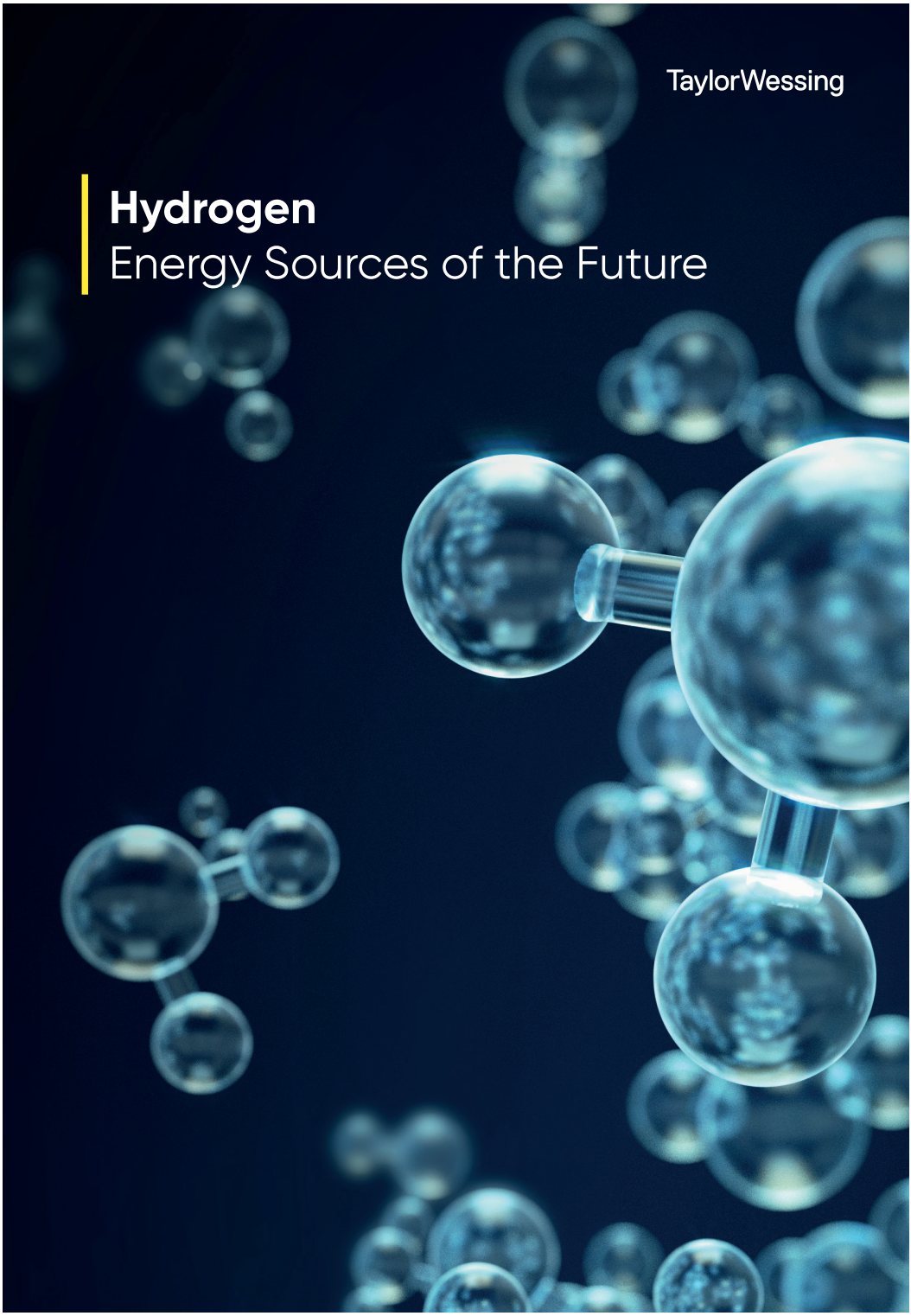
TaylorWessing

Hydrogen
Energy Sources of the Future



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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 the German environmental targets based on them. Hydrogen can and will play a key role in the future as a versatile source of energy. It can make it possible to significantly reduce CO2 emissions in industry and transport by using renewable energy sources. According to the EU Commission, hydrogen should play a central role in the European energy market by 2030 at the latest.

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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.

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.

2 | **EU Green Deal –** Development of the Energy Market

The first draft of the EU Climate Protection Law presented in March 2020 (the so-called Green Deal) is a concept presented by the European Commission with the aim of reducing the EU's net greenhouse gas emissions to zero by 2050, making it the first continent to become climate neutral. It includes an investment plan that is expected to activate 1 billion Euros of public and private investment over the decade. In this context, several well-known investors and investment companies have already announced that they will at least partially decarbonise their portfolios and withdraw from environmentally unfriendly investments.

After the corona crisis escalated in Europe from mid-March 2020 onwards and brought the global economy to a standstill, the EU heads of state and government decided on an aid package worth billions to revive the European economy. The exact form of this aid package and its impact on the Green Deal are still unclear. However, the EU Commission and the EU Parliament intend to give the "green transition" and digitalisation a central role in the planned reconstruction fund and presented corresponding programmes. Whether and how the reconstruction programme will be linked to the green transformation of the European economy remains to be seen. If this is continued under the forthcoming German EU Council Presidency, which Germany intends to use to further advance climate protection, it will represent an opportunity for the European renewable energy market and also for the hydrogen industry.

The EU named Hydrogen a key priority to achieve the European Green Deal and Europe's clean Energy transition. According to the European Hydrogen Strategy that was presented by the European Commission, the European Commission expects hydrogen technologies to reach maturity from 2030 onwards and towards 2050 and expects to deploy it at large scale to reach sectors that are difficult to decarbonize otherwise. The European Hydrogen Strategy prioritizes green hydrogen but acknowledges, that the use of different types of hydrogen that are low in carbon emission will be inevitable in the short and medium term. The European Hydrogen Strategy is categorized into phases, each scaling up the production and use of hydrogen further until reaching large scale capacities in 2050. To reach these milestones, the European Hydrogen Strategy aims at employing different tools like investment agendas and scaling up demand by decreasing the cost for hydrogen production through clean energy. Large energy companies like E.ON SE, Air Liquide, OGE, Bosch Group, Iberdrola and Shell all joined the ranks of the European Clean Hydrogen Alliance which aims at bundling resources and building an investment pipeline. The European Clean Hydrogen Alliances self proclaimed goal is the creation of a market for hydrogen and increasing the demand in an industrial scale all while decarbonizing industries that are difficult to decarbonize.

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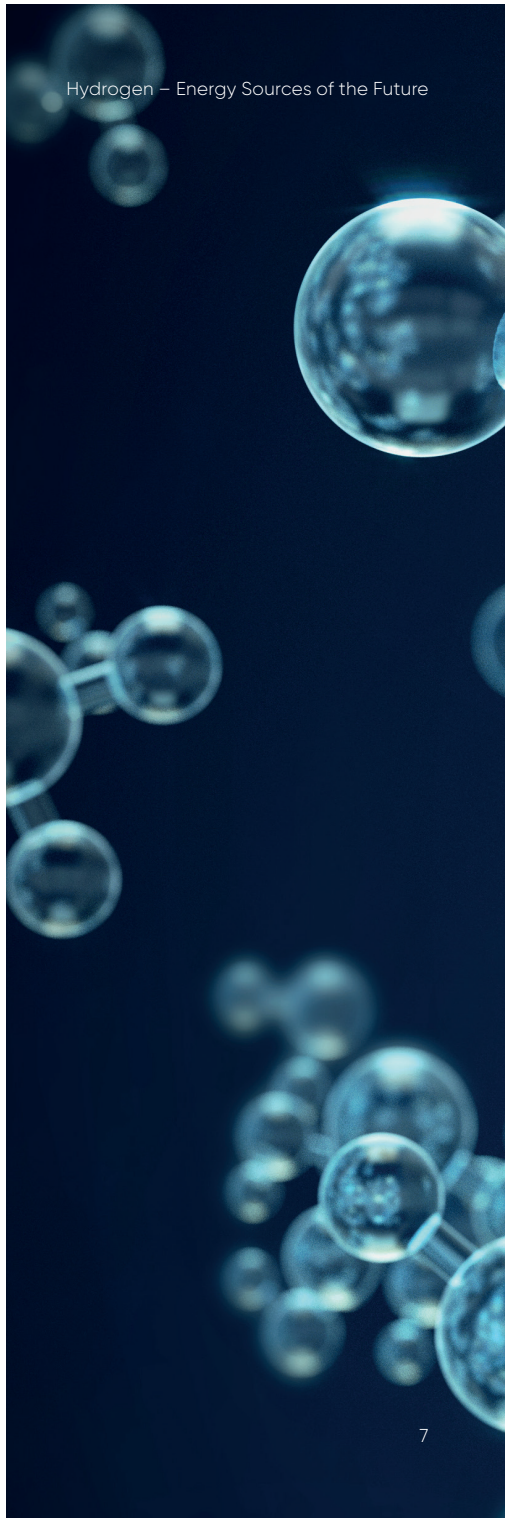

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3 Economic Aspects

The European hydrogen market is taking up speed as well. While currently still making up a small fraction of the energy mix, the number of new projects that are being planned and implemented increases. New investment plans and collaborations between energy companies are being announced weekly, often in the gigawatt range. 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% will 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 projects37 are envisaged and would require further elaboration and confirmation.

a The German Market

Hydrogen production in Germany is currently not competitive

Under the current framework conditions, the production and use of hydrogen is not yet economically viable. This is due on the one hand to the fact that the use of fossil fuels is currently still cheaper and on the other hand to the fact that hydrogen technology is a new technology, so that the technology costs are still high. In addition, there are legal regulations in force to date, such as the EC Renewable Energy Law surcharge on electrolysers. However, as technology continues to develop, generating costs are expected to decrease in the future. According to a recent study by the Hydrogen Council, it is estimated that the cost of producing green hydrogen from dedicated European offshore wind farms can be reduced from about $2.50 per kg by 2030, compared to about $1.50 per kg for grey hydrogen today.

Industry is also in favour of expanding hydrogen production in Germany and has presented the 10-point plan of the Power-to-X Alliance (whose members include Audi, BP and Uniper). Among other things, the plan calls for an expansion target of 5,000 MW by 2025 and the abolition of the Renewable Energy Law surcharge for electrolysers.

A National Hydrogen Strategy

The German government plans to promote the use of green hydrogen in particular. To this end, the "National Hydrogen Strategy" of the Federal Government was adopted at the beginning of June 2020, which provides for about 9 billion Euros in funding.

The Federal Government lists a whole range of measures here, subdivided according to subject areas. The initial aim is to create a "home market" for domestic hydrogen production and use. Building on this, international markets and cooperation for hydrogen are to be established. One of the aims is to create generating plants with a total capacity of up to 5 GW in Germany by 2030. Another 5 GW are to be added by 2035, or 2040 at the latest. To monitor the implementation and further development of the national hydrogen atoms, a committee of state secretaries for hydrogen from the ministries concerned is to be formed, as well as a national hydrogen council consisting of high-ranking experts from industry, science and civic society.

To achieve a successful energy turnaround, hydrogen is to be established as an **alternative source of energy**. Fossil fuel is not to be used in the future in air, sea and heavy-duty traffic. Instead, alternative fuels based on renewable electricity will be used. This includes for example, kerosene produced by the PtX process.

Industry already requires 55 TWh of hydrogen today. This demand is still mainly covered by using fossil energy sources. In addition, there is also the large energy requirement to operate the industries. Both the use of green hydrogen as a raw material and as an energy source, for example in steel production, offer great potential on the way to CO_2 neutrality. The resulting enormous demand for hydrogen should make German industry a driver in the market ramp-up of hydrogen according to the National Hydrogen Strategy and also an international pioneer for hydrogen technologies.

Moreover, the promotion of the hydrogen market can only succeed if the appropriate **infrastructure** is in place. Since Germany already has a good gas infrastructure, the extent to which the existing gas infrastructure can be used for hydrogen transport is being discussed.

According to the National Hydrogen Strategy, the EU's Renewable Energy Directive **(RED II)** is to be implemented by 2020: By 2030, the mandatory share of renewable fuels in the transport sector is to be increased significantly above the EU targets. In order to achieve this goal, the Energy and Climate Fund will provide, among other things, 3.6 billion Euros as additional support for investments in vehicles with alternative technologies (including hydrogen).

A further pillar of the National Hydrogen Strategy is the financing of so-called "real laboratories", in which, among other things, the production and application of hydrogen is to be tested on an industrial scale. 600 million Euros are to be made available for this purpose for the period from 2020 to 2023

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b | 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.

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 fossile 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.

Another difficulty is the lack of a level playing field between fossile and renewable hydrogen production within the European Union. Finally, land-use planning and building permits for electrolysis plants are not harmonised in Austria.

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 two 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.

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 biomethane) 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, a 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.

Hydrogen – Energy Sources of the Future

C | 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, where 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 as low as 2 to 3 €/kg, based on a strong industrialization[2].

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.

National hydrogen strategy

As announced by the French President Emmanuel Macron during its 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.

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, as transports.

For this purpose, a National Hydrogen deployment plan for the energy transition (hereafter, the "National

Hydrogen Plan") was been adopted by the French Government in 2018, involving 100 million euros for the sector, while a new national plan has 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 in (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").

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[1] Ministry of Ecological and Solidarity Transition, *Hydrogen deployment plan for the 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

4 Legal Aspects

4a Germany

However, the legal challenges associated with the production, transport and use of hydrogen as an energy source are hardly reflected in the National Hydrogen Strategy. A new regulatory framework has not been created and existing regulatory obstacles are hardly addressed.

The current outstanding questions include the **classification of hydrogen** in the already existing legal regulations and the resulting consequences.

For example, hydrogen produced by water electrolysis is explicitly put on an equal footing with gas within the meaning of Section 3 No. 19a of the German Energy Industry Act **(EnWG)** and biogas within the meaning of Section 3 No. 10c of the EnWG. The extent to which the EnWG is applicable to the hydrogen economy as a whole and whether the existing gas infrastructure can be used with hydrogen from a legal point of view is not yet clear.

This also applies to the question of how hydrogen can be integrated into the regulatory regime of other energy legislation. This becomes relevant, for example, in view of the **privileges and subsidies under the Renewable Energy Sources Act (EEG**). In this context, the exemption from the EEG surcharge for electrolysis electricity is currently being discussed.

Depending on the corresponding integration of hydrogen in the energy industry law, it will also be decided on which basis there is an entitlement to grid connection, the obligation to pay a grid fee or even the possibility of including the construction costs of a power-to-gas plant in the grid costs.

Finally, it is still unclear whether the operation of hydrogen infrastructures through **cooperation between electricity and gas network operators** must comply with the **unbundling regulations** or whether it is in line with them. This means the regulation based on European law that the generation of energy and its distribution via the networks should be in different hands; network operators in the gas and electricity sectors are prohibited from generating, storing and distributing it. Nevertheless, electricity and gas network operators want to pursue power-to-gas projects. The Federal Network Agency takes a critical view of such projects and argues that power-to-gas technology is not a technical necessity for the network in the foreseeable future. Criticism is also being voiced from industry, with the objection that the construction and operation of sector coupling plants should be left to the market and not transferred to the regulated sector with its regulated equity interest rates.

In addition to energy law issues, the economic assessment of a project will also be influenced by the admissibility of **state subsidies** under European subsidy law and the approvability of large plants in particular under the Federal Emission Control Act.

Against the background that the use of hydrogen is politically desired at both German and European level and that Germany and the EU want to create a corresponding legal framework, it is important to always keep an eye on possible legal changes and to be able to react and seize opportunities as soon as they arise.

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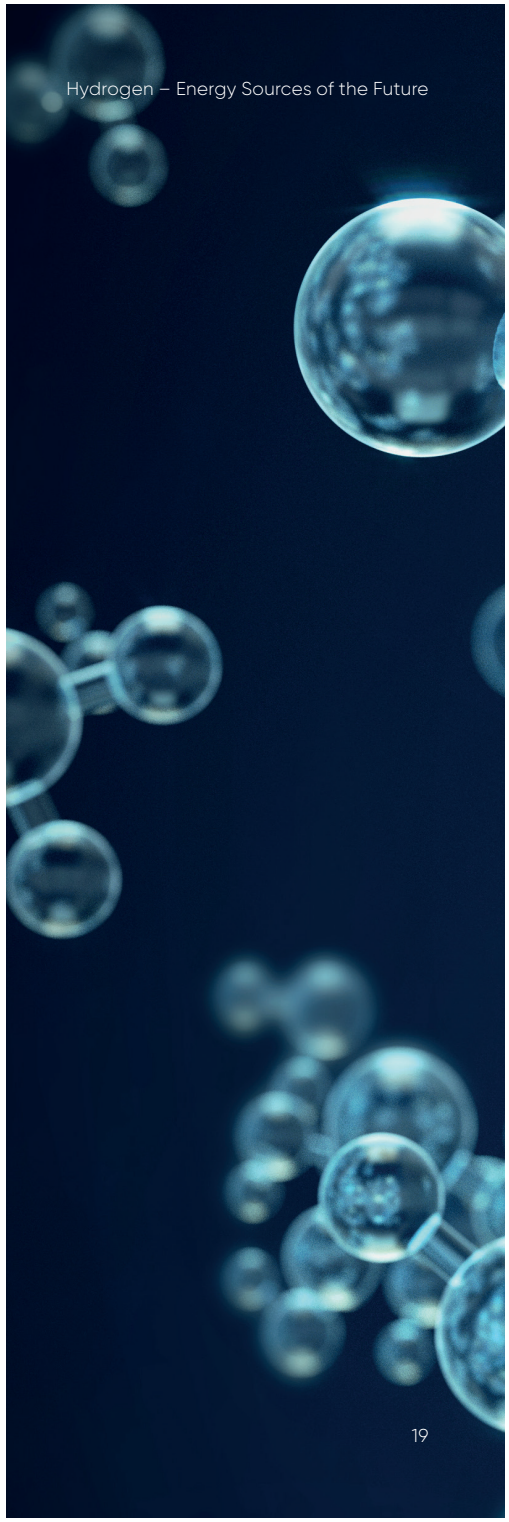

4b Austria

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 exploitation 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 *("Erdgasabgabegesetz")*. In addition, a tax advantage will be granted for renewable hydrogen in the form of a remuneration.

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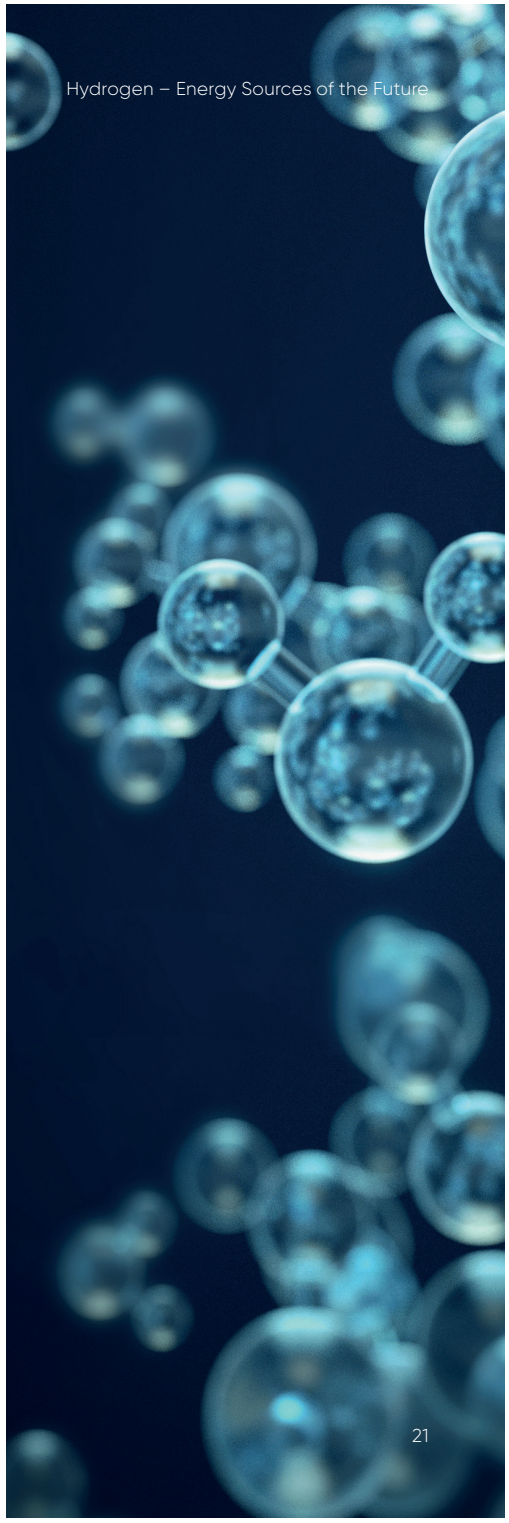

4c France

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[5]. 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'Aménagement et du Logement* ; the "DREALs").

In the same time, another decree was published on 22nd October 2018, providing for the concerned regulations for such type of facilities, applicable since 1st January 2019[6]. 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 the either French Government and 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 suppose, 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.

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

[6] 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 nomen-clature 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.

If you have any questions or need advice on related or general energy economic issues, please do not hesitate to contact us.

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