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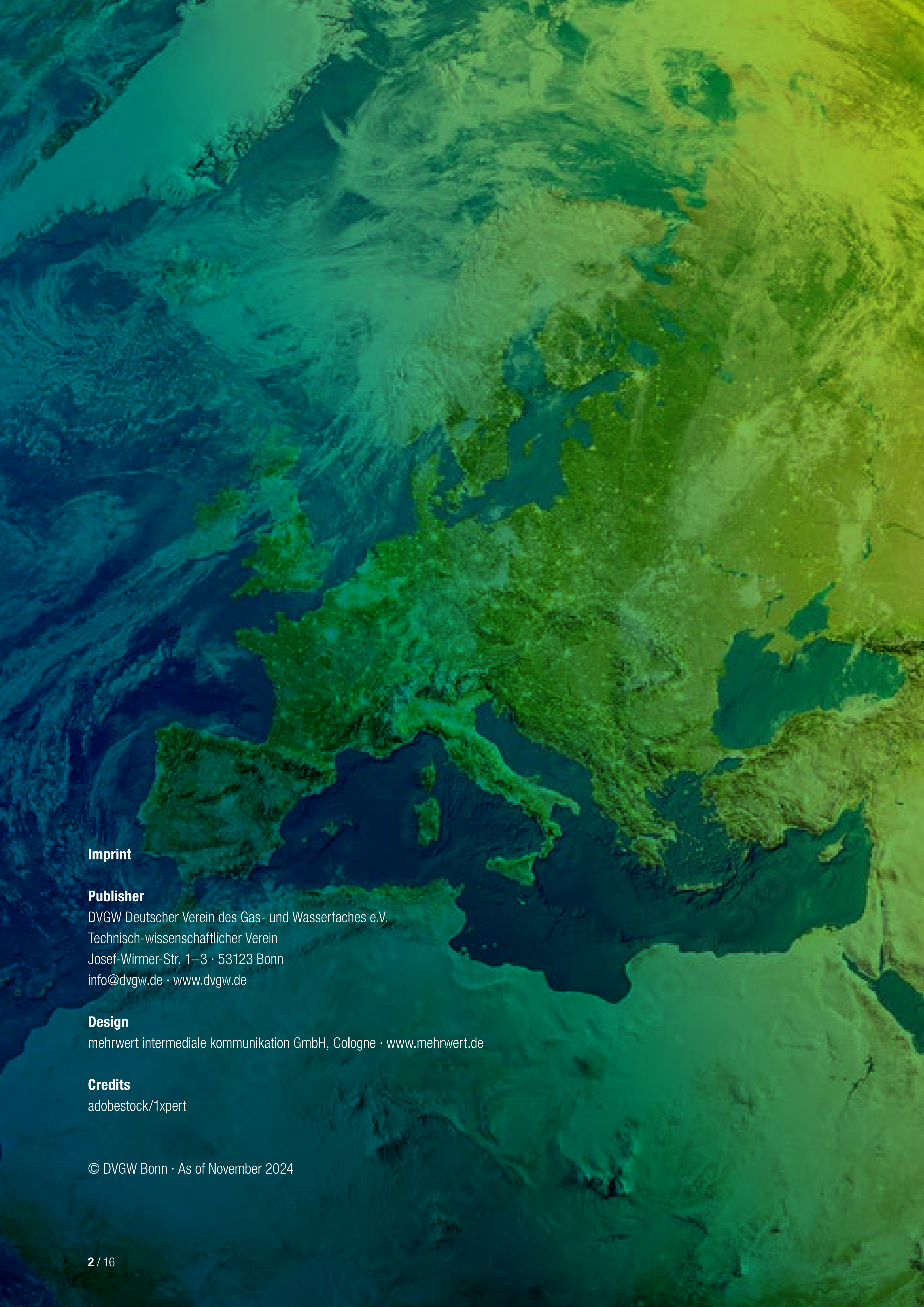
Climate-neutral Europe – recommendations for a successful transition of the gas supply



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EU Policy Paper: Climate-neutral Europe – recommendations for a successful transition of the gas supply

With its goal of becoming climate-neutral by 2050, the European Union has set itself a Herculean task. The foundation for this transition to a climate-neutral economy will be laid by the transformation of our energy system from fossil fuels to renewable, low-carbon sources of energy. In addition to the central development of power generation from renewable sources such as wind and solar energy, it will however be important to ensure that another large share in energy supplies is not neglected in the transition to climate neutrality. At 20 percent, gaseous fuels account for a considerable share in final energy consumption in the EU, especially in the heating and industrial sectors. The decarbonisation of fossil gas supplies via a transition to hydrogen, biomethane or synthetic methane will therefore be a key prerequisite for achieving these climate goals. A strong, decarbonised gas supply sector can also relieve the burden on the electric power system during the transition and provide the storage capacity to guarantee secure, resilient supplies of energy in Europe.

EU legislators already laid the foundation for this transition with the European Green Deal during the last legislative period. Economic players along the entire value chain are already working to implement the ambitious requirements stated. Nevertheless, some of the regulatory levers will not be sufficient to ensure a rapid transition to decarbonised gases. In view of this fact, the task for the next legislative period will be to:

shape the value chains of new, climate-neutral gases such as hydrogen so that they can deliver their key contribution to the climate neutrality goal of the EU

The successful transition to decarbonised gases will call for a comprehensive and coordinated strategy as well as specialist expertise. The levers necessary for the transition can be identified by considering the entire process from production through import and infrastructure to the final customer.

DVGW

The **DVGW Deutscher Verein des Gas- und Wasserfaches e.V.** is a technical and scientific association. With its long-term expertise based on research results and practical experience from the industry, it provides support for and enables specialists and political decision-makers. The German gas supply system is one of the safest in the world and has taken a leading position in comparison with other countries for many years. Strict requirements apply along the supply chain from the source to the user. German legislators have explicitly entrusted to DVGW the task of formulating these standards. This also applies to hydrogen infrastructure. In order to maintain these high standards, DVGW supports the conversion process of natural gas infrastructure to renewable, low-carbon gases on the basis of scientific knowledge. DVGW pools the experience of its more than 13,000 members – transmission and distribution system operators, local authorities and other players in the German gas industry – and contributes its 165 years of experience in the gas industry and standardisation to transformation at the national and European level. In the EU, DVGW is actively involved in the European Committee for Standardisation (CEN) as well as the associations Marcogaz, Hydrogen Europe and Eurogas. DVGW also provides support for the research initiatives European Research Institute for Gas and Energy Innovation (ERIG) und Hydrogen Europe Research.

From the point of view of DVGW, the following steps will be necessary in order to shape the value chains for hydrogen and decarbonised gases:

What we recommend

for decarbonised gas supply along the entire value chain

Gas production

- Establish reliable requirements in the form of pragmatic production criteria and clear certification systems
- Create the same competitive conditions for all fuels allowing the same CO_2 reduction – irrespective of whether they are biogenic, based on eco-power or low-carbon
- Fully exploit European production potential through decentralised biomethane feed-in, biomethane pyrolysis and support for offshore electrolysis

Imports

- Rapidly expand import quantities via marine routes and pipelines
- Support global trade through guarantees of origin, with links to CO_2 footprint with a view to creating additional incentives for the production of decarbonised gases

Networks and storage

- Establish a European transformation plan for distribution networks in order to ensure that power stations, industrial facilities and households supplied via distribution networks are not excluded from the transformation
- Define a pan-European target for underground hydrogen storage
- Adopt a CO_2 regulatory package to regulate CO_2 transport, infrastructure and market as soon as possible

Final customers and demand

- Introduce a green gas quota within the framework of the adaptation of EU legislation to the climate goals for 2040, in order to create demand for renewable and low-carbon gases
- Retain freedom of choice for final customers and not discriminate against the use of decarbonised gases, for example for heating, compared with direct electric applications

1 Gas production

What are new, climate-neutral gases, and how are they produced?

A variety of different gases can contribute to reducing the CO_2 emissions of the current gas mix: Biogas is produced by the digestion of organic raw materials and waste and can be processed to obtain biomethane or biogenic hydrogen. **Renewable fuels of non-biological origin (RFNBO)** [§] include hydrogen and hydrogen derivatives produced by electrolysis using eco-power (also known as power-to-gas [PtG]). Low-carbon fuels (LCF) are also synthetic, but achieve a CO_2 reduction either through carbon capture and storage or as a result of the low-carbon energy such as atomic power used for electrolysis. LCF can also be produced by the pyrolysis of biogas; the biomethane is cracked into hydrogen and solid carbon. In order to ensure that these new gases are significantly more climate-friendly than their fossil equivalents, the EU has defined minimum values for emission reduction. RFNBO and LCF must have a CO_2 reduction of at least 70 percent compared with fossil fuels. Depending on the sector and the date of commissioning of the plant, biogases must offer a reduction of 50 to 80 percent.

[§] The sustainability criteria and the CO2 reduction required for biogases are laid down in the Renewable Energy Directive (EU) 2018/2001 (RED) revised in 2023.

Establishment of clear definitions and reliable certification

In addition to the minimum emissions reduction requirements, the EU has stated complex regulatory requirements concerning **the production criteria for RFNBO** [§] such as green hydrogen and synthetic methane. This complexity has created two obstacles to a rapid market ramp-up of green hydrogen and derivatives. Firstly, after a delay of one and a half years had occurred in the announcement by the Commission, significant further delays in the implementation, applicability and approval of certification systems occurred following the entry into force of the Delegated Regulations as a result of unclear phrasing and legal uncertainty. Due to these impracticalities and long processing times, final investment decisions were significantly delayed leading also to postponements of the commissioning of many plants. Secondly, the restrictive criteria led to an increase of between 20 and 30 percent in production costs.[1]

[§] The Delegated Regulations (EU) 2023/1184 and (EU) 2023/1185 define the renewable electricity types that may be used for producing RFNBO and the calculation of the CO_2 emissions saving

However, in order to meet the tremendous demand for decarbonised gas fuels, it will be necessary to ensure that complex regulations do not impede or prevent an early ramp-up or more cost-effective production. This principle should also apply to the development of **production criteria for low-carbon hydrogen (LCH)** [§], which have still not been announced. Rapid, pragmatic implementation of these criteria, creating the same competitive conditions as for other decarbonised gases, would mean that LCH could play its part in supplying climate-neutral gas fuels to the European economy. It will be necessary to ensure that the production criteria consider all the production pathways for low-carbon gases – not only electrolysis using low-carbon energy but also carbon capture and the pyrolysis of biogas.

[§] The legal foundation for low-carbon fuels such as low-carbon hydrogen was laid by the Internal Gas Market Directive (EU) 2024/1788.

The technical standards for these technologies and facility design have already been defined. DVGW is supporting the hydrogen industry in Germany with the safe and successful implementation of plants with codes and requirements for the design and operation of power-to-gas plants as well as technical and approval guidelines

[1] Frontier Economics (2024): Regulatorische und technische Rahmenbedingungen für den Hochlauf und den Import von Wasserstoff, (Regulatory and technical conditions for the ramp-up and import of hydrogen) last retrieved on 31 July 2024.

➔ **DVGW Code of Practice G 220 2021-08** for the design, production, installation, testing, commissioning and operation of power-to-gas energy plants
➔ **DVGW Gas Information Bulletin 27 2021-02** Technical guidelines for power-to-gas plants and
➔ **DVGW Gas Information Bulletin 26 2021-02** Approval guidelines for power-to-gas plants

H_2 markt index | With its H_2 markt index mDVGW is making the hydrogen ramp-up measurable. On the basis of a survey covering market players from all segments of the gas industry, the H_2 market index measures satisfaction in the areas of innovation development, political and regulatory framework, infrastructure expansion and market development. The market players covered by the survey have given a generally negative assessment of the regulatory framework in view of the underlying obstacles to the entire value chain. The market index is currently limited to Germany but there are plans to extend it to the EU

Targeted demand incentives to promote European production of decarbonised gases

As the political debate concerning energy policy becomes more and more emotional, it is important not to forget that the social goal of climate neutrality is the top priority. The various routes to climate neutrality should therefore not be set against each other but should be used to the greatest extent possible to decarbonise our economy as rapidly as possible. In addition to the establishment and further development of new technological pathways such as the production of hydrogen by electrolysis or pyrolysis, established technologies also need to be used and promoted.

[§] The REPowerEU-Plan COM/2022/230 was presented by the European Commission in 2022 and is intended to reduce the dependence of the EU on energy imports from Russia.

Especially biomethane already offers the possibility of producing renewable gas at decentralised locations in Europe and feeding it to the natural gas grid. The European Commission has also recognised the tremendous potential of biomethane as a low-carbon, domestic fuel in its **REPowerEU plan** [§] and the associated biomethane action plan, which provides for annual production of biomethane to reach 35 billion m^3 by 2030. Biomethane already plays a key role in the resilience of energy systems within the EU, but has by no means reached its full potential. In Germany alone, the production capacity can be expected to reach 90 – 102 TWh– more than a quarter of the total quantity corresponding to 380 TWh called for by the REPowerEU plan.[2]

[§] The Net Zero Industry Act (EU) 2024/1735 defines a list of net-zero technologies which are to be fostered, for example by faster permit-granting procedures.

This potential may be realised by appropriate regulatory measures. **The Net Zero Industry Act** [§], which lists sustainable biogas and biomethane technologies as net-zero technologies, qualifying them for more rapid approval procedures, is a first step in the right direction, which could be followed by further measures to promote European biomethane production. Especially increasing the demand by definite quotas for renewable and low-carbon gases (See chapter 4) may accelerate the replacement of fossil gas with biomethane and create security of supply in the gas sector, independent of imports from non-EU-member countries

A further decentralised reduction possibility for decarbonised gases in the EU is the installation of electrolysers at renewable energy plants, which would be beneficial from the point of view of the overall system. Especially at times with abundant solar and wind energy, the production of green hydrogen could relieve the burden on electric power grids and make it possible to use and store renewable energy which would otherwise be lost as a result of shutdowns. In view of the geographically wide distribution of renewable energy generation, notably offshore wind farms are well-suited for decentralised hydrogen production. By 2050, it will be feasible to produce up to 300 TWh of green hydrogen at offshore wind farms in the North Sea alone, corresponding to 15 percent of the forecast hydrogen demand of 2,000 TWh for the EU as a whole.[3] With low-cost transport via gas pipelines, hydrogen produced in the North Sea and carried by pipelines would also become competitive with hydrogen imported via marine routes.

[2] BDEW, DVGW and Zukunft Gas (2023): Wege zu einem resilienten und klimaneutralen Energiesystem 2045. Transformationspfad für die neuen Gase, (Routes to a resilient, climate-neutral energy system. In 2045. Transformation pathway for the new gases). Last retrieved on 31 July 2024.
[3] DNV (2023): Specification of a European Offshore Hydrogen Backbone, last retrieved on 31 July 2024

In order to develop and realise this European production possibility in the long term, a concrete, joint European strategy for promoting hydrogen production at offshore wind farms is required. This should go hand-in-hand with the integrated planning of gas and power grids.

What we recommend

- Establish reliable requirements: a successful, affordable ramp-up of hydrogen calls for unbureaucratic, pragmatic, legally well-founded production criteria with clear certification schemes.
- Do not exclude any solutions: when selecting decarbonisation options, the top priority must be CO_2 reduction. The same competitive conditions should apply to all fuels offering similar CO_2 reductions, whether they are biogenic, based on eco-power or low-carbon.
- Make full use of European production potential: in order to strengthen security of supply within the European Union without dependence on imports, the decentralised production of renewable gases in the EU should be intensified. This applies both to biomethane, the production of hydrogen from biogas by pyrolysis and the production of green hydrogen through the installation of electrolysers at renewable energy plants, especially offshore, combined with efficient, cost-effective pipeline transport

2 Imports

Diversification of supply countries and import routes for greater security of supply
In addition to domestic fuel production, imports play a key role. In 2022, the EU imported almost 63 percent of its energy demand; in the gas sector, the share of imports was as high as 89 percent.[4] In future, too, Europe will continue to depend on energy imports from other countries. Regions such as North Africa, where conditions are favourable for renewable energies, are predestined for the production and export of decarbonised gases such as renewable hydrogen and synthetic methane.

In this context, it will be important to learn from past errors in energy supplies and to avoid deficiencies. The diversification of supply countries will be essential in order to ensure security of supply. The import of these renewable, decarbonised gases is already supported by declarations of intent concluded by the EU with a large number of other countries, including Australia, Japan and Argentina. Broad-based global trading in these gases will also result in cost reduction of up to 30 percent compared with supply from domestic sources. This approach is therefore not only necessary to make energy supplies secure but also affordable.[5]

[4] Eurostat (2023): Energy production and imports, last retrieved on 31 July 2024.
[5] Global Alliance Powerfuels und LUT University (2020): Powerfuels in a renewable energy world. Global volumes, costs, and trading 2030 to 2050, last retrieved on 31 July 2024.

Definition of clear and transparent criteria for the import of new, climate-neutral gases in quantities sufficient to meet demand

The forecast global production potential for decarbonised gases is enormous. At more than 1,500,000 TWh per year, the global technical production potential for green hydrogen could even exceed demand.[6]

This figure and the projected capacity of projects already announced have risen continuously over the past few years. New projects announced in 2023 alone increased the projected production potential of climate-neutral hydrogen in 2030 by 50 percent compared with the previous year.[7] If all the projects announced were implemented, the global capacity could reach 38 Mt[8] by 2030, with green hydrogen, accounting for 70 percent of this figure. This would be a massive rise compared with the current global production figure for green hydrogen, which is below 1 Mt. On the basis of the projects announced, the global electrolyser capacity installed could reach 175 GW by the end of the decade; if projects which are in an early stage are included, this figure could even reach 420 GW. To exploit this potential and to further reinforce the positive development of projects already announced and realised, clear import criteria and transparent documentation of origin will be needed.

What import routes are feasible for new, climate-neutral gases? | In principle, two transport routes are used for importing gases: long-distance pipelines and marine transport, using ships.

The appropriate transport route depends on the distance from the export country. Pipelines are especially well-suited for less distant regions with reference to Western Europe, such as Norway, the Middle East and North Africa. These transmission systems already carry natural gas as a gas. Most of the existing pipeline network could be changed over to hydrogen and could therefore continue to be used. Appropriate codes and standards have already been introduced. European and international standards are currently being prepared. In addition, new hydrogen pipelines are planned. These are to facilitate hydrogen imports from Morocco, Tunisia, Turkey and Ukraine within the framework of the European Hydrogen Backbone.

In the case of longer-distance or intercontinental transport, for example from the USA to Europe, natural gas is shipped as liquefied natural gas (LNG) using tankers. In order to save space, the gas is liquefied by cooling to -161 °C or using high pressure and then regasified for feeding to the natural gas grid upon delivery to the LNG terminal in Europe. In view of requirements for future energy supplies, new LNG terminals are already designed to be “ammonia-ready” and could therefore also be used for importing hydrogen and its derivatives following appropriate modifications. For transport, hydrogen will need to be liquefied by cooling to -253 °C; alternatively, it could be processed to produce hydrogen compounds such as ammonia or methanol, which would be easier to ship and would then be converted back into hydrogen upon delivery. Thanks to the existing infrastructure and experience with LNG, the import of hydrogen as synthetic LNG is theoretically already possible today, while other processes such as ammonia cracking are not yet commercially attractive. However, the most efficient option in the long term is the transport of pure hydrogen in liquid form.[9]

The hydrogen quality can vary greatly depending on the form of transport or storage. High-purity hydrogen is required for sensitive applications in mobility and the PEM fuel cells used for this purpose. Burners such as those in lime or cement works can easily be supplied with an H_2/natural gas mixture. This balancing act about the necessary gas quality requires an assessment of the individual components of the entire value chain with regard to their influence on the hydrogen quality and any necessary processing steps. The standardised technical requirements for the quality of gases have already been defined in Germany since 2021 and the DVGW, as a key player in gas standardisation, is contributing its technical expertise on hydrogen quality to CEN at EU level.

[6] International Renewable Energy Agency (2022): Global Hydrogen Trade to meet the 1.5°C Climate Goal. Part III Green Hydrogen Cost and Potential, last retrieved on 31 July 2024.
[7] International Energy Agency (2023): Global Hydrogen Review 2023, last retrieved on 31 July 2024.
[8] Corresponds to approximately 1,226 TWh (1 Mt ≈ approx. 33.33 TWh)
[9] DVGW (2024): Wasserstoff – woher, wie viel und wie? (Hydrogen – from where, how much and how), last retrieved on 31 July 2024.

Rapid expansion of hydrogen import quantities

Using pipelines and ships, decarbonised gases can be imported to the EU from all the regions of the world. However, transport via pipeline offers several advantages over the sea route. Network transport, especially within Europe and beyond up to a transport distance of 1,400 kilometers, is the most cost-efficient route.[10] In addition, maritime transport, which is currently mainly fossil-fueled, generates additional CO_2 emissions that lead to disadvantages in the Carbon footprint of the fuels and could jeopardise regulatory recognition in the EU.[11] The introduction of project-specific default values for upstream emissions for the calculation of the GHG quota of low-carbon hydrogen could - at least until shipping is CO2-neutral – lead to increased imports from more distant regions.

➔ **Code of Practice G 260 2021-09** on gas composition

➔ **Code of Practice G 265-3 2022-12** Plants for the Injection of Hydrogen into Gas Supply Networks; Design, Manufacture, Construction, Testing, Commissioning and Operation

Strengthening interregional cooperation

Irrespective of this, the overall import capacity is particularly important in order to meet the demand for decarbonised gases. A targeted, rapid cross-border development of the planned hydrogen network and expansion of maritime import capacities is therefore crucial to ensure a secure supply for Europe. This also includes ports, which serve as important hubs for energy production and supply as well as regional logistics centres. In addition to the landing of hydrogen with the help of terminals, they also play an important role as potential locations for ammonia crackers.

A systematic and coordinated exchange at European level on the financing of hydrogen infrastructure is the key to success for a European hydrogen network and thus a guarantee for the development of large import potentials for Europe.

The European Hydrogen Backbone is leading the way: As a role model and starting point, cross-sector projects must be set up along its paths without bureaucracy and bureaucratic hurdles caused by national legislation and lengthy authorisation processes must be removed.

Establishment of transparent certification systems for global trading

In order to allow global trading with renewable and low-carbon gases, an effective, transparent documentation system with internationally recognised certifications will be required. In the RED, the EU has already laid the legal foundation for “guarantees of origin” for decarbonised gases and hydrogen. These guarantees provide evidence to final customers that a given quantity of energy was produced from renewable sources. Together with other items, the guarantee of origin includes information on the type and source of energy and the time of production. However, information on the carbon footprint, which would have a significant positive effect on climate protection, is not required. As guarantees of origin may be traded independently from the physical delivery of energy, companies placing gases on the market may generate a further stable source of income via separate voluntary trading of the type which has already become established on the electric power market. The integration of the carbon footprint of the gas could therefore provide additional financial incentive for the production of low-carbon gases. Guarantees of origin are also crucially important for the injection of gases into the gas grid (see Chapter 3). It will be important to implement appropriate control mechanisms to ensure that certificates cannot be manipulated and to enable geographically flexible physical delivery via mass balance systems.

[10] Frontier Economics (2024): Regulatorische und technische Rahmenbedingungen für den Hochlauf und den Import von Wasserstoff, (Regulatory and technical conditions for the ramp-up and import of hydrogen) last retrieved on 31 July 2024.
[11] Flagship Project TransHyDE (2024): European Hydrogen Infrastructure Planning, last retrieved on 31 July 2024.

In future, the traceability of decarbonised gas is to be ensured by a dedicated EU database. This will lay the foundation for transparency concerning compliance with sustainability criteria. In order to perform this task, the database must be pragmatic and easy to use and must be linked to the corresponding national databases. In addition, the recognition of imports will be essential for making the global production potential for decarbonised gases available to the EU.

What we recommend

- Expansion of import quantities: energy imports are a key element in our energy supplies and will continue to play an important role in the future. The planned German and European hydrogen grids as well as marine import capacities will therefore need to be rapidly developed in order to ensure that adequate seaborne and pipeline import capacities are available in the future. This will also include enabling a variety of different import routes and not excluding seaborne transport, for example, by applying greenhouse gas criteria that are too stringent.
- Support for global trade through certification of origin: globally, sufficient potential is available to enable global trading with renewable and low-carbon gases and to safeguard security of supply in Europe. Guarantees of origin can create transparency and accelerate the development of global trading. If guarantees of origin are coupled with the carbon footprint, this will provide an additional incentive for the production of decarbonised gases.

3 Networks and storage

The transmission and distribution grids are hydrogen-ready: utilization of potential for decarbonised energy supply

DVGW codes of practice for the hydrogen industry of the future from production through to use

On their way from decentralised production facilities, an import pipeline or a terminal to power stations, industrial customers and private households for use in heating, gases pass through thousands of kilometres of transmission pipelines and finely branched distribution systems. The conversion of these infrastructure systems, most of which have been fully depreciated, and their continued use is technically feasible. The admixture of biomethane and synthetic methane to these systems is already possible without any problems. Most of the offshore pipelines and almost 70 percent of the total length of onshore pipelines can also be converted for pure hydrogen service.[12] Additional new pipelines planned within the framework of the European Hydrogen Backbone (EHB) will supplement the existing pipelines, creating a large-scale hydrogen transmission system and ensuring supplies to major customers.

Code of Practice G 655 2021-04
Guideline for H_2-readiness for the admixture of up to 20% hydrogen by volume

It will also be feasible to use gas distribution systems for decarbonised gases such as hydrogen. The admixture of up to 20 percent hydrogen has already been successfully tested under real-life conditions without any modifications to the gas system or gas appliances.[13] The use of hydrogen-compatible materials means that a further increase in hydrogen concentrations up to 100 percent can also

[12] Carbon Limits AS und DNV AS (2021): Re-Stream - Study on the reuse of oil and gas infrastructure for hydrogen and CCS in Europe, last retrieved on 31 July 2024.
[13] Avacon Netz GmbH und DVGW (2023): Wasserstoff in der Gasinfrastruktur: DVGW/Avacon-Pilotvorhaben mit bis zu 20 Vol.-% Wasserstoff-Einspeisung in Erdgas – H2-20, (hydrogen in gas infrastructure) last retrieved on 31 July 2024.

be accomplished in the long term. 96 percent of the local gas networks included in the EU initiative Ready4H2 are already hydrogen-ready.[14] The measures taken to reduce methane leakage improve the value of the network and also increase safety levels for hydrogen service. In addition, DVGW is ensuring that the technical know-how required is available in good time by updating its codes of practice and through its verifHy database.

➲ **Code of Practice G 404 2023-07**
Measures for the technical reduction of methane and hydrogen emissions from gas infrastructure

verifHy | verifHy is a unique hydrogen database created by DVGW, including information provided by scientists and manufacturers concerning the hydrogen compatibility of gas systems, components and materials. It is one of the most important tools for the hydrogen ramp-up as it allows gas system operators, manufacturers and utilities to verify the hydrogen compatibility of their grid infrastructure. verifHy is also available in English.

verifHy HydrogenREADY Database

Essential for network stability, industry and households: inclusion of distribution networks in the transition

The final customers supplied with gas via distribution networks represent enormous demand. In Germany alone, the distribution grids supply gas to about 1.8 million industrial and commercial customers, representing 90 percent of German industry. These figures are many times higher than the number of industrial customers, about 500, connected directly to the transmission system. Many companies see decarbonised gases as a building brick for their transformation: according to a survey carried out by the H2vorOrt initiative, approx. 70% of the about 2,000 industrial companies covered by the survey expect to use hydrogen in the future. In addition, gases are essential for many industrial processes, either as a feedstock or as a fuel.

80 percent of the more than 70,000[15] power station locations in Germany analysed, representing power generating capacity of 62 GW, about three quarters of total capacity, depend on distribution networks for gas supply.[16] Especially for compensating for variations in power generation from renewable sources, gas-fired power stations, which can be started up at short notice to stabilise the power grid, are tremendously important. In addition to the possibility of operating with biogenic or synthetic methane, turbines from Siemens, for example, are already designed to run on a 20 per cent hydrogen admixture.

Distribution networks not only supply the industrial and energy sector, but also play a fundamental role in the heating supply of households: About 40 percent of European households are connected to the gas grid. In Germany, as many as 50% of households are supplied with fuel for heating via the gas grid. Heating systems typically operate reliably for 20 – 30 years before they need to be replaced. Consequently, for an unseeable amount of time, a significant proportion of these households will continue to need gas fuels. Furthermore, especially in the case of older, unrenovated buildings, the use of alternative heating systems such as heat pumps would not be highly energy-efficient, would not be feasible or would be connected with considerable modernisation expenses. The regulations in force already recognise the possibility of transforming space heating through the feed-in of decarbonised gases. The European Renewable Energy Directive (RED), which imposes on the member states an obligation to improve the share of renewable energies in heating and cooling, includes the admixture of renewable energies as a permissible option. **The European Energy Performance of Buildings Directive (EPBD)** [§] allows the supply of decarbonised gases to new, so-called zero-emission buildings. Renewable and low-carbon gases are therefore a clear compo-

[§] The Energy Performance of Buildings Directive (EU) 2024/1275 (EPBD) sets out requirements for improving the energy efficiency of buildings by renovation, up to and including zero-emission buildings.

[14] Ready4H2 (2022): Local gas networks are getting ready to convert, last retrieved on 31 July 2024.
[15] 689 gas power plants, 69,615 combined heat and power plants, 84 coal and 71 lignite plants, DVGW 2024.
[16] DVGW (2024): Bedeutung der Gasnetze für die Versorgung von Kraftwerken, (importance of gas networks for supplies to power stations), last retrieved on 31 July 2024.

➲ DVGW Code of Practice G 655:2021-04 for H_2 readiness in gas utilization

nent of the EU goal of a decarbonised building stock by 2050, whether in the form of the sole fuel or in hybrid solutions. In Germany, surveys carried out by the H2vorOrt initiative indicate that by far the majority of the local authorities covered will opt for decarbonised gas supplies. Only 5 percent of the local authorities covered by the survey do not plan to use renewable or low-carbon gases.[17]

Initiatives for the transition of distribution grids I In order to evaluate the transformation pathway of German gas distribution grids to climate neutrality, DVGW established the H2vorOrt distribution grid initiative together with Verband kommunaler Unternehmen (VKU – the German Association of Local Public Utilities). The initiative has developed a transformation approach for the secure supply of renewable and low-carbon gases at the regional level. In 2024, 252 distribution system operators[18] participated in the preparation of the Gas Distribution Transformation Plan (GTP) and analysed at the individual level the feed-in, capacities, network conversion and the demand for biomethane and hydrogen from the end customers to be supplied. A European equivalent of this initiative, Ready4H2, was already established in 2021. DVGW is involved in the European initiative via H2vorOrt with a view to developing a European network development plan.

Creating a level playing field at the distribution grid level

For these legislative possibilities to be exploited and the climate ambitions of the various final customers to be realised, it will be necessary to involve distribution grids more closely in the transformation of energy supplies. The decarbonisation of gas networks can be ensured on an equal footing by developing and participating in network development and transformation plans, but also by financing instruments for implementing the transformation.

[§] The Gas Package, comprising the Internal Gas Market Directive (EU) 2024/1788 and Regulation (EU) 2024/1789, sets out rules for the operation of hydrogen networks, laying the foundation for the decarbonisation of the gas market.

The amendment of **the EU gas package** [§] finally provides the long-awaited regulatory framework. Gas network operators are now legally permitted to operate hydrogen networks. The revision of the unbundling rules is an important prerequisite for network operators to be able to use their existing infrastructure and gas expertise. However, distribution system operators are not taken into consideration in the preparation of the Ten-Year Network Development Plans (TYNDP), which assess infrastructure development requirements over the next 10 years. In accordance with the Gas Package, these are initially to be developed jointly by the European Network of Transmission System Operators for Gas (ENTSO-G) and the newly established European Network of Network Operators of Hydrogen (ENNOH). Since the organisations only consider the assets of the transmission system operators, the perspective of the distribution system operators at EU level is not directly incorporated into network planning.

As distribution system operators have detailed knowledge of the needs of their customers, the technical possibilities of their networks and demand for decentralised feed-in, the immediate inclusion of gas distribution network transformation plans in the expansion of the European Hydrogen Backbone is an optimal addition. Only if both transmission systems and distributions systems are taken into consideration for the changeover will it be possible to accomplish decarbonised energy supplies to all final customers.

[17] H2vorOrt (2023): Der Gasnetzgebietstransformationsplan. Ergebnisbericht, (gas network area transformation plan, report on the results) last retrieved on 31 July 2024.

[18] The gas distribution networks covered by the GTP 2024 have a total length of around 450,000 kilometres. This corresponds to around 80% of the total length of the distribution network.

Enabling the injection of decarbonised hydrogen on the basis of mass balances

In particular, with the existing infrastructure, there is a possibility that in some regions there will be no complete conversion at the beginning, but that the share of renewable and low-carbon gases in the existing gas supply could be gradually increased as production and import capacities increase. In addition to technical feasibility, regulations will play a key role in enabling flexible feed-in.

The guarantees of origin issued for decarbonised gases will confirm their sustainability and can be traded independently of the physical gas upon injection into the network. This separation of physical and balance trading, which is also established in the electric power sector will mean that decarbonised gases may be fed to the system without any geographical connection with the final customer concerned. The booking in and outwill prevent double booking. In addition, the Union Database, when it has been established, will contain data concerning the feed-in and feed-out of decarbonised gases as well as compliance with sustainability criteria.

➔ **Code of Practice G 221 2021-12** concerning the supply of hydrogen and gases containing hydrogen via pipelines

Development of technical codes, standards and know-how

To ensure that the technical framework for the use of decarbonised gases and in particular hydrogen in industry is available in a timely manner, the DVGW is developing technical rules in ist technical committees. The rules will become binding when the German Energy Industry Act designates the DVGW as the technical regulator for hydrogen. The association contributes its expertise in the gas industry to initiatives supported by the German government, such as the standardisation roadmap for hydrogen technologies and the Regulations, Codes and Standards (RCS) roundtable. e In addition, the DVGW, as the sponsor the DIN Standards Committee on Genetic Engineering and as a standard setter in the national (DIN), European (CEN) and international (ISO) standardisation committees, the DVGW plays a decisive role in shaping the technical foundations and requirements for the development of a functioning and safe hydrogen market.

For the conversion of gas pipelines with operating pressures over 16 bar **DVGW Code of Practice G 409:2024-07**, for fracture mechanics assessments **DVGW Code of Practice G 464:2023-03**; for construction, operation and maintenance
➔ **DVGW Code of Practice: G 463:2021-10** and **G 466:2021-06** for the changeover of gas distribution pipelines up to an operating pressures 16 bar **G 407:2022-08**, **G 462:2020-03**

The first step in the standardisation roadmap, a list of national and international standards, was drawn up in cooperation with other industry associations, politicians, academics and civil society with a view to identifying any technical standards which were required, but not available, for the ramp-up of hydrogen and to closing these gaps. Gaps in industrial standardisation have been identified, and the network side is comprehensively and adequately covered by the DVGW regulations. Strong European standardisation supports technological progress and can be a pioneer for international standardisation, opening up the free movement of goods beyond the EU internal market.

➔ **DVGW Code of Practice G 100:2021-06** concerning the requirements for independent experts

Optimising power supplies from renewable sources: development of hydrogen storage facilities

Another integral part of the gas infrastructure is storage. Its task is to balance production and sales. In crisis situations or global supply bottlenecks, they ensure the constant availability of energy. With the German storage volumes alone, a quarter of Germany's annual gas demand can be easily covered. In the future, gas storage facilities will become even more important: they allow us to react flexibly to the fluctuations of volatile renewable energies. Converting and storing them as hydrogen will enable a constant supply of renewable energy to Europe and at the same time significantly relieve the pressure on the electricity grid during its transition. A large part of existing storage capacities can be changed over to hydrogen. The technical requirements and standards

Gas industry standards DIN EN 1918-1 bis -5 for storage and aquifers, oil/gas fields, salt and rock caverns, as well as above-ground facilities

Gas industry standard DIN EN 1918-1 2016-11 for the underground storage of gas for the underground storage of gas have already been established and are currently being adapted to hydrogen requirements. However, existing storage capacities will not be sufficient to grasp these flexibility benefits effectively. With a view to reducing costs through the integration of electric power and hydrogen systems, the optimum level of storage capacities would be 45 TWh up to 2030 and 270 TWh up to 2050.[19] However, projects announced up to the end of 2023, will only deliver capacity of 9 TWh by 2030 – leaving a gap of 36 TWh with reference to the demand determined. This gap will lead to significant additional cost. By 2050, the discrepancy between storage capacity announced and required will be even larger, at almost 250 TWh.

In order to meet hydrogen storage demand, investments will need to be made in alternative technologies for underground hydrogen storage and international links between pipeline systems. A more precise analysis and the definition of a European target for hydrogen storage up to 2030 will be crucial in order to heighten awareness of this investment shortfall.

[§] The Industrial Carbon Management Strategy COM/2024/62, published in 2024 addresses the measures required for the ramp-up of European CO_2 management.

➔ **Code of Practice C 260 2022-04** on the properties of CO_2 and CO_2 flows as well as
➔ **Code of Practice C 491 2023-09** on facilities in CO_2 transmission systems

Using long-term system expertise in the EU for the new raw material CO_2
In addition to gases which have traditionally been used, such as methane or hydrogen, CO_2 is becoming increasingly important. Well-functioning CO_2 infrastructure is an essential prerequisite not only for the transport of CO_2 as a raw material, for example for sustainable fuels or for the chemical industry, but also for the separation of CO_2 emissions from difficult-to-decarbonise industries such as cement production. In its Industrial **Carbon Management Strategy** [§], the Commission sets out various targets. In addition to a target for CO_2 separation and new incentives for CO_2 utilization, a regulatory package for CO_2 transport is to be developed. The rapid adoption of this package can provide support for the development of a CO_2 industry and the necessary network infrastructure. The DVGW has already developed a set of technical regulations for the safe and efficient transport of CO_2 and has translated these into both European (CEN) and international (ISO) standards.

What we recommend

- Establish a European transformation plan for distribution networks: gas distribution systems are crucially important for supplying power stations, industrial facilities and households, which must not be excluded from the transformation. Distribution system operators should therefore be included in the preparation of the European network development plans as a bridge between the European Hydrogen Backbone and the many industrial and private final customers.
- Incentivise and accelerate the construction of new hydrogen storage facilities. Set a target for underground hydrogen storage facilities: In order to enable the most efficient integration of electricity and gas grids, an EU-wide target for underground hydrogen storage should be defined and its construction incentivised with measures. Adopt a CO_2 regulatory package: the CO_2 regulatory package mentioned in the Carbon Management Strategy to regulate CO_2 transport and infrastructure as well as the CO_2 market should be adopted by the Commission as soon as possible.

[19] Artelys und Frontier Economics (2024): Why European Hydrogen Storage needs should be fulfilled, last retrieved on 31 July 2024..

4 Final customers and demand

Creation of incentives for the ramp-up on the demand side: introduction of a green gas quota in the gas sector

Reliable, long-term demand will be one of the most important levers for the successful ramp-up of renewable and low-carbon gases. Demand from final customers, ranging from private households to industrial customers, must be shaped in a way which is compatible with social and competition considerations.

These aspects are not given sufficient consideration in the current political conditions. Although **the EU emissions trading scheme** [§] is gradually making the utilization of fossil gases more and more expensive, the carbon prices set are not yet sufficiently high to provide incentive for a changeover to decarbonised gases. A further foundation has been laid by the requirements stated in the amended RED to change over from fossil hydrogen to RFNBO hydrogen in the industrial sector. However, this only covers part of the gases used in industry and only allows gases produced by electrolysis using eco-power as substitute gases. The directive does not provide any incentives for a changeover from other fossil gases such as methane used in industry or the use of further low-carbon gases such as biomethane.

[§] In the EU emissions trading scheme (EU) 2023/959 Industry, aviation and shipping as well as the buildings and transport sector, in a separate trading scheme, must acquire allowances for their emissions via auctions. The quantity of allowances available is being reduced step-by-step.

The revision of energy policy legislation in connection with adaptation to the climate goals for 2040 offers an opportunity to create long-term prospects and security for users and producers of renewable and low-carbon gases as well as infrastructure operators. One possibility is the green gas quota. A green gas quota would impose on gas dealers an obligation to supply a gradually growing share of decarbonised gases, thus reducing the carbon intensity of gas supplies. Models such as the requirements of **the RED** [§] in the transport sector already show that such mechanisms can incentivise blending of decarbonised fuels and help to reduce a significant amount of greenhouse gas emissions. In its biomethane action plan in connection with the REPowerEU communication, the Commission has already listed an extension of the fuel supply obligation in the RED as an appropriate mechanism.[20]

[§] The RED (EU) 2018/2001, calls for 42 percent of the hydrogen used in industry to come from renewable fuels of non-biological origin (RFNBO) by 2030, and for this figure to rise to 60 percent by 2035.

Climate protection technologies should not be played off against each other

In addition to greater supply, regulatory support for the utilization of renewable and low-carbon gases is extremely important. Whether electrification, a switch to hydrogen or a gradual transition to decarbonised methane is the right step depends on the use case. Options must be designed to be technology-neutral in order to achieve effective decarbonisation effects. Especially in the heating sector, it will be necessary to ensure the long term approval of hydrogen-fired boilers as a decarbonisation option for a large number of households, especially in existing buildings. An implicit ban of gas applications via **the Ecodesign Regulation** [§] would run counter to the intention of legislators, expressed explicitly in the RED and the EPBD, to recognise the supply of renewable gases as a climate protection measure in the buildings sector. Especially in view of the lower conversion costs required, the continued use of gas heating appliances with the new, climate-neutral gases would lay the foundation for a socially compatible transition in the space heating sector.

[§] The Ecodesign Regulation (EU) 2024/1781 lays down harmonised standards for appliances which must be met for market approval. One of the regulated categories is space heating appliances, which must meet defined energy efficiency and pollutant emission limits.

Decarbonised gases will also play a role in mobility. **The Regulation on the Deployment of Infrastructure for Alternative Fuels** [§] state specific requirements for the development of an area-wide refuelling network for hydrogen. Infrastructure for liquid methane is also to be developed along the roads and in ports. Natural gas in compressed (CNG) or liquefied (LNG) form is already reducing CO_2 and pollutant emissions in the transport sector, both in individual transport and in heavy duty transport. Thanks to the existing natural gas network, a far-reaching supply can be guaranteed without

[§] The Regulation on the Deployment of Infrastructure for Alternative Fuels (EU) 2023/1804 (AFIR) sets out binding requirements for recharging infrastructure, hydrogen refuelling and LPG infrastructure.

[20] European Commission (2022): Commission Staff Working Document. Implementing the REPowerEU Action Plan: Investment Needs, Hydrogen Accelerator and Achieving the Bio-Methane Targets. SWD(2022)230, last retrieved on 31 July 2024.

➔ **Code of Practice G 711 2020-10** on CNG refuelling stations, gas industry standard DIN EN ISO 23306 2022-11 for LNG as a marine fuel, gas industry standard DIN EN 17127 2019-09 for hydrogen refuelling stations

any problems. Decarbonised gases are the only sensible option, particularly for heavy duty transport, long-distance transport and shipping - where electrification is almost impossible to implement. DVGW is responsible for safety standards for LNG, SNG and hydrogen refuelling stations and is involved in national (DIN), European (CEN) and international (ISO) standardisation work.

Shaping the supply of new, climate-neutral gases in a socially compatible way

In order to make the ramp-up of renewable and low-carbon gases socially compatible for all final customers, it will be essential to ensure that decarbonised energy supplies are affordable. In addition to the production cost of hydrogen, which represents the largest cost factor, the cost of infrastructure adjustments is an aspect that has given rise to considerable discussion. However, even if the number of households connected is reduced by a third compared with 2023, the infrastructure measures will be affordable. The annual investments of €7.3 billion required in the hydrogen readiness of the German transmission and distribution system up to 2045 would only result in network utilization costs of about 1.8 cents per KWh.[21] The infrastructure adjustments required will therefore only make hydrogen slightly more expensive.

[§] The Energy Tax Directive 2003/96/EC (ETD) lays down minimum tax rates for fuels. The directive can only be amended by unanimous agreement of the Member States.

The prices of renewable and low-carbon gases could be further reduced by amending the Energy Tax Directive. The current **Energy Tax Directive** [§] was adopted in 2003 and does not distinguish between decarbonised and fossil gases as regards taxation. Amendments will therefore be essential in order to recognise a considerable contribution of renewable and low-carbon gases in tax terms and to contribute to a socially compatible ramp-up.

What we recommend

- Introduction of a green gas quota: a quota for the gradually rising admixture of decarbonised gases will play a key role in creating demand for renewable and low-carbon gases. A strong role for decarbonised gases can therefore be ensured in connection with the adjustment of EU legislation to the climate goals for 2040.
- Retention of freedom of choice for final customers: different use cases call for different solutions. For this reason, decarbonisation options should not be played off against each other and the use of renewable and low-carbon gases should not be discriminated against, compared with direct electric applications, for example in the heating sector.

[21] EWI (2024): Abschätzung zukünftiger Wasserstoffnutzungsentgelte, (estimate of future hydrogen utilization charges), last retrieved on 31 July 2024.