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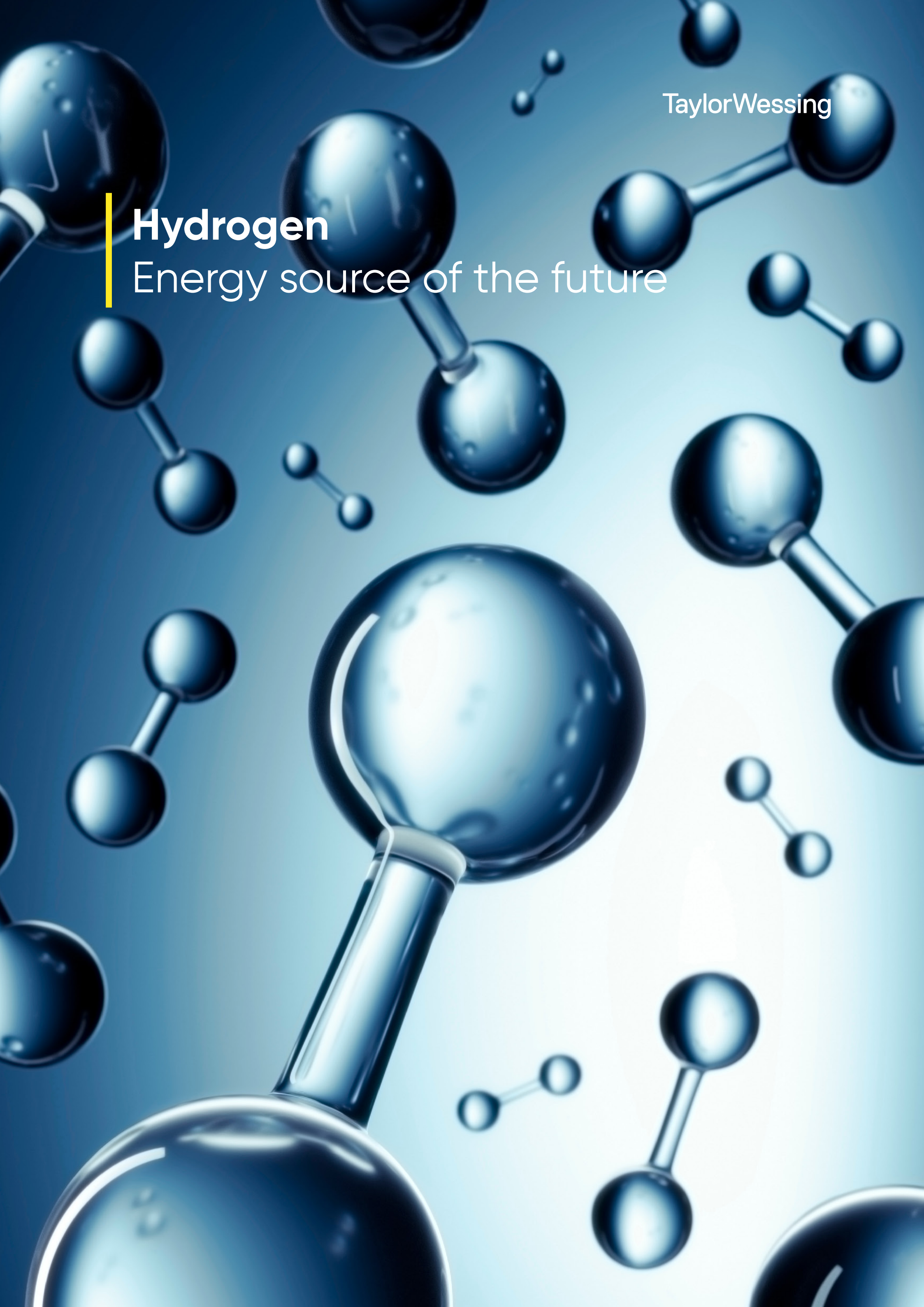
Hydrogen
Energy source of the future



Hydrogen
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The energy demand of our globalised world is constantly increasing, not least due to rising mobility, data processing and industrial production. The Federal Ministry of Economics has recently corrected its previous estimates of electricity demand in Germany. In June 2021, the Ministry announced that consumption in 2030 would be around 10 % higher than previously assumed. Climate change is the central challenge in this context. Most of the fuels used for the mobility of the world's population, in an industrial context or for energy supply are neither renewable nor environmentally friendly. Alternatives to fossil fuels are needed for the long-term success of the energy transition and for climate protection. The same applies to achieving the ambitious climate goals of the European Union and the German environmental goals based on them. Hydrogen can and will play a key role as a versatile energy source. If the electricity needed for hydrogen production comes from renewable energy sources, this will enable a significant reduction in CO_2 emissions in industry and transport. According to the European Commission's estimates, hydrogen should be produced on a system-relevant scale on the European energy market by 2030 at the latest.

1 Hydrogen

Depending on the origin as well as the type of production, a distinction can be made between different types of hydrogen:

Green hydrogen

Green hydrogen is produced through 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 in the same way as black/grey hydrogen, but combined with carbon capture and storage (CCS). This type of production also accounts for only a very small fraction of current hydrogen production. In turquoise hydrogen, methane is thermally cracked, producing solid carbon. In order for this process to be CO_2 neutral, it is not only necessary to use CO_2 neutral energy sources, but also to permanently bind the resulting carbon.

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 generates CO_2 which is released unused into the atmosphere.

Hydrogen is suitable as an energy source, as a feedstock for greenhouse gas-neutral applications, as a link between the heat, mobility, electricity and industry 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 goods transport or in shipping and aviation. A whole range of different feasibility studies, living laboratories and hydrogen grid or electrolyser projects are being planned and implemented across Europe.

2 Hydrogen strategies in the EU Green Deal

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	Phase II	Phase III
2020-2024	**2025-2030**	**2030-2050**
▪ 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.	▪ 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.	▪ 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).

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 cooperations 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 until the end of May 2021, which will be funded with a total of more than eight billion euros in federal and state funds.

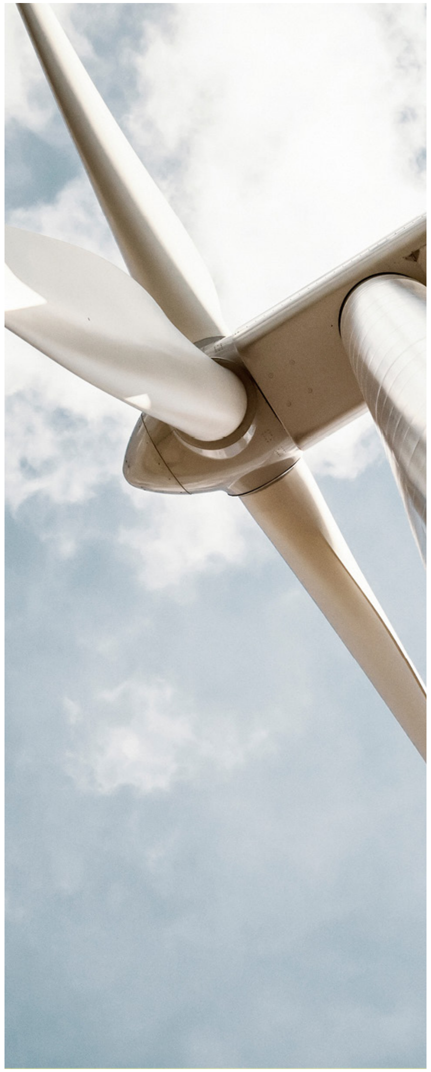
Hydrogen also plays a decisive role within the framework of the “Fit for 55” packages of measures. In this context, the legislative package for the decarbonisation of the gas market is to be presented at the end of 2021. It will then have to be clarified, for example, which companies are allowed to operate electrolysers, which production processes for hydrogen have priority and how the necessary investments in the hydrogen infrastructure are to be financed.

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 which 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 already 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. 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. 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 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 economical. 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, meaning that the technology costs are still high. In addition, unfavourable legal regulations, e.g. the statutory burdening of electrolysers with the EEG levy existed up until the end of 2020. However, advancing technological development should reduce generation costs in the future. According to a recent study by the Hydrogen Council, it is estimated that the cost of producing green hydrogen through special European offshore wind farms can be reduced to $2.50 per kg by 2030, compared to about $1.50 per kg for grey hydrogen today.

The 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 at least a proportionate reduction in the EEG surcharge for electrolysers. At least the latter aspect has been implemented in the meantime by means of changes in the German Renewable Energy Sources Act (EEG) 2021.

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.

The federal government lists a whole series of measures here, 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 National Hydrogen Strategy provides for a 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.

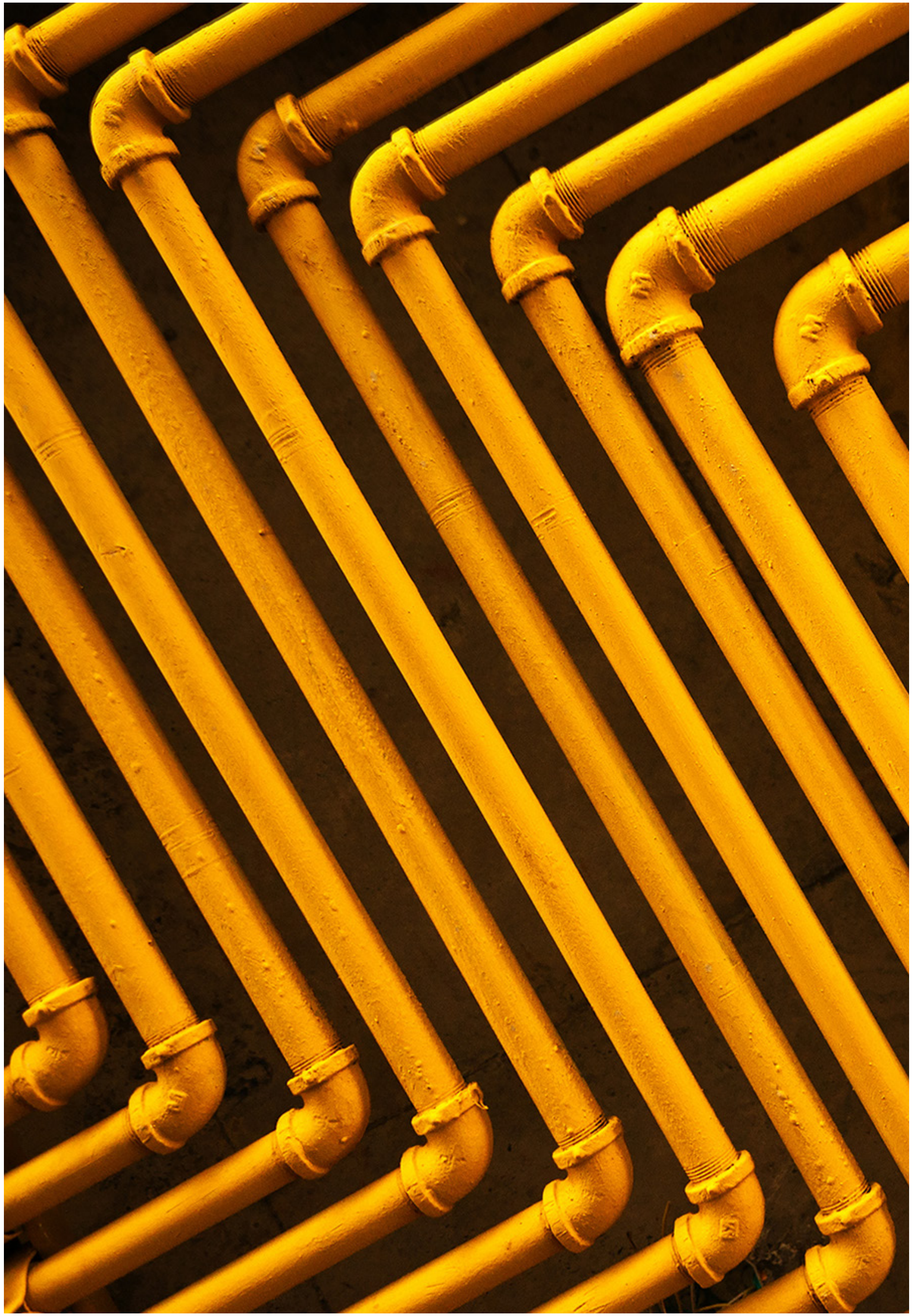
In order to achieve a successful energy transition, the goal is to establish hydrogen as an alternative energy source. Instead of fossil fuels, alternative fuels based on renewable electricity should be used in the future for air and sea transport as well as heavy goods vehicles. This includes, for example, paraffin produced by the PtX process.

Industry already needs 55 TWh of hydrogen today. This demand is still mostly covered by the use of fossil energy sources. Both the use of green hydrogen as a basic material and as an energy source, for example in steel production, offer great potential on the way to CO_2 neutrality. Due to the resulting enormous demand for hydrogen, German industry is to become a driver in the market ramp-up of hydrogen and also an international pioneer for hydrogen technologies, according to 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 (including hydrogen).

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



5 Legal aspects

The legal challenges associated with the production, transport and use of hydrogen as an energy source are not adequately addressed in the amendments to the Energy Industry Act (EnWG) which came into force on 27 July 2021. The latest regulatory changes represent a transitional solution until a common European regulatory framework exists.

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 addition, the concept of hydrogen networks was defined in Section 3 No. 39a EnWG, according to which they must be designed in such a way that they are available to an indefinite number of customers. The general connection obligation according to Section 18 EnWG, on the other hand, is not to apply to hydrogen grids.

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 distribution. 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 April 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.

Overall, no uniform picture emerges for the future regulation of hydrogen networks. It remains to be seen whether and how sensible the separation of gas and hydrogen grids is and whether it can in particular ensure an investment-friendly and efficient market ramp-up. Legal uncertainty, unattractive revenue regulations and a lack of planning certainty - especially due to the transitional nature of the German regulations - do not contribute to the creation of sustainable investment incentives.

Nevertheless, hydrogen production is supported by further innovations in the EEG 2021: Section 69b EEG 2021 standardises the complete exemption from the EEG levy for green hydrogen and Section 64a EEG 2021 provides for a reduced EEG levy for the production of hydrogen in electricity-cost-intensive companies.

In addition to energy law issues, the admissibility of state subsidies under European subsidy law as well as the approval procedure for large-scale plants, in particular, under the Federal Emission Control Act will also play a role in the economic assessment of a project.

Against the background that the use of hydrogen is politically desired at both German and European level and that both Germany and the EU want to create a corresponding legal framework, it is important to keep a constant eye on legal changes in order to react and seize opportunities if necessary.

If you have any questions or need support with related or general energy industry issues, please feel free to contact us at any time.

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