Ashurst

Investing in hydrogen

A global guide

Outpacing change

contents

Introduction

With the growing investor focus on the emerging hydrogen market, our interactive tool helps clients navigate the evolving hydrogen strategies and regulations, the available incentives and major projects taking place in countries that are focused on this market.

The purpose of the interactive map is to enable better decision-making with regards to investability in hydrogen around the world. The tool provides our clients with a complete picture when considering their investment opportunities by covering the same questions for each country on policy, regulation, market developments and opportunities to allow comparison.

Argentina

Ashurst collaborated with **Beccar Varela** in the preparation of this content. We are grateful for their input.

Policy and regulation

1. Is there a government hydrogen strategy or policy?

Yes, the National Strategy for the Development of the Hydrogen Economy, a public policy tool that lays down lines of action and goals for 2050 to generate certainty around the development path of low-emission hydrogen.

The first actions, aimed at promoting public-private dialogue, began in 2021 and resulted, in February 2023, in the constitution of the Hydrogen Intersectoral Roundtable. This space worked on the coordination between the private sector and different areas of government, national and provincial, to develop the National Hydrogen Strategy (NHS).

In May 2023, the National Executive Power submitted to the National Congress the bill for the "Promotion of Low Carbon Hydrogen and Other Greenhouse Gases". The purpose of this legislative initiative is to promote low-emission hydrogen production projects, organize the governance of the sector and promote productive and technological development along the entire value chain.

Finally, the Secretariat of Strategic Affairs, in coordination with the Ministry of Environment and Sustainable Development, is conducting a Strategic Environmental Assessment to provide a sustainability framework for the NHS, plan the territorial deployment of this new activity and ensure the objectives of a just transition.

These actions promoted by national public policy are in addition to the strategic planning efforts made by provincial governments, the private sector and the academic sector.

2. What are key goals and commitments included in the strategy/policy?

The vision guiding the NHS has three axes. First, it recognizes the importance of promoting technological and productive development throughout the value chain, including the production of critical capital goods and the provision of technological services.

Secondly, taking into account the different resources and capacities available in the Argentine territory, it contemplates the production of low-emission hydrogen by means of different technologies, either from renewable sources (green), from nuclear energy (pink), or from fossil fuels with carbon capture (blue).

Third, it establishes two pillars for the deployment of the hydrogen economy: the domestic market, fundamental to generate initial conditions, evaluate prototypes and develop national technology; and export markets, oriented to highly competitive large-scale production, taking advantage of the quality of natural resources and built capacities.

Some of the goals and commitments included in the NHS are:

- To promote competitiveness in the hydrogen production poles to create and promote the domestic and export markets.
- To promote the development of local suppliers of capital goods, inputs and equipment, and knowledge-based services, especially those associated with the demands of the production poles.
- To promote pilot-scale demonstration projects that allow estimating real costs of low-emission hydrogen production with different technologies, in different locations and considering logistics.
- To improve the efficiency of critical technologies for the production of low-emission hydrogen, such as electrolysis and Carbon Capture, Utilization and Storage (CCUS) technologies, based on technology transfer and innovation.
- To increase the generation of renewable energies at competitive costs.

3. Which industry sectors are most likely to be affected by hydrogen deployment?

In Argentina, low-emission hydrogen involves several value chains: those associated with energy generation; the production and storage of hydrogen itself and its by-products and derivatives; and chains related to the uses of hydrogen and its applications. Each of these chains in turn is made up of specific segments that require a wide range of technological and industrial skills. These include: (i) the provision of critical inputs and materials; (ii) the production of capital goods, as well as their parts and pieces; (iii) the construction of infrastructure for transportation and storage; (iv) the provision of knowledge-intensive services, from engineering services to research and development activities; (v) the adaptation of goods and services for the use of low-emission hydrogen; (vi) the production of hydrogen-derived products such as synthetic fuels; and (vii) the production of industrial goods using low-emission hydrogen to access new markets, such as steel or low-emission fertilizers.

4. Who are the main regulators for the hydrogen market?

Given the premature nature of the clean hydrogen market in Argentina, there is no clear-cut answer to this question. There are no specific regulators of hydrogen production and exportation in Argentina. Notwithstanding the foregoing, the bill for the "Promotion of Low Carbon Hydrogen and Other Greenhouse Gases", which aims to regulate the market, sets forth that the main regulator shall be the Secretary of Energy of the Ministry of Economy which shall be empowered to issue the necessary derivative, complementary, clarifying, and operational regulations for the proper compliance of the bill. So, it is expected that if the bill is passed, the Secretary of Energy will be the enforcement authority.

5. Does the government hydrogen strategy or policy support the development of both low carbon (blue) hydrogen and renewable (green) hydrogen?

Yes. Argentina has great potential for the generation of green, pink and blue hydrogen. The first due to the optimal conditions to generate renewable energies such as solar, wind and hydroelectric, being the country recognized globally as one of the potential suppliers of hydrogen. Argentina also has potential to produce pink hydrogen due to its nuclear capabilities. Argentina has been recognized as one of the leading countries in the region in terms of nuclear technology and nuclear energy.

In the case of blue hydrogen, Argentina has the second largest unconventional gas reservoir in the world. In particular, Argentina has the possibility of leveraging the production of blue hydrogen from its vast gas resources, converting the current production of grey hydrogen to the production of blue hydrogen, with carbon dioxide capture and storage and emissions measurement.

6. If the government hydrogen strategy or policy supports the development of low-carbon hydrogen, to what extent is carbon capture and storage being taken forward?

In Argentina, the contribution of scientific and technological research to increasing the efficiency of technological assets is essential to improve the competitiveness of local low-emission hydrogen production. Over the next few years, the government expects that due to the NHS a number of technological sectors will become very dynamic, mainly electrolysers and CCUS technologies. Strengthening the country's research and development, together with industrial capabilities in the field of electrolysers, mainly alkaline, is a strategic aspect for Argentina to position itself in the technological race linked to hydrogen. These technological developments will make possible to offer local technology to projects in the country.

7. Are there targets for the production of hydrogen?

Neither the bill for the "Promotion of Low Carbon Hydrogen and Other Greenhouse Gases" nor the NHS set forth any hard targets for the production of hydrogen.

8. Are there any incentive mechanisms/business models in place to support the production of hydrogen?

The NHS foresees the need for a framework of incentives to promote the production of hydrogen and that it is essential to have an active policy of seeking investments and promoting the opportunities offered by the country in order to establish Argentina in the world markets as a safe and reliable supplier of hydrogen, ammonia and low-emission synthetic fuels.

Currently, there are no incentive mechanisms or business models in place to support the production of hydrogen. In fact, the bill for the "Promotion of Low Carbon Hydrogen and Other Greenhouse Gases" is still being debated in Congress, so there are still many issues to be closed. In order to encourage investments, the bill includes measures such as accelerated amortization of income tax, early VAT refund and the establishment of a tax stability regime. The following are some of the measures included in the bill:

- Accelerated amortization in Income Tax and accreditation and/or early refund of Value Added Tax
- Accelerated amortization in Income Tax
- Extension of the term to compute losses
- Deduction of the Financial Burden of Financial Liabilities
- Exemptions for importation of goods
- Benefits for suppliers
- Specific and exclusive allocation of the imported goods
- Fiscal Stability for THIRTY (30) years
- Access to the Free Exchange Market

In fact, the bill for the "Promotion of Low Carbon Hydrogen and Other Greenhouse Gases" includes a whole chapter regarding the encouragement of investment through different incentive mechanisms.

9. Are there any standards in place for the classification and/or certification of low-carbon or renewable hydrogen?

One of the main goals of the NHS is to develop low-emission hydrogen certification and build capacity for agile and transparent certification with international acceptance, as well as to strengthen certification capabilities and increase the total number of supplier companies certified according to international quality and industrial safety standards. In Argentina, the National Institute of Industrial Technology (NIIT) is working on the development of a roadmap for the certification of origin of green and low-emission hydrogen. Progress is being made within the framework of an Interinstitutional Project on Strategic Issues (PITES), coordinated by Y-TEC (an entity owned by YPF S.A., the largest oil & gas company in Argentina and CONICET, the National Scientific Investigation entity).

It is expected that Argentina will implement before 2030 a certification of origin scheme based on emissions criteria without technological preference. This system will be supported by existing public capacities and will have clear mechanisms for determining emissions, adaptable to technological change and aligned with the requirements of the adopting markets.

10. Does the regulatory framework clearly define the regulatory requirements relating to the production, storage, transportation or supply of hydrogen?

No, although the NHS emphasises the need for regulation and the development of public policies on this regard.

11. Are there any foreign investment restrictions related to energy and infrastructure sectors?

No, foreign investment is actually encouraged throughout the NHS document (the expected amount of investments compatible with expected production is around US$90 billion.). In this sense, the bill for the "Promotion of Low Carbon Hydrogen and Other Greenhouse Gases" foresees the adoption of effective promotion tools to encourage investments.

12. What international treaties are in place that may offer protection to international investors in hydrogen projects in the jurisdiction

Argentina has signed 50 bilateral investment treaties (BITs) that are currently in force, in addition to other treaties that may contain protections for foreign investors. These can be viewed through the following link **here**.

Market developments and opportunities

13. Are there any government grants or other government funding available to hydrogen projects (including for research and development)?

Currently, there are no government fundings available to hydrogen projects, although the bill for the "Promotion of Low Carbon Hydrogen and Other Greenhouse Gases" entrusts the Executive Committee of the National Fund for Productive Development (FONDEP) to carry out the necessary actions for the purpose of constituting a Specific Allocation Fund aimed at financing projects of manufacturers of equipment of the low emission hydrogen value chain, as well as suppliers of goods and/or services of high technological content for the same sector. The Specific Allocation Fund is expected to be able to:

- Provide funds and grant facilities through loans, acquisition of public or private trust securities, to the extent that these were issued for the exclusive purpose of obtaining financing for projects in any of the phases of the low emission hydrogen value chain and in research, innovation or pilot projects that promote the generation of local value, the development of national technology, qualified employment and the improvement of the competitiveness of the national hydrogen industry in the domestic or international market.
- Make capital contributions in companies that carry out the projects and subscribe any other financing instrument determined by the authority of application.
- Discount percentage points of the interest rate of credits and securities granted or in which financial entities or other actors intervene in the role of financing providers.
- Provide a mandatory minimum contribution on its total available resources to be destined to investments in science and technology, innovation and development, in public and private entities belonging to the National System of Science, Technology and Innovation defined by the Law of Science, Technology and Innovation No. 25,467; for the promotion of the development of the hydrogen industry in the national territory and the training of technicians and professionals in the matter.

14. Are there any notable pilot/demonstration projects in place or planned for the production or offtake of clean hydrogen?

The NHS aims to promote pilot-scale demonstration projects that allow estimating real costs of low-emission hydrogen production with different technologies, in different locations and considering logistics. Two pilot plants, pioneers in the region, are currently operating in the country:

- **Hychico Pilot Plant**, in the Province of Chubut, has been producing high purity green hydrogen since 2008, with a 2.3 km pipeline system and a geological storage facility. The production is experimentally applied to mixtures with natural gas and a 1.4 MW generator, it is also suitable for use in fuel cells.
- **Pico Truncado Experimental Plant**, in the Province of Santa Cruz, is a Green Hydrogen Experimental Plant and a human resources training centre for the development and testing of technology in a real environment. Nearby, the Energy Scientific and Technological Pole for Southern Patagonia will be built, promoted by the National Ministry of Science, Technology and Innovation, the Institute of Science, Technology and Innovation of the Province of Santa Cruz and the Innovation and Development Agency.

15. Are there any commercial-scale clean hydrogen production projects in development or already operating?

There are currently no existing commercial-scale clean hydrogen production projects operating in Argentina. But some initiatives were recently announced. In this sense, Fortescue Future Industries announced that it has entered into a Framework Agreement with the Province of Rio Negro to commence prospecting and feasibility work for green hydrogen projects in such Province. Pursuant to public announcements, Fortescue aims to invest US$8.4 billion in the country for the production of green hydrogen, creating more than 15,000 direct jobs in Argentina.

16. Have there been any hydrogen-related disputes in your jurisdiction?

No.

Last updated April 2024

Australia

Policy and regulation

1. Is there a government hydrogen strategy or policy?

1.1 National and State Hydrogen Strategy

Yes, **Australia's National Hydrogen Strategy** was published on 22 November 2019. **The State of Hydrogen 2022**, the **National Hydrogen Strategy 2023 Review** and the **National Hydrogen Infrastructure Assessment 2023** provide an update of the Australian Government's progress on the National Hydrogen Strategy so far.

Each Australian State and Territory, except for the ACT, have also released their own hydrogen strategies and policies, including the:

- **Queensland Hydrogen Industry Strategy 2019-2024**, published on 30 May 2019, **Queensland Energy and Jobs Plan** update published in November 2023 and **Queensland Hydrogen Investor Toolkit** published in April 2024;
- **Western Australian Renewable Hydrogen Strategy (2021 Update)** published in January 2021, **Mission Update** published in December 2022; **Renewable Hydrogen Roadmap** published on 17 November 2020 and **Western Australia Renewable Hydrogen Investment Prospectus** published in November 2023;
- **South Australia's Hydrogen Action Plan** and **Hydrogen Export Prospectus**, published in September 2019 and October 2020, respectively;
- **Northern Territory Renewable Hydrogen Strategy**, published in July 2020 and **NT Renewable Hydrogen Master Plan** published in October 2021;
- **Victorian Renewable Hydrogen Industry Development Plan**, published on 25 February 2021 and **Gas Substitution Roadmap update** published in November 2023;
- **Tasmanian Renewable Hydrogen Action Plan**, published in March 2020 and **Tasmanian Renewable Hydrogen Action Plan Status Report**, published in February 2021;
- **New South Wales Hydrogen Strategy**, published in October 2021 and **New South Wales Hydrogen Investment Prospectus** published in March 2022; and
- **ACT 2020-2025 Sustainable Energy Policy Discussion Paper** (which is not a specific hydrogen strategy but discusses the consumption of hydrogen as part of the Territory's general renewable energy strategy and the development of a natural gas transition plan) published in 2019 and **ACT Zero Emissions Vehicles Strategy 2022-30**, published in 2022.

1.2 Hydrogen Headstart

The Australian Government will invest $2 billion in the new Hydrogen Headstart program, providing revenue support for large-scale projects through competitive hydrogen production contracts. The EOI process for the Hydrogen Headstart program opened on 10 October 2023. On 21 December 2023, the Australian Government announced the six shortlisted applicants who are required to submit a full application by 27 June 2024. The shortlist shows a healthy pipeline of hydrogen projects which represent a total electrolyser capacity of 3.5GW across various end uses predominantly in hard to abate sectors such as ammonia. This funding is intended to bridge the commercial gap between the cost of hydrogen production from renewables and its current market price for early projects.

1.3 The National Energy Transformation Partnership (NETP)

On 12 August 2022, the Energy Ministers at Commonwealth, State and Territory levels agreed to establish a new **National Energy Transformation Partnership (NETP)**, which reports to the Energy and Climate Change Ministerial Council. The National Energy Transformation Partnership is a framework for the Australian Government and State and Territory governments to collaborate on reforms to help transform Australia's energy system to achieve net zero by 2050. Through the partnership, each jurisdiction works collaboratively whilst continuing to pursue its own energy policies. Priority work agreed under the NETP includes the establishment and expansion of the **Capacity Investment Scheme**, agreeing State-based support for the **Rewiring the Nation** program, and the development of a **First Nations Clean Energy Strategy**. The Australian government has made a $157.9 million commitment to facilitating the priority works of the NETP.

1.4 Hydrogen Production Tax Incentive (HPTI)

As part of the Future Made in Australia agenda, the Australian Government announced the **Hydrogen Production Tax Incentive (HPTI)** as part of the 2024–25 Federal Budget. The HPTI aims to attract investment in Australia as an emerging player in hydrogen by incentivising renewable hydrogen production with a refundable, uncapped tax offset that will apply to eligible producers for a maximum of 10 years between 2027-28 and 2039-40. Notable features of the HPTI include that hydrogen

production will be matched with GO Scheme, it will support the cleanest hydrogen with an emissions intensity threshold of less than or equal to 0.6kg of carbon dioxide up to the production gate, and will only be available to producers that align with the Future Made in Australia Community Benefit Principles. Eligible entities can also apply for the HPTI in conjunction with Hydrogen Headstart funding. Public consultation on the HPTI's proposed design, administrative arrangements and interaction with other government incentives closed on 12 July 2024.

1.5 Policy Amendments Affecting Hydrogen

On 28 October 2022, Energy Ministers agreed to amendments to the National Gas Law and National Energy Retail Law (**NERL**) to bring hydrogen, biomethane and other renewable gases under the national gas regulatory framework. The reforms aim to provide regulatory certainty to support investment in innovative projects that will reduce emissions in Australian gas networks. This consistency will support Australia's approach to developing a competitive and cost-efficient hydrogen market. The reforms also ensure existing regulatory provisions and consumer protections under the NERL work as intended when hydrogen and renewable gases are incorporated into the gas network.

Following public consultation and input from the Australian Energy Market Commission, in September 2023 the Statutes Amendment (National Energy Laws) (Other Gases) Bill 2023 (SA) was introduced into the South Australian Parliament (the jurisdiction seat of national energy regulation in Australia). The Statutes Amendment (National Energy Laws) (Other Gases) Act 2023 (SA) received assent on 23 November 2023 and came into operation on 7 March 2024.

2. What are key goals and commitments included in the strategy/policy?

The key goals of Australia's National Hydrogen Strategy are that by 2030:

2.1 Export: Australia is one of the top three exporters of hydrogen to Asian markets

How?: Australia has committed to co-funded projects with various nations that range from technological collaborations, supply chain testing and standards development. Australia and many Australian States have also entered into a variety of hydrogen-related Memorandums of Understanding (**MoU**) in the Asian and European markets, including the:

- **Comprehensive Strategic Partnership** between Australia and Korea to support research on hydrogen supply chains between Korean and Australian companies;
- **MoU between NSW and Tokyo**, which will open doors for bilateral investment opportunities and further trade ties, focusing on hydrogen;
- **Memorandum of Cooperation between the Australian Hydrogen Council and the Japan External Trade Organisation** to foster collaboration to advance hydrogen priorities and advance trade ties between Australia and Japan;
- **MoU between Australia and the Netherlands** to support the Port of Rotterdam's work with State governments in **Tasmania**, **Queensland**, **Western Australia** and **South Australia** towards the establishment of a large-scale hydrogen network between the two countries;
- **Australia-Germany Hydrogen Accord** to advance the global renewable hydrogen industry, including committing to the **Hydrogen Innovation and Technology Incubator**, facilitating industry-to-industry cooperation on demonstration projects in Australian Hydrogen Hubs and facilitating trade of Australian hydrogen and its derivatives produced from renewable energy sources, including through H2Global; and
- **Terms of reference for the India-Australia Green Hydrogen Taskforce** to report to the India-Australia Ministerial Energy Dialogue on trade, commercial and research opportunities between the two countries through the manufacture and deployment of green hydrogen.

2.2 Safety: Australia has an excellent hydrogen-related safety track record

How?: The Australian Government is a member of the U.S. Centre for Hydrogen Safety. This gives all Australian governments access to some of the world's foremost expertise in hydrogen safety. Standards Australia and CSIRO have also developed HyStandards to identify the relevant hydrogen standards in a range of hydrogen facility scenarios, including electrolyser hydrogen production, gaseous hydrogen transport by road, hydrogen transport by pipeline, blended hydrogen transport by pipeline and hydrogen refuelling. Additionally, Standards Australia has also formed its own ME-093 Hydrogen Technologies committee, dedicated to developing international standards and representing Australia's national interests in hydrogen technologies to ISO and IEC, as detailed in the ME-0903 Hydrogen Technologies Strategic Work Plan.

2.3 Economy: Hydrogen is providing economic benefits and jobs in Australia

How?: The Australian Government has set a goal for hydrogen production of under $2 per kilogram ('H2 under $2') to make hydrogen competitive with conventional fuels. Some Australian States, including NSW, WA and NT, have set similar goals as part of their hydrogen strategies. NSW, for example, has set a goal of hydrogen priced at under $2.8 per kilogram by 2030. Other States, including VIC, QLD, SA, TAS and ACT, have not made any such goals but have rather set out key focus areas for developing the hydrogen industry in their respective States.

QLD has also released its **Energy and Jobs Plan** (update published in 2023) which includes a goal to finish constructing the Queensland SuperGrid which includes key Hydrogen Hubs at Gladstone and Townsville, and will create around 100,000 jobs by 2040, including across key sectors like renewable hydrogen. Construction of the SuperGrid is supported by the ***Energy (Renewable Transformation and Jobs) Bill 2023* (Qld)** which will enshrine the commitments into legislation, creating the frameworks needed to progress the SuperGrid and assist in the renewable energy transition. The Energy and Jobs Plan is backed by the boosted $4.5 billion Queensland **Renewable Energy and Hydrogen Jobs Fund** which aims to unlock opportunities in and grow the future of the renewable hydrogen industry in Queensland.

South Australia has a **Hydrogen Jobs Plan** too, which commits more than half a billion dollars to build the **200 MW Whyalla hydrogen power plant** which, once operational, will be a new source of flexible power, providing additional grid stability around the State by utilising excess renewable energy generated from large-scale wind and solar farms to provide a consistent output of supply. The Hydrogen Jobs Plan project objectives include to: (1) help unlock pipelines of renewable energy developments and business opportunities; (2) prove large-scale hydrogen production and generation technology; and (3) activate other hydrogen projects in development, including export-focused projects, all while maximising the employment opportunities for South Australians in the delivery of these significant projects.

In Victoria, public consultation is currently occurring on the proposed **Victorian Energy Jobs Plan** set to be published in late 2024. The plan, as it is proposed, will support Victoria in developing the workforce required to deliver 95% renewable electricity generation by 2035. The Victorian Government has designed the consultation paper to present an update on current developments of the plan and provide key stakeholders, rightsholders and unions with an opportunity to give feedback and input on key questions and issues.

2.4 Certification: Australia has a robust, internationally accepted, provenance certification scheme in place

How?: The Department of Climate Change, Energy, the Environment and Water has developed, in partnership with the Clean Energy Regulator, an internationally aligned, voluntary and product-based emissions accounting framework called the Guarantee of Origin Scheme. The **Guarantee of Origin Scheme** will show where a product has come from, how it was made, and the emissions throughout its lifecycle. It is intended to assist in unlocking economic opportunities for the Australian industry to meet growing domestic and international demand for verified green hydrogen. Public consultation on the Guarantee of Origin scheme design closed on 24 October 2023, and the last round for feedback to inform the final legislation and drafting of regulations ended on 14 November 2023. It is anticipated that legislation will be in place in 2024. Australia is also signatory to the **COP28 Declaration of Intent on Mutual Recognition of Certification Schemes for Renewable and Low-carbon Hydrogen and Hydrogen Derivatives**.

3. Which industry sectors are most likely to be affected by hydrogen deployment?

The industry sectors which are most likely to be affected by hydrogen development include:

- the energy sector (including electricity grid support, electricity generation and gas networks);
- chemical production (including ammonia production);
- mining and other off-grid large electricity consumers;
- heavy and light transport industries;
- steel making;
- industrial heat; and
- marine and agricultural industry.

4. Who are the main regulators for the hydrogen market?

The Energy and Climate Change Ministerial Council (**ECMC**) works closely with Energy Consumers Australia and has oversight of the energy market institutions responsible for regulating the hydrogen industry: the Australian Energy Regulator, the Australian Energy Market Commission and the Australian Energy Market Operator. Various Commonwealth Departments and authorities in each State regulate planning and environmental approvals, workplace health and safety, the supply of power and utilities and dangerous goods regulation and standards. Both the Commonwealth and NSW have published regulatory guides which set out the key regulators for various example projects including hydrogen production and export (see **here** (Commonwealth) and **here** (NSW)). The Clean Energy Regulator will be the regulator of the Guarantee of Origin scheme. The ECMC's Hydrogen Working Group and Legal Frameworks Review Sub-working Group also provide strategic oversight and suggest areas for future national policy investigation and review, for example by co-developing the **National Hydrogen Codes of Best Practice**, expected in 2024.

5. Does the government hydrogen strategy or policy support the development of both low-carbon (blue) hydrogen and renewable (green) hydrogen?

The **National Hydrogen Strategy** supports the development of both blue and green hydrogen and includes both types in its definition of renewable hydrogen. However, the Hydrogen Headstart program ruled out funding for blue hydrogen, shifting its focus to green hydrogen production only.

Some Australian States, including NSW, QLD, NT and TAS, have committed to pursuing green hydrogen only. WA, similar to the federal government, explicitly supports the development of both blue and green hydrogen, whereas other States have not explicitly expressed a preference for the development of blue or green hydrogen.

6. If the government hydrogen strategy or policy supports the development of low-carbon hydrogen, to what extent is carbon capture and storage being taken forward?

The **National Hydrogen Strategy** recognises that Australia is well situated to take advantage of carbon capture and storage (**CCS**) and carbon capture use and storage (**CCUS**) technologies to produce low-emissions hydrogen from coal and natural gas. However, Australia does not currently have a national CCS strategy, or any policy specifically aimed at encouraging or facilitating the development of a CCS industry in Australia. Historically, the Federal Government has established the $50 million **CCUS Development Fund** and the $250 million **CCUS Hubs and Technologies Program**. Both funds are now closed, with the Hubs and Technologies Program being replaced in the 2022-23 Federal Budget with $141.1 million for the '**Carbon Capture Technologies for Net Zero and Negative Emissions**' program, which was removed from the 2023-24 Federal Budget.

The Australian Government has developed a method to credit abatement from new CCS projects under its **Emissions Reduction Fund** (a fund established to purchase abatement of carbon emissions, in the form of Australian carbon credit units).

The Victorian and Australian Governments are developing a multi-user CCS hub network in Gippsland, Victoria through their joint **'CarbonNet project'**. CarbonNet plans to build a 100km CO2 pipeline from the Latrobe Valley to the Gippsland Basin, enabling new decarbonised industries to contribute to Victoria's 2035 interim emissions reduction target and a net zero emissions outcome by 2045. The **NT Hub** (Northern Territory) and **South West Hub** (Western Australia) CCUS projects are also in their research phase.

Notably, due to legislative constraints, the Australian Government-owned green bank, the Clean Energy Finance Corporation (CEFC), expects to be prohibited from investing in blue hydrogen projects due to the fact that they include a CCS component. In 2022, the CEFC became the first Industry Supporter of the Australian Carbon Industry Code of Conduct, which is identified as an important risk management and due diligence tool in assisting the participation and procurement in the hydrogen market. Since July 2021, the Australian Renewable Energy Agency's (ARENA) funding scope includes CCS projects, aiming to reduce the mean cost of carbon dioxide compression, hub transport and storage in Australia to below $20 per CO2 tonne.

7. Are there targets for the production of hydrogen?

There are currently no targets for the production of hydrogen as part of the **National Hydrogen Strategy**. The Australian Government considered in its National Hydrogen Strategy that mandatory national targets would not be appropriate at this time but should be re-considered periodically as the market develops. The NSW State Government has in the **NSW Hydrogen Strategy** set a target for the production of 110,000 tonnes of renewable hydrogen production per year by 2030, but other States have not set such targets.

8. Are there any incentive mechanisms/business models in place to support the production of hydrogen?

The **National Hydrogen Strategy** and State and Territory strategies include a number of financial incentive mechanisms to support the production of hydrogen (these are detailed below in the discussion of government funding available for hydrogen projects (13)). The National Hydrogen Strategy and many State and Territory government strategies do not include any business models to support the production of hydrogen. There are various investor tools available, such as the **Queensland Hydrogen Investor Toolkit** and **South Australia's Hydrogen Export Prospectus**, to assist potential proponents reach financial decisions in respect of hydrogen projects in Australia. The **Hydrogen Economic Fairways Tool** also help policymakers and investors make decisions about the location of new infrastructure and the development of hydrogen hubs.

9. Are there any standards in place for the classification and/or certification of low-carbon or renewable hydrogen?

As noted above, the Australian Government has developed an internationally aligned **Hydrogen Guarantee of Origin Scheme** (the **GO Scheme**). The GO Scheme is intended to assist in unlocking economic opportunities for the Australian industry to meet growing domestic and international demand for verified renewable electricity and low emissions products. The GO Scheme is designed to be a voluntary, product-based emissions accounting framework that measures and tracks emissions and associated information across value chains. The GO Scheme has been developed with internationally aligned emissions accounting methodologies in close collaboration with international energy partners and forums to ensure consistency in meeting the needs of importers of Australia's clean energy. It is intended that the GO Scheme will expand to international trading partners in the future. At COP28 in 2023, Australia signed the **Declaration of Intent on Mutual Recognition of Certification Schemes for Renewable and Low-carbon Hydrogen and Hydrogen Derivatives** under which the participants seek to work towards mutual recognition of their respective certification schemes.

As part of the **National Hydrogen Regulatory Review**, the Australian Government along with State and Territory governments are currently reviewing legal frameworks and standards relevant to the development and safety of the hydrogen industry to determine if existing regulatory frameworks are sufficient and if any amendments are required.

10. Does the regulatory framework clearly define the regulatory requirements relating to the production, storage, transportation or supply of hydrogen?

10.1 National Regulations

The Australian federal regulatory framework does not currently clearly define regulatory requirements relating to the production, storage, transportation and/or supply of hydrogen. However, any hydrogen production facility should consider broad regulatory issues such as environmental impact, storage of dangerous goods and water sourcing requirements. The Federal Government has published **lists of legislation and relevant regulators for six hypothetical hydrogen projects**. As a result of a recent review of Australia's legal frameworks to assure hydrogen safety, industry development and national consistency, the Australian Government, States and Territories are developing a range of **National Hydrogen Codes of Best Practice** which are expected to progress in 2024. The NETP aims to provide certainty in the storage and transmission of hydrogen nationally.

10.2 State Regulations

- (**New South Wales**) Most of the legislation relevant to the Hydrogen Strategy is in the **Electricity Supply Act 1995 (NSW)** as amended by the **Energy Legislation Amendment Act 2021 No 34 (NSW)** under Schedule 1 'Amendment of Electricity Supply Act 1995 No 94 (NSW)', which introduced significant exemptions from government fees for green hydrogen producers. NSW has also introduced the **Gas Supply (Safety and Network Management) Regulation 2022 (NSW)** which includes requirements in regards to the safe injection of hydrogen-natural gas blends within the gas distribution network. The regulations commenced on 1 September 2022. The NSW Government published its **Hydrogen Guideline - Guide to the NSW planning system** in March 2023 and its **Hydrogen Regulatory Guide** in December 2023. It is anticipated that other States and Territories will publish their own legislation lists.
- (**South Australia**) SA has currently published its draft ***Hydrogen and Renewable Energy Regulations 2024* (SA)**, which will implement Australia's first "one window to government" licencing and regulatory system for large-scale hydrogen and renewable energy projects. Under the ***Hydrogen and Renewable Energy Act 2023* (SA)**, fit for purpose licensing arrangements will be established for projects across all land types, enabling **regulation of the whole project life cycle**. Consultation on the regulations concluded on 15 April 2024, and are expected to be finalised in the first half of 2024. SA has also declared hydrogen to be a regulated substance under the ***Petroleum and Geothermal Energy Act 2000* (SA)**. It received assent on 23 November 2023 and the ***Statutes Amendment (National Energy Laws) (Other Gases) Act 2023* (SA)** came into operation on 7 March 2024.
- (**Queensland**) In May 2020, the Queensland Government released the **Queensland Hydrogen Investor Toolkit** which provides an overview of the information on regulatory approvals in Queensland. In October 2023, the ***Gas Supply and Other Legislation (Hydrogen Industry Development) Amendment Bill 2023* (Qld)** passed in Queensland Parliament, which amends the ***Gas Supply Act 2003* (Qld)** and ***Petroleum and Gas (Production and Safety) Act 2004* (Qld)**. The ***Gas Supply and Other Legislation (Hydrogen Industry Development) Amendment Act 2023* (Qld)** commenced on 4 April 2024. It will apply the existing safety frameworks for pipelines in Queensland to hydrogen and other renewable gases, including the requirement to develop safety management systems and comply with safety requirements. In February 2024, the Queensland Government released a consultation paper '**An effective regulatory framework for Queensland's hydrogen industry**' and consultation closed on 1 March 2024.
- (**Western Australia**) WA introduced the **Petroleum Legislation Amendment Bill 2023 (WA)** on 29 November 2023 which proposes to amend the **Petroleum and Geothermal Energy Resources Act 1967 (WA)**, the **Petroleum Pipelines Act 1969 (WA)** and the **Petroleum (Submerged Lands) Act 1982 (WA)** to provide a framework for permanent geological storage and transport of greenhouse gases and provide for the exploration and production of naturally occurring hydrogen as a regulated substance. The status of the Bill is currently at the Legislative Council Second Reading Speech stage. Updates on the status of the Bill are available **here**.

11. Are there any foreign investment restrictions related to energy and infrastructure sectors?

The energy and infrastructure sectors in Australia are subject to Australia's foreign investment regulatory regime, which involves assessment and approval by the Foreign Investment Review Board (**FIRB**). Amendments to the **Security of Critical Infrastructure Act 2018 (Cth)**, effective from 2 and 14 December 2021, expanded the scope of 'critical infrastructure assets' to the energy sector. Critical infrastructure assets are subject to greater scrutiny from FIRB. Critical infrastructure assets relating to the energy sector include critical electricity, gas, energy market operator and liquid fuel assets. Proposed foreign investment into 'critical infrastructure assets' will likely require mandatory FIRB approval. Significant criminal and civil penalties can apply for non-compliance with the **Foreign Acquisitions and Takeovers Act 1975 (Cth)**, such as taking an action notified to FIRB prior to receiving FIRB approval.

12. What international treaties are in place that may offer protection to international investors in hydrogen projects in the jurisdiction?

The **United Nations Conference on Trade and Development** (**UNCTAD**) website states that Australia is a signatory to 15 bilateral investment treaties (**BITs**) in force and 25 other treaties in force which may contain protections for investors in Australia. These can be accessed from **UNCTAD's Investment Policy Hub**.

Australia was a party to the **Energy Charter Treaty** (**ECT**), a multilateral investment treaty which specifically addresses energy trade, transit and investment between its contracting parties, however, Australia withdrew from the treaty in December 2021.

Market developments and opportunities

13. Are there any government grants or other government funding available to hydrogen projects (including for research and development)?

See above for further details on the **Hydrogen Headstart program**.

As part of its **National Hydrogen Strategy**, the Australian Government committed $464 million over 5 years from 2021-22 to develop hydrogen hubs in regional Australia of which an estimated $30 million is available for **Hydrogen Hub Development and Design Grants**. Applications for this grant program closed on 22 November 2021. Federal government funding was also available through the Australian Renewable Energy Agency (**ARENA**) **Renewable Hydrogen Development Funding** program which closed on 20 January 2021. The **2023-24 Portfolio Budget Statement** for Climate Change and Energy delivers a $2 billion investment towards strategic hydrogen projects to cover the commercial gap between the cost of hydrogen production from renewables and its market price.

On 11 April 2024, ARENA **announced its award of $59.1 million in funding across 21 projects** to support the research and development and commercialisation activities covering renewable hydrogen and low emissions iron and steel. A further list of ARENA-funded hydrogen projects is available **here**. The CEFC **Advancing Hydrogen Fund** is aiming to invest up to $300 million in eligible projects to support the development of the hydrogen industry. A further $22.8 million has been committed to support the Australian Energy Regulator to assist in the integration of renewable energy into the National Energy Market.

Australian State and Territory governments, including NSW, VIC, WA, QLD, SA and TAS, have created similar funds including grant programs. Victoria, for example, has created the **Hume Hydrogen Highway** grant which will support the development of refuelling stations along the Hume Highway. The NSW Government is establishing a $250 million **Renewable Manufacturing Fund** to expand local supply chains for renewable energy content. The **Queensland Hydrogen Industry Development Fund** ($15 million) and **Queensland Renewable Energy and Hydrogen Jobs Fund** ($2.5 billion) further support the Hydrogen Strategy and provide funding to successful projects which so far have included **HyP Gladstone**, **SunHQ Hydrogen Hub** and **Kogan Creek Renewable Hydrogen Demonstration**. Tasmania previously launched the $50 million **Tasmanian Renewable Hydrogen Industry Development Funding Program** (in May 2020), which has now closed. From the first round of the Program, the Government provided $2.6 million to support three feasibility studies investigating large-scale renewable hydrogen projects in Tasmania, which have now concluded.

Recently, on 11 April 2024 the **Australian Government announced its 'Future Made in Australia Act'** which proposes taxpayer-funded incentives to advance the manufacturing and clean energy industries in the highlighted areas of hydrogen, green metals and advanced clean energy manufacturing and assembly. At least $18 billion worth of incentives for renewable hydrogen, solar and manufacturing will be consolidated or subsumed within the new policy rubric and additional announcements are likely in the upcoming budget.

14. Are there any notable pilot/demonstration projects in place or planned for the production or offtake of clean hydrogen?

There are a number of different pilot projects being deployed in Australia to examine and test the feasibility of clean hydrogen production and use in different sectors. The CSIRO Hydrogen Industry Mission focuses on leveraging CSIRO's hydrogen research capabilities in partnership with government, industry and the research community.

The Australian and Victorian governments are jointly supporting the **Hydrogen Energy Supply Chain Pilot (HESC) Project** to produce hydrogen in Victoria and export it to Japan in order to test the liquefied hydrogen supply chain from Australia to Japan. The first shipment of liquefied hydrogen took place on 21 January 2022, which successfully ended the pilot phase. Data gathered from the pilot phase is currently under review to determine whether to proceed to a commercialisation phase. An overview of the pilot is available **here**.

The **Central Queensland Hydrogen Project** (**CQH2**) commenced in 2020 as a concept study into a large-scale liquefied renewable hydrogen supply chain between Central Queensland and Japan, with the feasibility study was completed in June 2022. In May 2023, the project plans indicated a commercial operations date of renewable hydrogen targeted for 2029 ramping up in 200 tonnes per day increments as additional offtakes are secured, with full scale production capacity targeted at around 800 tonnes per day by the early 2030s. In October 2023, the Stanwell Corporation Limited (a Queensland Government owned corporation and one of the main proponents of CQH2) announced that it had signed a 15-year, 380-MW Power Purchase Agreement with ACCIONA Energía to purchase 100 per cent of the output from its planned Aldoga Solar Farm, 20 kilometres north-west of Gladstone to the CHQ2 Project. The Aldoga Solar Farm will be located adjacent to the proposed hydrogen production facility and further information on this project is available **here**.

Other notable projects include the **Hydrogen Utility (H2U) Eyre Peninsula Gateway Project** in South Australia.

Recently, Curtin University was awarded $5 million in funding from ARENA or its **Kotai Hydrogen Project**, developed in partnership with Velox Energy Materials, which is a research project investigating the feasibility of using Sodium Borohydride (NaBH4) as a safe 'carrier' of hydrogen that can be deployed on demand (i.e. transporting hydrogen in an inert powder form which can then be added to water to generate hydrogen).

Pure Hydrogen also recently **signed a 5-year lease at Archerfield Airport**, Queensland, to develop the first green hydrogen demonstration micro-hub to service commercial transport operators and the aviation industry, with first supply anticipated at the end of 2024.

15. Are there any commercial-scale clean hydrogen production projects in development or already operating?

There are currently no existing commercial-scale clean hydrogen production projects in Australia, however there are a number of projects in the pipeline. The **AusH2 tool** by GeoScience and the **Hydrogen Map** by CSIRO track hydrogen projects under development, construction or operating in Australia. Notable projects include: **Hunter Energy Hub** and **Illawarra Hydrogen Technology Hub** (NSW), **Port Pirie Green Hydrogen Hub** (SA), H2U **Eyre Peninsula Gateway Hydrogen Facility** (SA), **Port of Bonython Hydrogen Hub** (SA) and the **Edify Green Hydrogen Plant** (QLD).

Despite there being no commercial-scale production projects, in Western Australia, the **Clean Energy Innovation Hub** (WA) has been in operation since mid-2019 providing small-scale services. It incorporates the production, storage and use of hydrogen in micro-grid system applications, including blending with natural gas and in power use. There are some exciting prospects such as the **Gladstone Electrolyser Facility** (QLD), which has seen the completion of the first-phase of the project, the manufacturing facility, which will be the first of its kind in Australia to build electrolysers at a commercial scale. There are also two demonstration projects in WA, the **Commercial Demonstration Plant** and the **Denham Hydrogen Microgrid Demonstration Project**, that are providing hydrogen energy at a small scale, showcasing industry advancement in Australia.

16. Have there been any hydrogen-related disputes in your jurisdiction?

On 18 October 2023, the High Court of Australia handed down its decision in ***Vanderstock & Anor v State of Victoria* [2023] HCA 30**. It ruled that Victoria's charge on the use of Zero and Low Emission Vehicles (**ZLEVs**) (including hydrogen vehicles) was invalid because the charge imposes a duty of excise within the meaning of section 90 of the Constitution. Under that section, imposing duties of excise is a power vested exclusively in the Commonwealth Parliament. Looking ahead, States and Territories will be prohibited from implementing taxes similar to the ZLEV Charge, and in the context of rapidly developing Commonwealth and State policies on climate change, the Court's decision could result in a significant shift in the fiscal balance, with some taxing powers moving away from the States and Territories, and towards the Commonwealth. This is particularly relevant in circumstances where the Commonwealth is fulfilling its international responsibilities under the Paris Agreement. Read more **here**.

Key resources used:

Australia's National Hydrogen Strategy 2019

Australian Government's State of Hydrogen 2022 Report

Advisian Australian hydrogen market study, Sector analysis summary dated 24 May 2021

ARENA's Renewable Hydrogen Development Funding Round

ARENA – Hydrogen Energy

ARENA – Yuri Renewable Hydrogen to Ammonia Project

AEMC's 'Hydrogen: the new Australian manufacturing export industry and the implications for the National Electricity Market (NEM)'

COP28 Declaration of Intent regarding hydrogen and derivatives

CSIRO HyResource

CSIRO - Hydrogen Map

DCCEEW – Extending the national gas regulatory framework to hydrogen blends and renewable gases Joint media release: Delivering Australia's climate and energy transformation

GeoScience – H2 Tool

National Energy Transformation Partnership Australia | Green Hydrogen Organisation (gh2.org)

National Hydrogen Strategy Review 2023

DCCEEW - Hydrogen Headstart program CSIRO HyResource – Industry

Last updated August 2024

Belgium

Policy and regulation

1. Is there a government hydrogen strategy or policy?

On October 29, 2021, the Belgian federal government adopted its first hydrogen strategy. This document announced Belgium's ambitions for renewable molecules and the role it would like to play as an import and transit hub in Europe.

On October 12, 2022, the federal government validated an update of this strategy to reflect the state of progress of its implementation. Additional measures are announced therein taking into account recent developments in the sector.

The strategy of the federal government can be found here.

2. What are key goals and commitments included in the strategy/policy?

The federal hydrogen strategy aims to prepare Belgium for the climate challenges, alongside the technological, political and economic challenges of the coming decades. This strategy is based on 4 pillars/objectives described below.

Pillars/objectives	Measures to achieve the pillars/objective
Positioning Belgium as an import and transit hub for renewable molecules in Europe	• Since 2021: Engage with key partners in order to open 3 main import routes (North Sea route, Southern route and the shipping route) for renewable molecules • 2022: Support the development of hydrogen import infrastructure to have the first imports of H2-molecules (or of H2-derivatives to be cracked into H2-molecules) by 2026 • 2023: Organise hydrogen master classes together with the Belgian Hydrogen Council to establish close relationships with key exporting partners • 2023-2024: Investigate how the development of both electricity and hydrogen networks can complement each other in the North Sea
Expanding Belgian leadership in hydrogen technologies	• 2021: Support research and pilot projects on hydrogen technologies with the two federal R&D funds (Energy Transition Fund and call Clean Hydrogen for Clean Industry) • By 2025: Develop a hydrogen test infrastructure • By 2026: Develop a limited electrolysis capacity of minimum 150 MW
Establishing a robust hydrogen market	• 2023: Set up a framework ensuring an optimal planning of energy transport networks • 2022-2023: Adapt the legal and regulatory framework for the transport of hydrogen per pipeline • 2023-2024: Investigate with the Belgian Regions and/or Europe how the federal government can help to put in place a system to unlock the demand for renewable H2-molecules and • H2-derivatives • By 2025: Develop a European voluntary certification scheme and a register for H2-molecules and H2-derivatives • By 2025: Develop a market hub for H2-molecules and H2-derivatives linked to physical supply hubs in Belgium • By 2026: Develop 100 to 160 km of additional H2 pipelines (new and/or repurposed) to be operated under non-discriminatory third-party access conditions • By 2028: Interconnect the Belgian H2 transport network with Germany, France and the Netherlands
Investing in cooperation as a key success factor	• Implement a structural consultation on hydrogen within Belgium • Adopt a proactive and dynamic attitude within the working groups dedicated to hydrogen (Benelux, Pentalateral Energy Forum and European Union) • Represent Belgium in international organisations and forums on hydrogen • Continuous interactions with the sector, research institutes and citizens to keep this hydrogen strategy up to date with the evolution of the barriers and needs

3. Which industry sectors are most likely to be affected by hydrogen deployment?

The Belgian federal government strategy identifies four sectors that hydrogen will help to make climate neutral by 2050:

- the industry sector (chemical, steel, glass, etc...);
- the transport sector;
- the heating of buildings; and
- the energy distribution sector.

4. Who are the main regulators for the hydrogen market?

The Commission for Electricity and Gas Regulation (the CREG) is entrusted as the independent regulatory authority responsible for overseeing hydrogen transport.

The Belgian government has yet to appoint the hydrogen transport network operator who will be responsible for planning, developing and managing the hydrogen transport network in Belgium.

5. Does the government hydrogen strategy or policy support the development of both low-carbon (blue) hydrogen and renewable (green) hydrogen?

Yes, the federal government hydrogen strategy supports the development of both low-carbon hydrogen and renewable hydrogen.

The federal government hydrogen strategy aims to have only renewable hydrogen in the Belgian energy mix by 2050 or before if possible.

In order to achieve that objective, it is considered necessary to have a phased approach where fossil production with lowered GHG emissions can play a transitional role to kickstart the market.

According to the strategy, such a phased approach would be best suited to ensure both the lowest possible carbon emission and a level-playing field for hydrogen in the current economic context while giving priority only to the climate neutrality of the H2 production would slow down the pace of development of the sector, and thus the development speed of decarbonised solutions for the industry, the transport sector and the other H2 applications.

6. If the government hydrogen strategy or policy supports the development of low-carbon hydrogen, to what extent is carbon capture and storage being taken forward?

The Belgian federal government hydrogen strategy only supports the development of hydrogen production via steam methane reforming and auto-thermal reforming provided that the production installations are coupled with carbon capture and storage as well as pyrolysis plants.

Large scale projects aiming to capture and store CO2 are currently in development in Belgium e.g. the Antwerp@C project.

7. Are there targets for the production of hydrogen?

The production of renewable hydrogen will remain limited in Belgium because of the limited local renewable energy potential. Nevertheless, Belgium has set itself the target of having at least 150 MW of electrolysis capacity into operation by 2026.

8. Are there any incentive mechanisms/business models in place to support the production of hydrogen?

The incentive mechanisms in place in Belgium to support the production of hydrogen consist mainly in subsides granted to selected projects (see question 13 below).

The Belgian federal government also tries to incentivise investors to finance hydrogen projects in Belgium by establishing a legal framework providing sufficient legal certainty to companies active in the sector (see question 10 below).

9. Are there any standards in place for the classification and/or certification of low-carbon or renewable hydrogen?

The Renewable Energy Directive 2018/2001 (RED II) introduced guarantees of origin for renewable hydrogen. The Belgian federated entities (i.e the Regions of Belgium) have transposed that directive with the Flemish Decree of 26 April 2019 establishing a system of guarantees of origin for gas, heat and cooling, the Walloon Decree of 25 May 2022 amending various energy provisions in the context of the partial transposition of Directives 2019/944/EU of 5 June 2019 concerning common rules for the internal market in electricity and the Renewable Energy Directive 2018/2001/EU and the Brussels Ordinance of 6 May

2021 on the organisation of thermal energy networks and the accounting of thermal energy in the Brussels-Capital Region and their respective implementing governmental orders.

Except for guarantees of origin, there are no standards existing at Belgian level to distinguish between low-carbon and renewable hydrogen. In the future, the Belgium authorities intend to rely on the standards that are being developed at EU level.

The Belgian federal government is also supporting Hinicio, a strategy consultancy firm specialized in energy transition and sustainable mobility, in the development of a European voluntary certification scheme and a register for H2-molecules and H2-derivatives via the Energy Transition Fund. A pilot phase in Belgium is foreseen within this project. In a second phase, this work could also be extended to low-carbon molecules.

10. Does the regulatory framework clearly define the regulatory requirements relating to the production, storage, transportation or supply of hydrogen?

The regulatory requirements relating to the transport of hydrogen is governed by the Law of 11 July 2023. This law (i) guarantees non-discriminatory access to the hydrogen transport network for all interested parties, (ii) determines, among other things, the rules and procedures for preparing the network development plan and for setting regulated network tariffs, and (iii) designates the CREG as the regulator for hydrogen transport.

The regulatory requirements relating to the production, storage or supply of hydrogen are currently mainly governed by the Law of 12 April 1965 on the transport of gaseous and other products through pipelines and the various Royal Decrees implementing this law. Some regional environmental laws may also be applicable in case a hydrogen project requires an environmental/ building licence. These laws and implementing acts do not explicitly cover hydrogen.

11. Are there any foreign investment restrictions related to energy and infrastructure sectors?

In July 2023, Belgium introduced an ex ante federal foreign investment screening mechanism, primarily inspired by Regulation (EU) no 2019/452.

The federal screening regime applies to direct and indirect acquisitions by non-EU investors of:

- more than 25% of the voting rights in undertakings or entities established in Belgium whose activities touch upon, among others, critical infrastructure for energy, transport, water, health etc., technologies and raw materials that are of essential importance to public health, defence, public security etc. and the supply of critical inputs like energy; or
- more than 10% of the voting rights in undertakings or entities established in Belgium whose activities touch upon, among others, energy provided that the target's turnover exceeded EUR 100 Mio in the preceding book year.

It implies a mandatory and suspensory notification of the acquisition. The responsible entity will assess whether the acquisition may negatively impact on national security, public order or the strategic interests of the Belgian federated entities and may possibly impose remedies.

In January 2019, the Region of Flanders introduced an a posteriori regional screening mechanism regarding foreign (EU or non-EU) controlling investments in a Flemish or local governmental entity or any other entity controlled by the Flemish government, representing public strategic interests in Flanders.

No distinct foreign investment screening mechanisms are currently in force or foreseen in the Walloon or Brussels Regions.

12. What international treaties are in place that may offer protection to international investors in hydrogen projects in the jurisdiction?

According to the United Nations Conference on Trade and Development (UNCTAD) Belgium is a signatory to 61 bilateral investment treaties (BITs) that are in force (**here**). Moreover, certain other treaties may contain other investment protection provisions.

Belgium is also a signatory to the Energy Charter Treaty (ECT), a multilateral investment treaty which specifically addresses energy trade, transit and investment between its contracting parties.

Belgium currently has no bilateral investment treaties in force with Member States of the European Union as the European Union has competence in this area on behalf of the Member States.

Market developments and opportunities

13. Are there any government grants or other government funding available to hydrogen projects (including for research and development)?

Yes, the Belgian federal government has set up a number of programmes and funds to support research and development in the field of hydrogen. For instance:

- The Energy Transition Fund supports, among other things, research and development on the production, transport and storage of hydrogen and its derivatives. It has been active since 2017, remain in place until 2025 and subsidises various projects following an annual call for projects for a total amount of 20 to 30 million euros per year.
- The call for projects Clean Hydrogen for Clean Industry is organized within the framework of Belgium's national recovery and resilience plan. It focusses on the development of promising technologies for the production and use of hydrogen and its derivatives with a relatively high maturity level. In this way, the federal government aims to stimulate investments that will enable a faster scaling of commercial applications. A first call was launched in April 2022 for a total support of maximum 50 million euros. A second one was launched in 2023 for a total support of 10 million euros.
- The H2 Import Call focuses on the development and demonstration of technologies that enable the import of hydrogen (in any form whatsoever, H2-derivatives included) and its injection on a hydrogen transport network. This call was launched in early 2023, with an envelope of 10 million euros.

The Walloon government via, among others, its Walloon Kyoto Fund and its Walloon Recovery Plan and the Flemish government via, among others, its Ecology Premium have also made funding available to hydrogen projects.

Belgian companies active in the hydrogen sector can also ask for public funding at EU level to several public bodies like the EU Innovation Fund.

14. Are there any notable pilot/demonstration projects in place or planned for the production or offtake of clean hydrogen?

Yes, there are several pilot projects in Belgium to produce and collect clean hydrogen. For instance:

- The University of Liège, via one of its spin-off BeBlue, has launched a pilot project to produce green hydrogen from solar energy for ESA's spacecrafts.
- Scientists from the University of Leuven have launched a pilot project to produce green hydrogen from solar energy and moisture.
- A pilot project is underway at the University of Gent to produce green hydrogen from wind energy.

15. Are there any commercial-scale clean hydrogen production projects in development or already operating?

There are currently no existing commercial-scale clean hydrogen production projects in Belgium, but there are plenty of projects ongoing, at different stages of development, including:

- The HyoffWind project, being developed by a consortium of different companies like Virya Energy, Fluxys, John Cockerill and BESIX, which aims to build a green hydrogen production facility in Zeebrugge;
- Plug Power's project to build a 35-tonnes-per-day green hydrogen generation plant at the Port of Antwerp-Bruges;
- Antwerp@C project in Antwerp which aims to store and reuse CO2 to produce blue hydrogen; and
- The HaYrport project in Liège, being developed by Liege Airport and CMI, which aims to equip the airport with installations for production, distribution and the use of green hydrogen.

16. Have there been any hydrogen-related disputes in your jurisdiction?

There are no disputes that we are aware of.

Last updated May 2024

Brazil

Ashurst collaborated with **Cescon Barrieu Advogados** in the preparation of this content. We are grateful for their input.

Policy and regulation

1. Is there a government hydrogen strategy or policy?

Yes, the Brazilian government has adopted the following hydrogen initiatives and policies:

- The National Energy Plan, published in December 2020 by the Ministry of Mines and Energy and the Energy Research Company (*Empresa de Pesquisa Energética*), a state-owned think-thank;
- The National Energy Policy Council Resolution, published in February 2021;
- The Basis for the Consolidation of the Brazilian Strategy for Hydrogen, published in February 2021 by Energy Research Company; and
- The National Hydrogen Program ("PNH2"), published in June 2022 by the National Energy Policy Council.

Brazil does not have a specific law or regulation regarding low-carbon emission hydrogen. Still, the Brazilian Congress is discussing specific legal initiatives to create the Legal Framework for Low Carbon Hydrogen. However, only two of these bills have already been approved in their respective legislative based house and, consequently, these bills are further advanced in the political discussion:

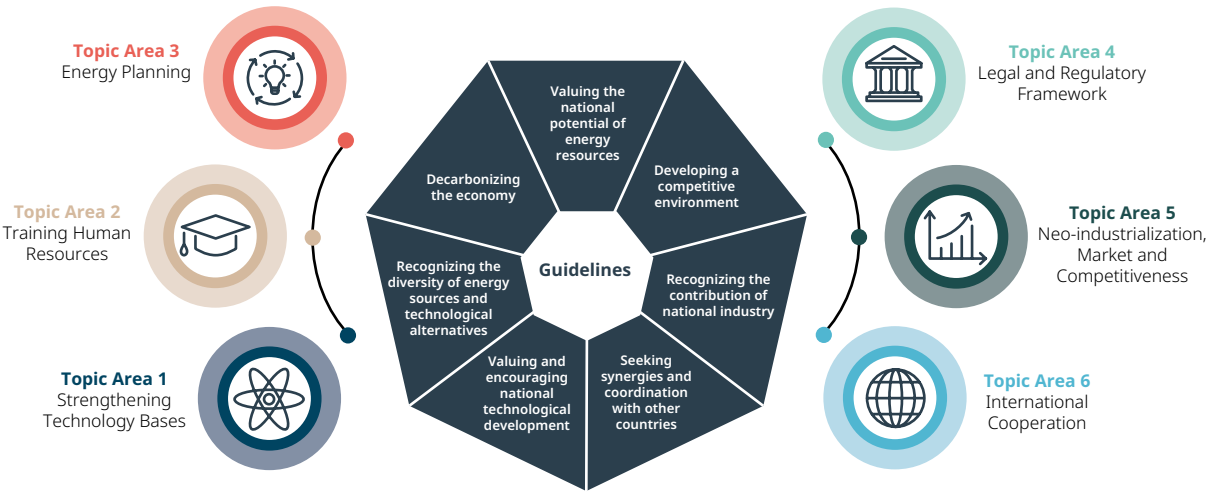
Bill of Law 2,308/2023 was already approved by the House of Representatives (the Parliament's lower house) and is currently being debated at the Federal Senate (the Parliament's upper house) and

The Federal Senate approved bill 5,816/2023, which is currently under discussion in the House of Representatives.

Both share many similarities and complement each other in several matters, such as specific financial instruments. However, a lot can change in the political discussion, and Brazil still needs a legal landmark for low-carbon hydrogen and a definition of its regulatory authority.

2. What key goals and commitments are included in the strategy/policy?

Brazilian strategy/policy is based on the following guidelines and topic areas under the PNH2:



Besides these guidelines, both Bills of Law 2,308/2023 and 5,816/2023, which aim to create the Legal Framework for Low Carbon Hydrogen, establish in their sections regarding the National Low Carbon Hydrogen Policy the following main goals:

- To preserve national interest, consumer rights, and free competition;
- To attract and encourage national and foreign investment in the production, transportation, and storage of low-carbon hydrogen and its by-products;

- To promote sustainable development and expand the labor market in the production chains of low-carbon hydrogen and its by-products;
- To promote the energy applications of low carbon hydrogen and its by-products and enhance its role as a vector for energy transition in various sectors of the national economy and exportation;
- To promote the energy transition to comply with the Paris Agreement;
- To foster the national supply chain of inputs and equipment for the manufacture of low-carbon hydrogen;
- To encourage research and development related to the use of low-carbon hydrogen and its by-products for energy and industrial purposes;
- To stimulate public-private collaborations to develop low-carbon hydrogen projects and
- To encourage the development of domestic production of nitrogen fertilizers from low-carbon hydrogen, reduce external dependence, and guarantee food security.

To achieve these goals, according to Bill of Law 2,308/2023, the National Policy shall implement the following policies:

- PNH2, the national program that will be responsible for establishing the guidelines for implementing the National Policy based on three aspects: (i) public policies, (ii) technology, and (iii) the sector stakeholders;
- The Low Carbon Hydrogen Development Program ("PHBC"), as a source of resources for the hydrogen energy transition;
- Low Carbon Hydrogen Certification System ("SBCH2");
- Creation of a Special Incentive Regime for Low Carbon Hydrogen Production ("Rehidro"), which seeks to promote technological and industrial development competitiveness and add value to national production chains;
- Technical and financial cooperation between the public and private sectors to develop research into new products, methods, processes, and technologies for producing low-carbon hydrogen; and
- Tax, financial, credit, and regulatory incentives.

On the other hand, Bill 5,816/2023 aims to use Brazil's already existing regulatory framework to stimulate low-carbon hydrogen, applying the Special Incentive Regime for Infrastructure Development (REIDI), legal framework for startups and innovative entrepreneurship, and incentivized infrastructure bonds.

3. Which industry sectors will most likely be affected by hydrogen deployment?

Hydrogen has many applications and, in Brazil, has the opportunity to integrate the following industry sectors:

- Fertilizers: Green hydrogen can replace fossil fuels to produce fertilizers.
- Green steel: Green hydrogen can be introduced into the steel production chain as an alternative to decarbonization.
- Fuel: Green hydrogen can be an alternative to fossil fuel burning. Potential benefits include naval, heavy transport, chemical industry, and aviation.
- Batteries: Hydrogen is an excellent alternative to solve the intermittency of renewable energy sources, such as wind and solar power. In this sense, it can be used as a "battery" to store chemical energy.

Therefore, introducing hydrogen in the industry chain can promote the reduction of national industry's carbon emissions; that is, hydrogen can be the vector of the energy transition in various sectors of the national economy.

4. Who are the primary regulators for the hydrogen market?

Brazil does not yet have a specific regulator for the hydrogen market. Most of the bills in discussion appoint the National Oil, Gas, and Biofuel Agency ("**ANP**") as the regulatory entity responsible for authorizing and supervising hydrogen exploration and production activities, especially considering its know-how in the gas production and commercialization regulation, that can and will be vastly applied for hydrogen.

However, one of the proposed bills (5,816/2023) establishes the responsibility of the National Electric Energy Agency ("**ANEEL**") to regulate the hydrogen produced from water electrolysis. Regardless of who will be the official entity responsible for regulating hydrogen production in Brazil, it is most likely that both governmental agencies (ANEEL and ANP) will issue a joint normative on this matter since hydrogen involves both sectors, i.e., natural gas and electric energy.

5. Does the government hydrogen strategy or policy support the development of both low-carbon (blue) hydrogen and renewable (green) hydrogen?

Brazilian Strategy for Hydrogen and the PNH2 aims to invest in other hydrogen variants besides the "green" hydrogen, considering the diversity of energy sources available in the country to produce hydrogen.

Although Brazil has one of the cleanest energy matrixes in the world, the strategy encompasses various sources for obtaining renewable hydrogen and a wide range of applications in multiple sectors of the economy (transport, energy, steel, and mining, for example).

In this regard, the Brazilian national plan, as well as the bills under discussion, aim to establish and develop "low carbon hydrogen"—an expression that is mainly used in all the national documents related to this matter.

The recent discovery of natural gas reserves in Brazil and South America is driving the option to adopt a regime for low-carbon hydrogen, produced both from renewable sources and from natural gas.

6. If the government hydrogen strategy or policy supports the development of low-carbon hydrogen, how much progress is being made in carbon capture and storage?

Currently, Brazil is focused on developing green hydrogen infrastructures.

The Brazilian Strategy for Hydrogen and the PNH2 set guidelines for low-carbon hydrogen. Brazil has know-how and infrastructure related to natural gas production and other types of renewable energy that will not be ignored in the production of hydrogen, although both the availability and usage of such infrastructure are limited (most, if not all, the current infrastructure is not technically prepared to receive H2).

The bills currently being discussed aim to create a "National Low-Carbon Hydrogen Policy," establish incentives for "the low-carbon hydrogen industry," with a "Special Incentive Regime for Low-Carbon Hydrogen Production," and design the "Low-Carbon Hydrogen Development Program." Thus, we can predict that "low-carbon hydrogen" will be supported as much as green hydrogen.

7. Are there targets for the production of hydrogen?

No targets are currently set. However, according to a study developed by the International Renewable Energy Agency ("IRENA") and McKinsey, Brazil could meet a domestic demand of 9 million tons of hydrogen and export up to 4 million tons to the United States and Europe by 2040.

8. Are any incentive mechanisms/business models in place to support hydrogen production?

As mentioned in previous items, sectorial planning bodies in the Brazilian energy sector are already discussing the inclusion of hydrogen into the energy matrix, and the Government aims to develop a specific policy to boost the industry.

However, this emerging industry still requires appropriate and specific regulation to create an environment of greater legal certainty for investments, including other forms of incentives for site operation, such as tax and grid tariff discounts.

The regulation and the market framework for hydrogen can be supported by numerous previous successful institutional experiences tested in Brazil concerning the power sector:

- **Demand incentives**. At a time when renewable energy sources in Brazil were not competitive, a series of policies were created to encourage demand for such sources. These projects could serve as inspiration or play for policies aimed at developing the competitiveness of low-carbon hydrogen by creating demand.
    - **Wheeling Fee Discounts**. Previously, energy generators from incentivized sources had discounts on fees for using transmission and distribution systems. Users who purchased energy from these sellers also benefited from such discounts. This system allowed greater competitiveness for energy from incentivized sources. Still, the discounts are subsidized by other players and users of the sector – which, in addition to the sharp decrease in costs to implement renewable assets, led to the termination of this policy in 2021.
    - The **Special Energy** policy created a new category for energy consumers—called "special consumers"—who could only use energy from these generators. Non–special forms of power could not access special use requirements.
- **Fuel Blending**. Brazilian law No. 8,723/1993 establishes a mandatory proportion of anhydrous ethanol to be blended with the gas commercialized in Brazil to create demand and incentivize the usage of biofuels over oil derivatives. Blending green hydrogen derivatives with natural gas or fuel could provide a similar alternative.
- **Specific financing—public banks**. Specific credit lines could be opened for hydrogen projects. Financing already exists for the purchase and sale of energy generation systems that contribute to reducing greenhouse gas emissions in general.

- **Reduction of tariffs for equipment imports (ex-tariff)**. The ex-tariff regime allows the temporary reduction of import tax rates for capital goods. For example, in 2020, the Ministry of Economy included specific photovoltaic equipment in the ex-tariff regime. Similar solutions could be adopted for equipment aimed at hydrogen production without national equivalents.

This "toolbox" (and others) available to Brazilian regulators in the energy sector can be taken as an example by players interested in contributing to the development of the hydrogen segment because it will probably be similar to what is applicable to the hydrogen sector.

9. Are there any standards for classifying or certifying low-carbon or renewable hydrogen?

Yes. Brazilian Energy Trading Chamber ("**CCEE**") developed the First Brazilian certification initiative for renewable hydrogen. The Certification Guide was updated in 2023 but still lacks the requirements of the European regulation and shall be further updated also to consider its standards.

The main goal of the CCEE certification is to meet national and international requirements, acting as a verification tool in which users can verify the origin and trace the product's environmental attributes and facilitate the qualification of the hydrogen producer in the market, strengthening the safety and credibility of its product. Considering that, CCEE will:

- Analyze the origin of the electricity used to produce the hydrogen. This validation is essential to meet the requirements of origin criteria, attesting to the portion of renewable electricity used with a power purchase agreement ("**PPA**") or self-production and the portion that may have been consumed from the grid lacking proof of being renewable.
- Periodically verify the electricity generated and used by the hydrogen producer. The hydrogen produced will be certified as hydrogen from a renewable source, proportional to the renewable energy used in the PPA for production in the period. Suppose the energy verified was insufficient, and the hydrogen producer generated energy outside the PPA framework. In that case, the proportional share of hydrogen will be certified as hydrogen from a partially renewable source.

CCEE is a member of the international work group that creates international guidelines and requirements for hydrogen certification. This initiative includes energy sector leaders from Australia, Canada, Spain, the United States, Holland, Israel, Italy, and the United Kingdom. By the end of 2024, provide guidelines that can be used by companies marketing hydrogen and its derivatives on all continents.

Furthermore, the bills under discussion aim to establish guidelines for certifying hydrogen produced in Brazil. However, they do not establish standards for certification; this will be defined in a specific law in the future.

10. Does the regulatory framework clearly define the regulatory requirements relating to hydrogen production, storage, transportation, or supply?

Currently, there are rules applicable to the production of hydrogen for medical purposes, for the transport of dangerous products, and technical regulations for its storage, in addition to the zoning and environmental licensing rules for such relevant activities.

No approved regulation is explicitly related to the hydrogen production, storage, transportation, or supply. The bills currently under discussion set forth ANP as the agency responsible for regulating, authorizing, and inspecting the exploration and production of hydrogen in the national territory, as well as activities related to the loading, processing, treatment, import, export, storage, warehousing, packaging, transportation, transfer, resale, and marketing of hydrogen.

Once legally approved, ANP should be responsible for creating the regulations related to such activities. Bill 2,308/2023 sets forth that the activities must be carried out by companies incorporated under Brazilian Law and that the rules to be created by ANP shall (i) observe the powers of the regulatory agencies to establish the attributions, (ii) establish the possibility and requirements for the prior consent by ANP to the transfer of the authorization ownership; and (iii) establish the hypotheses in which the authorization may be dispensed with, especially concerning the volume produced and the use of hydrogen.

11. Are there any foreign investment restrictions related to the energy and infrastructure sectors?

One of the guidelines of Brazilian strategy is engagement with international programs and initiatives. Several ongoing Brazilian initiatives and debates on green hydrogen production, such as GIZ (Deutsche Gesellschaft für Internationale Zusammenarbeit), the World Bank, and the European Union, count on foreign cooperation and investments.

The bills under discussion aim to limit the authorizations for production, storage, transportation, or supply to companies incorporated under Brazilian Law but do not restrict foreign investors' investment or share ownership.

Finally, Brazilian state legislation restricts foreign-controlled companies' ownership or lease of rural properties.

12. What international treaties are in place that may offer protection to global investors in hydrogen projects in the jurisdiction

Brazil has signed bilateral agreements with Germany, the European Union, and the United Kingdom to develop green hydrogen. Brazil and Chile also created the Brazil-Chile Working Group to perform explanatory technical work on potential bilateral hydrogen cooperation.

Market developments and opportunities

13. Are any government grants or other government funding available for hydrogen projects (including research and development)?

Brazilian regulators such as the ANEEL and the ANP monitor and direct mandatory investments in research and development in their industries. At the same time, the National Fund for Scientific and Technological Development (**"FNDCT**") is a fund that finances innovation in Brazil.

ANEEL approved a strategic Call for Research, Development, and Innovation Projects (PDI) No. 23/2024 in March 2024 to receive expressions of interest in funding projects focusing on hydrogen in the electricity sector. The Call aims to promote projects that study the application of hydrogen, from production to use, in the electricity sector, with an emphasis on low-carbon sources. According to the report published on April 2nd, 2024, 95 energy companies or groups have expressed an interest in funding projects focused on hydrogen in the electricity sector.

The **Brazilian Development Bank (BNDES)** launched a program to promote pilot projects for the production of green hydrogen generated from renewable energies. The program combines two support instruments: the BNDES Finem—Environment line and the Climate Fund Program.

The **State of São Paulo** also launched an initiative to promote decarbonization with BRL 500 million in credit. The credit is aimed at technological innovation startups aligned with decarbonization and state and municipal programs aimed at the energy transition.

Also, as mentioned in item 8, other forms of incentive are in development. In this regard, both the Bill of Law 2,308/2023 and 5,816/2023 aim to develop new programs of incentive, including the Low Carbon Hydrogen Development Program – PHBC, a program of accounting and financial nature, to provide funds for the energy transition from the use of low-carbon hydrogen, with public and private resources. Bill of Law 2,308/2023 also proposes the creation of REHIDRO, a special tax incentive regime to promote technological and industrial development and the competitiveness of hydrogen in Brazil. Bill 5,186/2023 proposes the inclusion of low-carbon hydrogen projects belonging to the PHBC in the (i) Special Incentive Regime for Infrastructure Development – REIDI; (ii) legal framework for startups and innovative entrepreneurship regime, set forth by Law 182/2021; and (iii) the possibility of issuing incentivized infrastructure bonds.

14. Are there any notable pilot/demonstration projects in place or planned for the production or offtake of clean hydrogen?

Several pilot projects are being deployed in Brazil to develop electrolyzer production and to examine and test the feasibility of clean hydrogen production and use of hydrogen in different sectors:

Piauí State and the companies **Green Energy Park** and **Solatio** launched the world's biggest green hydrogen project in the Export Processing Zone (Zona de Processamento de Exportação—ZPE) located on Parnaíba, on Piuaí's coast. The project's installed capacity will be 20 GW, and Green Energy Park and Solatio will invest BRL 200 billion over the years.

Pecém Complex Initiatives: The **Pecem Complex (CIPP)** is a joint venture formed by the state government of **Ceará** and the **Port of Rotterdam**. CIPP has entered into a series of MoUs and other agreements related to viability analysis and development of hydrogen projects aimed at the external market. Among the MoUs and agreements entered by CIPP or the government of Ceará and partners for the development of such projects, we point out:

- **Transhydrogen Alliance (THA)**, a consortium among **Proton Ventures, Trammo DMCC, Varo Energy**, and **GES**, executed an MoU with CIPP for the execution of a feasibility study for a USD2 billion project that will produce 2.5 million tons of green ammonia per year, with 500,000 tons of green hydrogen as feedstock at the Pecém Complex. In February 2023, THA signed a MoU with **Casa dos Ventos** and **Comerc Energia Group** to construct a green hydrogen plant and export more than 2.0 million tons of green ammonia to Europe from 2026.
- **White Martins (Linde Group)** signed a MoU with CIPP to establish and develop the potential to produce local hydrogen to sell to the European market. White Martins is a company with technology and expertise in several key areas of green hydrogen production, distribution, and application chains, including electrolyzers, ammonia production, hydrogen liquefaction, technology for the use of hydrogen in mobility applications, and experience with the insertion of hydrogen in natural gas networks.

- **Qair Brasil**, a renewable power generation company, signed an MoU with the government of Ceará to develop a green hydrogen production plant using energy generated by the Dragão do Mar offshore wind complex. The expected CAPEX is USD 6.95 billion.
- **EDP**, a company that operates across the entire supply chain of the Brazilian electrical sector, has produced in the Pecém Complex the first green hydrogen molecule in December of 2023 and inaugurated, in January 2023, a green hydrogen production plant as part of the Pecém Hydrogen Research & Development project.

Porto do Açu Initiatives is a privately owned port and industrial complex in Rio de Janeiro that has signed a MoU with **Fortescue** to develop green industrial projects based on hydrogen. The MoU allows the company to conduct feasibility studies to install a green hydrogen plant with a capacity of 300 megawatts, with the potential to produce 250,000 tons of green ammonia per year at the Açu complex.

Camacari industrial complex, located in Bahia, intends to inaugurate the country's first industrial-scale green hydrogen plant, held by the petrochemical company **Unigel**. This initiative aims to supply its production to the Camaçari industrial complex's internal market. In June 2023, the first delivery of components and equipment for implementing the country's first hydrogen and green ammonia plant began. The parts were stored and later transported to the site where the Unigel plant will be installed. Unigel received the "Energy Transition Changemakers" prize in COP28 due to the hydrogen project in Camaçari.

The **Brazilian Pact for Renewable Hydrogen**, founded by the Brazilian Association of Wind Energy and New Technologies (**ABEEólica**), the Brazilian Photovoltaic Solar Energy Association (**ABSOLAR**), the Brazilian Biogas Association (ABIOGÁS), and the German-Brazilian Chamber of Commerce and Industry in Rio de Janeiro (**AHK Rio**), aims to contribute to the development of the green hydrogen sector in Brazil, mainly through economic and regulatory aspects.

15. Are any commercial-scale clean hydrogen production projects in development or already operating?

There are no commercial-scale clean hydrogen production projects in Brazil, but there are several projects under development, most still in their early stage. We highlight the following commercial-scale clean hydrogen projects that are currently under development:

- **Atlas Agro**, a fertilizer company, will invest more than USD 850 million to build a plant in Uberaba to produce nitrogen products from green hydrogen. The project is planned to be concluded in mid-2027.
- **Neuman & Esser**, a German company, has signed an MoU with the state government of **Minas Gerais** to invest more than BRL45 million in producing and manufacturing green hydrogen generation equipment. This will be Latin America's first green hydrogen generation equipment manufacturing plant.
- **Porto Central** signed a MoU with **Companhia Energética Integrada (CEI)** to construct photovoltaic and green hydrogen production plants. The goal is for the plants in this first phase to be operational by 2026, with an expected investment of BRL100 million.

16. Have there been any hydrogen-related disputes in your jurisdiction?

There have not been any hydrogen-related disputes in Brazilian jurisdiction.

Last updated May 2024

Canada

Ashurst collaborated with **Blake Cassels & Graydon** in the preparation of this content. We are grateful for their input.

Policy and regulation

1. Is there a government hydrogen strategy or policy?

Yes, a federal Hydrogen Strategy was published in December 2020. Specific provinces across the country have also published their own hydrogen strategies that include individualized targets and ambitions. For example, Alberta, Canada's current largest producer of hydrogen, has published the Alberta Hydrogen Roadmap, which sets forth its plans to position itself as a global supplier-of-choice in clean hydrogen exports by 2030.

2. What are key goals and commitments included in the strategy/policy?

The Hydrogen Strategy's (the "Strategy") aim overall is to reduce emissions while promoting domestic and international opportunities in the hydrogen economy.

The Strategy's primary short-term goal is to establish a foundation for Canada's hydrogen economy by 2025 through the development of necessary infrastructure and technologies to support both the growth of existing hydrogen applications and the development of emerging applications. The Strategy advises further diversifying the hydrogen sector to apply existing industrial technologies to new applications, such as residential heating, between 2025 and 2030. The Strategy's eventual long-term goal is to expand Canada's supply and distribution of hydrogen, with the goal of hydrogen making up a significant portion of domestic end-use energy by 2050.

3. Which industry sectors are most likely to be affected by hydrogen deployment?

The industry sectors that are most likely to be affected by the replacement of fossil fuels by clean hydrogen in Canada include:

- the power sector;
- transportation;
- heating; and
- refining and manufacturing.

The Strategy highlights opportunities to reduce emissions through actions such as retrofitting existing technology with carbon capture and storage, installing new clean hydrogen technology that does not produce carbon, and switching to hydrogen blends in heavy industry. The Strategy mentions that hydrogen has the potential to decarbonize sectors of the Canadian economy, including resource extraction, freight, and the production of other inputs, such as steel and cement.

4. Who are the main regulators for the hydrogen market?

No response provided.

5. Does the government hydrogen strategy or policy support the development of both low-carbon (blue) hydrogen and renewable (green) hydrogen?

Yes, the Strategy highlights Canada's opportunities to take advantage of blue hydrogen development, particularly given the abundance of fossil fuels found in several of its provinces. The Strategy also emphasizes that Canada is in a strong position to produce green hydrogen, with projects to develop this type of hydrogen already in motion in certain provinces.

6. If the government hydrogen strategy or policy supports the development of low-carbon hydrogen, to what extent is carbon capture and storage being taken forward?

The development of low-carbon hydrogen is a strategic priority for Canada. Canada has a target of net-zero emissions by 2050, and to achieve this goal, all hydrogen production must either be carbon neutral or offset. Currently the most cost-competitive of these strategies is to use fossil fuel-derived hydrogen coupled with carbon capture utilization and storage (CCUS) to produce carbon neutral hydrogen due in large part to Canada's ample low-cost natural gas.

The Strategy recognizes that there is significant growth potential in CCUS and clean hydrogen production in Canada. Moving forward, Canada is considering various strategies that will use the country's natural advantages to achieve its hydrogen goals. These include reducing industrial emissions and facilitating the production of low-carbon hydrogen. The Strategy also recognizes that emissions resulting from hydrogen production can be decreased using bioenergy with CCUS and identifies that there is a significant opportunity to reduce emissions associated with hydrogen in midstream oil and gas by retrofitting existing conversion technology with CCUS.

Other provincial strategies are also moving CCUS forward. Alberta, as a world leader in hydrogen production and CCUS technology, has mature natural gas-based hydrogen production processes currently in place throughout the province. These processes can realize near-term clean hydrogen by retrofitting existing infrastructure and building new facilities outfitted with CCUS. Over time, emissions can be further reduced using competitive, cost-effective technologies such as renewable energy-based hydrogen production and emerging natural gas decomposition. As further detailed in Section 14 below, a number of CCUS projects are currently underway or in development in Alberta.

7. Are there targets for the production of hydrogen?

Canada's Hydrogen Strategy has suggested a vision for hydrogen to make up 6% of delivered energy by 2030 and 30% of delivered energy by 2050.

8. Are there any incentive mechanisms/business models in place to support the production of hydrogen?

There are several incentives in place to support hydrogen production in Canada. Canada's Strengthened Climate Plan, which includes carbon pricing, the Clean Fuel Standard, and a $1.5 billion Low-carbon and Zero-emissions Fuel Fund, implements foundational federal initiatives the federal Government believes are required to achieve the Strategy's goals. Carbon pricing adds costs to the production of greenhouse gas emissions; the Clean Fuel Standard incentivizes the use of low-carbon hydrogen through tax credit eligibility; and the Low-carbon and Zero-emissions Fuel Fund supports projects that reduce greenhouse gas emissions. Each incentive aims to encourage hydrogen uptake and production over time.

In the 2023 budget, the federal government introduced three tax credits to drive the transition to a net-zero economy. The Clean Hydrogen Investment Tax Credit is particularly relevant for hydrogen production, offering refundable credits ranging from 15% to 40% based on hydrogen's carbon intensity. It can offset equipment expenses for hydrogen projects via the produced electrolysis or natural gas, provided emissions are reduced through CCUS when using natural gas.

Tax credit rates depend on emissions as follows:

1. Less than 0.75 kg carbon dioxide equivalent (CO_2e) per kg of hydrogen: 40% tax credit.
2. 0.75-2 kg CO_2e per kg: 25% tax credit.
3. 2-4 kg CO_2e per kg: 15% tax credit.

Eligibility for the full credit rate also hinges on labour requirements. Organizations must pay prevailing wages and ensure 10% of tradesperson hours are worked by registered apprentices in the Red Seal trades. Organizations that do not meet these labour requirements can still claim tax credits through the program but not at the highest rate available.

Furthermore, the Clean Technology Manufacturing Tax Credit is a refundable tax credit, which will offset 30% of the expenses associated with acquiring new machinery and equipment used in the production or processing of clean technologies and the extraction, processing, or recycling of critical minerals.

Canada's Net Zero Accelerator initiative provides up to $8 billion over seven years to support projects to decarbonize large greenhouse gas emitters, fast-track the growth of clean technology, and expedite industrial transformation to achieve Canada's net-zero goals.

Individual provinces, including Alberta, British Columbia, and Quebec, have also implemented their own incentives to encourage hydrogen adoption.

9. Are there any standards in place for the classification and/or certification of low-carbon or renewable hydrogen?

As of July 1, 2023, Canada's Clean Fuel Regulations (CFR) mandate that suppliers of liquid fossil fuels like gasoline and diesel progressively lower the carbon intensity of the fuels they provide in Canada. The CFR aims to boost the development and use of cleaner fuels, technologies, and processes. The objective of the regulation is to achieve about a 15% reduction in the carbon intensity of gasoline and diesel compared to 2016 levels by the year 2030, contributing to a cleaner and more sustainable energy future. CFR will replace the current federal Renewable Fuels Regulations.

These measures include the allocation of $1.5 billion to establish the Clean Fuels Fund, aimed at promoting the production and use of low-carbon fuels like hydrogen and biofuels. These investments not only support the growth of clean hydrogen but also aligns with the objectives outlined in the Strategy.

10. Does the regulatory framework clearly define the regulatory requirements relating to the production, storage, transportation, or supply of hydrogen?

Canada does not currently have a clear, harmonized regulatory framework setting out regulatory requirements related to hydrogen. Certain federal legislation such as the Canadian Environmental Protection Act, 1999 and the Canada Water Act will apply to the hydrogen industry across the country.

Much of the regulation of hydrogen is done at a provincial level. For example, in October 2022, the British Columbia Government introduced amendments to the Oil and Gas Activities Act and the Petroleum and Natural Gas Act to enable further hydrogen development in the province. Alberta has clear regulatory requirements related to the production, storage, transportation and supply of hydrogen through the Responsible Energy Development Act, applicable portions of the Pipeline Act and the Oil and Gas Conservation Act. It is also the first jurisdiction in Canada with regulation for large scale CCUS projects, with the Carbon Sequestration Tenure Regulation.

Further, in July 2023, Ontario's Ministry of Energy unveiled its strategy, titled "Powering Ontario's Growth: Ontario's Plan for a Clean Energy Future," outlining how the province intends to meet rising electricity demand. This plan focuses on constructing clean energy infrastructure, including generation, storage, and transmission, in response to projections that Ontario may need to nearly double its current generating capacity from 42,000 to 88,000 megawatts (MW) by 2050. The primary drivers behind this demand surge are economic expansion, the electrification of various sectors, and population growth. The plan also highlights key ongoing and upcoming initiatives aimed at achieving these goals.

While early hydrogen projects can be expected to operate within existing regulatory regimes, it can be expected that there will be development of a comprehensive and long-term policy and regulatory framework that includes hydrogen in the near future.

11. Are there any foreign investment restrictions related to energy and infrastructure sectors?

Foreign investment in Canada is generally regulated by the federal Government under the Investment Canada Act (the "ICA"). The ICA applies when a non-Canadian establishes a new business in Canada or proposes to acquire control (directly or indirectly) of an existing Canadian business. For relevant transactions, a notification or an application for review must be filed with the Department of Industry and/or the Department of Canadian Heritage, as per the ICA.

12. What international treaties are in place that may offer protection to international investors in hydrogen projects in the jurisdiction?

Canada is a signatory to 37 bilateral investment treaties (BITs) that are in force, and in addition certain other treaties may contain protections for investors in Canada. These can be accessed from the Government of Canada Treaty Series online **database** maintained by the Treaty Law Division of the Department of Foreign Affairs and International Trade, and the United Nations Conference on Trade and Development's **Investment Policy Hub**.

In 2021, the Government of Canada signed a Memorandum of Understanding with the Government of the Netherlands on cooperation in the field of hydrogen energy. The intention is that this will lead the way for increased cooperation between the two countries, cementing the role that hydrogen plays in building a cleaner net-zero future. Priority areas of cooperation set out in the Memorandum of Understanding are: 1) cooperation on setting up export-import corridors for clean hydrogen between Canada and the Netherlands; and 2) creating an aligned agenda for promoting investments in hydrogen infrastructure, the hydrogen supply chain, and facilitating collaboration between private parties in both countries.

In August 2022, the Government of Canada signed a joint declaration of intent with the Government of the Federal Republic of Germany to establish a Canada-Germany Hydrogen Alliance (the "Alliance"). The Alliance will commit the two countries to: enable investment in hydrogen projects through policy harmonization; support the development of secure hydrogen supply chains; establish a transatlantic Canada-Germany supply corridor; and export clean Canadian hydrogen by 2025.

Market developments and opportunities

13. Are there any government grants or other government funding available to hydrogen projects (including for research and development)?

There have been a number of different funding initiatives regarding various different areas of hydrogen development in Canada.

In June 2021, the federal government launched the Clean Fuels Fund which aims to invest $1.5 billion to grow the production of clean fuels in Canada, such as hydrogen. Funding is provided through conditionally repayable contribution agreements of up to 30 percent of the total eligible project costs, to a maximum of $150 million, per production project and up to $5 million for feasibility studies.

In the 2022 federal budget, the federal government introduced the Canada Growth Fund (CGF), a $15 billion investment fund established under Canada Development Investment Corporation (CDEV) in December 2022. The CGF's main goal is to make

strategic investments that stimulate significant private sector contributions to Canadian businesses and projects. This initiative aims to accelerate and expand Canada's transition to a net-zero economy.

In the 2023 federal budget, additional information was included with respect to the Clean Technology Investment Tax Credit, initially introduced in the 2022 Fall Economic Statement. This tax credit is relevant to hydrogen due to its coverage of industrial zero-emission vehicles and associated charging or refuelling equipment, including heavy-duty hydrogen trucks. Starting on March 28, 2023 until December 31, 2034, the Clean Technology Investment Tax Credit is set at 30% of eligible property costs. However, it gradually reduces to 15% in 2034 and expires in 2035.

Also, see Section 7 for discussion of Canada's Net Zero Accelerator initiative.

Additionally, there are various provincial-level funding incentives for hydrogen projects. The Government of Alberta announced on August 1, 2023, that they are allocating $50 million to boost technology development crucial for advancing its Hydrogen Roadmap and Natural Gas Strategy. Emissions Reduction Alberta (ERA) will provide $25 million for advanced innovations via the Accelerating Hydrogen Challenge. Alberta Innovates will contribute $20-25 million for early-stage innovations through the Hydrogen Centre of Excellence Competition 2, with additional support from Natural Resources Canada (NRCan).

14. Are there any notable pilot/demonstration projects in place or planned for the production or offtake of clean hydrogen?

There are a number of different pilot projects being developed in Canada regarding the production or offtake of clean hydrogen, including those that are outlined below.

FortisBC Energy has partnered with Suncor Energy and Australia-based Hazer Group to test the production of "turquoise hydrogen," an almost zero-emission method for capturing and converting methane from burning gas. This would be the first project of its kind in Canada, following similar projects in Germany and France. If developed commercially, the plant could eventually produce up to 2,500 tonnes of zero-emission hydrogen fuel a year.

The **Edmonton Region Hydrogen HUB** was launched in 2021 by an alliance of government, Indigenous, academic and economic development leaders to kickstart the Edmonton Region's low-carbon hydrogen economy. The Hydrogen HUB will serve as a blueprint of how to accelerate a strong hydrogen economy that can be replicated in other regions across the country with low-cost, low-carbon hydrogen. With help from the Transition Accelerator, a Canadian organization working towards a net-zero future, over 25 potential projects are planned relating to the supply, delivery and use of low-carbon hydrogen. These projects include the use of hydrogen for municipal and commercial vehicle fleets and home and industrial heat and power.

The **Alberta Zero Emissions Truck Electrification Collaboration** is a pilot project to test the ability of hydrogen to fuel the province's heavy freight transportation sector. The project is led by the Alberta Motor Transport Association and features the development of two long-range fuel cell trucks for operation between Edmonton and Calgary. The project intends to test and demonstrate a 700-kilometre plus range fuel cell truck performance in Alberta conditions. If successful, this project will pave the way towards broader decarbonization in the transportation sector across Canada.

In 2022, ATCO began delivering a blend of natural gas containing five percent hydrogen to approximately 2,100 customers in Fort Saskatchewan in a first-of-its-kind project for Alberta. The **Fort Saskatchewan Blending Project** is intended to be used as a stepping-stone into the Canadian hydrogen market, and if successful, will validate the pursuit of larger-scale hydrogen-blending activities across the country.

British Columbia is investing $4 million in the **BC Hydrogen Ports Project** (BCH2 Ports Project), which aims to bring clean hydrogen technology to the challenging commercial transportation sector. This project, a collaboration between public and private sectors, is pioneering made-in-B.C. technology to help the province achieve its decarbonization objectives. It represents a significant effort to utilize hydrogen and fuel cells in shipping and transportation, marking a significant step toward cleaner transportation in the region.

15. Are there any commercial-scale clean hydrogen production projects in development or already operating?

There are currently no existing commercial-scale clean hydrogen production projects in Canada, however, there are a number of projects in varying stages of development. These include:

- Varennes Carbon Recycling, the 88MW water electrolysis plant being developed in Quebec, which is expected to produce 11,000 metric tons of green hydrogen annually. This will be one of the world's first and biggest production facilities for green hydrogen and is expected to be active by 2025;
- the Air Products Hydrogen Production and Liquefication Facility in Alberta, which will capture three million tonnes of CO2 yearly and product 1,500 tonnes of hydrogen daily. The plant is expected to be operational in 2024;
- Suncor and ATCO's collaboration on a clean hydrogen production facility in Alberta;

- Japanese ITOCHU Corporation's partnership with Petronas for the creation of a natural gas-based ammonia facility with CCUS in Alberta to export ammonia as a hydrogen carrier to Asian markets;
- the development of Ekona Power's novel system for low-cost, clean hydrogen production for industrial processes. The project will demonstrate a direct carbon fuel cell, which converts solid carbon by-product from the hydrogen production process to electrical power, enhancing the economics of hydrogen production in Alberta;
- Aeolis Wind Power and Evolugen's Thunder Mountain Wind Project, which is set to produce renewable hydrogen in British Columbia;
- Artura Power's low carbon energy project, Niagara Hydrogen Centre, being developed in Ontario and is expected to be operational in 2024;
- Spirit of Scotia by Green Hydrogen International in Nova Scotia, which is expected to be an integrated green hydrogen production, storage and transport project up to a potential 500GW in size to supply a secure source of green hydrogen to Europe and North American markets; and
- Newfoundland and Labrador have chosen four companies to potentially build wind farms for future hydrogen plants, pending additional approvals. EverWind NL Company, Exploits Valley Renewable Energy Corp, ABO Wind, and World Energy GH2 have the opportunity to seek government land use approval, contingent on environmental assessments. These projects, if greenlit, could contribute to Canada's commitment to supply green hydrogen to Germany by 2025.

16. Have there been any hydrogen-related disputes in your jurisdiction?

No updated provided.

Last updated September 2023

Denmark

Ashurst collaborated with **Bech-Bruun** in the preparation of this content. We are grateful for their input.

Policy and regulation

1. Is there a government hydrogen strategy or policy?

With the **Danish Climate Agreement for Energy and Industry of 22 June 2020**, a Danish parliamentary majority decided that Power-to-X (PtX) and carbon capture and storage are key elements in Denmark achieving its climate policy objectives.

Several broad-based political agreements aim for developing and promoting hydrogen and green fuels in Denmark. The political initiatives generally support the establishment of Power-to-X facilities and the production of green hydrogen. On 15 December 2021, the Danish government published its proposal for promoting hydrogen and green fuels (PtX). Following negotiations, the government and all parties of the Danish Parliament but one reached a political agreement regarding promotion and development of hydrogen and green fuels in Denmark (the "**PtX Strategy**") on 15 March 2022. A sub-agreement from 23 May 2023 lays down that the state-owned companies Energinet and Evida shall own and operate the hydrogen infrastructure in Denmark. A follow-up agreement from 4 April 2024 lays down the economic framework conditions for hydrogen infrastructure.

In March 2023, Germany and Denmark signed a cooperation agreement regarding construction of a cross-border hydrogen pipeline by 2028.

2. What are key goals and commitments included in the strategy/policy?

The PtX Strategy from 15 March 2022 sets out an aim to build upwards of 4 - 6 GW of electrolysis capacity by 2030. Key initiatives in the PtX Strategy include the following:

- Funding (DKK 1.25 billion) through a tender for operational support of the production of hydrogen and other PtX products. Subsidies will be granted as a fixed-price supplement for a 10-year period.
- Dialogue between the government and the European Commission on allocating DKK 344 million of REACT-EU funds and the Just Transition Fund to establish an investment subsidy scheme for innovative green key technologies focusing on PtX and hydrogen, including green production and demonstration projects.
- An application-based scheme for construction of direct links between major electricity consumers (e.g., PtX plants) and electricity producers (wind farms/solar parks) if such direct links are socio-economically beneficial.
- Option for Energinet and the grid companies to use geographically differentiated consumption tariffs and local tariffs with respect to energy communities and industry communities producing and consuming electricity concurrently.
- An analysis of possibilities and consequences of introducing a derogation for projects involving PtX plants with direct connection to offshore wind farms with respect to a distance limitation of 15 km under the open-door scheme for offshore RE installations. However, the open-door scheme for offshore RE installations have been cancelled, which may affect this initiative.
- Framework for construction of hydrogen infrastructure that can eventually be linked to a common European hydrogen infrastructure. This includes giving Energinet and Evida the possibility of owning and operating hydrogen infrastructure. A sub-agreement from 23 May 2023 supports this initiative.
- A PtX task force will be assigned to identify and handle regulatory barriers blocking the establishment of a new Danish utility sector using PtX solutions. The task force will also be assigned to strengthen the framework conditions for hydrogen and PtX products. Further, a secretariat within the Danish Energy Agency is set up as a point of contact for project developers and authorities requesting guidance with authorisation procedures etc.

3. Which industry sectors are most likely to be affected by hydrogen deployment?

According to the government's proposal for promoting hydrogen and green fuels (PtX), PtX fuels may play an important role in sectors where direct electrification is not possible or prohibitively expensive. It is assessed that the following sectors have significant potential for PtX fuels:

- Aviation
- Shipping
- The industrial sector's internal heavy road transport and high-temperature processes
- Parts of heavy road transport

4. Who are the main regulators for the hydrogen market?

The Ministry of Climate, Energy and Utilities is responsible for the overall strategy and policy for the development and regulation of the energy sector.

The Danish Energy Agency administers energy and supply in Denmark, including new hydrogen technologies. A secretariat within the Danish Energy Agency is set up as a point of contact for project developers and authorities requesting guidance with authorisation procedures etc. regarding PtX.

Further, a PtX task force is established under the PtX secretariat. The PtX task force contributes to coordination across governmental authorities, ensuring ongoing dialog with the PtX sector and identification and handling of regulatory and legislative barriers.

Some market players have asked for a one-stop-shop for PtX projects, but according to the PtX secretariat, the Danish authorities do not see this as an option for the time being.

5. Does the government hydrogen strategy or policy support the development of both low-carbon (blue) hydrogen and renewable (green) hydrogen?

The Danish PtX strategy focuses exclusively on producing green hydrogen.

6. If the government hydrogen strategy or policy supports the development of low-carbon hydrogen, to what extent is carbon capture and storage being taken forward?

Separate strategies have been adopted for PtX and carbon capture and storage (CCS). The PtX Strategy focuses exclusively on the production of green hydrogen.

Denmark has decided to establish a basis for safe and sustainable storage of CO2 in Denmark and import/export of CO2 to/from Denmark. A political agreement regarding CCS from June 2021 lays down the first initiatives promoting CCS in Denmark. Since then, further political agreements have been made and new regulation introduced. The initiatives concern, amongst others, framework conditions for CO2 storage in Denmark, construction and operation of CO2 transportation pipelines, funding for CCS/CCUS through subsidy tenders, a licensing regime for CO2 storage and state participation in CO2 storage licenses.

Funding of approximately 5 billion EUR has been set aside for CCUS (cf. Danish Ministry of Climate, Energy and Utilities). The first subsidy tender for a full-scale CCS project in Denmark was held in 2023 and won by Ørsted. Two more subsidy tenders with a pool of DKK 27 DKK billion in total are scheduled for June 2024 and June 2025.

Denmark aims for becoming a European hub for CO_2 storage and has signed agreements with Belgium, Flanders, Netherlands, France, Norway and Sweden allowing for transportation of CO2 across national borders for geological storage.

7. Are there targets for the production of hydrogen?

The PtX Strategy from 15 March 2022 sets out that Denmark is aiming to build upwards 4-6 GW of electrolysis capacity by 2030.

8. Are there any incentive mechanisms/business models in place to support the production of hydrogen?

The PtX Strategy aims to create framework conditions that are appropriate for ensuring that the production and use of hydrogen and PtX products may eventually perform on market terms.

Innovative energy and supply projects may apply to the Danish Energy Agency for a so-called regulatory test zone status if regulatory barriers prevent the implementation of the respective projects. If the Danish Energy Agency grants a project a regulatory test zone status, the project may be exempted from specific regulation for a defined period of time. Two PtX projects, Brande Brint and GreenLab Skive, were the first projects to obtain regulatory test zone status in 2021.

Substantial funds have been allocated for promoting PtX technologies and enabling the production of green hydrogen to reach an industrial scale. See question 13.

9. Are there any standards in place for the classification and/or certification of low-carbon or renewable hydrogen?

The European Commission has issued two delegated regulations that lay down detailed rules on the EU definition of renewable hydrogen:

Delegated regulation (EU) 2023/1185 establishing a minimum threshold for greenhouse gas emissions savings of recycled carbon fuels and by specifying a methodology for assessing greenhouse gas emissions savings from renewable liquid and gaseous transport fuels of non-biological origin and from recycled carbon fuels.

Delegated regulation (EU) 2023/1185 establishing a minimum threshold for greenhouse gas emissions savings of recycled carbon fuels and by specifying a methodology for assessing greenhouse gas emissions savings from renewable liquid and gaseous transport fuels of non-biological origin and from recycled carbon fuels.

The delegated regulations were formally adopted in June 2023. Guarantees of origin can be issued for green hydrogen in Denmark.

10. Does the regulatory framework clearly define the regulatory requirements relating to the production, storage, transportation or supply of hydrogen?

In 2021, the Danish Energy Agency and Energinet (Danish TSO for electricity and gas) conducted a market dialogue with relevant actors within the hydrogen industry. In the market dialogue, the actors highlighted the need for a clear regulatory framework to realise the potential of hydrogen projects.

Since 1 January 2023, transmission, distribution and storage of hydrogen are regulated by the Danish Gas Supply Act with the recognition that future updates of the legal framework may be necessary due to upcoming EU rules regarding hydrogen infrastructure.

On 1 May 2023, new rules for direct electricity supply lines came into force making it possible to apply for approval to construct a direct electricity connection between production and consumption facilities. It is expected that PtX plants can save part of the tariff payment for the electricity that is delivered directly from the producer to the consumer and thus does not burden the collective grid.

The market is awaiting decisions from the state-owned companies Energinet and Evida on investments in hydrogen infrastructure. A broad-based political agreement from 23 May 2023 lays down that Energinet and Evida shall own and operate the hydrogen infrastructure in Denmark. A political agreement from 4 April 2024 lays down the economic framework conditions for the hydrogen infrastructure, including that the Danish State, under certain conditions, is willing to take on part of the risk in connection with Energinet's potential investments in a hydrogen backbone etc. Following the latest political agreement from April 2024, Energinet is conducting studies and is aiming for an investment decision in first quarter 2025.

The Danish Energy Agency has prepared an overview of planning and administrative permits to be obtained for PtX plants. The overview is available on the agency's website (in Danish).

11. Are there any foreign investment restrictions related to energy and infrastructure sectors?

On 1 July 2021, the Danish Investment Screening Act (FDI Act) entered into force. The FDI Act introduces a mandatory sector-specific foreign investment control and a voluntary cross-sector foreign investment control.

Under the mandatory sector-specific foreign investment control, foreign investors must apply for authorisation from the Danish Business Authority if their investment or special financial agreement falls within particularly sensitive sectors and activities and meets other detailed conditions.

One of the particularly sensitive sectors is "critical infrastructure". The specific assessment of what constitutes critical infrastructure is based on socially important sectors and underlying socially important functions. According to the Danish Executive order no. 1491 of 25 June 2021, socially important functions in the energy sector comprise:

- Production, storage capacity, transport and delivery of electricity.
- Production, transport and storage of heating and cooling.
- Production, storage capacity, transport and delivery of gas.
- Production, storage and transport of crude oil as well as oil products for transport and the petrochemical industry.

12. What international treaties are in place that may offer protection to international investors in hydrogen projects in the jurisdiction?

According to the website of the United Nations Conference on Trade and Development (UNCTAD), Denmark is a signatory to a number of bilateral investment treaties (BITs).

Denmark signed the Energy Charter Treaty (ECT) in 1994. The ECT grants foreign investors fundamental rights with regard to their investments and offers investor-state dispute settlement. In April 2023, the Danish government announced that it will be seeking withdrawal from the ECT due the ECT creating unnecessary uncertainty about the green transition. The Danish Parliament is expected to formally consent to Denmark's withdrawal from the ECT in 2024.

Market developments and opportunities

13. Are there any government grants or other government funding available to hydrogen projects (including for research and development)?

Substantial funds have been allocated for promoting PtX technologies and enabling the production of green hydrogen to reach an industrial scale:

A subsidy pool of DKK 1.25 billion is allocated for a tender for operational aid for the production of hydrogen and other PtX products within a 10-year period. The tender was held from 19 April 2023 to 1 September 2023 and the subsidy pool was distributed on six winning projects.

DKK 850 million is allocated for the Danish participation in the Important Project of Common European Interest (IPCEI) on hydrogen. Two projects on Danish soil have been selected to participate in the pan-European project and receive funding, one of them is Green Fuels for Denmark, see section 15 below.

The Energy Technology Development and Demonstration Programme (EUDP) supports new technologies in the energy sector.

In order to mature the technologies, PtX has been designated as one of the four green research missions to receive funding from the Danish research reserve, which is part of the Danish Finance Act. DKK 200 million has been allocated from the research reserve in 2021, DKK 295 million in 2022 and DKK 301.8 million in 2023.

14. Are there any notable pilot/demonstration projects in place or planned for the production or offtake of clean hydrogen?

Several different pilot projects are being deployed in Denmark to examine and test the feasibility of clean hydrogen production and use in different sectors, for instance:

- **Brande Hydrogen project**: The project shall demonstrate that green hydrogen can be produced without using any power from the grid ("island mode"). The project has been granted an official regulatory energy test zone.
- **GreenHyScale**: The project aims to accelerate the large-scale production of green hydrogen by building and operating the world's first 100 MW green pressurized alkaline electrolysis plant both onshore (GreenLab Industrial Park, Skive – Denmark) and offshore. The project is EU funded.
- **Estech**: The engineering and development company, Estech, has developed a pilot project combining carbon capture and production of green hydrogen. The project is funded by EUDP.

15. Are there any commercial-scale clean hydrogen production projects in development or already operating?

There is currently no existing commercial-scale green hydrogen production operating in Denmark. However, several projects are in the pipeline or are already being built, for instance:

- **H2 Energy Esbjerg**: H2 Energy Europe plans to invest in a hydrogen production plant of 1 GW in Esbjerg. The project received an environmental approval from the Danish Authorities on 10 January 2024.
- **Green fuels for Denmark**: In the project's first two phases, the project aims for producing renewable hydrogen for trucks and enough e-methanol to supply an ocean-going vessel or several ferries.
- **HySynergy 2.0**: Everfuel is together with partners planning to establish a large-scale production and storage facility of green hydrogen. The project has received Danish IPCEI funding.
- **Idomlund**: Ørsted and Skovgaard Energy are planning to build a plant which in its first phase will have an expected electrolysis capacity of 150 MW and can, depending on the planned offshore wind capacity and hydrogen infrastructure, be increased to more than 3 GW.

According to the Danish Energy Agency (draft precondition memorandum for climate change projections 2024), PtX projects corresponding to more than 9 GW electrolysis capacity in total in 2030 have been announced, however, final investment decisions have not been made for the majority of the announced projects.

16. Have there been any hydrogen-related disputes in your jurisdiction?

To our knowledge, no hydrogen related disputes of relevance have been brought before the Danish courts.

Last updated April 2024

Egypt

Ashurst collaborated with **Shalakany Law Office** in the preparation of this content. We are grateful for their input.

Policy and regulation

1. Is there a government hydrogen strategy or policy?

Yes, the Egyptian Prime Minister signed and approved the National Green Hydrogen Strategy on 22 November 2023 (the "**Strategy**").

Recently, Egypt introduced new legislation granting new incentives tailored specifically for investment in green hydrogen programs.

2. What are key goals and commitments included in the strategy/policy?

The Strategy aims to make Egypt one of the leading countries in the production of low-carbon hydrogen (i.e. green hydrogen) in the world.

The goals of the Strategy are as follows:

- Reaching a percentage of renewable energy in the electricity mix to more than 42% by 2035;
- Issuing approvals for the establishment of green hydrogen and green hydrogen derivatives projects, and granting them the necessary incentives to attract more investments in this field;
- Making Egypt one of the leading countries in the green hydrogen economy in the world by utilizing world-leading expertise and innovations in the production of hydrogen, its derivatives, and promising renewable energy sources;
- Gradually expanding the local use of green hydrogen, with increased production capacities of hydrogen and its derivatives, leading to the use of green hydrogen in all sectors, especially manufacturing and transportation;
- Exporting the excess green hydrogen;
- Unifying the efforts made by the State to encourage and stimulate investment in the field of green hydrogen and its derivatives, in line with the requirements of sustainable development and the plans of the State for economic and social development, and ensuring competitiveness at the regional and international levels; and
- Producing green hydrogen using 100% renewable energy.

3. Which industry sectors are most likely to be affected by hydrogen deployment?

According to the Strategy, the main sectors to be affected by the green hydrogen deployment are the manufacturing and transportation sectors.

4. Who are the main regulators for the hydrogen market?

The main regulator/competent entity in Egypt with regards to green hydrogen is the Prime Minister. Also, Prime Ministerial Decree No. 3445 of 2023 established a committee named the National Council for Green Hydrogen and its Derivatives headed by the Prime Minister (the "Committee"). The Committee's members include the ministers of electricity and renewable energy, petroleum and mineral resources, finance, environment, and the Executive Director of the Sovereign Fund of Egypt.

Regarding the green hydrogen projects established in special economic zones (e.g., Suez Canal Special Economic Zone) or free zones (e.g., Alexandria free zone), they will be supervised by the board of directors of the relevant special economic zone or free zone.

The Committee has the following mandates:

- Following up on the implementation of the Strategy, and proposing updating it in light of international and national developments;
- Approving the policies, plans and mechanisms necessary to implement and update the Strategy;
- Coordination between ministries and relevant authorities, and proposing the necessary solutions to overcome obstacles to investment in the field of green hydrogen and its derivatives; and
- Reviewing the legislation, regulations and rules regulating the field of green hydrogen and its derivatives and proposing their update.

Moreover, the construction and operation of any hydrogen producing facilities outside special economic zones and free zones are subject to the supervision of the Industrial Development Authority.

Overall, in terms of electricity production from green hydrogen, the Egyptian Electric Utility and Consumer Protection Agency is the regulator of the production, transportation and distribution of electricity in Egypt and therefore, it could be involved in the production of electricity from hydrogen/green hydrogen.

5. Does the government hydrogen strategy or policy support the development of both low-carbon (blue) hydrogen and renewable (green) hydrogen?

In July 2022, the Egyptian Natural Gas Holding Company (EGAS) signed a Memorandum of Understanding (MoU) with Wintershall Dea to prepare commercial and technical feasibility studies of blue and turquoise hydrogen in Egypt.

6. If the government hydrogen strategy or policy supports the development of low-carbon hydrogen, to what extent is carbon capture and storage being taken forward?

According to a statement by the Minister of Petroleum and Natural Resources, the Ministry and Italian energy firm "Eni" are implementing a pilot carbon capture project at the Italian energy firm's Meleiha concessions in the Western Desert. The pilot project — which marks Egypt's first carbon capture initiative — is being implemented at a cost of USD 25 million and aims to store some 25-30k tons of carbon dioxide each year. If successful, similar schemes will be rolled out in other locations, the statement read.

7. Are there targets for the production of hydrogen?

The Egyptian government's target is to have 42% of electricity produced via renewable energy (including green hydrogen) by the year 2035.

8. Are there any incentive mechanisms/business models in place to support the production of hydrogen?

Law No. 2 of 2024 was issued on 27 January 2024 regulating the Incentives for green hydrogen and green hydrogen derivatives production (the "**New Law**"). The said New Law's scope applies to the green hydrogen related projects that sign project agreements within five (5) years from the date of entry into force of the New Law (i.e., 28 January 2024), which are as follows:

1. Factories producing green hydrogen and its derivatives.
2. Desalinated water production stations that allocate at least 95% of their production to be used in the production of green hydrogen and its derivatives.
3. Electric energy/electricity production stations from renewable energy sources, which allocate no less than 95% of their production to feed green hydrogen and green hydrogen derivatives production plants and desalinated water production plants referred to above.
4. Projects whose activity is limited to transporting, storing or distributing green hydrogen and its derivatives produced within Egypt.
5. Projects whose activity is directly limited to the manufacture of production supplies or inputs necessary for the factories producing green hydrogen and green hydrogen derivatives and for which a decision shall be issued by the Council of Ministers based on the proposal of the competent minister and after taking the opinion of the minister concerned with electricity and renewable energy affairs and the minister of finance.

The incentives granted by the New Law can be summarized as follows:

Tax incentives:

- A monetary investment incentive denominated as "the green hydrogen incentive", ranging from 33% to 55% of the tax amount paid upon declaring the income resulted from initiating activities in the project or its expansions. The said incentive shall be paid/reimbursed within a maximum period of 45 days from the end of the period for submitting the tax return, otherwise, a delay interest calculated on the basis of the credit and discount rates announced by the Central Bank of Egypt on the first of January preceding the incentive due date shall be due in favour of the project.
- An exemption from value-added tax on equipment, tools, machinery, devices, raw materials, supplies and transportation means needed for the initiation of the project (passenger cars are not included).
- A VAT rate of 0% is applicable to exports of green hydrogen projects and their related products.

Non-tax incentives (fast approvals and less bureaucracy):

1. Project companies engaging in green hydrogen production projects may obtain a single approval (i.e., golden license).
2. Project companies are permitted to import all required materials and equipment for the establishment, expansion and operation of the project without the requirement to register themselves in the importer's register. Similarly, they can export products without a licence or registration in the exporter's register.
3. During the first ten (10) years after the signing date of project agreements, the project company may employ foreign workers up to 30% of the total workforce.
4. Special customs ports may be established specifically for the import and export activities of the project.
5. 30% reduction in fees for seaport usage, sea transport and related services provided to ships in Egyptian seaports.
6. 25% reduction in the usufruct right fees of industrial lands allocated for establishing a green hydrogen and hydrogen derivatives production plant, along with a 20% reduction for fees of storage warehouse lands at the ports.
7. A grace period is granted for the payment of the usufruct right fees for industrial and storage lands, starting from the project's commercial operational date, without imposing interest or fines.
8. The terms of licences granted to green hydrogen production projects will match the duration the usufruct right for the project's land.

In order to obtain the previously mentioned incentives, the New Law sets several conditions as follows:

- The project is required to begin its commercial operation within five (5) years from the date of concluding the project agreements;
- Financing for the project must predominantly originate from foreign sources, representing at least 70% of its total investment cost;
- The project must prioritize the use of domestically manufactured components whenever they are available in the local market, with a minimum requirement of 20% of the project's components;
- The project is obligated to facilitate the transfer and localization of modern and advanced technologies to Egypt, and commit to the development and implementation of training programs for Egyptian workers; and
- The project company is required to devise a plan aimed at fostering the development of surrounding local areas. This plan must adhere to the guidelines for corporate social responsibility as outlined in Egyptian Investment Law No. 72 of 2017 (the "Investment Law").

9. Are there any standards in place for the classification and/or certification of low-carbon or renewable hydrogen?

No.

10. Does the regulatory framework clearly define the regulatory requirements relating to the production, storage, transportation or supply of hydrogen?

There have not been any laws or decrees regulating the production, storage, transportation or supply of hydrogen (other than the New Law and the Prime Ministerial Decree No. 3445 of 2023, which do not provide details directly regulating to these matters).

The framework is determined according to the memoranda of understanding ("**MoUs**") and agreements concluded by the Egyptian government with the energy companies and investors undertaking the establishment of hydrogen projects in Egypt.

However, and further to point 1 of the non-tax incentives under question 8 relating to the single approval/golden license, the Cabinet of Ministers Decree No. 56 for the year 2022 considers projects relating to the production, storage, transmission and/or exportation of green hydrogen and green ammonia as national/strategic projects that can be subject to a single approval (i.e., golden license), provided that the project fulfils at least two (2) criteria of the below list:

- The project shall contribute to increasing exports by exporting at least 50% of its products abroad annually, within maximum period of three (3) years from the date of starting the activity.
- The project shall obtain its financing as foreign funds transferred from abroad through an Egyptian bank, in accordance with the conditions determined by the Board of Directors of the Central Bank of Egypt.
- The project shall aim at reducing imports, localize the industry and deepen the local component in its products. The percentage of the local component of raw materials and production requirements in its products should be a minimum of

50%, provided that said percentage is calculated by deducting the value of the imported components from the cost of the product.

- The project is established in one of the areas in need of development.
- The project must contribute to the transfer and localization of modern and advanced technology in Egypt, and to support innovation, development and scientific research.
- The project shall aim at securing strategic goods for the country and limit its import.
- The project should use national labor intensively.
- The project shall contribute to reducing the environmental impact, reducing heat and gas emissions, and improving the climate.

Companies establishing green hydrogen projects and fulfilling at least two (2) of the above criteria, shall submit an application in order to obtain a single approval from GAFI, which will either accept or reject the application after verifying whether at least two of said criteria are fulfilled.

11. Are there any foreign investment restrictions related to energy and infrastructure sectors?

There are no foreign investment restrictions related to energy and infrastructure sectors. The Investment Law grants foreign investors protection such as financing the project from abroad without restrictions in foreign currency. The foreign investor shall also have the right to freely own, manage and use the project, gain profits and transfer such profits abroad. In addition, the foreign investor shall have the right to liquidate the project at any time. All cash transfer operations related to foreign investment are allowed to be undertaken without any delay. The State further allows the transfer of the local currency into foreign currency.

The above being said, the Egyptian bank undertaking the transfer may request, at its sole discretion, the documents it deems justifying the transfer of funds abroad. As such, the entity making the transfer will have to submit documents to its Egyptian bank justifying the transfer of the funds abroad.

12. What international treaties are in place that may offer protection to international investors in hydrogen projects in the jurisdiction?

Egypt has entered into numerous Bilateral Investment Treaties ("**BITs**"). The BITs to which Egypt is a signatory party are with, inter alia, Albania, Algeria, Argentina, Armenia, Australia, Austria, Belarus, Belgium and Luxembourg, Bosnia and Herzegovina, Bulgaria, Canada, China, Comoros, Croatia, Cyprus, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, India, Indonesia, Italy, Japan, Jordan, Kazakhstan, Latvia, Lebanon, Malaysia, Morocco, the Netherlands, Occupied Palestinian Territory, Oman, Poland, Portugal, Qatar, Republic of Korea, Romania, the Russian Federation, Singapore, Slovakia, Spain, Sri Lanka, Sweden, Switzerland, Syria, Thailand, Turkey, Turkmenistan, Ukraine, the United Arab Emirates, the United Kingdom, the United States and Vietnam.

Egypt has also entered into a number of Multilateral Investment Treaties and free trade agreements. These include the Unified Agreement for the Investment of Arab Capital in the Arab States and the COMESA Investment Treaty, which provide substantive investment protections and easy recourse to international arbitration. Egypt is also a signatory to the 1958 New York Convention on the Recognition and Enforcement of Arbitral Awards.

Market developments and opportunities

13. Are there any government grants or other government funding available to hydrogen projects (including for research and development)?

There are no grants or other governmental funding available to hydrogen products to date. That said, the government provides incentives to hydrogen projects including tax and non-tax incentives under the New Law. Please refer to our responses to questions (8) and (10) above.

14. Are there any notable pilot/demonstration projects in place or planned for the production or offtake of clean hydrogen?

The Egyptian government has signed multiple MoUs and agreements with international investors to produce hydrogen, such as the following:

- On 8 July 2021, the government, represented by the Egyptian Electricity Holding Company (EEHC) and the Egyptian Natural Gas Holding Company (EGAS), signed an initial agreement with Italian energy company Eni to assess the technical and commercial feasibility of projects for the production of green hydrogen through the storage of CO2 in depleted natural gas fields.

- The first MoU was signed in August 2021 with Siemens Energy to build a plant with a capacity of 100 to 200 MW. Under the MoU, Siemens and the Egyptian government will jointly promote investment, technology transfer and implementation of projects related to hydrogen production.
- The Sovereign Fund of Egypt concluded an agreement in March 2022 with the consortium of Norway's Scatec, Egyptian businessman Nassef Sawiris, ammonia producer Fertiglobe and Orascom Construction, in order to establish and operate a 100 MW green hydrogen plant in Ain El Sokhna. The project is set to start by 2024, making it Egypt's first operational green hydrogen plant.
- South Korean company Hyundai Rotem signed on 23 January 2022 in consortium with Orascom Construction and France's Colas Rail a MoU with to build a green hydrogen-powered tram in Egypt's new administrative capital.
- During COP 27, held in Sharm El Sheikh, Egypt (through the Minister of Petroleum and the Minister of Electricity and Renewable Energy) and the European Commission signed an MoU on 16 November 2022 on a strategic partnership on renewable hydrogen.
- The Egyptian government, represented by the New and Renewable Energy Authority, the Ministry of Electricity, the Egyptian Electricity Transmission Company, the Suez Canal Special Economic Zone and the Sovereign Fund of Egypt signed 7 MoUs for the production of green hydrogen, since August 2022.
- Elsewedy Electric in partnership with ReNew Power Private Limited signed a Framework Agreement with the Egyptian Government represented by the Infrastructure and Utilities Sub Fund of the Sovereign Fund of Egypt, the New and Renewable Energy Authority, the Egyptian Electricity Transmission Company and the General Authority for Suez Canal Economic Zone to jointly develop, finance, construct, operate and maintain a green hydrogen project with its related ancillary facilities. Initially, a pilot electrolysis plant is expected to produce 20,000 tons of green hydrogen annually. While for the next phase, the annual output of the plant will be raised by up to 200,000 tons of green hydrogen, bringing the total production to 220,000 tons. The pilot phase project is expected to be commissioned in 2026.
- Infinity Power and its consortium partners, Masdar and Hassan Allam Utilities, announced that they have signed a framework agreement with leading Egyptian state-backed organizations for the development of a 2 GW green hydrogen program in the Suez Canal Economic Zone (the "SCZONE"). The consortium signed two MoUs in April 2022 with Egyptian entities, related to the development of two green hydrogen production plants in the country, one in the SCZONE and the other in the Mediterranean. The consortium is targeting an electrolyzer capacity of 4 GW by 2030, and an output of up to 480,000 tonnes of green hydrogen per year.
- On 20 February 2024, Egypt signed seven (7) new MoUs, the value of which is up to USD 12 billion for pilot facilities, and an additional USD 29 billion for the first phase of large-scale production of those MoUs, amounting to an investment of up to USD 40 billion to be invested over the next ten (10) years, according to Egypt's Minister of Planning. Details of such MoUs include:
    - Smartenergy: A Swiss renewables investor planning to develop 1 GW of electrolysis capacity to produce 830,000 tonnes of green ammonia, destined for two primary uses: producing fertilizers and as green fuel for the maritime sector.
    - Pash Global: A London-headquartered renewables investor focusing on projects in Africa and Latin America signed an MoU to develop a large-scale green hydrogen and ammonia project in the Suez Canal Economic Zone.
    - Gama Construction: A Cairo-based construction firm, part of a consortium with French investor Meridiam.
    - SK Ecoplant Co.: A subsidiary of a Korean industrial conglomerate, in a consortium with the China State Construction Engineering Corporation (CSCEC), the world's largest builder, are set to team up on a USD 1.9 billion renewable energy project in Egypt, their first joint project since the two companies agreed to cooperate on the eco-friendly business.
    - Gila Al Tawakol Electric: A Cairo-based electrical equipment supplier.
    - Amm Power: A Canadian-based green ammonia producer.
    - United Energy Group: A Hong Kong-headquartered oil and gas exploration firm.

15. Are there any commercial-scale clean hydrogen production projects in development or already operating?

There are no projects that have materialized on the ground yet; only MoUs and agreements that have been concluded between the government and investors.

16. Have there been any hydrogen-related disputes in your jurisdiction?

We have not been aware of any hydrogen-related disputes in Egypt.

Last updated April 2024

Finland

Ashurst collaborated with **Dittmar & Indrenius** in the preparation of this content. We are grateful for their input.

Policy and regulation

1. Is there a government hydrogen strategy or policy?

In June 2022, the Finnish Government announced a new national energy and climate strategy aiming at carbon neutrality by 2035. The new energy and climate strategy includes a section on hydrogen and this forms Finland's hydrogen strategy. Based on the national hydrogen strategy, the Finnish Government adopted a resolution defining the national hydrogen objectives and describes the measures to promote them on hydrogen in February 2023.

2. What are key goals and commitments included in the strategy/policy?

As a part of the goal to achieve carbon neutrality by 2035, Finland is preparing comprehensively for the deployment of hydrogen solutions throughout the value chain for when hydrogen solutions reach commercial viability. Finland's goal is to become the European leader in the hydrogen economy in the entire value chain. Finland has the capability to produce at least ten per cent of the EU's emissions-free hydrogen in 2030.

The objectives of the Finnish Government's resolution on hydrogen are to manufacture clean hydrogen and electrofuels for the needs of the Finnish industry, transport and energy system, to renew industry and grow exports with high value added, and to secure investments in Finland. The objective is to grow a new industry in Finland based on hydrogen and hydrogen-based products, which will support the renewal of the manufacturing industry and turn the technology companies in the sector into internationally leading suppliers.

The Finnish gas transmission system operator Gasgrid Finland Oy announced in June 2022 that it will develop a national hydrogen transmission infrastructure to enable a regional hydrogen market in the future. Gasgrid published preliminary plans for the national hydrogen infrastructure in May 2024 and mapping of concrete route alternatives with counties and municipalities will begin in early summer 2024. In May 2022, Gasgrid Finland Oy together with two industrial partners also announced the potential construction of Finland's first hydrogen transmission infrastructure demonstration project extending beyond an industrial site. In February 2023, EUR 9.5 million in RRF energy investment support under the EU's NextGenerationEU funding instrument was granted for project design and potential construction. In May 2023, the scenario works of the joint project were completed, in which hydrogen production will become the largest user of electricity, while wind power will be the number one form of electricity production. The project proceeded to basic design stage in May 2024, where, among other things, the pipeline routing will be specified.

3. Which industry sectors are most likely to be affected by hydrogen deployment?

The industrial sectors likely to be affected by the hydrogen deployment are:

- the power sector;
- road freight;
- shipping and aviation.

Currently, the biggest users of hydrogen in Finland are oil refineries, biofuel production companies and the chemical industry. In these sectors, where hydrogen is already being used, a shift to low-carbon hydrogen is expected.

4. Who are the main regulators for the hydrogen market?

There is currently no sector-specific legislation in place and therefore no sector-specific regulators either.

5. Does the government hydrogen strategy or policy support the development of both low-carbon (blue) hydrogen and renewable (green) hydrogen?

The hydrogen strategy as well as the Finnish Government's resolution on hydrogen support both low-carbon hydrogen and renewable hydrogen.

6. If the government hydrogen strategy or policy supports the development of low-carbon hydrogen, to what extent is carbon capture and storage being taken forward?

The Government has allocated EUR 150 million in its Sustainable Growth Programme towards investment, among other things, in hydrogen projects and carbon capture and recovery projects. In addition, some EUR 66 million were granted by the Ministry of Economic Affairs and Employment in October 2022 through the EU's Recovery and Resilience Facility (RRF) for investments into industrial-size production facilities for renewable methane and methanol, respectively. The Government-controlled innovation investor Business Finland also has various programs related to supporting innovation in the hydrogen economy and carbon capture, usage and storage (CCUS), for example, Bio and Circular Finland, Power to X, Smart Energy, and Smart Manufacturing. In December 2022, the remaining budget authority available was transferred to Business Finland for important projects of common European interest (IPCEI) on hydrogen. At the time, Business Finland granted some EUR 61 million for the development of green hydrogen. In spring 2023, Business Finland launched a new program (The Hydrogen & Batteries – Dual Helix of Decarbonization) for the hydrogen and battery industry to fund, among other things, future hydrogen investment projects. The hydrogen strategy also includes plans to accelerate the development and introduction of CCUS.

In addition, according to the Government Programme, "A Strong and Committed Finland", published in June 2023, the Government will explore and introduce policy instruments to ensure that carbon dioxide emissions to atmosphere from large industrial sources are eliminated by the mid-2030s. The Government will introduce a reverse auction of negative emissions or a similar mechanism to encourage the capture of carbon dioxide.

7. Are there targets for the production of hydrogen?

Finland has not set targets for hydrogen production. However, according to the hydrogen strategy, Finland's non-binding target is to have at least 200 MW of electrolyser hydrogen production capacity by 2025 (in 2021, the capacity was 9 MW) and at least 1000 MW by 2030.

8. Are there any incentive mechanisms/business models in place to support the production of hydrogen?

The Government has allocated EUR 150 million in its Sustainable Growth Programme towards investment, among other things, in hydrogen projects and carbon capture and recovery projects.

The primary target group for these investments is large companies in the energy technology and energy-intensive industries and their supplier networks, as well as SMEs that commercialise innovations. There are no restrictions on the size of company that can benefit from these investments and no specific regions or industries are targeted however, investments will not be allocated to projects for the production of hydrogen from natural gas. The funding from the Sustainable Growth Programme is therefore intended to foster innovation in the field of electrolyser hydrogen however, the Government acknowledges the difficulties relating to commercialisation of such technologies in the hydrogen strategy.

In its hydrogen strategy, the Government announced that it will investigate the feasibility of introducing carbon contracts-for-differences (CCfDs) as an incentive mechanism to accelerate transformation into low-carbon industry.

Hydrogen distribution stations for traffic use can already obtain investment aid and hydrogen fuel is now included in the renewable fuel distribution obligation system.

The Finnish Government's resolution on hydrogen states that a supportive regulatory framework, a favourable business environment and economic incentives must be promoted to encourage investment.

According to the Government Programme, "A Strong and Committed Finland", published in June 2023, the Government is preparing to introduce sufficient incentives to advance investments. The Government will introduce a reverse auction of negative emissions or a similar mechanism to encourage the capture of carbon dioxide. In addition, preparations will be made for investments in the hydrogen transmission network with the aim of encouraging the processing of electricity and hydrogen into high value-added goods in Finland. The Government Programme has also taken into account the need to ensure streamlined and predictable investment permit procedures.

9. Are there any standards in place for the classification and/or certification of low-carbon or renewable hydrogen?

There are no national standards in place for the classification of low-carbon or renewable hydrogen. The European Commission has issued two delegated acts outlining rules on the EU definition of renewable hydrogen. The Delegated Regulation (EU) 2023/1184 defines under which conditions hydrogen, hydrogen-based fuels or other energy carriers can be considered as renewable fuels of non-biological origin (RFNBOs). The Delegated Regulation (EU) 2023/1185 provides a methodology for calculating life-cycle greenhouse gas emissions for RFNBOs.

10. Does the regulatory framework clearly define the regulatory requirements relating to the production, storage, transportation or supply of hydrogen?

To date there are no national regulatory requirements relating to the production, storage, transportation or supply of hydrogen in Finland. The hydrogen strategy states that if necessary, national regulation regarding hydrogen will be developed.

According to the Finnish Government's resolution on hydrogen the promotion of renewable and low-carbon hydrogen production and the launch of investment require a supportive regulatory framework. In particular, safety regulatory reform is an important part of the development and deployment of hydrogen technologies.

11. Are there any foreign investment restrictions related to energy and infrastructure sectors?

There is no sector-specific legislation in place in Finland relating to foreign investments in energy and infrastructure sectors. However, there is legislation in place that provides that a foreign corporate acquisition will be subject to monitoring if, as a result if the proposed corporate acquisition, a foreign owner will control a certain proportion of votes or will have actual influence in a company active in the defence and security sector or a business undertaking considered critical for vital functions of society.

In this instance, a notification must be made to the Ministry of Economic Affairs and Employment which confirms the proposed acquisition in the first instance, but may refer it to the Council of State of Finland which in turn may refuse to confirm the acquisition if it is deemed necessary due to a critical national interest.

12. What international treaties are in place that may offer protection to international investors in hydrogen projects in the jurisdiction?

The United Nations Conference on Trade and Development (UNCTAD) website states that Finland is a signatory to 55 bilateral investment treaties (BITs) that are in force, and in addition certain other treaties may contain protections for investors in Finland. These can be accessed from the Ministry of Foreign Affairs' website, and UNCTAD's Investment Policy Hub.

The Energy Charter Treaty (ECT) is a multilateral investment treaty which entered into force in April 1998 and specifically addresses energy trade, transit and investment between its contracting parties, which include Finland and all other EU states (except Italy). In April 2024, the EU Industry, Research and Energy, and International Trade committees have recommended that the EU exit the ECT. Parliament's approval is still required for the EU to exit from the ECT.

Market developments and opportunities

13. Are there any government grants or other government funding available to hydrogen projects (including for research and development)?

The Government has allocated EUR 150 million in its Sustainable Growth towards investment, among other things, in hydrogen projects and carbon capture and recovery projects. In addition, some EUR 66 million were granted by the Ministry of Economic Affairs and Employment in October 2022 through the RRF for investments into industrial-size production facilities for renewable methane and methanol, respectively.

In December 2022, the remaining budget authority available was transferred to the Government-controlled innovation investor Business Finland for important projects of common European interest (IPCEI) on hydrogen. At the time, Business Finland granted some EUR 61 million for the development of green hydrogen. In spring 2023, Business Finland launched a new program (The Hydrogen & Batteries – Dual Helix of Decarbonization) for the hydrogen and battery industry to fund, among other things, future hydrogen investment projects. The program will run for six years, ending in 2028.

14. Are there any notable pilot/demonstration projects in place or planned for the production or offtake of clean hydrogen?

There are a number of different pilot projects being deployed in Finland to examine and test the feasibility of clean hydrogen production and use in different sectors, such as:

- **SSAB's** industrial-scale research project, which aims to produce fossil-free steel using hydrogen reduction and clean electricity;
- Q Power and Wärtsilä aim to produce synthetic natural gas from hydrogen and carbon dioxide;
- **Flexens** which aims to produce and utilise clean hydrogen for ferry transport;
- **Gasgrid Finland's** hydrogen transmission infrastructure demonstration project, which is the first hydrogen transmission project extending beyond an industrial site;
- **Raahen Monivoima** is preparing a project combining the storage of wind and solar energy, a green hydrogen production plant, and a hydrogen storage facility.

- **Solar Foods** which produces protein by utilising carbon dioxide and renewable electricity. Solar Foods has constructed an industrial-scale demonstration plant which uses hydrogen technology. The plant started its operations in April 2024. ABB aims to develop and demonstrate megawatt-scale fuel cell solutions to enable zero-emission maritime transport (as part of the CLIC Innovation and Gasgrid Finland's BalticSeaH2-project); and
- **Helen** aims to produce green hydrogen with a PEM electrolyser (as part of the CLIC Innovation and Gasgrid Finland's BalticSeaH2-project). The first pilot plant is planned to be operational in 2024 and will mainly serve heavy-duty transport.

15. Are there any commercial-scale clean hydrogen production projects in development or already operating?

Finnish gas industry company Woikoski's plant in Kokkola, which started operating in 2014, appears to be the only commercial-scale clean hydrogen plant in Finland. There are also a number of projects in the pipeline at different stages of development, including the following projects:

- **Neste Corporation's** clean hydrogen project 'SHARC' which aims to produce clean and low-carbon hydrogen for refining oil and bio fuels. The EU Innovation Fund has granted €88 million to the project. The project is currently in the basic engineering stage. The investment decision readiness is expected to be reached in early 2024. An investment decision has not been made as of April 2024. If an investment decision is made, green hydrogen production could start in 2026.
- **P2X Solutions** plans to construct a 20 MW electrolyser plant, which will start producing green hydrogen using electricity produced by wind, solar, biomass or hydropower for industrial and transport use. The plant is due to be operational by the end of 2024.
- **Ren-Gas** has signed several co-operation agreements since the start of the year 2022 with different parties regarding feasibility studies of Power-to-Gas plants/facilities which would have electrolysis capacities ranging between 20-60 MW each. In 2023, at least one of these projects has progressed to obtaining investment support and planning a construction project. In April 2024, the Ren-Gas Lahti plant was given a EUR 45 million subsidy grant through the European Hydrogen Bank's first competitive bidding process.
- **CLIC Innovation and Gasgrid Finland's** BalticSeaH2-project, which aims to build the first significant, cross-border hydrogen valley in Europe. The goal is to create an integrated hydrogen economy around the Baltic Sea to enable self-sufficiency of energy and minimise carbon emissions from different industries. The project includes 40 partners from nine Baltic Sea area countries. The project has started in the beginning of June 2023 and lasts five years.
- **Neste Corporation, Gasgrid Finland, Helen and Vantaan Energia** have in collaboration started preliminary studies on the development of an industrial hydrogen valley. The industrial hydrogen valley would combine infrastructure, storage and transmission of renewable hydrogen, serving both producers and consumers of hydrogen.
- **Helen** announced in April 2024 that it will construct a green hydrogen plant in Helsinki, which is due to be operational in 2026. According to the company, the project will reduce carbon dioxide emissions by more than 3 700 tons per year.

16. Have there been any hydrogen-related disputes in your jurisdiction?

There have been no directly hydrogen-related disputes that are publicly available.

Last updated May 2024

France

Policy and regulation

1. Is there a government hydrogen strategy or policy?

Initially, the French Minister in charge of energy transition issued a hydrogen deployment plan for the energy transition in June 2018. This plan was based on three main axes: the creation of a decarbonised industry, the development of renewable energies storage capacities and the development of zero-emission solutions for road, rail and waterway transport.

This initiative was followed by the issuance of the National Strategy for the development of low-carbon Hydrogen in France by the government on 8 September 2020 (the "**Hydrogen National Strategy**") as part of the stimulus plan aiming to accelerate ecologic, industrial and social transition in France.

Three years after its launch and as part of the French Climate-Energy Strategy for 2024-2035, the French government has worked on a revised version of the Hydrogen National Strategy to adapt it to changes in the sector since its adoption in 2020. Although it was initially planned for June 2023, such revised Hydrogen National Strategy was subject to public consultation from 15 December 2023 to 19 January 2024. The revised Hydrogen Strategy should be enacted by the summer 2024, as announced in the last meeting of the National Hydrogen Council (26 March 2024).

In addition, hydrogen is at the heart of the massive investment plan France 2030 announced by the French President on 12 October 2021, one of the aims of which is for France to become the leader of green hydrogen. France 2030 increases the financial support for hydrogen up to EUR 9 billion.

According to the French government, as of December 2023, around one third of the EUR 9 billion envelope has been used to support the low-carbon hydrogen sector and 2.5 to 3 GW of electrolysis capacity out of the planned 6.5 GW have been secured.

2. What are key goals and commitments included in the strategy/policy?

There are three priorities in the initial Hydrogen National Strategy, namely industry decarbonisation to meet carbon-neutrality in 2050, development of hydrogen-powered heavy mobility and support to high-level research and development of training offers.

In this context, three major objectives have been set by the French government:

- Raising the number of electrolysers to significantly contribute to economy decarbonisation (development of 6.5 GW low-carbon hydrogen production capacities based on electrolyse, by 2030, and 10 GW, by 2035).

  Corresponding priority: decarbonising industry by creating a French electrolysis industry.

- Development of clean mobilities specifically for heavy mobilities, i.e. utility vehicles, trucks, trains, river shuttles, ships, planes (the objective is to save 6 million tonnes of CO2 by 2030).

  Corresponding priority: developing heavy-duty mobility with low-carbon hydrogen.

- Creation of an industrial sector generating jobs and guaranteeing technological expertise.

  Corresponding priority: support research, innovation and skills development to foster the uses of tomorrow.

The draft revised Hydrogen National Strategy adds a number of priorities to the original ones, among which:

- In addition to support for electrolysis production, supporting the deployment of new hydrogen production methods as part of the objective of installing a low-carbon electrolytic hydrogen production capacity of 6.5 GW by 2030 (and 10 GW by 2035): the government will allocate a funding to explore the potential of hydrogen naturally present in the subsoil. A first research permit has been granted in the Pyrénées-Atlantiques region on 23 November 2023.
- Developing economically relevant hydrogen "hub" networks, taking into account the characteristics of each region: priority should be given to the development of a network within hydrogen hubs (so-called "intra-hub" infrastructures), in particular the hubs of Fos-sur-Mer, Dunkirk, Havre-Estuaire de la Seine, and Vallée de la Chimie, and their connection to storage infrastructures.
- Promoting competitive low-carbon hydrogen production in France, in particular through a EUR 4 billion in the form of Carbon Contracts for Difference ("CCfD") to ensure, in addition to the existing support mechanisms, the competitiveness of low-carbon hydrogen as compared to fossil hydrogen over the next decade (see question 8).

- Supporting the French hydrogen industry in its international commercial development and promoting the emergence of a global market for hydrogen and its derivatives. In this respect, the French government has asked relevant authorities to analyse the appropriateness and methods of importing hydrogen. Their report should have been presented to the government in the first quarter of 2024.
- Making the deployment of hydrogen an opportunity to make the energy system more flexible, by improving electrolysers and developing storage capacity.
- Ensuring the necessary conditions for the development of the French hydrogen industry, including access to land, simplification of permitting and grid connection procedures or even the adaptation of the national regulatory framework to ensure a complete, readable and stable regulation.

3. Which industry sectors are most likely to be affected by hydrogen deployment?

The industry sectors where clean hydrogen may displace fossil fuels in France include:

- Steel and chemical industry
- Transport
- Power sector (in particular renewable energy)
- Refining industry
- Heating

Sectors where hydrogen is already being used in smaller quantities, such as electronics or food industry, are also expected to switch to low-carbon hydrogen.

4. Who are the main regulators for the hydrogen market?

As the market is nascent in France, a specific regulator for the hydrogen market has not been appointed as yet. However, the French Energy Regulatory Commission (known as the "**CRE**") and the Environment and Energy Management Agency ("**ADEME**") will play a role in the development of the market.

Based on the provisions of the Hydrogen Ordinance dated 17 February 2021 and the Hydrogen Decree dated 1 September 2023 (see question 8), the opinion of the CRE will be sought on the tender specification framing the tendering process and on the general terms and conditions of the aid which will be granted to low-carbon and renewable hydrogen production facilities by electrolysis of water, having been selected through the said tendering process.

Meanwhile, in application of those provisions, the ADEME will lead the tendering process for the granting of the public support mechanism (see question 8).

5. Does the government hydrogen strategy or policy support the development of both low-carbon (blue) hydrogen and renewable (green) hydrogen?

The Hydrogen National Strategy and the investment plan France 2030 aim to focus on the development of low-carbon hydrogen by electrolysis of water and renewable (green) hydrogen. The French government's strategy is first to promote hydrogen decarbonisation mechanisms through the development of electrolysers, in line with the European strategy for the development of hydrogen.

However, the CRE recently insisted on the fact that the priority should be the decarbonisation objective regardless of the primary energy source that is used (i.e., low-carbon hydrogen or hydrogen produced from renewable energy). While according to the CRE, the public support in favour of hydrogen should not be based on the category of hydrogen but only on the emission threshold of CO2 equivalents emitted per kilogram of hydrogen produced, the French government has published, in June 2023, a draft Carbon Capture, Storage and Utilisation (CCUS) strategy for consultation with the sector manufacturers (see question no. 6). The consultation closed on 29 September 2023.

6. If the government hydrogen strategy or policy supports the development of low-carbon hydrogen, to what extent is carbon capture and storage being taken forward?

The French draft CCUS strategy is based on the principle that CCUS is not a technology for maintaining "business as usual", but to manage incompressible residual emissions that cannot be reduced, in the absence of other economically accessible decarbonisation solutions, or a transitional solution.

The French CCUS strategy is built around 4 main guidelines:

1. The rapid deployment of CCS projects, by major industrial areas, in three phases: (i) the first starting in 2026 with the

industrial ports of Dunkirk, Le Havre and Fos-sur-Mer, (ii) the second from 2028, with the Lacq/Sud Ouest and Loire-Estuaire basins and (iii) the third from 2033, in the Grand Est through the potential development of onshore storage.

2. The launch of a public support mechanism for decarbonisation to ensure industrial competitiveness: the French government estimates the investment required to be between EUR 11 billion and EUR 18 billion, based on capture costs between EUR 40 per tonne of CO2 (/tCO2) and EUR 80 /tCO2, transport and storage costs between EUR 100 /tCO2 and EUR 150 /tCO2, and an initial investment by the manufacturers between EUR 100 million and EUR 400 million. Because of these additional costs – which according to the French government are not easily reflected in the final product by the manufacturer to the consumers – the French strategy provides for a support in the form of Carbon Contracts for Difference ("CCfD"), awarded through a tendering process, for identified carbon capture and sequestration projects. The support mechanism will have to be pre-notified to the European Commission and the first call for tenders was initially planned for the first half of 2024.
3. A regulatory framework for carbon transport infrastructures, which will be regulated by the CRE and including measures to share the financial risks related to such infrastructures between the French State, the grid operators and their manufactural users.
4. The development of various carbon storage possibilities in France: the French government has also launched, on 29 April 2024, a call for expression of interest (appel à manifestation d'intérêt – "AMI Capture et Stockage de Carbone") for geophysical exploration campaigns and CO2 injection tests at pilot sites, with the first tests scheduled by 2025. In particular, this first call for expression of interest aims at identifying the companies likely to be involved in the CCUS chain in France, which are asked to provide an estimate of their capacity for CO2 production and/or capture, liquefaction, transport, storage and injection monitoring tools. It will be closed on 26 July 2024. Based on its results, a call for proposals (appels à projets) may be launched in the future to support initiatives to improve knowledge of the subsoil and encourage research into carbon storage capacity in France.

   The French government also intends to facilitate the adoption of CCUS projects by launching an information and exchange campaign to promote local acceptance.

The French government is aiming to save 4 to 8.5 million tonnes of CO2 per year, by 2030, and 15 to 20 million tonnes of CO2 per year, by 2050.

7. Are there targets for the production of hydrogen?

France's target is to have 6.5 GW low-carbon hydrogen production capacities based on electrolysers and to save more than 6 Mt of CO2 (which is equal to the annual carbon emissions of a city like Paris) by 2030, and 10 GW, by 2035. France is aiming to be carbon neutral by 2050 (see question 1).

8. Are there any incentive mechanisms/business models in place to support the production of hydrogen?

1. The French public incentive plans

In the Hydrogen National Strategy, the French government announced that EUR 7 billion will be provided until 2030 in support of the three priorities mentioned in response to question 2 above. The France 2030 plan increased this amount up to EUR 9 billion (see question 1).

As part of the Hydrogen National Strategy, the French prime Minister announced in September 2022 that the 10 French projects approved by the European Commission as part of an Important Project of Common European Interest ("**IPCEI**") (see question 13) would be granted EUR 2.1 billion.

In addition, as part of France 2030, the French Minister for Energy Transition (among other ministers) announced in May 2023 the deployment of a new funding envelope of EUR 175 million to relaunch the "Territorial Hydrogen Ecosystems" call for proposals ("*AAP Ecosytèmes territoriaux hydrogène*") – through which 35 ecosystems across France were financed for more than EUR 175 million in public support – to promote the investments in the production and distribution of renewable and/or carbon-free hydrogen, for industrial use, mobility or stationary applications in the French territories. Applications could be submitted before the French Environment and ADEME until the end of September 2023.

On 31 August 2023, as part of the said EUR 9 billion announced at the end of 2020, the French government announced the release of a EUR 4 billion support package for the hydrogen industry, to subsidise the development of 1 GW of low-carbon hydrogen production capacity by electrolysis over the next four years (including EUR 700 million announced by the French government for the first period of the support mechanism).

2. The French incentive mechanisms in place

According to the Hydrogen National Strategy, the support for hydrogen deployment will take the form of incentive mechanisms.

To date, incentive mechanisms are mainly based on subsidies granted to hydrogen-related projects selected through competitive procedures, e.g. calls for proposals (appels à projets) and calls for expression of interest (appels à manifestation d'intérêt) – see paragraph 1 above.

Meanwhile, the Ordinance No. 2021-167 of 17 February 2021 with respect to hydrogen (the "**Hydrogen Ordinance**") establishes a specific legal framework including public support mechanisms which may only benefit low-carbon and renewable hydrogen production facilities by electrolysis of water. This public support is open to any person located on the territory of a Member State of the European Union or the European Economic Area who intends to build or operate a production facility on the national territory. It may take the form of either an operating aid (OPEX) or a combination of financial support to investment (CAPEX) and operating aid under terms and conditions to be set by the relevant administrative authorities. The operating aid cannot lead to a remuneration of the producer exceeding a reasonable return on invested capital, taking into account the risks in relation to the activities benefitting from the aid.

In both cases, the facilities or projects benefitting from such support will be selected through a three-stage tendering procedure based on transparency and equal treatment principles. Such a procedure is quite similar to those used for offshore wind projects in France, where ADEME – already involved in the selection of hydrogen related projects through the calls for proposals – plays a key role, whereas for offshore wind projects, the CRE plays that role.

The terms of this new tendering procedure are set out in a decree published on 1 September 2023 (the "**Hydrogen Decree**").

The procedure is led by the French Minister of Energy (with the support of ADEME). It is initiated with a submission phase to select applicants to participate in the tender, which may be followed, where appropriate, by a competitive dialogue phase, and a bidding phase to designate the awarded bidder. The applicable selection criteria (with quantitative criteria accounting for at least 70% of the weighting) together with the conditions for build and operate the facility are set out in the draft tender specification drawn up by the French Minister of Energy.

Awarded bidders will be eligible for a support contract (that should take the form of a Carbon Contract for Difference - "CCfD") of 15 years and to be signed within 6 months from the awardees' requests, according to the draft tender specification available to date.

The draft tender specification was subject to public consultation until 20 October 2023. An addendum to the tender specification takes into account the possible cumulation of the French national aid granted under this tender with the European Union aid granted under the European Hydrogen Bank scheme, and anticipates the case where the French national aid would be limited to operating aid (and would not include investment aid) in order to avoid double and cross-subsidisation.

To date, three call for tender waves are planned i.e., 150 MW in 2024, 250 MW in 2025 and 600 MW in 2026, representing a total of 1 GW of electrolysers installed and a EUR 4 billion public investment.

For the first launch of the call for tenders, the French government announced that a competitive dialogue phase will apply to design and finalise the applicable tender specification. The French government aims at beginning this competitive dialogue phase in 2024.

Meanwhile, the contemplated incentive mechanism has been pre-notified to the European Commission and seems to be still under discussion before the latter as part of the state aid regime, as the final tender specification is still awaited.

9. Are there any standards in place for the classification and/or certification of low-carbon or renewable hydrogen?

The Hydrogen Ordinance provides standards for the classification of the various categories of hydrogen. These definitions have been incorporated in **the French Energy Code**:

- "hydrogen" is defined as the gas composed of dihydrogen molecules (in a proportion set in a ministerial order) which results from the implementation of an industrial process.
- "renewable hydrogen" is defined as hydrogen produced either by electrolysis using electricity from renewable energy sources, or by any other technology using exclusively one or several renewable energy sources and which does not conflict with other uses allowing their direct valuation.
- "low-carbon hydrogen" is the hydrogen whose production process generates emissions which are less than or equal to the threshold triggering the qualification of renewable hydrogen without however falling within this qualification since other criteria are not met.
- "carbonaceous hydrogen" is defined as hydrogen which is not renewable hydrogen nor low-carbon hydrogen.

On 7 May 2024, the French government presented a draft ministerial order to the High Energy Council, proposing to distinguish between "renewable" and "low-carbon" hydrogen on the basis of different emission thresholds, based on the definition adopted by the European Parliament in 2023 (which discussed the inclusion of nuclear hydrogen). Although not yet published, this draft

ministerial regulation has raised concerns among green hydrogen producers as it assimilates low-carbon hydrogen with the hydrogen produced by the steam reforming of methane with carbon capture and storage (blue hydrogen). Such a classification would make it eligible for government subsidies. The ministerial order is expected to be published by summer 2024.

In addition, the draft revised Hydrogen National Strategy foresees government efforts at the international level to push for harmonised norms and standards to ensure fair competition and support French industry exports.

10. Does the regulatory framework clearly define the regulatory requirements relating to the production, storage, transportation or supply of hydrogen?

The regulatory framework applicable to hydrogen is mainly based on (i) the Hydrogen Ordinance and the Hydrogen Decree whose provisions have been incorporated into the French Energy Code, and (ii) the French Mining Code.

The Hydrogen Ordinance contains various regulatory requirements relating to the production, storage, transportation and supply of hydrogen (focusing however on renewable hydrogen) whereas the French Mining Code sets out provisions which apply only to storage of hydrogen.

As a general note, Law No. 2023-175 of 10 March 2023 relating to the acceleration of the production of renewable energies, authorizes renewable hydrogen production facilities on brownfields or industrial basins of unsaturated brine in coastal areas but not located in an urbanised area as an exception to the prohibition under the French Coastal Law (loi Littoral). In addition, the Green Industry Law of 23 October 2023 aimed at reducing the time needed to obtain an environmental permit for major national projects (including hydrogen production facilities), facilitate urban planning procedures, and increase legal certainty for projects with regard to biodiversity obligations by ensuring that these issues can be addressed as early as possible in the life of the project.

11. Are there any foreign investment restrictions related to energy and infrastructure sectors?

Foreign investment restrictions apply to activities likely to prejudice the interests of national defence, public order or public safety and which concern infrastructure, goods and services that are essential to guarantee integrity, security and continuity of energy supply. The same applies to research and development activities on critical technologies which include energy storage and technologies in relation to renewable energy production. As a result, provided that the transaction meets other criteria referred to in the French Monetary and Financial Code (see articles L. 151-1 et seq. and R. 151-1 et seq.), it may fall within the scope of French foreign direct investment regulations and be subject to the authorisation of the Minister in charge of Economy.

12. What international treaties are in place that may offer protection to international investors in hydrogen projects in the jurisdiction?

The Energy Charter Treaty ("ECT") is a multilateral investment treaty which specifically addresses energy trade, transit and investment between the contracting parties, which include France. Discussions as to the modernisation of the ECT led by the European Union have been ongoing for several years, and focus in particular on investment protection and "greening" the ECT. These discussions have focussed on reducing the protections accorded to fossil fuels and explicitly protecting emissions reduction technologies (including hydrogen).

Market developments and opportunities

13. Are there any government grants or other government funding available to hydrogen projects (including for research and development)?

As indicated in response to question 8 above, there are various government grants and subsidies available to hydrogen projects which are awarded on the basis of calls for tenders and calls for expression of interest issued by public authorities (e.g., *ADEME, Agence nationale de la recherche, Secrétariat Général pour l'investissement*).

As regards research and development projects, more than 150 projects have benefited from government subsidies to date, through various programs including:

- Hydrogen Research Program and Priority Equipment ("PEPR H2"): EUR 83 million over 8 years for 19 projects covering the hydrogen value chain, including production (electrolysis), storage, uses (fuel cells), system integration, socio-economic analyses and life-cycle analyses.
- Technological Bricks and Largs Demonstrators ("Briques technologiques et grands démonstrateurs") call for projects: EUR 350 million over the period 2024-2026 for 25 projects covering electrolysers, fuel cells, high-pressure tanks, etc.
- The Skills and Jobs for the Future ("Compétences et Métiers d'Avenir") call for expression of interest: 9 training projects in the hydrogen sector, worth EUR 41.5 million.

As regards production capacity, the "Territorial Hydrogen Ecosystems" call for proposals launched in 2018 and renewed in 2020 helped fund 46 projects with a total of EUR 320 million in aid and an investment amount of EUR 1.2 billion. A new wave has been launched in September 2023 and selected candidates are set to be announced early 2024.

In addition, several waves of the Important Project of Common European Interest ("IPCEI") on hydrogen have been launched jointly by European Union Member States since 2020. These initiatives should enable the development of numerous large-scale low-carbon and renewable hydrogen production projects in Europe and more particularly in France:

- Through the IPCEI "Hy2Tech", the European Commission approved in July 2022 the construction of four electrolyser production plants (held by McPhy (see question 15), Elogen, John Cockerill, Genvia) based on the 3 main electrolysis technologies (alkaline, proton exchange membranes, high temperature), but also hydrogen vehicles (Hyvia for commercial vehicles, Alstom for locomotives), fuel cells for road use (Symbio), and all the key components upstream in the value chain (Plastic Omnium and Forvia for tanks, Arkema for membranes).
- Through the IPCEI "Hy2Use", two French large-scale renewable hydrogen projects (held by Air Liquide France and Total Energies and Engie France as part of the MassHylia project) have been approved by the European Commission in September 2022 (see question 15).

For these first and second waves, the French government has reserved an exceptional public funding of EUR 1.9 billion, out of a total of EUR 31.8 billion of public and private investments deployed on the European level.

- Through the IPCEI "Hy2Infra", the construction of a 200 MW electrolyser production plant (Lhyfe project) was approved by the European Commission in February 2024 (see question 15).

14. Are there any notable pilot/demonstration projects in place or planned for the production or offtake of clean hydrogen?

There are different pilot projects being deployed in France to examine and test the feasibility of clean hydrogen production and use in various sectors.

For example, **GRHYD project** has been launched in 2014, and was inaugurated on 11 June 2018. GRHYD is a local-scale project led by Engie in partnership with GRDF, the French Atomic Energy and Alternative Energies Commission (Commissariat à l'énergie atomique et aux énergies alternatives), Areva H2Gen, and ADEME. The demonstrator uses wind-generated electricity and supplies 100 homes in the Dunkirk Urban Community with carbon-free hydrogen for heating, hot water and cooking. The hydrogen is mixed with natural gas to a maximum volume of 20% of the total volume of gas supplied. The experimentation of this demonstrator should make it possible to evaluate the economic and technical prospects of power-to-gas for housing.

The **Jupiter 1000 project**, piloted by the gas transport operator GRTgaz, has enabled it to carry out the first hydrogen injections into its network. The demonstrator, located in Fos-sur-Mer (South of France), has a capacity of 1 MW and a power production capacity of 5 million kWh over three years. By allowing hydrogen to be injected into existing networks, power-to-gas makes it possible to store the surplus renewable electricity in existing gas infrastructures, which leads to greater flexibility in the electricity network.

On 6 March 2020, Engie Solutions, Michelin and Morbihan Energies signed agreements to supply a Michelin industrial site in Vannes and to build a charging station for light and heavy vehicles, which will be located nearby ("**Hygo**"). The project is operational since October 2021 and carried out by Hygo (founded by Engie and Morbihan Energies). The project allows the development of the use of hydrogen at a local level in Morbihan.

In addition, several projects to experiment the use of hydrogen-powered buses have been launched. For example, the Tethys project led by Sytral is experimenting with the use of two hydrogen-powered buses on a bus line in the Lyon public transport network.

On 28 September 2022, the Sealhyfe project was inaugurated in Saint-Nazaire. It is the world's first offshore production site that will produce up to 400 kg of green energy per day. The hydrogen will be produced on a floating platform from a 1 MW electrolyser designed by Plug Power and directly powered by offshore wind turbines. In June 2023, the French startup announced that it had produced the world's first "green hydrogen" from electricity supplied by a floating wind turbine.

HOPIUM announced that its fuel cell was approaching the industrialization phase, with a commercialisation planned for 2025.

15. Are there any commercial-scale clean hydrogen production projects in development or already operating?

Within the framework of the French government's low-carbon and renewable hydrogen development policy, several calls for tenders have been launched.

In May 2021, McPhy announced its intention to develop an electrolyser gigafactory in Belfort. This project is part of the first wave of the IPCEI "Hy2Tech" and was approved by the European Commission on 15 July 2022 (see question 13). On 28 September 2022, the French government announced that this project will receive support up to EUR 114 million.

14 other projects are under development across the French territory as part of the IPCEI "Hy2Tech", covering hydrogen generation technology, fuel cells technology, storage and transportation / distribution technology and end user technology (see question 13).

In March 2021, **Air Liquide and ArcelorMittal** announced their intention to develop an innovative low carbon steel production unit using low carbon hydrogen in Dunkirk (North of France). Air Liquide will supply ArcelorMittal with low carbon hydrogen, contributing to the production of steel with reduced CO2 emissions. This project is part of the second wave of the IPCEI "Hy2Use" and was approved by the European Commission on 21 September 2022 (see question 13).

In March 2022, Air Liquide also received support from the French government for its 200 MW electrolyser project near the port of Le Havre (on the English Channel) ("**Air Liquide Normand'Hy**"). This project is also part of the IPCEI "Hy2Use" and is expected to be operational in 2025. It is worth noting that in September 2023, TotalEnergies and Air Liquide signed a long-term supply agreement of green and low carbon hydrogen for the TotalEnergies platform in Normandy. In the same approach, in May 2023, Air Liquide and Groupe Aéroport de Paris (ADP) announced the creation of a 50/50 joint venture specializing in supporting airports in their projects to integrate hydrogen into their infrastructures.

The other French project selected as part of the second wave of the IPCEI "Hy2Use" is the Masshylia project consisting in the construction of a 40 MW electrolyser production plant held by TotalEnergies and Engie, near the Fos-sur-Mer port (South of France) to supply Total's biorefinery of La Mède with green hydrogen.

Lastly, in March 2024, Lhyfe announced it was selected as part of the third wave of the IPCEI "Hy2Infra" and granted a public support, approved by the European Commission, of EUR 149 million for the construction of a green hydrogen production plant with an installed electrolysers capacity of 100 MW near Le Havre.

In addition to the French projects selected through the IPCEI scheme, there are a number of low-carbon and renewable hydrogen production projects planned and under development in France (at different stages of development), which can be found on the "Vig'Hy" platform, a "hydrogen observatory" organised by the French association "France Hydrogène"[1].

16. Have there been any hydrogen-related disputes in your jurisdiction?

There are no notable disputes related to the installation of a hydrogen production facility in France to date.

Last updated May 2024

1 https://vighy.france-hydrogene.org/cartographie-des-projets-et-stations/

Germany

Policy and regulation

1. Is there a government hydrogen strategy or policy?

Yes, the German Federal Government has adopted and recently updated a National Hydrogen Strategy for Germany.

In June 2020, the Federal Government presented the **National Hydrogen Strategy** ("**National Hydrogen Strategy 2020**"). The National Hydrogen Strategy 2020 laid down coherent policy goals for the future production, transport and use of hydrogen and its derivatives, including the relevant research, innovations and investments. Subject of the National Hydrogen Strategy 2020 was in particular the start of the market ramp-up for the hydrogen economy ("Phase 1").

In June 2022, the Federal Ministry for Economic Affairs and Climate Action published a **Progress Report** on the implementation of the National Hydrogen Strategy 2020 which outlined the key milestones that the Government had achieved since the National Hydrogen Strategy 2020 was adopted emphasising, inter alia, that with the 62 German IPCEI hydrogen projects, over 2 GW of electrolysis capacity and 1,700 km of hydrogen pipeline network for hydrogen had been initiated, or that with the amendment of the German Energy Industry Act (Energiewirtschaftsgesetz -EnWG) and the associated Hydrogen Network Charges Ordinance (Wasserstoffnetzentgeltverordnung) the first measures for implementing the necessary regulatory framework for hydrogen had been adopted. However, the Progress Report also revealed that there was still a number of remaining task for the successful ramp-up of a hydrogen economy.

In July 2023, the Federal Government has adopted the **German National Hydrogen Strategy Update**, which comprises – as a political statement of intent - a readjustment of the political and regulatory framework for the hydrogen ramp-up as well as a new vision for the hydrogen economy by 2030 ("National Hydrogen Strategy Update 2023"). The National Hydrogen Strategy 2020 is being adjusted by the National Hydrogen Strategy Update 2023 in order to reflect Germany's increased level of ambition in climate protection and the new challenges on the energy market, not least due to Russia's war of aggression against Ukraine. While the National Hydrogen Strategy 2020 focused on the first phase of market ramp-up, including research and demonstration, the National Hydrogen Strategy Update 2023 now aims on the entry into large-scale production and the technological transformation of the relevant fields of application (Phase 2).

2. What are key goals and commitments included in the strategy/policy?

Clean hydrogen is a key element of the German Government's decarbonisation strategy. With the National Hydrogen Strategy 2020 and the National Hydrogen Strategy Update 2023, the Federal Government intends to establish a coherent framework for the generation, transport and use of hydrogen, encouraging the relevant innovations and investment. It is, however, to be noted that the National Hydrogen Strategy is not a legal act, but rather a policy statement which still needs to be transposed into applicable law to become binding on any party.

The National Hydrogen Strategy 2020 and the National Hydrogen Strategy Update 2023 contain different key goals due to the fact that the National Hydrogen Strategy 2020 focused on the first market ramp-up phase (Phase 1), and the National Hydrogen Strategy Update 2023 rather focusses on the entry into large-scale production and the technological transformation of the relevant fields of application (Phase 2). Since the National Hydrogen Strategy 2020 still continues to apply, please find in the following the key goals of both, the National Hydrogen Strategy 2020 and the National Hydrogen Strategy Update 2023:

National Hydrogen Strategy 2020

- The National Hydrogen Strategy 2020 focuses in particular on the following key goals:
- Making hydrogen a competitive option for energy consumers;
- Developing a domestic market for hydrogen technology in Germany, paving the way for imports;
- Making hydrogen a sustainable base material for the industrial sector;
- Enhancing the transport and distribution infrastructure;
- Fostering science, mobilising skilled labour;
- Establishing international markets and cooperation for hydrogen;
- Building up and securing the quality assurance infrastructure for hydrogen production, transport, storage and use,
- Improving the policy environment and addressing current developments on an ongoing basis.

Based on these general aims, the National Hydrogen Strategy 2020 also contains an action plan with the steps necessary for the National Hydrogen Strategy 2020 to succeed. For that purpose, the National Hydrogen Strategy 2020 contains **38 detailed measures** for a first ramp-up phase.

National Hydrogen Strategy Update 2023

The National Hydrogen Strategy Update 2023 is intended to establish reliable guard rails for private investments in sustainable, but in particular the economic, ecological and social production, transport and use of hydrogen, its derivatives and hydrogen application technologies. For the National Hydrogen Strategy Update 2023, the German Federal government assumes a total hydrogen demand of 95-130 TWh for the year 2030. Against that background, the National Hydrogen Strategy Update 2023 contains the following key **goals**:

- Accelerated market ramp-up of hydrogen: the market ramp-up of hydrogen shall be significantly accelerated and the level of ambition along the entire value chain massively increased;
- Ensuring sufficient availability of hydrogen: the target for domestic electrolyser capacity in 2030 is increased from 5 GW to at least 10 GW. The remaining demand will be covered by imports. A separate import strategy will be developed;
- Development of an efficient hydrogen infrastructure: by 2027/2028, a hydrogen start grid with more than 1,800 km of repurposed and newly built hydrogen pipelines will be set up in Germany using IPCEI funding by which all major production as a "hydrogen backbone", import and storage centres will be connected to the relevant consumers by 2030;
- Implementation of hydrogen applications in the sectors: by 2030, hydrogen shall be used in applications in industry, heavy-duty commercial vehicles in particular, and increasingly in aviation and shipping. In the power sector, hydrogen shall contribute to the security of energy supply; by using gas power plants that can be converted to climate-neutral gases (H2-ready) and system-serving electrolysers, primarily as variable and system-serving stabilisers or flexible loads;
- Creation of appropriate regulatory framework: coherent regulatory conditions at a national, European and international level shall support the market ramp-up. The regulatory framework shall primarily include efficient planning and approval procedures, uniform standards and certification systems that are adequately equipped, in addition to coordinated administration at all levels.

3. Which industry sectors are most likely to be affected by hydrogen deployment?

The German National Hydrogen Strategy 2020 targets the following sectors and strategic markets, whereby the German Federal government has stated in the National Hydrogen Strategy Update 2023 that the area of application for hydrogen by 2030 will be primarily in the industrial sector, e.g. in the chemical and steel industries, as well as in transport for use in fuel cells or as a renewable fuel.:

- **Hydrogen and power production market**: To enable the market penetration and export of hydrogen technologies, the German Government wants to establish a domestic market that provides a strong and sustainable base for the production and use of hydrogen, while furthering the energy transition. As hydrogen is to have long-term prospects of being used in a sustainable and economic way, capacities for generating electricity from renewables (particularly wind power and photovoltaics) shall be systematically improved. The Federal Government is therefore placing a particular focus on the expansion of domestic electrolyser capacities on an industrial scale: in 2030, the German electrolyser capacity shall be at least 10 GW and the remaining demand shall be covered by imports. The basis for the domestic production of green hydrogen will be the expansion of electricity generation using renewable energy sources, where the German government also intends to make substantial progress, e.g. by the comprehensive amendments to the Renewable Energy Sources Act (EEG), to the Wind Energy at Sea Act (WindSeeG) and other laws, all adopted in 2022 in the Energy Emergency Package, the so-called "Easter Package".
- **Industry**: In the industry sector, the German Government intends that gaseous and liquid sources of energy shall be gradually replaced by alternative technologies, paving the way for the use of alternative resources or processes with either zero or very low carbon emissions (e.g. by implementing quotas for climate-friendly base substances). In the industrial sector, hydrogen-based technologies are an appropriate transformation option, especially in those sectors where they replace fossil raw materials such as natural gas, oil or coal in the way they are used. By the same token, it is possible that the energetic use of hydrogen is the only decarbonisation option in certain sectors. The National Hydrogen Strategy 2020 / National Hydrogen Strategy Update 2023 explicitly address the refinery, chemical and steel industries having processes that enable the use of hydrogen. The Government's aim is, wherever possible, to channel upcoming investments in production facilities on an industrial scale into climate-friendly technologies, In order to push ahead with the hydrogen ramp-up and boost the transformation-related investments necessary for the conversion to climate-neutral production processes in industry, and in particular to encourage the necessary springboard innovations, the Government also wants to provide financial support, at least in the short to medium term, in order to ensure that the transformation takes place at an early stage, e.g. by supporting carbon contracts for differences for the industry. Hydrogen is set to play an important long-term role in safeguarding the attractiveness of Germany's industrial sector.
- **Transport**: As mobility applications offer a great potential for hydrogen uses, the German Government intends to strengthen the hydrogen-based or PtX-based mobility in Germany (e.g. by more ambitious GHG reductions or minimum quotas for hydrogen-uses / renewable fuels of non-biological origin – RFNBOs). The introduction of fuel cell vehicles shall complement battery-powered electric mobility and help significantly reduce air pollutants and carbon emissions in mobility

areas such as local public passenger transport (buses, trains), parts of heavy-duty road transport (trucks), commercial vehicles (e.g. for use in construction work or agriculture and forestry) or logistics (delivery traffic; other commercial vehicles such as forklift trucks). For that purpose, the German Government also wants, inter alia, to support the German automotive and truck suppliers in their structural transformation process, to strengthen Germany's machinery and plant manufacturing sector or to promote investments in hydrogen infrastructure (e.g. refuelling stations). Furthermore, the German Government plans to develop a master plan for hydrogen and fuel cell technology in transport to drive forward the upscaling of hydrogen and fuels produced from it, fuel cell vehicles and fuel cell components and systems and the necessary infrastructures in a targeted manner.

- **Heating**: Even after the efficiency and electrification potentials for process heat generation and the building sector have been harnessed, the National Hydrogen Strategy 2020 states that there will continue to be long-term demand for gaseous fuels. In the long run, the German Government intends that hydrogen and its downstream products shall help in various ways to decarbonise parts of the heating market (e.g. by funding fuel-cell heating systems or H2-ready heating installations). However, the Government also states in the National Hydrogen Strategy Update 2023 that in the heating sector no broad application of hydrogen is envisaged to occur by 2030, albeit the repurposing of gas distribution networks for hydrogen and the use of decentralised H2 boilers are also to be made legally and technically possible. With regard to the competition for use between the industrial, transport and heating sectors, the Government assumes that the demand for hydrogen in the industrial and transport sectors will probably remain constant, even with relatively high or rising prices, while alternatives/ substitutes will exist in many buildings and residential areas.

4. Who are the main regulators for the hydrogen market?

The Federal Network Agency (*Bundesnetzagentur*) is the main regulator for the German hydrogen market. With regard to the different funding and support programs, the Federal Ministry for Economic Affairs and Climate Action (*Bundesministerium für Wirtschaft und Klimaschutz*) and Projektträger Forschungszentrum Jülich (PTJ), the responsible body for the national implementation of the EU IPCEI funding programme, are other key players.

In order to ensure the successful implementation, constant monitoring and further development of the National Hydrogen Strategy, a specific hydrogen governance structure has been established in Germany, including a State Secretaries' Committee (composed of the different relevant German ministries), a National Hydrogen Council (consisting of 26 experts from business, science and civil society) as well as a cooperation mechanism between the Federal Government and the different German states.

5. Does the government hydrogen strategy or policy support the development of both low-carbon (blue) hydrogen and renewable (green) hydrogen?

The German National Hydrogen Strategy 2020 emphasises that hydrogen needs to be established as a decarbonisation option for Germany to become GHG-neutral and to meet its international obligations under the Paris Convention.

In the National Hydrogen Strategy Update 2023 the Government emphasised again the Federal Government's goal is to achieve a reliable supply for Germany of hydrogen which is green and sustainable on a long term basis. Therefore, direct financial support for hydrogen production in Germany will be limited to the production of green hydrogen, i.e. hydrogen produced with renewable electricity.

However, the Government also makes clear in its National Hydrogen Strategy Update 2023 that in order to ensure a rapid development and ramp-up of the hydrogen market and to meet the expected demand, particularly in the transformation phase, other colours of hydrogen will also be used, at least until sufficient green hydrogen is available. This may entail primarily low-carbon hydrogen from waste or natural gas in combination with CCS, i.e. **low-carbon blue, turquoise and orange hydrogen**. Against this background, the Federal Government will also advocate uniform, workable and ambitious criteria with a threshold for GHG emissions for blue hydrogen.

6. If the government hydrogen strategy or policy supports the development of low-carbon hydrogen, to what extent is carbon capture and storage being taken forward?

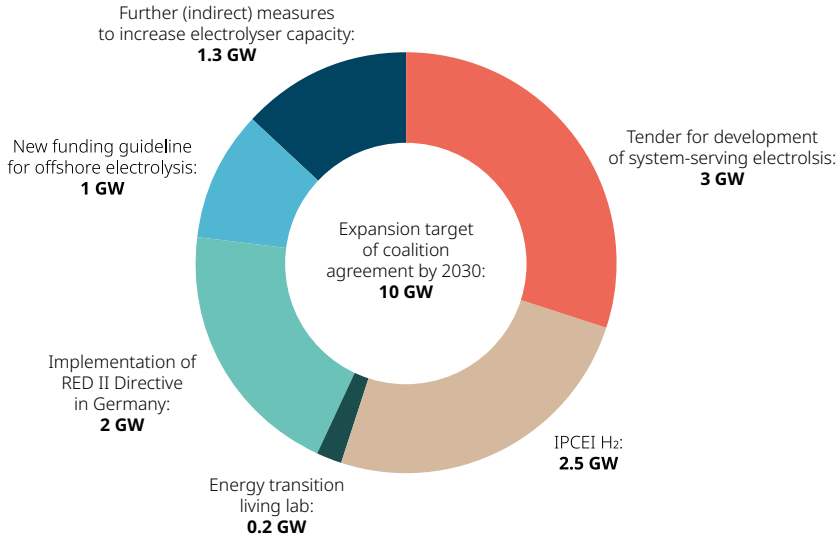
The German National Hydrogen Strategy does not focus on low-carbon (blue) hydrogen and considers low-carbon hydrogen only as a back-up option in the ram-up phase. Therefore, the National Hydrogen Strategy does not contain extensive support measures for blue hydrogen or CCS. The National Hydrogen Strategy Update 2023 only mentions that the Government will also advocate uniform, workable and ambitious criteria with a threshold for GHG emissions for blue hydrogen and that a carbon management strategy designed to identify possible areas of application for CCS is currently being developed. We note that whereas CCS is currently forbidden in Germany under the Carbon Storage Act (Kohlendioxid-Speicherungsgesetz), the Government is working on a "Carbon Management Strategy" which has been announced to be published in autumn of 2023 and which is expected to lift this ban.

7. Are there targets for the production of hydrogen?

In the National Hydrogen Strategy Update 2023, the German Government set out its aim to establish up to 10 GW of hydrogen generation capacity on an industrial scale by 2030. The remaining part of the German demand of green hydrogen (assumption: 95-130 TWh in 2030) will be covered by imports from other EU member states and international partner countries.

The National Hydrogen Strategy Update 2023 is intended to create the conditions for developing an appropriate mix of instruments to achieve the target of at least 10 GW of domestic electrolyser capacity by 2030 for the production of green hydrogen:

Mix of instruments



Source: BMWK

8. Are there any incentive mechanisms/business models in place to support the production of hydrogen?

The German National Hydrogen Strategy focuses on supporting private investments in the sustainable production, transport, and use of hydrogen.

For that purpose, private sector investments in hydrogen production facilities in Germany are supported by a variety of public investment subsidies.

As well as providing investment grants and as part of the efforts to promote climate-friendly industrial procedures, the National Hydrogen Strategy 2020 contains the ambition to support the use of electrolysers. For this purpose, the German Government has launched a new support programme for the industry entitled “Climate Protection Contracts”. Climate protection contracts are **carbon contracts for difference** which shall be concluded between the State and companies in the energy-intensive industry to offset the additional costs of climate-friendly production processes compared to conventional processes. The aim is to provide the industry with investment security and with incentives to bring forward climate protection projects. Under these carbon contracts for difference, the Government will guarantee that it will provide funding amounting to the difference between the actual cost of avoiding emissions (e.g. by agreeing on a project-based contractually agreed carbon price) and the EU ETS carbon allowance prices. Should the future ETS price rise above the contractually agreed carbon price (i.e. the emission avoidance cost), companies will be obliged to pay back the difference to the state.

The German Government has also implemented an obligation to place electricity-based PtL (Power-to-Liquid) aviation fuels on the market and introduced statutory sub-quotas for renewable fuels of non-biogenic origin (so-called RFNBOs) which fuel producer must meet.

Furthermore, the Government supports the **H2Global** Initiative, a support scheme designed to facilitate the market ramp- up of renewable hydrogen and its derivatives. Under this scheme, an intermediary company (HINT.CO) will procure long-term hydrogen purchase agreements in competitive auctions from international suppliers and will sell the hydrogen (or its derivatives) under short term sales agreements to EU-based customers, again based on competitive auctions. In this double-auction model, the German state will fund the expected difference in prices paid under the purchase agreements compared to the prices achieved by HINT.CO under the sales agreements and the Government has earmarked up to EUR 900 million for this purpose. A first auction for the procurement of hydrogen was launched under the programme in November 2022.

9. Are there any standards in place for the classification and/or certification of low-carbon or renewable hydrogen?

There are currently no legally binding standards in place in Germany for the classification of hydrogen. However, according to the coalition agreement of the parties of the new German Government, the German Government intends to support the development of a uniform certification mechanism for hydrogen at the European Level.

On a legally non-binding level, the German TÜV SÜD provides a green hydrogen certification that is already used in practise in Germany as the possibility of furnishing third-party evidence for climate-friendly hydrogen production.

In August 2023, the German legislator has presented a first draft act for an amendment of the 37th Ordinance on the Implementation of the Federal Emissions Control Act ("**37th BImSchV**") by which the Delegated Acts according to Art. 27 para. 3 and Art. 28 para. 5 RED II, i.e. Regulation (EU) 2023/1184 and Regulation (EU) 2023/1185, shall be implemented into German national law. This draft act also provides for the introduction of a system for demonstrating compliance with the requirements for the production and supply of renewable fuels non-biological origins ("RFNBOs") based on renewable hydrogen including the certification of the relevant economic participants. This system is modelled on the existing system for biofuels under the German Biofuel Sustainability Regulation (Biokraftstoff-Nachhaltigkeitsverordnung). Economic operators that are subject to certification are required to provide evidence of compliance with the criteria for the production and supply RFNBOs (including the use of renewable electricity meeting the requirements of additionality, temporal and geographical correlation) and to document this via a mass balance system.

10. Does the regulatory framework clearly define the regulatory requirements relating to the production, storage, transportation or supply of hydrogen?

Starting in 2021, Germany has decided to establish initial national regulatory measures for the market ramp-up of the hydrogen economy until regulation is developed at the European level. All stages of the hydrogen economy value chain - production, transport and consumption - are already subject to legal and regulatory requirements. However, these requirements have so far appeared to be more of a bundle of individual legislative measures and do not yet constitute a comprehensive hydrogen (regulatory) law so that areas remain where greater regulatory certainty is still required.

- **Production**: With regard to the production of hydrogen, the initial statutory regulations have been introduced in Germany in 2021 for the possible offshore wind-based production of hydrogen, which, at 3 GW, is to ensure almost one-third of the electrolysis capacity in Germany in 2030. The German Offshore Wind Energy Act (Windenergie-auf-See-Gesetz) contains special provisions for so-called "other energy production areas" (sonstige Energiegewinnungsbereiche) in which hydrogen can be produced offshore. The aim is to promote the production of green hydrogen in so-called "other energy generation facilities" (sonstige Energiegewinnungsanlagen) using renewable electricity from offshore wind plants. The WindSeeG regulates, inter alia, with the area development plan (Flächenentwicklungsplan), the approval and construction of other energy generation facilities and contains regulations for the eligibility to apply for a permit by way of tender procedures. There is currently no financial support for the offshore production of hydrogen under the EEG/WindSeeG, but this could change in the future with the Offshore Electrolysis Support Directive, which is currently being developed.
- **Transportation**: The regulation of hydrogen networks has so far been the focus of the regulatory framework in Germany. The German Energy Industry Act (Energiewirtschaftsgesetz) designates hydrogen as a separate energy source; hydrogen is "energy" insofar as it is pipeline-bound. It also stipulates that hydrogen is to be qualified as "gas" insofar as hydrogen is fed into a gas supply network. The Energy Industry Act also contains new regulations for pure hydrogen networks. So far, hydrogen networks in Germany have not been subject to strict regulation like gas supply networks. The current legal concept for hydrogen networks rather differentiates between mandatory and optional ("opt-in") network regulation. In practice, however, only a few hydrogen operators have opted for the opt-in model, which leaves it up to the voluntary decision of hydrogen network operators to be subject to regulation.

  In addition to optional regulation, the EnWG also contains regulations that apply to all hydrogen networks, regardless of whether a hydrogen network operator has submitted an opt-in declaration. This applies, for example, to the regulations on permitting and the use of public roads (Sections 43-48 EnWG), some of which contain special regulations for the establishment and expansion of hydrogen networks (cf. Section 43l EnWG).

  The most recent amendment to the EnWG also introduced regulations for the creation of a hydrogen core network or backbone (Wasserstoff-Kernnetz), which is intended to give the go-ahead for hydrogen network planning. The hydrogen core network will be a Germany-wide network for the national transport of hydrogen from central production centres to central consumption centres in Germany.
- **Storage**: The Energy Industry Act also contains new regulations for hydrogen storage facilities. Hydrogen storage operators are also subject to the (voluntary opt-in) regulation rules that apply to hydrogen network operators.
- **Supply**: No special regulatory requirements apply to the supply of hydrogen. The unbundling regulations must be observed for operators of hydrogen networks or hydrogen storage facilities, according to which these activities must be completely independent of the hydrogen supply.

- **Consumption**: In order to stimulate the hydrogen ramp-up at the consumption level, the legislator has chosen, on the one hand, subsidy instruments and, on the other hand, legal obligations for the use of green hydrogen. In the transport sector, a strict regulatory approach was chosen with the legal obligation for fuel suppliers to comply with certain GHG reduction quotas. For the industry, on the other hand, the legislator has adopted a soft regulatory approach and introduced climate protection contracts (see above) as a means of promoting demand for hydrogen.

In general, it is noteworthy with regard to the current German legal framework for hydrogen that the legislator intends this to be a transitional regime aimed at enabling a quick market ramp-up. A final legal framework is to be established in Germany only once the relevant EU regulations have also been developed and need to be implemented. The relevant EU regulations are expected by end of 2023.

11. Are there any foreign investment restrictions related to energy and infrastructure sectors?

Yes. The German Foreign Trade and Payments Act (Außenwirtschaftsgesetz) and the Foreign Trade and Payments Ordinance (*Außenwirtschaftsverordnung*) establish a strict investment control regime for direct and indirect investments in energy and infrastructure assets by non-EU investors. If energy and infrastructure assets in the single case qualify as "critical infrastructure" (e.g. generation and storage assets beyond a certain capacity), every acquisition of 10% or more of the voting rights in the respective companies is subject to a mandatory notification and clearance obligation and must not be closed before it has been cleared by the German Ministry of Economic Affairs and Climate Action, with strict gun-jumping provisions. In all other cases, acquisitions of 25% or more of voting rights may be subject to an ex-officio review procedure and can be reviewed and sanctioned up to five years after signing of a sale and purchase agreement.

The German Foreign Trade and Payment Act requires, however, that the respective company to be invested in is an "operator" of an existing critical infrastructure. Therefore, a greenfield investment is typically not subject to a review, as future critical infrastructure is not included in the scope of the foreign investment control. This may however change in the future, as German foreign investment restrictions become stricter and stricter.

12. What international treaties are in place that may offer protection to international investors in hydrogen projects in the jurisdiction?

The United Nations Conference on Trade and Development (UNCTAD) website states that Germany is a signatory to 155 bilateral investment treaties (BITs) that are in force, and in addition certain other treaties may contain protections for investors in Germany. These can be accessed from the UNCTAD's Investment Policy Hub on the website of the UNCTAD.

With the Treaty of Lisbon, responsibility for foreign direct investment was transferred to the EU so that the EU Commission has the possibility to negotiate agreements on investment protection for the EU and the 27 EU member states. These are to replace the bilateral agreements of the individual member states.

Market developments and opportunities

13. Are there any government grants or other government funding available to hydrogen projects (including for research and development)?

- Between 2006 and 2016, funding of around €700 million has been approved under the National Innovation Programme I on Hydrogen and Fuel Cell Technology (NIP I), and between 2016 and 2026, a total of €1.4 billion in funding will be provided in phase II of this program (NIP II).
- Under the Energy Research Programme, funding is provided to build an excellent research landscape. Between 2020 and 2023, €310 million will be provided for practice-oriented basic research on green hydrogen and another €200 million will be provided over this period to strengthen practice-oriented energy research on hydrogen technology.
- In addition, €600 million will be provided between 2020 and 2023 to foster the "Regulatory Sandboxes for the Energy Transition", which shall help to speed up the transfer of technology and innovations from the lab to the market, not least for hydrogen solutions.
- As part of Germany's decarbonisation programme, funding is also provided for investment in technologies and largescale industrial facilities which use hydrogen to decarbonise their manufacturing processes. More than €1 billion will be provided for this between 2020 and 2023. There are also programmes that promote the use of hydrogen in manufacturing and for the purpose of eliminating and utilising carbon emissions in the base materials industry.
- Under the "package for the future" program, a funding of another €7 billion for speeding up the market rollout of hydrogen technology in Germany and another €2 billion for fostering international partnerships will be provided.
- 62 German hydrogen projects are involved in the European IPCEI initiative, partly receiving also additional national support. In July 2022, the European Commission has already approved four initial projects in Germany (i.e. "BoschPowerUnits" of

Robert Bosch GmbH, "Sunfire1500" of Sunfire GmbH, "Pegasus" of Daimler Truck AG and "NextGen HD Stack" of EXPO Fuel Cell Technologies GmbH) under the EU state aid law on the basis of which these projects can now receive a national funding. Further German hydrogen projects are still in approval process under the IPCEI initiative.

- The German Government currently develops the Offshore Electrolysis Support Directive which shall introduce a financial support for the offshore production of hydrogen.
- As described above, the German Government has earmarked EUR 900 million under the H2 Global initiative.

In addition, there are numerous further funding programs initiated by the German States for regional hydrogen purposes. The precise amounts available for each of these programmes depend, inter alia, on the budget estimates made by the responsible ministries.

14. Are there any notable pilot/demonstration projects in place or planned for the production or offtake of clean hydrogen?

There are a number of different pilot projects being deployed in Germany to develop electrolyser production, and to examine and test the feasibility of clean hydrogen production and use hydrogen in different sectors. In particular, there are three hydrogen flagship projects in Germany representing an important contribution by the Federal Ministry of Education and Research to establishing the National Hydrogen Strategy 2020.

- **H2Giga**: The H2Giga flagship project aims at mass production of electrolysers for the scale-up of hydrogen. The project focuses on establishing the series production of electrolysers in a manner that is not limited to specific technologies. Together, established manufacturers of electrolysers, suppliers from various technology sectors (including many small and medium-sized enterprises) as well as research institutions and universities are working on the advancement of existing electrolysis technologies. The following technologies shall then be ready for series production: PEM electrolysis, Alkaline electrolysis (AEL) and High-temperature electrolysis (HTEL).
- **H2Mare**: The H2Mare flagship project explores the offshore production of green hydrogen and other power-to-X products. The project partners strive to integrate the water electrolyzer directly into an offshore wind turbine and thus provide innovative technologies to produce green hydrogen offshore. The direct coupling of wind turbines and electrolysers shall minimize the costs of hydrogen production, since infrastructure costs can be significantly reduced when a connection to the power grid is not needed. H2Mare also works on solutions to directly produce secondary products such as green methanol or green ammonia in addition to green hydrogen (i.e. offshore power-to-X).
- **TransHyDE**: The TransHyDE flagship project aims at developing a hydrogen transport infrastructure, whilst also evaluating and demonstrating several technologies for hydrogen transport. For that purpose, TransHyDE will separately test and scale up four transport technologies each in four respective demonstration projects: (i) hydrogen transport in high-pressure containers, (ii) hydrogen transport in existing and new gas pipelines, (iii) transport of hydrogen bound in ammonia and (iv) hydrogen transport by means of LOHC.

15. Are there any commercial-scale clean hydrogen production projects in development or already operating?

There are currently no existing commercial-scale clean hydrogen production projects in Germany, but there are a number of projects being developed at different stages of development. One key element for the market ramp-up of the hydrogen market in Germany is the Important Project of Common European Interest (IPCEI) programme on hydrogen. In June 2021, the German Federal Ministry for Economic Affairs and Climate Action selected a total of 62 projects (from a total of more than 230 submitted project outlines) that cover the entire hydrogen value chain and gives an overview of one of the most important commercial scale clean hydrogen projects that are currently under development in Germany, including inter alia:

- **GetH2**: The project aims to establish the core for a nationwide hydrogen infrastructure in Germany. The initiative consists of companies (e.g. bp, RWE, OGE, Evonik, BASF or ThyssenKrupp), municipalities and institutions (e.g. Technical University Clausthal) that are actively committed to creating a competitive hydrogen market. In several projects, the partners of the initiative are driving forward the development of technologies for the production, transport, storage and purchase of green hydrogen. They are planning the realisation of pipeline networks, electrolysis plants in the megawatt range and hydrogen applications in refineries, in the steel industry or in heavy-duty transport. The 5,100-kilometre GetH2 network shall be built step by step by 2030.
- **doing hydrogen**: The project "doing hydrogen" is the establishment of an eastern German hydrogen hub which connects H2 projects in Mecklenburg-Western Pomerania, Brandenburg, Berlin, Saxony and Saxony-Anhalt to form a hydrogen hub including production, transport, storage and consumption. The project is supported by, inter alia, Gascade, Ontrans, Enertrag and Vattenfall and shall be ready to launch in 2026.
- **LGH2**: bp aims to produce green hydrogen on an industrial scale. For this purpose, an electrolysis plant with a capacity of 100 MW is to be built in Lingen which will be supplied with electricity from renewable energy sources. The green hydrogen will be delivered to the nearby bp refinery in Lingen and other off-takers in Germany and Europe.

- **LHyVE**: The project "Leipzig Hydrogen Value chain for Europe (LHyVE)" shall establish a regional hydrogen network in the area of Leipzig consisting of hydrogen production and hydrogen storage facilities, a regional hydrogen network for the distribution of hydrogen and different hydrogen customers. The project is support by, inter alia, Leipziger Gruppe, Ontras and BMW and shall be ready to launch in 2026.
- **SENECA – H2 MOBILITY**: Deutschland GmbH & Co. KG (held by Air Liquide, Daimler, Linde, OMV, Shell and TOTAL. BMW, Honda, Hyundai, Toyota and Volkswagen) intends to extend the expansion of the hydrogen infrastructure in Germany. The initial goal is to operate 100 hydrogen stations in seven German metropolitan areas (Hamburg, Berlin, Rhine-Ruhr, Frankfurt, Nuremberg, Stuttgart and Munich) and along connecting trunk roads and highways. Starting in 2021, additional stations will be built where there is demand for commercial vehicles and where a public refuelling station makes sense for a growing network for passenger cars.

16. Have there been any hydrogen-related disputes in your jurisdiction?

No response provided.

Last updated September 2023

India

Ashurst collaborated with **Indian Law Partners** in the preparation of this content. We are grateful for their input.

Policy and regulation

1. Is there a government hydrogen strategy or policy?

Yes, the 'National Hydrogen Mission' was announced by the Prime Minister of India on 15 August 2021 and subsequently the Ministry of Power, Government of India (GoI) notified the Green Hydrogen/ Green Ammonia Policy ("**Green Hydrogen Policy**") on 17 February 2022.

Subsequent to the Green Hydrogen Policy, on 4 January 2023, the Union Cabinet of GoI approved the 'National Green Hydrogen Mission' ("**Green Hydrogen Mission**") with an outlay of INR 197,440,000,000 (Indian Rupees One Hundred Ninety Seven Billion Four Hundred Forty Million) (approx. USD 2,367,858,629) with a target of 5MMT production capacity of Green Hydrogen per annum to further boost the growth of green hydrogen in India.

In October 2023, the Ministry of New and Renewable Energy ("**MNRE**") released R&D Roadmap of INR 4,000,000,000 (Indian Rupees Four Billion) (Approx. USD 47,971,204) which seeks to provide guidance for developing a vibrant research and development ecosystem which can help commercialize green hydrogen and contribute to India's ambitious climate and energy goals. It focuses on developing new materials, technologies, and infrastructure to improve the efficiency, reliability, and cost-effectiveness of green hydrogen production, storage, and transportation. The R&D program will also prioritize safety, address technical barriers, challenges in developing a hydrogen economy and issue call for proposals and start awarding specific projects under the Mission. As per the R&D Roadmap, Projects are bifurcated and structured per timelines needed to achieve the targets in following manner: (1) Mission Mode Projects (Short term – up to 5 years), (2) Grand Challenge Projects (Medium term – up to 8 years), and (3) Blue Sky Projects (Long term – up to 15 years), and the Roadmap recommends performance targets and demonstration projects for the categories of Projects mentioned, respectively.

2. What are key goals and commitments included in the strategy/policy?

The Green Hydrogen Mission provides the vision, intent and direction for harnessing hydrogen energy and some key goals are as follows:

- to develop India as a global hub for manufacturing hydrogen and fuel cells technology across the value chain;
- put forward a specific strategy for the short term (4 years), and broad strokes principles for long term (10 years and beyond) would be devised;
- provide necessary flexibility to capture benefits from advances in the technological landscape;
- the GoI will facilitate demand creation in identified segments, including seeking use of green hydrogen in industry such as in fertilizer, steel, petrochemicals and so on;
- engaging in activities to create volumes and infrastructure, demonstrate usage in niche applications including transport and industry;
- have focused research and development, implement a facilitative policy to support usage, and putting in place a robust framework for standards and regulations for hydrogen technologies;
- to aid the government in meeting its climate targets and making India a green hydrogen hub, which will help in meeting the target of production of five million tonnes of green hydrogen by 2030 and the related development of renewable energy capacity.

The Green Hydrogen Policy itself did not set any goals/milestones for or by stakeholders, however, a supplementary report published by the National Institute for Transforming India (NITI Aayog) in June 2022 provides that India can achieve the following targets if the right steps are taken, with a USD 1 billion investment into hydrogen research and development to enable breakthrough technologies for the world at scale and the speed that is required to be the world's largest:

- electrolysis (green hydrogen generation) capacity of over 60 GW/5 million tonnes by 2030 for domestic consumption, which will help India meet the 500 GW renewable energy target;
- producer of green steel at 15-20 million tonnes by 2030 — a pioneering effort to make green steel mainstream for the world;
- electrolyser with an annual manufacturing capacity of 25 GW by 2028 delivering affordable ones for India and the world;
- producer of green ammonia for exports by 2030 helping India's allies to decarbonise, this may require up to 100 GW of green hydrogen.

The recently released R&D Roadmap for the green hydrogen ecosystem in India provides for objectives in relation to hydrogen production, hydrogen storage, hydrogen transport, safety and end-use application. The R&D Roadmap provides for various objectives and provides guidance with respect to *inter alia*:

- Need of extensive research in for Hydrogen Production in following areas/sections: Catalysis; Separations; Theory & Modelling; Interfacial Chemistry & Materials, Life Cycle Assessment. Further, it recommends the following inter alia: Mission Mode projects, Testing / Certification Infrastructure Augmentation, Fiscal support, Governing / monitoring mechanisms.
- National/International R&D in: Underground storage of Hydrogen Projects, Metal Hydride Storage Projects, Solid-state Hydrogen Storage; MOF Materials, and Advance/Novel Materials;
- Transportation of Hydrogen in India (comparative analysis of hydrogen transportation in India and globally);
- End-use applications for Hydrogen as a fuel;
- Hydrogen Plasma Smelting Technique for production of Green & Clean Steel;
- Observations w.r.t utilization of hydrogen as: *An Industrial chemical* (utilized as a Molecule), a *blend with CNG* in combustion devices, and as a pure energy molecule in Electrochemical devices; Safe & Effective use of Hydrogen via (*inter alia* Accurate modelling of hydrogen explosions; Upgrading Hydrogen sensing technology; Better analysis of Long-term effects of hydrogen exposure on materials; and Better understanding of Hydrogen deflagrations in partially enclosed areas.)

3. Which industry sectors are most likely to be affected by hydrogen deployment?

The Green Hydrogen Mission primarily aims to decarbonise industrial, mobility and energy sectors; and supports pilot projects in emerging end-use sectors and production pathways. The industry sectors where clean hydrogen may displace fossil fuels in India, subject to pilot trials, include:

- Refinery
- Iron ore and steel
- Nitrogenous fertilizers
- Petrochemicals production
- Fuel Cell Electric Vehicles (FCEVs) and Battery Electric Vehicles (BEVs)
- Power generation

4. Who are the main regulators for the hydrogen market?

The main regulator for the hydrogen market in India is the Ministry of New and Renewable Energy ("**MNRE**") as it is responsible for overall coordination and implementation of the Green Hydrogen Mission. Further, Ministry of Petroleum and Natural Gas ("**MoPNG**") is responsible for regulation of production, transportation and storage of hydrogen. However, as per the Green Hydrogen Mission, all concerned Ministries, Departments, agencies and institutions of the Central and State Government such as the Ministry of Power, Ministry of Road Transport and Highways, Ministry of Commerce & Industry etc. will undertake focused and coordinated steps to ensure successful achievement of the Green Hydrogen Mission objectives.

5. Does the government hydrogen strategy or policy support the development of both low-carbon (blue) hydrogen and renewable (green) hydrogen?

For now, the Green Hydrogen Policy and the Green Hydrogen Mission only support the development of Green Hydrogen.

6. If the government hydrogen strategy or policy supports the development of low-carbon hydrogen, to what extent is carbon capture and storage being taken forward?

For now, there is no specific policy which supports the development of low-carbon hydrogen. While the GoI has announced the National Hydrogen Mission, it has not, so far, communicated a clear ambition for low-carbon hydrogen deployment. Further, the Green Hydrogen Policy focuses on Green Hydrogen and Green Ammonia.

7. Are there targets for the production of hydrogen?

India's target is to develop green hydrogen production capacity of at least 5 MMT (Million Metric Tonne) per annum with an associated renewable energy capacity addition of about 125 GW in the country by 2030.

8. Are there any incentive mechanisms/business models in place to support the production of hydrogen?

The Green Hydrogen Mission provides various incentives including the ones stated below, in order to support the establishment of Green Hydrogen ecosystems:

- Under the Strategic Interventions for Green Hydrogen Transition (SIGHT) Programme, two distinct financial incentive mechanisms are provided targeting domestic manufacturing of electrolysers (i.e. Component I) and production of Green Hydrogen (i.e. Component II). INR 174.9 Billion (approx. USD 2.14 Billion) has been set aside for the SIGHT Programme.

  On 28 June 2023, the Ministry of New and Renewable Energy (MNRE) sanctioned following SIGHT Programme:

  (i) Component I (incentive scheme for Electrolyser Manufacturing) issued scheme guidelines, for a period from financial year 2025-2026 to financial year 2029-2030 with a total outlay of INR 44.4 Billion (approx. USD 537 Million).

  Under Tranche I, support will be provided for electrolyser manufacturing, in terms of INR/kW corresponding to manufacturing capacity. The base Incentive will start with INR 4440/kW (approx. USD 53.73) in the first year and will gradually taper down on an annual basis. The incentives proposed in Scheme I will be provided for 5 (five) years from the date of commencement of manufacturing of electrolysers. Scheme I aims to incentivise manufacturing of efficient and high–quality electrolysers in India.

  On 16 March 2024, the MNRE notified the scheme guidelines for Tranche II of Component I. In order to promote indigenously developed electrolyser technologies, the Scheme under Tranche II has introduced distinct capacity buckets (Bucket 1, Bucket 2A, Bucket 2B). Minimum Capacities for Bucket 1 and 2A shall be 100MW. Minimum and Maximum capacity for bidding under Bucket 2B shall be 30 MW and 10 MW, respectively. (ii) Component II (incentive scheme for Green Hydrogen production) and issued scheme guidelines, for a period from financial year 2025-2026 to financial year 2029-2030 with a total outlay of INR 130.5 Billion (approx. USD 1.57 Billion).

  Mode I of Component II is bidding on least incentive demanded over the 3 (three) year period, through a competitive selection process. To be eligible for incentive under the Component II, the bidder must ensure Green Hydrogen production in accordance with the detailed criteria laid down in the National Green Hydrogen Standard as notified by MNRE (see response to question 8). In cases where the end product is a derivative of Green Hydrogen such as Green Ammonia, the incentive would be made available based on the amount of Green Hydrogen (in Kg) utilized to produce the given amount of derivative. For Green Ammonia the equivalent amount of Green Hydrogen is prescribed at 0.1765 Kg Green Hydrogen per kg of Green Ammonia. For any other derivative, MNRE would declare an equivalence factor based on the criteria above.

  As stated above, under Mode I of Component II, the beneficiaries would be selected through competitive selection process and a direct incentive in terms of INR/Kg of Green Hydrogen production will be provided for a period of 3 (three) years from the date of commencement of Green Hydrogen production. The incentive would be capped at INR 50 (approx. USD 0.61) per Kg in the first year of production, INR 40 (approx. USD 0.48) during second year of production and INR 30 (approx. USD 0.36) during the third year of production.

  On 16 January 2024, the MNRE launched Mode II under Component II, which has two parts: Mode 2A for green ammonia production and Mode 2B for green hydrogen production. In Mode II of Component II, the aggregation of demand and calling for bids for production and supply of green hydrogen and its derivatives is done at the lowest cost through a competitive selection process.

  In Mode 2A, the implementation agency (i.e. the Solar Energy Corporation of India) shall aggregate demand and call for bids for production and supply of green ammonia at the lowest cost through a competitive selection process [capacity quoted should be constant over the period of Ammonia Purchase Agreement (in thousand metric tonnes i.e. MT)] with the incentive being fixed. The incentive would be capped at INR 8.82 (approx. USD 0.11) per kg of green ammonia in the first year of production and supply, INR 7.06 (approx. USD 0.085) per kg during the second year of production and supply and INR 5.30 (approx. USD 0.064) per kg during the third year of production and supply.

- In Mode 2B, the implementation agency/ agencies (i.e. Oil & Gas companies and Centre for High Technology (CHT)) shall aggregate demand and call for bids for production and supply of Green Hydrogen at the lowest cost for a single refinery or multiple refineries, as decided by the Implementing Agency, through a competitive selection process [capacity quoted should be constant over the period of Hydrogen Purchase Agreement (in thousand metric tonnes i.e. MT)] with the incentive being fixed. The incentive would be capped at INR 50 (approx. USD 0.61) per Kg in the first year of production, INR 40 (approx. USD 0.48) during second year of production and INR 30 (approx. USD 0.36) during the third year of production. Support to pilot projects in emerging end-use sectors and production pathways. INR 14.66 Billion (approx. USD 180 Million) has been set aside for such pilot projects.

The Green Hydrogen Policy issued by the Ministry of Power, GoI provides amongst others, the following benefits:

- Manufacturers of Green Hydrogen or Green Ammonia[1] are allowed to purchase renewable power from the power exchange or set up renewable energy capacity themselves or through any other developer. The open access for sourcing renewable energy will be granted within 15 days of receipt of application. The unconsumed renewable power can be banked up to 30 days with the distribution company and can be taken back when required.

- Distribution licensees can also procure and supply renewable energy to the manufacturers of Green Hydrogen or Green Ammonia in their States at concessional prices which will only include the cost of procurement, wheeling charges and a small margin as determined by the State Commission.
- Complete waiver of inter-state transmission charges for a period of 25 years from the date of commissioning of the project, will be allowed to the manufacturers of Green Hydrogen and Green Ammonia using renewable energy (commissioned after 8th March 2019), pumped storage system or battery storage systems or any hybrid combination of these technologies for the projects commissioned on or before 31st December 2030.
- The renewable energy plant which manufactures Green Hydrogen or Ammonia will be given connectivity to the grid on priority basis to avoid any procedural delays.
- Manufacturers of Green Hydrogen or Green Ammonia will be allowed to set up bunkers near Ports for storage for exports/ use by shipping, at applicable charges by the Port Authorities.

Further, a National Single Window System (NSWS) of Government of India has also been launched, which will provide a single window to industry for obtaining all approvals related to projects under the National Green Hydrogen Mission.Further, on 06 June 2022, the GoI's Ministry of Power, notified the Electricity (Promoting Renewable Energy Through Green Energy Open Access) Rules, 2022 (**Rules**) in order to accelerate India's ambitious renewable energy programmes, with the objective of ensuring access to affordable, reliable, sustainable and green energy for all. The aim of such legislations is to promote the generation, purchase, and consumption of green energy and to cut emissions by 45% in line with India's updated Nationally Determined Contributions (NDC) target for 2030. These Rules also provide for the incentive to exempt users from paying Cross-subsidy charges on power produced from waste-to-energy units or to produce green ammonia and green hydrogen.

Further, on 8th May 2023, the Government of Gujarat also announced its policy for leasing out government fallow land for green hydrogen production using non-conventional energy sources such as solar, wind, wind solar hybrid energy (**Policy 2023**). The Policy 2023 requires the production of at least 100,000 MT (One Hundred Thousand Metric Tonnes) of Green Hydrogen per year by the company through a solar, wind, wind solar hybrid energy plant and provides for the lease period of government land for 40 (Forty) years. Amongst other things, Policy 2023 fixes the annual rent of the land allotted by the government to INR 15,000 per hectare (approx. USD 182) with an escalation of 15 percent every 3 (three) years. Lastly, in India, the MNRE and its autonomous institutes under its administrative control have signed various memorandum of understandings/ programme/ agreements/ letter of intent/ joint declaration of intent with foreign countries/ institutes/ organisations such as Australia, Finland, France, Germany, Saudi Arabia, UAE, Uzbekistan and the United States of America.

9. Are there any standards in place for the classification and/or certification of low-carbon or renewable hydrogen?

Currently there are no specific set of definitive standards for classification and/or certification of blue hydrogen.

On 18th August, 2023 the Green Hydrogen Standard for India was passed by MNRE. The standards (outlining emission thresholds which must be met in order for the produced hydrogen to be classified as "Green Hydrogen") are as follows:

Green Hydrogen:

- shall mean hydrogen produced using renewable energy inter alia production through electrolysis or conversion of biomass. Renewable energy also includes such electricity generated from renewable sources which is stored in an energy storage system or banked with the grid in accordance with applicable regulations.

For Green Hydrogen produced through electrolysis:

- Non-biogenic greenhouse gas emissions arising from water treatment, electrolysis, gas purification and drying and compression of hydrogen shall not be greater than 2 kilogram of CO2 equivalent per kilogram of Hydrogen (kg CO2 eq/kg Hydrogen), taken as an average over last 12-month period.

For Green Hydrogen produced through conversion of biomass:

- Non-biogenic greenhouse gas emissions arising from biomass processing, heat/steam generation, conversion of biomass to hydrogen, gas purification and drying and compression of hydrogen shall not be greater than 2 kilogram of CO2 equivalent per kilogram of hydrogen (kg CO2 eq/kg Hydrogen), taken as an average over last 12-month period.

MNRE in due course would further specify detailed methodology for measurement, reporting, monitoring, onsite verification and certification of Green Hydrogen and its derivatives. Bureau of Energy Efficiency would be the nodal agency for accreditation of agencies for monitoring, verification and certification for Green Hydrogen production projects.

10. Does the regulatory framework clearly define the regulatory requirements relating to the production, storage, transportation or supply of hydrogen?

The Green Hydrogen Policy provides certain details with respect to production, storage, transportation and supply of hydrogen, such as:

Production:

- Green Hydrogen / Green Ammonia (Hydrogen /Ammonia) should be produced from biomass and by electrolysis of water using renewable energy, including renewable energy which has been banked, and from a co-located renewable energy plant, or sourced from a remotely located renewable energy plants.
- Land in renewable energy parks can be allotted for the manufacture of Green Hydrogen/ Green Ammonia.
- The GoI proposes to set up manufacturing zones, and Green Hydrogen / Green Ammonia production plants can be set up in such manufacturing zones.

Storage:

- Manufacturers of Green Hydrogen / Green Ammonia would be allowed to set up bunkers near Ports for storage of Green Ammonia for export / use by shipping at applicable charges.

Transportation:

- Connectivity to the ISTS for Renewable Energy capacity set up for the purpose of manufacturing Green Hydrogen / Green Ammonia would be granted on priority under the Electricity (Transmission system planning, development and recovery of Inter State Transmission charges) Rules 2021.
- The waiver of inter-state transmission charges would be granted for a period of 25 years to the producer of Green Hydrogen and Green Ammonia from the projects commissioned before 31st December 2030.

Banking:

- Banking would be permitted for a period of 30 days for Renewable Energy used for making Green Hydrogen/ Green Ammonia.
- The charges for banking would be as fixed by the State Commission which should not be more than the cost differential between the average tariff of renewable energy bought by the distribution licensee during the previous year and the average market clearing price (MCP) in the Day Ahead Market (DAM) during the month in which the Renewable Energy has been banked.
- In order to achieve competitive prices, MNRE may aggregate demand from different sectors and have consolidated bids conducted for procurement of Green Hydrogen/Green Ammonia through any of the designated implementing agencies.

Compliance:

- Renewable Energy consumed for the production of Green Hydrogen / Green Ammonia shall count towards Recruitment Process Outsourcing (RPO) compliance of the consuming entity. The renewable energy consumed beyond obligation of the producer would count towards RPO compliance of the Distribution Company (DISCOM) in whose area the project is located.
- Distribution licensees may also procure and supply Renewable Energy to the manufacturers of Green Hydrogen / Green Ammonia in their States. In such cases, the distribution licensee should only charge the cost of procurement as well as the wheeling charges and a small margin as determined by the State Commission.
- MNRE will establish a single portal for all statutory clearances and permissions required for manufacture, transportation, storage and distribution of Green Hydrogen /Green Ammonia. The concerned agencies/authorities will be requested to provide the clearances and permissions in a time-bound manner, preferably within a period of 30 days from the date of application.

The R&D Roadmap for Green Hydrogen ecosystem in India which was published in October 2023, recommends research and development actions for each part of the green hydrogen value chain including but not limited to hydrogen production, storage, transport, safety an end-use application.

11. Are there any foreign investment restrictions related to energy and infrastructure sectors?

The Foreign Direct Investment Policy of India allows 100% investment under automatic route in following activities:

- exploration activities of oil and natural gas fields,
- infrastructure related to marketing of petroleum products and natural gas,
- marketing of natural gas and petroleum products, petroleum product pipelines, natural gas/pipelines,
- LNG regasification infrastructure,
- market study and formulation and petroleum refining in the private sector,

subject to the existing sectoral policy and regulatory framework in the oil marketing sector and the policy of the Government on private participation in exploration of oil and the discovered fields of national oil companies.

Further, up to 49% equity investment under automatic route is allowed for activities such as Petroleum refining by the Public Sector Undertakings (PSU), without any disinvestment or dilution of domestic equity in the existing PSUs.

12. What international treaties are in place that may offer protection to international investors in hydrogen projects in the jurisdiction?

India is a signatory to 7 bilateral investment treaties (BITs) that are in force as on 10 January 2023, and in addition certain other treaties may contain protections for investors in India. These can be accessed from **UNCTAD's Investment Policy Hub**.

India is neither a member nor an observer of the Energy Charter Treaty, therefore, protection to international investors follow international recommendations and consensus such as by the OECD, UNCTAD, and WTO.

Market developments and opportunities

13. Are there any government grants or other government funding available to hydrogen projects (including for research and development)?

The Green Hydrogen Mission provides INR 197.4 Billion (approx. USD 2.4 Billion), including an INR 174.9 Billion (approx. USD 2.14 Billion) for the SIGHT programme, INR 14.66 Billion (approx. USD 180 Million) for pilot projects, INR 4 Billion (approx. USD 48.7 Million) for R&D, and INR 3.88 Billion (approx. USD 47.3 Million) towards other mission components.

Further, the Ministry of Petroleum & Natural Gas has a Hydrogen Corpus Fund (HCF) and this fund participates in funding R&D projects which are led by the oil industry. Among the projects currently being funded are for finding multiple pathways for production of hydrogen, H-CNG, and hydrogen production through decomposition of natural gas. Further, the recently released R&D Roadmap aims to foster a robust research and development ecosystem to drive the commercialization of green hydrogen and contribute to India's ambitious climate and energy objectives. It focuses on enhancing materials, technologies, and infrastructure to boost the efficiency, reliability, and cost-effectiveness of green hydrogen production, storage, and transportation. Additionally, safety measures and solutions to technical challenges in developing a hydrogen economy are prioritised.

14. Are there any notable pilot/demonstration projects in place or planned for the production or offtake of clean hydrogen?

On 20 April 2022, the Ministry of Petroleum and Natural Gas, GoI notified that Oil India Limited (OIL) has commissioned India's first 99.999% pure Green Hydrogen pilot plant, with an installed capacity of 10 kg per day at its Jorhat Pump Station in Assam.

Further, on 30 July 2022, Prime Minister of India participated in the Ujjwal Bharat Ujjwal Bhavishya–Power @2047 Programme and launched a pilot project named "the Green Hydrogen Mobility Project" at Leh, Ladakh, for five fuel cell buses to run in and around Leh. This pilot project would be the first deployment of FCEVs for public use in India. Further, the "Green Hydrogen Blending Pilot Project" was also launched at NTPC Kawas Township as India's first green hydrogen blending project helping in reducing the usage of natural gas.

Under the Research and Development projects supported by MNRE, a 5 Nm3/h (normal cubic meter per hour) Green Hydrogen production plant based on solar energy and electrolysis has been established at Gurugram, Haryana and a 6 kg per hour Green Hydrogen production plant based on biomass gasification has been established at IISc Bangalore, Karnataka.

Further, 1 (one) company has set up a manufacturing facility for Polymer Electrolyte Membrane electrolysers at Bengaluru. GoI has not provided any subsidy for such pilot projects. The Ministry of Petroleum and Natural Gas on its website has further listed pilots based on green hydrogen which are being planned. The below listed pilots are in preliminary stages and the modalities are being worked on to achieve its purpose.

- Two pilot for setting up of solar hydrogen refuelling stations at two locations- for demonstration of fuel cell vehicles at tourist sites like Delhi-Agra, Gujarat (Statue of Unity) etc.
- One pilot for setting up a green hydrogen plant to explore an opportunity of replacing conventional hydrogen in refinery to green hydrogen.
- One pilot for production of green hydrogen and its blending with CNG at an appropriate site in Rajasthan for dispensing at retail outlets.

One pilot for setting up of green hydrogen infrastructure and pipeline injection of green hydrogen in City Gas Distribution (CGD) network. Further, under the Ministry of Road Transport & Highways, Toyota Kirloskar Motor Pvt. Ltd. along with International Centre for Automotive Technology (ICAT) conducted a pilot project to study and evaluate the world's most advanced FCEV Toyota Mirai which runs on hydrogen, on Indian roads and climatic conditions. This was a first of its kind project in the country aimed at spreading awareness about Hydrogen, FCEV technology and disseminating its benefits to support hydrogen-based society for India. Union Minister of Road Transport & Highways, GoI inaugurated this pilot project on 16 March 2022. MNRE has announced various scheme guidelines in order to facilitate setting up of hydrogen hubs, implementation of pilot projects for use of green hydrogen in the steel sector and pilot projects for use of hydrogen in shipping sector.

15. Are there any commercial-scale clean hydrogen production projects in development or already operating?

There are a few existing commercial-scale clean hydrogen production projects in India, and there are a number of projects in the pipeline, at different stages of development, including the following:

- Larsen & Toubro's (L&T) Green Hydrogen Plant in Hazira, Gujarat produces 45 Kg of Green Hydrogen daily and L&T in January 2023 announced it has signed an agreement with the Norway-based H2Carrier to develop floating green ammonia projects for industrial-scale applications.
- Reliance Industries Limited (RIL) has signed a preliminary agreement with Government of Gujarat to invest INR 5.95 Trillion (USD 72.6 Billion) over the span of 10 to 15 years to set up 100 GW renewable energy power plant and green hydrogen eco-system development.
- Indian Oil Corporation Ltd. (IOCL) is going to set up subsidiary to house its green energy businesses and is setting up green hydrogen plant at its Panipat refinery. IOCL on 28th August, 2023 invited global tenders for setting up the unit next to its Panipat refinery on land owned by it. At 10 KTA capacity, this will be among the largest green hydrogen plants in India.
- Chennai Petroleum Corporation, a subsidiary of IOCL, has recently issued an EOI for the design, manufacturing and commissioning of the electrolyser and related items for the production of green hydrogen at its refinery at Manali in Chennai.
- Greenko Group announced that India will for the first-time export green energy from 2025, with the first shipments going to a Singapore power plant as it signed an MoU with Singapore's Keppel Infrastructure.
- GAIL announced that it has awarded a contract to set up one of the largest Proton Exchange Membrane (PEM) electrolyser in India which would be installed at GAIL's Vijaipur Complex, in Guna district of Madhya Pradesh.
- Bharat Petroleum Corporation Ltd. (BPCL) has invited bids and is in the process of installing a 5 MW electrolyser system to set up a green hydrogen production facility in a phased manner in one of its city gas distribution projects.
- Fusion Fuel Green, which has offices in Portugal and Ireland, has signed an agreement with BGR Energy Systems, an engineering, procurement, and construction (EPC) company based in Chennai, India, to install green hydrogen production facilities in Tamil Nadu.
- An MoU was signed between European Investment Bank and India Hydrogen Alliance for providing USD 1.06 billion for development of Green Hydrogen hubs and projects across India.
- A Letter of Intent was signed between Department of Science and Tech & Fraunhofer Institute for Solar Energy Systems (Germany) which is projected as a long-term collaboration for Green Hydrogen and other clean technologies.
- Diversified renewable energy company ACME Group signed a land agreement with Tata Steel Special Economic Zone (TSSEZL) for 343 acres for its green hydrogen and green ammonia project at the Gopalpur Industrial Park in Odisha. The Group plans to set up a 1.3 MTPA green ammonia production facility.
- Avaada Group signed a Memorandum of Understanding with Tata Steel Special Economic Zone Limited (TSSEZL) for setting up of a Green Hydrogen and Ammonia manufacturing unit at TSSEZL's Gopalpur Industrial Park, in Odisha.
- Reliance Green Hydrogen & Green Chemicals Limited, ACME Cleantech Solutions, Greenko Zero and several other companies (in total of 9 companies) have emerged as successful bidders for Government Incentives for setting up of facilities with production capacity up to 4.50 lakh tonnes of Green Hydrogen. A government-owned entity Solar Energy Corporation of India (SECI) on 10 July 2023 had invited bids for green hydrogen producers, for setting up of facilities with production capacity up to 4,50,000 tonnes of Green Hydrogen under the SIGHT Scheme, specifically under Mode-I-Tranche-I.

- THDC India Limited, an Indian Public Sector power company, has inaugurated India's largest green hydrogen pilot project in Rishikesh, Uttarakhand which would produce 50 kg of green hydrogen on daily basis, using energy from 01 MW rooftop solar plant.
- India's state-owned power generation company, National Thermal Power Corporation (NTPC) signed a land-lease agreement with Andhra Pradesh Industrial Infrastructure Corporation (APIIC) for building India's largest green hydrogen project in Andhra Pradesh. The said green-hydrogen hub shall be built on 1,200 acres of land in Pudimadaka, which would test & manufacture electrolysers, fuel cells and other related ancillaries.
- First Commercial-scale Green Hydrogen plant in India, at Jindal Stainless Limited's manufacturing unit which is expected with initial production of 78 tonnes per year, will be owned & operated by Hygenco India. After 20 years, the ownership shall be transferred to Jindal Stainless Limited. This pact stands as India's first commercial long-term offtake agreement of Green Hydrogen. Cochin International Airport Ltd. (CIAL) signed an MoU with Bharat Petroleum Corporation Ltd. (BPCL) for setting up a green hydrogen plant in the airport premises which shall result in world's first green hydrogen plant & fuelling station within airport premises.

16. Have there been any hydrogen-related disputes in your jurisdiction?

We are not aware of any significant hydrogen related disputes in India as the manufacturing and production of green hydrogen in India is currently at a very nascent stage.

Last updated April 2024

Indonesia

Policy and regulation

1. Is there a government hydrogen strategy or policy?

There is currently no specific government hydrogen strategy or policy in Indonesia. Instead, hydrogen is classified as "new energy" under **Law No. 30 of 2007 on Energy** (**Energy Law**) and **Government Regulation No. 79 of 2014 on National Energy Policy** (**Energy Policy**). Hence while there is no specific policy for hydrogen, there is a general policy for new energy sources within Indonesia's regulatory framework.

In **Presidential Regulation No. 22 of 2017 on National Energy Plan** (**Energy Plan**), there is also a general action plan on the utilization of liquified new energy (including hydrogen) for the transportation sector. This sets out the Indonesian government's plans to:

- develop technology to produce hydrogen and utilize hydrogen for transport;
- develop a hydrogen-fuelled vehicle industry; and
- draft regulations on hydrogen-fuelled vehicles for public and private transportation.

While the government's strategic direction on hydrogen is not yet concrete, in a press conference in June 2022, the Indonesian Minister of Energy and Mineral Resources, Arifin Tasrif, **stated that hydrogen** is expected to be one of the contributors to the energy transition and has an important role in decarbonising the global energy system. This is further illustrated by the government announcing plans to utilize hydrogen for transportation system and industrial sectors in the New Capital City of Nusantara. The Parliament is also drafting a New and Renewable Energy Bill which, **according to announcements**, is anticipated to provide a clearer framework for new energy, which may include hydrogen.

Separately, against the backdrop of Indonesia's energy transition, on November 16, 2022, the Indonesian Government and the International Partners Group (which comprises the governments of Japan and the United States, who are co-leaders of the partnership, and Canada, Denmark, the European Union, Germany, France, Norway, Italy, and the United Kingdom together the International Partners Group or **IPG**) launched the Just Energy Transition Partnership for Indonesia (**JETP**). JETP Indonesia has an initial commitment of US$20 billion, of which US$10 billion is IPG funding and the remaining US$10 billion is private financing from Glasgow Financial Alliance for Net Zero (GFANZ). JETP Indonesia marks the largest energy transition financing package in the world to date.

The Indonesian government and the IPG provide guidance to the JETP Secretariat, which in turn coordinates various working groups led by international institutions to produce a credible and workable Comprehensive Investment and Policy Plan (**CIPP**). The CIPP is a strategy document that the Indonesian government will use as a basis for planning and policymaking in relation to its energy sector as part of the JETP process and aiming at ensuring its energy transition. The CIPP provides that Indonesia must accelerate the decarbonization of end-use industries through the development of green industries such as hydrogen. Pursuant to the CIPP, for Indonesia to reach net-zero emissions by 2050, from 2040 onward, fossil-fuel based power plants (coal and gas) must be retired and retrofitted to fully run on bioenergy or ammonia, for coal power, and hydrogen for gas power. The CIPP mentions that after 2040, clean hydrogen production is projected to emerge as an additional key source of electricity demand in Indonesia.

2. What are key goals and commitments included in the strategy/policy?

As set out in Point 1, the Indonesian government does not yet have a specific hydrogen policy or strategy. However, there are plans for the use of hydrogen in relation to hydrogen-fuelled vehicles and using hydrogen to contribute to the energy transition.

Hydrogen-fuelled vehicles

As stated above, the Indonesian government has plans to utilize hydrogen in the transportation sector. Based on the Energy Plan, these plans are to be carried out by the Ministry of Transportation, the Ministry of Energy and Mineral Resources (**MEMR**), Ministry of Industry (**MOI**) and the Ministry of Research and Technology. The government aims for the outcomes of the Energy Plan to be achieved by 2050.

Energy Transition

In general, the Energy Law provides for the prioritization of new and renewable energy. This is consistent with the goals expressed in other laws such as **Law No. 30 of 2009 on Electricity, as amended by Law No. 11 of 2020** (**Electricity Law**), which states that utilization of primary energy sources must be performed by prioritizing new energy and renewable energy sources.

Pursuant to the Energy Policy, Indonesia aims for at least 23% of its energy mix to consist of new and renewable energy by 2025, provided that this is economically feasible. As of June 2022, the share of new and renewable energy in **Indonesia's energy mix was 12.8%**.

3. Which industry sectors are most likely to be affected by hydrogen deployment?

Numerous sectors in Indonesia including transportation, industrial manufacturing, heat, and power generation may use hydrogen.

Hydrogen deployment is expected to be most prevalent in Indonesia's energy sector as a substitution feedstock to coal for power generation. Coal-fired power plants (**CFPPs**) currently represent **approximately 61%** of Indonesia's installed capacity. The Indonesian government is now focusing on reducing coal's dominance in the generation mix by retiring coal-fired power plants. In light of this, hydrogen fuel may become an alternative to fossil fuel, especially for companies/industries that are looking to reduce their carbon emissions.

Furthermore, the Directorate General of New and Renewable Energy (**DGNRE**) within MEMR **has stated that the utilization of hydrogen** will primarily be used for internal combustion technology commonly used by motorized vehicles in Indonesia and will support Indonesia's electrical vehicle national programme.

4. Who are the main regulators for the hydrogen market?

In Indonesia, the main regulator overseeing the hydrogen market is the MEMR, which is the primary government institution in charge of formulating energy-related policies and regulations. Specifically within the MEMR, the DGNRE is tasked with the supervision of new and renewable energy resources and assets, including hydrogen. Additionally, the MOI oversees industrial development and regulations, which would include those related to hydrogen production facilities and manufacturing processes. Furthermore, local governments at provincial and municipal levels may have jurisdiction over specific aspects of hydrogen production, distribution, and utilization within their regions. These regulatory bodies collectively set standards, issue permits, and ensure compliance with laws and regulations governing the hydrogen market in Indonesia.

5. Does the government hydrogen strategy or policy support the development of both low-carbon (blue) hydrogen and renewable (green) hydrogen?

Currently, Indonesia's legislation and policies do not distinguish between the types of hydrogen (including blue or green hydrogen). The Energy Policy provides that sources of new energy can come from both renewable and non-renewable energy sources.

Nonetheless, the Indonesian government's policy has recently put more focus on renewable energy sources as a result of Indonesia's commitments under the Paris Climate Agreement (**Paris Agreement**). In an effort to decrease its carbon emissions, Indonesia has a nationally determined contributions (**NDC**) reduction target of 29% (unconditionally) or 41% (conditionally, with international assistance) against the business-as-usual scenario by 2030 in order to meet its Paris Agreement commitments.

In addition, **MEMR has declared** that Indonesia will rely on the development of green hydrogen in the future, especially to pursue the decarbonisation of industrial sectors (such as the cement, ceramics and glass industries).

6. If the government hydrogen strategy or policy supports the development of low-carbon hydrogen, to what extent is carbon capture and storage being taken forward?

Between 2023 to 2024, the Indonesian government has issued 3 separate regulations on Carbon, Capture and Storage (CCS) and Carbon, Capture, Utilization and Storage (CCUS):

- Presidential Regulation No. 14 of 2024 on the Organization CCS Activities (PR 14/2024)
- MEMR Regulation No. 2 of 2023 on the Organization of CCS and CCUS for Upstream Oil-and-Gas Business Activities (MEMR 2/2023)
- PTK-070/SKKIA0000/2024/S9 on the Implementation of CCS and CCUS in Oil and Gas Contractors' Work Areas (PTK 070)

The above regulations together provide a legal basis and regulatory framework for CCS activities and projects to be implemented in Indonesia. These regulations demonstrate the Indonesian government's strong commitment towards advancing CCS and its ambition to apply this technology for the abatement of CO2 emissions for domestic industries, and also to serve as a hub for the region and seek to monetize and give a second life to its increasing number of depleted reservoirs. (such as oil & gas, steel, cement and other heavy industries)

7. Are there targets for the production of hydrogen?

There are currently no specific targets for the production of hydrogen in Indonesia.

8. Are there any incentive mechanisms/business models in place to support the production of hydrogen?

There are no incentive mechanisms in place specifically for the production of hydrogen. However, **Presidential Regulation No. 112 of 2022 on the Acceleration of Renewable Energy Development for the Supply of Power** stipulates certain

government incentives which are available for the development of renewable energy. These incentives are applicable in the context of green hydrogen, which is produced using electrical energy from renewable electrical energy.

These incentives include:

Economic Incentives:

- Income tax facilities;
- Import tax facilities (in the form of import duty exemption);
- Land and building tax facilities;
- Financial support/facilities for geothermal development; and
- Financial and/guarantee facilities through state-owned-enterprises appointed by the government.

Non-Economic Incentives:

- Ministry support (which includes the prioritization of renewable energy projects);
- Ease of licensing; and
- Guarantee of land availability from the local government.

Additionally, there are a number of government incentives available for National Strategic Projects which are determined by the Indonesian government (i.e. these are significant projects with a strategic nature part of a scheme by the Government to accelerate growth and improve public welfare and regional development in Indonesia). These incentives include, amongst others, central government guarantee against political risks, waivers of certain regulatory requirements (e.g. local content requirements), easing of licensing processes, support on land acquisition & rights of way, and tax holidays.

Furthermore, the Minister of Finance (MOF) has issued MOF Regulation No. 103 of 2023 on the Provision of Fiscal Support through a Funding and Financing Scheme in the Framework of Accelerating Energy Transition in the Electricity Sector (MOF 103/2023) in order to provide a framework for the mobilization of the JETP funding. MOF 103/2023 provides the framework for the Indonesian government to screen and select eligible projects, including the development of new Renewable Energy Power Plants (REPPs), to receive JETP funding as well as additional funding from other sources such as from the State budget and future external funding which is not part of JETP package. MOF 103/20231 introduces an "Energy Transition Platform", which is one of the Indonesian government's fiscal measures established to support the development of REPPs to replace coal-fired power generation. The Energy Transition Platform is established to procure financing from international financial institutions and/or other institutions/agencies and channelling the funds to support Indonesia's energy transition.

9. Are there any standards in place for the classification and/or certification of low-carbon or renewable hydrogen?

There are no standards in Indonesia for the classification or certification of low-carbon or renewable hydrogen. However, the Indonesian Government has recently enacted a framework for carbon pricing, a carbon tax and carbon trading which will regulate carbon emissions across a wide range of industries.

One of these regulations is **Ministry of Environment and Forestry Regulation No. 21 of 2022 on the Guidelines for the Implementation of Carbon Pricing** which establishes "Carbon Credits" as an instrument for proof of performance of greenhouse gas emissions reduction. Each Carbon Credit represents a greenhouse gas emissions reduction or increase in greenhouse gas absorption which is equal to 1 tonne of CO2. As such, if an entity reduces its greenhouse gas emissions through the utilization of green hydrogen, it will be eligible to receive Carbon Credits.

10. Does the regulatory framework clearly define the regulatory requirements relating to the production, storage, transportation or supply of hydrogen?

There are currently no specific regulatory requirements or restrictions for the production, storage, transportation or supply of hydrogen in Indonesia.

11. Are there any foreign investment restrictions related to energy and infrastructure sectors?

As set out in Points 1 and 2, the Indonesian government has plans to utilise hydrogen in the transportation and industrial sectors (such as steel industry, cement, glass and other manufacturing sub-sectors). Pursuant to **Presidential Regulation No. 10 of 2021 on Investment Business Fields, as amended by Law No. 49 of 2021**, transport and industrial manufacturing are 100% open to foreign investment, with the exception of sea transportation and domestic commercial air transportation (both of which are restricted to a maximum of 49% foreign ownership).

12. What international treaties are in place that may offer protection to international investors in hydrogen projects in the jurisdiction?

Indonesia has not ratified any specific international treaty pertaining to hydrogen. Indonesia's commitments to energy transition are embodied through its ratification of the Paris Agreement under the United Nations Framework Convention on Climate Change through **Law No. 16 of 2016**.

Additionally, **Indonesia has entered into several Bilateral Investment Treaties** (**BIT**) to promote greater investment flows between Indonesia and other countries, and to set out standards of protection for investments made in Indonesia by foreign investors. As of January 2023, Indonesia had BITs in place with Singapore, UAE, Russia, Denmark, Finland, Iran, Saudi Arabia, Venezuela, Qatar, Mozambique, Czech Republic, Thailand, Bangladesh, Cuba, Syrian Arab Republic, Morocco, Mauritius, Mongolia, Jordan, Uzbekistan, Sri Lanka, Ukraine, Poland, Sweden, Tunisia, and the Republic of Korea.

These BITs may contain protections for international investors which include; the guarantee of fair and equitable treatment, physical security within the territory of Indonesia, protection from unwarranted expropriation or dispossession, and compensation for losses owing to war or other armed conflict.

In addition to BITs, **Indonesia is party to a number of investment-related intergovernmental agreements** such as the Agreement on Trade-Related Investment Measures (TRIMs), the General Agreement on Trade in Services (GATS) and the Multilateral Investment Guarantee Agency (MIGA) Convention. These agreements provide for, amongst others, fair treatment of investment, transparency in the trade system and protection against political risks.

Market developments and opportunities

13. Are there any government grants or other government funding available to hydrogen projects (including for research and development)?

Please refer to Point 8 above.

14. Are there any notable pilot/demonstration projects in place or planned for the production or offtake of clean hydrogen?

The following projects are currently under development in Indonesia:

- **Muara Karang green hydrogen production plant**: In October 2023 PLN kicked off the production of green hydrogen at what is said to be the first facility of its kind in Indonesia. The facility is located within the site of the Muara Karang gas-fired power plant in Jakarta and is expected to produce around 51 million tonnes of green hydrogen annually via electrolysis.
- **East Sumba hybrid project**: A green hydrogen hybrid project with solar and wind power generation is currently being developed in East Sumba (NTT province) by Hydrogène de France.
- **Ulubelu pilot project**: A green hydrogen fuel project being developed by Pertamina. The project aims to produce green hydrogen fuel from the Ulubelu geothermal working area with Pertamina's own Refinery Unit III Plaju as the offtaker.
- **Garuda Hydrogen Hijau project**: A green hydrogen facility project aiming to produce 150,000 tonnes of renewable ammonia per year, using 600MW of wind and solar power, which is planned to be developed by ACWA Power together with Indonesia's state-owned electricity company Perusahaan Listrik Negara (PLN) and its state-owned fertiliser company Pupuk Indonesia. The final investment decision for this project is planned by the end of 2025.

As set out in Point 1, the government of Indonesia has also expressed its intention to utilize hydrogen in the New Capital City of Nusantara. However, no formal plans have been made public to date.

15. Are there any commercial-scale clean hydrogen production projects in development or already operating?

Yes, there is the Muara Karang green hydrogen production plant which is already in operation since October 2023, as mentioned in Point 14 above.

16. Have there been any hydrogen-related disputes in your jurisdiction?

We are not aware of any hydrogen-related dispute in Indonesia to date.

Last updated April 2024

Ireland

Ashurst collaborated with **Arthur Cox LLP** in the preparation of this content. We are grateful for their input.

Policy and regulation

1. Is there a government hydrogen strategy or policy?

The National Hydrogen Strategy outlines a timeline roadmap in relation to production, transportation, storage and end uses and identifies 21 short-term actions to enable the development of the hydrogen sector.

2. What are key goals and commitments included in the strategy/policy?

The National Hydrogen Strategy aims at reducing uncertainty by providing a strategic vision of the role hydrogen will play in the Irish economy. Main points and timelines are set out at pages 5-6. First end use sectors are expected to be heavy duty transport, followed by industry and flexible power generation. Aviation and maritime are expected to be large end-users but will take longer to develop (page 43). Transport is expected initially to be provided by compressed tankers followed later by hydrogen pipelines. A list of 21 actions for this decade (at pages 86-87) include, in addition to implementation of relevant EU law:

- assessing the potential for hydrogen end uses in a National Industrial Strategy for Offshore Wind (2024-2026);
- reviewing licensing and regulatory regimes relevant to underground hydrogen storage (2024-2028);
- continuing to prove technical capabilities of the current network (2023-28) and developing a plan to transition the network to hydrogen (2023-26); and
- progressing work to support development of strategic hydrogen clusters and reviewing current approaches to energy system planning (2024-26).

Actions include the establishment of an innovation fund to support demonstration projects across the hydrogen value chain, details of which are to be communicated further.

Other relevant policy documents are:

- **Ireland's Climate Action Plan 2024 and Annex of Actions**;
- **Gas Network Ireland's (GNI) Ten Year Development Plan 2021 (NDP)**; and
- **Ireland's draft updated National Energy and Climate Action Plan 2021-2030 (NECP)**.

In Ireland, the key objectives and commitments indicated in the Climate Action Plan and the NDP align with EU policy and it is anticipated that hydrogen will play a significant role in achieving Ireland's decarbonisation goals. Beyond 2030, it is anticipated that the gas network in Ireland can be fully decarbonised by utilising hydrogen and in the interim, hydrogen could be in the network in low blended volumes. Ireland intends to align with the EU Hydrogen Strategy and EU Energy System Integration Strategy.

Ireland signed the EU Hydrogen Initiative by which signatories commit to continue research and investment in the production and use of hydrogen as a future-oriented technology.

In relation to power generation, Ireland has set a high renewable energy target (80% of electricity demand to be met by renewables by 2030). It has committed to delivery of 5GW of offshore renewable generation capacity by 2030 plus an additional 2GW of offshore capacity earmarked for hydrogen production which it considers could support as much as 2-4 TWh of renewable hydrogen production by 2030. Goals in the Climate Action Plan 2024 include commencing zero-emission gas-fired generation from biomethane and hydrogen commencing by 2030, and scaling electrolyser capacity.

Accommodating this volume of renewable capacity on a small island system will require investment in transmission infrastructure and significant investment in interconnection and storage. In this context, green hydrogen is seen as part of an integrated energy system in terms of providing back-up for intermittent renewables, seasonal storage of renewable energy, and ensuring security and resilience in energy suppliers.

3. Which industry sectors are most likely to be affected by hydrogen deployment?

The National Hydrogen Strategy and the Climate Action Plan 2024 envisage that hydrogen will have a role in decarbonising:

- power generation;
- heating;
- industry; and
- transport (particularly public transport, road freight, shipping and aviation).

4. Who are the main regulators for the hydrogen market?

The Commission for Regulation of Utilities (CRU) is the regulatory authority in the energy sector in Ireland. The Gas Act 1976 transposes EU Directive 2009/73/EC on the internal market in natural gas including the requirements in relation to third party access to the gas system and powers and functions of the CRU. Powers and functions of the CRU in relation to gas markets and gas safety are also provided for in the Electricity Regulation Act 1999 and the Gas (Interim) (Regulation) Act 2002. Functions include advising the Minister on the development of the gas industry and regulating the development of natural gas undertakings with respect to safety. In carrying out certain duties (under section 9(3) of the Electricity Regulation Act 1999 and Directive 2009/73/EC), the Minister and Regulator shall have regard to the need to "integrate large and small scale production of gas from renewable resources in networks in the most cost effective way".

The National Hydrogen Strategy notes that, while blends of hydrogen are within the remit of the existing regulatory and safety regime, "a new framework will be needed to be established for pure hydrogen transportation applications" and a statutory body will need to be assigned to develop and oversee this.

The national regulator responsible for health and safety of workers and those affected by work activity is the Health and Safety Authority (HSA). Under the Dangerous Substances (Flammable Liquids and Fuels Distribution and Commercial Supply Stores) Regulations 2019, which apply to the keeping, conveying, loading and unloading of dangerous substances (including hydrogen), the HSA is the appeals authority in relation to licence applications for retail stores.

5. Does the government hydrogen strategy or policy support the development of both low-carbon (blue) hydrogen and renewable (green) hydrogen?

There is no express distinction under Irish law between green hydrogen and blue hydrogen. However the policy focus is on green hydrogen. The National Hydrogen Strategy states that low-carbon hydrogen production "is not expected to play a significant role in Ireland" on the basis that it is not a zero-emission solution and therefore inconsistent with long-term national climate goals.

Ireland's draft updated NECP states that Ireland will focus its efforts on the scale up and production of renewable "green" hydrogen as it supports both decarbonisation and energy security needs. Prior to 2030, Ireland will explore the potential to produce green hydrogen from grid-connected electrolysis using surplus renewables.

6. If the government hydrogen strategy or policy supports the development of low-carbon hydrogen, to what extent is carbon capture and storage being taken forward?

The draft updated NECP indicates that there is a Steering Group to examine feasibility of CCS in Ireland. Climate Action Plan 2024 actions include development of a CCUS strategy to provide a clear policy framework to guide long-term investment decisions.

In 2022, gas network operator (now Gas Networks Ireland, formerly Ervia) completed a CCS feasibility study (see **here**), which considered receiving CO2 from emitters in Cork and Dublin at the battery limit of the carbon capture facilities.

7. Are there targets for the production of hydrogen?

As in the previous plan, the Government commits in the Climate Action Plan 2024 to delivery of 5GW of offshore renewable generation capacity by 2030 plus an additional 2GW of offshore capacity earmarked for hydrogen production which it considers could support as much as 2-4 TWh of renewable hydrogen production by 2030.

Considerations around hydrogen are also addressed in the draft **Offshore Renewable Energy Future Framework Policy Statement**. Proposed actions include assessing renewable hydrogen and renewable hydrogen derivatives transport options, including assessing the viability of potential hydrogen export pipeline routes by 2040.

8. Are there any incentive mechanisms/business models in place to support the production of hydrogen?

Several instruments provide support which may indirectly promote the production of hydrogen:

- the **Accelerated Capital Allowance** is a tax incentive scheme which promotes investment in energy efficient products and equipment and in 2022 there was an expansion of the relief for investment in hydrogen powered vehicles and refuelling equipment;
- the **Alternatively Fuelled Heavy-Duty Vehicle Purchase Grant** aims to promote the decarbonisation of the heavy duty sector and to assist market participants in the transport industry to transition from fossil fuels;
- the **CNG Vehicle Grant Scheme** is administered by Gas Networks Ireland and assists Irish fleet operators in the purchase of new CNG vehicles; and
- DECC **consulted** on a Renewable Heat Obligation until 29 September 2023 to be introduced in 2024. It is intended to incentivise suppliers of fuels in the heat sector to ensure a proportion of fuels they supply is renewable.

9. Are there any standards in place for the classification and/or certification of low-carbon or renewable hydrogen?

Commission Delegated Regulations (EU) 2023/1185 and (EU) 2023/1184 supplementing the Renewable Energy Directive (EU) 2018/2001 apply in Ireland.

10. Does the regulatory framework clearly define the regulatory requirements relating to the production, storage, transportation or supply of hydrogen?

There is no specific regulatory framework in Ireland for hydrogen, although hydrogen is likely caught by certain existing regulatory regimes.

The definition of "natural gas" in the Gas Act 1976 would, subject to certain technical criteria being met, include hydrogen. This means that the existing regulatory regime that applies to gas in Ireland would also apply to hydrogen i.e. the transmission, distribution and supply of hydrogen by pipeline would require a licence.

The storage of hydrogen in Ireland is subject to all applicable health & safety legislation.

In relation to the transportation of hydrogen, existing European Union legislation includes hydrogen within the definition of alternative fuels and such legislation regulates the operation of public hydrogen refuelling points to ensure compliance with EU standards.

The role of hydrogen in road transport vehicles will be further explored in the upcoming update to Ireland's National Policy Framework for Alternative Fuels Infrastructure 2017-2030.

11. Are there any foreign investment restrictions related to energy and infrastructure sectors?

The **Screening of Third Country Transactions Act 2023** gives effect to EU legislation which establishes a framework for the screening of foreign direct investments into the European Union on grounds of security or public order. The Department of Enterprise, Trade and Employment indicated that the screening mechanism is expected to commence in September 2024. Further information is available here: **An Overview of the Proposed Foreign Investment Screening Regime in Ireland - Arthur Cox LLP**.

Economic activity in Ireland must also comply with EU sanctions law.

12. What international treaties are in place that may offer protection to international investors in hydrogen projects in the jurisdiction?

Ireland is a party to international treaties with investment provisions (including Co-Operation Agreements with various countries internationally). The United Nations Conference on Trade and Development lists a number of treaties with investment provisions that Ireland is a signatory to and which are in force.

Ireland is also a signatory to the Energy Charter Treaty, a multilateral investment treaty which entered into force in April 1998 and specifically addresses energy trade, transit and investment between its contracting parties.The European Commission proposed that the EU and its Member States withdraw from the Treaty and Ireland supports this approach.

Ireland currently has no bilateral investment treaties in force as the EU has competence in this area on behalf of Member States. In May 2023, Ireland and Germany agreed a **joint declaration** of intent to cooperate in green hydrogen, in recognition that Germany will wish to import hydrogen.

Market developments and opportunities

13. Are there any government grants or other government funding available to hydrogen projects (including for research and development)?

Gas Networks Ireland had a Gas Innovation Fund and is working with the CRU to secure further innovation funding.

Ireland is to receive **funding** under the EU Just Transition Fund, which may be used, among other things, to develop systems and infrastructure for clean energy. The European Investment Bank has also made EUR 3.4 billion available to help accelerate the shift towards renewable energy and sustainable transport and EUR 2 billion of this will be invested in a number of projects across Europe, including wind power in Ireland and building pioneering PV plant using batteries and hydrogen.

The **EU Clean Hydrogen Partnership** is funding a study to explore the role of hydrogen in decarbonising energy in Valentia Island, Co. Kerry (the H2ORIZON study).

14. Are there any notable pilot/demonstration projects in place or planned for the production or offtake of clean hydrogen?

Gas Networks Ireland indicates that it is active in European gas organisations assessing the readiness of existing gas networks to carry hydrogen and blends of natural gas and hydrogen, and that there is increasing confidence in the ability of the existing distribution networks to carry up to 100% hydrogen.

Gas Network Ireland indicates in the TYNDP that it has started to receive connection enquiries from prospective renewable hydrogen producers and is actively engaging with these producers. It states that has begun work packages to prepare the network to transport hydrogen, and the development of a hydrogen technical strategy, intended as a road map for the business to transition to hydrogen.

ESB has announced plans to invest in a hydrogen facility at its Moneypoint site. The development is to include a green hydrogen production, storage and generation facility. Further information is available here.

Gas Networks Ireland established a Network Innovation Centre in Dublin at which it is developing a hydrogen technical strategy and working with University College Dublin's Energy Institute. It has collaborative with academic institutions on several studies and initiatives. It is also a partner in the European Hydrogen Backbone.

15. Are there any commercial-scale clean hydrogen production projects in development or already operating?

Projects under development include the following:

- **Bord na Móna** secured planning permission for a 2MW hydrogen electrolysis plant on its existing windfarm site at Mount Lucas, Co. Offaly. The development will form part of Bord na Móna's first phase of its hydrogen development strategy, with construction to commence in 2024;
- **Constants Energy Limited** has planning permission for a green hydrogen production facility in Co. Mayo;
- **Mercury Renewables Limited** wishes to develop a €200 million hydrogen production plant and accompanying wind farm;
- EI-H2 announced plans to develop €120 million **green hydrogen facility** comprising a 50MW electrolysis plant at Aghada, Co. Cork;
- ESB and dCarbonX signed a **Memorandum of Understanding** for the joint assessment and development of Irish offshore green hydrogen subsurface storage;
- ESB signed a **Memorandum of Understanding** with the Shannon Airport Group to explore the development of a hydrogen lighthouse project in the environment surrounding the airport's site;
- the **Galway Hydrogen Hub** (GH2) consortium (NUI Galway, the Port of Galway, CIÉ Group and Bus Éireann, Aran Islands Ferries, Lasta Mara Teo and Aer Arann Islands) have plans for a Hydrogen Valley in Galway.

16. Have there been any hydrogen-related disputes in your jurisdiction?

There is no publicly available information on ongoing or previous disputes concerning hydrogen in Ireland.

Last updated April 2024

Italy

Policy and regulation

1. Is there a government hydrogen strategy or policy?

To date, Italy has not adopted a hydrogen strategy. However, the "**National Hydrogen Strategy Guidelines**" have been published, setting out the Italian Government's vision of the role of hydrogen in the context of the national decarbonisation pathway in accordance with the European Union's Hydrogen Strategy and the EU's broader environmental agenda.

Moreover, hydrogen is the subject of attention of both the national integrated energy and climate plan (**Piano Nazionale Integrato Energia e Clima** – hereinafter the "PNIEC") and the national recovery and resilience plan (**Piano Nazionale Ripresa e Resilienza** – hereinafter the "PNRR").

In order to meet the 2050 coal phase-out targets set by the European Green Deal, in December 2019 Italy adopted the PNIEC, which includes the goal of reducing emissions by 55% by 2040 and further increasing the use of energy production sources from renewable sources. To achieve the energy transition objectives, the PNIEC expressly promotes the production and use of hydrogen produced from renewable electricity, starting with research, development and demonstration activities.

In addition, the PNRR has allocated 3.64 billion Euro for the development of hydrogen with the presence of two reforms and six investment linesMoreover, on May 2022 the European Commission presented the REPowerEU plan, which reaffirms the importance of the hydrogen energy vector, setting a target of 10 million tonnes of renewable hydrogen produced domestically and 10 million tonnes of imported renewable hydrogen by 2030.

Of particular relevance is Regulation (EU) 2023/180410 ("Regulation of the European Parliament and of the Council on the implementation of alternative fuels infrastructure, repealing Directive 2014/94/EU of the European Parliament and of the Council" - AFIR), which provides, in art. 6, targets for the hydrogen refuelling infrastructure of road vehicles.

2. What are key goals and commitments included in the strategy/policy?

According to the Guidelines for the National Hydrogen Strategy, in line with the European Hydrogen Strategy released by the EU in July 2020, hydrogen is uniquely positioned to contribute to national environmental goals and safer, more reliable energy production, especially when produced from renewable energy sources through electrolysis.

In particular, hydrogen can play a dual role in Italy:

- in the long term, up to 2050, it can support the decarbonization effort along with other low-carbon technologies, especially in hard-to-abate sectors; and
- in the short term, up to 2030, hydrogen will become progressively competitive in selected applications, enabling the development of a national hydrogen ecosystem, which is necessary to fully exploit hydrogen's potential over the long term.

For the next decade, the Government envisions the application of hydrogen in the transportation sector, particularly heavy-duty, in railways, and in industry, with specific reference to those segments where hydrogen is already used as a feedstock. The blending of hydrogen into the gas grid can be used to anticipate and stimulate the growth of the hydrogen market.

Since clean hydrogen is a key part of the government's decarbonisation strategy, to kick-start the development of the hydrogen market, the government plans to install about 5 GW of electrolysis capacity by 2030.

3. Which industry sectors are most likely to be affected by hydrogen deployment?

According to the Guidelines for the National Hydrogen Strategy, the Government anticipates that the sectors most affected by hydrogen development will be:

- hard-to-abate sectors, such as energy-intensive manufacturing processes, steelmaking, or aviation;
- transport sector, in particular heavy duty (e.g. long-haul trucks) and railways;
- industrial sector, with specific reference to those segments where hydrogen is already used as a raw material, for example in the chemical sector and in oil refining.

4. Who are the main regulators for the hydrogen market?

The main Italian regulators for hydrogen market are:

- The Ministry for the environment and energy security or MASE (before "Ministry for the ecologic transition or Mite");
- The Ministry for the economic development;
- The Ministry for the infrastructure and transport (MiT);
- The Italian Energy Authority (ARERA);
- The GSE (the Authority in charge in case of public incentives).

5. Does the government hydrogen strategy or policy support the development of both low-carbon (blue) hydrogen and renewable (green) hydrogen?

To kick-start the development of the hydrogen market, the Government plans to install about 5 GW of electrolysis capacity by 2030 to meet part of the demand.

Therefore, the focus seems to be substantially on green hydrogen. However, the Guidelines for the National Hydrogen Strategy also clarifies that domestic production of green hydrogen could be supplemented with imports - where the country's location could be exploited as a hub for hydrogen trade - or with other forms of low carbon hydrogen, such as blue hydrogen.

The PNRR only mentions green hydrogen. This is something that is being debated and will reasonably be better understood in the near future based on the adoption of the National Hydrogen Strategy.

6. If the government hydrogen strategy or policy supports the development of low-carbon hydrogen, to what extent is carbon capture and storage being taken forward?

Given that the actual regulatory framework (mainly the Guidelines for the National Hydrogen Strategy and PNRR) focuses on green hydrogen, currently there is no specific strategy or policy supporting the development of low-carbon hydrogen (i.e. blue hydrogen).

7. Are there targets for the production of hydrogen?

The minimum target for the development of traditional gas transmission networks also for the transport of hydrogen is indicated by the MISE, which stipulate that by 2030 an average of up to 2% of distributed natural gas can be replaced by hydrogen.

To kick-start the development of the hydrogen market, the government plans to install around 5 GW of electrolysis capacity by 2030.

Please also note that the art. 23 of Law Decree no. 36 of 30 April 2021, as converted with amendments by Law no. 79 of 29 June 2022, establishes:

1. the consumption of electricity from renewable sources in plants of electrolysis for the production of green hydrogen, even if the production plant and the electrolysis plant are connected through a grid with compulsory connection of a third party, is not subject to the payment of general system charges system referred to in art. 3(11) of Legislative Decree no. 79 of 16 March 1999.
2. Within 60 days of the date of entry into force of the present decree, a decree of the Minister for the ecological transition ("MITE") shall identify the cases and the technical conditions details to the occurrence of which paragraph 1 (above) shall apply. With the same decree shall also establish the modalities by which the Regulatory Authority for ((energy, networks)) and the environment shall provide for to implement the provisions referred to in paragraph 1, without new or greater burdens on the public finance.
3. Hydrogen produced pursuant to paragraph 1 is not included among the energy products referred to in art. 21 of the Consolidated Text ((...)) of referred to in Legislative Decree no. 504 of 26 October 1995, and is not subject to excise duty pursuant to the same Consolidated Text if not directly used in heat engines as fuel

In implementation of the provisions of art. 23, paragraph 2 (quoted above) of Decree Law no. 36 of 30 April 2022, the MITE Decree of 21 September 2022 identifies the cases and technical conditions under which the consumption of electricity from renewable sources in electrolysis plants for the production of green hydrogen can access the benefits under art. 4 (i.e. the derogation from payment of the variable portion of the general charges relating to the electricity system referred). In particular, those entities, whether public or private, in relation to their annual consumption of electricity from renewable sources used for the production of green hydrogen, in accordance with the provisions of artt. 3 and 4 of the MITE Decree, are eligible for the benefits of this Decree.

8. Are there any incentive mechanisms/business models in place to support the production of hydrogen?

Currently there are no incentive mechanisms in place. The Guidelines for the National Hydrogen Strategy provides that in order to kick-start the low-carbon hydrogen economy in Italy and meet the hydrogen penetration demand target, up to €10 billion of investment will be required between 2020 and 2030 (to which investments for renewable deployment should be added).

This figure includes: (i) Investment needed for hydrogen production, €5-7 billion; (ii) Investment in hydrogen distribution and consumption facilities (hydrogen trains and trucks, refuelling stations, etc.), €2-3 billion; (iv) Investment in R&D, €1 billion; and (v) Some investment in infrastructure (such as gas networks) to properly integrate hydrogen production with end uses.

The PNRR approved by the Italian government has allocated 3.64 billion Euro for the following hydrogen aspects: (i) production of hydrogen in industrial areas no longer in use; (ii) use of hydrogen in hard-to abate sectors; (iii) experimentation of hydrogen in local transport; (iv) experimentation of hydrogen in rail transport; (v) R&D on hydrogen sector; (vi) simplification of the regulatory framework; (vii) promotion of the competitiveness of hydrogen.

In this respect, the PNRR provides for different kinds of investments:

i. **investment 3.1 "Production in brownfield sites" of 500 million Euro**, aimed at stimulate the establishment of renewable hydrogen production centres, whereby it is stipulated that "to increase demand, the possibility of hydrogen refuelling at truck or local public transport stations is envisaged";
ii. **investment 3.2 "Use of hydrogen in the hard-to-abate sector" of 2 billion Euro**, aimed at supporting the replacement of fossil fuels or grey hydrogen in the chemical and petroleum refining, steel, cement, glass and paper sectors;
iii. **investment 3.3 "Hydrogen Experimentation in Road Transport" of 230 million Euro**, with which it is planned to build 40 hydrogen filling stations on the motorway network "suitable for trucks and cars, also operating at pressures of over 700 bar";
iv. **investment 3.4 "Experimentation of hydrogen in rail transport" of 300 million Euro**, with the possibility of synergy with other types of mobility;
v. **investment 3.5 "Research and Development on Hydrogen Technologies" of 160 million Euro**, which provides for the development of technologies for the storage and transport of hydrogen and for its transformation into other derivatives and green fuels;
vi. **investment 4.4.1 "Renewal of the bus fleet for local public transport with clean-fuel vehicles" of 2.4 billion Euro**, with which resources are earmarked for the renewal of the bus fleet and the construction of refuelling and recharging infrastructures for zero-emission vehicles, such as hydrogen-powered electric vehicles.

We are therefore awaiting the issuing of the National Hydrogen Strategy and the concrete application of the lines of investment envisaged in the PNRR.

9. Are there any standards in place for the classification and/or certification of low-carbon or renewable hydrogen?

Also in relation to hydrogen, Legislative Decree no. 199 of 8 November 2021 provides for the issuance of Guarantees of Origin (GO) in application of, and in accordance with, CEN - EN 16325 standards. The sole purpose of the GO is to demonstrate to final customers the amount of energy from renewable sources in an energy supplier's energy mix as well as that supplied to consumers under renewable energy agreements.

In addition, please note that the Renewable Energy Directive III ("Amending Directive (EU) 2018/2001, Regulation (EU) 2018/1999 and Directive 98/70/EC as regards the promotion of energy from renewable sources and repealing Council Directive (EU) 2015/652" – RED III), which amended the previous RED II Directive (which has been implemented into Italian law by Legislative Decree 199/2021), introduced further innovations with regard to hydrogen production. In this respect, art. 19 of the RED III Directive establishes that Member States should grant that, at the request of a producer of energy from renewable sources, a guarantee of origin is issued. The innovation provided by such disposition concerns the fact that it is applied also for the production of energy from gaseous renewable fuels of non-biological origin, such as hydrogen.

Please note that, according to art. 15 of the above-mentioned Directive, Member States shall ensure that national rules on authorisation, certification and licensing procedures applicable to installations and their transmission and distribution networks for the production of electricity, heat or cooling from renewable energy sources, as well as to the process of transformation of biomass into biofuels, bioliquids, biomass fuels or other energy products, and to renewable fuels of non-biological origin, are proportionate and necessary and contribute to the implementation of the principle of prioritising energy efficiency.

Finally, it must be specified that, despite the fact that the above-mentioned Directive plays an important role at European level in hydrogen production, it has not yet been transposed into Italian law.

10. Does the regulatory framework clearly define the regulatory requirements relating to the production, storage, transportation or supply of hydrogen?

Legislative Decree no. 199 of 8 November 2021, among the other things, provides for the regulation and simplification for the construction and operation of electrolysers. In particular, in terms of procedural simplifications, it is provided that the construction of electrolysers with power less than or equal to the threshold of 10 MW does not require the issuance of a specific permit (free-building activities). For other types of electrolysers, a more structured authorization regime is envisaged, but in any case unified (single authorisation), again with a view to simplification.

Furthermore, art. 23 of Decree-Law no. 36 of 30 April 2022 provides that the consumption of electricity from renewable sources in electrolysis plants is not subject to the payment of system charges (i.e., those charges established by the Italian Electricity and Gas Authority – ARERA - to cover the costs relating to activities of general interest for the electricity or gas system paid by end customers).

It should be noted that art. 21 of Legislative Decree No. 505 of 26 October 1995 exempts green hydrogen from the application of excise duty since it is not included among energy products (provided that it is not used directly as fuel in heat engines).

Within Law Decree 13/2023, which implemented the PNRR and which amended different provisions of Legislative Decree 152/2006, green hydrogen production plants are defined as "integrated chemical plants for the production of green or renewable hydrogen, i.e. plants for the production on an industrial scale, by means of chemical transformation processes, of green or renewable hydrogen, in which several production units are functionally connected to each other" by art. 41. In addition, it has been set out that the competence for the environmental impact assessment (i.e, "EIA procedure") for projects related to the green and renewable hydrogen production belongs to the State.

It must be also highlighted that such projects are added to those the PNRR-PNIEC Technical Commission must give priority to, as part of its investigative activities in EIA procedures under state jurisdiction.

With further reference to the most recent legislation, art. 6 of Regulation (EU) 2023/1804 (i.e., "AFIR"), which is directly applicable within the Italian law, focuses on the objectives for hydrogen refuelling infrastructure for road vehicles. In this respect, the most important provisions could be summarised as follows:

i. Member States must ensure that, by 31 December 2030, a minimum number of publicly accessible hydrogen refuelling stations are installed on their territory;
ii. Member States shall ensure that, by 31 December 2030, publicly accessible hydrogen refuelling stations are installed along the TENT core network ("Trans-European Transport Network", i.e. a set of linear (rail, road and river) and point infrastructures (urban nodes, ports, and airports) considered relevant at EU level) at a maximum distance of 200 km between them, designed for a minimum cumulative capacity of 1 ton/day and with at least one 700 bar dispenser;
iii. Member States shall ensure that, by 31 December 2030, at least one publicly accessible hydrogen refuelling station is installed at each urban node;
iv. in order to meet growing market needs, Member States have to establish, in their national strategic frameworks, a clear linear trajectory towards the achievement of the 2030 targets that ensures sufficient coverage of the core TEN-T network.

It should be finally noted that also the above-mentioned RED III Directive has been adopted with the aim of providing binding targets for the strengthening of renewable energy production and transport in the European economy, also with respect to green hydrogen. In this regard, the Directive provides that European industry will have to gradually increase its use of renewable energy by 1.6 per cent per year. Moreover, by 2030, 42% of the hydrogen consumed by the sector will have to come from renewable fuels of non-organic origin, rising to 60% by 2035. While, with reference to the transport sector, the RED III Directive establishes that it will be able to achieve several targets by the end of the decade, including a 14.5 per cent reduction in total greenhouse gas emissions.

Based on the analysis provided so far, despite the legislation on the hydrogen production is in ongoing state of development, the Italian regulatory framework can still be defined as immature and fragmented, thus it is reasonable to expect in the short term further regulations aimed at defining in a more detailed manner, also from a technical point of view, the production, storage, transportation and supply of hydrogen.

11. Are there any foreign investment restrictions related to energy and infrastructure sectors?

Yes, such restrictions are provided under the Golden Power regulation, which refers to the special power of the Italian government to limit or stop (i) foreign direct investments and (ii) corporate transactions involving Italian strategic assets.

The Golden Powers provisions specify that the Italian Government shall review transactions concerning Italian public and private companies which, inter alia, hold "assets having strategic relevance" in the energy, transport and communication sector.

This would require notifying the Italian Government of the details of the transaction. The Government may, within 45 business days of such notification (unless this term is extended should further information be required), determine if it considers the assets as being strategic and accordingly exercise certain special powers which may result in imposition of sector specific conditions or, in extreme cases, in the veto to the transaction, if it determines that such steps are necessary for the protection of the essential interests of the State, or the protection of security and public order.

12. What international treaties are in place that may offer protection to international investors in hydrogen projects in the jurisdiction?

The United Nations Conference on Trade and Development (UNCTAD) website reports a total of 102 Bilateral Investment Treaties (hereinafter the "BITs") that Italy has entered into, many of which are in force and those in force are with non-EU countries. In addition certain other treaties may contain protections for investors in Italy (a full list can be **accessed at the site**).

European investors can instead rely on future investment protection on domestic law and domestic courts of the EU member states, as well as EU law and potentially the European Court of Justice in order to enforce their rights. Italy has terminated all of its BITs with other EU member states several years ago. Moreover, the European Commission has stated that intra-EU BITs are incompatible with European law since all Member States are subject to the same rules on cross-border investments, such as freedom of establishment and of capital, thus implying that any rights conferred by intra-EU BITs on a bilateral basis to investors of some Member States constitute nationality-based discrimination.

A mention needs to be made to the Energy Charter Treaty (hereinafter the "ECT"), entered into force in April 1998 and specifically addressing energy trade, transit and investment between its contracting parties, which included Italy. Italy withdrew from the ECT with effect as of 1st January 2016. Asunset clause provided in the same ECT extends the validity of the ECT for 20 years after the effective withdrawal date (i.e. until 1st January 2036) but only for investments made prior to the withdrawal date. The ECT cannot be invoked to seek protection of investments made in Italy in the energy sector after the withdrawal date.

Market developments and opportunities

13. Are there any government grants or other government funding available to hydrogen projects (including for research and development)?

The PNRR foresees funds dedicated to hydrogen of over €3 billion, with investment lines linked to the use of hydrogen in the hard-to-abate, road and rail sectors, as well as for the creation of hydrogen valleys (i.e. industrial areas with an economy based fundamentally on hydrogen).

The Minister of Ecological Transition (Ministero della Transizione Ecologica - MITE), on 23 December 2021, issued a Ministerial Decree in order to implement the investment in research and development on hydrogen, provided within the PNRR, with the allocation of €110 million. The investment aims to support research and development activities focused on hydrogen in the following areas:

production of clean and green hydrogen;

- innovative technologies for storage and transport of hydrogen and its transformation into derivatives and e-fuels;
- fuel cells for stationary and mobility applications; and
- integrated intelligent management systems to increase the resilience and reliability of intelligent hydrogen infrastructures.
- Further actions related to the use of resources provided by the PNRR in the hydrogen sector are expected in the coming months.

Further resources can be granted by the Innovation Fund and the National Operational Plan (Programma Operativo Nazionale - PON) 2021-2027, and then allocated at local level by involving the relevant regional bodies. Finally, resources from the Important Projects of Common European Interest (Importanti progetti di Comune Interesse Europeo - IPCEI) could also be used to support the large-scale industrial development of green hydrogen projects.

The Italian government has also identified a number of funds for the period of 2020 - 2021. The funds available are the Sustainable Development Fund (Fondo Crescita Sostenibile - FCS), the Law-Decree of 14 August 2020, no. 104, and Mission Innovation, composed of funds for research and funds for enterprises.

Between 2022 and 2033, additional funds will be available: National Electricity System Research (Ricerca di Sistema Elettronico Nazionale), CleanTech Fund, and Development and Cohesion Fund (Fondo per lo Sviluppo e la Coesione - FCS). Like the European funds, part of the national resources could be invested in green hydrogen projects.

14. Are there any notable pilot/demonstration projects in place or planned for the production or offtake of clean hydrogen?

i. For the next few years, the goal in Italy is to develop the application of hydrogen in transport, railways and industry sectors, especially in the light of the resources made available by the PNRR. In this respect, several proposals have been made: the PNRR provides an investment of 3.64 billion Euro for the construction of hubs for the production of green hydrogen in industry and transport, but also for the redevelopment of derelict industrial areas. These are the so-called **Hydrogen Valleys**, of which 54 projects across the Country are currently being financed. Such Hydrogen Valleys will not only represent production centres, but real hubs from which an hydrogen market can develop, with the ultimate goal of decarbonising carbon-intensive sectors and contributing to the Country's economic independence. In this regard, an example within

the Italian territory is Valle Camonica, where the "**H2iseO" plan** of the Italian Companies Ferrovie Nord and Trenord, in collaboration with Snam and A2A, will soon start, which will intervene on 100 kilometres of the current diesel-fuelled railway line by starting the first green hydrogen trains;

ii. the MiT provided an investment of 103.5 million Euro for the construction of stations for both road and rail transport. In this respect, to the 2 already existing stations, built in the Provinces of Bolzano and Mestre, is added the aim of realizing 36 new stations by 2026. As for the companies involved, the approved projects have been presented by – among others – Eni, Italgas and Snam 4 Mobility;

iii. within the investments provided by the PNRR, the development of flagship projects for the use of hydrogen in industrial sectors is envisaged.

A number of small-scale pilot projects are also planned in other sectors, e.g. biological methanation or secondary steelmaking sites and in the electrolyser sector.

It appears that Enel and Eni are working together on two pilot projects to supply green hydrogen to refineries identified by the oil group, a joint note announced.

It should finally be noted that, according to the public consultation documentation initiated by the MASE on the draft of the Ministerial Decree on the production of hydrogen, Italy is developing a national auction system to allocate incentives for increasing renewable hydrogen production.

In this respect, the MASE envisages that incentives will be allocated over the period 2024-2027 through competitive auction procedures, carried out within specific quotas. In addition, the incentives, which will last for 10 years, will be paid out as follows:

i. a maximum value of 5 Euro per Kg of hydrogen for production from electrolysis plants of less than 10 MW capacity;

ii. a maximum value of 4 Euro per Kg of hydrogen for production from electrolysis plants with a capacity of 10 MW or more;

iii. a maximum value of 3 Euro per Kg in case of biohydrogen.

The GSE will publish notices of the procedures, with at least one procedure per six-month period.

As it is mentioned in the draft of the Ministerial Decree, *"the quotas will also have to take into account the possibility of participation also for hydrogen production plants located on the territory of other Member States of the European Union and other third countries bordering Italy, with which the European Union has entered into a free trade agreement, that physically export their hydrogen production to Italy"*.

15. Are there any commercial-scale clean hydrogen production projects in development or already operating?

In Italy, according to ENTSOG association (European Network of Transmission System Operators for Gas), five projects concern integrated systems for the production, transport and use of hydrogen, while four concern the final use of the vector. Such projects include:

- the **European Blue Dolphin project** involving the company Fincantieri, which envisages the construction of up to 50 hydrogen-powered vessels;
- the **DIVINA project** with which the companies Snam, RINA and Bormioli aim to introduce hydrogen into the glass industry cycle;
- the **H2iseO project** for a railway hydrogen valley in Valcamonica, the hydrogen road refuelling plant in Bolzano, realised by IIT and Autostrada del Brennero;
- the **Silver Frog project**, promoted by the companies Hydrogenics, Meyer Burger, EcoSolifer, SolarPower Europe, European Energy and aimed at installing 10 GW of electrolysis capacity to produce green hydrogen from solar energy in northern Italy and distribute it through special pipelines to the chemical industry;
- a project (already completed) by Snam, which used a **10% mixture of methane and hydrogen to power a pasta factory in Contursi**;
- Snam, RINA and GIVA Group's project to use hydrogen in the steel forging process;
- SGI's (Società Gasdotti Italia) **Pegasus project** for the production of 100% renewable natural gas from green hydrogen generated by electrolysis; and
- The **Prometeo project**, an initiative coordinated by ENEA (National Agency for New Technologies and Sustainable Economic Development) involving several Italian companies (Snam, Fondazione Bruno Kessler, Maire Techimont, NextChem), which aims to bring the cost of green hydrogen down to less than €2 per kg by combining different production technologies; and
- EP Produzione S.p.A. is going to realize an hydrogen valley in Sassari(SS) – locality Porto Torres. In this regard, EP Produzione S.p.A. started the authorisation procedure. The goal is to install a new plant for H2 production by means of electrolysis of 5 MW.

As of today, more projects have been started. These include:

- **The green hydrogen valley,** which envisages the construction of three green hydrogen production plants in the Municipalities of Brindisi, Taranto and Cerignola (Apulia Region) - for a total electrolysis capacity of 220 MW powered by around 400 MW of photovoltaic solar energy - and of the relevant pipelines that will connect the hydrogen generation sites to possible users.
- **The HyMed**, proposed in 2022 as the world's largest floating offshore wind and green hydrogen production project. This project, built by Aquaterra Energy and Seawind Ocean Technology, is expected to be operational by 2027.
- **NatPower H** promoted an initiative – to be realized by the year 2024 - for the construction of the first worldwide plant for the refuelling of green hydrogen in favour of recreational boats (imbarcazioni da diporto). In this respect, the green hydrogen, produced by wind and solar energy, as well as by other renewable energy infrastructures, will be converted into a stable and natural resource to meet the growing demand for sustainable energy sources. With the decision C(2022) 5158 of 15 July 2022, the European Commission has authorised State aid from fifteen countries, including Italy, to support the implementation of the first major project of common European interest on technologies for the creation of a European hydrogen value chain, the so called "IPCEI Hy2Tech" (also IPCEI H2 Technology or IPCEI Hydrogen 1). The aid authorised at EU level amounts to a total of 5.4 billion Euro and can be granted by the Member States to companies participating in the realisation of the IPCEI H2 Technology.

16. Have there been any hydrogen-related disputes in your jurisdiction?

Within the Italian jurisdiction, first related hydrogen disputes started to arise when the calls for incentives have been published.

In this respect, it is important to highlight that, within the hydrogen framework, we have no evidence of disputes of a general character that could prevent or hinder access to incentives related to hydrogen production.

Thus, we have only evidence of isolated cases where the rejection of the request for access to incentives has been depended on specific circumstances, to be evaluated on a case-by-case basis.

Last updated May 2024

Japan

Policy and regulation

1. Is there a government hydrogen strategy or policy?

Japan's hydrogen strategy is contained in a number of separate pieces of legislation and policy documents:

- The Green Growth Strategy Through Achieving Carbon Neutrality in 2050 (published December 2020) (Green Growth Strategy);
- The Act Concerning the Promotion of a Smooth Transition to a Decarbonised Economic Structure (enacted 30 June 2023) (GX Promotion Act); and
- The Basic Hydrogen Strategy (published December 2017 and revised on 6 June 2023).

2. What are the key goals and commitments included in the strategy/policy?

The Green Growth Strategy and Basic Hydrogen Strategy set specific goals for hydrogen production and usage by 2030, 2040 and 2050.

The Japanese government aims to achieve a hydrogen supply cost level of 30 ¥/Nm3 in 2030 (approximately one third of the current hydrogen sales price) and 20 ¥/Nm3 in 2050. Additionally, the Japanese government is aiming for a national Japanese hydrogen market size of 3 million tons by 2030 (including domestic production and imports), 12 million tons by 2040 and 20 million tons by 2050.

Power Generation - The Green Growth Strategy sets a target of 10% of power generation by hydrogen and ammonia. Power generation as a source of hydrogen demand is estimated at five to ten million tons of hydrogen per annum by 2050 (amounting to 15-30 GW of power generation capacity). Between the years 2025 to 2030, the Japanese government aims to expand hydrogen/ammonia consumption for co-firing power generation and to promote single-fired hydrogen/ammonia power generation.

Fuel Cell Vehicles – A specific target for hydrogen use by commercial vehicles has not been set, however it is anticipated to amount to a demand of 6 million tons per annum by 2050.

Industrial Hydrogen Use – A target of "zero carbon steel" by 2050 has been set and this is anticipated to increase domestic demand for hydrogen in the steel industry to approximately 7 million tons per annum by 2050.

3. Which industry sectors are most likely to be affected by hydrogen deployment?

The Basic Hydrogen Strategy anticipates that hydrogen will play a role in the following sectors:

- Power generation;
- Fuel cell (FC) vehicles (FCVs):
  - FC buses;
  - FC forklifts;
  - FC trucks; and
  - FC ships.
- Industrial applications:
  - Steelmaking; and
  - Oil refining.

4. Who are the main regulators for the hydrogen market?

Ministry of Economy, Trade and Industry (**METI**) – Responsible for the establishment and general enforcement of the GX Promotion Act. METI has significant influence on decision making in relation to investment schemes and financing under the GX Promotion Act and its implementation;

Ministry of Environment – Responsible for setting GX-related regulations concerning environment-related matters and its enforcement;

Ministry of Land, Infrastructure and Transport and Tourism – Responsible for setting GX-related regulations concerning matters such as transportation, houses and buildings, infrastructure and low carbon concrete and its enforcement;

Ministry of Internal Affairs and Communications – Responsible for the development and maintenance of infrastructure and facilities such as hydrogen stands;

Ministry of Finance – Responsible for the issue of the GX Transition Bonds;

Agency for Natural Resources and Energy (**ANRE**)- ANRE is an agency of METI and is responsible for the implementation of practical matters concerning the enforcement of the GX Promotion Act, such as the organisation of auctions;

New Energy and Industrial Technology Development Organization (**NEDO**) – Responsible for the promotion of technological developments concerning hydrogen;

Organization for Cross-regional Coordination of Transmission Operators, Japan (**OCCTO**) – Responsible for the maintenance of a stable and efficient supply of electricity from a neutral and impartial position; and

Prefectures – Responsible for the establishment and enforcement of local ordinances and rules concerning the hydrogen market.

5. Does the government hydrogen strategy or policy support the development of both low-carbon (blue) hydrogen and renewable (green) hydrogen?

The Japanese Government classifies hydrogen and ammonia production by carbon intensity rather than colour codes (i.e. green or blue). As such, the key threshold for 'low-carbon hydrogen' in the Green Growth Strategy is defined as 3.4kg of CO2 emissions per kilogram of hydrogen on a well-to-gate basis, and the threshold for 'low-carbon ammonia' is defined as 0.84kg of CO2 emissions per kilogram of ammonia on a gate-to-gate basis.

The Green Growth Strategy contemplates both the production of hydrogen through the processing of fossil fuel (e.g. steam methane reforming) combined with carbon capture utilization and storage (CCUS) (commonly referred to as "blue hydrogen"), as well as the production of hydrogen through renewable energy generation plus electrolysers (commonly referred to as "green hydrogen").

The Japanese government foresees a continued role for blue hydrogen which is intended to form part of the production target for 2030 (described in question 2). However, the Green Growth Strategy is silent on the subject of blue hydrogen in relation to the 2050 hydrogen production targets.

6. If the government's hydrogen strategy or policy supports the development of low-carbon hydrogen, to what extent is carbon capture and storage being taken forward?

The Japanese government views the use of both carbon capture utilisation (CCU) and storage (CCUS) technologies as essential to its broader Green Growth Strategy. Japan has been promoting the development and use of CCU and CCUS both domestically and internationally.

The Japanese government aims to support the development and introduction of CCUS through the enactment of a specific law for launching new CCUS projects by 2030 and to secure 6 million to 12 million tons of annual carbon dioxide storage by 2030.

In 2019 METI successfully concluded the Tomakomai project in Tomakomai City, Hokkaido, Japan. The Tomakomai project involved the construction and testing of CCUS facilities which ultimately culminated in the successful injection of 300,000 tons of CO2 underground.

In June 2021 Japan established the Asia CCUS Network, an international industry-academia-government platform for knowledge sharing and improvement of the business environment for the utilization of CCUS throughout the Asian region.

7. Are there targets for the production of hydrogen?

The Japanese government is aiming for a national Japanese hydrogen market size (demand side) of 3 million tons by 2030, 12 million tons by 2040 and 20 million tons by 2050. In terms of cost, the Japanese government is targeting to achieve a hydrogen supply cost level of 30 ¥/Nm3 by 2030 (approximately one third of the current hydrogen sales price) and 20 ¥/Nm3 by 2050.

8. Are there any incentive mechanisms/business models in place to support the production of hydrogen?

Funding Support

(i) GX Transition Bonds

The GX Promotion Act includes policy tools intended to encourage companies to make investments for decarbonisation by providing long-term support to projects in green transformation areas which are not yet financially viable as stand-alone projects. One of the key areas targeted by the GX Promotion Act in this regard is the promotion of the use of hydrogen and ammonia through the provision of long-term government subsidies.

In order to plug the current financial viability "gap" that is often a feature in projects utilising new technologies, the GX Promotion Act contemplates the issuance of "bonds for the transition to a decarbonised economic structure" (GX Transition Bonds) which are targeted to raise approximately ¥ 20 trillion. The funds raised through the GX Transition Bonds will in turn be made available to fund eligible projects. Eligible projects are those that satisfy the following:

Principal Conditions, an eligible project must be:

(a) presently un-investable due to uncertainty stemming from the use of innovative technologies;

(b) likely to promote national energy security, reduce emissions and increase industrial competitiveness and economic growth;

(c) targeted at changing corporate investment and demand-side behaviour; and

(d) directly result in increased capital and human resource investments in the Japanese domestic economy.

Note: Overseas projects that do not reduce Japanese domestic emissions are not eligible,

Eligible projects also have to satisfy at least one of the requirements under the Industrial Competitiveness section and Emissions Reduction section:

Industrial Competitiveness, an eligible project must:

(a) include investment in technological innovation which is expected to increase international export demand or domestic demand;

(b) contribute to both (i) the reduction in the use of fossil fuels; and (ii) improve profitability through the use of advanced technologies; or

(c) include measures to address the current lack of domestic demand due to the early stage development of the product (including supply side investment).

Emissions Reduction, an eligible project must :

(a) invest in research and development that will contribute to domestic reduction in emissions;

(b) provide capital to an investment that will directly reduce domestic emissions; or

(c) include measures to address the current lack of domestic demand due to the early stage of the product produced by the project, but which is expected to have nationwide demand in the future and will reduce emissions in the long-term.

The exact details of the process of award, value and term of the subsidy(ies) are still under preparation. However, at the time of writing this guide we understand several possible avenues are being considered for the deployment of the GX Transition Bond funds. This includes an auction by METI (implemented by ANRE and OCCTO) targeted for January 2024 called the "Long-Term Decarbonized Energy Auction Plan" which will make funds available to projects seeking to modify existing thermal power plants in order to convert such plants to ammonia co-fired plants.

(ii) Green Innovation Fund

As part of the Green Growth Strategy, METI has established a ¥2 trillion "Green Innovation Fund" falling under the administration of NEDO to provide continuous support for R&D projects, demonstrations and the social implementation of selected projects for a period of 10 years.

The Green Innovation Fund will focus on priority fields for which implementation plans have been formulated within the Green Growth Strategy. Selected projects will have the following characteristics:

- Average size of R&D projects (¥20 billion or more);
- Projects for which existing short-term government support programs are sufficient will not be eligible;
- The project implementers should be companies or other profit-making businesses capable of carrying out the entire process of implementing the project; and
- The project must include innovative and fundamental R&D elements that are worthy of being commissioned by the government.

NEDO has identified 18 focus areas for the Green Development Fund, of which, three are directly related to hydrogen, namely:

- Large-scale hydrogen supply chain construction;
- Hydrogen production by water electrolysis using electricity derived from renewable energy and other sources; and
- Hydrogen use in steelmaking.

Tax Support

The Green Growth Strategy views tax support as one the key policy levers for achieving the 2030 and 2050 targets. The following tax support mechanisms are of particular relevance:

- Establishment of the Investment Promotion Tax System Toward Carbon Neutrality: A tax credit of 10% or a special depreciation rate of 50% will be provided for certain qualifying projects.
- Expansion of the R&D tax system: The R&D investment deduction of 25% will be raised to 30% of the total amount of corporate tax payable for certain qualifying companies.

(iii) ANRE Hydrogen Supply Chain & Cluster Subsidy

In January 2023, the Japanese government through ANRE expressed its intention in the 'Interim Summary of the Joint Meeting of the Hydrogen Policy Subcommittee and the Ammonia and Decarbonized Fuels Policy Subcommittee" to implement an approach to support the establishment of a self-sustaining market for hydrogen and ammonia by (a) establishing large-scale and robust hydrogen and ammonia supply chains; and (b) developing efficient supply infrastructure that contributes to the creation of demand. The outline of the specific support measures are provided in the interim summary of the Joint Meeting of the Hydrogen Policy Subcommittee and the Ammonia and Decarbonised Fuels Policy Subcommittee held on January 4, 2023. The discussion on these supporting approaches is currently ongoing and has not materialised yet.

9. Are there any standards in place for the classification and/or certification of low-carbon or renewable hydrogen?

At the local level, Aichi Prefecture introduced its own "low-carbon hydrogen certificate" scheme for hydrogen that satisfies a certain criteria. However, this is not tradeable as it is not a national scheme.

Apart from this regional approach, the J-Credit Scheme is available, under which the government certifies the amount of greenhouse gas emissions (such as CO2) reduced or removed by carbon sinks through efforts to introduce energy-saving devices and manage forests, as "credit. The utilization of hydrogen has recently been added to the list of applicable uses under the J-Credit Scheme.

10. Does the regulatory framework clearly define the regulatory requirements relating to the production, storage, transportation or supply of hydrogen?

There are no laws or regulations specific to hydrogen in Japan at the time of writing this guide. Hydrogen is regulated as a "high pressure gas" under the High Pressure Gas Safety Act, which plays a primary role in regulating the production, storage, transportation and supply of hydrogen. Various other regulations also apply to each aspect of the hydrogen value chain, of which major ones are set out below. This is an evolving area under constant review and discussion for further legislative changes, which requires a close attention. Moreover, for some regulations, the applicable criteria differs depending on the municipality and thus the relevant local criteria would need to be confirmed.

Value Chain	Main Regulations	Major Applicable Regulations
Installation of production facilities and storage facilities	Permission for notification of production and storage, etc.	• High Pressure Gas Safety Act • Cabinet Order Concerning the Control of Hazardous Materials
	Requirements for ventilation, removal of dust etc., to prevent explosions	• Industrial Safety and Health Act and related ordinance • Noise Regulation Act and Vibration Regulation Act
	Requirements for spacing and distance etc., of equipment in facilities	Act on the Prevention of Disaster in Petroleum Industrial Complexes and Other Petroleum Facilities
	Area limits on hydrogen stations	• Building Standards Act • Port and Harbour Act
	Permission etc., for construction of port facilities involving hydrogen use	Port and Harbour Act
Marine transport	Requirements and permission etc., on loading methods and containers of liquefied hydrogen, etc.	• Ship Safety Act and related regulations • Port Regulations Act and related regulations

Value Chain	Main Regulations	Major Applicable Regulations
Production	Notification and periodic measurement of soot, smoke and NOx	Regulation for Enforcement of the Air Pollution Control Act
Storage by tank	Technical requirements on temperatures and location of containers	• Regulation on Safety of General High Pressure Gas • Regulation for Enforcement of the Warehousing Service Act
Supply	Transport by land: restrictions on passage of vehicles in long or underwater tunnels	Road Act
	Transport by pipelines: appointment of chief gas engineers and requirements regarding pipeline location, etc.	• Regulation for Enforcement of the Air Gas Business Act • Regulation on Safety of General High Pressure Gas • Regulations on Safety of Industrial Complexes • Seacoast Act, River Act and Road Act
	Transport by hydrogen stations: requirements regarding location and structure of equipment	• Regulation on Safety of General High Pressure Gas • Regulation Concerning the Control of Hazardous Materials

11. Are there any foreign investment restrictions related to energy and infrastructure sectors?

The Foreign Exchange and Foreign Trade Act (the Act) and the Cabinet Order on Inward Direct Investment restrict inward direct investment in various categories of business from the perspective of security and the smooth operation of Japan's economy, including energy and infrastructure sectors that deal with electric power (including electricity generation), gas and heat supply.

Under the Act, any inward direct investment by foreign investors in the restricted sectors are subject to the pre-notification to the government via the Bank of Japan and such investment will be subject to the inward direct investment review.

Such regulated inward direct investment includes the acquisition of 1% or more of the shares in a listed company in Japan or acquisition of any share in a non-listed company in Japan. However, foreign investors may be exempted from pre-notification requirements if certain conditions are met. For example, if the foreign investor or its closely-related party (i) does not serve as a director or a statutory auditor of the listed company, (ii) does not have an access to non-public technical information pertaining to any designated sector, and (iii) does not, whether directly or through other shareholders, make any proposal at any shareholders' meeting with respect to the transfer or disposition of any business belonging to a designated sector, then such foreign investor is exempted from the requirement to make pre-notifications.

Even in case where foreign investors are exempted from the pre-notification requirement, if the number of shares acquired by the foreign investors exceeds certain thresholds, then such foreign investors must submit a post-facto notification to the government. Different thresholds for a post-facto notification apply depending on whether the foreign investor is a financial institution or not.

12. What international treaties are in place that may offer protection to international investors in hydrogen projects in the jurisdiction?

The United Nations Conference on Trade and Development (**UNCTAD**) website states that Japan is a signatory to 36 bilateral investment treaties (BITs) that are signed or in force as at 9 August 2023, and certain other treaties with Investment Provisions (TIPs) and Investment Related Instruments (IRIs) which may also contain protections for investors in Japan. These can be accessed via UNCTAD's **Investment Policy Hub**.

Bilateral and regional free trade agreements (**FTAs**) may contain protections for investors in Japan. A chart that illustrates the FTAs, to which Japan is party, can be accessed **here** (in Japanese).

Japan is a signatory to the Energy Charter Treaty (**ECT**), a multilateral investment treaty which specifically address energy trade, transit and investment between its contracting parties. Therefore, international investors in hydrogen projects in Japan may seek protections under the ECT.

Market developments and opportunities

13. Are there any government grants or other government funding available to hydrogen projects (including for research and development)?

See answer to question 8.

14. Are there any notable pilot/demonstration projects in place or being planned for the production or offtake of clean hydrogen?

Japan has already commissioned several notable pilot/demonstration projects in the hydrogen sector:

- **Hokkaido Green Hydrogen Plant (2024)** – A joint venture between Hokkaido Electric Power, Green Power Investment, Nippon Steel Engineering and Air Water aims to produce 550 tons of green hydrogen per annum and is expected to commence operations in 2024.
- **Takasago Hydrogen Park (2022)** – Mitsubishi Power plans to develop the Takasago Hydrogen Park to be used to validate hydrogen-related technologies such as the development and testing of hydrogen gas turbines using hydrogen as a sole source of fuel.
- **Suiso Frontier (2022)** – Kawasaki Heavy Industries constructed the world's first liquified hydrogen carrier which delivered its first shipment of liquified hydrogen from Victoria, Australia to Kobe, Japan on 25 February 2022.
- **JERA Hydrogen Utilization Demonstration Project (2021)** – JERA will trial the practical use of hydrogen at one of its existing LNG thermal power plants. The Project will switch a portion of the LNG fuel used to generate electricity at JERA's large-scale LNG thermal power plant in Japan to hydrogen and evaluate the resulting operational and environmental characteristics over a period of approximately 5 years from October 2021 to March 2026.
- **Fukushima Hydrogen Energy Research Field (FH2R) (2020)** – This project was constructed in Namie town, Fukushima Prefecture and includes a renewable energy-powered 10MW-class hydrogen production unit. FH2R can produce up to 1200 Nm3 of hydrogen per hour using renewable energy.

15. Are there any commercial-scale clean hydrogen production projects in development or already operating?

The Fukushima Hydrogen Energy Research Field (described above) makes use of renewable energy for its hydrogen production, adjusting production in accordance with renewable energy availability. FH2R uses 20MW of solar power generation facilities alongside grid power to run a 10MW-class hydrogen production unit. It has the capacity to produce, store, and supply up to 1,200 Nm^3 of hydrogen per hour (rated power operation).

Last updated October 2023

Kenya

Ashurst collaborated with **Anjarwalla & Khanna** in the preparation of this content. We are grateful for their input.

Policy and regulation

1. Is there a government hydrogen strategy or policy?

Yes, the government of Kenya, launched its Green Hydrogen Strategy and Roadmap (the Strategy), during the Africa Climate Summit 2023. The full copy of the Strategy can be accessed here.

2. What are key goals and commitments included in the strategy/policy?

Green Hydrogen is stated to be a key part of Kenya's decarbonization strategy to help the country meet its obligations set out in the development blueprints, Vision 2030, the Bottom-Up Economic Transformation Agenda, the sustainable development goal (SDGs) and other climate change agreements such as the Paris Agreement and Africa Agenda 2063.

The Strategy aims to harness Kenya's renewable energy sources to enhance agricultural production, industrialisation and decarbonization.

The following are some of the priority action plans for the operationalisation and implementation of the Strategy:

- Establish a high-level "green hydrogen program coordination committee";
- Establish a green hydrogen secretariat to operate as a "one-stop-shop";
- Organize National Green Hydrogen roundtables on finance and green fertilizer;
- Develop a monitoring and evaluation plan;
- Develop a green hydrogen strategy and roadmap resource mobilization plan;
- Include dedicated provisions on green hydrogen in the national energy policy;
- Support/fast-track catalytic projects that demonstrate commercial viability, including implementation of KenGen's Olkaria green hydrogen demonstration project;
- Develop a green hydrogen stakeholder engagement and communication plan;
- Establish local and international partnerships to scale up training and capacity building; and
- Expand regional and international cooperation and partnerships on green hydrogen.

3. Which industry sectors are most likely to be affected by hydrogen deployment?

The sectors most likely to be affected by the development of hydrogen are:

- The power sector with hydrogen potentially replacing fossil fuels, or reducing their usage;
- Manufacturing i.e., with hydrogen being used for the production of fertilizers, ammonia, methanol, and green steel;
- Transport through decarbonising road transport, shipping, and aviation; and
- Agriculture through the production of green fertilizer/ammonia.

The government has committed to enhancing Kenya's climate action by adopting innovative, clean, and sustainable energy technologies including the use of hydrogen.

4. Who are the main regulators for the hydrogen market?

The hydrogen market in Kenya is nascent and laws and regulations addressing the regulation of the hydrogen value chain are yet to be enacted. However, based on the existing laws, the following are the key regulatory bodies that are likely to play a role in the regulation of the hydrogen market in Kenya:

- The Energy and Petroleum Regulatory Authority (**EPRA**), oversees the energy and petroleum sector in Kenya and is responsible for the regulation of the production, conversion, distribution, supply, marketing, and use of renewable energy. In the hydrogen sector, EPRA would be responsible for the development of the regulatory framework, licencing of the various sector players, and ensuring the safe and sustainable development, production, and utilisation of hydrogen and its derivatives;

- The Kenya Bureau of Standards (KEBS) is a key government regulatory body responsible for setting standards, metrology, and conformity assessment in Kenya. It is anticipated that KEBS will play a crucial role in establishing quality standards, ensuring safety, and promoting conformity assessment processes for the production, storage, handling, and distribution of hydrogen and the hydrogen derivatives in Kenya;
- The National Environmental Management Authority (NEMA) is a government agency established to exercise general supervision and coordination over all matters relating to the environment and to be the principal instrument of the Government in the implementation of all policies relating to the environment. NEMA regulates the transportation of hazardous substances (including hydrogen or ammonia) with the aim of mitigating any potential environmental risks and promoting sustainable practices in the transportation of hazardous substances;
- The Water Resources Authority (WRA) is responsible for the formulation and enforcement of standards, procedures and regulations for the management and use of water resources in Kenya. In the hydrogen market, WRA's role would include overseeing the use of the available water resources needed in the electrolysis process for the production of hydrogen; and
- The Fertilizer and Animal Foodstuff Board of Kenya (FAFB), to the extent of application of hydrogen towards fertiliser production. FAFB is responsible for the regulation of the production, manufacture, packaging, importation, and marketing of fertilizers.

5. Does the government hydrogen strategy or policy support the development of both low-carbon (blue) hydrogen and renewable (green) hydrogen?

The Strategy mainly supports green hydrogen but makes a lot of reference to the transition to a low-carbon future and the use of low-carbon products.

Further, the Joint Declaration on Renewable Clean Hydrogen signed in March 2023 between the Government of Kenya and the European Investment Bank (EIB) (the Joint Declaration) not only supports the investment in renewable clean hydrogen but will improve the country's understanding of how best to identify, structure, unlock and implement green hydrogen investment.[2]

6. If the government hydrogen strategy or policy supports the development of low-carbon hydrogen, to what extent is carbon capture and storage being taken forward?

The Strategy touches on the need to de-carbonize the road and transport sector for the realization of a low carbon future but does not expressly mention DAC and CCUS.

Whilst the CCUS technology is still in the early stages of development in Kenya, the Climate Change (Amendment) Act No. 9 of 2023 includes provisions that allow for the creation of guidelines on removal or sequestration credits that take carbon dioxide out of the atmosphere and either use or store it via afforestation, reforestation and nature-based solutions or technology removal. The Climate Change (Amendment) Act No. 9 of 2023 provides for technologies in the whitelist that can deliver mitigation outcomes that can contribute to the Nationally Determined Contributions and carbon capture is one such technology in the whitelist.

7. Are there targets for the production of hydrogen?

Yes, Kenya targets as follows:

- In the short term (2023-2027) – domestic market development: Develop policy and regulatory instruments, have the first commercial-scale green hydrogen projects(s) operational, and establish cooperations with international RTD[3]4 centres;
- In the medium term (2028-2032) – domestic market growth by 2030: 50% import substitution of nitrogen fertilisers (300,000 – 400,000 tonnes/year), pilot projects in other sectors including baseload power and transport, production of green shipping fuels, and explore regional export opportunities for green fertilisers;
- In the long term (2032 and beyond) – domestic and export market growth: roll out further green hydrogen applications, like transport and green steel, and expand existing and explore new export opportunities for green hydrogen products "Made in Kenya".

8. Are there any incentive mechanisms/business models in place to support the production of hydrogen?

EPRA published Kenya's Guidelines on Green Hydrogen and its Derivatives (the **Guidelines**) on 7 May 2024. The Guidelines came into effect on 1 May 2024 and aim to promote compliance with the relevant local and international standards, regulations and other best industry practices in the production, storage and handling of green hydrogen and its derivatives.

2 **Kenya: EIB and Kenya strengthen green hydrogen cooperation**, 1 March 2023.
3 This term has not been defined in the Strategy. We assume that it refers to Research and Technology for Development.

The Guidelines also highlight several general incentives in place that can be utilized by developers of green hydrogen projects. The Ministry of Energy and Petroleum has established the Kenya Green Hydrogen Secretariat (the **Secretariat**) to serve as a one-stop-shop for information, guidance and support relating to green hydrogen investments in Kenya.

In addition to the support that the Secretariat would offer in the development of green hydrogen projects, an investor/developer of green hydrogen projects can benefit from the incentives under the export processing zones (EPZ) and special economic zones (SEZ) frameworks in Kenya. Some of the incentives under the EPZ and SEZ framework include: a 10-year tax holiday, exemptions on duty and value-added tax, 100% investment deduction allowance over 20 years, access to special electricity tariffs, and no exchange control as Kenya has a liberalised foreign exchange regime.

Further, the Ministry of National Treasury & Economic Planning is developing the National Green Fiscal Incentives Policy which seeks to identify and prioritize the implementation of a coherent suite of green fiscal reforms that will allow the country to exploit the opportunities of continuing a low-emission development path while enhancing climate resilience and environmental sustainability.

9. Are there any standards in place for the classification and/or certification of low-carbon or renewable hydrogen?

There are no existing standards in place for the classification and/or certification of low carbon or renewable hydrogen.

However, the Central Bank of Kenya has recently released a draft Kenya Green Finance Taxonomy (the KGFT). The KGFT is intended to be a classification system or catalogue that defines a minimum set of activities that are eligible to be defined as "green" in line with international best practices and national priorities and provide a basis for regulators to align or reference green financial products.

The KGFT is currently in draft form and undergoing stakeholder engagement.

10. Does the regulatory framework clearly define the regulatory requirements relating to the production, storage, transportation, or supply of hydrogen?

The Guidelines sets out the regulatory requirements for the production, storage, transportation, and supply of green hydrogen. With respect to production, investors/developers of hydrogen projects are required to submit an expression of interest (EoI) accompanied by a pre-feasibility study report to the Ministry of Energy and Petroleum for evaluation and approval. Upon approval of the EoI, an investor will conduct a feasibility study in respect of the project. Once the feasibility study is approved, an investor/developer would be required to obtain the requisite project licences and permits.

The Guidelines stipulate that the installation and operation of green hydrogen infrastructure shall adhere to safety standards and regulations governing the production, storage, and transportation of toxic and highly inflammable products. Additionally, storage facilities should be well-ventilated, equipped with leak detectors, and clearly marked with warnings such as "Extremely Flammable and Pressurized Gas". Prior to commercial operations of the green hydrogen facility, the developer is to provide proof of conformity to applicable KEBS standards and/or international certificate of green hydrogen.

The transportation of green hydrogen may be by pipeline, rail, road tankers, ships or any other method approved by EPRA. Depending on the form of transport, investors would also need to obtain additional licences/certifications from the National Transport and Safety Authority (NTSA) (in the case of road transport) and (in the case of marine transportation), the transporter is required to provide proof of membership of the Oil Spill Mutual Aid Group (OSMAG).

11. Are there any foreign investment restrictions related to energy and infrastructure sectors?

There are no foreign investment restrictions related to the energy and infrastructure sector that we are currently aware of. However, there is a proposal before Parliament to amend the Investment Promotion Act CAP 485 of the Laws of Kenya, to make it a mandatory requirement for foreign investors to apply for an investment certificate and ensure compliance with the Investment Promotion Act.[4] This proposed amendment to the law is still at the early stage of discussion in Parliament.

12. What international treaties are in place that may offer protection to international investors in hydrogen projects in the jurisdiction?

The United Nations Conference on Trade and Development (UNCTAD) website states that Kenya is a signatory to 21 bilateral investment treaties (BITs) that are in force, and in addition, outlines certain other treaties that may contain protections for investors in Kenya. These can be accessed from the Kenya Treaties online database maintained by UNCTAD's Investment Policy Hub.

4 https://www.businessdailyafrica.com/bd/economy/mps-want-foreigners-to-get-permits-before-investing--4560268

Market developments and opportunities

13. Are there any government grants or other government funding available to hydrogen projects (including for research and development)?

We are not aware of any government funds set aside specifically for green Hydrogen. However, the Strategy recognises that blended financing and innovative financial instruments will play a crucial role in spurring green hydrogen investments in Kenya.

It further mentions the following facilities that have been set up globally to support the development of the green hydrogen sector: Hydrogen Bank facility, EU-EDFI facility and The European Fund for Sustainable Development Plus (EFSD+) guarantee facility.

The government of Kenya on Tuesday 05 September 2023, signed an understanding with the European Union (EU), that will see the EU provide nearly Sh1.9 billion (€12 million) in grants for investment in Kenya's green hydrogen industry.[5]

14. Are there any notable pilot/demonstration projects in place or planned for the production or offtake of clean hydrogen?

While there are currently no government-initiated pilot/demonstration projects in place or planned for the production or offtake of clean hydrogen, through the Joint Declaration, the Government of Kenya plans to develop projects that will develop green hydrogen as part of the Kenya Energy Roadmap 2040.[6]

We are also aware of certain start-ups seeking to deploy various hydrogen projects as well as DAC/CCUS projects in Kenya.

In respect of Direct Air Capture (DAC) projects, Project Hummingbird, a partnership between Cella Mineral Storage and Octavia Carbon, has announced a carbon capture project in Kenya.[7] Octavia Carbon has also announced the deployment of machines designed to directly capture atmospheric carbon dioxide from the atmosphere using DAC technology.[8]

Climeworks and Great Carbon Valley are also exploring the development of large scale DAC + S projects in Kenya.[9]

According to the Green Hydrogen Organisation, below are some notable proposed green hydrogen projects in Kenya [10]:

- a proposed development by Fortescue of a green ammonia and fertiliser facility using the Olkaria geothermal resource in Naivasha;
- a proposed KenGen Green Hydrogen Ammonia to Green Fertilizer project; and
- a proposed hydrogen power plant by Renewstable Kenya/HDF Energy.

TalusAg has partnered with Kenya Nut Company to install a commercial modular green ammonia system to enable the production of fertilizer.[11]

15. Are there any commercial-scale clean hydrogen production projects in development or already operating?

There are currently no commercial-scale clean hydrogen production projects operating in Kenya. However, Maire Tecnimont S.p.A., an Italian group of 50 companies, through its subsidiaries MET Development, Stamicarbon and NextChem announced in 2021, their interest in a commercial scale renewable power–to-fertilizer (nitrate fertilizer) plant in Kenya.

Furthermore, Fortescue Future Industry (**FFI**) has recently entered into arrangements with the government of Kenya for the proposed development of green energy and green ammonia projects in Kenya.[12]

As noted above, we are also aware of several other projects being developed by private sector sponsors in areas such as green ammonia, fertilizer, and carbon removal/CCUS.

16. Have there been any hydrogen-related disputes in your jurisdiction?

We are not aware of any reported hydrogen-related disputes in Kenya as of April 2024.

Last updated July 2024

5 **https://nation.africa/kenya/health/kenya-signs-sh1-9bn-green-hydrogen-pact-with-the-eu-4359542.**
6 **Kenya: EIB and Kenya strengthen green hydrogen cooperation.** 1 March 2023.
7 https://carbonherald.com/octavia-carbon-cella-mineral-storage-pilot-direct-air-capture-plant-kenya/
8 https://climateinsider.com/2024/01/10/octavia-carbon-kenyan-climate-tech-startup-secures-funding-for-carbon-capture-technology/
9 https://climeworks.com/press-release/climeworks-and-great-carbon-valley-chart-path-to-large-scale-dac
10 https://gh2.org/countries/kenya#:~:text=Project%20Spotlight&text=Renewstable%C2%AE%20Kenya%20%E2%80%93%20HDF%20Energy,the%20project%20is%20%24500%20million
11 https://energynews.biz/kenya-nut-and-talus-renewables-to-manufacture-sustainable-fertilizer-with-hydrogen/#google_vignette
12 Fortescue.Com https://fortescue.com/news-and-media/news/2023/07/10/kenya-and-ffi-take-major-step-forward-on-green-energy-and-green-ammonia projects 15 March 2023.

Malaysia

Ashurst collaborated with **ZICO Law** in the preparation of this content. We are grateful for their input.

Policy and regulation

1. Is there a government hydrogen strategy or policy?

Malaysia is a federation and has Federal laws and policies which apply throughout the country, and State laws and policies which only apply to individual states.

On the Federal government level, the Government of Malaysia ("**the Government**") launched the Malaysia National Energy Policy (2022-2040) ("**NEP**") in September 2022 to outline action plans for the development of a national hydrogen economy. The National Energy Transition Roadmap ("**NETR**") was also announced in August 2023 to expedite Malaysia's transition to a more sustainable energy landscape.In October 2023, the Government launched the Hydrogen Economy and Technology Roadmap ("**HETR**"), setting out the pathway for the development of a hydrogen economy in Malaysia.

At the State government level, the Sarawak Government through its Economic Planning Unit presented Sarawak's Hydrogen Economy Framework ("**Sarawak Hydrogen Framework**") in 2021, charting the development of the Sarawak hydrogen economy from around 2020 to 2030 and beyond.

2. What are key goals and commitments included in the strategy/policy?

The HETR recognises the need to develop infrastructure for the adoption of hydrogen to support the decarbonisation of Malaysia's industrial and electricity sectors. It is the stated aim of Malaysia to be a leading hydrogen economy country by 2050 through accelerated technological advancement leading to the development of a robust and competitive ecosystem across the hydrogen value chain.

Among others, the HETR also lays down the following goals:

Hydrogen to be the cornerstone for a new energy economy in Malaysia;

Malaysia to achieve a sustainable energy mix through the diversification of energy types or sources, including cleaner energy;

Malaysia to invest in hydrogen technologies to address domestic consumption, the stability and security of energy and to sustain efforts in international energy trading and the decarbonisation of emissions.

Meanwhile, under the Sarawak Hydrogen Framework, Sarawak's main goal is to enable the widespread use and commercialization of hydrogen and fuel cell technologies through the adoption of the following five Strategic Pillars:

a) Producing hydrogen via renewable energy sources at a competitive cost;
b) Optimising the transportation cost for hydrogen for domestic use and the export market;
c) Commercialising green hydrogen in potential markets both in the region and beyond;
d) Upscaling the usage of green hydrogen and hydrogen fuel cells in the transportation sector and other industries; and
e) Increasing research & development efforts relating to the green hydrogen economy.

3. Which industry sectors are most likely to be affected by hydrogen deployment?

Presently, most of Malaysia's hydrogen supply is used in the production process of heavy industries such as oil refining and the manufacturing of methanol, ammonia, iron, and steel. Grey hydrogen is the main type of hydrogen currently used in such processes13. The deployment of blue / green hydrogen for the purpose of being used as a resource has the potential to decarbonise these production processes.

The NETR focuses on delivering hydrogen to the transportation sector, with special reference to aviation, heavy and light vehicles, rail, buses and shipping. The HETR also aims to develop infrastructure for the adoption of hydrogen to support the decarbonisation of Malaysia's industrial and electricity sectors

4. Who are the main regulators for the hydrogen market?

There are currently no specific regulators for the hydrogen market in Malaysia, and no new regulator is created by HETR. As of now, the hydrogen market and relevant policies are being shaped through the collaborative efforts of separate ministries of the Government.

13 "Hydrogen as an attractive new energy source/carrier", MIDA e-Newsletter (July 2021)

5. Does the government hydrogen strategy or policy support the development of both low-carbon (blue) hydrogen and renewable (green) hydrogen?

Yes.

The existing mix of policies and frameworks discussed above prioritise the development of blue and green hydrogen. This is demonstrated as follows –

- The NEP states that the adoption of **green** hydrogen will be a key technology focus area for Malaysia. It also states that Malaysia has the potential to be an export hub for **green** hydrogen in the long-term and sets out the Government's intention to position Sarawak as a **green** hydrogen production hub.
- The NETR outlines the reshaping of Malaysia's energy landscape with **blue hydrogen** serving as a crucial stepping stone towards a fully green hydrogen economy.
- MyRER refers to plans for developing new storage technologies for **green** hydrogen in the longer-term.
- The HETR will enable Malaysia to tap into the global **green** hydrogen market[14]. The long-term strategic approach outlined in HETR is to facilitate the transition to **green** hydrogen use by focusing on new technologies and increasing the targeted conversion efficiency of hydrogen-related technologies across the hydrogen value chain. **Blue** hydrogen can serve as a supplement, given the limitation of green hydrogen due to finite renewable energy resources[15].
- The Sarawak Hydrogen Framework concerns the development of **green** hydrogen as Sarawak aims to be the front-runner for the **green** hydrogen economy in Southeast Asia by 2030.

6. If the government hydrogen strategy or policy supports the development of low-carbon hydrogen, to what extent is carbon capture and storage being taken forward?

The NETR underscores the importance of carbon capture and storage ("**CCS**") and carbon capture, utilisation, and storage ("**CCUS**") in helping Malaysia achieve its net-zero emissions goals. The use of captured CO2 is seen as a catalyst for the emergence of new industries, contributing to Malaysia's sustainable growth and climate resilience.

A policy and regulatory framework for CCS or CCUS has not yet been developed but the Government has already announced in 2022 various tax incentives for companies engaged in in-house CCS activities, as well as those using CCS services.

The NETR sets forth specific targets related to CCS/CCUS[16]:

The development of three CCU hubs, with two located in Peninsular Malaysia and one in Sarawak with a total storage capacity of up to 15 Mtpa by 2030

The development of three CCU hubs with a total storage capacity ranging from 40 to 80 Mtpa by 2050 Additionally, the NETR outlines several key initiatives for CCS/CCUS, which are[17]:

a) The development of CCUS specific policies and regulations;
b) Strengthening CCUS adoption through provisions of incentives across various sectors;
c) Facilitating CCUS hub infrastructure development;
d) Establishing transboundary CO2 agreements; and
e) Promoting CO2 utilization in industries

It is also a stated Action Plan of the HETR that the Government would study the economic feasibility of developing a blue hydrogen production plant with CCS/CCUS facilities, with the target being to develop clean industrial clusters that use low-carbon sources including hydrogen, complete with CCS/CCUS facilities[18].

The development of the Kasawari and Lang Lebah high-CO2 gas fields for CCS in collaboration with the Sarawak Government is one the ten flagship catalyst projects outlined in the NETR. These projects are expected to become operational by 2026 and 2028, respectively. The CCS technology will capture CO2 emissions from gas production fields and store them in depleted fields[19].

At the state level, Sarawak has taken preliminary legislative steps to support the growth of CCS in the state. On 18 May 2022 the Sarawak State Legislative Assembly unanimously passed the Land Code (Amendment) Bill 2022 which, once officially in force, will empower the Sarawak Government to regulate and control the use of land for the storage, retention, capture and sequestration of carbon dioxide and other greenhouse gases[20]. Such regulation and control would entail requiring industries operating in the state to comply with international requirements on reducing carbon emissions.

14 **Fadillah: M'sia set to become regional renewable energy industry leader with launch of Hydrogen Economy and Technology Roadmap – Malaysian Green Technology And Climate Change Corporation (mgtc.gov.my)**
15 **Hydrogen Economy & Technology Roadmap | Malaysian Science and Technology Information Centre (mosti.gov.my),** page 5
16 **NETR**, page 50.
17 **NETR**, page 51.
18 **HETR**, page 132.
19 **NETR**, page 55.
20 **Ling, "Sarawak first state to legislate carbon storage regulation, says deputy minister", The Star (18 May 2022)**

7. Are there targets for the production of hydrogen?

Yes.

The NETR prioritises the development of blue and green hydrogen and it proposes the following key targets[21]:

a) Blue Hydrogen: To completely phase out the use of grey hydrogen as a feedstock by 2050
b) Green Hydrogen: To produce up to 2.5 Mtpa of green hydrogen by 2050 from RE such as hydroelectric power and solar
c) Low-carbon Hydrogen Hubs: To establish one low-carbon hydrogen hub by 2030, and an additional two hubs by 2050, bringing the total to three hubs.

More detailed targets are set forth in the HETR, covering the five strategic thrusts of –

a) strengthening the governance system, institutional frameworks and regulatory mechanisms[22];
b) facilitating an enabling environment and economic instruments[23];
c) accelerating the commercialisation of technology to enable export and domestic uptake[24];
d) developing capacity and enhancing capability[25]
e) improving communication, education and public awareness[26]

8. Are there any incentive mechanisms/business models in place to support the production of hydrogen?

Yes.

The NETR provides key initiatives on financing and investment which are designed to support various aspects of the energy transition, including hydrogen production. The relevant key initiatives are as follows[27]:

a) Establishment of a National Energy Transition Facility ("**NETF**")
   - Launch an initial seed fund with a value of RM2 billion;
   - Explore the use of a catalytic blended finance platform, aimed at accelerating the mobilization and allocation of capital. This platform is intended to make funds more accessible, simplify the investment process, and ensure a smooth flow of financial resources towards energy transition projects;

b) Mobilization and attraction of private capital for energy transition
   - Attract private capital from sources such as green foreign direct investments (FDI), international and domestic capital markets, venture capital (VC), and private equity (PE)
   - Speed up the adoption of innovative sustainable finance instruments
   - Develop a capacity-building programme to enhance the skills of financial institutions (FI) and fund managers, in collaboration with Joint Committee on Climate Change (JC3) and financial industry training institutes
   - Scale-up sustainable finance literacy, awareness programmes and technical capacity building targeting small and medium-sized enterprises (SMEs) by JC3 including through pilot programmes such as Greening the Value Chain
   - Expedite venture capital investments in high-risk, early-stage energy ventures in suitable areas

c) Implementation of a carbon pricing mechanism

Implement a phased and meticulously calibrated carbon pricing mechanism that provides clear market signals on decarbonisation while simultaneously creating an additional capital pool for investments in energy transition

Implement a communication strategy to gain support from businesses and the public for this carbon pricing approach

9. Are there any standards in place for the classification and/or certification of low-carbon or renewable hydrogen?

No.

There are currently no specific standards in place for the classification and/or certification of blue and green hydrogen.

21 **NETR**, page 37.
22 **HETR**, page 122.
23 **HETR**, page 130.
24 **HETR**, page 138.
25 **HETR**, page 147.
26 **HETR**, page 150.
27 **NETR**, page 59.

10. Does the regulatory framework clearly define the regulatory requirements relating to the production, storage, transportation or supply of hydrogen?

Malaysia does not yet have a regulatory framework which specifically concerns hydrogen. However, under the NEP and the NETR, the Government commits to developing regulations to ensure safe, secure and equitable roll-out of hydrogen production, transport and end-use applications[28].

It is also recognized in the NETR that there is a deficiency in policy support, defined standards and regulations governing hydrogen from a policy and regulatory standpoint. It has been noted that determining the suitable primary legislation to govern hydrogen could involve a division of responsibilities between the existing Gas Supply Act 1993 and the Renewable Energy Act 2011[29].

In addition, the following regulations currently in place may be relevant for the production, storage, transportation, or supply of hydrogen before any hydrogen-specific regulations are rolled-out in the future[30]:

The Environmental Quality Act 1974, in particular, Section 22 (which sets out restrictions on pollution of the atmosphere), the Environmental Quality (Clean Air) Regulations 2014 and the Environmental Quality (Control of Solid Waste Transfer Stations and Landfill) Regulations 2009 set out environmental regulations that businesses and industries must comply with.

The National Land Code, Industrial Co-ordination Act 1957 and Occupational Safety and Health Act 1994 may be applicable in governing the storage and production of hydrogen in facilities situated in industrial zones or in approved standalone areas.

The Technical Code for Hydrogen Storage and Safety with Fuel Cell as Power Generator for ICT Infrastructure developed pursuant to the Communications and Multimedia Act 1998 specifies requirements for the handling, labelling and storage of hydrogen by ICT industries utilising hydrogen-powered fuel cells as a power supply.

11. Are there any foreign investment restrictions related to energy and infrastructure sectors?

The Government allows foreign investors to hold up to 49% equity ownership in Malaysian incorporated companies that own power generating facilities utilising either renewable energy or non-renewable energy[31].

For the oil and gas industry, upstream activities require a licence from PETRONAS, and depending on the specific type of activity, the foreign equity limit falls between 30% and 100%[32].

12. What international treaties are in place that may offer protection to international investors in hydrogen projects in the jurisdiction?

Malaysia is a signatory to 54 bilateral investment treaties (BITs) and 24 treaties with investment provisions (TIPs) in force that may offer protection to international investors in Malaysia.

Furthermore, Malaysia is currently a party to Investment Guarantee Agreements ("**IGAs**") with 64 countries which are in force. A table of the countries that are parties to these IGAs can be found here. Additionally, Malaysia recently ratified the Comprehensive and Progressive Agreement for Trans-Pacific Partnership ("CPTPP") on 30 September 2022 to bolster foreign investments. CPTPP is a free-trade agreement between 11 countries around the Pacific Rim which are Canada, Mexico, Peru, Chile, New Zealand, Australia, Brunei, Singapore, Malaysia, Vietnam and Japan[33].

IGAs and CPTPP will protect against nationalization and expropriation, ensure prompt and adequate compensation in the event of nationalization or expropriation, provide free transfer of profits, capital and other fees and ensure settlement of investment disputes under the Convention on the Settlement of Investment Disputes of which Malaysia has been a member since 1966.

Market developments and opportunities

13. Are there any government grants or other government funding available to hydrogen projects (including for research and development)?

One of the NETR's key initiatives in relation to hydrogen is to develop domestic green electrolyser manufacturing capabilities.

This entails funding research and development ("**R&D**") projects related to electrolysers in local universities. These efforts are aimed at lowering manufacturing expenses and offering financial incentives to encourage private-sector involvement in electrolyser R&D activities[34].

28 **NEP** page 64.
29 **NETR**, page 38..
30 **Abdullah, "The Use of Hydrogen in the Energy System in Malaysia and the Relevant Laws and Regulations" (10 January 2023)**
31 **"Renewable energy regulations in Malaysia", Asia Business Law Journal (15 December 2021)**
32 **Looi et. al, "Doing Business in Malaysia: Overview", Practical Law (1 September 2021)**
33 **Malaysia's Ratification of CPTPP to Help Increase Trade (2 November 2022)**
34 See footnote no.9.

Hydrogen projects in Malaysia in the past has also seen the Government providing financial support. The Malaysian hydrogen energy R&D community, which mainly constitutes local universities such as UKM, UTM, UM, UITM and UNITEN, have to date garnered research funding of over RM 40 million from the Ministry of Science, Technology and Innovation and Ministry of Higher Education[35].

14. Are there any notable pilot/demonstration projects in place or planned for the production or offtake of clean hydrogen?

Yes. They are as follows:

Southeast Asia's first integrated pilot hydrogen production plant and refuelling station in Kuching, Sarawak. This pilot project was officially launched by the Sarawak Government on 27 May 2019. Construction and operation of the pilot project was undertaken by Sarawak Energy in collaboration with Linde EOX Sdn. Bhd., a subsidiary of Linde Malaysia. The production plant produces green hydrogen through electrolysis and is able to produce 130kg of hydrogen per day at a purity of 99.999%. The station is capable of fully refuelling up to 5 fuel cell buses and 10 fuel cell cars per day[36].

Pilot project to use vehicles powered by hydrogen in Sarawak's public transport system. Sarawak introduced Southeast Asia's first hydrogen-powered buses in Kuching in 2019 under a pilot project closely tied to the pilot project above31. Currently, the Sarawak Economic Development Corp ("SEDC") is importing more hydrogen fuel cell buses for the provision of free transport in the city[37]. Malaysia's first hydrogen-powered smart tram, known in Sarawak as the Autonomous Rapid Transit (ART), has been shipped into Sarawak in August 2023. The prototype will be undergoing a two-month engineering run and stages of exercises before it comes into operation.[38]

15. Are there any commercial-scale clean hydrogen production projects in development or already operating?

Yes. Some commercial-scale clean hydrogen production projects include the following:

a) On 26 January 2022, Samsung Engineering Co., Lotte Chemical Corp. and POSCO signed a MoU with SEDC to develop green hydrogen and ammonia at a plant to be built in Bintulu, Sarawak. Under this Sarawak H2biscus Project, a plant with the annual capacity to produce 7,000mt of green hydrogen will be built[39].

b) On 11 March 2022, PETRONAS Hydrogen Sdn Bhd and ENEOS signed a Joint Feasibility Study Agreement ("JFSA") to advance the studies for a commercial hydrogen production and conversion project in Kerteh, Terengganu. Under the JFSA, both parties will pursue detailed technical and commercial feasibility studies for the production of low carbon hydrogen from PETRONAS's existing facilities and production of green hydrogen from a new hydro-powered electrolyser facility, amongst other things[40].

c) On 24 May 2022, Hydrogène de France signed a MoU with PESTECH International Berhad to collaborate on green hydrogen production from hydropower plants in Cambodia and Malaysia[41].

d) On 21 July 2022, PETRONAS Technology Ventures Sdn Bhd entered into a Supply Arrangement on Hydrogen Production Technology with SEDC Energy Sdn Bhd. The Supply Arrangement focuses on expanding the application of green hydrogen technologies in Sarawak. The parties will also explore opportunities for the design and development of a "Hydrogen City" in Sarawak[42].

As part of the NETR's flagship catalyst projects three integrated projects to produce green hydrogen are planned to establish Sarawak as a regional green hydrogen hub. These projects include the development of a green hydrogen plant in Kuching by 2025 for domestic use and two plants in Bintulu by 2027, primarily for export purposes. Sarawak State Government through SEDC Energy is collaborating with strategic partners to develop Sarawak into a green hydrogen hub.

16. Have there been any hydrogen-related disputes in your jurisdiction?

There have to date been no hydrogen related disputes in Malaysia

Last updated April 2024

35 **Position Paper on Hydrogen Economy by Academy of Sciences Malaysia**, page 44.
36 **Sarawak Energy Media Release on 27 May 2019**
37 **"Sarawak gets into hydrogen-powered fuel cell electric vehicles", MIDA e-newsletter (1 August 2022)**
38 **ART: World's first hydrogen-powered smart tram begins journey to Sarawak (VIDEO) | Malay Mail**
39 **Kang, "Samsung, Lotte, POSCO to build hydrogen plant in Malaysia", The Korea Economic Daily (26 January 2022)**
40 **"PETRONAS partners ENEOS for first commercial scale hydrogen-to-MCH project", PETRONAS (11 March 2022)**
41 **"HDF Energy Inks Mou with PESTECH...", Hydrogen Central (6 June 2022)**
42 **"PETRONAS, SEDC Energy collaborate to spur adoption of hydrogen, renewable oil in Sarawak", PETRONAS (21 July 2022)**

Morocco

Ashurst collaborated with **Mokhtari Avocats** in the preparation of this content. We are grateful for their input.

Policy and regulation

1. Is there a government hydrogen strategy or policy?

The Ministry of Energy, Mines and Environment published a Green Hydrogen Roadmap in January 2021 and, on 21 August 2021, the current Ministry of Energy Transition and Sustainable Development published the National Green Hydrogen Strategy.

As part of the development of Morocco's green hydrogen sector, Circular No. 03/2024, issued by the Head of Government on March 11, 2024, marks the launch of the Morocco Offer for the development of the green hydrogen industry (the '**Circular**'). This initiative, the fruit of collaboration between The Moroccan Agency for Investment and Export Development (Agence Marocaine de Développement des Investissements et des Exportations - AMDIE) and the Moroccan Agency for Sustainable Energy (Agence Marocaine pour l'Energie Durable - MASEN), aims to encourage investment in projects integrating the entire green hydrogen value chain, for the domestic market or for export.

2. What are key goals and commitments included in the strategy/policy?

Through the hydrogen roadmap and strategy, Morocco aims to initiate a regional dynamic market by creating an economic and industrial sector focused on green molecules, particularly hydrogen, ammonia and methanol. This will consolidate Morocco's energy transition by reducing greenhouse gas emissions and supporting the decarbonisation of partner countries.

Green hydrogen will be implemented gradually in order to optimise the full potential for both the national economy and for export.

2020 – 2030: In the short term, Morocco will focus on two areas to develop the industry:

- The first is local use as a raw material in industry, particularly for the production of green ammonia in the fertiliser industry.
- The second is the export of green hydrogen products to countries committed to ambitious decarbonisation targets.

During this period, the costs of green hydrogen products would remain higher than those of conventional products. The development of the hydrogen industry would be based on various pilot and development projects supported by public authorities and subsidised funding from national and international financial institutions.

2030 – 2040: In the medium term, other specific favourable conditions, such as the reduction of the costs of green hydrogen products and the implementation of environmental regulations, will allow the development of the first economically viable projects, particularly for green ammonia and hydrogen, at national and international level.

Similar applies to exports of synthetic liquid fuels, namely paraffin, diesel and gasoline. As regions that import green hydrogen derivatives, such as Europe, adopt encouraging environmental regulations, Morocco will be presented with the opportunity to progressively develop this sector.

The local use of green hydrogen products in the electricity sector as a carrier for energy storage and in transport as a fuel could support the expansion of the hydrogen industry in Morocco. Pilot projects for these sectors could be launched in the short to medium term to test the technological applications and readapt them to the Moroccan context, with a view to optimising their long-term deployment.

In the energy sector, green hydrogen can be used as a vector for energy storage to reduce grid congestion and improve the flexibility of the national electricity system.

2040 – 2050: For this period and beyond, as the business cases for ammonia, hydrogen and green synthetic fuels for export improve, the development of green hydrogen technologies and industry will accelerate both globally and in Morocco.

This expansion will further evolve through the local use of green hydrogen in industry, for heat production, in the residential sector, for urban mobility, and for air transport. Nevertheless, the demand in these sectors, particularly in the residential sector, for green hydrogen or synthetic methane is likely to be small due to high investment requirements for the development of major distribution infrastructure.

In the transport field, the long-term development opportunities are mainly in heavy land transport and aviation. Some demand may emerge in the transport sector, likely associated with green hydrogen used for freight, mining and public transport in pilot projects.

3. Which industry sectors are most likely to be affected by hydrogen deployment?

The industry sectors that will be affected through the hydrogen deployment include:

- electricity sector;
- shipping and aviation sector;
- fertiliser industry; and
- heating in the residential sector.

4. Who are the main regulators for the hydrogen market?

The main regulator /authority for the hydrogen market in Morocco is the Ministry of Energy Transition and Sustainable Development.

There are other institutions/actors, such as (i) the Moroccan Agency for Energy Efficiency (*Agence Marocaine pour l'Efficacité Energétique*), whose mission is to contribute to the implementation of government policy on renewable energy and energy efficiency, (ii) the National Authority for the Electricity Regulation (Autorité Nationale de Régulation de l'Electricité), which is responsible for regulating the electricity sector, including, among others, proposing draft laws to the government in the electricity sector and (iii) the Moroccan Agency for Sustainable Energy (*Agence Marocaine pour l'Energie Durable – MASEN*), which is the leading renewable energy group in Morocco and a central actor dedicated to the valorisation of renewable sources.

5. Does the government hydrogen strategy or policy support the development of both low-carbon (blue) hydrogen and renewable (green) hydrogen?

No, the National Green Hydrogen Strategy, the Green Hydrogen Roadmap, and the Circular does not support low-carbon (blue) hydrogen.

6. If the government hydrogen strategy or policy supports the development of low-carbon hydrogen, to what extent is carbon capture and storage being taken forward?

N/A – We know however that CCS solutions are being studied by certain energy developers and might be proposed to the government.

7. Are there targets for the production of hydrogen?

There are no official figures for the production of hydrogen. However, the Green Hydrogen Roadmap envisages that Morocco will have:

a local market of 4 TWh and an export market of 10 TWh in 2030;

a local market of 22 TWh and an export market of 45.9 TWh in 2040; and

a local market of 39.2 TWh and an export market of 114.7 TWh in 2050.

In addition, two studies presented in 2020 by three German Fraunhofer research institutes (IMWS, IGB and ISI) revealed that, thanks to its privileged geographical location and its exceptional potential in wind and solar energy, Morocco could capture a significant share of the demand for green hydrogen, estimated at between 2 and 4% of world demand in 2030.

8. Are there any incentive mechanisms/business models in place to support the production of hydrogen?

A new framework law 03-22 forming an investment charter (the "**Investment Charter**") came into force with the recent publication of its implementing decrees. This new investment charter introduces various investment support measures, in particular certain incentives granted by the State for renewable energy projects up to a maximum amount of 30 million MAD.

The Circular does not provide specific investment incentives for the hydrogen sector, as Morocco already has a well-defined incentive framework, namely the Investment Charter. Projects aligned with Morocco's offer can therefore benefit from the incentives provided in this Investment Charter, in accordance with current legislation and regulations.

However, the Circular specifies tax and customs incentives. It proposes exemptions from import duties and value-added tax for goods purchased or imported domestically. Additionally, it envisions the establishment of industrial acceleration zones to strengthen the green hydrogen industrial ecosystem. These zones will offer tax and customs benefits to projects aiming to locally integrate the green hydrogen value chain, both horizontally (equipment required for green hydrogen production) and vertically (industries utilizing hydrogen and its derivatives).

9. Are there any standards in place for the classification and/or certification of low-carbon or renewable hydrogen?

Currently, there is no hydrogen certification system adapted to the Moroccan context. However, a study is underway by the German International Cooperation Agency for Development (GIZ), which has been commissioned by the Minister of Energy Transition and Sustainable Development of Morocco, to establish a certification system for green hydrogen produced in Morocco.

10. Does the regulatory framework clearly define the regulatory requirements relating to the production, storage, transportation or supply of hydrogen?

There are no regulatory framework relating to the production, storage, transportation or supply of hydrogen so far.

11. Are there any foreign investment restrictions related to energy and infrastructure sectors?

To the best of our knowledge, there are no exceptions to the foreign exchange office rules for investors in the energy and infrastructure sector.

12. What international treaties are in place that may offer protection to international investors in hydrogen projects in the jurisdiction?

N/A

Market developments and opportunities

13. Are there any government grants or other government funding available to hydrogen projects (including for research and development)?

Through the Circular, the Government has planned the allocation of up to one million hectares of land for green hydrogen projects, with an initial mobilization phase covering 300,000 hectares, providing the flexibility needed for technological advances. The focus is on developing infrastructure to international standards, including power grids, port facilities, desalination plants, hydrogen pipelines, and salt cavern storage systems. Morocco, which currently imports 90% of its energy needs, aims to produce more than half of its consumption using green hydrogen by 2030.

Additionally, there are funding opportunities related to the research and development of hydrogen projects. Mohammed VI Polytechnic University (UM6P), backed by the OCP Foundation, is investing in green hydrogen research, driven by Morocco's renewable energy potential. UM6P focuses on applied research to address African needs and develop scalable solutions, covering the entire green hydrogen value chain, from reducing renewable energy costs to storage. Plans include establishing 4 MW and 10 MW research platforms funded by OCP. UM6P will launch a hydrogen program and a master's program.Prospects include substituting ammonia imports with green alternatives, potentially 25-30% of OCP's usage by 2027.

A partnership between OCP Group and Fortescue Energy plans a Joint Venture for green energy, hydrogen, and ammonia in Morocco, with potential manufacturing facilities and an R&D Hub near UM6P in Marrakech. This Hub will focus on renewable energies, green hydrogen, and mineral processing research, with corporate venture capital funds driving technological advancements.

14. Are there any notable pilot/demonstration projects in place or planned for the production or offtake of clean hydrogen?

There are currently several large-scale pilot and demonstrative projects underway or planned to promote the production and consumption of clean hydrogen, such as:

- "Proof of Concept" Pilot Project

  On August 2, 2023, new partnership agreements were signed between Chariot Green Hydrogen Limited, the Mohamed VI Polytechnic University (UM6P), and Oort Energy Limited (Oort) to test Green Hydrogen production using a patented 1 MW polymer membrane electrolyzer system developed by Oort. The project will be hosted at UM6P's research and development facilities at OCP Jorf Lasfar in Morocco.
- "Power-to-X µPilot" Micro-Pilot Project:

  On September 1st, 2022, the Institute for Research in Renewable Energies and New Energies (IRESEN) implemented its first demonstrative project for green hydrogen generation (solar-based) at the Micro-Pilot scale under its "Power-to-X µPilot" project. This involves a 20-kilowatt (kW) electrolyzer coupled with photovoltaic solar panels, which will be tested under varying renewable electricity loads.

The "Power-to-X µPilot" project is incubated at the heart of the Green Energy Park in Benguerir in collaboration with the Mohammed VI Polytechnic University (UM6P). In its upcoming developmental phases, it will incorporate additional technological components from the green hydrogen value chain and its applications, commonly referred to as the "Power-To-X" pathway, according to IRESEN.

The objective of this system is the production of green ammonia, green methanol, green fuels, as well as aspects like sustainable mobility and renewable electricity storage, using hydrogen and fuel cells.

15. Are there any commercial-scale clean hydrogen production projects in development or already operating?

As far as we know, the development of many projects have been announced (mainly through medias):

- **HEVO Ammoniac Maroc Project**: HEVO Ammoniac Maroc Project: a project being developed by the Portuguese technology company Fusion Fuel Green, Consolidated Contractors (CCC) and Vitol. The total estimated investment is $865 million with the objective of achieving a production of 31,850 tonnes per year of green hydrogen, 151,800 T/year of nitrogen and 183,650 T/year of green ammonia.
- The project aims to produce 3,650 tonnes of green ammonia in 2022, 20,000 tonnes in 2023, 40,000 tonnes in 2024 and 60,000 tonnes in 2025 and 2026. As for hydrogen production, 616 tonnes will be manufactured in 2022, 3,472 in 2023, 6,940 in 2024, 10,411 in 2025 and 2026.
- **Total Eren Project**: The French group Total Eren has announced its decision to engage an investment of 100 billion Dirhams (approximately $10,1 billion) in the realisation of a mega-project of hydrogen and green ammonia production in the region of Guelmim-Oued Noun in Morocco. This is a hybrid project, which will generate more than 10 GW by combining solar and wind energy.
- Consortium composed of Gaia Energy, Energy China International Construction Group, the Saudi company Ajlan Bros: The consortium recently signed a memorandum of understanding to develop a green hydrogen project in the southern region of the Kingdom. The project aims to produce 1.4 million tons of green ammonia annually from approximately 320,000 tons of green hydrogen4337.
- OCP Group: the group has presented before the King Mohammed VI a promising green investment project, worth around 130 billion dirhams, extending over the period 2023-2027, aimed at supplying all its industrial facilities with green energy and producing one million tons of green ammonia, with a view to achieving carbon neutrality by 2040. The green ammonia complex, with a production capacity of one million tons, will include a hydrogen electrolyser plant, a 60 million m3 seawater desalination plant, as well as a 1.2 GW photovoltaic solar farm and a 2.6 GW wind farm.

16. Have there been any hydrogen-related disputes in your jurisdiction?

As of today, no dispute exists in relation to green hydrogen in Morocco.

Last updated April 2024

43 https://www.upstreamonline.com/energy-transition/chinese-contractor-to-build-green-hydrogen-project-in-morocco/2-1-1438501

Namibia

Ashurst collaborated with **Koep & Partners** in the preparation of this content. We are grateful for their input.

Policy and regulation

1. Is there a government hydrogen strategy or policy?

There is currently no Government hydrogen strategy or policy that outlines key goals, establishes a regulatory framework or provides policy support and incentives. However, the Government of Namibia has issued a Request For Proposals inviting experts to develop a strategy and roadmap for the production and use of hydrogen (with particular application to synthetic fuels) in Namibia. This strategy and roadmap will be the foundation for an "energy plan" for the country.

2. What are key goals and commitments included in the strategy/policy?

Not applicable.

3. Which industry sectors are most likely to be affected by hydrogen deployment?

The **SYSTEMIQ Impact Presentation**, developed in collaboration with the Government of Namibia, highlights the following sectors as the first to be impacted by the deployment of hydrogen:

- long-haul trucking;
- mining trucking;
- fertiliser; and
- rail.

Hydrogen does not yet form part of any existing energy infrastructure in Namibia.

4. Who are the main regulators for the hydrogen market?

Not applicable.

5. Does the Government hydrogen strategy or policy support the development of both low-carbon (blue) hydrogen and renewable (clean) hydrogen?

Not applicable.

6. If the Government hydrogen strategy or policy supports the development of low-carbon hydrogen, to what extent is carbon capture and storage being taken forward?

Not applicable.

7. Are there targets for the production of hydrogen?

Not applicable.

8. Are there any incentive mechanisms/business models in place to support the production of hydrogen?

Not applicable.

9. Are there any standards in place for the classification and/or certification of low-carbon or renewable hydrogen?

Not applicable.

10. Does the regulatory framework clearly define the regulatory requirements relating to the production, storage, transportation or supply of hydrogen?

Not applicable.

11. Are there any foreign investment restrictions related to energy and infrastructure sectors?

There are currently no foreign investment restrictions specifically related to investment in the energy and infrastructure sectors.

However, there are standard regulations regarding foreign investments i.e. exchange control restrictions.

12. What international treaties are in place that may offer protection to international investors in hydrogen projects in the jurisdiction?

Namibia is not signatory to any international treaties that offer specific protection for international investors in the energy sector. Only the standard investor protections provided to all foreign investors are applicable. For instance, the Government of Namibia has entered into double taxation agreements with the Governments of the following countries:

- Republic of Botswana;
- French Republic;
- Federal Republic of Germany;
- Republic of India;
- Malaysia;
- Republic of Mauritius;
- Romania;
- Russian Federation;
- Republic of South Africa;
- Kingdom of Sweden; and
- United Kingdom of Great Britain and Northern Ireland.

Market developments and opportunities

13. Are there any Government grants or other Government funding available to hydrogen projects (including for research and development)?

Yes, the **PTX Pilot Project Programme** provides grants for pilot projects. The grants provided by the Government are aimed at promoting international collaboration in the field of clean hydrogen and its derivatives with a specific focus on storage, transport, and the use of integrated application technologies. The funding arrangement will comprise of two modules:

- Module 1: Projects - Module 1 will fund companies/institutions that are systematically developing and promoting the sustainable production of clean hydrogen and its derivatives. This includes projects dealing with the production, storage, transport and the integrated use of clean hydrogen and its derivatives. Funding will be provided for technologies that make a contribution to an early market ramp-up as well as preparatory or accompanying development, where applicable.
- Module 2: Research Projects - Module 2 will fund research projects that are designed to accompany projects funded in Module 1. This includes preparatory or accompanying research like material development, simulations, modelling, scientific analyses, and studies.

14. Are there any notable pilot/demonstration projects in place or planned for the production or offtake of clean hydrogen?

There are currently no notable pilot projects in place or planned. Any future pilot projects are likely to be commissioned through the **PTX Pilot Project Programme**.

15. Are there any commercial-scale clean hydrogen production projects in development or already operating?

There are currently no existing commercial scale clean hydrogen production projects in Namibia but the **Hyphen Southern Corridor Development Initiative Project** is in development.

The Hyphen Southern Corridor Development Initiative Project has passed the pre-feasibility stage. The key figures on this project include an installed capacity of 5GW of renewable energy, 3GW of electrolysis, 300,000 tonnes of clean hydrogen per annum and a total investment of USD 9.4 billion. The project timeline is set up as follows:

- Development of this project commenced in 2021 and is expected to proceed until 2024.
- Phase one - construction on phase one is set to commence in 2025 and operations are set to commence in 2027.
- Phase two - construction of phase two is set to commence in 2027 and operations are set to commence in 2029.

16. Have there been any hydrogen-related disputes in your jurisdiction?

No response provided.

Netherlands

Ashurst collaborated with **NautaDutilh** in the preparation of this content. We are grateful for their input.

Policy and regulation

1. Is there a government hydrogen strategy or policy?

The Dutch hydrogen targets are set forth in the **Climate Agreement** (*Klimaatakkoord*, described below under 7). In addition, the government published a **Government Strategy on Hydrogen** (*Kabinetsvisie waterstof*) on 30 March 2020 (the **Strategy**). The Strategy presents the government's vision on hydrogen and the associated policy agenda. It serves as a prelude to establishing and implementing a hydrogen programme in collaboration with stakeholders, aligning with the ambitions for hydrogen set out in the Climate Agreement.

Furthermore, the **National Hydrogen Programme** (*Nationaal Waterstof Programma*, the **NWP**) was established in February 2022. This programme is a public-private partnership aimed at collectively achieving the ambitions and agreements related to hydrogen. The NWP focuses on connecting, facilitating, accelerating, and monitoring efforts to realise these goals. It serves as an umbrella under which all developments related to hydrogen are monitored and interconnected where necessary. However, it is important to note that the NWP itself is not a decision-making body; actual decisions are made through regular policy processes.

On 7 July 2021, a cross-sectoral hydrogen working group comprising 19 organisations (including government ministries, branch organisations, TSOs, and the port of Rotterdam) drafted and adopted a **National Hydrogen Programme Work Plan 2022-2025** (*Werkplan Nationaal Waterstof Programma 2022-2025*). This work plan contains an outlook towards 2030 and recommends collaborative efforts towards developing a **Hydrogen Roadmap** (*Routekaart Waterstof*, the **Roadmap**). The Roadmap, which was published in November 2022, focuses on the ambitions set out in the Climate Agreement; linking production, import, infrastructure, applications, and all necessary preconditions for hydrogen development.

In the **Climate and Green Growth National Budget 2025** (*Klimaat en Groene Groei Rijksbegroting*) a decision was made to cut €1.2 billion from Climate Fund resources, including those designated for green hydrogen and batteries, is part of the. Despite this, the government has allocated €354 million for 2025 to stimulate hydrogen production and import, insisting it is deeply committed to the energy transition.

2. What are key goals and commitments included in the strategy/policy?

The Strategy acknowledges the Netherlands' advantageous position for further developing and integrating hydrogen into its energy system. The country has significant potential to increase renewable power generation, necessary for producing CO2-free hydrogen, through offshore wind farms in the North Sea. This supply is conveniently located near industrial clusters with substantial demand as they aim to enhance their sustainability. The Netherlands' ports, including the major port of Rotterdam, offer opportunities for importing hydrogen. Additionally, its well-developed gas infrastructure can be repurposed for transporting renewable hydrogen. The country also possesses the requisite knowledge institutions to conduct both fundamental and applied research essential for advancing the hydrogen economy through innovation.

The Strategy outlines an initial phase focused on reducing costs and scaling up renewable hydrogen production. It also emphasises preparing for a subsequent phase involving the development of transport and storage infrastructure. In this context, the Strategy sets forth a policy agenda with four main elements: legislative development; cost reduction and scaling up green hydrogen; sustainable end-use; and supporting policies.

- Legislative development: establishing preconditions necessary for further integrating hydrogen into the energy system. Key areas include identifying conditions under which existing gas infrastructure can be repurposed for hydrogen transport and distribution, general market regulation and assigning temporary tasks to grid operators to initiate the hydrogen market, developing guarantees of origin and certification schemes in compliance with EU legislation, ensuring safety, and coordinating energy infrastructure development, particularly electricity and hydrogen grids.
- Cost reduction and scaling up green hydrogen: scaling up electrolysis capacity to approximately 500 megawatts (**MW**) by 2025 and 3-4 gigawatts (**GW**) by 2030, with a goal of reducing costs by over 50% within the next decade. The government plans to achieve this through financial instruments supporting research, scaling up, and implementation; potentially linking offshore wind energy development to hydrogen production via integrated tenders; and possibly imposing a blending obligation for green hydrogen in the gas grid to boost demand.
- Sustainable end-use: increasing demand for CO2-free hydrogen across various sectors including ports and industrial clusters; the transport sector (e.g., establishing 50 hydrogen filling stations by 2025); the built environment; the electricity sector; and agriculture.
- Supporting policies: continuing international strategy aimed at global and European cooperation; regional policies aimed at stimulating regional development and improving cooperation; as well as supporting both fundamental and applied research by companies and knowledge institutions.

The National Hydrogen Programme Work Plan 2022-2025 identifies two key goals: upscaling offshore production of renewable electricity linked to increased electrolysis capacity to benefit sustainable end-use in five main industrial clusters (Rotterdam-Moerdijk, Chemelot, Noordzeekanaalgebied, Schelde-Delta, Noord-Nederland), heavy transport logistics in Dutch port areas; as well as demonstrating decentralised hydrogen production.

The Roadmap outlines a comprehensive strategy for advancing the Dutch hydrogen market, aligning with national climate targets and broader energy transition goals. It adopts a holistic approach to integrate various aspects of the hydrogen value chain, including supply, transport, distribution, storage, application, and necessary preconditions. The Roadmap's primary goals include setting national targets for hydrogen production and use, supported by annual interim targets to ensure progress. It emphasises the importance of scaling up renewable hydrogen production in tandem with offshore wind energy development. This linkage is crucial as it leverages the Netherlands' potential for renewable power generation from North Sea wind farms. Additionally, the Roadmap highlights the need for developing suitable infrastructure for hydrogen transport and storage, repurposing existing gas infrastructure where feasible.

Key commitments within the Roadmap focus on legislative development to create a conducive regulatory environment for hydrogen integration into the energy system. This includes establishing conditions for repurposing gas infrastructure, market regulation adjustments, safety standards, and certification schemes compliant with EU legislation. Cost reduction strategies aim to scale up electrolysis capacity significantly by 2030 while reducing costs through financial instruments supporting research and implementation. Another critical area addressed in the Roadmap is sustainable end-use across various sectors (as set out below under 3). Supporting policies are also outlined to foster international cooperation, regional development initiatives, and continuous support for fundamental and applied research by companies and knowledge institutions. Large industrial clusters connected to regional gas networks will need access to hydrogen to achieve sustainability targets by 2030. A transport network providing access to storage facilities and connecting all large industrial clusters within the Netherlands and neighbouring countries is planned for around 2027.

The **Main Energy Structure Programme** (*Programma Energiehoofdstructuur*, the **PEH**) is a strategic government policy aimed at developing essential energy infrastructure necessary for achieving a climate-neutral energy system by 2050. It encompasses crucial components such as national pipelines, large-scale energy production sites, energy storage (including batteries and hydrogen), electrolysis facilities, and controllable power sources. Overall, it serves as a foundational framework ensuring the infrastructure is in place to meet both current and future energy demands sustainably.

The PEH aims to secure adequate space for the development of essential national energy infrastructure necessary for achieving a climate-neutral energy system by 2050. Its primary goals include facilitating the transition from a centralised, fossil-fuel-based energy system to a decentralised model that relies on renewable energy sources. The PEH also focuses on promoting a coherent spatial arrangement of the energy system, ensuring effective integration of various energy sources while maintaining a high quality of living environments. Additionally, it aligns with national climate objectives, aiming for a 55% reduction in greenhouse gas emissions by 2030. Recognising the evolving nature of technology and policy, the PEH is designed to be adaptable, allowing for updates based on new insights and decisions emerging from the **National Energy System Plan** (NPE).

A hydrogen-based energy system cannot function effectively without large-scale hydrogen storage, which is essential for ensuring supply reliability and facilitating the decarbonisation of various sectors. The development of a hydrogen supply chain also presents numerous economic opportunities. As part of this initiative, the government will begin exploring options to expand underground hydrogen storage capacity in the coming years. Initially, the focus will be on increasing onshore hydrogen storage capacity in salt caverns. Simultaneously, the technical feasibility of alternatives in depleted gas fields, both onshore and offshore, will be assessed. In future salt extraction operations, the government aims to align new salt extraction sites with potential underground energy storage locations as much as possible. The exploration of new sites will occur within the framework of the national program for the sustainable use of the subsurface, and decisions regarding which mining activities can take place under what conditions will be made through public dialogue. The use of deep subsurface resources will not be permitted unless mining activities occur in designated suitable areas and comply with safety and responsible usage requirements.

The **Hystock** project reflects the government's commitment to developing essential hydrogen storage capabilities. With a total investment of €162 million (including the recently reserved €37 million for 2025), the Hystock project focuses on storing hydrogen in four underground caverns, thereby enhancing the capacity for safe and reliable hydrogen storage crucial for a hydrogen-based energy system. The Hystock project directly addresses the need for large-scale hydrogen storage, which is vital for ensuring supply reliability and supporting the decarbonization of various sectors. This aligns with the government's broader goals to explore options for increasing underground storage capacity, particularly in salt caverns, as part of its hydrogen strategy. Furthermore, the planned vision on safe underground hydrogen storage to be released in early 2025 will provide essential guidelines and safety standards, helping to shape the future of hydrogen storage projects, including Hystock.

3. Which industry sectors are most likely to be affected by hydrogen deployment?

As described in the Roadmap, the deployment of hydrogen is set to have a profound impact on several key industry sectors in the Netherlands. The production sector, for instance, is expected to undergo a significant transformation. Currently, a large portion of hydrogen in the Netherlands is produced from natural gas. However, future production will increasingly rely on renewable hydrogen generated through electrolysis. This shift is driven by (anticipated) binding targets for the use of renewable hydrogen in both industrial applications and mobility. Electrolysers will play a crucial role not only in producing hydrogen but also in energy storage and alleviating congestion on energy grids.

In the industrial sector, which currently consumes approximately 180 PJ of hydrogen annually, there will be a gradual transition from hydrogen derived from natural gas to renewable and low-carbon alternatives. This change is essential for reducing CO2 emissions and achieving sustainability goals within high-temperature processes. Industrial clusters have already incorporated renewable hydrogen into their long-term strategies for decarbonisation. However, the current pace of electrolyser project rollouts and the need for extensive infrastructure modifications poses a challenge for a complete transition by 2030. A national transport network for hydrogen is being developed to connect major industrial clusters along the coast with inland regions like Chemelot (a large cluster of chemical plants in the south-eastern part of the Netherlands). This network aims to support both domestic production and import of hydrogen while ensuring adequate storage capabilities through underground caverns or tanks.

The mobility sector stands to benefit greatly from hydrogen deployment across road transport, shipping, and aviation. Hydrogen can power long-distance heavy transport where battery-electric solutions may not be feasible. By 2025, a basic network of at least 50 hydrogen refuelling stations is planned to support this transition. For maritime applications hydrogen offers a viable alternative besides electrification and other clean fuels, as the government aims for 150 zero-emission inland ships by 2030 and to achieve virtually emission-free and climate-neutral inland navigation by 2025. In aviation, sustainable fuels derived from renewable hydrogen are key to reducing emissions. The Netherlands targets a blend of 14% sustainable fuels by 2030 with ambitions for fossil-free flying by 2050.

Lastly, in electricity generation, flexible CO2-free power generation using hydrogen can complement intermittent renewables like wind and solar power. However, large-scale use in power plants may not occur until post-2030 due to current limited availability and competing demands from other sectors.

The role of hydrogen in residential heating remains uncertain until after 2030 due to ongoing research into various applications within buildings using existing gas networks or waste heat from electrolysers.

4. Who are the main regulators for the hydrogen market?

The Netherlands Authority for Consumers and Markets (**ACM**) is the regulatory authority in the energy sector in the Netherlands. HyNetwork Services, a 100% subsidiary of Gasunie, has been assigned by the Dutch government to develop and manage the hydrogen transmission infrastructure in the Netherlands, set to begin operations in 2025. The ACM is expected to become the regulator for this network from 2031 onwards and will have an advisory role from 2025 until 2031.

Hydrogen production, transportation, supply and storage are regulated as industrial activities, and are therefore subject to environmental and health and safety regulations. The regulators would include local, provincial and/or national environmental authorities, as well as health and safety regulators. For example, provincial executives are the competent authorities to grant environmental permits for environmentally harmful activities with hydrogen, such as the realisation and operation of a hydrogen production facility. The underground storage of hydrogen is subject to mining regulations. Therefore, the Dutch State Supervision of Mines oversees the safety of underground hydrogen storage.

5. Does the government hydrogen strategy or policy support the development of both low carbon (blue) hydrogen and renewable (green) hydrogen?

The government's strategy aims to prioritise green hydrogen, which is primarily produced through electrolysis using renewable electricity, as well as from biogenic feedstocks, provided they are sustainably sourced. Simultaneously, the strategy acknowledges the role of blue hydrogen – produced from natural gas with carbon capture and storage (CCS) – in contributing to the overall hydrogen system. The objective is to ensure that blue hydrogen supports the development of a broader hydrogen infrastructure without impeding the growth of green hydrogen.

6. If the government hydrogen strategy or policy supports the development of low-carbon hydrogen, to what extent is carbon capture and storage being taken forward?

In the Climate Agreement, the deployment of CCS is addressed as a cost-effective measure to achieve Dutch climate goals. Notably, its role in blue hydrogen is highlighted as an area where the Netherlands can distinguish itself internationally. CCS in the Netherlands is supported by various government measures, including pricing mechanisms for CO2 emissions and subsidy schemes that help reduce the financial risks associated with CCS-projects. The government also actively participates in state-owned entities like Energie Beheer Nederland (**EBN**), Gasunie, and the Port of Rotterdam Authority in key CCS-projects.

To complement the EU Emissions Trading System (**EU ETS**), the Dutch government has implemented additional pricing mechanisms under the Environmental Taxes Act (*Wet belastingen op milieugrondslag*) to encourage companies to invest in CO_2 reduction measures:

- Minimum CO2 price for electricity generation: sets a minimum price for CO_2 emissions from electricity generation by EU ETS companies. The tax applies only if the EU ETS price falls below this minimum threshold; if the EU ETS price is higher, the tax is not applied.
- Carbon tax: applies to both EU ETS installations and some non-EU ETS installations. For EU ETS installations, the tax amount is reduced by the EU ETS price per ton of CO_2 emissions. If the EU ETS price exceeds the carbon tax base amount, tax is effectively zero for these installations. Non-EU ETS installations are required to pay the full carbon tax amount. The tax is calculated based

on the total annual CO_2 emissions, minus any 'dispensation rights' for exempted emissions. These rights are gradually being reduced over time. The carbon tax is designed to be high enough to ensure that the Netherlands achieves its CO_2 reduction targets for 2030 with a 75% certainty.

CCS is supported by various financial assistance programs, including the Stimulation of Sustainable Energy Production and Climate Transition (**SDE++**) (as described under 8 and 13 below).

Two prominent CCS-projects are currently running in the Netherlands: Aramis and Porthos.

- The **Aramis** project focuses on creating new infrastructure for CO_2 from land to platforms under the North Sea. The CO_2 will be stored in empty gas fields in the underground. The project is in the Front end Engineer and Design **(FEED**) phase as of the 30th of November 2023. This means that the partners involved, Gasunie, TotalEnergies, Shell and EBN, have agreed on the development of key components of the required infrastructure, including the offshore transmission pipeline and the technical/ operational integration of the source-to-sink CCS value chain.
- **Porthos** is a CO2 transport and storage project based in the Port of Rotterdam. It is a collaborative project of EBN, Gasunie, and the Port of Rotterdam Authority. The project aims to capture CO2 from industrial companies in the port and store it in empty gas fields under the North Sea as of 2026, with an annual capacity of 2.5 Mton. The construction of the infrastructure has commenced on the 15 April 2024.

7. Are there targets for the production of hydrogen?

The Climate Agreement of 2019 sets an initial target to achieve 500 MW of electrolysis capacity by 2025, and subsequently, 3 to 4 GW by 2030. At the end of 2022, the government revised these targets, setting a new goal of achieving 8 GW of electrolysis capacity by 2032.

8. Are there any incentive mechanisms/business models in place to support the production of hydrogen?

Hydrogen production in the Netherlands is supported through several subsidy schemes, most notably the SDE++ subsidy scheme (*Stimulering Duurzame Energieproductie en Klimaattransitie*). Under this scheme, the Minister of Climate Policy and Green Growth grants subsidies for a maximum period of 15 years to parties who produce hydrogen by electrolysis of water, provided that the production plant has a nominal capacity of at least 500 kW. Once the subsidy is granted, the production plant needs to be fully operational within four years. This installation must be either connected to the electricity grid or directly connected to an installation generating electricity from wind or solar energy.

For installations connected to the electricity grid, the subsidy is only provided for hydrogen that is fully renewable. This means that production must comply with specific European regulations laid down in Regulation (EU) 2023/1184. The renewable electricity used for production must come from wind or solar power, and this must be demonstrated through renewable power purchase agreements (**PPAs**). If the plant produces both fully renewable and non-renewable hydrogen, the total greenhouse gas emission reduction of both types of hydrogen combined must be at least 70%. The subsidy recipient must be able to prove that the electricity used is renewable by submitting guarantees of origin for the renewable electricity, which comes from installations generating wind or solar energy and for which PPAs are in place.

Other specific conditions apply to installations directly connected to a wind- or solar-powered installation. The plant must consume less than 1% of its maximum capacity while on standby. Moreover, in this case, subsidies are only provided for hydrogen produced with electricity from a wind or solar plant that has not received any other subsidy for producing that electricity. The electricity used must come directly from the plant to which the hydrogen production plant is connected.

An extensive overview of potentially applicable subsidy schemes is included under 13 below.

9. Are there any standards in place for the classification and/or certification of low-carbon or renewable hydrogen?

Dutch standards for the classification and/or certification of low-carbon or renewable hydrogen are primarily based on European regulations.

The establishment of a system for Guarantees of Origin (**GOO**) pertaining to renewable hydrogen is mandated by article 19 of the Renewable Energy Directive (**RED III**). This regulatory framework has been incorporated into Dutch law through the Act Implementing the EU Renewable Energy Directive for Guarantees of Origin (*Wet implementatie EU-richtlijn hernieuwbare energie voor garanties van oorsprong*). The provisions of this Act are further detailed in the existing Regulations that govern GOOs and Certificates of Origin (*Regeling garanties van oorsprong en certificaten van oorsprong*). GOOs serve as a certification mechanism for renewable hydrogen.

The RED III contains standards for 'Renewable Fuels of Non-Biological Origin' (RFNBO), which includes hydrogen produced by electrolysis from renewable electricity and its derivatives. The term renewable hydrogen is often used as a simplification for hydrogen that qualifies as an RFNBO under the RED III. In order to comply with the standards of RFNBOs, the hydrogen must meet a number of cumulative requirements, as set out in articles 27(6), 29a and 30(1 and 2) of the RED III.

While a GOO does not confirm that the hydrogen complies with all the criteria for RFNBO, the GOO can be utilised as partial evidence to support claims of compliance with such standards. Ongoing discussions within the European Commission continue to explore the interplay between GOOs and voluntary certification schemes.

RED III only addresses GOOs for gas from renewable sources, but the European Commission also expressed its intention in its hydrogen strategy (COM 2020, 301) to enable certification for hydrogen from non-renewable sources (low-carbon hydrogen or 'blue' hydrogen). The European Commission still needs to develop this further. The introduction of certificates/guarantees for low-carbon hydrogen in the Netherlands will need to take place via legislative amendments.

10. Does the regulatory framework clearly define the regulatory requirements relating to the production, storage, transportation or supply of hydrogen?

Currently, there is no comprehensive regulatory framework in the Netherlands regarding the production, storage, transportation or supply of hydrogen. The production, storage, transportation and supply of natural gas is regulated in the Dutch Gas Act (*Gaswet*). Hydrogen is not considered 'gas' as defined in the Gas Act, therefore the majority of the provisions in the Gas Act are not applicable.

In November 2022, the Roadmap (as described under 1 and 2) was published. The Roadmap takes a total approach on the development of the Dutch hydrogen market, by connecting supply, transport, distribution, storage, application and preconditions. The Dutch legislator plans to implement European legislation regarding market regulation and the transport, storage and import of infrastructure of hydrogen in Dutch legislation around 2025/early 2026, by including provisions in a new Dutch Energy Act (*Energiewet*), which is yet to enter into force. A full Dutch regulatory framework on hydrogen is to be expected in 2033.

The new Dutch Energy Act is being introduced to amend and consolidate the current Dutch Gas Act and the Dutch Electricity Act 1998 (*Elektriciteitswet 1998*) into one new Act, without the emphasis being on the regulation of hydrogen. Although the regulation of hydrogen infrastructure will largely be shaped by the evolving European regulatory framework, the Dutch legislator has seized the opportunity of this new Act to include 'hydrogen gas' to the new definition of 'gas' and has initiated the regulation of hydrogen in a limited number of aspects (set out below) in the current legislative proposal for the new Dutch Energy Act (the **Energy Act Proposal**). The Energy Act Proposal was approved by the Dutch House of Representatives on 4 June 2024 and is currently being debated in the Dutch Senate. A general framework for hydrogen has not yet been included in the current Energy Act Proposal.

As anticipated at the outset of the legislative process, the Energy Act Proposal will be followed by new 'tranches' or phases of legislative amendments. In the context of the European Union, the recently adopted 'Hydrogen and Gas Decarbonisation Package' (Directive 2024/1788 and Regulation (EU) 2024/1789) (the **Decarbonisation Package**) is particularly relevant for the regulation of hydrogen. This package contains a recast of Directive (EU) 2009/73 (the Gas Directive) and of Regulation (EU) 715/2009 (the Gas Regulation) and provides regulatory frameworks for the development, construction and management of hydrogen networks both onshore and offshore, to which the established principles of network management (*netbeheer*) for natural gas, such as third-party access, apply. It includes that EU member states must ensure, by 1 January 2033 at the latest, the implementation of a system for regulated third-party access to hydrogen networks based on published tariffs, which are applied objectively and without discrimination among hydrogen network users. Regulated third-party access means, among other things, that users pay regulated fixed tariffs for the services. Until 1 January 2033, EU member states may also operate a system of negotiated access to hydrogen networks based on objective, transparent and non-discriminatory criteria. Negotiated access means that tariffs are negotiated bilaterally, but access requirements are supervised by regulatory authorities. These provisions regarding network management, including the (final) designation of a Dutch hydrogen network operator, and third-party access have not yet been included in the Energy Act Proposal. The Decarbonisation Package (and potentially other relevant EU legislation) will eventually result in a new implementation round and amendment of the Energy Act Proposal; it is likely that the regulation of the hydrogen market will then be incorporated into the Dutch Energy Act.

The Energy Act Proposal currently includes the below noteworthy provisions and/or amendments relating to the production, storage, transportation or supply of hydrogen.

- The expanded role of infrastructure companies in energy transition: in the Energy Act Proposal, the role of infrastructure companies has been expanded, including with respect to hydrogen. An infrastructure company (not being a transmission system operator (**TSO**) or a distribution system operator (**DSO**)) is a state enterprise that forms part of an infrastructure group, which includes one or more TSOs or DSOs. Infrastructure companies do not perform statutory system operator tasks but engage in various infrastructure-related activities. Unlike TSOs and DSOs, they operate in competition with market entities and have no legal monopoly. However, their affiliation with a TSO or DSO and status as state enterprises often grant them undue competitive advantages. These advantages can deter market participants from undertaking new activities in the energy market. Unrestricted market activities by infrastructure companies could also pose risks to TSOs and DSOs within their group and affect the state as a shareholder. Since the Act of 9 April 2018 amending the Electricity Act 1998 and the Gas Act, their permissible actions and activities have been legally framed. Simultaneously, infrastructure companies possess extensive knowledge and tools that should be utilised to support the energy transition. As acknowledged by the Dutch legislator, an infrastructure group or infrastructure company may also play a significant role regarding hydrogen (including the import of hydrogen, hydrogen derivatives, and hydrogen carriers), particularly in facilitating and initiating the market. Although private parties are currently preparing investments for e.g. hydrogen terminals, this is particularly important, as private parties often hesitate to fulfil these roles in this uncertain market phase. In the Energy Act Proposal, it has been specified that infrastructure companies (of all TSOs and DSOs) are permitted in the Netherlands to (i) establish, maintain and manage pipelines and associated facilities

for the transport of hydrogen gas, (ii) establish, maintain and provide (parts of) hydrogen gas installations on behalf of third parties, (iii) establish, maintain and provide measuring devices and services for hydrogen gas, and (iv) carry out activities and operations related to hydrogen exchanges (*waterstofbeurzen*), under similar rationales applied to electricity and gas. In addition, it is proposed to allow infrastructure companies of the TSO for gas to establish, maintain, manage, and operate hydrogen gas storage facilities, hydrogen gas terminals (i.e. facilities used for converting liquid hydrogen or liquid derivatives of hydrogen into hydrogen gas, or for converting hydrogen gas into liquid hydrogen) and other infrastructure for the import, export, transit, conversion or transshipment of hydrogen gas or hydrogen carriers.

- Dutch gas TSO (i.e. Gasunie Transport Services (**GTS**)) under conditions bound to accept injection of hydrogen gas into the gas transmission system: the Energy Act Proposal provides that a gas TSO (i.e. GTS) shall accept the injection (*invoeding*) of hydrogen gas upon request, provided that the TSO can reasonably mix it using the system and comply with the delivery specifications established by ministerial regulation. In connection with this amendment, the Energy Act Proposal further stipulates to extend the already existing group prohibition (i.e. that an infrastructure group shall not be under common ownership with a production, supply, and/or trading company, which ensures that the TSOs/DSOs are independent from companies that produce, supply, or trade energy) to include the production of hydrogen gas (which is an implementation of the current Gas Directive), as a result of which a TSO or DSO may no longer be part of a group that also includes a legal entity that produces, supplies or trades in electricity, gas or hydrogen gas.
- Possibility of project decisions for construction of hydrogen gas production facilities: there is a preliminary European agreement on binding European targets for the use of hydrogen (and hydrogen carriers) in industry and mobility. Achieving these targets will require a serious effort from the Netherlands. In order to achieve those targets, it is expected that approximately 4-8 GW of electrolysis capacity will be required domestically or abroad. This is largely in line with the national target of 8 GW of electrolysis capacity by 2032. To realise these ambitions in a timely manner and streamline procedures, the Dutch legislator proposes to apply the project procedure for large-scale electrolysis within the meaning of the Environment and Planning Act (*Omgevingswet*). This procedure allows projects of national importance to be authorised through a project decision (*projectbesluit*). The national interest, besides realising the above-mentioned ambitions, lies in the impact of large-scale electrolysis projects on the systems for the transport of hydrogen gas and the transmission or distribution systems for electricity. The Dutch Minister of Climate Policy and Green Growth will adopt a project decision for the construction of hydrogen gas production facilities using electrolysis with a certain minimum capacity. As capacities expand, it may be necessary to increase this minimum. The minimum capacity will therefore be determined by ministerial regulation.

11. Are there any foreign investment restrictions related to energy and infrastructure sectors?

Yes, there are foreign investment restrictions related to energy and infrastructure sectors. These are, however, currently not directly applicable to hydrogen projects.

The Dutch Electricity Act and the Dutch Gas Act provide that the Minister of Climate Policy and Green Growth may, for reasons of public safety or security of supply, prohibit or attach conditions to a change of control in (i) an electricity generating facility with a nominal electrical capacity exceeding 250 MW or a company managing such a generation facility or (ii) a liquefied natural gas (**LNG**) facility or an LNG company irrespective of capacity or size, respectively. Furthermore, electricity and gas grids and their operators are publicly owned by law.

On 1 June 2023 the Investment, Mergers and Acquisitions Screening Act (*Wet veiligheidstoets investeringen, fusies en overnames*) entered into force. This act and the Decree on the scope of application of sensitive technology trigger a notification obligation for investments that could pose a threat to national security through the acquisition of control over, amongst others: (i) vital providers, (ii) managers of corporate campuses; and (iii) companies active in (highly) sensitive technology. The notification obligation also applies when acquiring or increasing significant influence over companies operating in the field of certain (highly) sensitive technologies (photonics, high-assurance identification, quantum mechanics and semiconductors).

The government may by governmental decree designate additional categories of vital providers and/or expand what constitutes sensitive technology. The government has specifically pointed out that the hydrogen sector is on the list of sectors for which in the future a notification obligation may be introduced.

12. What international treaties are in place that may offer protection to international investors in hydrogen projects in the jurisdiction?

The Netherlands is a signatory to 90 bilateral investment treaties (BITs), of which 85 are currently in force, according to the website of the United Nations Conference on Trade and Development (UNCTAD). As per 28 June 2025, the Netherlands will no longer be a party to the Energy Charter Treaty (**ECT**). Practically, this means that the ECT will not be applicable to investments made on or after 28 June 2025 (which is one year after the formal notification of withdrawal). Qualifying existing investments should continue to benefit from ECT protection for twenty years after the effective withdrawal date. Furthermore, in 2023 and in 2024, the Netherlands entered into several hydrogen related Declarations of Intent and Memoranda of Understanding with other states, mainly to promote cooperation in the field of hydrogen.

Market developments and opportunities

13. Are there any government grants or other government funding available to hydrogen projects (including for research and development)?

To support hydrogen projects, the Dutch government has established the **SDE++ subsidy scheme**, as detailed under 8. In addition to the SDE++ subsidy scheme, various other subsidies and funding options are available for hydrogen (related) projects. The applicability of these schemes depends on the specific type of project, and some schemes may require that no other subsidy or fund has been granted for the same project.

- **Subsidy scheme for large-scale hydrogen production using an electrolyser** (**OWE**): This subsidy scheme is designed to provide financial support for both investment and operational costs associated with large-scale hydrogen production through electrolysis, starting from a minimum input capacity of 0.5 MW up to a maximum of 50 MW. Subsidy is given for the investment costs of the power generation facility (i.e. the investment part) and for producing the hydrogen using the facility for at least 5 and a maximum of 10 years (i.e. the operating part). This subsidy is being put out to tender. That means that the companies compete for the available subsidy. Projects that have already been given subsidies under the SDE++ scheme or the OWE scheme of 2023 are not eligible for the subsidy.
- **Subsidy for Hydrogen in Mobility** (SWIM): The Hydrogen in Mobility subsidy program is designed for businesses that are engaged in collaborative investments in hydrogen technology. This partnership, referred to as a consortium, must include a minimum of one operator of hydrogen fuelling stations and at least one company involved in transportation services. The primary beneficiaries of this initiative encompass the transport and distribution sectors, including small and medium-sized enterprises (**SMEs**), operators of hydrogen refuelling stations, shippers who are manufacturers moving their products, and passenger transport services, specifically those providing buses and wheelchair-accessible transport with a capacity of at least five seats.
- **Subsidy for Clean and Zero-Emission Construction Equipment** (**SSEB**): this subsidy scheme is designed to support construction companies in acquiring and converting to emission-free (zero-emission) construction machinery and vessels. Additionally, the SSEB provides funding for the retrofitting of existing construction equipment and vessels to reduce emissions. Innovative proposals aimed at enhancing emission-free construction machinery and charging infrastructure may also qualify for subsidies under the SSEB.
- **Dutch Research Council** (NWO): The funding provided by the Dutch Research Council is designated for fundamental research initiatives.
- **Energy & Climate Research and Development** (EKOO): subsidy scheme for research and development aimed at SMEs to create more affordable, climate-neutral, and/or circular products, services, and processes, with the goal of initial market introduction by 2034.
- **Subsidy Mission-driven Research, Development and Innovation** (**MOOI**): The MOOI subsidy scheme aims to fulfil the objectives outlined in the Climate Agreement through collaboration with other parties. This program encompasses several categories, including electricity, the built environment, industry, and biobased circular initiatives.
- **Subsidy Demonstration Energy Innovation (DEI+):** As of 3 July 2023, the DEI+ Hydrogen and Green Chemistry subsidy scheme has been reinstated, aiming to stimulate the growth of novel products and services in hydrogen technology. This initiative is particularly focused on supporting entrepreneurs who are working on innovative solutions for hydrogen production, transport, storage, and application.
- **Top Sector Energy (TSE) Studies Industry**: The TSE Industry program offers two distinct schemes. The Energy & Climate Research & Development (R&D) tender is designed for entrepreneurs focused on researching and developing cost-effective, carbon-neutral circular products and services. Meanwhile, the TSE Industry Studies subsidy supports entrepreneurs who are investigating the feasibility of innovative projects aimed at significantly reducing carbon emissions by the year 2030.
- **HER+ Renewable Energy Transition**: The objective of the innovation initiative is to lower CO2 emissions by leveraging renewable energy sources, including solar, wind, or hydropower. Alternatively, it may focus on minimizing the expenses associated with CO2 reduction through advanced techniques such as CSS, hydrogen production, or the utilisation of waste heat. This initiative can encompass various forms of research, including industrial studies, experimental development, or energy demonstration projects, or a combination of these approaches.
- **GroenvermogenNL**: focuses on innovation and scaling up hydrogen projects for the energy transition and green chemistry by investing in R&D, pilot projects, demonstration projects, and human capital, including education and training.
- **SME Innovation Stimulus for Regional and Top Sectors** (**MIT**): the MIT subsidy is designed for SMEs seeking to partner with other SMEs on innovative initiatives within the Netherlands' leading sectors. The Netherlands has recognised ten specific sectors as top priorities, where companies can contribute to addressing global challenges. This funding opportunity aims to foster collaboration and innovation among SMEs in these critical areas.

- **Accelerating climate investment industry** (VEKI): this subsidy scheme is designed to support investments in industrial devices, systems, or techniques that have a payback period exceeding five years, aimed at achieving a cost-effective reduction of CO_2 emissions within the Dutch industrial sector by 2030.
- **Investment subsidy manufacturing climate neutral economy** (**IMKE**): IMKE is a financial assistance program designed to support investments in manufacturing facilities that produce key components for electrolysers, batteries, and solar panels.

In addition, hydrogen projects may be able to make use of more general instruments supporting innovation, including:

- Favourable financing: **Innovation credit** (*Innovatiekrediet*), **Growth facility** (Groeifaciliteit) and **Early Stage Financing** (*Vroegfasefinanciering* (VFF));
- Guarantees for bank loans: **Guarantee Financing Entrepreneurs for medium-sized and large companies and the Guarantee for SME Credit** (Borgstelling MKB-kredieten (BMKB)); and
- Investments: **Seed capital funds for techno starters** and **Regional development companies** (*Regionale ontwikkelingsmaatschappijen*).

There are also several tax incentives available, such as:

- **Innovation scheme Promotion of Research and Development Act** (WBSO) (R&D Tax Credit): offers a tax incentive scheme to stimulate R&D activities by reducing wage costs for Dutch R&D companies involved in innovative projects, subject to certain conditions. It offers a tax credit for payroll taxes that are withheld by the Dutch R&D company and other costs and expenditures related to research and technological development;
- **Innovation Box** (IP Box): profits derived from qualifying intangible assets generated by R&D activities may be subject to a reduced corporate income tax rate; the IP Box effectively taxes certain qualifying income at a reduced rate (9% in 2024) instead of the general Dutch corporate income tax rate (up to 25.8% in 2024);
- **Energy Investment Allowance** (EIA): allows for a tax deduction of a percentage of the investment costs for investments in energy-efficient technologies and renewable energy;
- **Environmental Investment Deduction** (MIA): allows for a tax deduction of a percentage of the investment cost of certain environmentally friendly assets; and
- **Random Depreciation for Environmental Investments** (Vamil): allows for the arbitrary depreciation of certain environmentally friendly investments.

14. Are there any notable pilot/demonstration projects in place or planned for the production or offtake of clean hydrogen?

PosHYdon, a pilot project by Neptune Energy, represents the first offshore production of green hydrogen. This initiative integrates three offshore energy systems – wind, gas, and hydrogen – on the Q13 platform in the North Sea. The project aims to convert seawater into demineralised water and subsequently into hydrogen. PosHYdon seeks to explore the integration of energy systems at sea and assess the impact of offshore conditions on hydrogen production. The onshore pilot has commenced successfully, indicating a promising future for large-scale green hydrogen production at sea. The transfer of the electrolyser to the Q13 platform is scheduled for Q4 2024.

Groene Hart Waterstof (GH2) is a collaborative initiative by Vermeulen Groep, NettEnergy, and Delphy focused on producing hydrogen, thermal energy, and biochar from organic waste streams such as verge grass and wood waste. Launched in October 2022 and set to run for three years, this pilot aims to produce 500 kg/day of hydrogen by gasifying 10 tons of biomass daily. The objective is to determine the technology's efficacy and quantify how much hydrogen and electricity can be generated from a kilogram of grass. Part of the produced hydrogen will be utilised by Vermeulen Group to enhance its sustainability efforts.

H2 Hollandia is a demonstration project initiated by Avitec and Novar at the Vloeivelden solar farm. By installing an electrolyser, the project aims to halve the curtailment of solar power generation. This curtailed power can then be converted into 300 tons of hydrogen annually, enabling 3,500 full-load hours due to the high ratio of solar farm power (110MWp) to electrolyser power (5MW). Whilst this project aims to demonstrate technical feasibility and commercial viability, it will also avoid the emission of 2.7 kton CO2 annually.

HyNoCa Alkmaar is a subproject within the InVesta green molecules initiative focused on converting various biomass streams into hydrogen through an innovative thermal process suitable for use in transportation. In addition to producing hydrogen, this process generates biochar from biomass's carbon component. Biochar can significantly contribute to climate change mitigation as it serves as a soil improver, helps circularise fertilisers, and acts as a raw material for bio-composites.

The Atoll is an innovative project led by SolarDuck and Voyex, aimed at powering ships using hydrogen refuelled at floating solar islands. A prototype will soon be displayed on the Waal near IJzendoorn, supported by a €350,000 subsidy from the Province of Gelderland and facilitated by Dekker. This initiative seeks to make inland shipping more sustainable through a research and development partnership between SolarDuck and Voyex. The project involves a floating solar island producing 65 kW of peak

power, connected to a 10-kW electrolyser that generates hydrogen. This hydrogen is stored in a 'Liquid Organic Hydrogen Carrier' (LOHC), which allows for safe and efficient transport under normal conditions.

15. Are there any commercial-scale clean hydrogen production projects in development or already operating?

- **Shell Hydrogen Holland I** involves the construction of a 200 MW electrolyser at the Tweede Maasvlakte in Rotterdam. This facility will produce 60,000 kilograms of renewable hydrogen per day using electricity from the offshore wind farm Hollandse Kust (noord). The project, developed by Shell and over 150 contractors and suppliers, aims to provide a sustainable hydrogen solution for heavy transport and industrial sectors. The plant is expected to be operational in the second half of this decade.
- **NortH2** is a consortium project by Eneco, RWE, Equinor, and Shell aimed at producing large-scale green hydrogen to decarbonise industry. The goal is to supply 2-4 GW of green hydrogen by around 2030, with ambitions to expand to over 10 GW by 2040. This would equate to approximately 750,000 tons of green hydrogen annually, significantly reducing CO_2 emissions by 8-10 megatons per year. Having completed feasibility studies in late 2022, the project is now preparing for the FEED phase.
- **The H2 Conversion Park project** focuses on creating a stable supply of green hydrogen through an integrated approach involving wind energy, electrolysis, transport, and storage. Aimed at providing 2-4 GW of green hydrogen by around 2030 with plans to scale up to over 10 GW by 2040, this initiative could reduce CO_2 emissions by 8-10 megatons annually. The consortium behind this project includes Eneco, RWE, Equinor, and Shell.
- **ELYgator** is a large-scale water electrolyser project being developed by Air Liquide in Terneuzen. With a capacity of 200 MW powered entirely by renewable energy sources, it aims to produce more than 15.5 kilotons of green hydrogen annually starting in 2026. This will be injected into Air Liquide's European cross-border hydrogen network for use in mobility and industrial applications. Over its first decade of operation, ELYgator is expected to avoid three million tons of CO_2 emissions.
- **Energiepark Eemshaven-West** combines solar and wind energy technologies to produce renewable hydrogen. The park will utilise shared grid connections via the Dutch TSO's (TenneT) network for optimal capacity usage. Expected electrolyser capacity ranges between 50 and 100 MW with an investment decision anticipated in 2025. The produced green hydrogen will support sustainable mobility and industrial sectors.
- **H2ermes** aims to establish a facility with a capacity of up to 100 MW capable of producing up to 15,500 tons of green hydrogen annually using only renewable electricity from nearby offshore wind farms in the North Sea. Port of Amsterdam and Gasunie will manage regional distribution as part of the Hydrogen Hub Amsterdam/Noordzeekanaalgebied plans. The produced hydrogen will be used for green steel production, sustainable fuels, mobility solutions, and circular chemistry applications.
- **Hydrogen Delta** focuses on producing and utilising green and low-carbon hydrogen in the Zeeland border region as part of an ambitious programme aimed at phasing out grey hydrogen through clean alternatives. Several electrolyser projects totalling more than 2 GW are currently under advanced planning stages alongside significant blue hydrogen and CCU initiatives.
- **The Hydra Smart Rectifier project** involves developing scalable high-power rectifier technology (5 MW) for water electrolysis at lab scale while exploring the impact of various current forms on efficiency and topology. Key aspects include cost-effectiveness, reliability, and controllability within future electricity grids. Following an investment decision in late 2023 with realisation planned for 2024/2025; product launch is set for 2026 targeting total capacity reaching up to 3GW/year from-2027 onwards.

16. Have there been any hydrogen-related disputes in your jurisdiction?

N/A.

Last updated October 2024

New Zealand

Ashurst collaborated with **Anderson Lloyd** in the preparation of this content. We are grateful for their input.

Policy and regulation

1. Is there a government hydrogen strategy or policy?

There is no specific hydrogen strategy or policy currently in place in New Zealand. However, in 2022 as part of the Emissions Reduction Plan, the Government committed to developing the Hydrogen Roadmap. This will inform the New Zealand Energy Strategy which is expected to be finalised by the end of 2024. The Government sought public consultation in late 2023 on its Interim Hydrogen Roadmap, which outlines the Government's preliminary views on the future role of hydrogen in New Zealand. The new Government is reviewing submissions and will produce a summary report in early 2024 that will inform the ongoing work programme.

2. What are key goals and commitments included in the strategy/policy?

The Hydrogen Roadmap will delineate the pathway to establishing a hydrogen industry that will support New Zealand's transition to net zero emissions by 2050. The primary goal is to "optimise the potential for hydrogen [particularly green hydrogen] to contribute to New Zealand's emissions reductions, economic development and energy security and resilience in line with our broader electrification goals."[44] We note that the newly elected government may change these policies as part of the 2024 budget in May 2024, or when it releases the New Zealand Energy Strategy at the end of 2024.

Notable goals and commitments included:

Key policy objectives:

- ensuring supply can scale up, so hydrogen production can match electricity and other inputs;
- enabling the safe use of hydrogen and facilitating early projects that encourage the sector to develop; bringing forward and supporting early demand for hydrogen, linking this to the most viable use cases within New Zealand's energy system and aligning this with other priorities; and
- monitoring outcomes and progress over time,

Commitments:

- establishing a government and sector coordination body (which could develop views on regulatory matters, workforce needs, infrastructure requirements);
- progressing a regulatory work programme, prioritising common infrastructure and near-term cases like heavy road transport;
- a regional hydrogen transition consumption rebate (up to $100m over 10 years);
- a clean heavy vehicles grant scheme (Budget 2023 - $30m over 3 years);
- considering certification, emissions intensity standards and guarantee of origin for hydrogen production; and
- continuing work on: international cooperation and engagement, supporting public awareness and profile for hydrogen.

3. Which industry sectors are most likely to be affected by hydrogen deployment?

Hydrogen will likely play a pivotal role in New Zealand's energy transition with industries that are impractical or challenging to electrify. These include:

- industrial feedstocks;
- heavy road transport;
- the marine/maritime sector;
- some high temperature process heat; and
- aviation.

It also has potential to impact specialty vehicles, power backup, green peaking, light-duty vehicles and the rail sector.

44 Ministry of Business, Innovation & Employment, Interim Hydrogen Roadmap (Te Kawanatanga o Aotearoa, New Zealand Government, August 2023) at 6.

4. Who are the main regulators for the hydrogen market?

Currently, there are no sector-specific regulators for the hydrogen market in New Zealand. The main regulators for the hydrogen market, and their roles include:

- Ministry of Business, Innovation and Employment (MBIE): oversees energy policy and regulation, including the development and implementation of policies related to hydrogen as an energy carrier.
- Energy Efficiency and Conservation Authority: promotes energy efficiency and the use of renewables, including hydrogen.
- Environmental Protection Authority: is responsible for regulating activities that may impact the environment, including any environmental considerations related to the production, storage, and use of hydrogen.
- Electricity Authority: regulates integration into the electricity system.

MBIE is currently developing the Hydrogen Roadmap, which will require the involvement of each of these agencies. The Government has also initiated the Hydrogen Regulatory Settings Project and formed a cross-agency working group to identify regulatory barriers and prioritise the development of appropriate regulatory settings to the deployment of hydrogen. Collectively, these agencies will play a part in enabling the growth of the hydrogen market in New Zealand while ensuring safety, environmental sustainability, and economic efficiency. It is anticipated that as the Government continues to develop policy and invest in hydrogen energy initiatives, that the regulatory responsibilities will be clarified and authority delegated to specific agencies.

5. Does the government hydrogen strategy or policy support the development of both low-carbon (blue) hydrogen and renewable (green) hydrogen?

The Hydrogen Roadmap is predominantly concerned with green hydrogen production, using electrolysis. Grey or blue hydrogen are not included within the Interim Hydrogen Roadmap's scope, however future low and zero emissions production sources, such as naturally occurring hydrogen and biogenic hydrogen may have some part to play.

The Interim Roadmap signals that a potential demand pathway for green hydrogen includes replacing grey hydrogen as an industrial feedstock.

6. If the government hydrogen strategy or policy supports the development of low-carbon hydrogen, to what extent is carbon capture and storage being taken forward?

The New Zealand Government's proposed Hydrogen Roadmap will primarily focus on the development of green hydrogen. Currently, existing legislation is not equipped to deal with the inherent complexities of carbon capture and storage (CCS). These regulatory deficiencies can act as a barrier to the uptake of these technologies, however the impending Resource Management Act (RMA) reforms may cover carbon capture and storage.

7. Are there targets for the production of hydrogen?

There are no current targets for the production of hydrogen in New Zealand. Although it is anticipated that the Hydrogen Roadmap may well set out targets.

The main incentive for developing a hydrogen industry in New Zealand is to support New Zealand's statutory target of net zero emissions of greenhouse gases by 2050. Hydrogen provides a sustainable alternative to diversify New Zealand's renewable energy production and increases the resilience of the energy system to mitigate the impacts of a dry year (given that over 50% of New Zealand's electricity is produced by hydro power).

8. Are there any incentive mechanisms/business models in place to support the production of hydrogen?

The Hydrogen Roadmap will likely establish mechanisms to incentivise the production of clean hydrogen. In the 2023 budget, the Government established the Regional Hydrogen Transition Initiative which will provide a rebate to early hydrogen adopters. This is one of the key actions to contribute to building a market for hydrogen. However, it is important to note that New Zealand had a change of government in October 2023. It is unclear whether the new coalition Government will continue to support this initiative, albeit it has been signalled in coalition agreements that the Government supports the growth of the hydrogen sector.

If continued by the new Government on the same terms, the Regional Hydrogen Transition Initiative will be guaranteed through long-term contracts between the Crown and commercial hydrogen consumers. The proposed $100m investment will support early adopters in hard-to-abate industries to reduce emissions and build industry knowledge, skills, and supply chains.

Recipients of the rebate are expected to consume hydrogen at commercial scale and contribute to the development and scaling of a hydrogen sector over time. Participants in the scheme will be expected to partner with iwi and communities in the "just transition" regions of Southland and Taranaki to deliver long-lasting social and economic benefits.

The rebate will be available to consumers of green hydrogen for domestic consumption in NZ, (not for hydrogen exports). The hydrogen production will be backed by renewable energy generation, contributing to the development of the renewable energy sector and contributing to the nation's emissions reductions.

MBIE has indicated that it will run a competitive process to select participants in early 2024, but at the time of writing no recipients have been announced.

9. Are there any standards in place for the classification and/or certification of low-carbon or renewable hydrogen?

New Zealand has not committed to the singular use of a classification or certification model for the categorisation of hydrogen.

MBIE led the APEC low-carbon hydrogen international standard project, which was completed in July 2022. This project initiated an APEC-wide discussion on how to define low-carbon hydrogen, the benefits of certifying it, how an international standard could be implemented, and the value of developing a standard that reflects APEC's views. These standards and frameworks are likely to become increasingly important, and the Government has indicated that it will utilise its existing international relationships and agreements to foster the development of these standards.

10. Does the regulatory framework clearly define the regulatory requirements relating to the production, storage, transportation or supply of hydrogen?

The Government has made it a priority to develop appropriate regulatory settings and standards to facilitate the uptake of hydrogen, by:

- initiating the "Hydrogen Regulatory Settings Project" and forming a cross-agency working group to identify and prioritise regulatory barriers to the deployment of hydrogen;
- identifying a potential regulatory landscape that could interact with hydrogen, which covers 90 Acts, regulations and technical standards;
- Standards NZ completing a standards development implementation strategy that outlines a suite of standards adoption recommendations to enable the use of hydrogen across NZ's energy landscape; and
- WorkSafe establishing a working group to ensure the risks to health and safety in adopting new hydrogen technologies are adequately managed.

The Government has outlined that the Hydrogen Roadmap framework will need to:

- deal with the regulatory barriers that exist in New Zealand (e.g. indigenous rights and interests);
- interact with other legislation, regulations and technical standards; and
- be fit for purpose by considering the safety, use, market and resources associated with hydrogen.

11. Are there any foreign investment restrictions related to energy and infrastructure sectors?

Renewable energy projects that have more than 25 per cent ownership or control by overseas persons, and involve investment in "sensitive land" or "significant business" assets, may require a consent from the Overseas Investment Office (**OIO**) under the Overseas Investment Act (**OIA**) before the investment can proceed.

Whether land is sensitive land under the OIA will depend on the area of land being acquired and the land type. For example, all non-urban land larger than five hectares is considered sensitive land. Temporary interests in sensitive land may also require consent, for example, where a lease has a term of 10 years or more. Leases of rural land with a term of less than 10 years and true easements are not considered interests in land under the OIA and do not require OIO consent. Where the investment involves farm land, the landowner will be required to advertise the farm land to the market (to allow New Zealanders an opportunity to acquire the land) before entering into an agreement with the overseas person, but exemptions to this requirement may be obtained from the OIO.

Overseas investment in 'significant business assets', being acquisitions in assets exceeding NZ$100 million (or higher for certain jurisdictions), will also require consent from the OIO.

Additionally, investments in 'strategically important businesses' may need to be notified to the OIO. Strategically important businesses include businesses involved in electricity generation, distribution, metering, or aggregation if the business is a generator with a total nominal capacity in a financial year exceeding 250MW. These transactions may be blocked, or have conditions imposed, if it is considered necessary to manage significant national security and public order risks.

The OIO has provided guidance that:

- easements used for wind farms are a true easement and no OIO consent is required; and
- regardless of the type of land right actually used, solar farm land rights will be considered to be a lease and, if exceeding more than 10 years, will require OIO consent.

12. What international treaties are in place that may offer protection to international investors in hydrogen projects in the jurisdiction?

New Zealand is party to:

- four bilateral investment treaties;
- nineteen treaties with investment provisions; and
- twenty-eight investment related instruments

which protect investors' interests in investments in projects in New Zealand generally (found here). New Zealand is also party to fourteen free trade agreements that do not impose any specific tariffs on renewable energy equipment (including hydrogen equipment) from its trading partners. Details of the free trade agreements can be accessed here.

The Government has also pursued a range of international accords and understandings related to hydrogen. These include: international projects and forums dedicated to country coordination on common hydrogen challenges, including the:

- IEA Clean Energy Ministerial Hydrogen Initiative;
- Asia-Pacific Economic Corporation (APEC);COP27 Breakthrough Agenda and the Hydrogen Energy Ministerial Meeting; bilateral cooperation arrangements on hydrogen;
- Japan (memorandum of cooperation signed in 2018);
- Singapore (arrangement of cooperation signed in 2021); and
- the establishment of He Honoka Hauwai, the German New Zealand Green Hydrogen Research Centre.

Market developments and opportunities

13. Are there any government grants or other government funding available to hydrogen projects (including for research and development)?

The Government has financially supported the development of many projects and research initiatives. Prior to the 2023 budget, the Government contributed:

- $35 million to support capital investment in key supply chain focused projects;
- $45.5 million in research and development initiatives;
- $7.5 million in pilot and demonstration projects; and
- $19.9 million from the Provincial Growth Fund to support the joint venture between Ballance Agri-Nutrients and Hiringa Energy to develop a green hydrogen production facility in Taranaki.
- $6 million from the EECA and COVID-19 Response and Recovery Fund to support TR Group in purchasing 20 heavy freight hydrogen trucks, which will be leased to customers and use Hiringa's hydrogen refuelling network.
- New Zealand Green Investment Finance Limited (**NZGIF**) was established in 2019 to invest in New Zealand's low carbon future. The current pool of capital is now at $700m after receiving a $300 million injection from the 2023 budget. The NZGIF operates independently from Government to mobilise private investment. NZGIF does not offer grants, subsidies or concessionary funding but supports investment through a partnership and co-investment model. While NZGIF has not yet partnered with any hydrogen investors, the NZGIF is open to support investment in the hydrogen industry.
- A further $100m for the Regional Hydrogen Transition consumption rebate and $30m for the Clean Heavy Vehicles grant was announced in Budget 2023. $16 million was invested from the COVID-19 Recovery Fund in Hiringa Refuelling's heavy vehicle refuelling network, with four stations in the North Island.

14. Are there any notable pilot/demonstration projects in place or planned for the production or offtake of clean hydrogen?

Despite the current lack of a regulatory framework, there has been national and international interest in testing the viability and feasibility of the production and offtake of clean hydrogen. Notable projects include:

- **Firstgas New Zealand Hydrogen Pipeline Feasibility study**: In 2020, Firstgas commenced a comprehensive feasibility study targeting how it can deliver hydrogen most cost-effectively to decarbonise energy and transport demands, and how hydrogen can be introduced into New Zealand's gas network. In 2022, following its study, Firstgas announced it had shortlisted three locations to pilot blending hydrogen with natural gas, with the ultimate aim to distribute a blended gas into its network by 2030. A blended gas product will prevent the need to build expensive new gas pipelines. Firstgas is working with regulators at WorkSafe and MBIE to ensure its study and project complies with the distribution network and regulatory framework.
- **Tuaropaki Trust and Obayashi green hydrogen plant**: The partnership's pilot project commenced in 2018 and now produces 1.5MW of green hydrogen using electricity generated from the Mokai geothermal power plant. The pilot project was used to assess the feasibility of developing a commercial scale hydrogen supply chain.

- **Hyundai Xcient Fuel Cell truck**: Hyundai has partnered with NZ Post to distribute its first hydrogen-powered fuel cell electric truck. The truck is currently refuelled by green hydrogen supplied by BOC Limited, but aims to utilise Hiringa's refuelling network when the network becomes operational in 2023.
- **Toyota NZ's car sharing project**: Toyota NZ has partnered with eight companies to create New Zealand's first commercial fleet of hydrogen powered cars which will be shared between the eight companies in the partnership.

15. Are there any commercial-scale clean hydrogen production projects in development or already operating?

There are currently no commercial-scale hydrogen production projects in operation in New Zealand, however there are an increasing number of projects in development and planning stages. Notable projects in development include:

- Hiringa Energy's hydrogen refuelling stations: Hiringa Refuelling achieved financial close in September 2021 to develop New Zealand's first national wide refuelling network for New Zealand's heavy transport industry. The first substations were recently commissioned and the company has a plan to roll out a number of stations throughout the country that will produce and supply clean hydrogen fuel.
- Ports of Auckland production and refuelling facility: In 2021, Ports of Auckland partnered with Obayashi to develop a hydrogen production and refuelling facility. The port plans on developing an electrolyser in Auckland City that will supply green hydrogen to the port's transport infrastructure and assist the Ports of Auckland in reaching their target of being a zero-emission port by 2040.
- Southern Green Hydrogen Initiative: In September 2023, Meridian, Woodside Energy and Mitsui & Co announced they are close to formalising a partnership for the development of a 600MW green hydrogen and ammonia facility. The project is in the initial planning stages and seeks to produce up to 500,000 tonnes of ammonia per year utilising electrolysis from renewable power. The project will provide flexibility and security to the electricity industry as the plant will be able to be efficiently turned off and on to meet the required supply demands in the market.
- Hiringa Energy and Ballance Agri-Nutrients green hydrogen JV: The JV was granted resource consent in December 2021 to construct New Zealand's first hydrogen production facility, but an appeal by a local iwi group and Greenpeace stalled progress for two years (see further below). The project is planned to construct a 24MW wind farm to generate electricity for the production of green hydrogen in Kapuni, Taranaki. The project is expected to reach financial close in 2024. The electricity generated from the wind turbines is intended to power an electrolysis plant to produce hydrogen and ammonia, which will be used to decarbonise the agriculture, horticulture and transport industries.
- HW Richardson's dual-fuel hydrogen diesel truck: HW Richardson has purchased 10 retrofitted diesel vehicles that will use hydrogen and diesel fuel. The company is working towards commissioning its first hydrogen production and refuelling facility that will include a 1.1MW containerised hydrogen production and storage system.

16. Have there been any hydrogen-related disputes in your jurisdiction?

In December 2023, the Court of Appeal of New Zealand dismissed an appeal and upheld a consent for Hiringa Energy and Ballance Agri-Nutrients' proposed $70 million Kapuni Green Hydrogen Project.45 The resource consent was granted on the basis that the hydrogen produced would be initially used for the production of synthetic nitrogen fertiliser, and over a five-year period, transition to supplying hydrogen fuel for commercial and heavy transport. This intended transition underpinned the consenting decision. Greenpeace appealed the decision claiming that the High Court erred in failing to include any condition requiring the transition to actually occur. The Court of Appeal dismissed the appeal, citing that the conditions of the consent, requiring Ballance and Hiringa to report to the Taranaki District Council on the progress of the transition, reflected the justification for fast-tracking the consent.

Last updated April 2024

45 *Greenpeace Aotearoa Incorporated v Hiringa Energy Limited and Ballance Agri-Nutrients Limited* [2023] NZCA 672.

Nigeria

Ashurst collaborated with **Banwo & Ighodalo** in the preparation of this content. We are grateful for their input.

Policy and Regulation

1. Is there a government hydrogen strategy or policy?

Nigeria does not currently have a standalone hydrogen strategy or policy. While the Federal Government of Nigeria (FGN) has consistently echoed its interest in facilitating a green and sustainable transition in the energy sector, this interest is yet to morph into a comprehensive hydrogen strategy or policy.

However, the FGN has introduced some renewable energy policies where hydrogen has been identified as an energy source in the energy mix of the country. These policies/plans are:

- National Energy Policy
- Renewable Energy Masterplan
- Energy Transition Plan
- National Energy Masterplan

It is noteworthy that the National Energy Masterplan introduces a significant step towards a hydrogen policy by providing for a Hydrogen Development Plan which consists of an action plan that delineates strategies, activities, implementing agencies, funding sources and timeframes for hydrogen development. However, this Hydrogen Development Plan does not provide a comprehensive roadmap for hydrogen infrastructure development.

Additionally, the Electricity Act 2023 emphasizes the importance of renewable energy in electricity generation and mandates the Nigerian Electricity Regulatory Commission (NERC) to promote the development and utilisation of renewable energy by making regulations, standards and issuing licences relating to the generation and distribution of renewable energy. The reasonable expectation is that States within the Federation of Nigeria will, following the empowerment by the Electricity Act, 2023 to create their own electricity markets, will now embrace the generation of electricity with hydrogen as an energy source and to this end, will actively seek **foreign investment in hydrogen infrastructure** development.

2. What are key goals and commitments included in the strategy/policy?

Whilst Nigeria does not currently have a formalized and standalone hydrogen strategy or policy, some key goals and commitments towards hydrogen deployment, use and infrastructure development, can be gleaned from some of the renewable energy policies identified above. Some of these goals and commitments include:

- Integrating hydrogen as an energy source in the Nigerian energy mix.
- Keeping abreast of international trends in hydrogen production and application.
- Developing local production capacity for hydrogen.
- Ensuring hydrogen utilization as a preferred energy source, where possible, on account of its high environmental friendliness.
- Encouraging research and development in hydrogen energy-related technologies.
- Developing domestic capacity in hydrogen production and application technologies.
- Providing incentives to popularize the use of hydrogen as an energy source.
- Intensive awareness and sensitisation campaigns.
- Building indigenous capacity.
- Promoting automation and standardization requirement to scale up hydrogen systems.

3. Which industry sectors are most likely to be affected by hydrogen deployment?

Hydrogen has the potential to impact nearly all sectors of the Nigerian economy where successfully deployed in the country. The industries that are likely to be impacted by hydrogen deployment are:

- Electricity.
- Manufacturing.
- Transportation.
- Agriculture.
- Shipping.

4. Who are the main regulators for the hydrogen market?

Due to the absence of a comprehensive hydrogen policy stating otherwise, the hydrogen market is currently not fully developed. However, going by the Hydrogen Development Plan in the National Energy Masterplan, and the existing powers/functions of some of the subsisting regulators in Nigeria, the regulators that will most likely regulate the deployment, use and development of the hydrogen market in Nigeria are:

- The Energy Commission of Nigeria (ECN), which has the statutory mandate for the strategic planning and co-ordination of national policies in the field of energy in all its ramifications.
- The Federal Ministry of Innovation, Science and Technology, which is a Nigerian ministry with the mission to facilitate the development and deployment of science and technology apparatus to enhance the pace of socio-economic development of Nigeria through appropriate technological inputs into productive activities in Nigeria.
- The Nigerian Electricity Regulatory Commission (NERC), which is the primary regulator of the electricity market in Nigeria and formulates and implements regulations, and standards that govern the generation, transmission, distribution, and supply of electricity.
- The Nigerian Upstream Petroleum Regulatory Commission (NUPRC), which is the primary regulator of the upstream sector of the Nigerian petroleum industry and the NMDPRA, which is the primary regulator of the midstream and downstream sector of the petroleum industry in Nigeria.
- *We note that the Petroleum Industry Act, 2021 (the "PIA") defines petroleum products as materials derived from crude oil and natural gas processing such transportation fuels –* ***which includes hydrogen. Therefore, to the extent that any form of hydrogen is derived from crude oil and natural gas processing, such hydrogen will be classified as petroleum products which will come within the purview of the PIA****.*
- The Federal Ministry of Power, which is the ministry of the FGN in charge of formulating policies related to electricity in Nigeria. In relation to renewable energy, a source of which is hydrogen, the Ministry has issued policies such as: the National Renewable Energy and Energy Efficiency Policy; the National Renewable Energy Action Plan; the National Energy Efficiency Action Plan; and the Sustainable Energy for All Action Agenda.
- The Federal Ministry of Environment, which oversees and executes programmes and policies that safeguard and manage the environment. It establishes rules for conducting Environmental and Social Impact Assessments (ESIAs) and authorises ESIAs for all renewable projects.
- The Rural Electrification Agency, which is responsible for providing electricity through renewable energy projects, specifically to rural areas.

5. Does the government hydrogen strategy or policy support the development of both low carbon (blue) hydrogen and renewable (green) hydrogen?

The National Energy Transition Plan aims to attain a 33% blue hydrogen milestone in ammonia production by 2030, and subsequently progress to 100% hydrogen (both blue and green) by 2060. By virtue of the capital-intensive nature of green hydrogen projects, the FGN seems to be looking to support the development of both blue hydrogen and green hydrogen before progressively transiting to focusing only on the development of green hydrogen, being the more desirable variant of hydrogen.

6. If the government hydrogen strategy or policy supports the development of low-carbon hydrogen, to what extent is carbon capture and storage being taken forward?

The absence of a standalone hydrogen policy limits the extent of the development of carbon capture and storage in Nigeria. However, consequent upon the power of States to create their own electricity market, it has been observed that carbon capture and storage is now part of the key conversations for the development of the power sector in many States in Nigeria. Further to this, it is expected that a legal framework would be enacted by NERC or State regulatory agencies, to commercially incentivize carbon capture and storage in Nigeria.

Additionally, the Petroleum Industry Act, 2021 envisages the need for decarbonisation, and therefore requires every concessionaire of a petroleum licence or lease to include an environmental management plan in its field development plan, and this clearly exhibits the intention to mitigate the negative environmental impacts of petroleum operations. To the extent that carbon capture and storage mechanisms are to be applied in such a plan, concessionaires may include such carbon capture and storage mechanisms in their environmental management plan, as one of the mitigating measures to be implemented in their operations.

The Nigerian Upstream Petroleum Regulatory Commission ("NUPRC"), which regulates upstream operations in Nigeria has sought to recognise carbon capture and storage, by providing in its Acreage Management, Drilling and Production Regulations that "with the consent of the Commission, the lessee may provide carbon capture and storage services with respect to reservoirs contained in the lease area."

7. Are there targets for the production of hydrogen?

No. We are not aware of any targets for the production of hydrogen in Nigeria.

8. Are there any incentive mechanisms/business models in place to support the production of hydrogen?

There are currently no specific incentives or business models applicable to the production of hydrogen. However, the production of hydrogen, being a renewable energy source, benefit from existing incentive mechanism available to all renewable energy projects in the electricity sector.

These include:

- **Customs duty exemptions**: Equipment and materials used in renewable energy projects benefit from a two-year exemption from customs duties.
- **Tax Holiday for Manufacturers**: Renewable energy manufacturers enjoy a five-year tax holiday from the commencement of their manufacturing activities.
- **Tax Holiday on Dividend Incomes**: Investors in domestic renewable energy sources also enjoy a five-year income tax holiday on the dividend they receive from the renewable energy business.
- **Pioneer Status Incentive**: This incentive grants up relief from income tax for a minimum of three (3) years and a maximum of five (5) years for companies that operate power generation, transmission, and distribution systems.

9. Are there any standards in place for the classification and/or certification of low-carbon or renewable hydrogen?

Whilst Nigeria does not have local certification schemes or technical standards for the classification of low-carbon hydrogen, it is and remains one of the thirty (30) countries that have endorsed the **COP28 Declaration of Intent on the Mutual Recognition of Certification Schemes for Renewable and Low-carbon Hydrogen and Hydrogen Derivatives**. The countries which have endorsed the declaration will work towards mutual recognition of hydrogen certification schemes to help facilitate a global market. Other African countries who have endorsed the declaration include South Africa, Sierra Leone, Namibia, Morocco, Mauritania, Ghana and Egypt.

10. Does the regulatory framework clearly define the regulatory requirements relating to the production, storage, transportation or supply of hydrogen?

As earlier stated, Nigeria currently has no standalone policy or regulatory framework peculiar to green hydrogen. However, to the extent that hydrogen is a petroleum product, the PIA and the Midstream and Downstream Petroleum Operations Regulations, 2023 ("**MDPRO**") issued by the Nigerian Midstream Downstream Petroleum Regulatory Authority ("**NMDPRA**") pursuant to the PIA, would govern the production, storage, transportation, and distribution of petroleum products. The MDPRO clearly delineates the licences and permits required for these activities, including the applicable fees and the duration of the licences.

Additionally, Nigeria's Energy Transition Plan makes provision for hydrogen as part of Nigeria's renewable energy sources towards attaining Nigeria's net zero emission goals. Specifically, provisions are made for hydrogen in the revised Nigerian Energy Policy. 2022 and the National Energy Masterplan, 2022. However, these policies and plans majorly lay down research information and policy statements and these have not been further developed to detail regulatory requirements for the production, transportation, and supply of hydrogen.

11. Are there any foreign investment restrictions related to energy and infrastructure sectors?

There are no foreign investment restrictions targeted at the energy and infrastructure sectors in Nigeria.

Instructively, Nigeria's national policy on foreign investment, permits foreign investments in all sectors of the economy except specified industries or enterprises designated as being on the "negative list" in the Nigeria Investment Promotion Commission ("NIPC") Act. Specifically, Section 17 of the NIPC Act provides ***that a non-Nigerian may invest and participate in the operation of any enterprise in Nigeria subject to the provisions of section 18, which stipulates that the section 17 shall not apply to the negative list***.

The prohibited sectors of investment under the negative list as provided in section 31 of the NIPC Act are: (a) production of arms, ammunition, etc.; (b) production of and dealing in narcotic drugs and psychotropic substances; (c) production of military and para-military wears and accoutrement, including those of the Police and the Customs, Immigration and Prison Services; and (d) such other items as the Federal Executive Council ("**FEC**") may from time to time determine. It is important to note that negative list does not contain an exhaustive list because of the grant of discretionary power to the FEC to determine other

enterprises that may be added to the investment prohibition list. However, the nature of business activities in the sectors which are listed under the investment prohibition list are enterprises involved in products or services that touch on national security.

Section 24 of the NIPC Act guarantees the unconditional transfer of funds through any licensed bank or licensed specialist bank in freely convertible currency, of dividends or profits (net taxes) attributable to the investment. This also covers payments towards loan servicing where a foreign loan has been obtained, remittance of proceeds (net of all taxes), and other obligations, in the event of either a sale or liquidation of the enterprise or any interest attributable to the investment.

Additionally, Section 25 of the Nigerian Investment Promotion Commission (NIPC) Act guarantees that there will be no nationalization or expropriation of foreign investments by the Nigerian government.

12. What international treaties are in place that may offer protection to international investors in hydrogen projects in the jurisdiction

Although there are no specific international treaties offering protection to international investors in hydrogen projects, Nigeria is signatory to multiple Bilateral Investment Treaties with several counties which guarantee investment protection and provide for obligations of the state towards such investors.

Indeed, Section 26(2) of the NIPC Act provides some protection, especially in relation to dispute resolution, by stating that any dispute which are not amicably settled through mutual discussions, may be submitted at the option of the aggrieved party to arbitration, in the case of a foreign investor, within the framework of any bilateral or multilateral agreement on investment protection to which the Federal Government and the country of which the investor is a national are parties.

However it is important to note that treaties between Nigeria and other subjects of international law do not transform into domestic laws unless they are specifically domesticated (this requires these treaties to enacted into laws by the Nigeria's legislative arm, known as the National Assembly).

Market developments and opportunities

13. Are there any government grants or other government funding available to hydrogen projects (including for research and development)?

We are not aware of any government grants or funding that are available to hydrogen projects in Nigeria. Nigeria's Energy Transition Office however, reports that it is working with public and private partners to facilitate financing commitments for Nigeria's Energy Transition Plan.

Further, Nigeria also enjoys support from foreign governments for hydrogen research as we are aware of the **Nigeria4H2 Project** which was launched in January 2024 and funded by the German Federal Ministry of Education and Research, and seeks to investigate the potential for green hydrogen whilst defining a path for an acceptable transition in Nigeria. With a budget of €342,700 Euros, (circa N417 million at the prevailing exchange rate), the study is expected to last four months and cuts across participants from the academia, research organisations, government among others.

14. Are there any notable pilot/demonstration projects in place or planned for the production or offtake of clean hydrogen?

In June 2023, **Impact Hydrogen**, a leading organizer of green hydrogen projects, partnered with local parties like **Technologic** in the development of a **Hydrogen Valley** in Nigeria. This partnership focuses on maximizing community engagement, ensuring that the project is sustainable and beneficial to the local population.

Additionally, in December 2023, the German DWS Group signed a $500 Million Memorandum of Understanding with Union Bank of Nigeria to **invest in renewable energy projects** in rural communities across Nigeria, with green hydrogen being a key focus.

Further, FuelCell Energy, Inc. (Nasdaq: FCEL) and Oando Clean Energy Limited (OCEL), the renewable energy subsidiary of Oando Energy Resources (OER), have **announced** the signing of a memorandum of understanding to collaborate on the development of Large-Scale Green Hydrogen production and a 5MW - 15-MW low carbon power plant.

Finally, in March 2024, CGK Global, a waste management company based in Qatar, **announced plans** to establish a state-of-the-art hydrogen plant in Kaduna State, Nigeria, with a possible total investment of $350 Million.

15. Are there any commercial-scale clean hydrogen production projects in development or already operating?

We are aware that the Memorandum of Understanding, signed by and between FuelCell Energy and Oando Clean Energy Limited (OCEL) relates to the development of a large-scale green hydrogen and low-carbon energy production in Nigeria. The project will include a 5MW - 15MW power plant with FuelCell Energy providing its fuel cell and electrolyzer technology.

16. Have there been any hydrogen-related disputes in your jurisdiction?

We are not aware of any hydrogen-related disputes in Nigeria.

Last updated May 2024

Norway

Ashurst collaborated with **Schjødt** in the preparation of this content. We are grateful for their input.

Policy and regulation

1. Is there a government hydrogen strategy or policy?

Yes, Norwegian Governments have launched both a **hydrogen strategy** and a **roadmap**.

The former Norwegian Government published in 2020 a Hydrogen Strategy. The present Government, which took over in 2021, has in its basic mission statement ("the Hurdal Platform") expressed that Norway shall develop a value chain for production, distribution and use of hydrogen produced with none or low emissions and contribute to the development of the hydrogen market in Europe.

In its 2023 "Roadmap 2.0 for Green Industrial Lift" the Government has pointed to the market possibilities that Norway's availability of renewable electric power for electrolysis of water to hydrogen ("green hydrogen") and of natural gas for production of hydrogen with carbon capture and storage ("CCS") ("blue hydrogen"). Several challenges are addressed: The present global low level of clean hydrogen production, the lack of a market for such hydrogen, and the needs for technological development, cost reductions and for energy. However, the Government will analyse the European market potential and contribute to a development of this market with the aim of Norwegian exports of clean hydrogen. with the ambition of a coherent value chain including production, distribution and use.

The Government's further ambition is to facilitate the production with no or low level of emissions to cover the national demand in 2030.

The Government will also facilitate the establishment of production of blue hydrogen in a socio-economic beneficial manner, and, including with the offshore gas network operator Gassco, to award offshore areas for CO2 storage.

2. What are key goals and commitments included in the strategy/policy?

Clean hydrogen is a key part of the Norwegian Government's decarbonisation strategy.

Norway is the third largest exporter of natural gas in the world behind Russia and Qatar. Norway also supplies between 20 and 25 % of the EU gas demand, making it the second largest supplier to the EU. Approximately half of the capacity of hydropower magazines of the EU/EEA are also placed in Norway.

Due to its significant resources of gas and hydropower, Norway is a country which can provide the primary energy required for production of hydrogen from existing accessible energy resources in a cost-effective way and with competitive prices.

Since Norway's electricity production is nearly 100 % renewable, the Strategy and the Road Map provide that hydrogen is to be used for the hard to abate sectors such as the maritime sector, heavy transport, and general industry.

Hydrogen will be produced by electrolysis and from natural gas combined with CCS. Ammonia will also be a key product in this regard.

There are, however, no established targets for green or blue hydrogen even though the Hurdal Platform has envisaged that such targets will be established by 2030.

Nevertheless, climate targets regarding the cutting of emissions have been set to a general reduction of 55% by 2030 compared to 1990 and climate sub-targets for certain sectors such as maritime have also been set. For example, all ferries and charter boats in coastal waters in Norway will be required to be zero emission vessels by 2026.

It is also worth noting that the current Norwegian Government issued a new export strategy on 10 March 2022 stating that offshore wind and green shipping are some of the key initiatives where hydrogen is expected to be an important contributor.

3. Which industry sectors are most likely to be affected by hydrogen deployment?

The power sector in Norway is nearly 100% fuelled by renewable energy due to the hydropower resources. As such, Norway does not have a downstream gas market but is a net exporter of gas. Heating is either covered by district heating or through direct electrification. Power and heating sectors are therefore already decarbonised in Norway.

Consequently, the industry sectors likely to be affected by hydrogen deployment are the hard to abate sectors, including:

- road transport;
- shipping and aviation; and
- general industry.

4. Who are the main regulators for the hydrogen market?

N/A

5. Does the government hydrogen strategy or policy support the development of both low-carbon (blue) hydrogen and renewable (green) hydrogen?

The Hydrogen Strategy supports both low-carbon (blue) hydrogen and renewable (green) hydrogen. This can be explained by Norway's significant resources i.e. hydropower and natural gas. In addition to the various green hydrogen initiatives, Norway promotes towards the EU the use of blue hydrogen with the use of CCS, at least as a transition low-carbon energy source for the expected quite long period before green hydrogen fully can supply the future hydrogen market. This is expected to continue beyond 2050.

6. If the government hydrogen strategy or policy supports the development of low-carbon hydrogen, to what extent is carbon capture and storage being taken forward?

In Norway, the Government has been providing substantial support for carbon capture and storage for more than a decade. Gassnova SF, a state-owned entity, was established in 2005 to promote technological development, and build competence for cost-effective and future-oriented solutions for CCS. Gassnova shall facilitate the Norwegian State's participation in CCS projects to provide maximum benefit for the State or State-owned entities.

As of today, the Norwegian CCS initiative consists of three main elements:

1. the **CLIMIT programme**, which provides financial support for development of CCS technology;
2. the **Technology Centre Mongstad (TCM)**, which is the world's largest and most flexible test centre for developing CO2 capture technologies and a leading competence centre for carbon capture. The State (being the majority owner) owns TCM together with Equinor, Shell and Total; and
3. the **Longship project**.

Longship is one of the first industrial CCS projects to develop an open access infrastructure with the intent and the capacity to store significant volumes of CO2 from across the European continent. It consists of two capture projects, Norcem (cement production) and Fortum Oslo Varme (waste to energy plant) and a transportation and storage project, Northern Lights. The Government provides substantial financial support to the Longship project, both for capital and operational expenditures.

On the regulatory side, Norway has implemented the CO2 Storage Directive through separate CO2 Storage Regulations.

Several licenses have been awarded both for exploration for and for exploitation of subsea reservoirs on the Norwegian Continental Shelf for injection and storage of CO2.

7. Are there targets for the production of hydrogen?

No targets have yet been set beyond the high level target of 55 % emissions cut by 2030. However, in the Government's Hurdal Platform it is suggested that hydrogen production targets will be set.

8. Are there any incentive mechanisms/business models in place to support the production of hydrogen?

There are several incentive mechanisms in place already.

Significant state funding is granted through Enova, the Norwegian Research Council, and Innovation Norway.

Moreover, two Research Centres for hydrogen have been established in Trondheim and in Bergen. These are connected to several other academic and industrial Clusters in Norway: **HYDROGENi** and **HyValue**.

Norway has also joined Europe's IPCEI (Important Project for Common Interest) initiative for hydrogen.

9. Are there any standards in place for the classification and/or certification of low-carbon or renewable hydrogen?

There are no existing standards in place for the classification of hydrogen, however in the Hydrogen Strategy, the Government states that green hydrogen will be produced from electricity from the grid, which is already fully renewable energy. The Strategy also refers to production from natural gas with carbon capture and storage.

10. Does the regulatory framework clearly define the regulatory requirements relating to the production, storage, transportation, or supply of hydrogen?

The existing regulatory framework defines safety standards for hydrogen referring to the regulation for dangerous substances.

Norway is also linked to the European internal market by the EEA Agreement. The European Commission presented its Hydrogen and Decarbonisation Package on 15 December 2021. Given the third liberalisation package incorporates both the power and gas market into the EEA Agreement, this Hydrogen and Decarbonisation Package is expected to be EEA relevant.

However, it is worth noting that the Renewable Energy Directive (RED II and III) in the Clean Energy Package is still not incorporated into the EEA Agreement - it is currently under negotiations between the EU and the EEA States. The EU has been putting political pressure on the Norwegian Government to implement RED II, but this is a contentious matter between the two political parties in the Government.

11. Are there any foreign investment restrictions related to energy and infrastructure sectors?

There are no limitations to foreign investment in hydrogen production or infrastructure. However, the hydropower installations are publicly owned, whilst the exploitation of oil and gas resources are open to qualified private investments.

12. What international treaties are in place that may offer protection to international investors in hydrogen projects in the jurisdiction?

Norway is part of the European Internal Market and is recognised for its stability, democratic rule and its openness and transparent protection of foreign investments, particularly at the Norwegian Continental Shelf.

The Energy Charter Treaty (ECT) is a multilateral investment treaty which entered into force in April 1998. Itspecifically addresses energy trade, transit, and investment between its contracting parties, which include the UK and all EU states (except Italy). Discussions as to the modernisation of the ECT have been ongoing for several years, focussing on investment protection and "greening" the ECT. Norway has however, not ratified this Treaty.

Market developments and opportunities

13. Are there any government grants or other government funding available to hydrogen projects (including for research and development)?

There has been a number of different funding initiatives targeted at different parts of the hydrogen value chain. Funds are channelled through Enova, Innovation Norway, and the Norwegian Research Council.

14. Are there any notable pilot/demonstration projects in place or planned for the production or offtake of clean hydrogen?

There are a number of different pilot projects being deployed in Norway to examine and test the feasibility of clean hydrogen production and use in different sectors.

The Norwegian hydrogen industry is under a rather rapid development with a large number of projects over the whole of Norway. The Norwegian industry association Norsk Hydrogenforum has on its website a map of the Norwegian hydrogen landscape (https://www.hydrogen.no/faktabank/det-norske-hydrogenlandskapet).

Enova has until the beginning of 2024 granted financial support with NOK 2.2 billion to projects within hydrogen and ammonia in the maritime sector and has recently established further support programs within this sector. The supported projects include five production plants for green hydrogen and a number of new vessels.

A number of production plants for green hydrogen are under construction or under planning. This includes projects for delivery to the maritime sector along the coast of Norway as well as projects for export to the European market.

The construction of an export pipeline for hydrogen from Norway to Germany has been agreed between Equinor and RWE. This is one element in a broader energy cooperation agreement between the two companies which also includes the construction of offshore wind farms for the production of green hydrogen.

The Norwegian based international leading fertilizer producer Yara is constructing one of the world's largest pilot projects producing green ammonia in Norway. As the world's second largest ammonia producer Yara is broadly engaged in developing blue and green ammonia projects within shipping fuel, power production, ammonia as hydrogen carrier and clean fertilizer for food segments.

15. Are there any commercial-scale clean hydrogen production projects in development or already operating?

Several clean hydrogen production projects are in different stages of development and as well as in early production. There is an increasing activity in the M&A sector where investors are already funding hydrogen production and development of the hydrogen value chain.

16. Have there been any hydrogen-related disputes in your jurisdiction?

None generally known in the public.

Last updated May 2024

Oman

Policy and regulation

1. Is there a government hydrogen strategy or policy?

No. There is currently no published national strategy relating specifically to hydrogen. However, Oman is actively pursuing a transition from relying on energy derived from hydrocarbons to renewable energy and is establishing a green economy as part of its national objectives (which are set out in Oman Vision 2040) and its recent commitment to reach net zero emission by 2050 (in line with the Paris Agreement). As part of this transition, the Oman government has recently increased its efforts to establish a vibrant hydrogen sector in Oman by pursuing various hydrogen projects. In March 2022, the Oman government also issued Royal directives which set out the steps Oman is taking to establish a framework for growth and investment in the sector.

Oman Vision 2040

In its national strategy document, Oman Vision 2040, Oman has identified "environment and natural resources" as a key focus area and has set out its key objectives. These include developing "a green and circular economy that addresses national needs and moves consistently with global trends". Oman Vision 2040 further provides that "new infrastructure projects will be geared towards a green economy, green strategies and renewable energy production". Oman has also set ambitious targets to meet 20% of its national energy demand by 2030 and, by 2040, to meet between 35% and 39% of its national energy demand.

Royal directives

In March 2022, Royal directives relating to the hydrogen sector were issued. The directives mandate the development of a legal framework and policies necessary for:

1. the growth of the hydrogen industry;
2. the allocation of sites for production of green hydrogen (focusing on attracting foreign investment);
3. the conduct of studies;
4. the establishment of new government structures within the Ministry of Energy and Minerals; and
5. the establishment of a new state entity.

The Oman government recently announced the establishment of a new state-owned entity called Hydrogen Oman ("Hydrom") in line with the directives.

The Ministry of Energy and Mines has also been instructed to write supporting guidelines to back and nurture the hydrogen industry's sustainable growth in line with Oman's Vision 2040 priorities.

2. What are key goals and commitments included in the strategy/policy?

Please see our responses to question 1.

3. Which industry sectors are most likely to be affected by hydrogen deployment?

Given that the hydrogen sector in Oman is still an emerging industry, it is difficult to predict which industry sectors are likely to be affected. The Oman government has stated that projects are being developed to meet local demands, including from the electricity and heavy industry (such as iron and aluminium) sectors, as well as global demands.

4. Who are the main regulators for the hydrogen market?

There is currently no specific regulatory body governing the hydrogen sector in Oman. However, the Royal directives of March 2022 relating to the hydrogen sector mandate the development of a legal framework and policies necessary for the establishment of new government structures within the Ministry of Energy and Minerals.

Following the promulgation of the Royal directives, progress has been made with the inception of Hydrom. This independent entity, under the ownership of Energy Development Oman and under the regulatory oversight of the Ministry of Energy and Minerals, is tasked with implementing a comprehensive vision for Oman's green hydrogen industry. Hydrom assumes a wide-ranging role, encompassing strategic planning for the sector, allocation of government-owned land for green energy ventures, structuring large-scale projects, managing developer assignments, overseeing project execution, and fostering the development of requisite infrastructure and associated industries.

In furtherance of the Royal directives, Royal Decree No. 10/2023 has been enacted, specifically designating land for renewable energy and clean hydrogen projects. Since February 2023, the Ministry of Energy and Minerals has been vested with full authority to delineate and execute the scope of green energy projects and clean hydrogen initiatives on designated sites, with Hydrom appointed as the usufructuary of such land. Hydrom, in turn, possesses the authority to partition the land and allocate sub-usufructs via auction to developers of renewable energy and clean hydrogen projects.

In light of these developments, we anticipate that Hydrom and the Ministry of Energy and Minerals will play integral roles in regulatory engagements pertaining to all participants in Oman's evolving hydrogen market, with the Ministry of Commerce, Industry and Investment Promotion playing a likely role as regulator..

5. Does the government hydrogen strategy or policy support the development of both low-carbon (blue) hydrogen and renewable (green) hydrogen?

There is currently no published national strategy on hydrogen. However, the Minister of Energy and Minerals of Oman announced that Oman will target an annual green hydrogen production of one million tons by 2030.

6. If the government hydrogen strategy or policy supports the development of low-carbon hydrogen, to what extent is carbon capture and storage being taken forward?

N/A. There is currently no published national strategy on hydrogen.

7. Are there targets for the production of hydrogen?

There is currently no published national strategy on hydrogen. However, the Minister of Energy and Minerals of Oman announced that Oman will target green hydrogen production of one million tons by 2030.

8. Are there any incentive mechanisms/business models in place to support the production of hydrogen?

There are currently no financial or regulatory incentives to promote or support the production of hydrogen.

9. Are there any standards in place for the classification and/or certification of low-carbon or renewable hydrogen?

We are not aware of any standards relating to the classification and/or certification of low-carbon or renewable hydrogen.

10. Does the regulatory framework clearly define the regulatory requirements relating to the production, storage, transportation or supply of hydrogen?

There is currently no legal or regulatory framework which regulates hydrogen. Oman is currently in the process of developing such a framework.

Law for the Regulation and Privatisation of the Electricity and Related Water Sector promulgated by Royal Decree 78/2004 (the Sector Law) regulates the generation, transmission and distribution of all electricity.

11. Are there any foreign investment restrictions related to energy and infrastructure sectors?

At present there are no restrictions relating to foreign investments in the energy and infrastructure sectors in Oman. The Sector Law allows 100% foreign ownership of companies that generate electricity through renewable energy. However, publicly tendered IPPs (including for renewable energy projects) in Oman typically include an obligation to list a minority shareholding in the project company on the local securities exchange for a specified period following commencement of commercial operations.

12. What international treaties are in place that may offer protection to international investors in hydrogen projects in the jurisdiction?

Oman is a party to international treaties relating to enforcement of foreign arbitral awards and judgments in Oman. While the Civil Procedure Law of Oman promulgated by Royal Decree 29/2002 does provide a framework for enforcement of foreign arbitral awards and judgments in Oman, the international treaties significantly enhance an international investor's ability to enforce (without the need to re-examine or re-litigate) where the arbitral awards or judgments are issued from other member states.

Enforcement of arbitration awards

Oman is a party to the New York Convention on the Recognition and Enforcement of Foreign Arbitral Awards of 1958 (the **New York Convention**) which it acceded to in 1998 and the Riyadh Arab Convention for Judicial Co-operation of 1983 (the **Riyadh Convention**) which it ratified in 1999. Where an arbitration award is issued from a member state of either the New York Convention or the Riyadh Convention, the courts of Oman should enforce such awards unless a party can raise valid grounds for refusing enforcement under the conventions or that the subject matter of the award is against Oman public policy.

International investors can therefore agree to dispute by arbitration outside of Oman. Member states of the New York Convention, in particular, include arbitration seats widely used in cross-border transactions such as the United Kingdom, Singapore, United States of America, Switzerland and the United Arab Emirates.

Enforcement of judgments

Oman is party to both the Riyadh Convention and the Gulf Cooperation Council Treaty for the Enforcement of Judgments, Judicial Delegation and Court Summons signed in 1996 (the **AGCC Protocol**) which, similar to the arbitration conventions, provide enhances the ability of investors to enforce foreign judgments issued from the courts of member states. .

Market developments and opportunities

13. Are there any government grants or other government funding available to hydrogen projects (including for research and development)?

We are not aware of any funding programmes or government grants set up for hydrogen projects.

14. Are there any notable pilot/demonstration projects in place or planned for the production or offtake of clean hydrogen?

Sohar Industrial Port has announced its plans to turn the port into a hub for lower-cost hydrogen in place of traditional hydrocarbons, as well as plans to develop 3.5GW of solar power capacity.

State-owned OQ Alternative Energy has collaborated with Belgium's DEME Concessions to develop a **green hydrogen project in Duqm**.

ACME Group have announced a **second, green hydrogen project** in partnership with the state-owned Tatweer. The project is expected to include a $3.5 billion green ammonia plant.

Hydrom has announced that agreements have been signed, awarding a numbe of blocks of land for the development of five hydrogen projects:

- The first projects was signed with a consortium comprised of Copenhagen Infrastructure Partners, Blue Power Partners and Al Khadra, part of Oman's Hind Bahwan Group.
- The consortium will develop around 200,000 tonnes per annum of green hydrogen from 4.5 GW of installed renewable energy capacity for planned green steel plants located in Block Z1-01 and Block Z1-02 in the Port of Duqm, within the Special Economic Zone at Duqm.
- The second project was signed with BP Oman for the development of green hydrogen for ammonia production and export. The anticipated annual production for this project is 150,000 tonnes per annum of green hydrogen from 3.5 GW of installed renewables capacity in Block Z1-03.
- The third project was signed with the consortium of Green Energy Oman (GEO) for the development of green hydrogen and its derivatives. The consortium includes Oman's integrated Energy Company OQ, Oman Shell, Kuwait's energy investor EnerTech, InterContinental Energy and Golden Wellspring Wealth for Trading. This project is expected to produce up to 150,000 tonnes per annum of green hydrogen from 4 GW of installed renewables capacity in Block Z1-04.
- The fourth project was signed with the a consortium of POSCO-ENGIE consisting of POSCO Holdings, MESCAT Middle East DMCC, Samsung Engineering Co. Ltd., Futuretech Energy Ventures, Korea East-West Power Co. Ltd. and Korea Southern Power Co. Ltd. The consortium is expected to produce more than 200,000 tonnes per annum of green hydrogen by 2030, utilising over 5.2 GW of combined wind and solar energy to produce and export ammonia. The plant will be built in the Al Wusta Governorate.
- The fifth project was signed with a consortium of Hyport Duqum consisting of OQ Alternative Energy, and DEME Concessions NV, to produce green hydrogen. The consortium aims to produce more than 50,000 tonnes per annum of green hydrogen by 2029 in the project's first phase.

Hydrom has announced the launch of Round 2 of its auction process and plans to award up to three land blocks in the Dhofar region in 2024.

15. Are there any commercial-scale clean hydrogen production projects in development or already operating?

Oman has announced a number of sizeable plans and has entered into several MOUs and agreements for feasibility studies in relation to clean hydrogen projects. However, these are currently in their early stages.

16. Have there been any hydrogen-related disputes in your jurisdiction?

N/A. We are not aware of any hydrogen-related disputes in Oman.

Last updated May 2024

Poland

Ashurst collaborated with **SSW Spaczyński, Szczepaniak i Wspólnicy sp. k.** in the preparation of this content. We are grateful for their input.

Policy and regulation

1. Is there a government hydrogen strategy or policy?

Yes. The National Hydrogen Strategy Until 2030 With An Outlook To 2040 ("**Strategy**"), published on 7 December 2021, is a strategic document which sets out the main objectives for developing a hydrogen economy in Poland and the kinds of activities required to achieve them. The geopolitical situation in Poland, Europe and the world has changed significantly since 2021. Accordingly, the Ministry of the Climate and the Environment has announced that it is preparing an updated Strategy. This will enable a review of the current state of development of the hydrogen economy in Poland and facilitate coordination with other strategic documents, such as the Energy Policy of Poland until 2040 ("**PEP2040**") and the National Energy and Climate Plan for the years 2021-2030 ("**NECP PL**"). Between 12-30 June 2023, the Ministry of the Climate and the Environment held a public pre-consultation on updating the NECP PL and the PEP2040.

2. What are key goals and commitments included in the strategy/policy?

The Strategy's overarching vision and objective is to create a Polish hydrogen economy which is developed so as to achieve climate neutrality and maintain the competitiveness of the Polish economy. The objectives formulated in the Strategy refer to three priority areas of hydrogen use (energy, transport and industry), to hydrogen production and distribution and to the need to create a stable regulatory environment.

The Strategy identifies 6 specific objectives:

OBJECTIVE 1: Implementation of hydrogen technologies in the power and heating sector

By 2025, this objective assumes, among other things, the commissioning of a P2G class plant of at least 1 MW to help stabilise the operation of the distribution networks, as well as the co-firing of hydrogen in gas turbines (depending on technical feasibility) and the conversion of existing natural gas-fired power plants of hydrogen power plants. The Strategy envisages, among other things, the commissioning of cogeneration and polygeneration plants (e.g. CHP plants with a capacity of up to 50 MWt, using hydrogen as the main fuel) and beginning to use hydrogen as an energy carrier for energy storage processes. Additionally, it envisages the installation of cogeneration and polygeneration plants from 10 kW to 250 kW using hydrogen fuel cells for housing estates, office buildings, small housing estates and public buildings. As part of the integration of hydrogen technology with RES, it is planned to extend photovoltaic systems with electrolysers and rainwater purification stations to produce renewable hydrogen.

Objective 2: Use of hydrogen as an alternative fuel for transport

The second objective assumes the introduction of zero-emission hydrogen-powered buses. Between 100 and 250 new hydrogen buses are anticipated by the end of 2025, and between 800 and 1,000 hydrogen buses, including those manufactured in Poland by the end of 2030. The development of a network of hydrogen refuelling and bunkering stations assumes that at least 32 new stations will exist by the end of 2025 and that further development of Poland's hydrogen infrastructure will continue in subsequent years. The next step in terms of transport is to gradually replace trains and diesel locomotives with hydrogen equivalents and to develop floating vessels with a hydrogen-based propulsion system (e.g. ammonia, methanol). This section of the Strategy also discusses the development of synthetic fuels based on hydrogen.

Objective 3: Supporting the decarbonization of industry

As a starting point, the Strategy sets out a series of actions up to 2025 for acquiring and applying low-carbon hydrogen for petrochemical, chemical and fertiliser production processes based on green industrial energy. It also envisages developing strategies and launching the first pilot projects to implement low-carbon hydrogen technologies in the most energy-intensive industries. The Strategy envisages the creation of at least 5 hydrogen valleys as centres of excellence for implementing the hydrogen economy, sector integration, industrial climate change and infrastructure construction. Additionally, the Strategy implies that the resulting investments will be integrated into a common European infrastructure. The Strategy also includes plans to transfer knowledge and exchange experience at a national and international level on the best hydrogen industry solutions.

Objective 4: Hydrogen production in new installations

Objective 4 is to support research and development of low-carbon hydrogen technologies and the commissioning of installations to produce hydrogen from low-carbon sources, processes and technologies with a total capacity of at least 50 MW by the end of 2025. It is also planned to launch the production of synthetic gases by the methanation of hydrogen and the use of low-carbon hydrogen in the production of ammonia. The Strategy aims to ensure a 2 GW capacity of installations for producing hydrogen and its derivatives from low-carbon sources, processes and technologies, including in particular the installation of electrolysers.

Objective 5: Efficient and safe hydrogen transmission, distribution and storage

The Strategy envisages that, by the end of 2025 the following will be prepared: an analysis of the most optimal form of energy transmission for developing the hydrogen economy; a feasibility study for a dedicated hydrogen north-south pipeline; and an investigation of Poland's existing gas infrastructure to assess the viability of injecting hydrogen and transporting hydrogen-gas mixtures. The next step is to adapt selected sections of the gas network to enable the transmission and distribution of hydrogen doped into gas and to build dedicated pipelines to transmit and distribute hydrogen or to enhance the electricity grid for transmitting electricity. The Strategy also aims to support research and development into certain areas, including: lightweight hydrogen distribution tanks; rail, road and intermodal hydrogen transport; and developing the storage of large-scale salt caverns hydrogen.

Objective 6: Creating a stable regulatory environment

Among the most important actions is the development of a legislative hydrogen package. This includes legislative regulations which define how the market should operate, implement EU law in this area and implement an incentive scheme for the production of low-carbon hydrogen.

Moreover, the National Energy and Climate Plan for the years 2021-2030 sets the following targets related to hydrogen production, storage and use:

- Objective. 1.2.2 Reducing GHG emissions from heating, including by developing RES: technologies which use a mixture of natural gas and hydrogen are one of the planned support mechanisms for GHG reduction, as are solutions based on using pure hydrogen as an energy source.
- Objective. 1.2.3 Reducing GHG emissions from transport, including by developing RES [and electromobility]: a legal framework is planned to develop hydrogen transport infrastructure and hydrogen infrastructure, to support the reduction of GHGs from transport.
- Objective. 1.2.4. Reducing GHG emissions from industry: to reduce emissions, it is planned inter alia to support the emergence of hydrogen valleys (i.e. ecosystems which expand the value chain of the hydrogen economy such as production, transport, storage and industrial end-use of hydrogen)
- Objective. 3.6.1 Ensure domestic hydrogen production: Poland would like to produce sufficient quantities of renewable and low-carbon hydrogen, as well as their chemical derivatives, to meet the needs arising from the energy transition.
- Objective. 3.6.2 Ensure the development of infrastructure for the transport of low-carbon hydrogen: ensuring the construction and development of safety infrastructure to transport hydrogen or its chemical derivatives to meet current and prospective demand for these energy carriers and raw materials.
- Objective. 3.6.3. Development of hydrogen storage infrastructure: it is estimated that Poland can potentially store up to 10,000 TWh of hydrogen in salt caverns. This is considered to be one of the largest storage capacities in Europe. Consequently, activities aimed at developing Poland's hydrogen storage infrastructure will include preparing a document to define the current state of knowledge on underground hydrogen storage, to identify rock salt deposits and seams in Poland which can be used for underground hydrogen storage, and to identify the technologies applicable to constructing and using underground hydrogen storage in Poland's salt caverns.

Additionally, as part of the infrastructure development activities, it is planned to support the implementation of the Nordic-Baltic Hydrogen Corridor and other cross-border hydrogen transport infrastructures. Support will also be given to the Programme for the Development of Hydrogen Storage in Salt Caverns to Strengthen Poland's Critical Infrastructure ("PDHSSC") within the auspices of the Gospostrateg Programme commissioned by the National Centre for Research and Development.

3. Which industry sectors are most likely to be affected by hydrogen deployment?

In line with the Strategy's assumptions and the current directions of hydrogen technology development, it will have the greatest impact primarily in areas such as energy and heating, transport and the chemical, petrochemical, refining and steel industries.

In the energy and heating sector, hydrogen is expected to be used as a fuel for cogeneration and polygeneration plants and to provide storage capacity for energy produced from renewable sources.

In the transport sector, it is envisaged that hydrogen will be used primarily as an energy source for FCEV fuel cells used to power public transport vehicles and heavy and long-distance transport. Hydrogen could also potentially be used in rail, marine, river, air and intermodal transport.

The industrial sector is highly likely to be the largest consumer of low-carbon hydrogen, given the absence of alternative decarbonisation options. Currently, Poland's main producer of grey hydrogen is the nitrogen fertiliser industry, whereas the second largest producer of hydrogen (in terms of volume) is the refining and petrochemical industry, which uses hydrogen to produce liquid fuels and refinery raw materials. Low-carbon hydrogen represents an opportunity to reduce emissions from chemical raw materials and reactants (i.e. ammonia, methanol, iron reduction and petrochemical products) by: producing and using low-emission hydrogen in technological processes; using hydrogen as a reducing agent in steel production; and blending hydrogen with natural gas in industrial processes.

4. Who are the main regulators of the hydrogen market?

No single public authority is responsible for regulating the hydrogen market (i.e. issuing decisions of key importance for the functioning of the market).

The so-called Constitution for Hydrogen will enter into force following the adoption of the *Act amending the Energy Law Act and certain other acts*. Accordingly, it seems likely that the President of the Energy Regulatory Office ("ERO") will be appointed to regulate the hydrogen market. The ERO President is the regulator of the energy market pursuant to the Polish Energy Law Act.

For a period of time, the hydrogen legislation was the responsibility of the Government Plenipotentiary for the Hydrogen Economy. This office has now been abolished. At present, the hydrogen legislation falls within the scope of responsibility of the Ministry of the Climate and the Environment ("MCE").

The MCE's task is to develop a legal and organisational framework for implementing the hydrogen economy in Poland. The MCE aims to create a regulatory environment to remove barriers to the development of the hydrogen market and to stimulate demand for this energy carrier.

Following a government reorganisation, responsibility for the hydrogen legislation will be split between the MCE and the newly created Ministry of Industry. The MCE will continue to oversee the renewable hydrogen sector, but the Ministry of Industry will regulate "grey" hydrogen produced from fossil fuels.

5. Does the government hydrogen strategy or policy support the development of both low carbon (blue) hydrogen and renewable (green) hydrogen?

Yes. The Strategy will support the introduction of both renewable (green) and low emission (blue) hydrogen production. The following sources, processes and technologies are envisaged

- Electrolysis,
- Gasification, fermentation or pyrolysis of biomass
- Steam reforming of biogas and biomethane,
- Gasification, thermal treatment or pyrolysis of waste,
- Use of waste gases,
- Steam reforming of hydrocarbons with CCS/CCU,
- Coal gasification using CCS/CCU, IGCC and IGFC technologies
- Other low carbon hydrogen processes and technologies;

6. If the government hydrogen strategy or policy supports the development of low-carbon hydrogen, to what extent is carbon capture and storage being taken forward?

The Strategy states that an alternative, interim development pathway may be to use current technological potential and implement carbon capture, storage and utilisation methods (CCS and CCU methods).

In addition, the NECP PL plans to support research and scientific, educational and commercial projects in the field of CCS and CCUS as one of the measures to reduce GHG emissions in the energy and heating sector.

However, the final assessment of the potential for developing CCS technology in Poland will depend on a number of factors, such as the cost of emission allowances, fuel and electricity prices, as well as the availability of alternatives for reducing CO2 emissions and verifying estimates of CO2 storage capacity.

A Polish company, Orlen S.A., together with Lafarge Cement and Air Liquide Polska, plans to build a CO2 marine transshipment terminal in the coming years, as part of a strategy to reduce CO2 emissions. According to information announced in December 2023, these plans to have the potential to develop or sequester 3 million tonnes of CO2 per year between 2027 and 2030.

7. Are there targets for the production of hydrogen?

Yes. The Strategy's current provisions specify a target for the installed capacity of low-carbon hydrogen production facilities of 50 MW in 2025 and 2,000 MW in 2030.

According to the information contained in the NECP PL and calculated by the Ministry of Climate and Environment, Poland will need about 270,000 tonnes of RFNBO hydrogen in 2030, which will be used in industry (mainly as a target or intermediate raw materials for ammonia production) and about 91.7 thousand tonnes in transport (understood as a fuel and feedstock for conventional fuel production). The 2,000 MW of production capacity planned to be installed in 2030 will enable the production of 193,500 tonnes of renewable hydrogen per year. The installation of renewable hydrogen production capacity will be partly made possible by funding from the National Reconstruction and Resilience Plan under the National Recovery Plan. The remaining capacity will be realised through potential funding from the Hydrogen Differential Contract. However, this volume will not cover all of Poland's low-carbon and renewable hydrogen needs in 2030, so imported raw materials will be required to make up the shortfall.

In contrast, the latest update of NECP PL/PEP2040 estimates that the installed capacity could double to about 410 tonnes in 2040, but the demand for hydrogen in Poland could reach about 1.3 million tonnes, mainly for decarbonisation of industry and transport. Meeting this demand with domestic production will be possible if the installed capacity of electrolysers increases to around 10-12 GW.

8. Are there any incentive mechanisms/business models in place to support the production of hydrogen?

At present, no statutory operational support exists for producers. However, the proposed NECP PL aims to implement Contracts for Differences for industrial hydrogen production. A Contract for Differences is designed to provide public support in the form of a predetermined subsidy on the price of 1 kg of hydrogen produced by a producer and consumed by a customer in Poland. The premium is intended to reduce the difference between the price of renewable hydrogen and grey hydrogen.

9. Are there any standards in place for the classification and/or certification of low-carbon or renewable hydrogen?

The Electromobility and Alternative Fuels Act of 11 January 2018 introduced criteria to be fulfilled by hydrogen in order to be classified into the following three categories:

- **low carbon hydrogen**: produced by electrolysis or other processes in a way that does not seriously harm environmental objectives and whose lifecycle greenhouse gas emissions do not exceed 3 tonnes of carbon dioxide equivalent per tonne of hydrogen;
- **electrolytic hydrogen**: low carbon hydrogen produced by the conversion of electricity by electrolysis;
- **renewable hydrogen**: renewable hydrogen within the meaning of Article 2(102c) of Commission Regulation (EU) No 651/2014 of 17 June 2014 declaring certain categories of aid compatible with the internal market in application of Articles 107 and 108 of the Treaty.

The Polish Renewable Energy Source Act of 15 February 2015 defines the renewable hydrogen. It is defined as hydrogen produced in a renewable energy facility using renewable energy sources, including by electrolysis. Producers of renewable hydrogen can obtain guarantees of origin.

10. Does the regulatory framework clearly define the regulatory requirements relating to the production, storage, transportation or supply of hydrogen?

The government is currently preparing legislation that is sometimes colloquially referred to as the *Constitution for Hydrogen*. Once adopted, Polish legislation will clearly define the regulatory requirements for the production, storage, transport or supply of hydrogen. At present, however, hydrogen issues are regulated in a fragmented way in various pieces of legislation.

According to the Geological and Mining Law Act of 9 June 2011, legislative provisions which apply to hydrocarbons also apply to hydrogen. This Act explicitly provides for the possibility of obtaining a concession for tankless hydrogen storage.

The Fuel Quality Monitoring and Supervision Act of 25 August 2006 obliges hydrogen producers to meet certain quality requirements. The same requirements also apply to those who transport, store and supply hydrogen. This Act also contains rules on supervising activities related to hydrogen. A Regulation Of The Ministry Of The Climate And The Environment On The Quality Requirements For Hydrogen, dated 23 December 2022, stipulates requirements regarding the use of hydrogen as a fuel used to propel vehicles.

The Renewable Energy Source Act of 15 February 2015 includes provisions on issuing guarantees of origin for renewable hydrogen producers.

A Regulation of the Ministry of the Economy On The Detailed Conditions For The Functioning Of The Gas System, dated 2 July 2010, stipulates pre-requisites for transporting hydrogen through the gas grid as a component of a gas mixture.

11. Are there any foreign investment restrictions related to energy and infrastructure sectors?

Poland is open to investment in the energy sector. In general, there are only a few restrictions on foreign investors.

The Control Of Certain Investments Act of 24 July 2015 is of fundamental importance in terms of establishing restrictions on foreign investment. Initially, this Act only protected a limited number of entities of strategic importance for the state. Entities deemed to be strategic, according to detailed criteria contained in the Act, were included in a list of protected entities established by a Regulation of the Polish Council of Ministers.

In connection with the Covid-19 outbreak, additional restrictions were introduced on the possibility for foreign investors to acquire shares or stocks in companies engaged in certain activities. These restrictions applied to investors from outside the European Union who are not based in the European Economic Area (EEA) or member states of the Organisation for Economic Co-operation and Development (OECD). Following the outbreak of war in Ukraine, these additional restrictions have been extended. They will expire on 25 July 2025.

12. What international treaties are in place that may offer protection to international investors in hydrogen projects in the jurisdiction

Poland withdrew from the Energy Charter Treaty ("ECT") with effect from 29 December 2023. Pursuant to Art. 47(3) of the ECT, its provisions shall continue to apply to investments made in Poland for 20 years from this date.

The United Nations Conference on Trade and Development ("UNCTAD") website states that Poland is a signatory to 36 bilateral investment treaties (BITs) that are in force. Poland has terminated its intra-EU investment treaties, but continues to be a signatory of non-EU investment treaties.

Market developments and opportunities

13. Are there any government grants or other government funding available to hydrogen projects (including for research and development)?

The National Recovery and Resilience Plan includes a programme of investment in hydrogen technology, production, storage and transport. It includes funding of almost €800 million. The programme should lead to a total installed renewable and low carbon hydrogen production capacity of at least 315 MW. Grants will be provided directly to the private sector to achieve this objective. At least €640 million in grants (net of costs and fees) will be made available.

Furthermore, the EU Commission has approved a third Important Project of Common European Interest (IPCEI) to support hydrogen infrastructure. The project, called "IPCEI Hy2Infra", was jointly prepared and notified by seven Member States: France, Germany, Italy, Netherlands, Poland, Portugal and Slovakia. The Member States will provide up to €6.9 billion of public funding, which is expected to leverage €5.4 billion of private investment. The IPCEI Hy2Infra programme applies to a large part of the hydrogen value chain, particularly by supporting the deployment of 3.2 GW of large-scale electrolysers for the production of renewable hydrogen.

The National Fund for Environmental Protection and Water Management organises a programme called "Support for Electric Vehicle Charging and Hydrogen Refuelling Infrastructure". The programme provides for the possibility of co-financing projects involving the construction or reconstruction of a publicly accessible hydrogen refuelling station. Support is provided in the form of a grant.

14. Are there any notable pilot/demonstration projects in place or planned for the production or offtake of clean hydrogen?

Solaris hydrogen bus: On 14 September 2022, Solaris unveiled the Urbino 18 hydrogen bus. The Urbino 18 hydrogen is powered by the most advanced hydrogen cell on the market, which acts as a miniature hydrogen power plant. The cell converts hydrogen into electricity, which is then transferred to the drive system.

Trigeneration in Gaj Oławski: A pioneering hydrogen management system has been implemented in Gaj Oławski. An electrolyser system powered by electricity from renewable energy sources and a hydrogen storage facility have been built. The technical parameters of the cogeneration unit are 0.999 MWe electrical capacity and 2.2 MWt thermal capacity (including 1.0 MWt outside the cogeneration process - waste energy from the electrolysis process). The project was developed by SBB ENERGY S.A. together with Promet-Plast.

Hydrogen housing estate in Śrem: The project is innovate because it uses hydrogen to heat homes and water in winter. However, the hydrogen is stored and produced in the summer using surplus energy from photovoltaic panels.

15. Are there any commercial-scale clean hydrogen production projects in development or already operating?

H2Silesia: This is a large-scale, green hydrogen plant project, developed by Polenergia. It will be built in Upper Silesia, a region associated with the extraction and use of fossil fuels. The plant will have a capacity of around 105 MW. It will produce 13,000 tonnes of green hydrogen per year. This hydrogen will be supplied to heavy industry and zero-emission transport. Polenergia is the only Polish company included in the Hy2Infra programme, under which the European Commission has approved funding of up to €142.77 million (over PLN 630 million) for the H2Silesia project.

Hydrogen refuelling station: In 2023, Polsat Plus Group and ZE PAK Group built and launched the first publicly accessible hydrogen refuelling station for cars and buses. It is one of Europe's most modern hydrogen refuelling stations. The network of hydrogen refuelling stations will be built under the NESO brand.

ZE PAK electrolyser: ZE PAK Group plans to start green hydrogen production in 2024, which will be produced through energy obtained from burning biomass at the Konin Power Plant. The production will use a HyLYZER 1000-30 electrolyser supplied by Hydrogenics Europe N.V. (now Accelera). ZE PAK plans to supply hydrogen to various entities, including six public refuelling stations that it is constructing.

Hydrogen Eagle PL02: is a comprehensive infrastructure project by ORLEN to ensure the holistic development of the entire hydrogen value chain in the region. The project's main objective is to establish five low-emission and zero-emission hydrogen production HUBs and up to 54 hydrogen refuelling stations. The hydrogen production facilities will be powered by a diversified portfolio of renewable energy sources (onshore, offshore, PV) and municipal waste treatment plants. The estimated installed capacity of electrolysers at all sites will be around 110 MW.

16. Have there been any hydrogen-related disputes in your jurisdiction?

No.

Last updated April 2024

Portugal

Ashurst collaborated with **Morais Leitão, Galvão Teles, Soares da Silva & Associados** in the preparation of this content. We are grateful for their input.

Policy and regulation

1. Is there a government hydrogen strategy or policy?

Yes, the National Hydrogen Strategy (*Estratégia Nacional para o Hidrogénio* or "**EN-H2**") was approved by Resolution of the Council of Ministers no. 63/2020, of 14 August 2020.

2. What are key goals and commitments included in the strategy/policy?

The EN-H2 is aligned with the 2050 Carbon Neutral Roadmap, approved by Resolution of the Council of Ministers no. 107/2019, of 1 July, which establishes the goal to achieve a carbon neutral economy by 2050, as well as with the National Climate and Energy Plan 2030, approved by Resolution of the Council of Ministers no. 53/2020, of 10 July, which constitutes the main instrument of the national energy and climate policy for the next decade towards a carbon neutral future.

In this context, Portugal envisages a key role for hydrogen in reducing emissions in difficult-to-decarbonize sectors and in end-uses, assuming as main goals for 2030:

- 2% to 5% of green hydrogen in energy consumption of the industry sector;
- 1% to 5% of green hydrogen in energy consumption of the road transport sector;
- 3% to 5% of green hydrogen in energy consumption of the domestic shipping sector;
- 1,5% to 2% of green hydrogen in final energy consumption;
- 10% to 15% of green hydrogen injection into natural gas grids;
- 50 to 100 hydrogen refuelling stations;
- 2GW to 2.5 GW of installed capacity in electrolysers;
- 50 to 100 hydrogen supply stations.

3. Which industry sectors are most likely to be affected by hydrogen deployment?

Portugal's strategy focuses on deploying green hydrogen to promote decarbonisation of the following sectors: industry, transports and electricity.

On the industry front, the most likely to benefit from hydrogen as an option to decarbonise are the metal, cement, refining, chemical, extractive, food, glass and ceramics industries.

4. Who are the main regulators for the hydrogen market?

No response provided.

5. Does the government hydrogen strategy or policy support the development of both low-carbon (blue) hydrogen and renewable (green) hydrogen?

EN-H2 only supports the development of renewable (green) hydrogen.

6. If the government hydrogen strategy or policy supports the development of low-carbon hydrogen, to what extent is carbon capture and storage being taken forward?

N/A.

7. Are there targets for the production of hydrogen?

Portugal's target is to have an installed capacity up to 2,5GW by 2030 to produce green hydrogen through electrolysers.

8. Are there any incentive mechanisms/business models in place to support the production of hydrogen?

At a national level, the Portuguese Government intends to implement a support scheme for green hydrogen production in 2020¬2030 – a transparent and competitive mechanism that provides support by covering the difference between the production price of green hydrogen and the price of natural gas in the national market. The funds expected to be allocated to this mechanism are around 500 to 550 million euros.

In fact, the National Gas System legal framework (*regime jurídico da organização e funcionamento do Sistema Nacional de Gás*), approved by Decree-Law No. 62/2020, of 28 August, establishes that the Government may approve specific regimes for the purchase of renewable or low carbon gases. Ministerial Order no. 15/2023, of 4 January, approved by the member of the Government for energy affairs, establishes the centralised purchasing system for biomethane and hydrogen produced by electrolysis from water, using electricity from renewable energy sources. According to such regulation, a competitive electronic auction for the acquisition, by the supplier of last resort, of hydrogen (120 GWh/year) for injection into the national gas network shall be launched. The maximum purchase price for hydrogen is € 127/MWh and the hydrogen purchase agreements to be entered into in the context of such auction will be valid for a period of 10 years (as of the date of the first hydrogen supply). At the moment, the electronic auction documentation is under public consultation.

Additionally, PO SEUR - Operational Programme for Sustainability and Efficient Use of Resources, established through an Execution Decision from the European Commission on 16 December 2014, issued an invitation in December 2020 calling for applications of renewable gas generation projects (including green hydrogen) with a view to grant a total of 40 million Euros to such projects.

The Portuguese Government has also launched, under Order nr. 6403-A/2020, of 17 June, a call for interested parties to manifest interest in participating in the Hydrogen Important Projects of Common European Interest (IPCEI) and, out of 74 interested parties, 37 have been considered eligible to constitute an IPCEI.

9. Are there any standards in place for the classification and/or certification of low-carbon or renewable hydrogen?

The EU's current energy regulatory framework does not provide exact standards to define renewable ("green") and low-carbon ("blue") hydrogen. This legal uncertainty has hampered the role-out of green and blue hydrogen markets and infrastructure in the EU. To correct this, the European Commission legislative Package on Hydrogen and Decarbonized Markets introduced new legal definitions of renewable and low-carbon hydrogen that the Commission will be empowered to detail by adopting specific calculation methodologies and threshold determinations in delegated acts. The package includes a proposal for an EU Directive on Common Rules for the Internal Markets in Renewable and Natural Gases and in Hydrogen ("Proposed Gas and Hydrogen Directive").

The Proposed Gas and Hydrogen Directive includes definitions of renewable and low-carbon hydrogen that are in line with those of the proposal to amend the Renewable Energies Directive II ("Proposed Directive to Amend RED II"):

Renewable hydrogen is defined by reference to the definition of the Proposed Directive to Amend RED II, as hydrogen that (i) derives its energy content from renewable sources other than biomass; and (ii) achieves a 70% GHG emission reduction compared to fossil fuels;

- Low-carbon hydrogen is defined as hydrogen with an energy content that is derived from non-renewable sources, and that meets a GHG emission reduction threshold of 70% compared to fossil-based hydrogen.
- Thus, the proposed main difference between renewable and low-carbon hydrogen would be the production process of the hydrogen and, in particular, the source of the energy that is used to produce hydrogen. This approach would allow low-carbon hydrogen to play a role in decarbonization and facilitate the energy transition until 2030. The expectation is that by 2030 the EU will introduce a stricter GHG reduction threshold for the definition of low-carbon hydrogen.

In Portugal, the legal framework for the organization and operation of the National Gas System (*regime jurídico da organização e funcionamento do Sistema Nacional de Gás*), approved by Decree-Law No. 62/2020, of 28 August, establishes the following definitions:

- Low-carbon gases are gaseous fuels produced from a process using energy from non-renewable sources whose carbon emissions correspond to less than 36.4 gCO(index 2)-eq/MJ;
- Gases of renewable origin are gaseous fuels produced from processes using energy from renewable sources within the meaning of Directive (EU) 2018/2001 (which establishes that "energy from renewable sources" or "renewable energy" means energy from renewable non-fossil sources, namely wind, solar (solar thermal and solar photovoltaic) and geothermal energy, ambient energy, tide, wave and other ocean energy, hydropower, biomass, landfill gas, sewage treatment plant gas, and biogas»).

It should also be noted that the European Commission, under the **Commission Delegated Regulation (EU) of 10 February 2023**, has set detailed rules for determining when electricity used for the production of renewable liquid and gaseous transport fuels of non-biological origin can be considered fully renewable. Accordingly, the Directorate General for Energy and Geology (*Direção-Geral de Energia e Geologia* or DGEG) issued an interpretative note (**Order no. 30/2023, of 13 July 2023**) further clarifying the procedure to be adopted by hydrogen generators using renewable sources. In particular, these generators must submit a statement whereby they undertake to fulfil all obligations stemming from the Directive (EU) 2018/2001 and all relevant delegated acts.

10. Does the regulatory framework clearly define the regulatory requirements relating to the production, storage, transportation or supply of hydrogen?

Although the national regulatory framework is not yet highly detailed, the DGEG and the Portuguese Environment Agency (*Agência Portuguesa do Ambiente* or APA) have published a Promoter's Guide on "Legislation and Regulation for the Hydrogen Economy", establishing that the production of green hydrogen, as a gaseous fuel of renewable origin, falls within the framework of the Responsible Industry Regime (*Sistema de Indústria Responsável* or SIR), annexed to Decree-Law no. 169/2012, of 1 August, which regime governs the prior administrative control of facilities intended for the production of gases of renewable origin in general.

Moreover, the legal framework for the organization and operation of the National Gas System, which provides for the regulation of the activities of production of low carbon gases and gases of renewable origin, determines that, in order to carry out these activities, interested parties must register in advance as producers of such gases, pursuant to Articles 69 et seq. of that legal framework.

Regarding the need for Environmental Impact Assessment (*Avaliação de Impacte Ambiental*), established by Decree-Law no. 151-B/2013, of 31 October, the law does not determine specifically that hydrogen projects are subject to such procedure. However, according to the abovementioned Promoter's Guide, the need to subject hydrogen production, transportation and storage projects to an environmental impact assessment procedure must be assessed in light of the activities that, pursuant to the abovementioned legal framework, may be obliged to carry out such procedure, in particular the following:

- Production: "integrated chemical process" and "treatment of intermediates and manufacture of chemicals";
- Storage: "surface and underground storage of fuels";
- Transportation: "Pipelines with a diameter of more than 800 mm and a length exceeding 40 km, for the transportation of gas" and "industrial installations for the transportation of gas";
- Associated projects: "water collection and transportation", "wind and solar photovoltaic power plants" and "infrastructures associated with electricity transmission".

Hydrogen is also one of the substances that falls within the scope of the Prevention of Severe Accidents Regime (*regime jurídico da prevenção de acidentes graves*), approved by Decree-Law no. 150/2015, of 5 August. Facilities where this substance is present in quantities equal to or greater than 5 tons (lower level) and 50 tons (upper level) are subject to a number of obligations, including communication obligations (Articles 14 and 15) and location compatibility assessment (Article 8), as well as the definition of a severe accident prevention policy (Article 16).

In addition, the operation of facilities where hydrogen production activities are carried out is conditional on obtaining an environmental licensing decision.

Decree-Law no. 12/2020, of 6 April, establishes the legal framework applicable to the Greenhouse Gas Emissions Trading Regime (*regime jurídico aplicável ao comércio de licenças de emissão de gases com efeito de estufa*), transposing Directive (EU) 2018/410 into national law. Under this regime and according to the provisions of Annex II, the production of hydrogen – specifically the production of hydrogen and synthesis gas by reforming or partial oxidation with a production capacity exceeding 25 tons per day, from which results in greenhouse gas emissions – is included in the scope of such legal regime. Therefore, depending on the type of project in question (depending on the type of technology, raw material and primary energy source used for the production of hydrogen or synthesis gas) it may or may be subject to the legal obligations set out in the abovementioned decree-law. Typically, green hydrogen projects based on the electrolysis of water using renewable energy sources (such as solar energy) are not covered by this regime.

It should be noted that the aforementioned diploma is also not applicable to facilities or parts of facilities used for research, development and testing of new products and processes, as well as to facilities using exclusively biomass, including equipment using fossil fuels only during start-up and shut-down situations.

Depending on the production process, the hydrogen production activity may also be covered by Decree-Law no 39/2018, of 11 June, the Air Emissions Legal Regime (*regime de emissões para o ar* or REAR), which establishes the regime for the prevention and control of emissions of pollutants into the air, as it may be considered an activity of chemical products manufacture.

11. Are there any foreign investment restrictions related to energy and infrastructure sectors?

There are no foreign investment restrictions related to energy and infrastructure sectors.

Please note, however, that the Council of Ministers may oppose to transactions resulting, directly or indirectly, in the acquisition of direct or indirect control, by an entity from outside the European Union and the European Economic Area, over strategic assets (such as the ones that are necessary to provide essential energy services) if such transactions will likely and seriously threaten national security or the country's security of supply.

12. What international treaties are in place that may offer protection to international investors in hydrogen projects in the jurisdiction?

Portugal is a signatory to the Energy Charter Treaty (ECT), an international agreement that entered into force in April 1998, which specifically addresses energy trade, transit and investment between its contracting parties, providing additional legal protection for international investments in the energy sector in signatory countries.

Market developments and opportunities

13. Are there any government grants or other government funding available to hydrogen projects (including for research and development)?

The Portuguese Recovery and Resilience Plan (Plano de Recuperação e Resiliência or PRR) establishes a set of reforms and public and private investments to be implemented in Portugal until 2026 with the European Union financial support, granted under the Recovery and Resilience Facility (as outlined in Regulation (EU) 2021/241) – particularly in what concerns the Climate Transition dimension, as 38% of the PRR's total allocation for reforms and investments is intended to support climate objectives, by means of measures such as supporting private projects for the production of hydrogen and use of other renewable energy sources, amid other energy transition measures.

The Portuguese government also instated the Environmental Fund (Fundo Ambiental), aimed at supporting sustainable development and climate change projects, and which revenues come from the carbon emission licenses auctions, the carbon tax on aviation, and maritime and fluvial travels, environmental administrative penalties, taxes such as the ISP (Tax on Petroleum and Energy Products), among others. The funding of the "Green Pipeline Project", a pilot project for the injection of green hydrogen into the natural gas grid and decarbonisation of the energy sector, is one example of the support being provided by this fund.

14. Are there any notable pilot/demonstration projects in place or planned for the production or offtake of clean hydrogen?

There are a number of different pilot projects being developed in Portugal regarding clean hydrogen production, among which:

- "Green Pipeline Project": pilot project for the injection of green hydrogen into the natural gas grid and decarbonisation of the energy sector, under which the Portuguese government has authorised a fund of 867,692 euros until 2024;
- Creation of a Collaborative Laboratory (COLAB) for the development of R&D activities around the main relevant components of the hydrogen value chain.

15. Are there any commercial-scale clean hydrogen production projects in development or already operating?

The are currently no existing commercial-scale clean hydrogen production projects in Portugal, but there are some projects under development (in different stages of development), mainly in the area of Sines and only a few in other industrial or port areas. One of the projects located in Sines is set to start production in 2026.

- Transportation: "Pipelines with a diameter of more than 800 mm and a length exceeding 40 km, for the transportation of gas" and "industrial installations for the transportation of gas";
- Associated projects: "water collection and transportation", "wind and solar photovoltaic power plants" and "infrastructures associated with electricity transmission".

Hydrogen is also one of the substances that falls within the scope of the Prevention of Severe Accidents Regime (*regime jurídico da prevenção de acidentes graves*), approved by Decree-Law no. 150/2015, of 5 August. Facilities where this substance is present in quantities equal to or greater than 5 tons (lower level) and 50 tons (upper level) are subject to a number of obligations, including communication obligations (Articles 14 and 15) and location compatibility assessment (Article 8), as well as the definition of a severe accident prevention policy (Article 16).

In addition, the operation of facilities where hydrogen production activities are carried out is conditional on obtaining an environmental licensing decision.

Decree-Law no. 12/2020, of 6 April, establishes the legal framework applicable to the Greenhouse Gas Emissions Trading Regime (regime jurídico aplicável ao comércio de licenças de emissão de gases com efeito de estufa), transposing Directive (EU) 2018/410 into national law. Under this regime and according to the provisions of Annex II, the production of hydrogen – specifically the production of hydrogen and synthesis gas by reforming or partial oxidation with a production capacity exceeding 25 tons per day, from which results in greenhouse gas emissions – is included in the scope of such legal regime. Therefore, depending on the type of project in question (depending on the type of technology, raw material and primary energy source used for the production of hydrogen or synthesis gas) it may or may be subject to the legal obligations set out in the abovementioned decree-law. Typically, green hydrogen projects based on the electrolysis of water using renewable energy sources (such as solar energy) are not covered by this regime.

It should be noted that the aforementioned diploma is also not applicable to facilities or parts of facilities used for research, development and testing of new products and processes, as well as to facilities using exclusively biomass, including equipment using fossil fuels only during start-up and shut-down situations.

Depending on the production process, the hydrogen production activity may also be covered by Decree-Law no 39/2018, of 11 June, the Air Emissions Legal Regime (*regime de emissões para o ar* or REAR), which establishes the regime for the prevention and control of emissions of pollutants into the air, as it may be considered an activity of chemical products manufacture.

16. Have there been any hydrogen-related disputes in your jurisdiction?

No response provided.

Last updated November 2023

PRC

Policy and regulation

1. Is there a government hydrogen strategy or policy?

Yes. The National Development and Reform Commission ("**NDRC**") published a comprehensive Medium-to-Long Term Plan for the Development of Hydrogen Industry ("**Hydrogen Plan**") in March 2022, laying out the government's overall policy and strategy on the hydrogen industry.

The key themes in the Hydrogen Plan are:

Making it clear that hydrogen is a critical component of China's national energy system in the future.

Recognizing hydrogen as an important medium in transitioning the energy consumption to a green and low-carbon manner.

Emphasizing the hydrogen industry as a strategic new industry.

2. What are key goals and commitments included in the strategy/policy?

The Hydrogen Plan lays out a three-stage development program with the relevant key goals as follows:

Phase	Key Goals
1 – by 2025	• Develop a relatively mature policy and institutional framework for the hydrogen industry • Maintain a basic level of control over the key technologies and manufacturing processes • Achieve substantive milestones in pilot projects • Establish a rudimentary supply of hydrogen based mainly on industrial by-product hydrogen and green hydrogen primarily targeted for near-site consumption • 50,000 fuel-cell vehicles in use
2 – by 2030	• Develop a complete system of hydrogen technological innovation and green hydrogen production and supply • Establish an orderly industrial supply chain • Achieve widespread application of green hydrogen
3 – by 2035	• Establish a mature hydrogen industry • Establish a hydrogen ecosystem with diversified application in sectors including transportation, energy storage and industrial process • Green hydrogen's contribution to the energy consumption has increased significantly as an important pillar in supporting the green transition of the energy industry

As of now, China has not set out specific goals beyond 2025 for the production of hydrogen or green hydrogen or its contribution to the energy consumption.

3. Which industry sectors are most likely to be affected by hydrogen deployment?

The industries that conventionally use fossil fuel as their primary energy source and manufacturing inputs are anticipated to be affected the most by hydrogen deployment. Some examples are as follows:

- Power (as one of the energy storage methods in addition to pumped hydro and battery storage; distributed fuel-cell power generation facilities in specific locations)
- Infrastructure (for hydrogen distribution, e.g., piping and hydrogen stations)
- Automobile and other mobility sectors (hydrogen-powered mobility, transportation and logistics, with a particular emphasis on fuel-cell medium and heavy duty trucks)
- Steel, petrochemistry, metallurgy (shifting from conventional fuel (e.g., coal and gas) to hydrogen for generation of power in industrial process, use of hydrogen as deoxidiser, expanding the replacement of conventional fossil fuel inputs with hydrogen in petrochemical process)

4. Who are the main regulators for the hydrogen market?

The main regulators for the hydrogen market in China are as follows:

- NDRC: overall industry regulator and promulgator of the primary regulations and policy guidelines
- Ministry of Industry and Information Technology: industrial regulator in charge of the equipment manufacturing and technological developments
- Ministry of Ecology and Environment: environmental regulator supervising the environmental aspects of the industry
- Ministry of Emergency Management: regulator focusing on the safety management in production and utilisation of hydrogen throughout the industry chain
- Ministry of Commerce: foreign investment regulator

5. Does the government hydrogen strategy or policy support the development of both low-carbon (blue) hydrogen and renewable (green) hydrogen?

The Hydrogen Plan does not lay out a specific national plan for the production of blue and green hydrogen, envisaging both grey and green hydrogen to be produced in light of the local resources and industries. A diversified hydrogen production system that is clean, low-carbon and low-cost will be gradually built.

In places with clustered coking, chlorine alkali and PDH industries, utilisation of industrial by-product hydrogen should be preferred. However, there is also a general policy push for carbon capture, utilisation and storage (CCUS) under China's zero-carbon policy, which presumably applies to the current grey hydrogen industry as well.

Green hydrogen, on the other hand, has been singled out for emphasis in the Hydrogen Plan, with areas of plenty renewable resources encouraged to develop green hydrogen projects on a pilot basis.

6. If the government hydrogen strategy or policy supports the development of low-carbon hydrogen, to what extent is carbon capture and storage being taken forward?

In a national policy paper issued in September 2021 following China's announcement of its goals for carbon-peak and zero-carbon, CCUS has been listed as an area for technological improvement, pilot project development and commercialisation. While China has promoted the experimentation and pilot projects in CCUS area since early 2010s, so far China's progress in most sub-fields of CCUS sector remains limited to the pre-commercialization stage. As of the end of 2021, it is estimated that about 21 CCUS pilot or commercial projects are still running, mostly in relation to coal-fired power plants and enhanced oil/gas recovery projects.

In terms of policy incentives, CCUS has been listed as an encouraged sector for foreign direct investment and included in the PRC central bank's financing support for carbon-reducing projects. It remains to be seen if the government will issue further, more specific incentives in this regard.

7. Are there targets for the production of hydrogen?

As of 2021, China's annual hydrogen production is about 33 million tonnes, of which 12 million tonnes are of industrial quality.

The government has not set out any specific target for hydrogen production save that the Hydrogen Plan targets the green hydrogen production to reach a modest 100,000 to 200,000 tonnes by 2025.

8. Are there any incentive mechanisms/business models in place to support the production of hydrogen?

On the national level, the following hydrogen related projects have been listed as encouraged category and thus are capable of enjoying the general policy benefits applicable to encouraged industries:

- Technological development and application of the complementary system of hydrogen and solar and wind power generation.
- Technological development and application and equipment manufacturing in high-efficiency hydrogen production, hydrogen transportation and high-density hydrogen storage.

Some of the more developed regions in China, on the other hand, have promulgated more specific measures to incentivize the development of hydrogen industries, including setting out specific targets for hydrogen production, hydrogen filling stations and fuel cell vehicles. These measures are constantly evolving and investors are expected to approach the authorities for more details for any particular project.

9. Are there any standards in place for the classification and/or certification of low-carbon or renewable hydrogen?

There is no classification and/or certification of low-carbon or renewable hydrogen in China but the market expects green hydrogen to be one of the priority products for which a national standard for its carbon footprint may be promulgated by 2025.

Some local government (such as Beijing) has indicated their plan to establish certification standards for certifying renewable hydrogen in the coming years and industry bodies have been pushing for issuance of national standards in this regard in recent years, including convergence of national standards with international ones.

10. Does the regulatory framework clearly define the regulatory requirements relating to the production, storage, transportation or supply of hydrogen?

The regulatory requirements relating to the production, storage, transportation or supply of hydrogen are scattered and lack consistency. There have been a few industry standards issued in relation to the specific components of the hydrogen supply chain but most of them are rudimentary.

Recognising the problem, the National Energy Agency under NDRC issued a standardisation-related work plan in 2022 for the energy sector, which includes the following key workstreams for the hydrogen industry:

- Fast pace the top-level design and system set-up for hydrogen related standards.
- Carry out the research and preparation of the standards for the production, storage, transportation, filling and diversified application of hydrogen to support the full development of the hydrogen industry chain.
- Pay particular attention to developing standards in relation to renewables hydrogen, complementary use of power and hydrogen, fuel cell and related system.

Further to the 2022 plan, the Standardisation Administration of China, jointly with other ministries overseeing the hydrogen industry, issued in 2023 a guideline for building up the standards for hydrogen industry, which has integrated the existing standards and called for more comprehensive work on filling the gaps in standards along the industry chain.

11. Are there any foreign investment restrictions related to energy and infrastructure sectors?

China is generally supportive of foreign investment in the energy sector. In terms of power sector, the only restriction is that nuclear power plants must be majority owned by Chinese investors.

In addition, foreign investment in both large-scale conventional power plants and renewables/clean energy power plants is encouraged, including:

- Production, storage, transportation and liquefaction of green hydrogen
- Manufacturing of equipment for production, storage, transportation and safety-check of hydrogen
- Renewables power plants including solar, wind, geothermal etc
- Waste to energy projects
- Hydrogen filling stations
- New power storage equipment including hydrogen-related

12. What international treaties are in place that may offer protection to international investors in hydrogen projects in the jurisdiction?

The United Nations Conference on Trade and Development (UNCTAD) website states that China is a signatory to about 120 bilateral investment treaties (BITs) that are in force as at December 2022, and in addition certain other treaties may contain protections for investors in South Korea. These can be accessed from **UNCTAD's Investment Policy Hub**.

Market developments and opportunities

13. Are there any government grants or other government funding available to hydrogen projects (including for research and development)?

China's government grants, subsidies and funding for the hydrogen sector are scattered among the many policy documents issued by both the national and local governments, with the local governments providing more specific funding in most cases. So far, there is no specific grant or funding for hydrogen production projects per se but the following measures are illustrations of how the grants, subsidies or funding may be obtained in practice for hydrogen investors:

- Currently, there are various national and local subsidies for purchasing fuel cell vehicles and for breakthroughs in fuel cell vehicle related technologies, in particular of those that can be demonstrated as being capable of commercialization. Reduced tariffs also apply to the import of key upstream equipment used in the manufacturing of fuel cell vehicles.
- Some local governments has issued policies granting subsidies for building hydrogen filling stations on a per station basis in amount reaching RMB 1.5 to 2.5 million.

14. Are there any notable pilot/demonstration projects in place or planned for the production or offtake of clean hydrogen?

It appears that most of the demonstration projects in China so far have been undertaking by the SOE power majors – the following being some recent examples:

- Sinopec has put into operation its first large-scale green hydrogen project in Kuche, Xinjiang in August 2023. The project is expected capable of producing 20,000 tons of hydrogen per year using PV-generated electricity.
- SPIC started in late 2022 a solar and wind power supported green hydrogen to ammonia demonstration project in Baicheng, Jilin. The project is expected to generate green hydrogen of 32,000 tons per year (which can then be converted into green ammonia of 180,000 tons per year) by utilizing a power installation capacity of 800MW.
- Three Gorges Group put into operation PV solar plus green hydrogen project in December 2023. The PV-based hydrogen project with 75MW capacity is capable of generating 10,000 tons of green hydrogen per year, in Erdos, Neimenggu.

Overall, it is reported that around 40 green hydrogen projects were started in 2023 nationwide with total investment exceeding RMB260 billion.

15. Are there any commercial-scale clean hydrogen production projects in development or already operating?

Due to cost and technological constraints, so far there is no reported commercial scale green hydrogen project in China.

16. Have there been any hydrogen-related disputes in your jurisdiction?

There has not been major dispute reported in respect of hydrogen projects in China.

Last updated April 2024

Saudi Arabia

Policy and regulation

1. Is there a government hydrogen strategy or policy?

As of now and to the best of our knowledge, no national hydrogen strategy/policy has been launched as yet, the Kingdom has launched National Industry Strategy, which aims to reach an industrial economy that attracts investment and contributes to achieving economic diversification, developing domestic product and non-oil exports, in line with the objectives of the Saudi Vision 2030.

2. What are key goals and commitments included in the strategy/policy?

During Saudi-South African Investment Forum, 11 agreements and memoranda of understanding were signed in the public and private sectors in energy, water, green hydrogen, waste diversion, logistics, and aerial survey services, aimed at promoting the developing investment sectors between the two countries and between the Middle East and South Africa region. **www.spa.gov.sa/2392578**.

3. Which industry sectors are most likely to be affected by hydrogen deployment?

The Ministry of Investment has signed a memorandum of understanding with Alstom Company. The MoU aims to explore the future of sustainable transport in the Kingdom of Saudi Arabia and identify investment opportunities in the public transport sector related to railway infrastructure, sustainable transport technologies and reducing carbon emissions, in line with the objectives of the Kingdom's Vision 2030. **www.spa.gov.sa/2374677**.

4. Who are the main regulators for the hydrogen market?

Given all above mentioned MoU's were signed by the Minister of Energy, it can be assumed that The Ministry of Energy, Industry and Mineral Resources will be regarded as the main agency having oversight of the hydrogen market in Saudi Arabia, despite not being appointed a regulator per se. It is expected the National Hydrogen Strategy might address the question of a hydrogen market regulator once published.

5. Does the government hydrogen strategy or policy support the development of both low-carbon (blue) hydrogen and renewable (green) hydrogen?

As stated above, there is no strategy or policy available in the public domain. However, through Saudi's public announcements, it can be inferred that Saudi Arabia has the required resources to pursue a green or blue hydrogen strategy. The Eastern region is more likely to produce and export blue hydrogen while the Western region would be suitable for producing green hydrogen with the development of renewable energy resources.

6. If the government hydrogen strategy or policy supports the development of low-carbon hydrogen, to what extent is carbon capture and storage being taken forward?

As previously stated, there has been no information released in the public domain of a strategy or policy that can determine to what extent carbon capture and storage would be taken further.

7. Are there targets for the production of hydrogen?

Kindly refer to Question 13.

8. Are there any incentive mechanisms/business models in place to support the production of hydrogen?

For the plans that have been confirmed and released to public domain, refer to Question 13.

Theoretically, Saudi's endorsement to '**The Circular Carbon Economy framework**' could be deemed significant and provide an idea of where future business models and incentive mechanisms would be put in place to support the production of hydrogen.

9. Are there any standards in place for the classification and/or certification of low-carbon or renewable hydrogen?

There is currently no defined statement in the public domain regarding the classification or certification of low carbon and/or hydrogen from renewable resources.

10. Does the regulatory framework clearly define the regulatory requirements relating to the production, storage, transportation, or supply of hydrogen?

There is no dedicated legislation for hydrogen.

11. Are there any foreign investment restrictions related to energy and infrastructure sectors?

If it falls under the activity (oil exploration, drilling and production) it would be excluded from foreign investment.

12. What international treaties are in place that may offer protection to international investors in hydrogen projects in the jurisdiction?

We are not aware of any international treaty; however Saudi Aramco is a member of the Hydrogen Council.

Market developments and opportunities

13. Are there any government grants or other government funding available to hydrogen projects (including for research and development)?

Research and development grants regarding hydrogen projects are being executed at King Abdullah Petroleum Studies and Research Center (KAPSARC) and the King Abdullah University of Science and Technology (KAUST).

14. Are there any notable pilot/demonstration projects in place or planned for the production or offtake of clean hydrogen?

- Saudi Arabia has catalysed the expansion of hydrogen in September 2020. **Aramco and the Institute of Energy Economics, Japan, in partnership with SABIC, successfully demonstrated the production and shipment of blue ammonia from Saudi Arabia to Japan** with support from the Japanese Ministry of Economy, Trade and Industry. Forty tons of high-grade blue ammonia were dispatched to Japan for use in zero-carbon power generation. This was the world's first blue ammonia supply-chain demonstration – a significant milestone.
- Saudi plans to build the world's **largest export-oriented green ammonia plant in the city of Neom**. Saudi's zero-carbon fuel plan is to build a four gigawatt plant completely powered by wind and solar energy. This electricity will produce 650 tonnes of hydrogen daily via water electrolysis in a process known as 'green' hydrogen. This hydrogen will be used to produce 1.2 million tonnes of ammonia per year, which will be shipped from Saudi Arabia's western coast to markets in Europe and Asia. (Scheduled in 2025).
- On the 18th of June in 2019 **Saudi Aramco inaugurated the first hydrogen fuelling station in Saudi Arabia**. This pilot station will fuel an initial fleet of six Toyota Mirai fuel cell electric vehicles with high purity compressed hydrogen.

15. Are there any commercial-scale clean hydrogen production projects in development or already operating?

At present, projects plans in Saudi through public announcements as mentioned in Question 13.

16. Have there been any hydrogen-related disputes in your jurisdiction?

There has been nothing in terms of hydrogen related disputes, to the best of our knowledge.

Last updated May 2024

Singapore

Policy and regulation

1. Is there a government hydrogen strategy or policy?

Yes, Singapore published its National Hydrogen Strategy in October 2022, which can be found here.

2. What are key goals and commitments included in the strategy/policy?

Singapore believes that low-carbon hydrogen has the potential to be a major decarbonisation pathway to support Singapore's transition towards its committed target of net zero emissions by 2050. While not an explicit goal or commitment, the expectation is that hydrogen will complement and diversify Singapore's power mix alongside solar, imported electricity, and other potential low-carbon energy sources; and that (depending on technological developments and the development of other energy sources), hydrogen could supply up to half of Singapore's power needs by 2050 and play an important role in decarbonising Singapore's industry.

3. Which industry sectors are most likely to be affected by hydrogen deployment?

Hydrogen deployment in Singapore is expected to be most likely relevant to the following industrial sectors:

- power generation
- manufacturing (both as a fuel and as a feedstock)
- maritime and aviation
- land transport

4. Who are the main regulators for the hydrogen market?

While there is no dedicated hydrogen market regulator in Singapore, the storage and transport of hydrogen in Singapore is regulated by various governmental agencies, including the Singapore Civil Defence Force, the Land Transport Authority and the Maritime and Port Authority of Singapore; it may also be relevant to note (e.g. in connection with hydrogen-for-power) that the Energy Market Authority is the regulator of the power market in Singapore.

5. Does the government hydrogen strategy or policy support the development of both low-carbon (blue) hydrogen and renewable (green) hydrogen?

Singapore's National Hydrogen Strategy refers to "low-carbon hydrogen" and does not explicitly distinguish between blue hydrogen and green hydrogen.

6. If the government hydrogen strategy or policy supports the development of low-carbon hydrogen, to what extent is carbon capture and storage being taken forward?

Singapore expects to be a net hydrogen importer and the focus of the National Hydrogen Strategy is in developing the low-carbon hydrogen supply chain and value chain.

7. Are there targets for the production of hydrogen?

Singapore's National Hydrogen Strategy does not contain any explicit target for the domestic production of hydrogen.

8. Are there any incentive mechanisms/business models in place to support the production of hydrogen?

Singapore's National Hydrogen Strategy does not include any explicit incentive for the domestic production of hydrogen.

9. Are there any standards in place for the classification and/or certification of low-carbon or renewable hydrogen?

No. However, part of Singapore's National Hydrogen Strategy is to work collectively with international partners (governments and international organisations) on a number of relevant areas including the development of "Guarantee of Origin" certification methodologies to certify low-carbon hydrogen with verified emissions intensities.

10. Does the regulatory framework clearly define the regulatory requirements relating to the production, storage, transportation or supply of hydrogen?

Not specifically. However, certain existing laws will likely apply to various activities relating to hydrogen; for example:

- *the Fire Safety Act 1993* and the *Fire Safety (Petroleum and Flammable Materials) Regulations* regulate hydrogen as a "flammable material" and therefore regulates, among other things, certain acts in respect of hydrogen such as: (i) import; (ii) storage; (iii) dispensation; (iv) conveyance over pipelines; and (v) transportation;
- the *Maritime and Port Authority of Singapore Act 1995* and the *Maritime and Port Authority of Singapore (Dangerous Goods, Petroleum, and Explosives) Regulations 2005* designate compressed hydrogen as a "First Schedule dangerous good", such that any vessel carrying compressed hydrogen is subject to certain restrictions on movement in certain prescribed areas of the Singapore ports as well as in relation to the handling, discharging and loading of compressed hydrogen;
- the *Gas Act 2001* defines "gas" as including "town gas" which is defined as "any substance in a gaseous state which is conveyed in gas pipes and is manufactured from petrochemical feedstock or natural gas, and has hydrogen as one of its main constituents" and this may capture some forms of hydrogen (though likely not low-carbon hydrogen); and
- the *Workplace Safety and Health Act 2006* and the Workplace Safety and Health (Major Hazard Installations) Regulations 2017 set out hydrogen as a "dangerous substance", so that any premises where processing, manufacturing or bulk storage by way of trade or for the purpose of gain is carried on in respect of hydrogen where a prescribed quantity of hydrogen is present or likely to be present, is deemed to be a "major hazard installation" and subject to more stringent workplace health and safety requirements.

11. Are there any foreign investment restrictions related to energy and infrastructure sectors?

Singapore operates a generally open policy towards foreign investment and there are no restrictions expressly targeted against foreign investment relating to the energy and infrastructure sectors. It should also be noted that Singapore offers a number of incentives such as tax breaks and grants to encourage international companies to base their regional headquarters or other key facilities in Singapore.

12. What international treaties are in place that may offer protection to international investors in hydrogen projects in the jurisdiction?

The United Nations Conference on Trade and Development (UNCTAD) website states that Singapore is a signatory to 38 bilateral investment treaties (BITs) and 33 treaties with investment protections (TIPs) that are in force, as well as a number of Investment Related Instruments (IRIs) – these can be accessed from the online database maintained by UNCTAD's Investment Policy Hub **here**. Singapore's "Enterprise Singapore" agency also maintains an online database of bilateral and regional free trade agreements (FTAs) that Singapore is party to, which may contain protections for investors in Singapore; these can be accessed **here**.

Market developments and opportunities

13. Are there any government grants or other government funding available to hydrogen projects (including for research and development)?

Certain grants for research and development are available specifically for low-carbon technology-related research, including in connection with hydrogen (in addition to the tax breaks and grants available for qualifying foreign investments).

Singapore introduced the Low-Carbon Energy Research (LCER) Funding Initiative in 2020 and the first phase of the programme awarded S$55 million to projects aiming to improve the technoeconomic viability of low-carbon technologies such as carbon capture, utilisation, and storage (CCUS) and hydrogen. For hydrogen, the LCER funded projects in areas such as the development of catalysts for ammonia cracking, and methane pyrolysis.

The National Hydrogen Strategy provides and an additional S$129 million of research funding under LCER will be set aside to support the development of low-carbon technologies including hydrogen; and that the need for further funding will be further assessed, depending on Singapore's national needs.

14. Are there any notable pilot/demonstration projects in place or planned for the production or offtake of clean hydrogen?

There are currently no particularly notable pilot projects in place or planned for the production of clean hydrogen in Singapore. On the offtake front:

- Keppel Infrastructure, through its wholly-owned subsidiary Keppel Energy, has announced that it has reached FID to develop the Keppel Sakra Cogen Plant, a 600-megawatt advanced combined cycle gas turbine (CCGT) power plant which can be run entirely on clean-burning hydrogen, and that the EPC contract for the construction of the plant has been awarded to a consortium comprising Mitsubishi Power Asia Pacific and Jurong Engineering. The plant is expected to be ready by the first half of 2026; and
- Keppel New Energy Pte Ltd, a wholly owned subsidiary of Keppel Infrastructure; Mitsubishi Heavy Industries, Ltd. and DNV, have announced that they have signed a Memorandum of Understanding (MoU) for a strategic collaboration to explore the feasibility and implementation of an ammonia-fired gas turbine on Jurong Island, Singapore

15. Are there any commercial-scale clean hydrogen production projects in development or already operating?

There are currently no existing commercial-scale clean hydrogen production projects being developed, or in operation, in Singapore.

16. Have there been any hydrogen-related disputes in your jurisdiction?

No.

Last updated May 2024

South Africa

Ashurst collaborated with **Bowmans** in the preparation of this content. We are grateful for their input.

Policy and regulation

1. Is there a government hydrogen strategy or policy?

Yes, the Department of Science and Innovation (DSI) published the South African Hydrogen Society Roadmap (HSRM) on 17 February 2022. The HSRM intends to serve as a national framework for policy and actions relating to hydrogen in South Africa. In October 2023, the Cabinet approved the Green Hydrogen Commercialisation Strategy (GHCS).46 The GHCS is a strategy framed within the HSRM and it builds on the Hydrogen South Africa programme (HySA). HySA was a 15-year programme by the DSI that was approved by the Cabinet in May 2007 and officially launched in September 2008.47

Other government policies also recognise hydrogen's role and potential uses in the South African economy. These include:

- the Renewable Energy Policy of South Africa;
- the Integrated Energy Plan; and
- the Integrated Resource Plan.

2. What are key goals and commitments included in the strategy/policy?

The identified goals and commitments in the HSRM policy include:

- the decarbonisation of the transport and energy-intensive sectors by 2050;
- the creation of a green hydrogen export market so that South Africa can capitalise on the projected increase in demand in response to international climate commitments;
- the creation of a Centre of Excellence in Manufacturing for hydrogen products and fuel cell components which will contribute to their respective value chains;
- transforming and stabilising the power sector by employing green technologies; and
- increasing the role of hydrogen in the South African energy system.
- The identified goals and commitments in the GHCS strategy include:
- Prioritising exports by targeting exports of green hydrogen and green chemicals by leveraging on South Africa's proprietary Fischer Tropsch technology and utilising financing support mechanisms including grants, concessional debt and contract for difference / price subsidies to improve the financial viability of these projects;
- Stimulating domestic market by developing projects along the value chain to stimulate demand for green hydrogen in South Africa. "Low hanging fruit" opportunities to be prioritised to provide confidence in the domestic market. Examples include green steel, hydrogen valley mobility programme and sustainable aviation fuel projects;
- Supporting localisation by developing local industrial capability to produce fuel cells, cells, electrolyser, ammonia cracking and balance of plant equipment and components by leveraging on South Africa's PGM resources. Together with demand stimulation this will drive longer term GH2 price reduction allowing penetration in various sectors;
- Securing funding from various sources and in various forms including grants, concessional debt and contract for differences;
- Maximising development impact (including skills and economic development and social inclusion). Ensure gender equality, BBBEE and community participation; and
- Prioritising the execution of the green hydrogen commercialisation strategy and the development of a national GH2 infrastructure plan. Drive the required policy and regulatory changes required to sustain long term growth of the new hydrogen industry.

3. Which industry sectors are most likely to be affected by hydrogen deployment?

The following sectors are most likely to be impacted by the deployment of hydrogen:

- the transport sector;
- energy-intensive sectors;
- the electricity sector;
- the aviation sector; and
- the mining sector.

46 See **https://www.sanews.gov.za/south-africa/sas-green-hydrogen-commercialisation-strategy-approved-cabinet.**
47 See **https://www.hysasystems.com/index.php/about-hysa.**

4. Who are the main regulators for the hydrogen market?

There are no specific regulators of hydrogen production and exportation in South Africa. The production, storage, transportation or supply of hydrogen would largely be regulated as an industrial process, and it may be subject to environmental and health and safety regulations. The regulators would include local, provincial and/or national environmental authorities, as well as health and safety regulators from the local or national authorities. In addition, renewable energy production ties to the production of green hydrogen and would be regulated by the National Energy Regulator of South Africa (NERSA).

5. Does the government hydrogen strategy or policy support the development of both low-carbon (blue) hydrogen and renewable (green) hydrogen?

Yes, one of the aims of the HSRM is to develop the role of blue and green hydrogen in the energy system and the HSRM makes provision for the eventual transition from blue to green hydrogen by 2050. In the short term, South Africa will focus on catalytic projects to stimulate local demand for all types of hydrogen to illustrate its commercial viability and scalability. As noted above, the GHCS also aims to prioritise the export of green hydrogen. However, the GHCS does not make mention of blue hydrogen.

6. If the government hydrogen strategy or policy supports the development of low-carbon hydrogen, to what extent is carbon capture and storage being taken forward?

As part of the building blocks for creating a South African hydrogen society, the HSRM includes two carbon capture, usage and storage (CCUS) pilot projects. One project focuses on creating a **CCUS site in an identified priority area in Mpumalanga** that has a high concentration of coal mining and power generation. This project forms part of HSRM's Action Plan for Hydrogen generation, storage and distribution and will be implemented between 2021 and 2024. It has been reported by the Council for Geoscience that geological mapping at the site has commenced and the project is set to become active in 2023. The second pilot project aims to create CCUS projects on a national scale.

7. Are there targets for the production of hydrogen?

Yes, the HSRM provides targets for hydrogen production. The targets, and their respective timeframes, are as follows:

- 2021-2024: small scale electrolysis production and at least 1MW of green hydrogen to be used, for example, in the transport sector and in power generation;
- 2025-2030: the construction of 5GW electrolysis capacity; the deployment of a total of 11.7GW electrolyser capacity; and, at least, 500kt of Hydrogen produced annually by 2030. The main areas of utilisation include power generation and the transport sector; and
- 2030-2040: increase electrolysis capacity to at least 15GW for full use in the transport industry and power generation.

8. Are there any incentive mechanisms/business models in place to support the production of hydrogen?

There are currently no direct incentive mechanisms or business models that support hydrogen production. However, the HSRM recognises existing incentive opportunities, such as tax incentives, that could support hydrogen production. These include:

- section 11D of the Income Tax Act No 58 of 1962 (ITA) may be used to advance research and development relating to hydrogen production as it does not circumscribe the categories of R&D;
- companies operating in Special Economic Zones (i.e. designated areas for targeted economic activities) may have a reduced corporate tax rate of 15% and an accelerated 10% tax allowance on buildings; and
- the Support Programme for Industrial Innovation (SPII), which is particularly focused on the development phase of innovative products or processes may be used to promote the development of hydrogen technologies.

9. Are there any standards in place for the classification and/or certification of low-carbon or renewable hydrogen?

There are no existing standards in place for the classification and/or certification of low-carbon or renewable hydrogen in South Africa.

10. Does the regulatory framework clearly define the regulatory requirements relating to the production, storage, transportation or supply of hydrogen?

South Africa does not have a regulatory framework that specifically concerns hydrogen. However, there are other, non-specific, regulatory regimes that may impact upon its production, storage, transportation or supply. This includes, for example, the Occupational Health and Safety Act 85 of 1993 regulations.

11. Are there any foreign investment restrictions related to energy and infrastructure sectors?

There are no restrictions on foreign investments in the energy and infrastructure sectors. Neither the primary legal framework governing foreign investment in South Africa, the Protection of Investment Act 22 of 2015 (Investment Act), nor sectoral regulations provide for such restrictions. However, the ownership requirements in the Broad-Based Black Economic Empowerment Act 53 of 2003 must be considered, these do not create compulsory investment thresholds, but such thresholds may be a requirement for participation in any government investment support scheme.

12. What international treaties are in place that may offer protection to international investors in hydrogen projects in the jurisdiction?

According to the United Nations Conference on Trade and Development (UNCTAD), South Africa has signed 50 bilateral investment treaties (BITs). Of the 50, however, 26 were signed but are not in force, 12 have been terminated and only 12 are currently in force. A summary of these treaties can be found on the UNCTAD's Investment Policy Hub **database**.

It must be noted, however, that South Africa is not currently engaged in any new BIT negotiations and future negotiations are unlikely. The Investment Act is national legislation that is aimed at providing protection to investors and their investments. Significantly, the Act states that existing investments that were made under such treaties will continue to be protected for the period and terms stipulated in the treaties. Any investments made after the termination of a treaty, but before promulgation of this Act, will be governed by the general South African law. Therefore, it is envisaged that international investors will likely be protected in terms of national and not international law.

Market developments and opportunities

13. Are there any government grants or other government funding available to hydrogen projects (including for research and development)?

The Netherlands and Denmark are collaborating with South Africa to create the **SA-H2 Fund** to advance South Africa's green hydrogen sector and circular economy. This fund was announced in June 2023, and involves several organisations, including Climate Fund Managers, Invest International B.V. (II), Sanlam Limited, the Development Bank of Southern Africa, and the Industrial Development Corporation of South Africa. The goal of the SA-H2 Fund is to secure USD$1 billion in funding for South Africa in order to expedite the funding and development of large-scale green hydrogen projects in South Africa.[48] Also in June 2023, South Africa and Germany signed a joint declaration of intent to establish the **South African German Hydrogen Task Force**.[49] The primary objective of this task force is to promote the economic feasibility of green hydrogen projects, as well as the development of related industries and infrastructure in both South Africa and Germany. Additionally, the Critical Infrastructure Programme (CIP), run by the Department of Trade, Industry and Competition (DTIC) aims to, amongst other objectives, provide financial support to projects that alleviate dependency on the national grid. In the revised guideline to the CIP, published in November 2021, support for clean/green energy infrastructure was included. Although the CIP guideline does not define 'clean/ green energy', the Deputy Minister of the DTIC has stated that the CIP would involve financial assistance in alleviating the infrastructure costs associated with hydrogen production, fuelling and transport facilities. The CIP guideline does not provide an estimate of the available funding.

14. Are there any notable pilot/demonstration projects in place or planned for the production or offtake of clean hydrogen?

Yes, there are a number of pilot projects planned to determine the feasibility of green hydrogen in different sectors and to kick-start the development of a hydrogen society in South Africa. These include the following projects:

- **the Hydrogen Valley or Platinum Valley Project** is a project of the DSI, with various partners, to study the feasibility of developing catalytic green hydrogen hubs. These hubs will form part of the Hydrogen Valley and will be connected to form a 'Hydrogen Corridor'. The identified hubs are in Johannesburg, Durban/Richards Bay and Mogalakwena/Limpopo. The hubs will host pilot projects in the industrial, mobility and building sectors. The projects involve, for example, developing ethylene and ammonia from green hydrogen and running paper mills with hydrogen instead of natural gas fuels;
- **the COALCO2 – X Project** aims to use green hydrogen and other pollutants found in flue gas from coal-fired boilers to make value-added products. The objective is to support the transition to a decarbonised energy system and assist in reducing gas emissions. This project will also be used to scale up domestic demand for hydrogen and create capabilities for the export market;

48 See **https://www.dbsa.org/press-releases/unveiling-sa-h2-fund-south-africas-dedicated-green-hydrogen-fund**
49 See **https://www.gov.za/speeches/minister-electricity-dr-kgosientsho-ramokgopa-signs-joint-declaration-intent-german**

- **Boegoebaai**, an area in the Northern Cape, has been identified by the government as a Strategic Integrated Project in the South African National Development Plan. The project, led by Sasol, is focused on determining whether an export hub for green hydrogen and ammonia is feasible and proposed construction projects include green hydrogen and ammonia production sites, a desalination plant to support the production of green hydrogen and a storage facility. In addition, Sasol has finalised a memorandum of agreement with both national and local government to develop the Boegoebaai site. The development aims to produce 400,000 tonnes of green hydrogen annually; and
- The **Prieska Power Reserve Project**,[50] set to commence in 2025, intends to develop technology for producing hydrogen and ammonia using renewable energy sources, while also focusing on their storage and distribution. This initiative is expected to play a significant role in advancing South Africa's socio-economic development goals.15. Are there any commercial-scale clean hydrogen production projects in development or already operating?

15. Are there any commercial-scale clean hydrogen production projects in development or already operating?

There are currently no commercial-scale clean hydrogen production projects in development or already operating in South Africa.

16. Have there been any hydrogen-related disputes in your jurisdiction?

There have not been any hydrogen-related disputes in South Africa that have been addressed in open court.

Last updated May 2024

50 See https://prieskapower.com/#:~:text=The%20Prieska%20Power%20Reserve%20Project,resources%20of%20water%20and%20air

South Korea

Content provided by **Ashurst Korea JV**

Policy and regulation

1. Is there a government hydrogen strategy or policy?

Yes, on 17 January 2019, the Ministry of Trade, Industry and Energy (MOTIE) announced the **Hydrogen Economy Vitalization Roadmap** (Roadmap) which focuses on hydrogen utilisation, such as hydrogen fuel cell vehicles and fuel cells. Further, South Korea enacted the Hydrogen Economy Promotion and Hydrogen Safety Management Act (the **Hydrogen Act**) on 4 February 2020 which came into effect on 5 February 2021. The latest amendment bill for the Hydrogen Act was passed in June 2022 and came into effect on 11 December 2022 (the **Amendment**).

On 26 November 2021, MOTIE established the **First Master Plan for Hydrogen Economy Implementation (Master Plan)** which covers the entire hydrogen value chain of production, storage, transportation and utilisation. Following the March 2022 change in administration, the new administration updated the country's hydrogen roadmap with the Plan for Creating a Clean Hydrogen Ecosystem (the 3UP Policy) in November 2022.

2. What are key goals and commitments included in the strategy/policy?

The policy goal is to pioneer in the clean hydrogen economy through establishing a full-cycle ecosystem of hydrogen economy. The Master Plan includes four pillars of strategy and 15 objectives as set out below:

Phase	Key Goals
(1) Pioneer in domestic and global production of clean hydrogen	(i) Green hydrogen production (ii) Blue hydrogen production (iii) Overseas production of clean hydrogen
(2) Establish compact infrastructure	(iv) Establishment of hydrogen distribution infrastructure (v) Construction of hydrogen piping network (vi) Increase the number of hydrogen stations
(3) Utilise hydrogen in all aspects of day-to-day lives	(vii) Enlargement of hydrogen power generation (viii) Pioneer in global market of hydrogen mobility (ix) Establish foothold for hydrogen utilization in industrial fields
(4) Strengthen the foundation of the ecosystem	(x) Technology development/manpower cultivation/standardization (xi) Procurement of world-class hydrogen-safety (xii) Lead global collaboration (xiii) Nurture hydrogen-specialised enterprises and vitalize hydrogen finance (xiv) Diffuse hydrogen cluster city special regulatory zones (xv) Establish policy foundation and enhance public acceptance

The Master Plan puts a particular emphasis on clean hydrogen generation (i.e. green hydrogen and blue hydrogen), and aims to meet 100% of the anticipated annual demand of 27.9 million tons of hydrogen in 2050 with clean hydrogen, 60% of which is produced domestically or based on domestic technology and/or capital. The milestone targets under the Master Plan are:

- to reach a clean hydrogen ratio of 75% by 2030 and 100% by 2050; and
- to reach a self-sufficiency rate of 34% by 2030 and 60% by 2050.

The new administration's updated policy under the 3UP Policy has three key goals: scale up, build up and level up.

Scale up – expand the clean-hydrogen ecosystem by creating demand for hydrogen energy in power and transportation	Development of dual fuel-based power generation technology using hydrogen and ammonia by 2027 (50% hydrogen, 20% ammonia) Construction of a hydrogen-ammonia-mix power plant by 2028, with production centres set up in Korea and overseas Expansion of number of hydrogen-fuelled commercial vehicles to 30,000 by 2030
Build up - develop infrastructure and regulations	80 liquified hydrogen charging stations by 2036 Ammonia receiving terminals with a capacity of 4 million tons a year to be set up in areas with a high concentration of coal plants (e.g. Incheon, Gangwon, and South Gyeongsang); liquified hydrogen receiving terminals with an annual capacity of 100,000 tons to be set up near LNG generators Installation of hydrogen-exclusive pipes Regulatory base for safe and clean hydrogen distribution (including hydrogen power exchange market and certification system for clean hydrogen starting 2024)
Level up – focus on industry and technology development	Seven strategic technologies: water electrolysis, liquid hydrogen carriers, trailers, charging stations, fuel cells for mobility, fuel cells for power generation and hydrogen turbines 600 companies specialising in the hydrogen business by 2030

The new policy updated the country's hydrogen milestone targets, with hydrogen and ammonia to make up 2.1% of total electricity production by 2030, and clean hydrogen to make up 7.1 percent of domestic hydrogen energy by 2036. With this policy, MOTIE intends to expand its scope from areas such as hydrogen vehicles and power generation fuel cells to include all areas of the hydrogen value chain.

3. Which industry sectors are most likely to be affected by hydrogen deployment?

The industries that conventionally use fossil fuels as their primary energy sources are anticipated to be affected the most by hydrogen deployment. Some examples are as follows:

- the energy sector (due to the introduction of hydrogen power generation);
- infrastructure (for hydrogen distribution, e.g. piping and hydrogen stations);
- the automobile and other mobility sectors (e.g. hydrogen-powered mobility; transportation and logistics); and
- the steel, petrochemistry and cement sectors (due to the shift from conventional fuel (e.g. coal) to hydrogen for the generation of power).

The automobile industry has experienced the biggest impact so far, and it is expected that it will continue to be affected. Korea's current production capacity for hydrogen fuel cell cars is 10,000 cars per year. Under the 3UP Policy the government has a goal of producing 30,000 hydrogen commercial vehicles by 2030.

4. Who are the main regulators for the hydrogen market?

The main government entity responsible for the hydrogen economy is the Ministry of Trade, Industry and Energy (MOTIE). The Hydrogen Act regulates MOTIE's authority in relation to the promotion and management of the country's hydrogen economy.

Article 6 of the Hydrogen Act provides for the establishment of the Hydrogen Economy Committee, which is chaired by the Prime Minister and includes the Minister of Economy and Finance, the Minister of Science and ICT, the Minister of the Interior and Safety, the Minister of Trade, Industry and Energy, the Minister of Environment, the Minister of Land, Infrastructure and Transport, the Minister of Oceans and Fisheries, the Minister of SMEs and Startups, and other persons working at industrial, academic, research institutes, etc. with sufficient expertise and experience in fostering the hydrogen economy who are commissioned by the Prime Minister. The Hydrogen Economy Committee is responsible for the following:

1. Matters concerning formulating and executing master plans in accordance with the Hydrogen Act, and reviewing and evaluating the implementation results thereof;
2. Matters concerning recommendations for improving statutes and regulations pertaining to implementing the hydrogen economy;
3. Matters concerning policy coordination, cooperation, and support related to the hydrogen economy by relevant central administrative agencies and local governments;
4. Matters concerning cooperation between countries, establishment of a hydrogen industry ecosystem, and handling of grievances of enterprises, etc. in relation to the hydrogen economy;
5. Matters required to undergo deliberation of the Committee under other statutes; and
6. Other matters deemed necessary by the Chairperson of the Committee in relation to the hydrogen economy.

In accordance with the Hydrogen Act, the following institutions have been designated as the corresponding designated organizations:

1. Hydrogen Convergence Alliance (H2KOREA) as the designated organization for hydrogen industry promotion;
2. Korea Gas Corporation (KGS) as the designated organization for hydrogen distribution; and
3. Korea Gas Safety Corporation (KGSC) as the designated organization for hydrogen safety.

The designated organizations are responsible for facilitating the government's hydrogen economy policies by laying the requisite foundations such as training professionals and standardization, achieving price stabilization and establishing a fair distribution ecosystem, and establishing safety standards.

5. Does the government hydrogen strategy or policy support the development of both low-carbon (blue) hydrogen and renewable (green) hydrogen?

MOTIE introduced a policy paradigm shift in the Roadmap from conventional grey hydrogen to renewable green hydrogen in 2019. It supports a safe and economic hydrogen production and supply system through water electrolysis and importing the same from overseas. In addition, the Master Plan puts emphasis on clean energy, both green and blue hydrogen.

With regard to green hydrogen, the Korean government plans to scale up:

- electrolysis technology capacity from the current 500 KW to 1 MW by 2025, and 10 MW by 2030; and
- electrolysis efficiency from the current 55% to 69% by 2030 and 77% by 2050.

In addition to setting out the expansion plan of water electrolysis for green hydrogen production, the Master Plan introduced a roadmap for the production of blue hydrogen, such as the establishment of new blue hydrogen clusters by 2025, technology development for early commercialization of CCUS (carbon capture, utilisation and storage), and procurement of storage facilities, inside and outside of Korea.

South Korea's hydrogen policy had been criticised for depending too heavily on fossil-fuel based grey hydrogen. The updated plan under the 3UP Policy makes it clear that the government is focusing on building a low-carbon and renewable hydrogen ecosystem, with a goal of 7.1 percent clean hydrogen power by 2036, and a clean hydrogen certification system to be active by 2024. The policy also supports research and development of key technologies such as water electrolysis.

The Amendment introduces a graded clean hydrogen certification system, classifying clean hydrogen as "carbon-free hydrogen", "low-carbon hydrogen", and "low-carbon hydrogen compound". Further, it adds an obligation to develop, produce and supply clean hydrogen unto the national and municipal governments, as well as mandating the inclusion of matters regarding the promotion of development, production, supply of clean hydrogen and matters regarding the transition to hydrogen economy for carbon neutralization to the Master Plan.

6. If the government hydrogen strategy or policy supports the development of low-carbon hydrogen, to what extent is carbon capture and storage being taken forward?

The Master Plan explicitly aims to achieve early commercialisation of CCUS technology in relation to blue hydrogen.

With regard to CCS (carbon capture and storage), it is proposed that exhausted gas fields in the East Sea (with a total storage capacity of 12 million tons) will be utilised for early commercialisation. The plan is for environmental reviews and safety evaluations to be completed by mid-2023, with facilities constructed by 2024, and for facilities to be operated for 30 years from 2025 to 2054. The project is ongoing as of February 2024, as a bilateral project between South Korea and Australia.

- In 2022, six Korean companies signed a memorandum of understanding to establish a CCS project with Malaysia's state energy company, with the first step being a feasibility study. Through this project, carbon dioxide emitted in Korea will be captured, transported to Malaysia, and stored.

With regard to CCU (carbon capture and utilisation), it is proposed that CCU products will be commercialised to reduce green-house gas emissions through large scale substantiation focusing centrally on business sites with high green-house gas emissions. The plan is for the government to lead substantiation of small- and mid-size technology by 2026; procure commercial technology by 2028; and diffuse commercial technology through private technology transfer by 2030The Master Plan also proposes participation in international joint research in order to procure advanced CCU/CCS technology.

On 11 April 2023, the government published the 1st National Basic Plan for Carbon Neutrality and Green Growth (the "Carbon Basic Plan"), which facilitates hydrogen production technology, CCUS and the application of carbon reduction technology in industrial sites. It aims to enact a single law on CCUS, including provisions to foster the CCUS industry, and establish certification standards.

7. Are there targets for the production of hydrogen?

When the Roadmap was published in January 2019, MOTIE anticipated that the annual demand for hydrogen would rise to 5.26 million tons by 2040. The Roadmap anticipated this demand would be met by extracted hydrogen (30%) and water electrolysis, byproduct hydrogen and overseas production (70%).

However, in November 2021, MOTIE renewed its forecast and proposed an updated plan which anticipated annual demand for hydrogen would rise to 27.9 million tons by 2050, all of which is targeted to be supplied with clean hydrogen, with a self-sufficiency rate of 60% (accounting for hydrogens produced domestically as well as those produced overseas with domestic technology or capital). More specifically, the Master Plan includes the following production targets:

- Green hydrogen: 250,000 tons per annum by 2030 and 3 million tons per annum by 2050; and
- Blue hydrogen: 750,000 tons per annum by 2030 and 2 million tons per annum by 2050.

The Master Plan further intends to establish 40 overseas hydrogen supply chains by 2050 to diversity the supply chain for energy security enhancement, whereby the country would, together with the green hydrogen and blue hydrogen produced domestically, achieve a 60% self-sufficiency rate for clean hydrogen.

8. Are there any incentive mechanisms/business models in place to support the production of hydrogen?

Currently, there are no incentive mechanisms/business models in place which specifically support the production of hydrogen. However, the following incentives may indirectly stimulate the production of hydrogen:

- national and local governments are authorised, pursuant to Article 17 of the Hydrogen Act, to grant certain tax benefits to businesses engaging in hydrogen activities and the Master Plan states that the government will push to enlarge tax incentives for hydrogen R&D activities and infrastructure investment to support the establishment of the foundation of supply and demand of hydrogen economy (as of 23 January 2024, R&D of certain hydrogen technologies is now included under regulations allowing higher rates of tax credits);
- the government may, pursuant to Article 9 of the Hydrogen Act, provide administrative and financial support to 'hydrogen-specialised enterprises' which meet certain thresholds in relation to its hydrogen business-related turnover or hydrogen business-related R&D investment amount compared to its total turnover. As part of the initiative to strengthen the foundation of the hydrogen ecosystem under the Master Plan, the government plans to designate 1,000 enterprises as hydrogen-specialised enterprises by 2040, and provide a distinguished support system, such as with regard to R&D and securement of market; and
- the Master Plan also provides a plan in relation to hydrogen finance which includes: utilising the existing climate fund to create an early market for hydrogen, establishing a hydrogen infrastructure fund to support the infrastructure for hydrogen production and distribution, and encouraging private hydrogen industry funds to nurture promising hydrogen businesses (including hydrogen-specialized enterprises). The Hydrogen Act also introduces 'hydrogen-specialised investment companies', which are required by law to invest more than half of their funds into hydrogen-specialised companies.

Since the government's introduction of different grades of clean hydrogen under the certification system (see question 9), there has been speculation that a tax credit system similar to the US' Inflation Reduction Act may be introduced. However, as 1 May 2024 there has been no official confirmation.

9. Are there any standards in place for the classification and/or certification of low-carbon or renewable hydrogen?

The Amendment introduced legal grounds for the certification of clean hydrogen, and the government began implementing the system in late 2023.

An amendment to the Enforcement Decree of the Hydrogen Act was approved by the Cabinet in November 2023, containing detailed provisions for the enforcement of the certification system. Under the amended Enforcement Decree, the MOTIE minister will, in consultation with heads of relevant central administrative agencies, notify the greenhouse gas emission volumes and other specified standards in the Clean Hydrogen Notification. MOTIE issued an administrative notice of the Proposed Notification on the Operation of Clean Hydrogen System (the "**Proposed Notification**") on 19 December 2023. The Proposed Notification establishes the greenhouse gas ("**GHG**") emissions standard for clean hydrogen as four kilogrammes of carbon dioxide equivalent per kilogramme of hydrogen, and classifies clean hydrogen into four different grades depending on the actual amount of GHG emissions.

Classification	Grade 1	Grade 2	Grade 3	Grade 4
Emissions (kgCO2eq/kgH2)	0.00 – 0.10	0.11 – 1.00	1.01 – 2.00	2.01 – 4.00

GHG emissions are calculated by life cycle assessment, meaning calculation begins from raw material extraction through to hydrogen production/import. These GHG emissions are then divided into direct emissions (Scope 1), indirect emissions (Scope 2), and other indirect emissions (Scope 3).

On 28 December 2023, MOTIE designated the Korea Energy Economics Institute as the certification operating institution, and the Korea Testing Certification Institute and the Korea Testing & Research Institute as the certification testing and evaluating institutions. In order to obtain a clean hydrogen certificate, a business operator must file an application with the certification

operating institution after completing construction of the clean hydrogen facility. Once the facility certificate is issued, a certificate for certified clean hydrogen production volume will be issued. Such volume will be determined based on either (a) the amount of hydrogen when the producer began to sell clean hydrogen in Korea, or (b) the amount of hydrogen at the point when permission for unloading at a port was secured.

The Proposed Notification is due to be finalized in early 2024.

10. Does the regulatory framework clearly define the regulatory requirements relating to the production, storage, transportation or supply of hydrogen?

The Hydrogen Act has introduced a three-step safety assurance: technological safety at the design stage, on-site examination upon completion of a facility, and annual safety checks. The Korea Standards Association is the central organisation designated by the Act to certify fuel cells and other downstream hydrogen technologies. Otherwise, the regulatory requirements relating to the production, storage, transportation and supply of hydrogen are unclear and lack consistency.

Safety management of hydrogen equipment is governed under different statutes depending on whether the hydrogen is high pressure or low pressure. Under the Hydrogen Act, all hydrogen-related equipment rated at over 10 bar design pressure is high pressure gas equipment which must be certified by KGSC, whereas equipment below 10 bar design pressure is low-pressure gas equipment which is regulated by Korea Occupational Safety and Health Agency.

The Hydrogen Safety Management Roadmap 2.0 was announced on 9 May 2023, to develop safety standards relating to acquisition, storage, distribution and infrastructure. It also established safety standards for various clean hydrogen production facilities.

11. Are there any foreign investment restrictions related to energy and infrastructure sectors?

The Foreign Investment Promotion Act and the Rules on Foreign Investments prohibits/restricts foreign investment in the following categories of business:

<table>
<tr><th>Business</th><th>Foreign Investment Restriction</th></tr>
<tr><td>Nuclear power generation</td><td>Fully restricted</td></tr>
<tr><td>Water power generation</td><td rowspan="4">The aggregate domestic power generation facilities acquired by foreigners from KEPCO must be less than 30% of the aggregate domestic power generation facilities (only applicable with respect to purchase of facilities from KEPCO)</td></tr>
<tr><td>Thermo power generation</td></tr>
<tr><td>Solar power generation</td></tr>
<tr><td>Other power generation</td></tr>
<tr><td>Electricity transmission and supply</td><td rowspan="2">Foreign investment ratio must be less than 50% and foreign investors shall not hold more voting rights than the largest domestic shareholder</td></tr>
<tr><td>Sale of electricity</td></tr>
</table>

12. What international treaties are in place that may offer protection to international investors in hydrogen projects in the jurisdiction?

The United Nations Conference on Trade and Development (UNCTAD) website states that South Korea is a signatory to 81 bilateral investment treaties (BITs) that are in force as at 1 May 2024, and certain other treaties also contain protections for investors in South Korea. These can be accessed from **UNCTAD's Investment Policy Hub**.

Korea is currently only an observer and not an official member of the Energy Charter Treaty. Therefore, the protection of international investors follow international recommendations and consensuses including from the OECD, UNCTAD, and WTO.

The Master Plan states various international treaties sought by the Korean government including:

- overseas blue hydrogen storage treaties;
- Korea to take the initiative in establishing a global hydrogen association, with members of which Korea shall seek to enter into or amend existing FTA to introduce a new chapter on hydrogen; and
- mutual recognition agreement with regard to clean hydrogen certification by preparing joint evaluation standards with respect to the quantity of greenhouse emissions from production to release.

Market developments and opportunities

13. Are there any government grants or other government funding available to hydrogen projects (including for research and development)?

Article 10 of the Hydrogen Act provides that the government may support hydrogen-specialised enterprises by providing subsidies or loans for:

- expenses incurred in technology development and training of experts necessary to innovate safe, economically friendly, and eco-friendly hydrogen businesses;
- expenses for international cooperation and technology exchanges with foreign countries; and
- expenses for the commercialisation of developed technology, the securement of market, or the filing of applications for intellectual property rights.

The Ministry of Science and ICT is planning to support up to KRW 2.75 billion by 2026 for R&D of core technology for biochemical fermentation hydrogen production and source technology for liquid ammonia electrolysis-based hydrogen storage/ extraction through the "Future Hydrogen Source Technology Development Project".

Further, in September 2021, 17 key players participating in the hydrogen value chain voluntarily established the Korea H2 Business Summit, and announced in July 2022 the establishment of their first KRW 500 billion hydrogen fund, which will start investing in early 2023 to solidify the foundations for CCUS and the development of core hydrogen technology. The Korean government has committed to grant certain financial support (e.g. lower interest rates and expansion of loans) to the invested companies and support the fund's activities, such as deal sourcing, commercialisation of technology, and supporting SME's R&D.

At the beginning of 2023, the government announced that it had earmarked KRW 205.9 billion of funding for the development of technologies for electrolysis, fuel cells and low-carbon power generation. This includes an ammonia co-firing demonstration project to run from 2023 until 2027.

As of May 2024, subsidies of up to KRW 8.2 billion have been allocated to hydrogen refuelling stations in order to support fuel purchase costs, encourage participation in the hydrogen industry and improve operating conditions. This is part of an ongoing subsidies programme in which support is paid twice a year to private operators.

14. Are there any notable pilot/demonstration projects in place or planned for the production or offtake of clean hydrogen?

The Master Plan includes various clean hydrogen production projects such as:

- Green hydrogen production: A project is ongoing in Jeju island to utilise excess energy from wind power generation to produce 706 kg of green hydrogen.
- H2 STAR Project: Development of renewable energy, including clean hydrogen, overseas, based on domestic capital and technology. The proposal for this project in the Master Plan states the potential counterparty country (e.g., Australia, Saudi Arabia, UAE, etc.), the subject substance (e.g., green/blue ammonia), and usage (e.g., vehicles, coal power generation). The name of the project STAR stands for supply, transportation, application and relationship.
- Establishment of an international hydrogen exchange: According to the Master Plan, the hydrogen exchange, targeted to be established in 2023, will aim to set the standard price for hydrogen by procuring sufficient quantity by publishing the transaction price between domestic producers and domestic purchasers in 2023, and the price of overseas hydrogen upon domestic arrival by 2027.
- Clean hydrogen auctions: The world's first hydrogen power bidding market (the General Hydrogen Market) was held in South Korea in late 2023, with tender rounds held in June 2023 and October 2023. These tenders opened without any constraints on emission intensities, but tenders for 3,000 to 3,500 GWh of 'clean hydrogen' (the Clean Hydrogen Market) are planned for 2024 (with delivery in 2027).

15. Are there any commercial-scale clean hydrogen production projects in development or already operating?

The Master Plan contains various commercialisation plans in relation to clean hydrogen production. Some examples are:

- Mass substantiation: Commercialisation of gigawatt-level water electrolysis facilities through mass substantiation for green hydrogen production in order to create an early market for hydrogen utilising renewable energy complexes in Jeju, Jeonbuk, and Jeonnam provinces. Most recently, MOTIE announced the country's largest green hydrogen production substantiation project of 12.5MW scale in Jeju, which will be able to produce 1,176 tons per year at a 60% rate of operation to supply hydrogen to 200 garbage trucks and 300 intra-/inter-city buses in Jeju island.
- Maritime green hydrogen: Commercialisation of stationary and floating hydrogen production plants utilizing maritime-based renewable energy (wave power and wind power) by 2036 and maritime-bio linked plants by 2028.

The Chungju Bio Green Hydrogen Station, the first commercial green hydrogen station in Korea established in March 2022, is expected to produce 500 kg of green hydrogen every day by producing and refining biogas produced from food waste.

Other ongoing commercialisation projects in relation to hydrogen production include:

- Lotte Chemical installed CCU equipment which applies gas separation membrane in its facility , which is currently under operation and is being plans for commercialisation of this technology.
- Doosan Heavy Industries & Construction is planning to construct the Changwon Hydrogen Liquefaction Plant, an equipment which produces blue hydrogen by liquefying captured carbon dioxide using CCUS technology, by 2023.
- Biox is producing 20 litres of hydrogen per day by HAAMA system which utilises food waste, and is also testing an integrated process that simultaneously manages green hydrogen production and waste fluid.
- Samsung C&T will build the first hydrogen compound blending power generation infrastructure in South Korea, in Gangwon Province, together with the Korea Southern Power Co. These facilities will comprise a 30,000-ton tank to compress and store hydrogen compounds, as well as loading and distribution facilities. The KRW 140 billion project is planned for completion in 2027.

16. Have there been any hydrogen-related disputes in your jurisdiction?

There do not appear to be any major hydrogen related disputes publicly available as of April 2024.

Last updated May 2024

Spain

Policy and regulation

1. Is there a government hydrogen strategy or policy?

Yes, the Council of Ministers approved the **Spanish Hydrogen Roadmap** (*Hoja de Ruta del Hidrógeno*) on 6 October 2020.

On 14 December 2021, the Council of Ministers approved the Strategic Project for the Recovery and Economic Transformation on Renewable Energies, Renewable Hydrogen and Storage (Proyecto Estratégico para la Recuperación y Transformación Económica (PERTE) de Energías Renovables, Hidrógeno Renovable y Almacenamiento) which foresees a public budget of €1,555 million for the development of renewable hydrogen.

2. What are key goals and commitments included in the strategy/policy?

The Hydrogen Roadmap aims to develop 4GW of electrolyzing capacity by 2030 and intends to qualify Spain as a technological benchmark in the production and use of renewable hydrogen, as well as the creation of innovative hydrogen value chains to contribute to the following objectives:

- Reducing local pollutant emissions and greenhouse gases generated during the production cycle.
- Take advantage of the surplus of renewable energy generated during off-peak electricity consumption hours, by allowing manageability and continuity of the production cycle from renewable energy sources through energy storage.
- Extending decarbonisation and renewable energy consumption to such sectors where electrification is not feasible or cost-effective.

Please note that the Spanish government has initiated the process of updating the Integrated National Energy and Climate Plan for the period 2023-2030 which serves as the primary programmatic tool outlining the energy initiatives to be undertaken by the Spanish government. This process was initiated by releasing a draft proposal on 28 June 2023. In regards to hydrogen, the document envisions a potential increase in electrolysis capacity for producing green hydrogen, with a target of 11 GW by 2030. This is a significant increase from the aforementioned projected 4 GW outlined in the Hydrogen Roadmap presented in 2020. The draft underwent the public consultation phase which ended on 4 September 2023 and was, according to the MITERD, subsequently communicated to the European Commission, which assessed the modification. The draft is currently pending approval by the Spanish government.

3. Which industry sectors are most likely to be affected by hydrogen deployment?

- Refining, chemical and metallurgical industries;
- Gas and electric sectors including energy storage;
- Mobility (road, maritime, railway and/or aviation transportation); and
- Residential sector.

4. Who are the main regulators for the hydrogen market?

There is a regulatory gap on specific provisions applicable to green hydrogen production facilities. Indeed, the existing legal framework considers hydrogen production as an industrial activity (chemical industry for the production of inorganic gas). Despite the foregoing, rulemaking and oversight competences in Spain belong to State, regional and local administrations:

- Mainly, the Ministry for the Ecological Transition and Demographic Challenge (MITERD) (in particular, Subdirectorate General for Hydrocarbons and New Fuels).
- The Ministry of Industry and Tourism.
- The National Markets and Competition Commission (CNMC).
- The Department of Energy/Industry in each relevant autonomous region.
- The Department of the Environment in each relevant autonomous region.
- Local authorities.

5. Does the government hydrogen strategy or policy support the development of both low-carbon (blue) hydrogen and renewable (green) hydrogen?

No, both the Hydrogen Roadmap and the **the Strategic Project for the Recovery and Economic Transformation on Renewable Energies, Renewable Hydrogen and Storage** are only intended for the development of green hydrogen.

6. If the government hydrogen strategy or policy supports the development of low-carbon hydrogen, to what extent is carbon capture and storage being taken forward?

N/A.

7. Are there targets for the production of hydrogen?

The target set out in the Hydrogen Roadmap is to achieve 4GW of electrolyzing capacity by 2030.

As we mentioned in section two of this query, the Spanish government has issued a draft proposal to update the Integrated National Energy and Climate Plan for the period of 2023-2030. Should the current content of this draft proposal be approved, it would raise the electrolysis capacity targets for 2030, increasing them from 4 GW to 11 GW.

8. Are there any incentive mechanisms/business models in place to support the production of hydrogen?

Currently there are no incentive mechanisms in place to support the production of green hydrogen. However, measure No. 5 of the Hydrogen Roadmap states that taxation should provide incentives for renewable hydrogen as opposed to hydrogen whose origin is not traceable. No further actions have been carried out yet in this regard.

The Value Chain of the Automotive Industry Boosting Plan (*Plan de Impulso de la Cadena de Valor de la Industria de la Automoción*) promotes an integral review of vehicle taxation schemes in order to introduce a greater environmental approach.

In contrast to the absence of tax incentives, there are economic incentives to support the production of hydrogen in the form of government grants and other government funding, which are explicitly mentioned in subsequent sections of this query.

9. Are there any standards in place for the classification and/or certification of low-carbon or renewable hydrogen?

Yes, Royal Decree 376/2022, of 17 May, on the sustainability and reduction of greenhouse gases emissions' criteria for biofuels, bioliquids and biomass fuels as well as on the system of guarantees of origin of renewable gases (*Real Decreto 376/2022, de 17 de mayo, por el que se regulan los criterios de sostenibilidad y de reducción de las emisiones de gases de efecto invernadero de los biocarburantes, biolíquidos y combustibles de biomasa, así como el sistema de garantías de origen de los gases renovables*), which partially transposes Directive 2018/2001 on the promotion of the use of energy from renewable energy sources and provides for the implementation of a guarantees of origin scheme for gases obtained from renewable sources (e.g., biogas, biomethane or renewable hydrogen, etc.). Additionally, Royal Decree 376/2022, of 17 May has been implemented by Order TED/1026/2022, of 28 October on the supervision and auditing scheme for the abovementioned guarantees of origin.

10. Does the regulatory framework clearly define the regulatory requirements relating to the production, storage, transportation or supply of hydrogen?

There is currently a regulatory gap on regulation applicable to green hydrogen production facilities (e.g. administrative authorisations, requirements for the accreditation of the renewable origin of the energy consumed for the production of green hydrogen).

There was a bill for a Hydrogen Law at parliamentary process of enactment, which was published as a proposal on 26 July 2021. However, as of today, we are not aware of any further developments in its processing or of any similar legislative/regulatory initiatives.

The existing regulatory framework considers the hydrogen production as a chemical industry consisting on the production of inorganic gas and is subject to strict environmental requirements.

The Hydrogen Roadmap provides for the simplification and removal of regulatory burdens that currently affect the production of green hydrogen and proposes several measures intended to this purpose.

In light of the foregoing, a new specific regulatory framework for the injection of renewable gases was approved in August 2022 and foresees two different forms of supply: (i) by direct injection into the natural gas transmission and distribution grids; and (ii) by direct piping to a gas consumption facility. Nevertheless, please bear in mind that, this new regulatory framework will require further regulatory and technical development.

In addition to the foregoing, the MITERD has initiated the processing of an order to establish the regulatory framework for calls for aid for Hydrogen Cluster or Valley projects. The draft underwent a prior public consultation phase which concluded on 22 April 2024.

11. Are there any foreign investment restrictions related to energy and infrastructure sectors?

Yes, a new foreign direct investment (FDI) control was implemented in the context of the COVID crisis and is still in force, in accordance to which acquisition transactions in which the Investor (as defined below) (i) acquires a stake of ten per cent or more of the share capital; or (ii) as a result thereof, effectively takes part in the management or control of a Spanish company, are subject to an administrative authorisation if carried out:

- in certain strategic sectors (objective restriction), including, among others, supply of fundamental inputs (e.g. energy, raw materials), with certain specific exceptions for energy sector; or
- where the Investor is considered to be a "risky" person (subjective restriction), including: (i) Investors directly or indirectly controlled by the government of a third country; (ii) foreign Investors that have invested or participated in sectors affecting security, public order and public health (especially those listed above) in another Member State; and (iii) if there is a serious risk that the foreign Investor carries out criminal or illegal activities affecting public security, public order or public health in Spain.

For the purposes of FDI Control, **Investor** means:

- residents of non-EU or EFTA countries;
- residents of EU or EFTA countries whose real ownership corresponds to residents of non-EU or EFTA countries, or
- residents of other EU/EFTA countries may qualify (on a transitory basis until 31 December 2024) as foreign Investors if the investment is made in (i) companies listed in Spain; and (ii) unlisted companies if the value of the investment exceeds 500 million euros and, in both cases, if carried out in strategic sectors.

12. What international treaties are in place that may offer protection to international investors in hydrogen projects in the jurisdiction?

The United Nations Conference on Trade and Development (**UNCTAD**) website states that Spain is a signatory to 70 bilateral investment treaties (**BITs**) that are in force, and certain other treaties may contain other investment provisions.

The Energy Charter Treaty (ECT) is a multilateral investment treaty which entered into force in April 1998 and specifically addresses energy trade, transit and investment between its contracting parties, which include all EU states (except Italy). Discussions as to the modernisation of the ECT have been ongoing for several years focussing, in particular, on investment protection and "greening" the ECT.

These discussions have focussed on reducing the protections accorded to fossil fuels and explicitly protecting emissions reduction technologies (including hydrogen and CCUS). This should be kept under review. There are differing views as to whether hydrogen production and CCUS would be afforded protection under the current terms of the ECT, and to our knowledge the question has not been considered by an arbitral tribunal.

Market developments and opportunities

13. Are there any government grants or other government funding available to hydrogen projects (including for research and development)?

Yes, on 18 and 22 February 2022, the Spanish Government launched:

- four calls for incentive programmes for the green hydrogen innovative value chain amounting to a total of €250 million. The funding will be allocated (i) for large electrolysers (€100 million); (ii) vehicles demonstration and validation (€80 million); (iii) industrial and experimental research (€40 million); and (iv) capacity building and technological advances in test and manufacturing lines (€30 million).
- a call for public grant amounting to a total of €50 million for pioneering renewable hydrogen projects, with commercial viability, for local production and consumption in sectors that are difficult to decarbonise, such as industry and heavy transport.

In addition to the aforementioned, the Spanish government approved on 18 May 2023 a call for public grant amounting to a total of €150 million for pioneering and unique renewable hydrogen projects (second round of "H2 PIONEERS" programme) in the framework of the EU-funded Recovery, Transformation and Resilience Plan (specifically PERTE ERHA programme). IDAE, entity affiliated with the MITERD has also granted on 26 January 2023 a direct allocation of subsidies amounting to € 74 million to Spanish projects participating in the Important Project of Common European Interest in hydrogen technology (the so-called PIICE Hy2Tech). Furthermore, the Spanish Prime Minister office's webpage published on 6 February 2024 the Spanish government's intention to grant €900 million to 10 major projects participating in the Important Project of Common European Interest (PIICE) for the production, transport and development of renewable hydrogen technologies.

Certain regional governments have also launched additional grants.

14. Are there any notable pilot/demonstration projects in place or planned for the production or offtake of clean hydrogen?

Different pilot projects have been deployed to examine and test the feasibility of green hydrogen production and its potential use in different sectors, such as the projects outlined below:

- **The Basque Hydrogen Corridor** aims at creating a hydrogen ecosystem, based in the Basque Country, which will enable progress to be made towards decarbonising the energy, industrial, residential and mobility sectors.
- **The Hydrogen Valley of Catalonia** which emerged as the region's response to the strategy launched by the European Commission in 2020. So far two projects are been developed in the context of this program: (i) Project VAL2H2 is a project for the development of technologies for the generation of renewable hydrogen from waste that is difficult to manage; and (ii) Project T-HYNET aims to develop an electrolyser with a capacity of 150 MW in its first phase, scheduled for commissioning in 2026, and then increase the renewable hydrogen production capacity to 1 GW in a second phase starting in 2027.
- **H2Ports** is a pilot project located in the Port of Valencia that develops the transformation to green hydrogen of a reach stacker and a yard tractor in real operating conditions. The project includes the development of green hydrogen generation facilities at 350 bars, as well as the study and development of the green hydrogen supply logistics in the Port of Valencia.
- **BenorthH2** a green hydrogen production facility which aims at achieving the injection of hydrogen into the existing natural gas grid through a pipeline of more than 15 kilometres across eight municipalities of Bizkaia.
- **H2Sarea**, which intends to research and develop the necessary technological solutions for the safe distribution of hydrogen mixed with natural gas through the natural gas grid.
- **Green Hydrogen Valley Platform of the Region of Murcia**. This project intends to develop the production of green hydrogen in the Escombreras Valley (Murcia). Iberdrola's hydrogen project at Palos de la Frontera (Huelva) that aims to produce over 62.000 tonnes/year of green hydrogen.

15. Are there any commercial-scale clean hydrogen production projects in development or already operating?

There are a number of projects in the pipeline, at different stages of development, including:

- **Lloseta industrial green hydrogen production plant**, comprised within the "Power to Green Hydrogen Mallorca", which is powered by photovoltaic sources. The project entered into operation in March 2022 and envisages to produce at least 300 tonnes/year of green hydrogen.
- **Ibredrola's hydrogen project at Puertollano (Ciudad Real)**, which aims to be one of the largest green hydrogen plants in Europe. It is expected to start operations in 2022 with a capacity of 20 MW and the green hydrogen produced will be used in a nearby Fertiberia's factory.
- **Coagener's hydrogen project at Campo de Gibraltar** (Cádiz) that aims to produce 80 tonnes/year of green hydrogen with a electrolyzing capacity of 1 MW from July 2023 for commercial purposes.
- **Hydrogen Cluster of the Valencian Community (HyVal) at BP's Castellón refinery**. This initiative focuses on the development of up to 2 GW of electrolysis capacity.
- **La Robla (León)**. Project aimed at developing a clean hydrogen initiative to install an electrolyser with an initial capacity of 60 MW, and eventually extending it to 280 MW.
- **'HyDeal España'.** Consortium involving ArcelorMittal, Enagás, and Grupo Fertiberia. The project aims to start delivering green hydrogen in 2028 through electrolysers with a capacity of 3.3 GW.

16. Have there been any hydrogen-related disputes in your jurisdiction?

We are not aware of any hydrogen-related disputes in our jurisdiction.

Last updated April 2024

Sweden

Ashurst collaborated with **Schjødt** in the preparation of this content. We are grateful for their input.

Policy and regulation

1. Is there a government hydrogen strategy or policy?

There is currently no government hydrogen strategy or policy. However, on 26 November 2021 the Swedish Energy Agency published a "national strategy on hydrogen, electro-fuels and ammonia" which is currently under review by the Ministry of Infrastructure. It is not clear if or when a final strategy will be adopted.

2. What are key goals and commitments included in the strategy/policy?

The proposed strategy indicates a goal of 5GW of hydrogen production by 2030 and 15GW of hydrogen production by 2045. The proposed strategy also includes the creation of financial incentives and a regulatory framework for hydrogen. However, the proposed strategy has been criticised by the market for setting goals that are too far in the future and not ambitious enough.

3. Which industry sectors are most likely to be affected by hydrogen deployment?

The industry sectors most likely to be affected by hydrogen deployment are:

- the steel industry;
- heavy road freight;
- refineries and chemical industries; and
- fertilisers.

The power sector in Sweden is already largely based on clean energy (namely hydropower (45%), wind (17%) and nuclear (30%)) and Swedish households mainly rely on electricity because Sweden lacks a gas distribution network. Therefore, as the power and the heating sectors are already decarbonised, they will most likely not be affected by hydrogen deployment.

4. Who are the main regulators for the hydrogen market?

Sweden has not appointed an authority to be responsible for the hydrogen gas market. The Swedish Energy Agency (Energimyndigheten), the authority that drafted the proposal for a national strategy on hydrogen, is responsible for supervising traditional gas companies and their compliance with different regulations such as the new EU regulation concerning measures to safeguard the security of gas supply and access to natural gas transmission networks. As such, hydrogen market would likely come under their jurisdiction at present.

5. Does the government hydrogen strategy or policy support the development of both low-carbon (blue) hydrogen and renewable (green) hydrogen?

The proposed strategy focusses on renewable (green) hydrogen produced by electrolysis. However, as the proposed strategy has not yet been finalised it is not clear whether both blue and green hydrogen will be supported.

6. If the government hydrogen strategy or policy supports the development of low-carbon hydrogen, to what extent is carbon capture and storage being taken forward?

The proposed strategy does not currently include carbon capture.

7. Are there targets for the production of hydrogen?

The proposed strategy includes the following targets:

- 5GW of hydrogen capacity by 2030; and
- 15GW of hydrogen capacity by 2045.

8. Are there any incentive mechanisms/business models in place to support the production of hydrogen?

There are currently no direct incentive mechanisms in place other than negative incentives in the form of energy and CO2 taxes. However, there are a number of initiatives related to government funding.

Further, the research institute of Sweden is taking an active role in supporting the development of a sustainable society by providing active support to a large number of industry and research projects.

9. Are there any standards in place for the classification and/or certification of low-carbon or renewable hydrogen?

There are no existing national standards in place for the classification of hydrogen. However, as a member state of the European Union, Sweden relies on the EU classifications as outlined in the EU hydrogen policy.

10. Does the regulatory framework clearly define the regulatory requirements relating to the production, storage, transportation or supply of hydrogen?

As Sweden has no legacy of gas use for household heating, there are currently no relevant regulations. The proposed strategy identifies that there is a need for a new regulatory framework regulating inter alia production, distribution, and storage of hydrogen.

11. Are there any foreign investment restrictions related to energy and infrastructure sectors?

The European Union has established a framework for the screening of foreign direct investments into the European Union and the new regulatory framework will come into force in Sweden on 1 January 2023 and shall apply to investments implemented on or after 1 February 2023.

12. What international treaties are in place that may offer protection to international investors in hydrogen projects in the jurisdiction?

The Electronic Database of Investment Treaties (EDIT) website states that Sweden is a signatory to 79 bilateral investment treaties (BITs) that are in force. As Sweden is a member state of the European Union, there are also certain other treaties entered into by the European Union which contain protections for investors in Sweden.

The Energy Charter Treaty (ECT) is a multilateral investment treaty which entered into force in April 1998 and specifically addresses energy trade, transit and investment between its contracting parties, which include Sweden and all other EU states (except Italy). Discussions as to the modernisation of the ECT have been ongoing for several years focussing, in particular, on investment protection and "greening" the ECT.

Market developments and opportunities

13. Are there any government grants or other government funding available to hydrogen projects (including for research and development)?

There are currently a number of national and EU support mechanisms which provide financing for hydrogen-related projects. This includes the following:

- **Klimatklivet (the Climate Leap)** - an initiative by the Swedish Environmental Protection Agency which is actively promoting a number of hydrogen projects and has set aside BSEK 2.8 for clean energy projects during 2022;
- Industriklivet (the Industry Leap) - an initiative by the Swedish Energy Agency which provides support for feasibility studies, research, pilot projects, demonstration projects and investment projects which aim to reduce industrial emissions and has set aside MSEK 909 for projects during 2022; and

Swedish Agency for Economic and Regional Growth - provides subsidies, loans and guarantees to SMEs.

14. Are there any notable pilot/demonstration projects in place or planned for the production or offtake of clean hydrogen?

There are a number of different pilot projects being deployed in Sweden to examine and test the feasibility of clean hydrogen production and the use of hydrogen in different sectors. The main projects are within the steel industry and include the following:

- **Hybrit pilot project** - a pilot project for the production of green steel and the storage of hydrogen in Luleå in northern Sweden; and
- **Ovako** – a new hydrogen plant in Hofors, which is expected to be completed by the end of 2022, which will heat steel with hydrogen prior to rolling and is expected to generate 3,500 cubic meters of green hydrogen per hour.

15. Are there any commercial-scale clean hydrogen production projects in development or already operating?

There are currently no existing commercial-scale clean hydrogen production projects in Sweden, but there are a number of projects in the pipeline, at different stages of development, including the following:

- **Hybrit Development** – a pilot project by SSAB, LKAB and Vattenfall which substitutes coal for hydrogen in the steel making process;
- **H2 Green Steel** – a pilot project which will produce green steel using hydrogen produced from wind and hydropower;
- **Spanish Grupo Fertiberia and Swedish Cinis Fertilizer** – are investing in two production plants in northern Sweden for the production of commercial fertilizers;
- **OKG** - a Swedish nuclear plant operator, is intending on producing and selling hydrogen;
- **BotnialänkenH2** - a project run by Uniper, ABB and the Port of Luleå which plans to establish a regional hydrogen hub in Luleå where hydrogen is produced from wind power, and where the hydrogen can both be used in the regional process industry or converted into fuel;
- **Volvo Group and Daimler Trucks** – are forming a joint venture for the development of fuel cells for their fuel cell electric vehicle trucks; and
- **Hydrogen Refueling Stations** – there are currently four hydrogen refueling stations in Sweden but this is expected to increase to 50 by 2025 as Nilsson Energy has announced that it will build 24 hydrogen refueling stations before the end of 2025 and a number of other projects are underway.

16. Have there been any hydrogen-related disputes in your jurisdiction?

To our knowledge, there has not been any hydrogen-related disputes in Sweden.

Last updated May 2024

UAE

Policy and regulation

1. Is there a government hydrogen strategy or policy?

The UAE unveiled its Hydrogen Leadership Roadmap on 31 October 2021. The Hydrogen Leadership Roadmap is part of the "UAE Net Zero by 2050 Strategic Initiative", the first strategic 2050 initiative in line with the 2015 Paris Agreement announced by a country in the MENA region.

In July 2023, the UAE's Ministry of Energy and Infrastructure ("MoEI") publicly released the UAE's National Hydrogen Strategy ("The Strategy"). It forms part of the UAE's Hydrogen Leadership Roadmap and helps establish the UAE's vision and inform its policy decisions. The Strategy outlines the key steps the UAE aims to take to position itself as a top global producer and supplier of low-emission hydrogen by 2031 and to meet the UAE's commitment to net zero by 2050.

As well as these national commitments, the Supreme Council for Financial and Economic Affairs in Abu Dhabi , together with the Abu Dhabi Department of Energy ("DoE") launched the Abu Dhabi Public Policy on Low-Carbon Hydrogen in November 2023 The specifics of the policy are not yet fully developed, and no official communication regarding timelines for the release of further details or the finalisation of the policy has been made at the time of writing. It is expected that the policy will focus on creating hydrogen oases and clean electricity parks, which will be managed within a comprehensive governmental regulatory framework, to attract investment and increase operational efficiency in low-carbon hydrogen production and associated sustainable industries.

2. What are key goals and commitments included in the strategy/policy?

The Hydrogen Leadership Roadmap comprises three core objectives:

- unlocking new sources of value creation through exports of low carbon hydrogen, derivatives and products to key importing regions;
- creation of new hydrogen derivative opportunities through low-carbon steel; and
- development of sustainable kerosene as well as other priority UAE industries.

As outlined in the Hydrogen Leadership Roadmap, the UAE aims to support the low-carbon hydrogen business through five critical enablers:

- a clear regulatory framework backed by policies, incentives, standards, and certifications;
- best-in-class technology through value-add partnerships and the UAE domestic research and development structure;
- access to existing and new intergovernmental relationships to accelerate growth of a domestic ecosystem;
- readily available traditional land and infrastructure resources to support domestic production; and
- green financing within the UAE and in international capital markets.

In addition, through the Strategy, the UAE aims to contribute to:

- developing a regulatory framework and policies that support hydrogen as a sustainable fuel for the future;
- strengthening regional collaboration to establish a regional hydrogen market;
- bolstering investments in research and development to improve the cost effective of hydrogen production, transport and utilisation; and
- fostering the domestic market.

The UAE aims to achieve the objectives set out in the Strategy through ten enablers:

- building international partnerships and creating investment opportunities to drive the global transition to a hydrogen economy;
- leveraging natural resources and existing assets to competitively lead future energy markets;
- guiding society to embrace hydrogen and unlocking the common good as a result of global carbon mitigation;
- creating the infrastructure necessary to link production with demand, accelerating hydrogen availability and utilisation;
- incubating and accelerating next generation hydrogen technology development across the value chain;
- establishing the legislative mechanisms needed to support the low carbon hydrogen transition, including hydrogen certification and guarantees of origin;

- creating an attractive investment environment to support the hydrogen transition, as well as developing green finance mechanisms domestically;
- providing the certainty, predictability and confidence that industry needs to transition to hydrogen;
- achieving and maintaining globally competitive hydrogen pricing through a long-term market driven support mechanism; and
- nurturing and growing a highly skilled workforce to drive forward the transition to hydrogen.

3. Which industry sectors are most likely to be affected by hydrogen deployment?

The primary use for low-carbon hydrogen is aimed at supporting the decarbonisation efforts of the UAE's domestic industry with a focus on stimulating local demand in the following sectors:

- energy sector (storage and generation);
- oil and gas;
- chemical and fertiliser production;
- transport, shipping and aviation;
- iron and steel production;
- aluminium sector; ands
- infrastructure (refineries, ports and terminals, fuelling stations).

There is an expectation that the export of hydrogen and hydrogen derivatives will be considered in parallel once domestic demand is met.

4. Who are the main regulators for the hydrogen market?

As the UAE is in the process of developing its Hydrogen Leadership Roadmap and related regulations, it is not yet clear which bodies will be primarily responsible for regulating hydrogen development in the country.

However, it is likely this would fall under the ambit of the MoEI (given this ministry is leading the development of the hydrogen roadmap) and/or the Ministry of Climate Change and Environment, as the Ministry responsible for the UAE Net Zero by 2050 strategic initiative which encompasses the Hydrogen Leadership Roadmap. At present, hydrogen-related projects may also deal with the relevant Emirate's Department of Economic Development (in respect of any foreign investment component) and Environmental Agency (for general permitting and approvals), as applicable.

In addition, the Strategy envisages a governance structure which comprises of four layers:

1. the Federal Hydrogen Committee;
2. the Hydrogen Strategy Advisory Council,
3. the Working Groups; and
4. the Coordination Office.

The Federal Hydrogen Committee, chaired by the Undersecretary of the Ministry of Energy and Infrastructure, will be responsible for the overall implementation of the strategic objectives by facilitating cohesive support on required Cabinet decisions relating to policy, regulatory, fiscal, and non-fiscal interventions. The Committee will include Undersecretaries of key government ministries assigned and responsible for monitoring and updating the performance of each of the ten elements of the hydrogen strategy.

The Hydrogen Strategy Advisory Council will include senior leaders of major hydrogen stakeholders from relevant Emirates and organisations who will be responsible for providing recommendations to the Federal Hydrogen Committee. The Council Collaborate to identify, inform, and promote actions for enabling the production, transmission, storage, and end of low carbon hydrogen across different sectors to accelerate the UAE's sectoral demands and export needs.

The Working Groups will comprise five layers of expert focus groups in Production, Demand, Safety, Standards and Certification, Policy and Regulation, and Research and Development. The Working Groups will collaborate with the existing groups, such as the National Hydrogen Technical Committee, the Abu Dhabi Hydrogen Alliance, and the Hydrogen leadership Initiative, on existing and new priorities as the market develops. These working groups will actively engage stakeholders in the community to educate and collect insights.

The Ministry of Energy and Infrastructure will act as the Coordination Office to facilitate and coordinate the activities of the National Hydrogen Committee, the Hydrogen Strategy Advisory Council, and the Working Groups. The coordination office will be responsible for tracking and reporting activities regarding the actions and progress of recommendations of the Strategy. Terms of Reference will be established to define the detailed organisation, including structure memberships, objectives, priorities, and meeting schedules of the Hydrogen Strategy Advisory Council and the Working Groups.

5. Does the government hydrogen strategy or policy support the development of both low-carbon (blue) hydrogen and renewable (green) hydrogen?

The Strategy welcomes the development of all clean hydrogen and contemplates the following categories of hydrogen:

- Light green, referring to renewable energy through electrolysis;
- Dark green, referring to renewable energy through water gasification;
- Blue, referring to energy generated by natural gas through methane reforming with CCUS;
- Turquoise, referring to energy generated by natural gas through methane pyrolysis); and
- Pink, referring to nuclear energy.

The UAE is already well positioned to be a leader in clean hydrogen with natural competitive advantages for both blue and green hydrogen, including abundant hydrocarbons, existing large-scale hydrogen and ammonia production facilities, access to some of the world's most cost-competitive solar PV energy and large-scale carbon capture and storage capacities, which Abu Dhabi National Oil Company (ADNOC) already possesses and continues to advance in.

The UAE sees blue hydrogen a stepping stone to increase domestic hydrogen use and distribution and plans on adding CCUS technologies to hydrogen production using natural gas.

Green hydrogen is envisaged to play a significant role in UAE's domestic strategy to meet the UAE 2050 Net-Zero goals and which will also assist globally by exporting hydrogen. Green hydrogen production however remains in its infancy, requiring an international collaboration to accelerate its development.

6. If the government hydrogen strategy or policy supports the development of low-carbon hydrogen, to what extent is carbon capture and storage being taken forward?

The UAE Ministry of Economy has identified carbon-capture technology as a promising sector for growth given rising industrialisation along with soaring investments toward introduction of emission control machineries. The Strategy confirms that CCUS infrastructure will be linked to hydrogen and non-hydrogen projects and will need to be developed continuously over time. However, there is limited public information in respect of the pipeline of CCUS projects and investment.

The UAE currently has one CCUS project, Al Reyadah, which captures CO2 from the flue gas of an Emirates Steel production facility, uses the captured CO2 for enhanced oil recovery in ADNOC's nearby gas fields and then stores the CO2 underground. ADNOC has announced plans to expand the capacity of this program by over 500%, capturing CO2 from its own plants with the aim of reaching 5 million tonnes of CO2 each year by 2030 and intends to incorporate CCUS technology at its Shah and Habshan-Bab gas plants.

7. Are there targets for the production of hydrogen?

The UAE aims to become a leading global producer of low-carbon hydrogen by 2031, with the Strategy targeting a production capacity of 1.4 million tonnes annually. This capacity includes 0.5 million tonnes of green hydrogen produced domestically, another 0.5 million tonnes abroad, 0.4 million tonnes of blue hydrogen, and 0.0075 million tonnes of pink hydrogen, with potential for upward revision. While specific production targets are yet to be set by the government, the UAE aims to capture 25% of the global low-carbon hydrogen market by 2030.

Despite these targets, domestic sectoral demand within the UAE is projected to reach 2.1 million tonnes annually by 2031, providing an opportunity to exceed export targets by an additional 0.6 million tonnes annually. Looking ahead to 2050, forecasts suggest that hydrogen sectoral demand in the UAE could potentially expand to around 10.1 million tonnes annually by 2050.

In addition, company specific targets have been announced at the industry level. ADNOC has existing plans to increase hydrogen production to 500 kt per annum and is exploring several new growth opportunities. ADNOC is already a producer of over 300 kt per year of hydrogen in its downstream facilities, which is largely used for industrial purposes.

8. Are there any incentive mechanisms/business models in place to support the production of hydrogen?

Incentives such as public ownership stakes, direct grants, and long-term contracts from public bodies for hydrogen purchases to accelerate the development of a future hydrogen economy in the UAE are envisioned for the initiative. The initial focus is on finding incentives for hard to abate industries such as steel, aluminium, cement and heavy goods vehicles, with sustainable aviation fuel and ancillary grid services to follow in 2026 and 2028 respectively.

At the time of writing, there are no formal incentive mechanisms or established business models to support hydrogen production in the UAE. However, the Strategy outlines various incentives to foster the growth of the UAE's hydrogen industry:

- On the supply side, the Strategy references cost support mechanisms to diminish the Levelised Cost of Hydrogen for projects with the precise form this will take to be established at a later stage in the Hydrogen Leadership Roadmap;
- On the demand side, potential carbon pricing mechanisms and cap-and-trade systems are contemplated;

- On the finance side, revenue support guarantees are contemplated with the overarching goal of offering low-interest sustainable financing options; and
- A market price for clean hydrogen is intended to be established between 2026 and 2028 to ensure stability for hydrogen consumers.

In addition to following standard business models to establish a hydrogen market, the Strategy contemplates a number of different models:

- Contracts for Difference to help bridge the cost gap between low carbon hydrogen and alternative fuels of greater carbon intensity;
- Regulated Asset Bases to incentivise private investment into public projects, helping guarantee developers' payback in order to create the lowest capital cost basis for projects to reach construction;
- Hydrogen Purchase Agreements as a market-driven model that could link supply and demand. The UAE expects this to work similarly to Power Purchase Agreements, where a Hydrogen Purchase Agreement is entered into between a green hydrogen producer and the end user for a specific sale price for a specific amount of hydrogen over an agreed timeframe; and
- Other auction-based mechanisms to promote a timely and effective power to synthetic fuels (PtX) market ramp-up on an industrial scale similar to the the H2Global mechanism.

9. Are there any standards in place for the classification and/or certification of low-carbon or renewable hydrogen?

There is currently no defined statement in the public domain regarding the classification or certification of low carbon and/or hydrogen from renewable resources.

However, the UAE is exploring the establishment of a Hydrogen Certification Scheme ("Scheme") designed to monitor carbon emissions throughout the entire hydrogen value chain. The Scheme will track emissions from each process across the hydrogen value chain from renewable energy generation to construction and production, through to distribution. The goal is to engage with key export markets and international entities to devise the Scheme in order to meet cross-jurisdictional standards. The envisioned timeline targets implementation between 2026 and 2028, with subsequent reviews and adjustments scheduled for 2029 to 2031 to ensure optimisation of the Scheme as necessary.

10. Does the regulatory framework clearly define the regulatory requirements relating to the production, storage, transportation or supply of hydrogen?

The Strategy sets out the guiding principles, targets and institutional design for the hydrogen sector in the UAE and requires all relevant public and private entities to develop and implement further coordinated and supporting strategies and regulatory frameworks to achieve the Strategy's objectives. However, the UAE has not yet established the legal and regulatory framework that is necessary to encourage and regulate the emerging hydrogen economy.

11. Are there any foreign investment restrictions related to energy and infrastructure sectors?

Foreign investment in certain economic activities in the UAE is regulated and there is a "negative list" of certain sectors and economic activities that are not permitted or significantly restricted for foreign direct investment, which includes exploration and production of petroleum materials. There is also a positive list prescribed by the resolution for which up to 100% foreign ownership is accepted – this includes, broadly, permitted activities within the agricultural, manufacturing and services sectors. In respect of activities on neither the negative or positive list (including ownership of pipeline infrastructure and many other activities required for hydrogen projects), the general rule that there shall be no less than 51% local ownership applies.

Further, the Department of Economic Development within each Emirate of the UAE has discretion to specify which business activities will be open to 100% foreign ownership. The Department of Economic Development in each of Abu Dhabi and Dubai, for example, identify over 1,000 registered commercial and industrial activities, for which non-citizens, whether natural or legal persons, have the right to own economic licence, establish commercial companies with up to 100% ownership in the relevant Emirate. The positive list in Dubai currently includes green hydrogen production.

An approval and licensing regime is applicable to any such permissible foreign direct investment.

The Strategy confirms that the UAE plans on collaborating with financial institutions and regulatory bodies to establish an environment conducive to regional foreign investment activity.

12. What international treaties are in place that may offer protection to international investors in hydrogen projects in the jurisdiction?

Intending to promote its developmental goals, the UAE concluded 106 bilateral investment treaties, with most of its trade partners, which at a high level operate to:

- protect investments from all non-commercial risks like nationalization, expropriation, sequestration and freezing;
- allow the establishment of investments and licensing such investments;
- confirm the free transfer of profits and other returns in a freely transferable currency; and
- set the dispute settlement procedures between the investor and the State via amicable solution, local courts or international arbitration.

We are not aware of any treaties specific to hydrogen production and development in the UAE.

Market developments and opportunities

13. Are there any government grants or other government funding available to hydrogen projects (including for research and development)?

In November 2021, His Highness Sheikh Mohammed Bin Zayed mandated ADNOC to explore potential opportunities in hydrogen with the ambition to position the UAE as a hydrogen leader.

The Strategy confirms that the UAE intends to dedicate funding for R&D and innovation by establishing a Hydrogen Innovation Fund. Similarly, the Government of Dubai launched the Dubai Green fund to fund investments in green and sustainable projects aligned with the Dubai Clean Energy Strategy which captures hydrogen projects.

Beside direct grants, the UAE plans on collaborating with financial institutions and regulatory bodies to establish an environment conducive to regional foreign investment activity.

14. Are there any notable pilot/demonstration projects in place or planned for the production or offtake of clean hydrogen?

Practical steps also have been taken in terms of implementing pilot projects, as follows:

- **The Abu Dhabi Hydrogen Alliance** was created in January 2021, comprised of Mubadala, ADNOC and ADQ and the launch on 17 November 2021 of a new global renewable energy venture between ADNOC and TAQA;
- Dubai's first green hydrogen plant was commissioned in May 2021. DEWA, in collaboration with Expo 2020 Dubai and Siemens Energy, is implementing the green hydrogen project at DEWA's R&D Centre at the **Mohammed bin Rashid Al Maktoum Solar Park**;
- DEWA, in partnership with Emirates National Oil Company, is studying building a hydrogen fuelling station in furtherance of the objectives of the Dubai Green Mobility Strategy 2030 to encourage the use of sustainable transportation, as well as the UAE's Hydrogen Vehicles System, which aims to develop the hydrogen economy in the UAE, and open up local markets to hydrogen vehicles;
- Complementing this pilot green hydrogen vehicle project is the development of the first set of domestic technical regulations regarding hydrogen vehicles by the Emirates Authority for Standardization and Metrology;
- Al Futtaim Toyota has partnered with Air Liquide to open the first hydrogen refuelling station at Al Badia, Dubai Festival City;
- ADNOC and German logistics company Hamburger Hafen und Logistik AG signed an agreement with ADNOC in March 2022 to test the transport chain for hydrogen from the UAE to Germany. A pilot delivery of low-carbon ammonia (produced by Fertiglobe, a partnership between ADNOC and OCI, at its Fertil plant in Abu Dhabi's Ruwais industrial complex) was unloaded in Germany in September 2022. This delivery was the first ever shipment of low-carbon ammonia to Germany and set an important milestone for the medium-term imports of green hydrogen;
- Emirates Global Aluminium ("EGA") has partnered with MoEI to become a member of the Hydrogen Leadership Initiative. The Initiative is dedicated to increasing research and development into the increasing use of hydrogen in industrial decarbonization. EGA's membership in the organization means it also becomes a member of the Abu Dhabi Hydrogen Alliance and the National Hydrogen Technical Committee;
- TAQA and Abu Dhabi Ports have partnered to develop an industrial-scale green hydrogen-to-ammonia project in Abu Dhabi, with a production capacity of 73,339 tonnes per year; and
- ADNOC has a joint study agreement with two Japanese companies, INPEX and JERA, and a government agency, the Japan Oil, Gas and Metals National Corporation, to explore blue hydrogen production in the UAE to supply Japanese markets.

- Are there any commercial-scale clean hydrogen production projects in development or already operating? The UAE hydrogen market is already active across the end-to-end value chain for hydrogen, with more than 20 projects and developments which are either completed or underway via the main stakeholders, such as the Abu Dhabi Hydrogen Alliance (ADNOC, Mubadala, & ADQ) and DEWA, including: the Mohammed bin Rashid Al Maktoum Solar Park in Dubai, the first solar PV and green hydrogen producing facility in the MENA region;
- the Fertil blue ammonia production plant in Abu Dhabi's Ruwais industrial complex with a capacity of 1,000 kilotons per annum;
- green hydrogen demonstration plant (initially for road transport, then expanding to e-kerosene synthesis and ocean shipping);
- establishing a UAE hydrogen hub in collaboration with BP;
- the UAE's first green ammonia plant powered by solar based electrolyzer facility developed by Helios and Abu Dhabi Ports (with a 2 GW green ammonia export facility developed by TAQA and Abu Dhabi Ports to be located in the same area);
- Al Reyadah, a large-scale green hydrogen project enabling the first green steel produced in the MENA region; and
- a large scale green hydrogen project to enable green steel production with the capacity of 73,000 tonnes of hydrogen per annum developed by Emirates Steel and TAQA.

15. Have there been any hydrogen-related disputes in your jurisdiction?

N/A. We are not aware of any hydrogen-related disputes in the UAE.

16. Have there been any hydrogen-related disputes in your jurisdiction?

There has been nothing in terms of hydrogen related disputes, to the best of our knowledge.

Last updated May 2024

United Kingdom

Policy and regulation

1. Is there a government hydrogen strategy or policy?

Yes, a Hydrogen Strategy was published on 17 August 2021. This Strategy has since then been further developed and augmented, as discussed elsewhere in this guide.

2. What are key goals and commitments included in the strategy/policy?

Clean hydrogen is a key part of the UK Government's **Net Zero Strategy**. In the **Energy White Paper**, published on 14 December 2020, and subsequently in the **Hydrogen Strategy**, published on 17 August 2021, the Government set out its aim to develop 5GW of low-carbon hydrogen production capacity by 2030 and for the UK to becoming a global leader in the development of clean hydrogen. The 5GW target was subsequently revised upwards to 10GW as part of the UK's **Energy Security Strategy**, published in April 2022.

The Hydrogen Strategy acknowledges that the Government will need to take a leading role in developing the business models and regulatory framework for hydrogen. As such, the Government has also taken forward proposals for:

- a Hydrogen Business Model, to provide long-term revenue support to hydrogen producers;
- a UK Low Carbon Hydrogen Standard; and
- a Net Zero Hydrogen Fund (NZHF), which is intended to provide up to £240 million of government co-investment to support new low-carbon hydrogen production out to 2025. The NZHF opened to applicants in May 2022.

Strands 1 and 2 of the NZHF opened to applicants in May 2022 and July 2022 respectively.

3. Which industry sectors are most likely to be affected by hydrogen deployment?

The industry sectors where clean hydrogen may displace fossil fuels in the UK, subject to pilot trials, include:

- the power sector;
- road freight;
- shipping and aviation; and
- heating.

Sectors where hydrogen is already being used, such as those that use hydrogen for industrial applications, are expected to switch to low-carbon hydrogen.

4. Who are the main regulators for the hydrogen market?

The Department for Business, Energy and Industrial Strategy has overall responsibility for the development of hydrogen policy and regulation.

Hydrogen falls within the ambit of the downstream gas regulatory regime, under the Gas Act 1986, and therefore in Great Britain the gas and electricity markets regulator, Ofgem, is responsible for issuing the licences required to transport and supply hydrogen by pipeline, and for the administration and enforcement of this licensing regime.

The upstream oil and gas regulator, the North Sea Transition Authority, has had its remit extended to facilitating the energy transition in the North Sea, and therefore has a role to play in relation to hydrogen, particularly in relation to the re-use of existing oil and gas infrastructure for the purpose of hydrogen production.

Other regulators also have responsibility for regulating various aspects of hydrogen production, transport and supply, including the Health and Safety Executive (in relation to safety issues) and environmental regulators (in England, this is the Environment Agency). The environmental permitting and decommissioning regimes are relatively complex, and which regulator is responsible for their enforcement depends on whether the activity/infrastructure is onshore or offshore, and in which part of the UK it is located.

5. Does the government hydrogen strategy or policy support the development of both low-carbon (blue) hydrogen and renewable (green) hydrogen?

The Hydrogen Strategy supports both low-carbon hydrogen and renewable hydrogen – referred to by the Government as a "twin track" approach. However, the Strategy contemplates that initially at least, low-carbon hydrogen may take a leading role.

The Strategy notes that CCUS-enabled methane reformation is currently the lowest cost low-carbon hydrogen production technology, and given the potential production capacity of CCUS-enabled hydrogen plants, the Government expects this route to be able to deliver a greater scale of hydrogen production while a UK hydrogen economy is being established during the 2020s.

6. If the government hydrogen strategy or policy supports the development of low-carbon hydrogen, to what extent is carbon capture and storage being taken forward?

Since July 2019 the Government has been progressing a programme towards the deployment of carbon capture, usage and storage (CCUS) by developing the business models and regulatory regime for CCUS. A key component of the CCUS programme is the development of a business model and regulatory regime for the carbon transport and storage networks (T&S networks) that will be used to transport and store the carbon dioxide from emitters such as low-carbon (blue) hydrogen producers. It is envisaged that a transmission and storage operator will own and operate a T&S network. The revenue of T&S Co will be subject to an economic regulatory regime (ERR) overseen by an economic regulator.

The Government has selected two CCUS clusters to be initially developed using the ERR model described above: the HyNet North West (**HyNet**) Cluster and the Northern Endurance Partnership's East Coast (**NEP**) Cluster. While both clusters will be available to be used by a large number of different carbon dioxide emitters, they will play a key role in the production of blue hydrogen. The HyNet Cluster will support the HyNet hydrogen plant which is expected to deliver 350MW of low-carbon hydrogen capacity by 2025, while the NEP Cluster will support hydrogen projects in the Net Zero Teesside and Zero Carbon Humber hubs, including the H2Teesside hydrogen project.

7. Are there targets for the production of hydrogen?

The UK's target is to have 10GW of low-carbon hydrogen production capacity by 2030 for use across the economy.

8. Are there any incentive mechanisms/business models in place to support the production of hydrogen?

The Government is developing incentives through a Hydrogen Business Model (HBM). The HBM will involve support for hydrogen producers in the form of private law contracts between hydrogen producers and a government counterparty. A similar model (referred to as the Contracts for Difference regime) is already in place for renewable electricity generators and is also being developed for emitters of carbon dioxide who will connect to the carbon capture and storage networks described in question 6.

The HBM will be applicable across different production technologies, including the main types of production (natural gas reforming with CCUS, and electrolytic hydrogen) as well as other potential production technologies, such as hydrogen from biomass gasification with CCUS. The key features of the HBM contract (as set out in a consultation response of April 2022) include the following:

- price support to be provided under a bilateral contract between the hydrogen producer and a counterparty that will make price support payments to the producer;
- the price support will be a variable premium, calculated as the difference between a strike price and a reference price for each unit of hydrogen sold, with the strike price being the pre-agreed production cost of low-carbon hydrogen and the reference price being the producer's achieved sales price (with a price floor set at the natural gas price); and
- a contract term of between 10 and 15 years.

The HBM contract heads of terms were published in April 2022. The Government intends to develop the terms and conditions for the HBM contract in 2022, so that the first HBM contracts can be awarded in July 2023.

The first allocation window for HBM contracts opened in July 2022. This allocation round – the Electrolytic Allocation Round – invited applications from developers of projects for the production of hydrogen using electrolysis. Producers were invited to apply for both HBM contract support and also for NZHF support. Full details of the first Electrolytic Allocation Round are set out in the application guidance document. The Government is aiming to run a second Electrolytic Allocation Round in 2023, for contract award in 2024.

In the medium-term (likely to be from 2025), the Government intends to progress to competitive allocation of contracts (e.g. through an auction process).

CCUS-enabled hydrogen projects seeking support under a HBM contract are being selected through the "cluster sequencing" process, whereby carbon dioxide emitters (such as hydrogen producers) are selected to connect to a CCUS transport and storage network (described in question 6). CCUS-enabled hydrogen projects selected to proceed to the due diligence stage of the "phase-2 cluster sequencing process" were announced in August 2022.

The Energy Bill 2022-23, currently before Parliament, includes provisions required to provide the legislative framework for the HBM.

Existing producers of hydrogen looking to retrofit using carbon capture and storage (CCS) technology will not be eligible for support through the HBM, but may be eligible to apply for support through the separate Industrial Carbon Capture Business Model, which is intended to support industrial emitters of carbon dioxide who enter into arrangements to have their carbon dioxide transported and stored.

Some support for hydrogen used in transport is also available through the Renewable Transport Fuel Obligation (RTFO), a green certificate scheme for sustainable renewable fuels used in transport. The RTFO imposes an obligation on fuel suppliers to ensure that sustainable renewable fuel makes up a percentage of the volume of fuel they supply for transport. Two types of renewable hydrogen are supported under the RTFO. The first is hydrogen produced by electrolysis powered by renewable electricity. The second is biohydrogen produced from biological feedstocks, mainly biomethane via reformation.

9. Are there any standards in place for the classification and/or certification of low-carbon or renewable hydrogen?

As part of taking forward the Hydrogen Strategy, the Government has developed a **UK Low Carbon Hydrogen Standard** that must be complied with by hydrogen producers seeking support under Government support schemes, including the NZHF and the HBM. The Standard defines what is meant by "low-carbon" hydrogen, by setting a GHG threshold for GHG emissions. Consignments of hydrogen derived from biogenic inputs must also meet sustainability criteria in addition to satisfying the GHG emissions threshold.

The Standard covers the methodology for UK production pathways only at this stage, but the Government intends to set up a hydrogen certification scheme by 2025 to underpin deployment of low-carbon hydrogen and support future international trade.

10. Does the regulatory framework clearly define the regulatory requirements relating to the production, storage, transportation or supply of hydrogen?

The existing regulatory framework defines the requirements applying to different aspects of the hydrogen value chain, but there are areas where greater regulatory certainty is required. In particular, hydrogen falls within the definition of "gas" under the Gas Act 1986, which means that the existing regulatory framework that applies to downstream gas in Great Britain also applies to hydrogen. The application of the Gas Act 1986 regime to hydrogen means that the transportation, shipping (i.e. arranging for transportation) and supply of gas by pipeline are all activities which require a licence under the Gas Act 1986. Similarly, the health and safety regime that currently applies to downstream natural gas also applies to hydrogen.

As noted in the Hydrogen Strategy, while early projects can be expected to operate within existing regulatory regimes, new rules and regulations may be required to facilitate the further expansion of the market. In particular, regulatory changes will be required if a decision is made to proceed with using hydrogen in the existing gas grid, either as blended hydrogen or pure hydrogen.

The Hydrogen Strategy states that the Government will continue to work with industry and regulators in the early 2020s to identify and address regulatory barriers faced by first-of-a-kind hydrogen projects and consider changes needed to unlock hydrogen investment and deployment across the value chain.

11. Are there any foreign investment restrictions related to energy and infrastructure sectors?

The National Security and Investment Act 2021 (**NSIA**), which came into force on 4 January 2022, contains a mandatory notification regime, backed up by criminal sanctions, for transactions involving the acquisition of a right or interest (typically a holding of more than 25%) in 17 key sectors. The regime applies to both foreign and UK investors. For relevant transactions, clearance must be obtained before closing. Certain activities in the energy sector are caught by the mandatory notification regime, including the ownership and operation of various gas infrastructure, such as gas distribution and transmission networks. Because pipeline transportation of hydrogen is covered by the Gas Act 1986 regime that applies to gas distribution and transmission, this means that the NSIA regime would also apply to hydrogen distribution and transmission.

The regime also includes a voluntary notification process (underpinned by a "call-in" power) for other transactions that may affect UK national security interests.

12. What international treaties are in place that may offer protection to international investors in hydrogen projects in the jurisdiction?

The United Nations Conference on Trade and Development (UNCTAD) **website** states that the UK is a signatory to 90 bilateral investment treaties (BITs) that are in force, and in addition certain other treaties may contain protections for investors in the UK. These can be accessed from the UK Treaties online **database** maintained by the Foreign, Commonwealth and Development Office, and UNCTAD's Investment Policy Hub.

The Energy Charter Treaty (ECT) is a multilateral investment treaty which entered into force in April 1998 and specifically addresses energy trade, transit and investment between its contracting parties.

There are differing views as to whether hydrogen production and CCUS would be afforded protection under the current terms of the ECT, and to our knowledge the question has not been considered by an arbitral tribunal.

A number of states have withdrawn, or announced that they intend to withdraw, from the ECT. On 28 May 2024 the depositary of the ECT confirmed that it had received written notice of the UK's withdrawal from the ECT, with the withdrawal to take effect on 27 April 2025. New energy investments in the UK will not be protected under the ECT if made after that date. However, investments already made at this point in time will likely continue to enjoy protection for a period of 20 years under the so-called 'sunset provision' of the ECT.

Market developments and opportunities

13. Are there any government grants or other government funding available to hydrogen projects (including for research and development)?

There have been a number of different funding initiatives targeted at different parts of the hydrogen value chain. The Low Carbon Hydrogen Supply Competition has provided funding to a number of pilot projects for the production of low-carbon hydrogen. Funding has been made available to various pilot projects for the use of hydrogen in sectors such as heating and transport (see question 10). The Net Zero Hydrogen Fund (NZHF), which is intended to provide up to £240 million of government co-investment to support new low-carbon hydrogen production out to 2025, was launched in May 2022.

14. Are there any notable pilot/demonstration projects in place or planned for the production or offtake of clean hydrogen?

There are a number of different pilot projects being deployed in the UK to examine and test the feasibility of clean hydrogen production and use in different sectors. One area that is of particular interest as it has the potential to create a large market for low-carbon hydrogen is heating, and this is being explored in the pilot projects outlined below.

The HyDeploy demonstration project is testing the potential for blending up to 20% hydrogen with natural gas in the existing gas grid. The project is being delivered by a consortium of partners, led by Cadent, a gas distribution network operator.

The H21 programme is funded by the regulator Ofgem and led by Northern Gas Networks (another gas distribution network operator) in partnership with other stakeholders, including the HSE. The focus of the H21 programme, which involves a number of different projects, is a complete conversion of the gas grid to 100% hydrogen.

In the Hydrogen Strategy, the Government has committed to supporting industry to conduct first-of-a-kind hydrogen heating trials, including a neighbourhood trial by 2023 and a village scale trial by 2025. The village trial will look to build on learning from the neighbourhood trial, involving a larger and more diverse range of consumers, and conversion of existing local area gas infrastructure to 100 per cent hydrogen. These trials are intended to inform the Government's decision on the role of hydrogen in heating, a decision which the Government has committed to make by 2026.

15. Are there any commercial-scale clean hydrogen production projects in development or already operating?

There are currently no existing commercial-scale clean hydrogen production projects in the UK, but there are a number of projects in the pipeline, at different stages of development, including:

- bp's H2Teesside hydrogen project that aims to produce 1GW of CCUS-enabled low-carbon hydrogen from 2027;
- bp's HyGreen Teesside project, to produce renewable hydrogen;
- ITM Power's Whitelee Windfarm Green Hydrogen Phase 1, which has secured government funding from the Energy Innovation Portfolio competition. The £9.4 million of funding is for a 10MW electrolyser and associated four tonnes of storage, and is the first phase in the development of the 20MW facility;
- the HyNet North West project, being developed by a consortium of different companies, which will produce, store and distribute low-carbon hydrogen from 2025;
- the Acorn low-carbon hydrogen project being developed by Pale Blue Dot Energy; and
- Project Mayflower, which has received finance from the Clean Maritime Demonstration Competition, funded by the Department for Transport and delivered in partnership with Innovate UK, to help develop around 20MW green hydrogen production for use at the Port of Immingham.

16. Have there been any hydrogen-related disputes in your jurisdiction?

There have been no material publicly reported hydrogen-related disputes to date.

USA

Policy and regulation

1. Is there a government hydrogen strategy or policy?

There is currently no comprehensive hydrogen strategy for the United States. However, the Infrastructure Investment and Jobs Act (Infrastructure Plan) – which built upon the Energy Policy Act of 2005 (EPA) – contains a number of provisions aiding the advancement of hydrogen as an alternative energy source.

In addition, multiple federal and state agencies have overlapping authority to research and regulate hydrogen depending on its application. Principally, the US Department of Energy (DOE) released its **Hydrogen Program Plan** on 12 November 2020 which provided a strategic framework incorporating the research, development, and demonstration efforts of the Offices of Energy Efficiency and Renewable Energy, Fossil Energy, Nuclear Energy, Electricity, Science, and Advanced Research Projects Agency. This has been supplemented more recently by the DOE"s June 2023 release of its final National Clean Hydrogen Strategy and Roadmap (Strategy), which aims to advance hydrogen adoption and production within the US in the three following ways:

i. targeting strategic, high impact uses of clean hydrogen, such as industrial applications, transportation and power sector applications;
ii. reducing the cost of clean hydrogen across the value chain, with a targeted hydrogen production cost of $1 per kg by 2031 and an interim goal of $2 per kg by 2026; and
iii. focusing on regional networks to enable large-scale clean hydrogen close to hydrogen users and the development and sharing of critical mass of infrastructure, including leveraging the regional clean hydrogen hubs introduced in the Infrastructure Plan.

The Inflation Reduction Act was signed into law in August 2022 and included $369 billion in energy and climate spending, introduced a clean hydrogen 10-year production tax credit (45V Credit) and broadened the existing investment tax credit to apply to hydrogen projects.

In January 2023, DOE, the US Department of Transportation, the EPA, and the US Department of Housing and Urban Development jointly released the US National Blueprint for Transportation Decarbonization (Blueprint), which is aimed at cutting all greenhouse emissions from the transportation sector by 2050. The Blueprint identifies a strategic role of clean hydrogen particularly in freight applications, emphasizes the importance of further developing and deploying clean-energy technologies.

Each state in the US has its own regulatory and financial landscape in relation to hydrogen with California, Texas and Louisiana generally recognized as being the most advanced in their low-carbon hydrogen policies. The focus of this summary is the federal landscape; should you require further state-specific information, please speak to your respective Ashurst contact.

2. What are key goals and commitments included in the strategy/policy?

The Infrastructure Plan established the Clean Hydrogen Research and Development Program (Program) to: (1) advance research and development and commercialize the use of clean hydrogen in the transportation, utility industrial, commercial, and residential sectors; and (2) demonstrate and commercialize the use of clean hydrogen in the transportation, utility, industrial, commercial, and residential sectors by 2040.

The Infrastructure Plan also added the following important provisions to the EPA:

- providing $8 billion over four years for the creation of four Regional Hydrogen Hubs;
- requiring the Secretary of Energy to develop a technologically and economically feasible national energy strategy and roadmap to facilitate widescale production, processing, delivery, storage and use of clean hydrogen;
- providing $500 million over four years to award multiyear grants and contracts for research, development, and demonstration projects to advance new clean hydrogen production, processing, delivery, and storage; as well as to use equipment manufacturing technology and techniques; and
- providing $1 billion to fund a clean hydrogen electrolysis program, focused on reducing the cost of hydrogen produced using electrolysis.

As well as the goals identified above, the Strategy also sets goals for the US to produce 50 million tons of clean hydrogen per year by 2050, with interim targets of 10 million tons by 2030 and 20 million tons by 2040. It also restated the Infrastructure Plan's requirement on the DOE to set a clean hydrogen production standard of less than 2kg of carbon dioxide-equivalent (CO_2e) per kg of H_2—however, the DOE more recently stated a proposal to double that standard to 4kg of CO_2 per kg of H_2.

The Blueprint sets the following goals for hydrogen research in relation to transportation:

- Before 2030: achieve hydrogen electrolysis, sustainable fuel cost targets, and enable seamless integration with energy systems;

- 2030-2040: ensure infrastructure needed to support clean technologies and zero emission vehicles, including by building out hydrogen refuelling networks for commercial trucks and other applications.

3. Which industry sectors are most likely to be affected by hydrogen deployment?

It is expected that hydrogen will play the largest role in the following five sectors of the US economy:

- as fuel for buildings;
- as transportation fuel (with a growing focus on heavy-duty vehicles, rail, maritime and aviation sectors);
- as feedstock for industry and long-distance transport;
- as industrial fuel (with a growing focus on steel and cement manufacturing); and
- for power generation and grid balancing (particularly for large-scale power, off-grid distributed power, back-up or emergency power and long-duration energy storage)

Sectors where hydrogen is already being used, such as petroleum refining, fertilizer production, ammonia and methanol processing, and the chemical industry, are expected to switch to low-carbon hydrogen.

4. Who are the main regulators for the hydrogen market?

There is no clear-cut answer to this question given the lack of comprehensive federal hydrogen strategy and the split between federal and state regulation. However, aligning with our main focus on the federal landscape in this chapter, the main federal agencies with the ability to influence the development of hydrogen industry and infrastructure at a federal level include: the DOE, the Federal Energy Regulatory Commission (FERC), the Pipeline and Hazardous Materials Safety Administration (PHMSA), and the EPA.

5. Does the government hydrogen strategy or policy support the development of both low-carbon (blue) hydrogen and renewable (green) hydrogen?

The Infrastructure Plan defines "clean hydrogen" as hydrogen produced from any fuel source as long as it meets the carbon intensity requirement. This would include hydrogen produced from renewables, fossil fuel with carbon capture, utilization, and sequestration/storage (CCUS) technologies, and nuclear.

6. If the government hydrogen strategy or policy supports the development of low-carbon hydrogen, to what extent is carbon capture and storage being taken forward?

Although still in its nascency due to costs, regulatory uncertainty, infrastructure, and technology needs, CCUS continues to be a central focus for the US in its energy efforts. As part of the Infrastructure Plan, Congress took the following related measures:

- required the DOE to account for and support opportunities for hydrogen production from diverse energy, including fossil fuels with CCUS;
- appropriated $937 million for the DOE to fund carbon capture large-scale pilot projects over FY22-FY25 and an additional $2.04 billion for the DOE to fund carbon capture demonstration projects over FY22-FY25;
- established the Department of Energy Program comprised of both a front-end engineering and design program for carbon dioxide transport infrastructure to enable deployment of CCUS technologies and a carbon dioxide infrastructure finance and innovation program to provide low-interest loans for carbon dioxide transport infrastructure projects; and
- provided $310 million in grant funding for carbon utilization for use over FY22-FY26.

7. Are there targets for the production of hydrogen?

In 2021, the Biden Administration set a goal of net-zero green gas emissions in the United State by no later than 2050 and 100% clean electricity in the United States by 2035.

The Strategy sets the following targets for domestic clean hydrogen production: 10 million tons by 2030, 20 million by 2040, and 50 million by 2050. It also includes a targeted hydrogen production cost of $1 per kg by 2031 and an interim goal of $2 per kg by 2026

The DOE has an Energy Earthshots Initiative that aims to accelerate breakthroughs of more abundant, affordable, and reliable clean energy solutions. The first Energy Earthshot, launched June 7, 2021—Hydrogen Shot—seeks to reduce the cost of clean hydrogen by 80% to $1 per 1 kilogram in 1 decade.

Furthermore, DOE's 'Pathways to Commercial Liftoff: Clean Hydrogen' released in March 2023 details the following goals for commercial-scale clean hydrogen production projects in the US:

- near-term expansion (2023-2026): clean hydrogen is expected to replace today's carbon-intensive hydrogen, particularly in industrial/chemicals use cases including ammonia production and oil refining;

- industrial scaling (2027–2034): hydrogen costs are expected to continue to fall, driven by economies of scale and research and development. There will be greater investment in the build-out of new midstream infrastructure which connect a greater number of producers and offtakers and will reduce the delivered cost of hydrogen which will drive clean hydrogen adoption in new sectors (e.g., fuel cell-based transportation); and
- long-term growth (2035+): a self-sustaining commercial market is expected to develop due to availability of low-cost, clean electricity, declining equipment costs, reliable and at-scale hydrogen storage and high utilization of distribution infrastructure.

8. Are there any incentive mechanisms/business models in place to support the production of hydrogen?

Whilst the Infrastructure Plan contains no specific tax incentives, the following related tax incentives have been introduced by the Biden Administration:

- in March 2021, the American Jobs Plan included numerous proposals to expand tax credits for clean energy and suggested pairing investment in 15 low-carbon hydrogen demonstration projects with a new tax credit for low-carbon hydrogen production facilities where construction begins before 2026;
- the 45V Credit, which creates a 10-year tax incentive for clean hydrogen of up to $3 per kilogram with the level of credit provided based on carbon intensity; and
- in June 2021, the Clean Energy for America Act introduced additional major new tax incentives and credits for investment in clean energy facilities and for the production of electricity from clean energy and clean fuel.

9. Are there any standards in place for the classification and/or certification of low-carbon or renewable hydrogen?

The Infrastructure Plan defines "clean hydrogen" as hydrogen produced with a carbon intensity equal to or less than 2 kilograms of carbon dioxide-equivalent produced at the site of production per kilogram of hydrogen produced. Under the Infrastructure Plan the DOE, in consultation with EPA, is directed to establish a "standard" for measuring that carbon intensity in the context of hydrogen production. As of June 2023, this Clean Hydrogen Production Standard (CHPS) establishes a target for well-to-gate lifecycle greenhouse gas emissions of ≤4.0 kgCO2e/kgH2, which is consistent with the Inflation Reduction Act's definition of "qualified clean hydrogen."

10. Does the regulatory framework clearly define the regulatory requirements relating to the production, storage, transportation or supply of hydrogen?

No, to achieve the level of hydrogen generation and deployment required to match ambitions, increased investment in research and development is crucial, as well as the introduction of a supportive regulatory framework at federal and state level.

11. Are there any foreign investment restrictions related to energy and infrastructure sectors?

The 1988 Exon-Florio Amendment to the Defense Production Act of 1950 empowers the president to block foreign acquisitions of US companies that threaten to impair national security. The president delegated authority to investigate transactions to the Committee on Foreign Investment in the United States (CFIUS). Congress subsequently enacted the Foreign Investment and National Security Act of 2007 on July 26, 2007 which formally established CFIUS including its mandated membership, established transaction-specific and general Congressional notification requirements and specifically included 'critical infrastructure' and 'energy security' within the concept of national security. Transactions that involve foreign governments, a threat to national security, or control of critical infrastructure are compulsorily subject to a 45-day formal investigation, except where the Secretary or Deputy Secretary of Treasury and the lead agency certify that there is no national security threat.

The Mineral Lands Leasing Act of 1920 limits the acquisition of rights-of-way for oil or gas pipelines, or pipelines carrying products refined from oil and gas, across onshore federal lands. These restrictions also apply to acquiring leases or interests in certain minerals (including coal and oil) on onshore federal lands. Citizens of other countries and foreign corporations may have up to a 100 percent stock ownership in a domestic company that owns such rights, interests, or leases, provided that the foreign investor's home country reciprocates with rights to US companies.

12. What international treaties are in place that may offer protection to international investors in hydrogen projects in the jurisdiction?

The US is a signatory to various bilateral investment treaties that are in force, and in addition certain other treaties may contain protections for investors in the US. These can be accessed from the online database maintained by the Trade Compliance Center.

Market developments and opportunities

13. Are there any government grants or other government funding available to hydrogen projects (including for research and development)?

The Infrastructure Plan includes $65 billion in clean energy investments at the DOE, including $8 billion for a Regional Clean Hydrogen Hubs Program to support the development of hubs for clean hydrogen production, delivery, and end-use in the US (H2Hubs). In October 2023, the following seven H2Hubs were selected to receive $7 billion in funding from the Infrastructure Plan (to be administered by DOE) to accelerate the commercial-scale deployment of low-cost, clean hydrogen:

- Appalachian Hydrogen Hub in West Virginia, Ohio, and Pennsylvania;
- California Hydrogen Hub in California;
- Gulf Coast Hydrogen Hub in Texas;
- Heartland Hydrogen Hub spanning Minnesota, North Dakota, and South Dakota with potential to expand into neighboring states;
- Mid-Atlantic Clean Hydrogen Hub spanning Delaware River and including Pennsylvania, Delaware, and southern New Jersey;
- Midwest Alliance for Clean Hydrogen spanning Illinois, Indiana, and Michigan, with the potential to expand into other Midwestern states; and
- Pacific Northwest Hydrogen Hub spanning Washington, Oregon, and Montana.

In addition, the DOE has launched other clean hydrogen programs:

- $1 billion for a Clean Hydrogen Electrolysis Program;
- $500 million for Clean Hydrogen Manufacturing and Recycling R&D Activities;
- In March 2024, the DOE announced $750 million in funding for 52 projects across 24 states as part of its Clean Hydrogen Electrolysis Program to reduce the cost of electrolyzers and other clean-hydrogen technologies; and
- the DOE Loan Programs Office has also completed investments in clean hydrogen facilities.

14. Are there any notable pilot/demonstration projects in place or planned for the production or offtake of clean hydrogen?

There are a number of pilot projects in the US, some of which are outlined below:

- Florida Power & Light completed its pilot clean hydrogen hub in Okeechobee County, Florida in February 2024. The hub is the first clean hydrogen plant of its kind in Florida – it runs off solar energy and will blend 5% hydrogen with natural gas in its pipelines to provide low-cost, clean energy to Florida Power & Light's customers;
- the Yara/BASF ammonia plant in Freeport, Texas, has developed a pilot using low-carbon by-product hydrogen from nearby petrochemical plants instead of natural gas from steam methane reforming;
- Mitsui and CF Industries signed a memorandum of understanding in August 2021 to carry out various feasibility studies in respect of ammonia produced using blue hydrogen production in the US;
- Chesapeake Utilities Corp. is piloting hydrogen blending in a combined heat and power plant and is looking to inject hydrogen into its distribution systems in its Florida and Mid-Atlantic territories;
- a DOE-backed project called HyBlend is marshalling the resources of four national labs to identify technical barriers to injecting hydrogen into gas infrastructure and life-cycle emissions linked to hydrogen-natural gas blends;
- the University of California (UCI), Irvine in collaboration with SoCalGas, is running a demonstration project through its Advanced Power and Energy Program to convert excess renewable power to hydrogen and blend it into the natural gas system. SoCalGas is developing a "hydrogen home", which will convert solar power into low-carbon hydrogen which can then be stored, blended, or used to power a fuel cell within the home and are also conducting research with a view to increasing hydrogen blending on the grid up to 20%;
- the California Energy Commission awarded $7.3 million to Shell Hydrogen in December 2021 to deliver 8 of the 51 Shell hydrogen refuelling stations that have been proposed;
- Bloom Energy in California will begin offering electrolysers alongside hydrogen-powered fuel cells which is expected to produce the lowest cost clean hydrogen through electrolysis and intends to assist hard-to-decarbonise heavy industries in achieving net-zero emissions through the Bloom Electrolyser's use of solid oxide technology delivering better efficiency by operating at high temperatures. Orders are currently being accepted, with commercial shipment expected in Autumn 2022; and
- SGH2 Energy Global, part of the Solena Group, announced that they had entered into the first and only long-term green hydrogen off-take agreement in the world to date in July 2021 under which they agreed to sell 3,850 tonnes a year of carbon-negative green hydrogen to refuelling stations across southern California. SGH2 is said to be in negotiations with major global energy companies to launch similar projects in Northern California, as well as across parts of Europe, Australasia, and South Africa.

15. Are there any commercial-scale clean hydrogen production projects in development or already operating?

There are currently no existing commercial-scale clean hydrogen production projects in the US, but there are a number of projects into which investment has begun, including

- the H2Hubs:
  - Appalachian Hydrogen Hub in West Virginia, Ohio, and Pennsylvania, with a federal cost share up to $925 million, in order to take advantage of the region's ample low-cost natural gas;
  - California Hydrogen Hub in California, with a federal cost share up to $1.2 billion, in order to leverage California's clean energy technology to produce hydrogen exclusively from renewable energy and biomass and to decarbonize public transportation, heavy duty trucking and port operations;
  - Gulf Coast Hydrogen Hub in Texas, centered in the Houston region and stretching across the Texas coast, with a federal cost share up to $1.2 billion, using hydrogen for fuel cell electric trucks, industrial processes, ammonia, refineries and petrochemicals and marine fuel (e-Methanol), with plans to develop salt cavern hydrogen storage, a large open access hydrogen pipelines, and multiple hydrogen refueling stations;
  - Heartland Hydrogen Hub in Minnesota, North Dakota, and South Dakota with potential to expand into neighboring states, with a federal cost share up to $925 million, that will help decarbonize the agricultural sector's production of fertilizer and decrease the regional cost of clean hydrogen, with unique opportunities of equity ownership with the Mandan, Hidatsa and Arikara Nation and to local farmers and farmer co-ops through a private sector partnership;
  - Mid-Atlantic Clean Hydrogen Hubspanning Delaware River and including Pennsylvania, Delaware, and southern New Jersey, with a federal cost share up to $750 million, to help unlock hydrogen-driven decarbonization in the Mid-Atlantic while repurposing historic oil infrastructure and using existing rights-of-way;
  - Midwest Alliance for Clean Hydrogen spanning Illinois, Indiana, and Michigan, with the potential to expand into other Midwestern states, which will enable decarbonization through strategic hydrogen uses including steel and gas production, power generation, refining, heavy-duty transportation, and sustainable aviation fuel; and
  - Pacific Northwest Hydrogen Hub spanning Washington, Oregon, and Montana, with plans to produce clean hydrogen exclusively via electrolysis, playing a key role in driving down electrolyzer costs, making the technology more accessible to other producers, and reducing the cost of hydrogen production;
- a $2 billion investment by Fidelis New Energy, LLC into the state of West Virginia for a lifecycle carbon neutral hydrogen production facility (The Mountaineer GigaSystem) and net-zero hydrogen powered data centers (The Monarch Cloud Campus);
- Mitsubishi Power Americas and Magnum Development's jointly-developed Advanced Clean Energy Storage project in Utah which aims to build a storage facility for 1,000 megawatts of clean power, partly by putting hydrogen into underground salt caverns;
- Bakken Energy and Mitsubishi Power America's acquisition and redevelopment of a synthetic natural gas plant in North Dakota into a blue hydrogen production facility, with the aim of connecting the hub by pipeline to other hubs throughout the US;
- a 20 megawatts electrolyser plant in Florida that will produce 20,000 tonnes per year of hydrogen from solar power;
- a 5 megawatts proton exchange membrane electrolyser project in Washington State that will provide renewable hydrogen for the Douglas County Public Utility District (Douglas County PUD) in Washington;
- Intermountain Power Agency's replacement of its coal units at the Intermountain Power Plant with a gas turbine combined cycle technology, which will initially be capable of utilizing 30% renewable hydrogen as a clean energy fuel and will reach 100% renewable hydrogen capability by 2045. This plant will supply stored renewable power to the Los Angeles basin and other power users throughout California and Utah; and
- first-of-a-kind nuclear-to-hydrogen projects in multiple states throughout the US.

16. Have there been any hydrogen-related disputes in your jurisdiction?

As of April 2024, there appear to be no material disputes related to the use of clean hydrogen at a Federal-level in the US. There are various reports of potential litigation against the 45V Credit by industry players allegedly disputing the provisions that require hydrogen producers to use new sources of clean electricity to run their plants instead of power already on the grid (rather than existing energy sources), and the eventual required hourly time matching of green energy use to hydrogen production to go into effect in 2028.

Last updated April 2024

Uzbekistan

Ashurst collaborated with **Centil Law Firm** in the preparation of this content. We are grateful for their input.

Policy and regulation

1. Is there a government hydrogen strategy or policy?

Although not adopted yet, the National Strategy for Renewable and Hydrogen Energy Development of Uzbekistan is currently in the pipeline.

In particular, on 9 April 2021, the President of Uzbekistan issued a milestone resolution No. PP-5063 "On Measures for the Development of Renewable and Hydrogen Energy in the Republic of Uzbekistan" ("**Resolution No. 5063**"). In accordance with Resolution No. 5063, the President established the Interdepartmental Commission for the Development of Renewable and Hydrogen Energy, which has been tasked with assisting ministries and agencies in conducting necessary research, training, and professional development of personnel in the renewable and hydrogen energy sectors as well as developing the draft National Strategy for Renewable and Hydrogen Energy Development (the "**Strategy**"). The Strategy remains at the draft stage and is not publicly available yet.

The Resolution of the President of Uzbekistan No. PP-436 "On Measures for Improving the Effectiveness of Reforms Aimed at Transition of The Republic of Uzbekistan to "Green" Economy by 2030" dated 02 December 2022 recognized the Ministry of Energy of the Republic of Uzbekistan as the authorized body for the wide introduction of renewable energy sources and hydrogen energy and instructs the Cabinet of Ministers to approve a plan of measures for the development of renewable energy sources and hydrogen energy in the country.

In addition, this year United States Agency for International Development (USAID) announced its initiative to support Uzbekistan in the development of a Green Hydrogen Hub. The Hub is expected to enhance the expertise of energy sector specialists in new clean energy technologies to shape the future energy landscape of the country.

On a project pipeline note, ACWA Power pioneers the construction of the first green hydrogen project with the first phase aiming to produce 3,000 tonne-per-year. When both phases are realized in full, 2.4 GW of wind energy will power the production of 500,000 tonnes of green ammonia per year.[51]

2. What are key goals and commitments included in the strategy/policy?

Although the draft Strategy is not publicly available yet, the Government has already disclosed some of its main short-term goals to develop the hydrogen deployment. In the Development Strategy of New Uzbekistan, enacted under the Presidential Decree No.60 on 28 January 2022, the Government sets out the objective to decrease its hydrocarbon dependence by increasing the share of renewable energy sources, including the hydrogen energy, to 25% by 2026. In particular, in respect of hydrogen, the Government's measures include:

- a hydrogen research programme with a programme budget of UZS 10 billion (~816 mln USD) and creation of technology for producing, storing, and transporting hydrogen energy on the basis of four new scientific projects; and
- arranging scientific internships for 20 young scientists and specialists at leading foreign research centres and universities in the field of hydrogen energy.

3. Which industry sectors are most likely to be affected by hydrogen deployment?

The Government views hydrogen as a long solution in tackling the fossil fuel dependence of the state and reduction of carbon emissions in the chemical industry. Therefore, the power sector, i.e., generation of electricity, and the chemical industry are expected to be mostly affected by hydrogen deployment.

4. Who are the main regulators for the hydrogen market?

Although, at present, there is no state regulator governing exclusively the hydrogen market, the Ministry of Energy and the Ministry of Economy and Finance of the Republic of Uzbekistan are public bodies regulating the development of the "green" economy of the country.

Resolution of the President of Uzbekistan No. PP-436 envisages that the Ministry of Energy is the authorized body for the development of "green" energy and implementation of renewable energy sources and hydrogen energy. The Resolution also states that the Ministry of Economy and Finance is the authorized body for coordination of activities on promotion of "green" economy and implementation of "green" growth principles.

51 https://www.acwapower.com/news/acwa-power-breaks-ground-on-green-hydrogen-project-in-uzbekistan

In addition, as stated above, the Interdepartmental Commission for the Development of Renewable and Hydrogen Energy is authorized to assist ministries and agencies in conducting necessary research and training in the renewable and hydrogen energy sector. Also, the National Research Institute for Renewable Energy Sources under the Ministry of Energy is tasked with developing legal acts and standards in the hydrogen and renewable energy sectors.

5. Does the government hydrogen strategy or policy support the development of both low-carbon (blue) hydrogen and renewable (green) hydrogen?

Currently, it is yet unknown whether the draft Strategy supports both low-carbon (blue) hydrogen and renewable (green) hydrogen.

However, based on the existing legislation and policy, we understand that "green" hydrogen is in the focus of the Government's attention. Last year, the Ministry of Energy of Uzbekistan negotiated the development of a pilot "green" hydrogen project with the leading investor from Saudi Arabia, ACWA Power. This project is in the construction phase now and is seeking funding of US$ 58.2 million on a project finance basis to finance the construction of an integrated renewable hydrogen production facility (https://www.ebrd.com/work-with-us/projects/psd/54561.html).

6. If the government hydrogen strategy or policy supports the development of low-carbon hydrogen, to what extent is carbon capture and storage being taken forward?

N/A.

7. Are there targets for the production of hydrogen?

The Government has not officially announced any indicative targets for hydrogen production. The pilot project with ACWA Power is expected to produce 3,000 tons of hydrogen per year. When both phases of the project are realized in full, 2.4 GW of wind energy will power the production of 500,000 tonnes of green ammonia per year.

8. Are there any incentive mechanisms/business models in place to support the production of hydrogen?

At present, there are no incentive mechanisms/business models in place that specifically apply to the hydrogen production. It is expected that the Strategy will reflect the incentive mechanism specific for the hydrogen industry.

Law of the Republic of Uzbekistan No. 539 "On the Use of Renewable Energy Sources" dated 21 May 2019 and the Tax Code of Uzbekistan (2020) provide tax incentives in respect of renewable energy sources, however, currently, it is unclear as to what extent such incentives apply to hydrogen projects in Uzbekistan since the definition of "renewable energy sources" in the Law No. 539 is rather restrictive (i.e., renewable energy sources are defined as "energy from the sun, wind, earth heat (geothermal), natural movement of water streams, biomass that naturally regenerates in the environment").

In addition, general investment legislation allows the Government of Uzbekistan to provide a special tax regime (e.g., exemption from payment of certain taxes, application of reduced tax rates etc.) for a foreign investor under an investment agreement with the Government to the extent permitted by the Tax Code.

9. Are there any standards in place for the classification and/or certification of low-carbon or renewable hydrogen?

To date, there are no existing standards in place for the classification of hydrogen. As stated above, under Resolution No. 5063, the National Research Institute for Renewable Energy Sources under the Ministry of Energy of the Republic of Uzbekistan is tasked with developing legal acts and standards in the hydrogen and renewable energy sectors.

10. Does the regulatory framework clearly define the regulatory requirements relating to the production, storage, transportation or supply of hydrogen?

No, as stated above, the relevant regulatory framework and laws are currently under development.

11. Are there any foreign investment restrictions related to energy and infrastructure sectors?

There are no foreign investment restrictions related to energy and infrastructure sectors.

12. What international treaties are in place that may offer protection to international investors in hydrogen projects in the jurisdiction?

Uzbekistan is a signatory to the Energy Charter Treaty (1994), the Convention on the Settlement of Investment Disputes between States and Nationals of Other States (ICSID Convention, 1965), the EC-Uzbekistan Cooperation Agreement (1996) and the US-Central Asia TIFA (2004) which offer protection to international investors implementing projects in Uzbekistan.

In addition, Uzbekistan has signed a number of bilateral investment treaties with more than 50 countries and almost all of them are currently in force.

Market developments and opportunities

13. Are there any government grants or other government funding available to hydrogen projects (including for research and development)?

Resolution No. 5063 established the National Research Institute for Renewable Energy Sources under the Ministry of Energy of the Republic of Uzbekistan and the Research Center for Hydrogen Energy. In accordance with Resolution No. 5063, the Ministry of Economy and Finance of the Republic of Uzbekistan is instructed to provide necessary funds for financing the activities of the Institute starting from 2022 in the annually approved parameters of expenditures of the state budget of Uzbekistan.

Resolution No. 5063 also provides for development of the program for financing of the costs arising from the implementation of research projects in the renewable and hydrogen energy sectors.

In addition, Resolution No. 5063 envisages attracting international research grants to the Center.

14. Are there any notable pilot/demonstration projects in place or planned for the production or offtake of clean hydrogen?

On 23 February 2024, the President of Uzbekistan adopted a resolution approving a "pilot" project for design, construction, and operation of a hydrogen plant by a Saudi investor ACWA Power through its project company ACWA Power Uzbekistan Hydrogen Holdings LTD in a joint venture with JSC Uzkimyosanoat (an entity uniting chemical enterprises in Uzbekistan). In accordance with the resolution, the hydrogen plant is expected to produce 3,000 tons of "green" hydrogen annually. Under the pilot project, Uzkimyoimpex LLC (an export and import agent in the chemical industry of Uzbekistan) shall offtake "green" hydrogen generated at the hydrogen plant.

15. Are there any commercial-scale clean hydrogen production projects in development or already operating?

In accordance with the publicly available sources, at present, there is only one commercial hydrogen project at the development stage in Uzbekistan, which is the aforementioned project involving ACWA Power.

16. Have there been any hydrogen-related disputes in your jurisdiction?

To date, no hydrogen-related dispute has been recorded in Uzbekistan.

Last updated April 2024

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Design Ref: R011777