Employment appointed a working group in July 2020 tasked with identifying the needs, opportunities and obstacles of energy sector integration, and to assess the possibilities for promoting the hydrogen economy and Power-to-X technologies. The Final report of the working group on sector integration was published in June 2021 highlighting that the legislative projects contained

in the EU's Fit for 55 climate package will be shaping the content of future legislation while bringing inevitable changes to the national regulatory landscape.

€520m

Available
funding

Funding & Support schemes

On 16 December 2021, the Government issued a decree that will allow support to energy investments under Finland's Recovery and Resilience Plan in 2022-2026. The aim is to promote energy investment and energy infrastructure projects that reduce greenhouse gas emissions in Finland and support the country's 2035 carbon neutrality target. Upon the adoption of the decree, calls for applications related to the energy system transformation and industrial energy solutions of the Sustainable Growth Programme can be opened. The amount of available funding will total about €520 million. The Decree's content is largely in line with the Government Decree on general terms and conditions for granting energy aid in 2018-2022, but it also lays down provisions on the general and special conditions related to the implementation of projects and the granting of aid in accordance with Finland's Recovery and Resilience Plan.

For example, the funding criteria include special requirements related to the use of the EU's Recovery and Resilience Facility, such as compliance with the "do no significant harm" principle. According to this principle, investments should not cause significant harm to environmental objectives. The Government Decree will enter into force on 16 December 2021 and remain in force until 31 December 2026.

As part of the Sustainable Growth Programme, the Finnish Government allocated €150 million in public funding to projects related to hydrogen technology and carbon capture and utilisation. The first application round for energy investment subsidies under the Sustainable Growth Programme for Finland will take place from 20



The roadmap serves as a basis for developing a hydrogen policy and determining the role of hydrogen in the national energy and climate strategy.

December 2021 to 4 March 2022. Funding will be available for energy infrastructure projects, new energy technology, production and storage of low-carbon hydrogen, carbon dioxide capture and use, and investments to reduce carbon use and electrify industrial processes. The aim is to reduce Finland's greenhouse gas emissions, support Finland's carbon neutrality targets and encourage businesses to adopt renewable energy and new energy technology.

Funding will be directed to national projects and projects linked to the hydrogen IPCEI (important Project of Common European Interest). The call for IPCEI applications closed 4 July 2021. The projects will support the objective of the Government to achieve a carbon neutral Finland by 2035.

Up-coming evolution

Finland has a proactive history in the field, both research organisations and companies have been active in developing fuel cell applications and utilisation of hydrogen — a full and working value chain for hydrogen, and decades of experience in large-scale industrial use of hydrogen is already present. In Finland, hydrogen is currently produced for the needs of industries such as oil refining, mainly from natural gas, the share of renewables is currently very limited. In addition, hydrogen arises as a by-product of certain industrial processes. However, alternative gases, e.g., mixing of hydrogen with natural gas, synthetic gas, bio- and gases produced from recycled raw materials and clean hydrogen have been given a key role in supporting the transformation of energy systems and bring solutions to energy transmission, storage, and flexibility needs. Finland looks at hydrogen in the energy market from the same starting point as other solutions that promote the integration of energy systems. Promotional activities are to be directed to hydrogen production methods that utilize zero-emission electricity (or are otherwise low-emission). This requires clean power generation technologies strong European electricity transmission connections and innovation investments in the development of hydrogen technology. Moreover, it is equally important is to make necessary adjustments in different laws and regulations so that the large-scale hydrogen production, transport, storage, and use can take place in the most efficient way.



A full and working value chain for hydrogen, and decades of experience in large-scale industrial use of hydrogen is already present

As illustrated by many actors, the key barrier to scaling up the hydrogen market is the 'causality dilemma' of "which came first — the chicken or the egg?" between supply, demand, and infrastructure. In the current landscape this translates to lack of transparency and trust in the market, hence, many players find themselves being in a mode of "wait-and see". Despite this, there is a positive and supportive buzz focusing on strong players, innovative technology, and cooperation.

Some recent examples

As stated in the national Hydrogen Roadmap, hydrogen offers for Finland great opportunity to create wide range of new businesses throughout the entire hydrogen value chain. To showcase the level of determination both private and public actors are already making significant contributions to hydrogen projects. Just to mention a few of these initiatives:

The Finnish gas transmission system operator, Gasgrid Finland, joined in April 2021 the European Hydrogen Backbone (EHB) initiative that envisions a European 39,700 km hydrogen transmission network by 2040. The EHB mirrors the vision of 23 European gas transmission network operators on how the infrastructure could be developed to support the achievement of carbon neutrality targets. The network would link the envisioned hydrogen infrastructure of 21 European countries and connect 11 new countries. Furthermore, Gasgrid Finland and Fingrid, Finland's transmission system operator for electricity, launched a joint research project to enable the hydrogen economy. The joint project involves envisaging scenarios for the development of Finland's hydrogen economy and energy transmission system based on summaries of viewpoints gathered from stakeholders on the development of the hydrogen economy. In addition, the project is studying the feasibility of building a hydrogen transmission network and developing the foundations for a hydrogen market and sector integration. The project will be completed by the end of 2022.

The joint project by Gasgrid Finland and Fingrid is being run as part of a consortium known as Hydrogen and Carbon Value Chains in Green Electrification (HYGCEL), which includes several Finnish companies and universities. Business Finland has awarded a grant for the HYGCEL project consortium, which has a budget of over €10 million. As part of this consortium, the joint project by Gasgrid Finland and Fingrid has received a positive funding decision.



The European Hydrogen Backbone (EHB) initiative envisions a European 39,700 km hydrogen transmission network by 2040

Gasgrid Finland carried out in fall 2021 a study on the potential of hydrogen economy and hydrogen market development. The analysis shows that Finland has significant potential in the hydrogen economy of the future, both as a hydrogen producer and as an export country. According to the analysis, the green hydrogen supply potential is of ~ 50 TWh/y by 2030, although this requires delivering on its vast onshore wind potential with 20 GW under development and 90 GW of grid applications received.

A national company-led Hydrogen Cluster was established in April 2021 to accelerate hydrogen economy and exports of hydrogen-related solutions.

In Finland, several projects have spotted the Gulf of Bothnia as a potential hydrogen valley. In the region, there are great resources for sustainable hydrogen production, industry needing hydrogen for decarbonisation, technological know-how and excellent infrastructure. With this potential in mind, an international network, umbrella brand and collaboration platform called BotH2nia was established in April 2021 for promoting and building a large-scale hydrogen economy around the Gulf of Bothnia.

P2X Solutions, a Finnish pioneer in green hydrogen and Power-to-X technology, intends to build Finland's first green hydrogen production plant in Harjavalta. When commissioned, the facility will produce green hydrogen for e.g., industrial needs by using electricity produced from renewable energy sources. The planned production facility has a capacity of 20 MW and as by-products it generates oxygen and thermal energy needed by industries. The company received in late December 2021 approximately €26 million grant for new energy technology and large-scale demonstration projects from the Ministry of Employment and the Economy of Finland. In addition, the Climate Fund has granted the company a capital loan of €10 million.

In addition to the above there are a myriad of R&D projects, both concluded and under development, steered by the leading universities, such as LUT University (Lappeenranta-Lahti University of Technology LUT).

France

The French Government unveiled its national hydrogen strategy in September 2020. €7.2 billion of public support will be granted for the next 10 years, including €2 billion from the “Big Green Recovery Plan”, a component of the national “Recovery Plan” (“Plan de relance”). France aims to achieve carbon neutrality by 2050 and become a leader in green technology for the production of decarbonised hydrogen.

Legal framework overview

In accordance with the November 2019 Energy and Climate Law, the so-called “Hydrogen Ordinance” dated February 17th, 2021 (n°2021-167) grants hydrogen an independent legal status. This detailed legal framework aims to promote the French hydrogen sector development, in particular by referring to three different types of hydrogen (renewable hydrogen (“hydrogène renouvelable”)

dissociated from low carbon hydrogen (“hydrogène bas-carbone”) and from carbonaceous/fossil hydrogen (“hydrogène carboné”).

To be qualified as renewable hydrogen, hydrogen must be

produced (1) either by electrolysis using electricity produced by renewable energy sources or by any other technology using exclusively one or more renewable energy sources, and (2) whose production process does not exceed a greenhouse gas emission threshold.

In addition, the Hydrogen Ordinance provides for guarantees of origin and unprecedented guarantees of traceability for renewable and low-carbon hydrogen to give clearer information to buyers and useful input to suppliers.

This 1st step as part of the definition of a legal framework is a strong signal for investors, project developers and industrialists.

€7.2 bn

Public support
for the next
10 years

On 24 August 2021, the Law to combat climate change and strengthen resilience to its effects (the “Climate and Resilience Law”) dated 22 August 2021 was published. According to the Climate and Resilience Law:

- Local authorities are entitled to take part in the development of hydrogen, and in particular to develop, operate or delegate the development and operation of hydrogen facilities in the same way as renewable energy projects (article L. 2224-32 of the General Code of Local Authorities).
- Municipalities and their groupings may participate in the capital of a public limited company or a simplified joint stock company whose corporate purpose is the production of renewable or low-carbon hydrogen in the same way as companies whose corporate purpose is the production of renewable energy (article L. 2253-1 of the General Code of Local Authorities).
- For hydrogen projects awarded by calls for tender and benefiting from a public support mechanism, the Administration may waive its right to organise a competitive bidding procedure relating to occupation of the public domain (article L. 2122-1-3-1 of the General Code of Local Authorities).

Funding & Support schemes

The Hydrogen Ordinance provides that renewable and low-carbon hydrogen producers are eligible for a support scheme in the form of investment aid (“CAPEX”), operating aid (“OPEX”), or a combination of both.

A tender process will be carried out depending on economic and environmental criteria, and will be open to any producer established in a Member State of the European Union’s territory or within the European Economic Area.

The regulatory texts implementing the Hydrogen Ordinance are expected by the end of June 2022 to detail the public support mechanism for hydrogen, the rules applicable to the guarantees of origin and the traceability mechanism.

Moreover, unveiled in 2020, the Multiannual Energy Program (“Programmation pluriannuelle de l’énergie” or “PPE”), set up for the periods 2019-

2023 and 2024-2028, provides for an increase in financial support for the French hydrogen sector.

The Big Green Recovery Plan sets out three key measures for green hydrogen industry: (1) to install enough electrolyzers to make a significant contribution to the decarbonisation of the economy; (2) to develop clean mobility, particularly for heavy vehicles; and (3) to foster the development of a clean hydrogen industry in France.

As part of the Big Green Recovery Plan, several calls for projects have been launched in 2020; further calls for projects dedicated to decarbonized hydrogen or hydrogen as a solution to industrial sector decarbonization are expected locally in 2021 and 2022.

In addition to the support mechanism and local calls for projects, decarbonized hydrogen projects will be funded through the PIA (Investment for the future program) and the IPCEI (important project of common European interest). With respect to IPCEI, France expects a notification of four hydrogen projects to the European Commission under the French presidency of the EU, therefore by the end of June 2022, once all the projects and companies involved have been identified.

Some recent examples

France has a central role to play in the decarbonisation of aviation: French aviation companies benefiting from State aid and thus €300 million have been allocated so far in 2020 to projects ranging from the Hyperion hydrogen propulsion project, to the Majestic wing efficiency project, which hopes to reduce aircraft emissions by up to 5%.

Indeed, the Airbus fleet represents approximately 45% of all aircraft in circulation, and Safran, through CFM International, supplies over 70% of all medium-haul aircraft engines.

In January 2022, Air Liquide Normandy, 100% owned by Air Liquide, obtained the authorisation to operate a plant with a capacity of 200 MW. It will produce 28,000 tons of hydrogen per year, by electrolysis of water, for industrial and heavy-duty mobility applications in Normandy. The commissioning of the plant is expected in 2025.



France has a central role to play in the decarbonisation of aviation

H2V is developing a 600 MW green hydrogen production unit in Fos-sur-Mer (Marseille), which will be developed in six 100 MW units between 2026 and 2031, on a 36-hectare site in the industrial-port area. Together with Ascométal electric steelworks, H2V Fos should produce 84,000 tons per year of renewable hydrogen by water electrolysis and avoid the emission of 750,000 tons of CO₂ each year. It represents an investment of €750 million. HysetCo is a joint venture created by Air Liquide, Idex, STEP, Kouros and Toyota, and dedicated to the development of hydrogen mobility. It owns the largest fleet of hydrogen taxis in the world, operated by Hype. The objective is to achieve zero emissions for taxis and VTC for the Paris Olympic Games in 2024. In May 2021, TotalEnergies SE acquired 20% stake in HysetCo; it plans to make its network of service stations available to Hysetco to expand hydrogen use.

MET 5 and Clean HY2 Infra Fund managed respectively by French Hy24 S.A.S. and Mirova S.A., signed their €200 million investment in green hydrogen pioneer Hy2gen AG in partnership with CDPQ and Technip Energies. It has been the biggest private investment in the Green Hydrogen Field.

The capital will be used for the construction of facilities in several jurisdictions across and outside Europe, producing green hydrogen-based fuels – or “e-fuels” – for maritime and ground transport, aviation and industrial applications. Production sites are located in France, Germany, Canada and Norway.

Germany

Germany has ambitions to become a leader in green hydrogen associated technologies. In 2020, the German Government adopted its National Hydrogen Strategy (“NWS”) to achieve these goals and ambitions. In the fall of 2021, when a new German government was elected, hydrogen quickly became the focus of the German energy transition. The German government intends to become the lead market for hydrogen technologies with an electrolysis capacity of 10 GW by 2030.

Legal framework overview

There is no consistent and complete legal framework covering the hydrogen value chain in Germany, whereas renewable energy is supported under the EEG (“Erneuerbare Energien Gesetz”). Initially, statutory feed-in tariffs were paid by the grid operators who took off the electricity. Meanwhile, only small plants still benefit from feed-in tariffs, whereas other installations have to sell the electricity and can receive additional support as a ‘market premium’ payable by the grid operator.



When a new German government was elected, hydrogen quickly became the focus of the German energy transition

The EEG 2021 framework benefits to hydrogen storage and plans inter alia that the payment of the EEG-surcharge (“EEG-Umlage”) shall be reduced to zero for electricity consumed by a green hydrogen production installation, irrespective of its intended use, from 1 January 2022 onwards. Further to that, the revised EEG 2021 expressly refers to “green” hydrogen-dependent on its manufacturing process and privileged contrary to other categories of hydrogen (i.e. grey etc.). For reasons of better transparency in this context, a regulation of the German Government entered into force on 20 July 2021. The regulation defines in more detail the requirements for hydrogen to be qualified as “green” hydrogen in the sense above and in differentiation to other categories of hydrogen. Notably, the regulation expressly stipulates that the requirements for green hydrogen will be adapted as soon as the European Union adopts any deviating requirements for green hydrogen.

On 27 July 2021, an amendment of the Energy Industry Act (“Energiewirtschaftsgesetz”) entered into force, setting the legal framework for a pure hydrogen grid infrastructure.

Up-coming evolution

German industry players are aiming to turn into green hydrogen production by building the required plants (power-to-gas plants, electrolysis plants, hydrogen liquefiers) over the next years.

Gas network operators have started planning for a separate gas grid, partially drawing on existing gas pipelines.

Some recent examples

A project has been initiated to replace the fossil fuel-based hydrogen used by the Heide oil refinery near Hamburg with carbon-free hydrogen produced from renewable energy sources using an adjacent 30MW electrolysis plant.

In 2024, a 60 MW electrolysis plant shall be commissioned on the site of the bp refinery in Lingen. The aim is to produce green hydrogen which will be used to produce fuels and replace 20% of the currently produced fossil fuel-based hydrogen.

Through the support of the German firm Siemens, which is developing “P2X” converters, Germany aims to become one of the main exporters of technologies for converting electrical energy into chemical, liquid or gaseous energy sources, such as hydrogen.

The German NWS also seeks to import substantial quantities of hydrogen from partner countries. For example, Australia and Germany announced a partnership to assess the feasibility of a hydrogen supply chain, and opened expressions of interest to involve the Australian industry.

The German government announced in May 2021 that it has chosen 62 German hydrogen projects to receive a total funding of more than €8 billion in the framework of the IPCEI on Hydrogen. The projects cover the entire value chain from hydrogen production, transport and industry application.

Italy

According to the Integrated National Energy and Climate Plan, Green hydrogen is considered as having a key role in reaching the target of reducing Italian greenhouse gas emissions by at least 30% (40% at European level) by 2030, compared to 1990.

Legal framework overview

Hydrogen was recognised by the Italian government as a renewable energy source in 2016, but the Italian legal framework covering production, exploitation and connection of hydrogen is imprecise, which has often proven to be an impediment for the industrial proponents and hydrogen producers.

For instance, no legal provision differentiates between authorisation procedures to produce fossil fuel-based hydrogen and to produce green hydrogen obtained through electrolysis process, which leads to the same level of restrictions being imposed. Then, local public authorities may require different requirements for land use.

These discrepancies between the legal areas concerned may lead to uncertainty to develop and implement hydrogen projects. Thus, legislation is needed to define the framework for authorisation processes and incentive systems.

Funding & Support schemes

Hydrogen production by electrolysis is still costly, but equipment's developers and suppliers are currently seeking to adapt their technologies to provide affordable green hydrogen. In that perspective, national and European financial support schemes have been already implemented or are in the process of being defined.

Investments required to achieve the Italian new green deal objectives should reach the quota of €50 billion up to 2030. Thus far, the 2021 Italian National Plan for Recovery and Resilience provides for the allocation of €1 billion to achieve the purported hydrogen-linked reforms.

Up-coming evolution

The Italian Government is drafting guidelines for a National Hydrogen Strategy to develop the Italian hydrogen industry to enhance its attractiveness for producers and investors and to strengthen the Italian industry in the European hydrogen market. The 2021 Italian National Plan for Recovery and Resilience, named "Italia Domani", establishes a series of practical measures to overcome the legal uncertainty surrounding the development of green hydrogen projects, which shall be implemented throughout the five years' period 2021-2026. In particular, the Italian government planned to enact two comprehensive legal frameworks, the first one regulating, among others: (i) safety matters in the fields of production, transportation, storage, and application of hydrogen; (ii) an accelerated authorization procedure for the building and management of small-sized hydrogen plants; (iii) regulation of participation of hydrogen plants to grid infrastructures; (iv) issuance of guarantees of origin for renewable hydrogen; (v) coordination of the 10-year development plan to be implemented by the national and the other European TSOs in order to develop common standards for the transport of hydrogen through existing or dedicated pipelines. On the other hand, a second reform shall include tax measures to incentivize the production and use of green hydrogen and implement the EU Directive 2018/2001 (RED II Directive). The purpose of this overall reform is to allow the use of hydrogen in rail and road transportation and in hard-to-abate industrial applications, then to support R&D hydrogen-focused activities and the creation of hydrogen valleys.



The 2021 Italian National Plan for Recovery and Resilience, named "Italia Domani", establishes a series of practical measures to overcome the legal uncertainty surrounding the development of green hydrogen projects

Singapore

Singapore is emerging as a hub for the development of hydrogen technology, which may enable Singapore to reduce its carbon footprint in the future by producing green hydrogen.

Legal framework overview

Singapore does not have a specific legislative framework for the use of hydrogen as an energy resource, and the current regulatory regime only governs its use for industrial purposes.

The main regulations governing the use of hydrogen in Singapore is the Fire Safety Act 1993, which stipulates that hydrogen is a highly “flammable material”, so licenses are required for its storage, import, transportation, dispensation and conveyance over pipelines. Further, hydrogen is deemed a “dangerous substance” under the Workplace Safety and Health (Major Hazard Installations) Regulations 2017, which is Singapore’s workplace health and safety laws, mandating enhanced safety measures for occupiers of premises that process, manufacture or store hydrogen in bulk.

Laws to regulate the deployment, import and use of hydrogen will be required in due course if the Government believes that hydrogen has a viable role to play in Singapore’s energy future.

Funding & Support schemes

With a view to accelerate the technical and economic viability of low-carbon energy technologies from 2020 to 2025, the Government has awarded S\$55 million under the Low-Carbon Energy Research Funding Initiative to fund 12 research, development and demonstration projects to support low-carbon energy technology solutions, with hydrogen being a key area of research¹.

To encourage innovation amongst small and medium-sized enterprises (“**SME**”), Enterprise Singapore (Singapore’s statutory board in charge of enterprise development and SME growth) and Innovation Norway jointly organised a Virtual Mission Trip to Norway in 2021 for local market players (with participation from taxi companies, refuelling station operators, bus companies and industry associations) to study the deployment of hydrogen fuel cell vehicles in Norway.

1

https://www.ema.gov.sg/media_release.aspx?news_sid=20211024M01pxaeHuLYZ#:~:text=Under%20the%20Low%2DCarbon%20Energy,low%2Dcarbon%20energy%20technology%20solu

Some recent examples

In 2021, the report from a consultancy study on “Hydrogen Imports and Downstream Applications for Singapore” (“**Consultancy Study**”), commissioned by the National Climate Change Secretariat, Singapore Economic Development Board and Energy Market Authority, was released. The key findings of the study are that: (i) hydrogen has the potential to diversify Singapore’s fuel mix towards low-carbon options for electricity generation, heavy transportation and some industrial processes; and (ii) given Singapore’s limited renewable energy resources, it is challenging for Singapore to produce green hydrogen at scale using domestic green electricity so Singapore would need to explore various supply pathways for price-competitive low-carbon hydrogen².

Following this, Singapore has made strategic investments and collaborations with industry partners in other countries to explore the potential for importing green hydrogen into Singapore.

In December 2021, it was announced that Singapore’s Keppel Data Centre is partnering with 4 energy players to explore the technical and commercial feasibility of developing a liquid hydrogen supply chain between Western Australia and Singapore, to power the company’s data centres in Singapore.

Singapore’s sovereign wealth fund, GIC, also announced in January 2022 a “strategic equity investment” into InterContinental Energy, a green fuels company behind the proposed 50 GW Western Green Energy Hub planned for Western Australia, which is also developing green hydrogen projects in Oman and Saudi Arabia.



Laws to regulate the deployment, import and use of hydrogen will be required in due course

ions.&text=Hydrogen%3A%20Hydrogen%20is%20a%20versatile,to%20store%20and%20transport%20energy.

² <https://www.nccs.gov.sg/media/press-release/singapore-looks-to-develop-and-deploy-ic-technological-solution>

These examples are on top of the slew of Memorandums of Understanding (“MOU”) signed between key local and foreign industry players, which include the following:

- In January 2021, Singapore’s Ministry of Trade and Industry and Chile’s Ministry of Energy and Mining signed an MOU to explore projects and initiatives to advance the deployment of hydrogen as an alternative energy source, including the establishment of supply chains for hydrogen and scaling up of the domestic hydrogen economy in both countries.
- In October 2021, Singapore energy and urban development company Sembcorp Industries signed an MOU with Chiyoda Corporation and Mitsubishi Corporation to explore a commercial-scale supply chain to deliver decarbonised hydrogen into Singapore. The supply chain would utilise Chiyoda’s technology which allows for hydrogen to be safely stored under ambient temperature and pressure in large quantities for long periods of time and to transport hydrogen over long distances in the form of methylcyclohexane (MCH).
- In December 2021, it was reported that Woodside Petroleum (based in Western Australia) is working with Singapore Keppel Corp and Osaka Gas Co to study a long-term supply of liquid hydrogen from Western Australia to Singapore and potentially Japan. The study, which is aligned with the Singapore Green Plan, will go on until mid-2022. The study seeks to ascertain whether Singapore will be an ideal export destination for hydrogen from Woodside’s planned H2Perth Hydrogen facility in Western Australia; Keppel Data Centres will be exploring the viability of the use of hydrogen to power its data centres.



There is keen interest amongst local players in the energy market to explore hydrogen use and deployment

Up-coming evolution

Although the hydrogen market in Singapore is still at early stages of growth, there is keen interest amongst local players in the energy market to explore hydrogen use and deployment. This is bolstered by the Government’s support for exploring low-carbon energy alternatives including hydrogen, and their recognition that hydrogen could potentially play a key role in Singapore’s efforts to decarbonise.

The Consultancy Study further highlighted the potential for hydrogen being deployed in various sectors in Singapore, which include the following³:

- **Maritime:** Hydrogen and hydrogen-carriers such as ammonia can be used to decarbonise the shipping industry, and the Maritime Port Authority is actively encouraging stakeholders to trial and test-bed low-carbon fuels.
- **Power:** Hydrogen can work alongside carbon capture, utilisation and storage (“CCUS”), solar and green electricity imports to decarbonise Singapore’s energy sector; and, in the future, hydrogen fuels may also be blended with natural gas to fuel Singapore’s combined Cycle Gas Turbines to generate electricity.
- **Aviation:** While the short-term efforts involve the extensive use of hydrogen to produce sustainable aviation fuels for aircraft, the industry plans to move forwards hydrogen propulsion for future aircraft, and the Civil Aviation Authority of Singapore aims to work closely with various stakeholders to study its feasibility.
- **Mobility:** While battery electric vehicles (“BEV”) are projected to remain the more viable cleaner-energy vehicle technology compared to hydrogen fuel cell vehicles (“FCEV”), the Consultancy Study recognises that FCEVs may be more economically viable than BECVs in the heavy vehicle segment.

³ https://www.nccs.gov.sg/docs/default-source/news-documents/hc_ccus_press_release_230621.pdf

Spain

Spain, benefitting from a large deployment of renewable projects, is resolutely committed to green hydrogen as a vector for the ecological transition and the decarbonisation of the EU.

Legal framework overview

Green hydrogen does not benefit from a single legal framework, being therefore subject to a wide range of applicable set of rules, from chemical and industrial regulations to environmental and power sector laws. In this context, a heterogeneous regulatory framework for hydrogen from renewable sources is being developed and/or amended to fit green hydrogen specificities.

On that basis, sponsor of hydrogen projects in Spain should consider the following regulations:

- As regards to the **power generation and evacuation activities**, as required for the electrolysis process, the legislation on the Spanish Power Act (Law 24/2003, of 26th December) and the Environment Law (Law 21/2013, of 9th December), and other implementing regulations.
- As regards to the **generation of hydrogen through electrolyzers**, industrial and environmental legislation, as well as any other legislation which applies to facilities involved in the production of inorganic chemicals like hydrogen or ammonia.
- As regards to **hydrogen storage**, the industrial legislation and any other standards and regulations applicable to the storage of this inorganic chemical products.
- As regards to the **transport of hydrogen** through the gas pipeline infrastructure, hydrocarbon legislation (Law 34/1998, of 7th October) and any other specific applicable regulations.

Given the complex governmental structure of the Kingdom of Spain (with different layers of competent authorities), sponsors of hydrogen projects shall consider national, regional and local regulations applicable to the development of hydrogen, industrial and power facilities.

Up-coming evolution

The Spanish Government has set ambitious goals as to the implementation of hydrogen projects, including a 4GW installed capacity of electrolyzers from renewable energy sources by 2030. For the purposes of achieving such target, the Spanish State has already approved the *Strategic Projects for the Recovery and Economic Transformation* (“*Proyectos Estratégicos para la Recuperación y Transformación Económica*” or PERTE by its Spanish acronym) of Renewable Energies, Renewable Hydrogen and Storage (ERHA).

Said comprehensive package of instruments and initiatives is aimed at developing technology, know-how, industrial capabilities and new business models to strengthen Spain's leading position in the field of clean energy; and will consist in the investment of more than €16.3 billion, including contributions from the Recovery, Transformation and Resilience Plan (PRTR) (i.e. the Spanish instrument for the management of the NextGeneration EU funds) and private investments.

This includes nearly €500 million exclusively allocated to hydrogen developments, including (i) a credit line of €150 million for pioneering renewable hydrogen projects, with commercial viability, for local production and consumption in sectors that are difficult to decarbonise, such as heavy industry or heavy transport, and (ii) €250 million credit line to promote the renewable hydrogen value chain, from components manufacturing to prototypes of new vehicles or electrolyser manufacturing projects to produce renewable hydrogen on a large scale.

Some recent examples

As part of Spain's commitment to the deployment of hydrogen projects, a first Nation-wide consortium (called “*Shyne*” – Spanish Hydrogen Network) has just been launched in 2022. The consortium, which includes 33 of the most important players in the Spanish energy market, as well as industrial and transport companies, is led by incumbent operators such as Repsol, Enagás, Iberia and Navantia. The consortium plants to develop projects in a dozen autonomous regions, with a combined investment of €3,230 million.

Similarly, major developers such as Naturgy and Enagás are currently considering the construction of hydrogen hubs, with the deployment of adequate infrastructure connecting power generators, hydrogen production facilities and end-consumers (including heavy industry operators), as prototype projects to be further replicated nationwide.

Additionally, Iberdrola — another key player in the deployment of hydrogen projects in Spain and abroad, has announced the development of 90 projects relating to the generation and storage of green hydrogen that could represent an investment close to €15,000 million.

Finally, considering the strong commitment of the Spanish Government and power producers to deploy large scale hydrogen production facilities, some major electrolyzers manufacturers have publicly announced their intention to build and operate large scale electrolyzers manufacturing premises in Spain, which are due to be operating in 2023.



€150m

Credit line for pioneering renewable hydrogen projects

€250m

Credit line to promote the renewable hydrogen value chain

The Netherlands

The Netherlands is Europe's largest producer of hydrogen after Germany. According to the Dutch Government Strategy on Hydrogen, green hydrogen is essential for achieving the national energy transition goals and maintaining energy-intensive industries.

The Netherlands set up the National Hydrogen Program which originates from the overall Climate Agreement. Central to the government's vision on hydrogen is the message that CO₂-free hydrogen is a necessary link in a sustainable energy system. In 2050, 30 to 50% of the end use of energy will come from gaseous energy carriers, including hydrogen. The government will take the lead in further developing the hydrogen ecosystem and will come up with a policy agenda as it believes that only with these steps can the Netherlands continue to lead the way in Europe and attract the associated economic activity. The substantive program is currently being prepared and set up by a cross-sectoral hydrogen working group (CSWW) though involvement of a diverse group of stakeholders in the development and application of hydrogen: governments, market parties, knowledge institutions, network companies and social organisations. The Dutch policy for Hydrogen is divided in different phases: (i) first phase-period up to and including 2021 which served as a preparation for the actual upscaling and roll-out of hydrogen from 2022. The second phase that started in 2022 which is the real start of the National Hydrogen Programme.



Only with these steps can the Netherlands continue to lead the way in Europe and attract the associated economic activity

Legal framework overview

The RED II directive sets national targets for renewable energy use per Member State, and requires a minimum share of renewable energy in road and rail transport. Green hydrogen can contribute to these objectives. However, this depends on the chosen definitions of green hydrogen and the calculation rules for using

electricity from the mix. Through RED II, these regulations find their way in the Dutch regulations.

According to the ministerial decree on gas quality ("*Regeling Gaskwaliteit*"), the Dutch legal framework allows hydrogen injection up to 0.5% in regional gas distribution systems. The Dutch Government is discussing the matter with network operators and large industrial users. The Government is also considering the possibility of mandatory injection of green hydrogen (physically or through certificates) to create a demand for green hydrogen.



The Government is also considering the possibility of mandatory injection of green hydrogen (physically or through certificates) to create a demand for green hydrogen.

Currently, the government is running an internet consultation on the regulation of the hydrogen market regulation (<https://internetconsultatie.nl/marktordeningwaterstof/b1>) until 11 March 2022, where companies are invited to contribute ideas about the organization of the hydrogen market. The questions raised in the consultation concern, for example, which parties may be active in the field of production/electrolysis, transport, (underground) storage and construction and management of import/export terminals, under which conditions these parties may do so and how it can be ensured that sufficient users can access these services on reasonable terms. The consultation is aimed at existing and future stakeholders in the hydrogen market.

Funding & Support schemes

Compared to the previous Renewable Energy Production Incentive Scheme ("*SDE+*"), the new 2020 and broadened "*SDE++*" targets of a 49% reduction in CO₂ emissions in the Netherlands by 2030 compared to 1990 and 95% by 2050.

SDE++ is a support mechanism for which ecological technologies are eligible and available through calls for tenders. This mechanism consists

of a subsidy to compensate for the difference between the cost price of the technologies (the “base amount”) and the market value of the product that the technologies delivers (the “market price”). It stimulates competition between different technologies and offers long-term security to investors.

In April 2021, the TKI New Gas published a subsidy scheme for projects on the theme of hydrogen technology. The scheme was intended to stimulate technology development that is necessary to successfully set up hydrogen chains and for technology that enables and/or improves the applicability of hydrogen. The projects must be able to make a concrete contribution in practice within 3-5 years.

Of the 29 expressions of interest, 13 projects were awarded funding within the available budget of €3 million. The projects have a value of more than €7 million. A total of 34 partners are working on it, 24 of which are unique partners. It concerns 6 knowledge institutions, 15 SME companies, 2 large companies and one field lab.

The awarded projects can be divided into the following themes:

- Electrolysis and electrolysis systems: 3 projects awarded
- Sensors and measuring equipment: 3 projects awarded
- Burners and model development for burners: 2 projects awarded
- Storage and Liquefaction: 2 projects awarded
- Production technology of electrolysers and fuel cells: 2 projects awarded
- Complete systems and system integration: 1 project awarded

Up-coming evolution

According to the 2019 “National Climate Agreement”, the stakeholders have formulated a goal to scale-up electrolysis to 500MW between 2022 and 2025; and 3GW to 4GW between 2026 and 2030.

In the national “Energy and Climate Plan 2021-2030”, the program for hydrogen is further explained. Amongst others, price reductions for electrolysis and renewable energy are needed for mass production of hydrogen, and it must be assessed how electrolysis installations can

contribute to the incorporation of renewable energy in the energy system and what consequences this will have for the infrastructure.

Many projects are in a transition phase between pilots and other options for CO2 reduction in the roll-out phase.

Some recent examples

In 2020, the Dutch Government announced several international agreements such as collaboration with the Portuguese Government regarding the export of green hydrogen from Portugal to the Netherlands.

Announced in 2020, the “NorthH2 green hydrogen Project” aims to produce green hydrogen through renewable electricity generated by a 3/4GW offshore windfarm in 2030, rising to 10GW by 2040.

The “Project Hy3” is a project between the Netherlands and Germany whereby the possibilities of international hydrogen infrastructure, delivery to industrial regions and a link to wind at sea is investigated.

The “HyWay 27” is a project between the Dutch Ministry of Economic Affairs and Climate Policy, TenneT and Gasunie on the development of a national hydrogen infrastructure.

The United Kingdom

In November 2020, the U.K. Government published its Ten Point Plan for a Green Industrial Revolution (the 'Ten Point Plan') which outlined its commitment to driving the growth of low carbon hydrogen and established the an ambition for 5GW of low carbon hydrogen production capacity in the UK by 2030. This was followed up by a detailed Energy White Paper published in December 2020 and a UK Hydrogen Strategy published in August 2021 which provided a roadmap for the development of the hydrogen economy to meet this ambition. The British Energy Security Strategy was then published in April 2022, increasing the UK's aim for low-carbon hydrogen production capacity to 10 GW by 2030, with at least half of that coming from green hydrogen production.

Currently, the main use of hydrogen in the UK is in industrial petrochemical manufacture, and it is predominantly produced from fossil fuels. However, government has identified this sector as a focus for the transition to green hydrogen. To date, green hydrogen production has been limited to localised demonstration projects, such as BIG HIT in Orkney. Little hydrogen is transported away from central production sites.

The UK Hydrogen Strategy acknowledges that the majority of UK hydrogen use to date does not use green hydrogen. It uses the term 'low carbon hydrogen' or 'zero carbon hydrogen' and highlights work by British companies including ITM Power, Johnson Matthey and Ceres Power in developing technology for low or zero carbon hydrogen. It also identifies near-future hydrogen production projects, including green-hydrogen production associated with existing offshore windfarms to power electrolysis.



The British Energy Security Strategy was then published in April 2022, increasing the UK's aim for low-carbon hydrogen production capacity to 10 GW by 2030

Legal framework overview

In common with many other jurisdictions, the UK does not have a well-defined legal framework for hydrogen projects specifically. The UK's gas hydrogen sector is subject to the legislative requirements of the Gas Act 1986 and is regulated by the Office of Gas and Electricity Markets (Ofgem) as part of the existing gas network used principally for the supply of natural gas. Key laws which will currently have an impact on green hydrogen projects include:

Planning

Hydrogen production and storage projects are not currently included as Nationally Significant Infrastructure Projects (NSIP) under the Planning Act 2008, though this may change in the future. Where a project does not qualify as an NSIP, planning approval from the Local Planning Authority would be required under the Town & Country Planning Act 1990.

Environmental

Under the Town and Country Planning (Environmental Impact Assessment) Regulations 2017, an Environmental Impact Assessment would be required before a facility for chemical products (which would include hydrogen). Any hydrogen production plant is also likely to require a separate environmental permit for the production of inorganic chemicals.

Health and Safety

There is a wide range of health and safety regulations which developers and operators of hydrogen projects need to consider. The primary piece of legislation is the Health and Safety at Work Act 1974 but consideration of the following should also be included: the Management of Health and Safety at Work Regulations 1999, COMAH, the Dangerous Substances and Explosive Atmospheres Regulations 2002, the Pressure Systems Safety Regulations 2000, the Pressure Equipment (Safety) Regulations 2016, and the Equipment and Protective Systems for Use in Potentially Explosive Atmospheres Regulations 2016.

Transportation

Gas and liquid hydrogen are both classified in UN Class 2.1 and are therefore treated as dangerous goods in the United Kingdom. Transportation of dangerous goods in Great Britain is regulated through the Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations 2009.

Hydrogen is currently limited to 0.1% (by volume) in Great Britain's (GB) natural gas networks, as outlined in the Gas Safety (Management) Regulations 1996. The Government is undertaking a study to understand the case for hydrogen blending of up to 20% hydrogen (by volume) into the gas networks and are targeting a decision in 2023. To undertake key activities in the gas network, transporters of hydrogen will require a licence, or licence exemption, as part of the licencing system established by The Gas Act 1986. Metering and billing rules for gas are currently set up under the Gas (Calculation of Thermal Energy) Regulations 1996.

Use in Vehicles

Hydrogen powered buses have already been tested, approved, and are in operation in the UK. Registered vehicles are subject to standard Ministry of Transport (MOT) testing, and this will apply to all hydrogen-powered vehicles. The UK has limited regulation for certain types of "L category" motorcycles using hydrogen combustion and hydrogen fuel cells.

Hydrogen refuelling station developers and operators will need be cognisant of the same planning, environmental and health & safety regimes outlined above. The storage and handling of hydrogen in tanks will need to meet local land use zoning requirements and the storage and handling will need to comply with safety and hazardous substance requirements.

As can be seen, an operational and economic barrier to the deployment of hydrogen production is the lack of a dedicated regimes for all of the above areas. Currently, hydrogen project developers must navigate the existing legislative framework that applies to gases generally and this situation creates numerous gaps and uncertainties. The UK Hydrogen Strategy has identified regulatory frameworks as something to be addressed, including network delivery, safety and other standards, planning and project regulation and future market regulation, and sets out a timeline for when these will be in place (further details of which are below).



The UK Hydrogen Strategy has identified regulatory frameworks as something to be addressed, including network delivery, safety and other standards, planning and project regulation and future market regulation

Funding & Support schemes

The UK Hydrogen Strategy sets out that the drive to increase the UK's hydrogen production capacity will be supported by a Net Zero Hydrogen Fund of £240 million and up to £100 million through a Low Carbon Hydrogen Business Model for new hydrogen production facilities. By 2030, the Government expects that there will be up to £9 billion of private investment in the industry.

In April 2022 the Government Department for Business Energy and Industrial Strategy (BEIS) released the outcomes of their consultations on these two funding and support schemes, and of funding for projects in the UK. These schemes are now due to open for applications across 2022 and 2023 in various phases.

Net Zero Hydrogen Fund (NZHF)

The NZHF is worth up to £240 million and aims to reduce financing costs with grant funding which will be delivered between 2022 and 2025. The NZHF has been designed to support all forms of hydrogen production, provided projects meet certain eligibility requirements.

The NZHF's grant allocation will be split into the following 4 strands:

- Strand 1: DEVEX (development expenditure) for FEED studies and post FEED costs
- Strand 2: CAPEX (capital expenditure) for projects that do not require revenue support through the hydrogen business model
- Strand 3: CAPEX for non-CCUS enabled projects that also require revenue support through the hydrogen business model
- Strand 4: CAPEX for CCUS-enabled projects that require revenue support through the hydrogen business model

In 2022 the NZHF competition brief documents will be published. These will outline the assessment process for the first NZHF funding wave and will detail the eligibility and assessment criteria. The first funding window for strands 1 and 2 will open in 2022 with the plan of a further funding window in 2023/24. The funding window for strand 3 should also open later in 2022.

Low Carbon Hydrogen Business Model (HBM)

The objective of the HBM is to provide long-term certainty to investors through revenue support. The Government intends to proceed with a contractual, producer-focused business model, applicable to a range of hydrogen production pathways. It will provide a variable premium price support model where the subsidy is the difference between a 'strike price' reflecting the cost of producing hydrogen and a 'reference price' reflecting the market value of hydrogen. The model will set a reference price based on the producer's achieved sales price, with a floor at the natural gas price, and a contractual mechanism to incentivise the producer to increase the sales price and thereby reduce the subsidy.

Funds for the allocation of HBM contracts will go to both electrolytic and CCUS-enabled projects, with up to £100 million for green hydrogen production capacity in 2023. The Government then aims to run annual allocation rounds for green hydrogen. The HBM should be finalised in 2022, enabling the first contracts to be allocated from 2023.

Low Carbon Hydrogen Standard

Published in April 2022, the Low Carbon Hydrogen Standard sets a maximum threshold for greenhouse gas emissions of 20g CO₂e/MJLHV of produced hydrogen or less for the hydrogen to be considered low carbon. The standard will be used to ensure that hydrogen production supported by government schemes and policies that apply the standard, such as the NZHF and HBM, is sufficiently low carbon.

Up-coming evolution

The UK Hydrogen Strategy provides a roadmap for future policies that will detail exactly how the government will deliver on its ambitions.

The strategy provides a timeline for the evolution of policy as follows:

- Early 2020s: Networks to be delivered through the existing regulatory and legal framework, but wider standards (e.g. safety and purity) will be updated, critical deployment barriers will be addressed and appropriate planning and permitting regimes put in place.
- From 2025-2027: An initial network regulatory and legal framework should be in place, including potentially on blending in the gas grid, system operation and a gas billing methodology in place.
- Late 2020s: A more established regulatory environment in place with a long-term regulatory and legal framework to support network expansion, a long-term system operator and all of the necessary regulations, codes and standards addressed.
- Mid-2030s: With the domestic environment well established, the roadmap looks to trading hydrogen outside the UK, with the aim for a framework in place enabling cross-border pipeline and shipping trade.

Evidence given in the UK Hydrogen Strategy suggest that the hydrogen economy could directly support over 9,000 jobs by 2030 — though this is based on the 5GW ambition which has now been doubled — and up to 100,000 jobs by 2050. The strategy also suggests that by 2030 hydrogen would be worth £900 million of the UK economy rising to £13 billion by 2050, albeit this includes all hydrogen types.

In relation to wholesale energy markets, under the Brexit trade and co-operation agreement, the parties agree to co-operate and access the actions needed to facilitate the integration of gas from

€240m

Net Zero Hydrogen Fund

€100m

Low Carbon Hydrogen Business Model

natural sources, which would include the development of blended hydrogen through the natural gas system.

Some recent examples

In addition to the schemes outlined above there are a wide variety of existing and planned smaller funding sources for projects related to hydrogen. The Hydrogen Supply Competition (£33 million) has already provided funding for 5 demonstration projects on hydrogen production. Two green hydrogen production focused projects awarded these funds include Gigastack, a project which will use polymer electrolyte membrane (PEM) electrolyzers manufactured by ITM Power, and Dolphyn which aims to produce green hydrogen from floating offshore wind in deep-water locations.

Larger projects include BP's plans for a major green hydrogen facility at Teesside, in northeast England, alongside the planned blue hydrogen plant there. In March 2022 EDF, and its hydrogen-focused subsidiary Hynamics, announced a plan to build a green hydrogen electrolysis plant also at Teesside initially for 30-50MW production of hydrogen but scaling up to 500MW, powered by offshore wind.

Further hydrogen specific funding sources are the Industrial Hydrogen Accelerator competition (£26 million), Hy4Heat competition (£25 million) and the Hydrogen for Transport Programme (£23 million). There are also several CCUS, industrial and transport decarbonisation & fuel switching funds which could be used for hydrogen related projects.

Portugal

Portugal has very competitive conditions for the installation of a green hydrogen production industry, both for domestic use and for export, due to the countries' low costs of electricity production and abundant solar resources.

In order to take advantage of these benefits, the Portuguese Government has been active and committed to the incorporation of green hydrogen into the economy, which is primarily reflected in the approval of the Roadmap towards Carbon Neutrality, that foresees the long-term goals of ensuring, by 2050, the decarbonization of the Natural Gas Network and of making the production of green hydrogen one of the priorities of the country's energy and industrial policy.



The Portuguese Government has been active and committed to the incorporation of green hydrogen into the economy

Legal framework overview

Although there is still no legal and regulatory framework specifically applicable to all activities to be carried out in the hydrogen sector in Portugal, the Government has been working on a framework to *boost* green hydrogen production.

In this context, the National Energy and Climate Plan 2021-2030 (PNEC 2030) and the National Strategy for Hydrogen have established a commitment to increase, within the next decade, the production and incorporation of renewable gases such as hydrogen, foreseeing the end of electricity production from coal by 2023.

More specifically, the Portuguese Government has made a very relevant effort to amend the existing legislation aiming precisely to potentiate not only the production, but all businesses associated to the green hydrogen sector, which necessarily need stability to be developed.

It was in this setting that the legislator enshrined new solutions in the revised law on the organization and functioning of the (new and renamed) National Gas System, which currently

foresees a simplified procedure of mere prior registration for access to the activity of production of renewable gases, which may be considered approved within 30 days.

This fundamental diploma, amended in 2020, also created the regulatory conditions for the decarbonization of the Natural Gas Network, setting the technical and regulatory requirements for the injection of hydrogen (and methane) into the transport and distribution networks (it is estimated that the national public network is almost ready to receive 20% of direct injection of green hydrogen without major investments) and extending (and adapting) the system of guarantees of origin/certification for renewable gases.

Finally, it is relevant to note that self-consumption of gases of renewable origin was recently enabled by the relevant applicable legislation, thus opening doors within the sector of gases of renewable origin, to what, nowadays, is a dynamic and growing reality in electricity.

Funding & Support schemes

The Portuguese Government has been drawing attention to the fact that stable support and incentive mechanisms are absolutely essential to allow volume and price risk mitigation, as well as to subsidize economic affordability in the initial stages of the implementation of hydrogen projects.

It is worth highlighting the way the Portuguese government designed the Recovery and Resilience Plan (RRP), placing the production of green hydrogen as one of the priorities of the country's energy and industrial policy. In this framework, it is planned to allocate more than €2.5 billion from the RRP to the so-called "industry mobilisation agendas", in which projects related to innovation, energy transition, export capacity and creation of skilled jobs are at the forefront of eligibility. Now, as it is easy to understand, green hydrogen industrial projects make the most of these markers, so it is anticipated that they will grab a huge slice of this €2.5 billion "funding envelope".

In what concerns direct public subsidies planned in the short and medium term, a first step was taken with the recent approval of 13 projects supported with public funds of €40 million, for investments of €62 million for the production of hydrogen and biomethane (8,500 T/year/34 MW year), followed by the launch of a tender under the Resilience and Recuperation Plan for the allocation of €62 million

for green hydrogen production projects (up to 10 million per project). The first tender, whose application period closed on 31st December 2021, will be succeeded by two other procedures, which should take place in 2022 and 2023 and which, together with the first, total a funding of €285 million.

Moreover, the Minister of Environment and Climate Action has very recently reaffirmed the Government's commitment to carry out an auction to support the capex of industrial consumer investments, to be launched in the first quarter of 2022, aimed at the purchase of 100,000 tonnes of green hydrogen, which will subsequently be made available to consumers at the cost of natural gas.

Finally, the decree of law applicable to the National Gas System now prescribes the possibility for the member of the government responsible for energy to set specific purchase schemes for gases from renewable sources and other production support mechanisms, provided the internal market rules on State Aid are respected.



H2Sines aims to produce 465,000 tons of hydrogen per year using solar and wind energy at competitive prices

Up-coming evolution

Portugal aims for a 47% share of renewables in final energy use by 2030, in all sectors, not just the electricity sector. The goal is 2.5 GW of green hydrogen capacity by the end of the decade to promote the decarbonization of heating and transport.

Portugal also plans to develop 2 valleys, one in the North of Portugal, in which the Bondalti project for the production of renewable gases and green ammonia assumes a prominent position, providing for an investment of €2.4 million in the years to come, and another in Sines, already being launched.

It is estimated that the creation of an industrial cluster in the field of green hydrogen could attract investments of €7 billion to Portugal by 2030.

Some recent examples

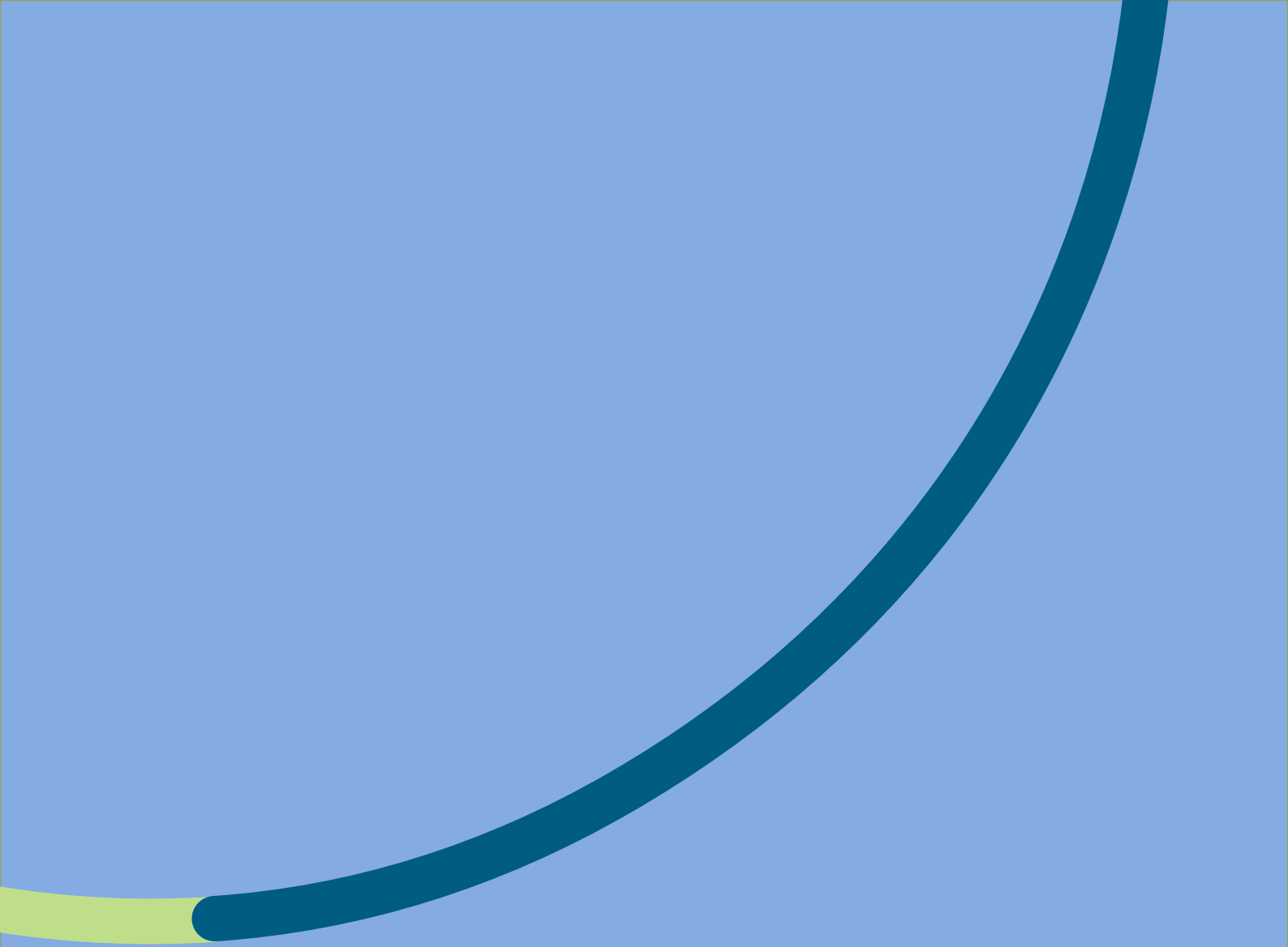
At the end of last year, the Government announced the approval by the European Commission of three projects — Bondalti, Fusion Fuel and 1s1 Energy — to be presented to the IPCEI (Important Projects of Common Interest), besides the H2Sines, which has already been granted €40 million of funding directly from Brussels.

Aiming to produce, on an industrial scale, 465,000 tons of hydrogen per year, using solar and wind energy at competitive prices, H2Sines represents a higher base investment that is expected to reach €2.85 million. This project also aims to optimize the network infrastructures (electricity and natural gas networks), as well as the Sines maritime terminal for the export of hydrogen, establish a filling station for hydrogen vehicles and enhancing the creation of a structure addressed to support scientific research areas for the development of a hydrogen economy.

The project in Sines is one developed on a large industrial scale that encompasses the entire value chain and will be developed by an international consortium consisting of several international private investors.

2.5 GW

Green hydrogen capacity by the end of the decade



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