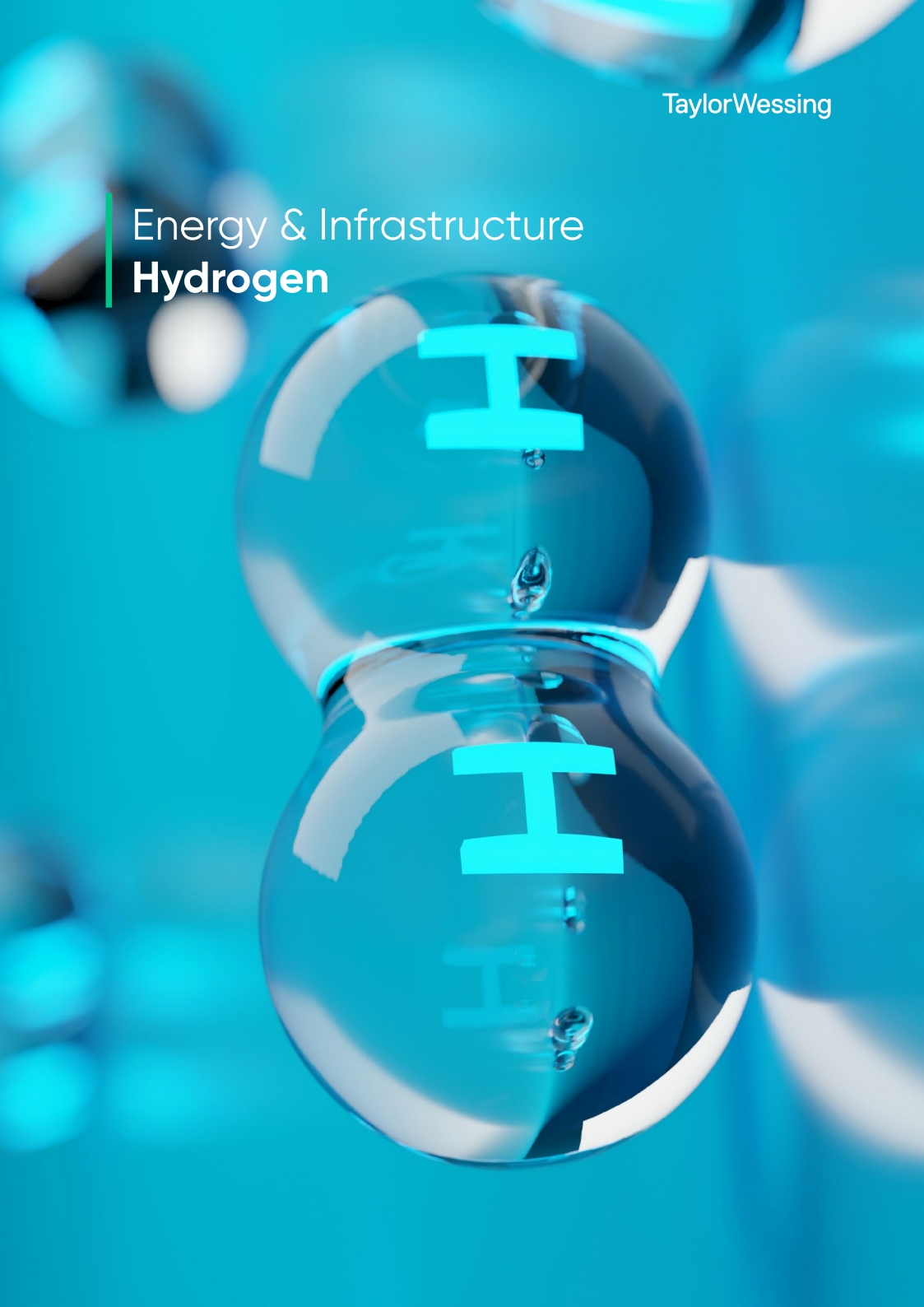
TaylorWessing

Energy & Infrastructure
Hydrogen



Hydrogen
Energy source of the future

The energy demand of our globalized world is constantly expanding, not least due to increasing mobility, data processing and industrial production. Climate change poses a major challenge. Most of the fuels used for the mobility of the world population, in an industrial context or for energy supply are usually neither renewable nor environmentally friendly. For the long-term success of the energy turnaround and for climate protection, alternatives to fossil fuels are needed. The same applies to achieving the ambitious climate targets of the European Union and respective national targets based on them. Hydrogen will play a key role here. According to the European Commission, hydrogen should play a central role in the European energy market by 2030 at the latest.

1 | Hydrogen

Depending on the origin and type of production, different categories of hydrogen can be distinguished:

Green Hydrogen

Green hydrogen is produced by the electrolysis of water. This type of production is completely emission-free if renewable energies are exclusively used during the process. This type of production currently accounts for a very small proportion of hydrogen production.

Blue / Turquoise Hydrogen

Blue hydrogen is produced like black / grey hydrogen, but combined with carbon capture and storage (CCS). This type of production also accounts for only a very small proportion of current hydrogen production. In the case of turquoise hydrogen, methane is thermally split to produce solid carbon. In order to achieve CO_2 neutrality of this process, it is necessary to use CO_2-neutral energy sources and to bind the resulting carbon permanently.

Black / Grey Hydrogen

This type of hydrogen is obtained from fossil fuels and accounts for about 98 % of current hydrogen production. During the production process natural gas is converted into hydrogen under the influence of heat. This process produces CO_2 which is released unused into the atmosphere.

Hydrogen is suitable as an energy source, as a starting material for greenhouse gas neutral applications, as a link between the heating, mobility, electricity and industrial sectors, and for storage and transport. Particularly promising is its use for storing electricity from fluctuating renewable energies and as an energy source in industry, heavy duty traffic or in shipping and aviation. A whole range of different feasibility studies, real laboratories and hydrogen grid or electrolyser projects are already being planned and implemented throughout Europe.

2 The EU Green Deal: Strategies on hydrogen at EU level

The target set in the EU Green Deal to reduce net greenhouse gas emissions by at least 55% by 2030 compared to 1990 levels was transposed into binding law with the European Climate Law, which came into force in July 2021. At the same time, the EU Commission adopted the initiative package known as Fit for 55. The package also contains proposals for legislation to implement the measures provided for in the European Climate Law. Already in July 2020, the European Commission presented "A Hydrogen Strategy for a Climate-Neutral Europe" as part of the Green Deal. The goal is the widespread use of hydrogen by 2050. The focus is on the extensive expansion of green hydrogen; however, other production processes are also to be promoted on a transitional basis. For example, the EU wants an electrolysis capacity of at least six gigawatts to be reached in the Member States by 2024. By 2030, this capacity is to grow to 40 gigawatts. This would correspond to 10 million tonnes of hydrogen. In the period from 2030 to 2050, green hydrogen is to be produced on a system-relevant scale. According to the EU, the decarbonisation of hydrogen production is possible due to the falling costs in the expansion of renewable energies and due to technological advances.

Phase I 2020–2024

- Installation of electrolysers in the EU with an electrolysis capacity of at least 6 GW.
- Target: production of up to 1 million tonnes of green hydrogen.
- In this way, hydrogen production in industry, which is harmful to the climate, is to be partially replaced.
- Planning of a long-distance pipeline structure for the transport of hydrogen over longer distances.

Phase II 2025–2030

- Installation of electrolysers in the EU with an electrolysis capacity of at least 40 GW.
- Target: production of up to 10 million tonnes of green hydrogen.
- Green hydrogen becomes relatively more competitive.
- Opening up of areas of application in industry and mobility.
- Emergence of regional hydrogen systems with locally produced hydrogen.
- Planning of a Europe-wide pipeline network.

Phase III 2030–2050

- Use of around 25% of the EU's renewable electricity to produce green hydrogen.
- Necessary technologies will have reached market maturity.

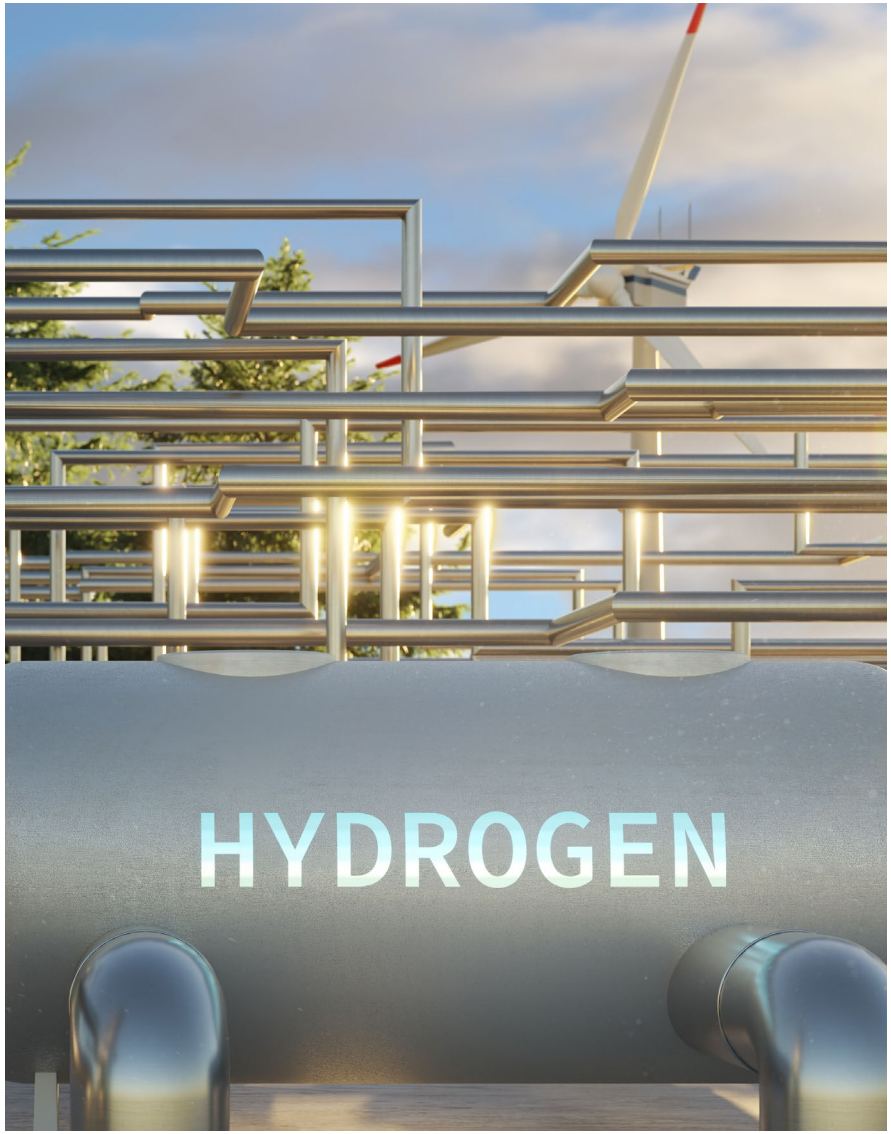
In order to achieve the European targets and to considerably increase the production of green hydrogen, the Commission announced the creation of appropriate political framework conditions, such as the setting of new thresholds for CO_2 emissions to promote hydrogen production plants. In order to promote a European hydrogen market, Europe wide criteria for the certification of renewable and low CO_2 hydrogen are to be introduced. Competitive disadvantages which exist in the production of green hydrogen are to be compensated for by so-called carbon contracts for difference. Central to the successful realisation of a European hydrogen market is above all the implementation of a comprehensive hydrogen infrastructure (cf. section 3).

In June 2022, the European Commission has presented a draft delegated act to specify the requirements for the production of green hydrogen in the EU. The draft delegated act aims to define the criteria that hydrogen produced in the EU must meet in order to be classified as "green" or "renewable". The draft delegated act is to be adopted on the basis of the Directive on the promotion of the use of energy from renewable sources (Renewable Energy Directive II/RED II). Article 27(3) of RED II stipulates that electricity from the electricity grid can be used for the operation of hydrogen plants. The draft delegated act describes in more detail the exact requirements that must be met by the electricity needed for operation so that hydro-

gen produced thereof can be classified as green.

The European Union is also addressing the European expansion of the hydrogen industry within the framework of a so-called Important Project of Common European Interest (IPCEI). IPCEIs are instruments under state aid law that enable the promotion of transnational cooperation and the mapping of the value chain from applied research to industrial implementation and corresponding infrastructure projects. Selected companies from participating Member States are allowed to participate after notification by the European Commission and are supported with state aid approved by the Commission. The IPCEI Hydrogen is the largest European project of its kind to date. In Germany, 62 major projects have been selected for the IPCEI Hydrogen, which will be funded with a total of more than eight billion euros in federal and state funds.

As already mentioned, hydrogen plays a decisive role within the framework of the "Fit for 55" packages of measures. In this context, the European Commission presented a proposal at the end of 2021 for a legislative package for the decarbonisation of the gas market. It proposes, for example, rules on the operation and financing of hydrogen networks, on the transparency of gas quality parameters and hydrogen blends, on the reallocation of existing natural gas networks for the transport of hydrogen, and on decentralisation and non-discriminatory network access. To facilitate cross-border trade and supply of hydrogen, it is also envisaged to establish a European Network of Hydrogen Network Operators (ENNOH).



3 Hydrogen infrastructure – construction and operation of production facilities

In principle, production plants for green hydrogen can be built both on land and at sea. In addition to potentially larger space capacities, production at sea would also offer the advantage that offshore wind farms can generate more electricity with greater regularity than onshore wind farms. Moreover, if the generated energy is completely converted into hydrogen, costly grid connections are no longer necessary. Especially in connection with floating foundations, this opens up completely new possibilities, as both water depth and distance to the coast are no longer limiting factors. Hydrogen could be transported from the offshore wind farms all over the world by ship. In addition, solutions for existing wind farms are also conceivable, e.g. as so-called energy islands or production plants where the electricity generated at sea arrives on land and cannot be fed into the grid. In this way, the now common short-term (partial) shutdowns of offshore wind farms when the electricity grids are under heavy load could be significantly reduced and the amount of usable energy increased without building additional generation plants.

Experience, especially in chemical plant construction, shows that a particular focus will be on the commissioning of the plants, especially how performance parameters, e.g. degree of effectiveness and purity, can be proven within the framework of trial operation and performance testing, and which legal consequences are associated with this. In the case of construction on the high seas, there are also the familiar issues of the offshore industry, such as complex construction logistics including weather, but also increased demands on materials and maintenance. Here, however, it is possible to draw on existing experience from the various offshore industries, above all, of course, offshore wind and oil and gas production.

Hydrogen enables the transport of (renewable) energy without electricity grids. In addition to pipelines, transport by ship, rail and road is also conceivable. For this, corresponding terminals and transhipment points would have to be expanded on a large scale. In the wake of the Ukraine crisis, the construction of terminals for the import of liquefied natural gas (LNG), for example, is currently being accelerated in order to maintain supply security in Germany. At the same time, the prospective changeover to the import of hydrogen is also being planned in order to be able to convert the terminals accordingly in the long term. For example, the transport of hydrogen from the United Arab Emirates could be made possible. In order to establish such a supply chain, cooperation agreements were already concluded in March 2022 between German companies and companies from the United Arab Emirates for initial test deliveries. According to the German Association of Energy and Water Industries (Bundesverband der Energie- und Wasserwirtschaft e.V.). (BDEW), the existing natural gas infrastructure, including storage caverns, can also be used for hydrogen transport on a national scale. Germany has the largest gas storage capacities in the European Union. Hydrogen could thus be stored and transported via the existing gas networks. Even if it remains to be seen which possibilities for global transport will emerge and become established in the ongoing research projects, considerable new or conversion projects are anticipated. Plant and infrastructure construction companies are already gearing themselves up for this.

4 | Economic Aspects

The European hydrogen market has seen an unprecedented development since 2020. A while ago, hydrogen was regarded a niche technology. Now, it plays as key role in the European Union's effort to transition to a carbon neutral economy and to reduce dependency on Russian gas Hydrogen will be key in meeting the EU's ambitious climate objectives. It will also be key in preserving its economic competitiveness.

Between November 2019 and March 2020, the number of electrolyser investments planned worldwide until 2030 was increased from 3.2 GW electrolysis capacity to 8.2 GW according to market analyses. Out of these 8.2 GW, 57% would be installed in Europe. According to the European Hydrogen strategy, already 1.5-2.3 GW of new renewable hydrogen production projects are under construction or announced in the EU, and an additional 22 GW of electrolyser projects are envisaged. However, according to market intelligence, demand for electrolysers will outperform global manufacturing supply significantly by 2030 thereby not least threatening the EU's economic competitiveness.

4a | The German Market

Hydrogen production in Germany is currently not competitive

Under the currently existing framework conditions, the production and use of hydrogen is not yet economical. On the one hand, this is due to the fact that the use of fossil fuels is currently still cheaper; on the other hand, the use of hydrogen is a new technology with (still) comparatively high costs. In addition, there were disadvantageous legal regulations, e.g. the statutory burdening of electrolysers with the EEG levy until the end of 2020. However, due to the advancing technological development, the generation costs are likely to be further reduced in the future. According to a study by the "Hydrogen Council", a reduction in the cost of producing green hydrogen through dedicated European offshore wind farms can be estimated at $2.50 per kg by 2030, compared to about $1.50 per kg for grey hydrogen today.

It is noteworthy, however, that in the wake of the Ukraine crisis and the resulting increase in natural gas prices, the production of green hydrogen was already more economical than the production of grey hydrogen in spring 2022. According to analysts at Bloomberg New Energy Finance (BNEF), a kilogram of green hydrogen in the EMEA region cost between $4.84 and $6.68, while a kilogram of grey, natural gas-based hydrogen cost $6.71. The multiplication of the gas price makes grey hydrogen less competitive. This could cost more than green hydrogen by 2030 in 16 of the 28 countries studied by BNEF, significantly accelerating the German and European market ramp-up.

Irrespective of pricing, the transport of hydrogen also limits rapid availability on the market. In Germany and throughout Europe, a network for transporting hydrogen is only just being established.

A National Hydrogen Strategy

The German government plans to promote the use of green hydrogen in particular. To this end, the Federal Government's "National Hydrogen Strategy" was adopted at the beginning of June 2020, which provides for around 9 billion euros in funding. A number of different measures are planned, subdivided according to subject areas. The first goal is to create a "domestic market" for domestic hydrogen production and use. Building on this, international markets and cooperations for hydrogen are to be established. The German government plans to establish production plants with a total capacity of up to 5 GW in Germany by 2030. By 2035, or 2040 at the latest, a further 5 GW are to be added. In addition to the State Secretary's Committee for Hydrogen, the Hydrogen Strategy provides for a National Hydrogen Council. This consists of 26 members from industry, science and civil society. The objective of the National Hydrogen Council is to accompany and advise the State Secretary's Committee for Hydrogen in the further development and implementation of the National Hydrogen Strategy.

The promotion of the hydrogen market can only succeed if the appropriate infrastructure is also in place. Since Germany already has a well-developed gas infrastructure, it is being discussed to what extent the existing gas infrastructure can be used for hydrogen transport (cf. Section 3). According to the National Hydrogen Strategy, the EU's Renewable Energy Directive (RED

II) is also to be implemented: By 2030, the mandatory share of renewable fuels in the transport sector is to be increased significantly beyond the EU requirements. To achieve this goal, 3.6 billion euros will be made available from the Energy and Climate Fund, among other things, as additional support for investments in vehicles with alternative technologies (i.e. also hydrogen).

Another pillar of the National Hydrgen Strategy is the funding of the so-called "Reallabs", in which, among other things, the production and application of hydrogen is to be tested on an industrial scale. In the "North German Reallab", for example, research is being conducted in particular on so-called sector coupling in order to exploit possible synergy effects. The projects planned there alone are expected to save more than 500,000 tonnes of CO_2 emissions annually. Funding of 600 million euros is to be made available for the period from 2020 to 2023 to finance the real laboratories. A funding guideline that also provides for the funding of real laboratories over 10 years, including additional funding for operating costs, is currently still being agreed with the EU Commission.

It can be assumed that the National Hydrogen Strategy will be comprehensively revised by the end of 2022. To this end, the Bundestag called on the Federal Government in July 2022 with the motion for a resolution on the Substitute Power Plants Maintenance Act. The Federal Government wants to double the expansion targets for hydrogen. However, this doubling has not yet been implemented in law.

Hydrogen in the 2022 Easter Package and beyond

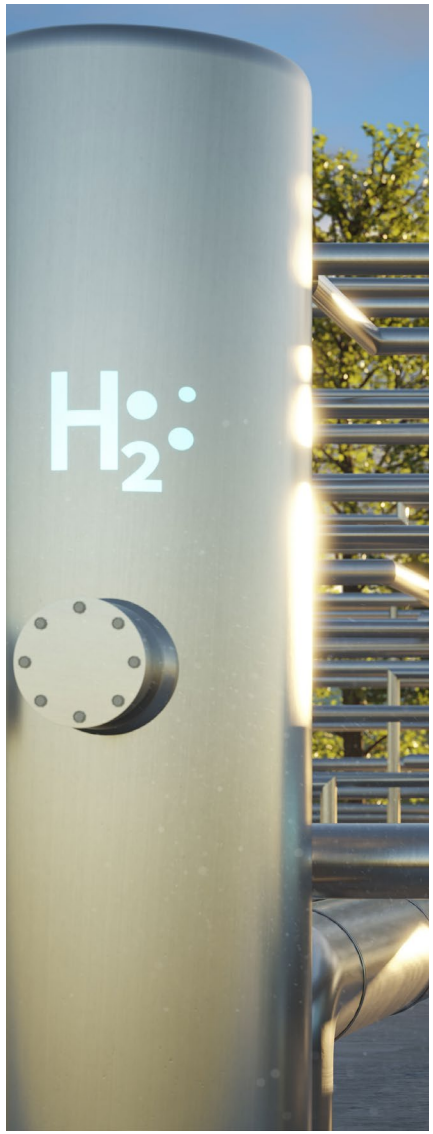
Against the backdrop of geopolitical developments since Russia's attack on Ukraine, the hydrogen market ramp-up in Germany is gaining additional importance.

Two tenders with a volume of more than 8,000 MW in total are planned with the EEG amendment in 2023 as part of the so-called Easter Package of the German government. For innovative concepts with hydrogen-based electricity storage (§ 39o EEG 2023), the total tender volume is 4,400 MW (§ 28 f EEG 2023). From 2023, the first tender is to be issued by the Federal Network Agency (BNetzA) with a volume of 400 MW; by 2028, the annual volume is to be increased to 1,000 MW. Details are to be regulated by a further legal ordinance. The second tender relates to plants for the generation of electricity from green hydrogen (§ 39p EEG 2023). A volume of 4,400 MW is also planned here by 2026, starting from 800 MW in 2023 (§ 28 g EEG 2023). The first bidding dates for both tenders are 15 December 2023.

In addition, the Federal Government is authorised to determine requirements for the production of green hydrogen by statutory order "in order to ensure that only hydrogen produced exclusively with electricity from renewable energy sources is considered green hydrogen".

Finally, Germany is cooperating within the framework of hydrogen partnerships with Australia and New Zealand, Canada and countries in West and South Africa. In the future, for example, green hydrogen is to be imported from Australia to Germany by ship in a complete supply chain.

In view of the energy crisis, initiatives of the private sector and associations also want to comprehensively accelerate the development of the hydrogen economy in Germany. For example, the network Offshore-Wind-H2-Achter wants to promote hydrogen production at sea and submitted an action paper to politicians for this purpose in June 2022. In addition, there are numerous other initiatives, such as the Power-to-X Alliance, GET H2 or the Green Hydrogen Crisis Taskforce (GHCT). What they all have in common is the demand that policymakers accelerate the development of the hydrogen infrastructure for production, transport and storage.



4b | The Austrian Market

The current state: still a developing niche alternative to fossil fuels

Austria has set itself the goal of achieving climate neutrality by 2040. One area of focus for implementation of this objective is green hydrogen. Austria intends to establish the domestic green hydrogen economy along the entire value-added chain from production to consumption. Austrian hydrogen strategy is designed to develop solutions for the existing challenges and, as a result, to achieve greater use of hydrogen. In July 2022 the Austrian minister of environment presented the plan to replace 80% of the grey hydrogen used in Austria with the more environmentally friendly green hydrogen.

But bringing the relevant technologies to market maturity is a long and complex process. The appropriate technologies and the legal framework must be established to ensure that green hydrogen is available both in sufficient quantity and at a competitive price.

Due to the price difference between the input resources natural gas and renewable electricity, the production of green hydrogen represents a process with significantly higher production costs than conventional fossil production. In addition, the final consumption of electricity is subject to higher taxes and levies than gas. The grid cost structure and the end-consumer levy are economic challenges in the production of hydrogen and occasionally cause double tariffs.

First legal steps were taken in July 2021 with the Renewable Energy Sources Act (EAG). The EAG regulates the requirements for subsidies of the production of electricity, gas and hydrogen from renewable sources. The law also provides for investment grants for the construction of plants to convert electricity into hydrogen or synthetic gas. It is a prerequisite that the plant is used solely for the production of renewable gases and draws only renewable electricity. Subsidies for plants that are built and operated by grid operators are excluded. Applications for investment grants must be submitted to the EAG funding authority within a limited time window and the guideline on the procedure for the tender must be observed. The funding budget for investment grants amounts to 40 million euros per year. As an additional incentive, a temporary exemption from the charge for grid use and grid losses for plants for the conversion of electricity into hydrogen or synthetic gas was stipulated in the law.

On May 5, 2022, EU Member States established an EU Energy Platform for voluntary joint procurement of, among other things, hydrogen. The focus will be on strengthening joint outreach activities and supporting clean energy projects. However, land-use planning and building permits for electrolysis plants are not harmonised yet. It is up to European and national legislators to create adequate legal framework quickly. Currently, the production and use of green hydrogen is still under development, but from the Austrian point of view, work is underway to establish hydrogen as a serious competitor to fossil fuels.

A strategy for a greener future: Hydrogen as the energy carrier of the future

For the necessary integration of hydrogen, the production of hydrogen from renewable electricity with electrolysis is considered a key technology. The aim is to make it possible to store electricity from renewable energy sources (wind, PV and hydropower) during production peaks. Around 200 MW of electrolysis capacity is to be installed in Austria by 2025 and up to 2 GW by 2030. Therefore, not only the strategic development of systems for integration of energy supply and demand is important but also the establishment of industrial production capacities for electrolysis plants. A sample project is a large-volume electrolysis plant to be constructed in Burgenland. When fully developed, 40,000 tonnes of green hydrogen shall be produced from wind and solar energy.

Moreover, Austria has a very well developed and modern gas network. The use of the existing infrastructure could provide a significant contribution to minimising the costs of decarbonising the energy system. Austria is also closely linked to the European gas market and serves as a gas hub in Europe. The possibility to store and transport renewable energy in the form of gases (hydrogen and bio methane) in the gas grid should therefore be used. The hydrogen share in the national gas network is currently < 1%, technically up to 4% would be permissible. Another goal of the federal government is to feed 5 TWh of green gas into the gas grid by 2030. Theoretically it would be possible to convert 11 TWh per year of renewable electrical energy and inject it into the Austrian gas distribution network via power-to-gas.

In addition to the gas network, Austria is in an excellent position to maintain security of supply through gas storage (cavern and porous storage) due to its geological and geological conditions.

The electricity producer Verbund AG, the oil and gas company OMV and the steel group Voestalpine have joined

forces for several hydrogen projects. In this context, an 18-million-euro investment in a plant for carbon dioxide-free hydrogen production was made in Linz on the premises of Voestalpine in co-operation with Siemens and Verbund AG.

For some time now, numerous Austrian companies, research institutes and universities have been focusing their research and development efforts on fuel cell and hydrogen technologies. To strengthen research in the fields of application, grid and storage technologies for hydrogen and renewable gases, they have founded the initiative "Hydrogen Initiative Showcase Region Austria Power & Gas". The initiative identified white spots and developed targeted projects. "HyTrack" is an example for a project concerning the development of an emission-free fuel cell drive train for commercial vehicles.

Further first measures to promote hydrogen in transport have been implemented. The revised Clean Vehicles Directive (CVD - [EU] 2019/1161) obliges Member States to achieve a minimum percentage of so-called "clean vehicles". The aim is not only to avoid negative environmental impacts by reducing air pollutant emissions, but also to promote the market and research for clean vehicles. The Road Vehicle Procurement Act implements the CVD in Austria. Essentially, this law obliges public procurers to acquire and use "clean" road vehicles, whereby heavy-duty vehicles are only considered clean if solely alternative fuels (such as electricity, hydrogen) are used.

4c | The French market

Current French hydrogen situation: a booming sector

According to the Ministry of Ecological and Solidarity Transition (Ministère de la transition écologique et solidaire), hydrogen French market represents currently about 1 Mega Ton, whereas black hydrogen represents around 94 % of total hydrogen production in France[1].

Today, the cost of hydrogen from fossil fuels is between €1.5 and €2.5/kg for industrial customers consuming large volumes (e.g. refineries). But for less intensive uses, for which hydrogen is transported and delivered by truck, hydrogen is around 10 to 20 €/kg, rarely below 8 €/kg. At the same time, hydrogen produced by electrolysis costs around €4/kg to €6/kg depending on the electrolysis technique, and for a period of use of around 4 000 to 5 000 hours per year, and an electricity cost of around €50/MWh. According to the Ministry of Ecological and Solidarity Transition, this cost could be decreased to as low as 2 to 3 €/kg, based on a strong industrialization[2].

In this context, a real market potential is accessible for hydrogen locally produced by electrolysis. Some current identified obstacles, such as the large investments to be made and the residual technical constraints due to the fact that hydrogen technology is still a new technology could be overcome in the short or medium term. For example, needs for large investments could be supported through the subsidies which will be granted by the EU as part of its reinforced long-term budget.

In this respect, The French Government encourages the decarbonized hydrogen development, precisely in order to speed-up decarbonization of many sectors, such as industry, mobility, or gas network. The French Government and local authorities are increasingly aware of the value of hydrogen to achieve the objectives set by the French Government for the development of renewable energies and the reduction of greenhouse gases.

In France, the deployment and the development of hydrogen is mainly governed by the Climate Energy Law[3] (Loi Energie Climat). Article 1 of the Climate Energy Law includes in the French Energy Code the objective of carbon neutrality in 2050, and the objective of developing low-carbon hydrogen to reach 20 to 40% of the total consumption of hydrogen and industrial hydrogen by 2030.

Article 52 of the Climate Energy Law also empowers the Government, through ordinance (within twelve months as from the publication of the Climate Energy Law), to define the

terminology of the different types of hydrogen according to the source of energy used for its production, to allow the production, transport, storage and traceability of hydrogen as well as to define a support framework applicable to hydrogen produced from renewable energy or by electrolysis of water using low-carbon electricity. A system of guarantees of origin is also planned for hydrogen of renewable origin.

To become a key player, French Government must launch as soon as possible large-scale projects in order to increase the availability of low-carbon hydrogen and lower its cost.

In this respect, leading industry actors are in favour of expanding hydrogen production in France and believe that France will become a main actor of hydrogen technology. At the beginning of July 2020, the French Association for Hydrogen and Fuel Cells (AFHYPAC) sent a letter, which several industrial companies have signed (ENGIE, Air liquid, EDF, Michelin, Total...), to the new prime minister Jean Castex, asking the Government to massively invest until 2023 in hydrogen sector, in order to give France a strategic industrial position in the low-carbon economy of tomorrow and beyond.

In late 2021, the French President also announced that EUR 1.9 billion of the State budget will be dedicated to hydrogen by 2030, especially in order to support producers of carbonaceous hydrogen to decarbonize their infrastructures.

National hydrogen strategy

As announced by the French President Emmanuel Macron during his annual speech of the 14th of July, the so-called massive economic recovery plan "France Relance" from the 3rd of September 2020 includes 2 billion euros in hydrogen sector that will be invested before 2022, as well as nearly 7.2 billion euro investments by 2030 that includes 3.4 billion euro investments for the period 2021-2023.

The French Government is indeed willing to achieve its goals concerning the development of renewable energy sources and reduction in greenhouse gas emissions by increasing the use of green hydrogen. For that, green hydrogen can be useful in two ways: decarbonization of sectors using black hydrogen, and development of renewable hydrogen in new sectors, such as transport.

For this purpose, a National Hydrogen deployment plan for the energy transition (hereafter, the "National Hydrogen Plan") was adopted by the French Government in 2018, involving 100 million euros for the sector, while a new national plan had to be announced on last September 8th following the above-mentioned recovery plan.

The actual National Hydrogen Plan (still into force) is based on three items: industry, mobility and energy. The targets set by the National Hydrogen Plan are incorporated in the French Multiannual Energy Programming ("Loi de programmation pluriannuelle"), which entered into force in April 2020, reinforcing national hydrogen strategy by deploying solutions by 2030-2040. Multiannual Energy Programming is set for two periods, the first one from 2019 to 2023 and the second one from 2024 to 2028. It defines in a decree and a report the national main energy objective as well as the orientations and priorities for action of the public authorities, mainly in order to reach its greenhouse gas emissions target. In this respect, the Multiannual Energy Programming measures provide, among others, for supplying development aid to low carbon hydrogen up to 50 million euros a year and launching calls for tenders for developing mobility and electrolysis hydrogen production. It also plans to maintain the financial supports[4] granted by the French Government and promoting the purchase and the use of vehicles producing low emissions and notably hydrogen cars.

On September 8th, 2020, the French Government unveiled its new Hydrogen Strategy (so called "France Hydrogène") for the coming decade, which aims to further develop hydrogen technologies in order to build a competitive industrial sector. In this respect, the strategy is articulated around three main axes that consist in accelerating investment for a low-carbon and competitive hydrogen industry over the period 2020-2030, thanks to the mobilization of € 7.2 billion in public support, half of which over the period 2020-2023.

"France Hydrogène" strategy thus sets 3 objectives consisting of (i) installing enough electrolyzers to make a significant contribution to the decarbonation of the economy with a target of 6.5 GW of electrolysers installed in 2030 (ii) developing clean mobility, particularly for heavy vehicles and (iii) building an industrial sector in France that creates jobs and guarantees France technological mastery.

To this end, the "France Hydrogène" Strategy comes with different instruments like projects of common European interest on hydrogen, large-scale national calls for projects (mainly focused on research) and public support mechanisms by premium (so called "contract for difference").

Taken pursuant to the aforementioned Climate Energy Law (Loi Energie Climat), Ordinance no. 2021-167 of February 17, 2021 introduced in the Energy Code new provisions dedicated to hydrogen[5]. The main contribution of the ordinance is to provide a clear and readable terminology for hydrogen based on its environmental attributes (instead of the "colour" i.e. green, blue, black hydrogen).

The new typology includes the three following categories:

- Carbonaceous hydrogen, which refers to hydrogen that is neither renewable nor low carbon. This category includes fossil fuel-based hydrogen, such as hydrogen produced by steam reforming of natural gas (about 11 $kgCO_2/kgH2$), by coal gasification (20 $kgCO_2/kgH2$) or by electrolysis powered by carbon-based electricity mixes. This category also includes potentially production from renewable energies that would not qualify for the emission threshold. This could concern, for example, hydrogen produced from biomass or biogas, depending on the nature of the inputs used and the associated carbon footprint, or even depending on the methane leaks taken into account upstream. The production of hydrogen in France is 90% carbon-based because of the technologies used (in particular steam reforming of methane[6]);
- Renewable hydrogen produced from renewable energy sources and whose production process respects a threshold of CO_2 equivalent emissions per kilogram of hydrogen produced. This category includes electrolysis using renewable electricity (solar, wind, hydro), as well as any other production process using renewable energies and "not conflicting with other uses allowing their direct recovery"[7];
- Low-carbon hydrogen produced from non-renewable energy sources and respecting the same $kgCO_2eq/kgH2$ threshold as carbonaceous hydrogen. Electrolysis fueled by electricity from the French electricity mix would qualify, as well as processes combining carbon capture, sequestration or use (CCSU) techniques that can significantly reduce CO_2 emissions from the plant.

The appropriate emission threshold is to be later defined by law. The choice will be made in line with the European discussions on green taxonomy and should be compatible with a decarbonized electricity mix.

The French Energy Code also provides for a financial public support mechanism which is, however, not expressly detailed to date. Based on the information given by the French Government, it seems that this support mechanism will be organized in the form of contracts to be entered into between the State and the producers under terms and conditions quite similar to the ones of the contracts entered into in the field of other renewable energies (solar, wind, etc.). The details of these support systems must be specified in Decrees that have not yet been adopted.

The aforementioned definitions appear to be important regarding the public support mechanisms. Indeed, only renewable hydrogen and low-carbon hydrogen produced by water electrolysis are eligible for financial public support (Article L. 812-1 of the French Energy Code).

Finally, two traceability mechanisms have been put in place within the Energy Code.

The first is a traceability guarantee to ensure that the hydrogen used is totally renewable or low carbon. If the hydrogen is not mixed with another type of hydrogen or another gas between the production and consumption stages, the traceability guarantee attests to its physical traceability.

The second is a guarantee of origin showing that at least part of the hydrogen is renewable or low carbon. A guarantee management organization will have to be created to issue the different guarantees.

Despite these evolutions, the legal framework remains partial and would have to be completed to give to potential producers some visibility. This is also true for the downstream usage of hydrogen which is not a topic broadly addressed by the State yet. Only few local administrations try to set up public initiative in the field of hydrogen uses.

[1] Ministry of Ecological and Solidarity Transition, Hydrogen deployment plan for thwe energy transition, 1st June 2018, page 1.
[2] Ministry of Ecological and Solidarity Transition, Hydrogen deployment plan for the energy transition, 1st June 2018, page 6.
[3] Law No. 2019-1147 of 8 November 2019 relating to energy and the climate.
[4] These financial aid mechanisms consist of a conversion bonus consisting in a tax arrangement for old vehicles' owners to encourage purchasing of low carbon vehicles provided by the article D. 251-3 of the Energy code, and of an ecological bonus granted to support the purchase of electric or hydrogen vehicles in accordance with article D. 251-1 of the energy code.
[5] Articles L. 811-1 to L. 851-2 of the Energy Code.
[6] Government, France must become the world "leader" in green hydrogen, October 1, 2021.
[7] Such as pyro gasification or thermolysis of biomass, steam reforming of biogas.

4d | The UK Market

The Net Zero commitment and UK hydrogen market

In June 2019, the UK Prime Minister made global headlines by announcing legislation (The Climate Change Act 2008 (2050 Target Amendment) Order 2019) committing the UK to a legally enforceable goal of net zero greenhouse gas emissions by 2050. The UK was the first major economy to take this step. There is general agreement that increasing the production and use of hydrogen as an energy source will be essential for the UK to achieve this target.

It is predicted that, by 2035, between £3.5 billion and £11.4 billion investment will be required to finance the development of the necessary hydrogen production capacity in the UK. The current cost of hydrogen production in the UK is about £8/kg. However, innovation and investment in the efficiency of electrolysers is forecast to decrease this cost to £2/kg by 2030 and £1.50/kg by 2050. In terms of purchasing hydrogen fuel, as an example, it costs £10 to £15/kg to buy enough fuel to travel 100km, whereas this same distance currently cost around £9 for an average petrol or diesel car.

In addition to the lack of hydrogen production capacity, another obstacle to the UK's planned switch to hydrogen energy is the current lack of hydrogen delivery infrastructure. The main sectors in which major delivery infrastructure development will be required are transport (including a network of liquid hydrogen pumps for vehicles and ships), and a gas transmission system for hydrogen for home heating and heavy industry. These three areas are currently heavily reliant on fossil fuels and natural gas. Two recent UK Government announcements (ending fossil fuel heating systems in new houses in the UK from 2025; and banning the sale of new petrol and diesel vehicles in the UK from 2030) are intended to stimulate investment in this new infrastructure.

The UK Government's Hydrogen Strategy

In August 2021, the UK Government presented its UK Hydrogen Strategy ("UKHS"). The UKHS sets out a clear vision that, by 2030, the UK will be a global leader on hydrogen, with an ambitious target of 5GW of low carbon hydrogen production capacity. The Hydrogen Strategy also set out that the UK Government's goals go beyond simply decarbonizing the UK energy system. Other key goals include: supporting industry to develop sustainable, home-grown supply chains including hydrogen transportation and storage, by taking a "whole system" approach; attracting up to £4 billion of private investment in the period up to 2030; and creating high quality jobs in the UK. The strategy sets an ambitious initial target of building 5 GW of low-carbon hydrogen production capacity (i.e. blue hydrogen and green hydrogen) by 2030 (from the current UK baseline of almost zero low-carbon hydrogen production). The 2020s are recognized as crucial years in which rapid and co-ordinated action is required both by government and the private sector if the UK is to achieve its goal to be a leading hydrogen economy, and of achieving Net Zero by 2050.

ITM Power, a UK company, will play an important role. It is one of the world's leading suppliers of proton exchange membrane ("PEM") electrolysers. It opened its Gigafactory at Bessemer Park in Sheffield in January 2021, which has a capacity 1 GW of electrolysis equipment per annum. ITM Power is also a key participant in the REFHYNE project which is being funded by the European Commission's Fuel Cells and Hydrogen Joint Undertaking ("FCH JU"). The REFHYNE project has installed and now operates the world's largest hydrogen PEM electrolyser at the Shell Rhineland Refinery in Wesseling, Germany. Other UK technology companies who are highlighted in the UKHS as playing a key role in developing the hydrogen economy include Johnson Matthey and Ceres Power. Ceres Power, is one of the world's leading suppliers of hydrogen fuel cell technology, which is particularly suitable for use in heavy transport such as HGVs and buses. Ceres Power's technology focuses on solid oxide fuel cells ("SOFCs"), which are not dependent on the widespread availability of high purity hydrogen before they can be deployed in volume. Additionally, Ceres Power's SOFC technology uses a thin layer of cerium oxide doped with gadolinium as the electrolyte, meaning that it operates at a much lower temperature (c 600°C) than other SOFC cells (c 800-900°C). This reduces manufacturing costs, therefore allowing the technology to be mass produced at an affordable price. Bosch has invested £40M in Ceres Power over the last two years, and the company is expected to be a major beneficiary of the global switch to hydrogen.

The Government is currently working towards defining a UK standard for low carbon hydrogen. The idea is that businesses seeking financial support from the government either through the Net Zero Hydrogen Fund ("NZHF") and the Hydrogen Business Model would meet this standard. Key points set out in the Hydrogen Strategy to

deliver on the UK Government's 2030 ambition include:

- a £240 million Net Zero Hydrogen Fund will be launched early in 2022 to co-invest in early hydrogen production projects. This is intended to support commercial deployment of new low carbon hydrogen production projects during the 2020s by addressing barriers related to the commercial risk and high production costs of hydrogen compared to their fossil fuel alternatives;
- the development of a Hydrogen Business Model to be finalised in 2022 in order to provide long-term revenue support to hydrogen producers to overcome the cost challenge of producing low carbon hydrogen;
- a technology-agnostic approach to hydrogen production, with the UK committing to supporting both electrolytic and CCUS-enabled hydrogen, with further details of the overall production strategy to be released early in 2022;
- defining a UK gas quality standard for low carbon hydrogen. The idea is that businesses seeking financial support from the government either through the Net Zero Hydrogen Fund ("NZHF") and the Hydrogen Business Model would have to meet this standard.
- a continuing role for the Hydrogen Taskforce, incepted in 2019, as a coalition of the hydrogen industry's largest organisations. It aims to secure the role of hydrogen in future energy production. The taskforce will work with the Government to help develop the necessary infrastructure and delivery frameworks.
- assessing the conditions necessary for the establishment of a thriving market for low carbon hydrogen, and the creation of a supportive regulatory framework.

The 5GW hydrogen production capacity target is predicted to create around 9,000 new high-quality jobs across the country by 2030, and up to 100,000 by 2050. Following the disastrous financial impact of COVID-19, hydrogen is also expected to be crucial in the economic recovery of the UK by creating new jobs and drawing investment. As mentioned above, in ITM Power, Johnson Matthey, and Ceres Power, the UK has three of the world's leading hydrogen technology suppliers. Overall, it is expected that hydrogen could be worth up to £18bn to the UK economy by 2035 through the creation of 75,000 jobs. Breaking this figure down, there is expected to be 28,000 new jobs in hydrogen production, 15,000 in transmission, distribution and storage infrastructure and another 31,000 in different end uses.

UK Hydrogen Strategy related consultations

At the same time as announcing the UK Hydrogen Strategy in August 2021, the UK Government launched a number of consultations to inform the policy and regulatory frameworks that will be required for the successful development of a hydrogen economy:

- Designing a UK low carbon hydrogen standard;
- Designing the Net Zero Hydrogen Fund;
- Design of a business model for low carbon hydrogen; and
- Hydrogen for heat: facilitating a grid conversion hydrogen heating trial.

These consultations have now closed, and the UK Government's reports on the outcome of the consultations are eagerly awaited.

Energy White Paper

The Energy White Paper, published in December 2020, has a wider focus than the UK hydrogen strategy. It presents a vision of how the UK will make the transition to clean energy and achieve Net Zero by 2050 and what this will mean for consumers of energy in their homes and places of work, and for businesses that use energy to produce goods and services. Much of the focus is on expansion of renewables generation. However, there is some discussion of the role which low-carbon hydrogen will have to play.

For example, the Acorn CCS and Hydrogen Project in St Fergus, Scotland, is supported by the Department for Business, Energy and Industrial Strategy's ("BEIS") Low Carbon Hydrogen Supply Competition. The Project aims to deliver an energy- and cost-effective process for producing hydrogen at a low cost.

The Paper also describes how the UK Government is pioneering trials for hydrogen heating in homes. The HyHeat Innovation programme opened in April 2021, and is funding the building of two semi-detached homes in Low Thornley, Gateshead. These become the UK's first fully hydrogen-powered homes. The homes will be open to members of the public, local schools, and universities, to encourage learning about the new technology. The Energy White Paper details that the Government hopes to scale this up to a Hydrogen Neighbourhood, and eventually a Hydrogen Town by the end of the decade.

4e | The Czech market

Market status: Early stages, already focussed on new technologies

Given the advanced Czech chemical industry, hydrogen is already being produced by large-scale industrial manufacturers. The annual Czech hydrogen production amounts to ca 126 kilotons, being predominantly grey hydrogen produced from fossil fuels via partial oxidation (POX) or steam methane reforming (SMR). The average emission intensity of hydrogen is currently 116g CO_2/MJ. Existing hydrogen production facilities may have limited options to transform the production into blue or green hydrogen. Therefore, construction of new facilities might be needed which could translate into economical barriers for the manufacturers. Regarding the CCS hydrogen production method, finding a suitable carbon storage space could be difficult as most of the suitable locations in the Czech Republic are already being used for the storage of the strategic natural gas reserves. Producing hydrogen via water electrolysis using the electricity from renewable sources (e.g. wind) does not seem widely practical due to the Czech Republic's geographical position. Producing hydrogen via water electrolysis using the electricity from the existing grid would increase the emission intensity of hydrogen to 176g CO_2/MJ, i.e. well above average SMR, thus making this method unfeasible. In this context, the water electrolysis using low-emission electricity (e.g. nuclear) may be seen as a perspective option for the future hydrogen production facilities.

In 2006, the Ministry of Industry and Trade (MIT) initiated the establishment of the Czech Hydrogen Technology Platform. The platform links together major stakeholders active in the development of hydrogen technologies, including commercial developers, state-owned universities and research institutes. The platform has played an important role in the regulatory and hydrogen economy related topics.

Lately, commercial stakeholders have been increasingly exploring new technologies and possible uses of hydrogen, particularly in the automotive and infrastructure sector. As regards the hydrogen production, Orlen Unipetrol, the largest Czech grey hydrogen producer (over 85 kilotons per year) announced its ca 37 million EUR investment plan to open a water electrolysis plant in Litvinov by 2025 with target production of 990 tons of green hydrogen per year using the electricity from a contemplated 52 MW solar powerplant. ČEZ, a state-controlled energy conglomerate, plans to produce green hydrogen from its future 10 MW water electrolysis plant by 2025. Solar Group plans to produce approx. 35 tons of green hydrogen per year in Napajedla by 2022 using the electricity from the existing solar powerplant. As regards the mobility projects, Orlen Unipetrol has engaged in constructing hydrogen refuelling stations in the Czech Republic, aiming to open 28 stations by the end of 2030. In June 2022, Vitkovice Machinery Group opened the first public refuelling station for passenger cars able to daily refuel 40 kilograms of hydrogen. In May 2022, ALSTOM showcased in the Czech Republic the hydrogen-fuelled train able to travel up to 1,000 km reaching speeds of up to 140 km/h. In July 2022, the European Commission approved the IPCEI Hy2Tech, a hydrogen technology value chain project among 15 EU Member States, in which IVECO Bus Czech Republic plans to produce intercity hydrogen buses. As regards the hydrogen infrastructure projects, NET4GAS, a major Czech gas pipelines operator, holds a conservative position stating that although the hydrogen transportation in the existing gas network is technically possible, it would still require complex feasibility assessment and amendments to the current regulations. According to GasNet, the Czech Republic's largest natural gas distributor that has joined the Ready4H2 initiative between 15 European countries, the Czech gas distribution infrastructure is currently ready to handle 20% of hydrogen injected into the system.

The Czech Republic's Hydrogen Strategy

In the light of the European Green Deal objective for an economy with net-zero greenhouse gas emissions by 2050, the Czech government adopted the Hydrogen Strategy on 26 July 2021. The Hydrogen Strategy follows two strategic goals: reducing greenhouse gas emissions and stimulating the economic growth. The Hydrogen Strategy delineates the vision and desired measures to support low-carbon hydrogen production and use, hydrogen transport and storage and hydrogen technologies. The Hydrogen Strategy introduces important timeline estimates, in particular:

- the price of blue hydrogen to drop to 4 EUR/kg by 2025 and to 1 EUR/kg by 2043, which would bring significant benefits to transportation businesses, particularly cargo;
- gradual replacement of grey with blue hydrogen in the chemical industry from 2030;
- continuous expansion of subsidized hydrogen vehicles and refuelling stations by 2032, at which point the subsidies would be restricted and

the hydrogen market should operate on commercial principles;
- commencement of hydrogen distribution network construction in 2037;
- blending of hydrogen into the natural gas distribution to households from 2038;
- gradual replacement of natural gas with hydrogen in industrial use from 2042. and
- the paradigm shift from high to low-emission economic in 2042.

Via the Hydrogen Strategy, various Czech ministries have been assigned in total of 26 tasks and asked to cooperate with the related industry stakeholders to complete them. The Majority of the tasks relates to addressing the persisting regulatory gaps and inconsistencies.

Apart of IPCEI, hydrogen projects in the Czech Republic may benefit from various subsidy system programmes. The programmes are not specific to hydrogen only, but rather to new technologies and energy sector transformation. The Technology Agency, an organizational unit of the Czech Republic, offers 5 relevant subsidy programmes with aggregated funds allocation of ca 740 million EUR. The State Environmental Fund, administered by the Ministry of Environment (MOE), manages the Modernisation Fund that was allocated ca 5.5 billion EUR from the EU budget, and consults on the EU Innovation Fund that is expected to be allocated with ca 10 billion EUR. MOE offers a special programme for coal regions with an allocation of ca 1.6 billion EUR. Ministry of Transportation's programme was allocated ca 5.3 billion EUR from the EU budget. Programmes offered by MIT have been allocated ca 226 million EUR so far. Ministry of Regional Development's programme is expected to be allocated with ca 4.8 billion EUR.

While tackling the recent global challenges, the Czech government that emerged from the Czech parliamentary election of October 2021 aims to focus primarily on securing the energy self-sufficiency for the Czech Republic and simultaneously explore the possibilities of alternative energy sources, including hydrogen. This underlines the importance of the continuous monitoring and reacting to related factual and regulatory developments.

5 | Legal Aspects

5a | Germany

The implementation of hydrogen projects is still subject to various challenges and individual issues that are linked to national and European law. A distinction must be made between the distribution stages of production, transport and use of hydrogen as an energy source.

Production of hydrogen

The construction and operation of generation plants, especially electrolysers, is still characterised by a lack of specific regulatory requirements. This applies both to the colour theory described under point 1, especially with regard to the question of when hydrogen is green, and to the issue of permits. For example, it currently depends on various details whether an immission control permit is required under the Federal Immission Control Act (BImSchG) and whether there are additional requirements, e.g. under the Industrial Emissions Directive (Directive 2010/75/EU). Further challenges arise in connection with building planning law, since unlike renewable energy plants, electrolysers do not have any express privileges in outdoor areas. For technical reasons, hydrogen electrolysers also require the discharge of electrolyte-containing (saline) wastewater directly into bodies of water or into public sewage systems, which poses different problems in terms of water law.

Transport of hydrogen – national level

In the area of hydrogen distribution, the greatest regulatory adjustments have been made so far, both to regulate feed-in to the natural gas grid and to create specifications for separate hydrogen grids. However, the amendments to the Energy Industry Act (EnWG), which came into force on 27 July 2021, are merely transitional regulations until a common European regulatory framework is established. In contrast to the previous regulation, hydrogen, insofar as it is used for grid-based energy supply, is now included in Section 1 para. 1 EnWG or Section 3 no. 14 EnWG as an independent energy source alongside electricity and

gas. Hydrogen produced by water electrolysis (green hydrogen) remains subject to the old regulation; it is treated as equivalent to gas pursuant to Section 3 No. 19a EnWG or biogas pursuant to Section 3 No. 10f EnWG.

In Section 28j EnWG, the operators of hydrogen grids are given the irrevocable option of subjecting themselves to the regulatory requirements of Sections 28k et seq. EnWG (opt-in). Those who opt for regulation must, in particular, grant access and connection to the hydrogen network in accordance with the principle of negotiated network access pursuant to Section 28n EnWG. In addition, the operators of hydrogen infrastructures are subject to the unbundling requirements pursuant to Section 28m EnWG. Generation of energy and its distribution should be in different hands; grid operators are prohibited from generation, storage and operation. In addition, the requirements of informational unbundling apply, according to which the confidentiality of economically sensitive information from business activities must be ensured. For network charges, Section 28o EnWG largely refers to Section 21 EnWG, but excludes the application of the ARegV. The cost review required for this takes place on the basis of a plan/actual cost comparison. A prerequisite is a positive needs assessment of the hydrogen infrastructure in accordance with Section 28p EnWG, so that the costs are recognised.

The transitional provision of Section 113a EnWG is intended to facilitate the conversion of gas pipelines to hydrogen-only networks by standardising the continued validity of the route utilisation contracts and concession contracts.

Parallel to the Gas Grid Development Plan, the operators of hydrogen grids are obliged under Section 28q EnWG to submit a report to the Federal Network Agency for the first time by 1 September 2022 on the current state of expansion of the hydrogen grid and on the development of a future hydrogen grid plan with the target year 2035.

Transport of hydrogen – European level

Up until now, no regulatory concept existed at a European level. The current legal framework for gaseous energy carriers (see Regulation 715/2009/EC and Directive 2009/73/EC) was not geared towards the use of hydrogen as an independent energy source and transport via special hydrogen networks. It was not until 15 December 2021 that the European Commission presented its proposal for a new legal framework for hydrogen: "Decarbonisation of gas markets, promotion of hydrogen and reduction of methane emissions". The draft has already been passed by the EU Council and is about to undergo its first reading in the European Parliament, so that final adoption is expected before the end of 2022. The new legal framework is intended to facilitate the market ramp-up of renewable and low-CO_2 gases and promote the development of a cost-efficient, cross-border hydrogen infrastructure and a competitive hydrogen market. To this end, the EU Commission's package focuses on four central goals:

- the creation of a legal framework for a hydrogen market,
- facilitating the injection of renewable and low-carbon gases into the existing gas grid,
- phasing out natural gas by 2050, and
- the empowerment of gas consumers and prosumers.

From a regulatory point of view, the requirements for unbundling in the operation of pure hydrogen networks and the requirements for the formation of network charges are of decisive importance. In contrast to the German legal framework, these do not provide for a right of choice or a principle of negotiated network access, but comparable requirements to those for existing electricity and gas networks. Until the end of 2030, however, the current drafts allow for different national exceptions. In addition, a certification system for renewable and low-CO_2 gases will be created. This should make it possible to evaluate the greenhouse gas footprint of the various gases and to take this sufficiently into account in the evaluation of the national energy mix and the decarbonisation of industry.

Storage and use of hydrogen

Further regulatory questions arise in the storage and use (e.g. via H2 filling stations) of hydrogen. In addition to the licensing and energy law requirements for the construction and operation of corresponding plants, storage in particular - as in many other storage situations (e.g. the use of battery storage) - raises questions regarding apportionments, levies and energy taxes, which must be observed or avoided in this context. In this context, the exemptions currently regulated in Sections 64a, 69b EEG 2021 are of particular importance (in future Sections 25-27, 36 Energy Surcharge Act). This applies irrespective of the refinancing / abolition of the EEG surcharge from 1 July 2022, as the reduction provisions are also relevant for other levies and surcharges.

5b | Austria

In order to achieve long-term CO_2 neutrality of national gas consumption by 2040, the competitiveness of renewable energy must be increased, such as through support measures or emission pricing of energy sources. In addition, economic planning security for producers must be established. Therefore, the introduction of a quota regulation for sales and binding national targets for hydrogen should create legal certainty for producers. In addition, the economic efficiency for the production of hydrogen should be increased by redefining the boundaries between producers and the gas grid.

In this sense, the new Renewable Energies Expansion Act ("Erneuerbaren-Ausbau-Gesetz") is to come into force in 2021 according to the Austrian government. This law is intended to strengthen the subsidies for green electricity by creating more efficient and better framework conditions for the expansion of renewable energy. The redesign of the state subsidy system in compliance with the European Union's state aid regulations is intended to ease the market integration of renewable electricity generation. At the same time, a positive investment climate is to be ensured and administrative barriers reduced.

In order to enable long-term storage of electricity using hydrogen and also to stimulate it, it is being examined whether future investments by the hydrocarbon industry (e.g. power-to-gas) that are close to the industry's needs can be taken into account when calculating the exploita-tion levy within the meaning of the Mineral Resources Act ("Mineralrohstoffgesetz").

The production of hydrogen by using electrolysis plants is intended to mitigate the production of surplus energy from renewable sources. The Energy Act New ("Energiegesetz Neu") should combine state support for renewable energy with the supply of storage capacity. Furthermore, the subsidized feed-in of hydrogen into the natural gas grid is to be made possible through the development of suitable mechanisms and devices.

In implementation of the integrated climate and energy strategy "mission 2030", biogas and hydrogen will no longer be subject to mineral oil tax under the Tax Reform Act 2020 but will be classified under the Natural Gas Levy Act ("Erdgababgabegesetz"). In addition, a tax advantage will be granted for renewable hydrogen in the form of a remuneration.

5c | France

The legal issues which come with the use of hydrogen are key questions, which remain unanswered, whether it relates to the transport or to the integration of hydrogen to existing networks.

Nevertheless, to date, the French Government appears to be moving towards the integration of hydrogen to existing networks, at least from an infrastructure perspective. Indeed, no regulation framework has been taken so far and only some adjustments to the existing regulation have been made for hydrogen exploitation: a right of access has been set for low carbon hydrogen to existing gas transport and distribution networks, in accordance with article L.111-97 of the French energy code. However, at this stage, legal gaps surrounding technical and economic constraints of its integration remain. Besides, the right to access to the existing network, issues related to network charges, as well as adjustments costs, will have to be legally set.

Although there is no global and dedicated law regulating hydrogen to date, sector-specific laws are gradually being taken. For instance, hydrogen service stations for electric vehicles are ruled under the classified installations (installations classées pour la protection de l'environnement) law since 2018[8]. As a result, facilities which fall under such rules, must be declared before the Préfet of the relevant Région, and may be subject to regular inspections by the relevant authorities (in practice, the Direction régionale de l'Environnement, de l'Amé-nagement et du Logement; the "DREALs").

In the same time, another decree was published on 22 October 2018, providing for the concerned regulations for such type of facilities, applicable since 1st January 2019[9]. The decree concerns stations, open or not to the public, which produce more than 2 kg of hydrogen per day and where the hydrogen is transferred from the stations to the vehicles. The text sets out the rules relating to the compliance of hydrogen service stations with applicable regulations, to the operation of such installations, to the safety, and to the management of water, waste and noise resulting from the operation of such installations.

Meanwhile, as part of the National Hydrogen Plan, various calls for projects and calls for expressions of interest (MAI) have been launched. Such calls, encouraged either by the National Hydrogen Plan or the French Multiannual Energy Programming, are widely used in France regarding low carbon hydrogen, creating initiatives in different

sectors – industry, mobility, transports. Under the initiative of either the French Government and the local authorities or the ADEME (the French ecological agency for the energy transition), investments are made in pilot projects aiming at developing the use of hydrogen, that is, at this stage, still being experienced. These calls form a solid base creating prospects to anticipate technical and legal issues concerning facilities, costs, billing, etc. and will play a key part in the creation of a future hydrogen legal framework.

Another core requirement for the development of hydrogen use will assume, at national and EU levels as at European one, to provide for support mechanisms at an early stage where hydrogen is not yet profitable, as it has been put in place for solar and onshore/offshore sector.

The implementation of the National Hydrogen Strategy is based on two ADEME calls for projects and operating aid measures in addition to the European system of important projects of common European interest (IPCEI) .

In October 2020, the ADEME launched two calls for projects which aim at:

- supporting innovations on technological bricks and demonstrators on fuel cells, high pressure tanks and other complex systems dedicated to the use of hydrogen (350 million euro-investments by 2023);
- supporting renewable or low-carbon hydrogen supply-demand projects in the regions by deploying low-carbon hydrogen distribution infrastructures and the associated uses (275 million euro-investments by 2023).

This call for projects is still ongoing.

It is also contemplated to use the IPCEI to contribute to the achievement of the objectives of the national strategy.

IPCEI projects require the participation of at least two private entities from two different Member States.

The development and operating costs of hydrogen, whether renewable or low-carbon, are still beyond a level that would make it competitive, and support measures will be put in place to accompany the efforts of industrialists through:

- support to compensate for operating costs that are often higher than with fossil hydrogen (a tender mechanism is currently being discussed);
- support for renewable H2 used in the refining sector through an exemption from the incentive tax on the use of renewable energy in transport.

[8] Decree No. 2018-900 dated 22 October 2018 creating a section 1416 "Storage or use of hydrogen" in the nomencla-ture of classified installations.

[9] Order of 22 October 2018 relating to the general requirements applicable to classified installations for the protection of the environment subject to declaration under heading No. 1416 (gaseous hydrogen distribution station) of the nomenclature of classified installations and amending the order of November 26, 2015 relating to the general requirements applicable to installations using gaseous hydrogen in an installation classified for environmental protection to supply trolleys with gaseous hydrogen when the quantity of hydrogen present in the establishment falls within the scope of the declaration regime for section no.4715 and amending the order of August 4, 2014 relating to the general requirements applicable to classified installations for the protection of environment subject to declaration under heading 4802.

[10] Ministry of Ecological and Solidarity Transition, Hydrogen and its benefits, February 23, 2021

[11] The IPCEI (Important Project of Common European Interest) is a European mechanism for supporting research and innovation published in 2014 by the European Commission to promote projects of transnational interest in strategic areas such as supercomputing, autonomous cars, nanoelectronics or, more recently, electric batteries.

5d | UK

General

In the UK, there is currently no planning law or environmental law regime specific to hydrogen projects. Therefore the general planning law and environmental law regimes will apply. the relevant regulations that also apply to chemical and gas processing industries are to be applied here.

Ofgem licences

The UK gas market is currently regulated by the Office of Gas and Electricity Markets authority which operates through the Office of Gas and Electricity Markets ("Ofgem"). A licence under the Gas Act 1986 is required for the supply of gas, the transportation of gas (i.e. by the National Transmission System and Gas Distribution Networks) or operation of gas interconnectors, and the provision of smart metering systems in relation to gas.

To obtain a licence for this purpose, the following must be provided:

- a credible plan to commence the licensed activities; and
- a risk assessment, approved by Ofgem.

Further, a gas licensee must also comply with various industry codes. Pending the development of a specific regulatory regime for hydrogen, the provisions of the Gas Act 1986 will apply to a hydrogen network as "gas" is expressly defined in that legislation (s48) to include hydrogen.

Infrastructure consents

Hydrogen production projects will also be subject to the general UK planning law regime:

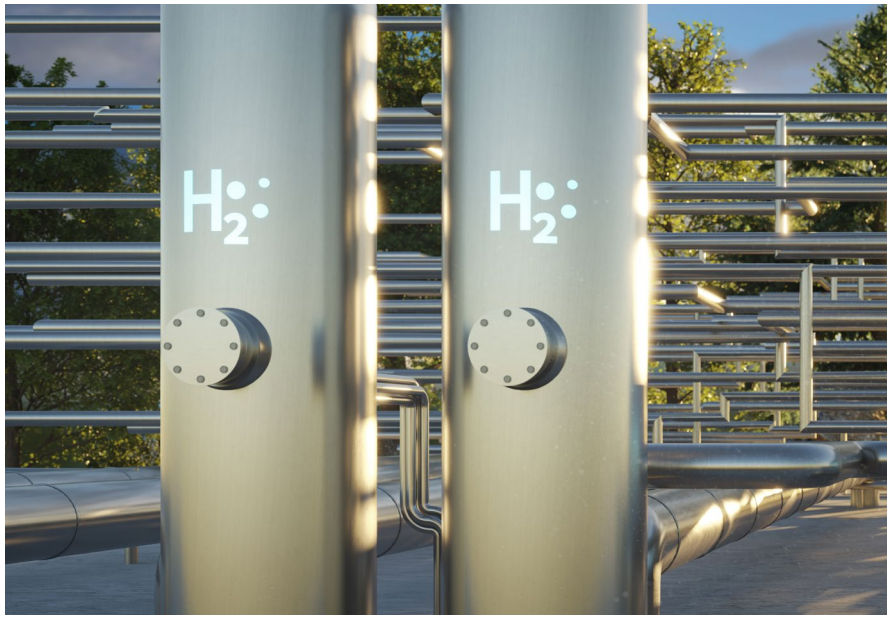
- Larger hydrogen projects will require development approval through a Development Consent Order ("DCO") under the Planning Act 2008. A DCO is the means for obtaining permission for Nationally Significant Infrastructure Projects ("NSIP").
- Smaller projects and pipelines will be governed by the Town and Country Planning Act 1990.
- In the case of repurposing existing infrastructure, amendments to existing rights will be required to accommodate the necessary technological upgrades and/or regulatory issues to be addressed.
- Regarding hydrogen storage, an Environmental Impact Assessment may be required if hydrogen is to be stored on-site or carried in pipelines. This is pursuant to the Town and Country Planning (Environmental Impact Assessment) Regulations 2017.

On 6 September 2021, the Department for Business, Energy and Industrial Strategy published a revised set of national policy statements ("NSPs") giving guidance and legal framework on development consent for NSIPs. The revised NSPs provide that the following hydrogen developments will require consent from the Secretary of State:

- Hydrogen gas-fired electricity generating infrastructure with over 50 MW capacity in England, and over 350 MW capacity in Wales;
- New hydrogen pipelines, whether or not blended with natural gas, if they meet certain size requirements; and
- Underground hydrogen storage developments, whether or not blended with natural gas, if they meet certain thresholds for capacity or rate of gas flow.

Pipelines

To facilitate the UK's transition to hydrogen fuel, the Health and Safety Executive ("HSE") has been working with the government on proposals to blend natural gas with up to 20% hydrogen for heating homes. The concentration that can currently be injected into the UK gas network is 0.1%, under the Gas Safety (Management) Regulations 1996.



5e | Czech Republic

The Czech legal framework pertaining to the production, transport, storage and use of hydrogen has been fragmented and incomplete, leading to potential regulatory barriers for hydrogen projects. The expert public alongside with the state authorities have been articulating the need for amendments to the existing regulations. The Hydrogen Strategy outlines the legislation measures necessary to address the gaps, however, the major legislation areas stand unaffected to this date.

The Czech energy sectors, including gas and electricity, are primarily regulated by the Energy Act No. 458/2000 Coll. Hydrogen does not fall under the definition of "gas" in the Energy Act. The Ministry of Industry and Trade (MIT) indicated that due to this shortcoming, the Energy Act does not apply to hydrogen. This results into regulatory uncertainties, impacting particularly the transportation and storage hydrogen projects. MIT aims to remedy these deficiencies by 2024-2025, while noting that the Czech Republic's geographical position may indeed stimulate the need to transport hydrogen across its territory (and, thus, the need to have the regulatory framework built) before the hydrogen market is fully developed at the national level.

The use of hydrogen as a fuel for automobiles is regulated by the Act No. 311/2006 Coll. on Motor Fuels and Gas Stations. The Act sets forth regulatory requirements on the sale of fuels, quality of fuels and fuel distributor registration duties. Pursuant to the Act, hydrogen is classified as an alternative fuel, yet it ultimately falls under the same definition as fossil fuels. To this date, hydrogen has not been subject to the gas excise tax as stipulated by the Art. LXXII of the Public Budget Stabilisation Act No. 261/2007 Coll. The Act taxes specific nomenclatures of gas products that are being used as a motor fuel or for heat production, whereas hydrogen is not listed in the said nomenclatures. To illustrate potential benefits resulting therefrom, when considering the use of the gas as a motor fuel, the current gas excise tax imposed on the liquid petroleum gas (LPG) effectively amounts to ca 0.08 EUR/litre and the tax imposed on the compressed natural gas (CNG) effectively amounts to ca 0.11 EUR/m3. Another tax advantage related to the use of hydrogen as a motor fuel is the tax exemption of the hydrogen-powered cars from the highway toll (vignette) pursuant to Section 20a of the Roads Act No. 13/1997 Coll. Hydrogen-powered cars are also eligible to have a special licence plate assigned pursuant to Section 7b of the Act No. 56/2001 Coll. on Operation of Vehicles on Roads. As regards the commercial road tax regulated by the Act No. 16/1993 Coll. on Road Tax, the cars using hydrogen as a fuel remain to be subject to the road tax, however, the cars using hydrogen power cells to generate electricity that is used as a fuel (i.e. electric vehicles) are exempt from the road tax.

Through an amendment to the Act No. 165/2012 Coll. on Supported Energy Sources, effective as of January 2022, a Guarantee of Origin may be obtained from the Czech market operator (state-owned company OTE) by a producer of hydrogen that was produced in the Czech Republic and supplied to the Czech distribution network or to a gas station. The particularities and interplays between the Guarantee of Origin and the other Act measures (e.g. state subsidies) are expected to be clarified soon as the effective date draws near. Generally, the Guarantee of Origin should help identify the source and category of the produced hydrogen.

In its resolution No. 696 of 26 July 2021, the Czech government adopted the Hydrogen Strategy. As described in Section 4e above, the Hydrogen Strategy delineates conceptual pillars of the hydrogen future in the Czech market. The Czech government will need to cooperate with the parliament to implement the envisaged measures. In this context, it is important to closely follow the upcoming developments in the Czech regulatory framework.

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