



Towards the New Age of Gas Networks

Proposal on the Regulation of a
European Hydrogen Infrastructure

MAY 2020

Executive Summary

OBJECTIVE: ESTABLISHMENT OF A EUROPEAN HYDROGEN NETWORK ECONOMY

As part of the decarbonisation of the energy sector and to meet the climate targets for 2050, the transformation of the gas industry – as set out by the European Green Deal – is an essential component. The existing natural gas industry is characterised by an extensive, meshed network of pipelines connecting almost all countries of the European Union and representing a considerable economic value that should not be jeopardised without need. Therefore, current gas networks must be prepared for a new task: *The transport of hydrogen and other clean gases.*

PROBLEM: REGULATORY BARRIERS

Today's regulation of the gas sector is not compatible with the above-mentioned objective; in fact, it may even stand in the way of deep decarbonisation. Hydrogen and other clean gases do not enjoy the same status in European law as natural gas, today. Yet, an investment opportunity not relying on public subsidies is given within the regulatory framework. The current legal framework at European and national level must therefore be prepared for the new tasks.

PROPOSED SOLUTION: "COMBINED NETWORK OPERATORS"

The central suggestion of GEODE's proposal is that the future hydrogen infrastructure should develop itself out of the traditional natural gas network operators, with the latter becoming *combined network operators*. Existing natural gas assets may be rededicated and the cash flow of the existing industry may be utilised for the benefit of old and new economy.

This requires equal regulation of natural gas and hydrogen. Therefore, the paper discusses how hydrogen can be established in European law as an additional base gas and how it can be incorporated – as pure hydrogen networks or for blending into the natural gas networks – within the *unbundled market*. Based on this, the paper outlines necessary adjustments with regard to *network development* and *network access*. Hence, a technology-neutral market ramp-up can be achieved by also using *blue hydrogen*, while green hydrogen is enjoying feed-in priority. Finally, the holistic approach also considers the *protection of end-use customers* in the transformation process and suggests *protection of property* for end-use applications.

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Objective: Establishment of a European hydrogen network economy

As part of the decarbonisation of the energy industry or the implementation of the climate targets for 2050, domestic, commercial and industrial consumers across Europe need a reliable, efficient and affordable energy system. Hydrogen has a significant role in meeting the needs of energy consumers and delivering the transition in an efficient and cost effective way.

An essential component of this is the transformation of the gas industry due to its central role in energy systems across Europe. In a transitional period, natural gas will remain an important energy carrier. Its use in highly efficient combined heat and power plants, for example, can reduce CO₂ emissions compared to coal-fired power generation. The gas sector has already embarked on a transformation journey to replace the use of CO₂-emitting natural gas with hydrogen and biogas.

Green gaseous energy supply is a necessary part of our future to provide safe, secure, low-carbon energy systems together with electrical energy supply. The current natural gas grid is a valuable and indispensable asset for the green energy supply of the future, particularly due to its ability to store energy until it is needed, and absorb generation when it is available. The continuity of the gas network operation in the transition from the fossil natural gas economy to the hydrogen economy as a regulated network operation requires new thinking from policy makers and regulators to deliver the necessary investment and financing structures. In this paper, we explore the opportunities and delivery mechanisms which can unlock the potential for hydrogen grids.

The **European Green Deal** of 11 December 2019 identifies a number of measures that will bring far-reaching changes, including in particular the “supply of clean, affordable and secure energy”.¹ This will require the introduction of innovative technologies and infrastructures (see point 2.1.2). In particular, the Green Deal identifies hydrogen networks which, therefore, need to be developed on a European scale. To ensure this, the European Commission expressly calls for existing infrastructures and assets to be modernised so that they continue to serve their purpose and become climate resilient (see the European Green Deal, op. cit.).

The existing natural gas sector today is characterised by an interconnected network of pipelines connecting almost all countries of the European Union. Natural gas is transported via transmission and distribution networks from the sources of supply to the domestic market and abroad to the final consumers. A considerable proportion of the natural gas comes from non-European sources. This unique network has grown historically since the 1960s and represents a considerable economic value that should not be jeopardized without need, and an opportunity through which carbon neutrality can be delivered. Therefore, these gas networks must be prepared for a new task: *The transport of clean gases*.

Hydrogen plays an important role here, but discussions are also underway on ammonia or non-conditioned biogas. Possible migration paths for the transformation of the natural gas infrastructure can be identified:

¹ https://ec.europa.eu/info/sites/info/files/european-green-deal-communication_en.pdf

1. In principle, hydrogen can be added to the transported natural gas; however, existing networks would have to be upgraded above a certain concentration. Since the natural gas networks must be continuously maintained at the same time, forward-looking up-grading (“H2-Readiness”) is a good idea.
2. Certain applications also require networks that transport and distribute pure hydrogen. These networks must be partly newly constructed and partly obtained by modifying existing natural gas networks. For this reason, network components must be rededicated to the transport of pure hydrogen.

In many countries and regions, the existing natural gas infrastructure has already been largely written off and could be integrated into new hydrogen networks at book value. This requires the transformation of today’s natural gas network operators into “combined network operators”; these can operate both mixed gas and pure hydrogen networks. This model has decisive operational and economic advantages.

3. Finally, there is a need to continuously develop the transmission network in line with demand and the changing requirements of customers. Due to the change in the sources of supply and possibly the relocation of consumption centres, combination of conversion, remodelling and new infrastructure can be expected.

Natural gas network operators will transport renewable gases in the future. Regulated “combined network operators” are therefore essential for the energy transformation.

New and rededicated infrastructure (see points 2 and 3 above) will primarily transport pure hydrogen (predominantly transmission networks), since, in light of the decarbonisation, industrial demand for pure hydrogen in material and energy use is expected to increase. If these developments (also) reach to existing distribution networks, an admixture at the network interconnection point is a suitable option (see point 1).

To be clear: Natural gas won’t last after 2050. Although today’s network operators and their networks will still exist, they will have changed their character. They will not serve natural gas but green gases.

Current regulation of the natural gas sector is not compatible with the above objective; in fact, it may even stand in the way of decarbonisation. The current legal framework at European and national level must therefore be prepared for the new tasks. This paper intends to provide an impulse for reflection on this issue.

Expansion of the regulation framework – An overview



In order to achieve the above objective, an equal integration of climate-neutral gases into the existing regulatory system for natural gas networks is necessary. While the regulation of energy infrastructure has so far mainly aimed at liberalising markets, it is now in order to fulfil the historic task of achieving a climate-neutral society. Only a harmonised regulatory framework can transform the existing gas transport infrastructure so that it can continue to fulfil its purpose and at the same time become climate resilient.

In essence, hydrogen must be defined as a base gas² alongside natural gas in all European regulations and directives (insofar as it is necessary to specify a specific type of gas). Higher-level standards, which form the basis and framework for pending discretionary decisions, can then be accompanied by gas-specific provisions – as is the case today in many forms, e.g. for natural gas networks – in subordinated regulations, specification by authorities and network codes which implement the current regulatory needs.

Opening the EU legal framework

In order to achieve the objective of a single European internal market for all gas types, the value opportunities of the existing market must be used. This presupposes that the EU regulations also allow the natural gas network operator to participate in the development of a hydrogen infrastructure. The current EU legal framework only partially fulfils this requirement.

The relevant rules for network operation can be found in Directive 2009/73/EC of the European Parliament and of the Council of 13 July 2009 (**Gas Directive 2009**). However, these rules only refer to natural gas networks. This may not yet be a problem for mixed gas networks where hydrogen is fed into the natural gas network, because the provisions of the Gas Directive apply to mixed gas networks according to Article 1(2) Gas Directive 2009.

This is not the case with pure hydrogen networks. The operation of hydrogen networks as such (e.g. the operation of an unregulated hydrogen network alongside a regulated natural gas network within the same company) is not expressly prohibited by EU law. Nevertheless, the development of pure hydrogen networks is *practically limited* because the current regulation framework neither allows such a network expansion nor its financing with network fees. In this respect, the legally separate treatment of natural gas networks is not conducive to the necessary transformation of the natural gas network operator.

The Gas Directive 2009, a fundamental legal basis in European law, must therefore be adapted. The explicit reference to natural gas should be omitted and instead it should only be listed as an example

² It is already possible today to mix hydrogen into natural gas networks as an additional gas, but only within the limits of technical safety and technical specifications ("Off-spec").

alongside hydrogen. A common European development will ultimately lead to a common internal market for hydrogen. As a consequence, subsequent legislation would also have to be explicitly limited to natural gas (for which there is still a need as long as a European internal market for natural gas exists).

The following chapter elaborates the European rules and principles governing regulation in the gas sector. Afterwards, it will be examined whether and to what extent these regulations inhibit the integration of hydrogen networks and what changes or measures might be necessary to overcome these obstacles.

Revisions in national law

The necessary changes in European law described above only represent the basic conditions for an integrated internal market across all gas types.

According to Article 194(2)(2) of the Treaty on the Functioning of the European Union (TFEU), energy policy measures of the European Union “shall not affect a Member State’s right to determine the conditions for exploiting its energy resources, its choice between different energy sources and the general structure of its energy supply”. Thus, the

specific design of the regulatory framework of alternative networks falls also in the responsibility of national law which can differ significantly depending on the specific national markets and energy policies.

Nevertheless, some principles of national regulation can be derived, which need to be adapted to meet the goal of a decarbonised internal gas market. These are only presented here as examples, based on the European legal framework.

Future-oriented development of downstream distribution networks

The future significance of hydrogen and other CO₂-free gases for distribution networks cannot be predicted at this point. Scenarios can be forecast which range from pure hydrogen distribution networks to biogas networks and the complete dismantling of distribution networks for natural gas. The actual development of the distribution networks will depend primarily on the technological progress of hydrogen applications and the individual local situation.

Today’s distribution system operators are best placed to assess the possible development opportunities based on their long experience, but their decision-making scope is limited because *de lege lata* regulatory restrictions exist both for investments in alternative gas infrastructure

and for the deconstruction of natural gas infrastructure. For this reason, the planning framework must be opened for distribution system operators, starting with EU law, in order to enable future-oriented planning in the distribution networks.

Furthermore, Gas TSOs and DSOs should be encouraged through national regulatory frameworks to undertake innovative activity which supports the energy system transition. This should include activity which would not be financed through normal regulatory mechanisms, for example testing new network assets for the transportation of hydrogen, and developing management procedures for blended and dedicated hydrogen networks.

Financing a hydrogen infrastructure

Insofar as future regulation (*de lege ferenda*) allows the construction of a hydrogen network for natural gas network operators in line with demand, the question of financing arises. That includes specific transformation costs. On the one hand, “combined network operators” could use their existing natural gas assets, e.g. by rededicating existing network components. On the other hand, however, new hydrogen networks in particular must be set up.

The development of the hydrogen infrastructure should be financed from **current income from the natural gas infrastructure**. This will enable substantial investments to be made, which will be offset by savings through the integration of partially written-off natural gas pipelines into new networks, as well as by negative depreciation effects achieved through the continued use of the natural gas infrastructure. It can therefore be expected that there will be **no significant increase in current tariffs or network fees** in a “combined network”; in fact, there are even advantages over a finite natural gas infrastructure, which can be incorporated into the transformation of the gas sector in line with the European Green Deal – i.e. the development of hydrogen networks.

An economic analysis³ of the financing potential of the natural gas networks in **Germany** showed that **approx. 11 billion euros could be invested in hydrogen networks in the period from 2021 to 2050** (Ø €368 million p.a.) while maintaining the cost level in the status quo, in form of constant network tariffs. If, at the same time, special write-offs by natural gas network operators are avoided, because they can continue to exist as combined network operators after 2050, the possible investment framework would even increase **to around 16 billion euros in the period mentioned**.

In simplified terms, this results in an annual investment of 534 million euros for the

transformation to climate resilient gas networks over a period of 30 years **for Germany** alone – without state subsidies.

Such a consideration for Germany cannot simply be transferred 1:1 to the situation in the entire European Union. Country-specific differences in the gas network infrastructure on the one hand, and in the regulatory regimes on the other, must be taken into account. Nevertheless, the thesis is proposed that the basic statement applies to all countries of the European Union and that the proposed regulation will thus make the financing of the hydrogen network economy possible throughout Europe. However, more case studies are needed and corresponding regulations need to be developed.

It can be assumed that alternatives, such as a separate development of further gas grids, are not economically viable. On the one hand, more gaseous energy carriers will be transported in the future, making investments in gas networks unavoidable. On the other hand, without integrating hydrogen and other gaseous energy carriers into the natural gas sector, double structures would have to be created. Instead of the required transformation to a climate resilient gas economy⁴, this would devalue the existing interconnected network in an unplanned way as the energy transition progresses.

There are no alternatives for a market ramp-up of hydrogen that could achieve a climate-neutral gas economy in 2050. This is because any other pan-European infrastructure required would have to be newly built and would not be able to be operated from a standing start. In case the production, transport and (material) use of hydrogen have to be combined, the above proposal is the only known possibility to effectively solve the “chicken or the egg” problem.

³ BBH: Principles of the regulation of German hydrogen networks in the context of an adaptation of the European legal framework and the financing of hydrogen networks by integration into the legal framework of gas network regulation, Berlin, April 2020.

⁴ European Green Deal, see above.

EU regulatory framework and principles



The following section examines which measures are necessary to implement the previously discussed considerations in European law.

Integration of new (hydrogen) networks in regulated gas network operations

THE TERM OF HYDROGEN IN THE EU REGULATORY FRAMEWORK

The basic legislation for the regulation of the internal gas market is the Gas Directive 2009, but the provisions contained therein are only intended for **natural gas**. According to Article 1(1) Gas Directive 2009, it governs the transmission, distribution, supply and storage of natural gas, the organisation and functioning of the natural gas sector, market access, the criteria and procedures for authorisations and the operation of the networks.

According to Article 1(2) Gas Directive 2009, the provisions of this Directive regarding natural gas also apply in a non-discriminatory way to biogas and gas from biomass or other types of gas in so far as such gases can technically and safely be injected into, and transported through, the natural gas system. Thus, other gases such as hydrogen are only included in the regulation (*de lege lata*) if they are fed into a natural gas network. This results in problems regarding both the blending of hydrogen into a natural gas network and the operation of pure hydrogen networks:

If quantities of hydrogen are fed into a natural gas network in such a way that the proportion of hydrogen outweighs that of natural gas (50%), it is questionable whether one can even speak of injecting into a natural gas network within the meaning of Article 1(2) Gas Directive 2009 and whether these cases are covered by the regulatory framework of the Gas Directive 2009.

With regard to the fact that, according to Article 1(2) Gas Directive 2009, the provisions of the Directive only apply to other gases if they are fed into a natural gas network, it also follows that the scope of the Gas Directive 2009 *is not open to the operation of a pure hydrogen network*. In other words: The operation of a pure hydrogen network is currently *unregulated* at EU level.

Whether and to what extent the status quo inhibits the operation and expansion of a hydrogen network by the natural gas network operator and which measures are necessary to overcome existing obstacles will be examined below.

UNBUNDLING AND MARKET ENTRY

From the perspective of the natural gas network operators, the question arises whether and to what extent EU regulations stand in the way of the operation of hydrogen networks as such. In this respect, the EU provisions on unbundling and market access must be considered.

UNBUNDLING – IS A SEPARATED OPERATION OF HYDROGEN NETWORKS NECESSARY?

Unbundling aims at ensuring the independence of transmission and distribution system operation from energy production and delivery activities, thereby guaranteeing non-discriminatory and transparent access to the network at reasonable prices and moving towards the European objective of a single internal energy market. The unbundling requirement even goes so far as to include other divisions. According thereto, operators of natural gas networks must also unbundle their direct or indirect sales of electricity.

The targets of unbundling are, in particular, vertically integrated companies. According to Article 2(20) Gas Directive 2009 these are a natural gas undertaking or a group of natural gas undertakings where the same person or the same persons are entitled, directly or indirectly, to exercise control, and where the undertaking or group of undertakings perform at least one of the functions of transmission, distribution, LNG or storage, and at least one of the functions of production or supply of natural gas. The general wording covers both transmission system operators and distribution system operators. To the extent that a natural gas undertaking is obliged to unbundle, the Gas Directive 2009 provides different unbundling models at transmission

system level⁵ as well as at distribution level.⁶ Among other things, a natural gas undertaking must implement informational unbundling in accordance with Article 16 Gas Directive 2009 (transmission system operators) or Article 27 Gas Directive 2009 (distribution system operators). Therefore, it is obliged to respect the confidentiality of commercially sensitive information obtained in the course of its business and to prevent the disclosure in a discriminatory manner of information about its own activities, which may be commercially advantageous.⁷ Furthermore, system operators shall not, in the context of sales or purchases of natural gas by related undertakings, abuse commercially sensitive information obtained from third parties in the context of providing or negotiating access to the system.⁸

The above-mentioned provisions on unbundling do not prevent the operation of hydrogen networks by natural gas network operators. However, besides legal restrictions practical limitations may arise. On the one hand, this applies if the natural gas network operators operate a hydrogen network for the purpose of admixture. On the other hand, this also applies in cases where they operate a pure hydrogen network parallel to their natural gas network as “combined network operators” or if they completely convert their existing natural gas network into a pure hydrogen network as “solitary hydrogen network operators”. This is because, in these cases, the natural gas network operators will be active **within the gas sector** on the **network operation side**, so that they will not be able to operate as vertically integrated undertakings (Article 2(20) Gas Directive 2009) and still be classified as horizontally integrated companies (Article 21(21) Gas Directive 2009).

⁵ At transmission system level, the Gas Directive provides for Ownership Unbundling (Article 9 Gas Directive 2009), the ISO model (Article 14 Gas Directive 2009) as well as the ITO model (Chapter IV Gas Directive 2009).

⁶ At distribution level, unbundling is governed by Article 26 and 27 Gas Directive 2009.

⁷ Article 16(1), Article 27(1) Gas Directive 2009.

⁸ Article 1(2), Art. 27(2) Gas Directive 2009.

In addition, policy makers and NRAs need to consider whether market participants will need different roles in order to manage the transition from natural gas to hydrogen networks. For example, regulatory frameworks for developing hydrogen production and storage may utilise a Regulated Asset Base model and – if only as an interim measure – require DSO activity outside of current unbundling principles.

Operation of hydrogen networks for the purpose of admixture

As far as natural gas network operators operate a hydrogen network for the purpose of blending hydrogen into their existing natural gas network, Article 1(2) Gas Directive 2009 applies accordingly. Thus, according to Article 1(2) Gas Directive 2009, they operate a “natural gas network” so that there is no obligation to unbundle.

Transformation to a “combined network operator”

If the natural gas network operator being active as a “combined network operator” intends to operate a pure hydrogen network in parallel to its existing natural gas network, these are not covered *de lege lata* by the regulatory framework set out in the Gas Directive 2009 (see above). Thus, a pure hydrogen network operated in parallel is not legally qualified as a “natural gas network” according to Article 1(2) Gas Directive 2009. Nevertheless, the parallel operation of an unregulated gas network, such as a pure hydrogen network, must ultimately be assigned to the gas sector. In contrast to electricity, the operation of hydrogen networks is therefore not to be classified as another division to be unbundled. This means that the operation of a parallel pure hydrogen network does not have to be unbundled from the operation of the natural gas network.

Transformation to a “solitary hydrogen network operator”

If the natural gas network operator as a “solitary hydrogen network operator” intends to use its existing natural gas network entirely for the exclusive transport of pure hydrogen, a corresponding rededication of the networks will be necessary. The rededication of the natural gas network to a pure hydrogen network means that only one network in the gas sector will be operated. In this respect, the statements on the transformation to a “combined network operator” made above apply accordingly.

Such a rededication also includes that the natural gas network operator will **give up its natural gas network** as part of its transformation to a “solitary hydrogen network operator”. The question therefore arises if the unbundling regulations allow the abandonment of the natural gas network in favour of operating pure hydrogen networks. Since the purpose of unbundling is to separate the operation of a natural gas network from sales (see above), this also means that unbundling is only necessary if a natural gas network is still in operation. If the operation of a natural gas network is given up, it cannot and need not be unbundled. The complete abandonment of the natural gas network associated with the rededication is therefore not a question of unbundling.⁹

MARKET ENTRY – AUTHORISATION OBLIGATION FOR HYDROGEN NETWORKS?

According to Article 4(1) Gas Directive 2009, the operation of natural gas facilities requires authorisation. Although the term “natural gas facility” is not defined in Article 2 Gas Directive 2009, it is to be interpreted broadly and also includes transmission and distribution networks.¹⁰ According to Article 4(2) Gas Directive 2009, the Member States shall establish objective and non-

⁹ Rather, the complete abandonment of the natural gas network, which goes hand in hand with the rededication, affects the regulations on demand-based network expansion and its planning, see chap. III sec. 2.

¹⁰ However, Article 4(4) Gas Directive 2009 sets out requirements regarding the authorisation procedure for distribution networks.

discriminatory criteria, which an undertaking applying for the operation of natural gas networks must meet. In this respect, the question arises for natural gas network operators whether and to what extent the operation of a hydrogen network according to the above criteria is **required to be authorised**.

If a natural gas network operator operates a hydrogen network for the purpose of admixture, the hydrogen network is legally qualified as a “natural gas network” by Article 1(2) Gas Directive 2009. Under the premise that the natural gas network operator has already been granted an authorisation for the operation of its natural gas network, this authorisation must consequently also cover the operation of a hydrogen network within the meaning of Article 1(2) Gas Directive 2009, which is intended to inject hydrogen into the already authorised natural gas network.

However, the situation is different for the operation of a *pure* hydrogen network, to which the provisions of the Gas Directive 2009 do not apply. In this respect, there is no **obligation for authorisation** due to the lack of regulation. This is not only the case where a hydrogen network is operated alongside a natural gas network (by a so-called combined networks), but also where the undertaking completely rededicates the existing natural gas network to a pure hydrogen network (acting as a “solitary hydrogen network” from then on). In the case of such a rededication, the regulations on market entry permissions do not apply, because the operation of a natural gas network, but not its abandonment, is subject to authorisation.¹¹

Hence, the provisions on market access do not prevent the operation of a hydrogen network for the reasons mentioned above.

Demand-based network expansion and network development planning

Certainly, the rules on unbundling and market access allow the operation of a hydrogen network as such (see above). However, its operation requires the construction of a corresponding network infrastructure. This affects the European Union regulations on network expansion¹² and network development planning. The following chapter therefore examines whether and to what extent these provisions permit the development of hydrogen networks and network development planning.

DEMAND-BASED NETWORK DEVELOPMENT AND NETWORK DEVELOPMENT PLANNING

DEMAND-BASED NETWORK EXPANSION

Under Article 13(1)(a) Gas Directive 2009 and Article 25(1) Gas Directive 2009, operators of natural gas transmission networks and operators of natural gas distribution networks are obliged to ensure the long-term ability of the network to meet

reasonable demands for the transport and distribution of natural gas and to develop a secure, reliable and efficient network under economic conditions and with due regard to environmental protection and energy efficiency in their area. In other words, the network must be developed *in accordance with demand*.

¹¹ The complete abandonment of the natural gas grid associated with the rededication rather affects the provisions on the demand-based expansion of the networks and its planning, see chap. III sec. 2.

¹² Network expansion means both the expansion of an existing network and the construction of a new network.

NETWORK DEVELOPMENT PLANNING

European law requires all gas transmission system operators to draw up common network development plans. A ten-year national network development plan (**NEP**) must be drawn up at national level and a Community-wide ten-year network development plan (**TYNDP**) at European Union level.

According to Article 22(1) Gas Directive 2009, all natural gas undertakings operating natural gas transmission networks within the territory of a Member State are obliged to submit a NEP to the national regulatory authority every year after consulting all relevant stakeholders. The NEP shall contain, inter alia, effective measures to achieve the objectives of system adequacy and security of supply.

According to Article 8(3)(b) of Regulation 2009/715/EC of the European Parliament and of the Council of 13 July 2009 (Gas Transmission Regulation 2009), all natural gas transmission

system operators in the territory of all Member States within the European network of transmission system operators for gas (**ENTSO (Gas)**) must adopt a non-binding TYNDP every two years. This shall include, in particular, the modelling of the integrated network, scenario development and an assessment of the resilience of the network.

With the TYNDP, the ENTSO (Gas) shall, in particular, promote the completion and functioning of the internal gas market and cross-border trade and ensure the optimal management, coordinated operation and appropriate technical development of the gas transmission system (Article 5 Gas Transmission Regulation 2009). In order to meet these requirements, the European legislator has therefore ordered **forecasts** to be made for both the NEP (Article 22(1) Gas Directive 2009) and the TYNDP (Article 8(10)(1) Gas Transmission Regulation 2009). These relate, inter alia, to future investments in the network infrastructure¹³, the needs of network users¹⁴ or the demand for natural gas.¹⁵

THE INDEPENDENT ROLE OF DISTRIBUTION NETWORKS

The effects of the energy transition on gas distribution networks are still unclear today. One option, for example, is to develop transmission networks with only (bio)methane and those with pure hydrogen in parallel. On the other hand, there may also be gas networks with a much higher share of hydrogen than today. The distribution networks, however, will be fed by the upstream transmission networks, as is the case today. However, admixtures of the gases could also take place at the coupling points to distribution networks, which are within reach of different gas transmission networks. Depending on regional production and regional demand, pure biogas networks would also be conceivable.

In addition, distribution networks themselves will also be developed, for example, if there is an increased focus on local heating networks. The future developments are difficult to predict today and the use of hydrogen in the distribution networks depends primarily on future end-use applications. Therefore, a regulation framework should be set up which already takes into account and enables different developments.

It is likely that there will be Member States that rely mainly on hydrogen, while other Member States will primarily pursue e.g. a biogas strategy. Some Member States may also combine different gases in their national policies. However, it is important

¹³ Article 22(2) Gas Directive 2009 (NEP), Article 8(10)(2)(a) Gas Transmission Regulation 2009 (TYNDP).

¹⁴ Article 8(10)(2)(b) Gas Transmission Regulation 2009 (TYNDP).

¹⁵ Article 22(1) first sentence Gas Directive 2009 (NEP).

that the expertise for local energy supply remains with the distribution network operators. On the basis of the subsidiarity principle, distribution system operators should therefore be empowered, on the basis of national regulations, to decide for themselves how to develop their networks. In one region, it may make sense to rededicate old natural gas networks to hydrogen networks, but in another, it may be preferable to dismantle the gas infrastructure in favour of heating networks. In any case, these decisions must be taken locally based on the local expertise of distribution system operators. The current scope for decision-making

of the distribution network operators in the Member States is actually too limited, because it is also largely focused on natural gas and aims to maintain the gas infrastructure – thus, an exit from gas supply is not possible at all.

Here, the **planning framework must be opened for distribution system operators**, whereby considerations of economy, efficiency, consumer protection and, decisively, climate protection must be taken into account. However, this also requires a relaxing of the regulations in European law (see below).

DEVELOPMENT OF HYDROGEN NETWORKS

Both the provisions on network expansion and those on network development planning refer to the **natural gas network**. While the network expansion of a hydrogen network for the purpose of admixture and its network development planning can be easily integrated in the current EU regulatory regime, this does not apply to pure hydrogen networks.

CASES OF ADMIXTURE COVERED BY THE REGULATORY FRAMEWORK

If a natural gas network operator intends to develop a hydrogen network for the purpose of blending hydrogen into the natural gas network, it must be taken into account that such networks are legally classified as “natural gas networks” according to Article 1(2) Gas Directive 2009. Therefore, the provisions on network expansion and network development planning in the Gas Directive 2009 apply accordingly. Pursuant to these provisions, the expansion of a hydrogen network within the meaning of Article 1(2) Gas Directive 2009 is permissible in any case if it is carried out in line with demand. In addition, such hydrogen networks and their development in the NEP and TYNDP must be taken into account.¹⁶

PRACTICAL UNENFORCEABILITY FOR PURE HYDROGEN NETWORKS

The provisions of the Gas Directive 2009 do not apply to the expansion of pure hydrogen networks and the related network development planning. In contrast to the provisions on market access, the lack of legal requirements *does not allow* the relevant network expansion and its consideration in the (hydrogen) network development planning.

De lege lata, however, the criteria of demand adequacy refer exclusively to **natural gas**, both with regard to the network expansion and the NEP and TYNDP. This also means that, currently, only the expansion of a natural gas network *is in accordance with demand and thus not the expansion of a pure hydrogen network*. If a natural gas network operator intends to expand a pure hydrogen network, e.g. due to the hydrogen demand of its network users, this would not be in accordance with demand under current EU legislation. Correspondingly, network development planning *cannot take the expansion of pure hydrogen networks into account*.

Particularly with regard to decarbonisation, the natural gas network operator is endeavouring to

¹⁶ The Gas Transmission Regulation 2009 does not contain any provision corresponding to Article 1(2) Gas Directive 2009. However, as the Gas Transmission Regulation 2009 only specifies the provisions of the Gas Directive 2009 and as Article 1(2) Gas Directive 2009 already allows hydrogen to be blended into natural gas networks, the provisions of the Gas Transmission Regulation 2009 and thus also those relating to the TYNDP must apply in parallel.

turn away from the natural gas network and to rededicate it – perhaps to a pure hydrogen network. Such a transformation of the natural gas network operator to a (green) “solitary hydrogen network operator” is not permitted by the current EU regulation framework.

NETWORK EXPANSION AND NETWORK DEVELOPMENT PLANNING ACROSS ALL GAS TYPES

In order to achieve the objective of a uniform, coordinated and internal market across all gas types, the provisions on network development in Article 13(1)(a) and 25(1) Gas Directive 2009 must be modified in such a way that they apply to the expansion of **gas networks of any kind**.

Particularly with a view to coordinated operation not only of the natural gas transmission networks but also of transmission networks of any kind, uniform rules should also apply to network development planning in order to counteract the obstacles described above. Here, for example, the regulations on the NEP and TYNDP could be modified in such a way that all gas transmission system operators, i.e. also operators of gas transmission networks for hydrogen, are obliged to jointly draw up the NEP and TYNDP. In any case,

one thing is certain: **network development plan across all gas types** is necessary. Above all, network development planning across gas types must be **in line with demand**.

The EU legal framework must therefore be adapted so that the transmission system operators are no longer limited to the transport of natural gas in their planning, but

- continue to develop a *demand-based scenario* in order to adequately take into account future transport needs,
- select the *appropriate gas types* for the scenario, in particular taking into account the material use of hydrogen and its possible admixture to downstream networks,
- while complying with *the objectives of EU climate legislation*.

The scenario framework, which in future will also include hydrogen, should continue to be developed under the authority of the transmission system operators. To this end, the latter must be allowed to make well-founded assumptions about the development of the hydrogen economy.

Network access

Insofar *de lege ferenda* the legal hurdles for the expansion of hydrogen networks and the related financing have been overcome (see above) and the natural gas network operators actually expand or set up a hydrogen network, the question arises whether and to what extent they must guarantee access to it. Yet, since new gas networks have the same attributes as the existing ones, there is little ground to believe that third parties could be treated differently.

NETWORK ACCESS FOR EVERYBODY

BACKGROUND

According to Article 32 Gas Directive 2009 and Article 14(1)(a) Gas Transmission Regulation

2009, Member States shall ensure the implementation of a system of third-party access to the transmission and distribution network. The access rules shall apply to all eligible customers,

including supply undertakings, and shall be implemented objectively and without discrimination between network users.

According to Article 35 Gas Directive 2009 natural gas undertakings or system operators may refuse network access only in the following cases. A ground for refusal exists if

- they do not have the necessary network capacity or
- the access to the network prevents the secure, cost-effective, consumer-friendly, efficient and environmentally friendly grid-bound supply of the general public with gas increasingly based on renewable energy in terms of Article 3(2) Gas Directive 2009 or
- they encounter serious economic and financial difficulties because of take-or-pay commitments accepted in one or more gas purchase contracts (Article 48(1) Gas Directive 2009).

However, the above-mentioned rules on network access are not an end in themselves. Rather, they are intended to mitigate the *natural monopoly position* of the system operator resulting from ownership of a natural gas network and the associated risk of discrimination against network users by imposing an obligation to contract on the natural gas network operator (Article 32 Gas Directive 2009 and Article 14(1)(a) Gas Transmission

Regulation 2009), which can only be deviated from in exceptional cases (Article 35 Gas Directive 2009).

OBLIGATION TO CONTRACT IS NECESSARY ACROSS ALL GAS TYPES

The obligations described above shall in any case apply to the operation of mixed gas networks used to blend other gases such as hydrogen into the natural gas network. This is because Article 1(2) Gas Directive 2009 stipulates that the provisions on network access also apply to cases of admixture.

However, where the operation of pure hydrogen networks is concerned, there is no legal framework for network access today. In the absence of a regulatory regime in this respect, operators of pure hydrogen networks are free to decide whether to guarantee or deny network users access to their hydrogen network. Like the operation of a natural gas network, however, the operation of a hydrogen network also constitutes a natural monopoly. Accordingly, there is a risk that network users will be discriminated against and denied access to the hydrogen network without an objective justification, such as that provided for in Article 35 Gas Directive 2009 regarding the natural gas network.

It is therefore necessary that uniform rules apply to all gas networks. Here, the above-mentioned provisions on network access should be modified in such a way that they are binding for all network operators **across all gas types**.

ENTRY-EXIT SYSTEM AND EQUIVALENT CONTRACTUAL TERMS AND CONDITIONS

While the Gas Transmission Regulation 2005¹⁷ did not contain any provision regarding a specific model for setting tariffs, Article 13 sec. subsec. 4 Gas Transmission Regulation 2009 now provides further harmonisation. Accordingly, tariffs may not be charged on the basis of contract paths (point-to-point system), but must rather correspond to the **entry-exit model**. The core of the entry-exit model is the separate booking of capacities at an entry point and an exit point of a network, which

can be combined with each other as desired without pricing the contractual path. Accordingly, network operators must offer entry and exit points separately.

The network user therefore does not have to book the actual transport path through a network, but is granted the right to inject gas at an entry point booked by him and to retrieve it at the booked exit point. For the network users, the transaction costs

¹⁷ Regulation (EC) No. 1775/2005 of the European Parliament and of the Council of 28 September 2005.

and effort are reduced considerably because they only have to conclude two contracts, one with the network operator of the entry point and one with the network operator of the exit point. In addition, the operator of a gas transmission system that offers the same service to different customers must offer **equivalent contractual terms and conditions** to them by using either harmonised transportation contracts or a common network code (Article 14(1)(2) Gas Transmission Regulation 2009). This is to counteract discrimination against network users.

In this respect, the question arises to what extent the requirement of equivalent contractual terms and conditions also applies to hydrogen networks.

As explained above, mixed-gas networks are legally classified as “natural gas networks”. The consequence of this is that the provisions of Article 13(1)(4) Gas Transmission Regulation 2009 and Article 14(1)(2) Gas Transmission Regulation 2009 also apply to hydrogen within the meaning of Article 1(2) Gas Directive 2009.

Such an obligation does not exist *de lege lata* for operators of pure hydrogen transmission networks. Nevertheless, given the above-mentioned advantages of the two-contract model and the need for equivalent contractual terms and conditions, the above-mentioned rules should apply to all transmission system operators **across all gas types**.

TARIFF-SETTING FOR FINANCING THE HYDROGEN INFRASTRUCTURE

As already stated above, financing the hydrogen infrastructure in an economically rational way is only possible through the tariffs or network fees for the use of natural gas networks. The question therefore arises whether and to what extent European law *de lege lata* precludes a tariff-setting in this sense.

The Gas Directive 2009 contains only a few legal requirements for the determination of tariffs. Article 41(10) first sentence Gas Directive 2009 empowers the national regulatory authority to amend tariffs to ensure that they are proportionate and applied in a non-discriminatory manner. The undefined legal concept of *proportionate* needs to be concretised by interpretation. In this respect, the recitals of the Gas Directive 2009 contain important indications that the network fees must be calculated in a *non-discriminatory* (Recitals 23, 32 Gas Directive 2009), *transparent* (Recital 23 Gas Directive 2009) and cost-reflective (Recital 32 Gas Directive 2009) manner. The principle of cost orientation is concretised in the sense that according to Article 41(6)(a) second sentence Gas Directive 2009, tariffs are to be designed in such a way that *the viability of the networks is*

guaranteed by necessary investments in the networks.

It is questionable here whether and to what extent the above principles, in particular Article 41(6)(a) Gas Directive 2009 allow a tariff setting in which the construction of the hydrogen infrastructure by the users of natural gas networks via the tariffs or network fees is co-financed.

LEGALITY OF FINANCING MIXED HYDROGEN NETWORKS

The tariff structure in Article 41(6)(a) second sentence Gas Directive 2009 relates to **natural gas networks**. Tariffs in this sense are therefore only to be understood as those payable by network users of natural gas networks. Since the expansion of mixed hydrogen networks via Article 1(2) Gas Directive 2009 is also legally classified as a “natural gas network” (see above), Article 41(6)(a) second sentence Gas Directive 2009 also applies. As a result, the tariffs to be paid by network users of natural gas networks may also serve to finance these networks, provided that this is a necessary network investment within the meaning of Article 41(6)(a) second sentence Gas Directive 2009.

INVESTMENTS IN PURE HYDROGEN NETWORKS ARE NOT POSSIBLE

The legal situation is completely different for using the above-mentioned tariffs to finance the construction or expansion of pure hydrogen networks. Just as the provisions on network development and network development planning in the Gas Directive 2009 and the Gas Transmission Regulation 2009 refer only to **natural gas networks** (see above), this also applies to Article 41(6)(a) second sentence Gas Directive 2009. Under the current legal situation, users of natural gas networks can be charged tariffs

solely for the purpose of financing necessary investments *in the natural gas network*. This means that a financing across all gas types by means of tariffs charged to users of natural gas networks is not permitted.

FINANCING ACROSS ALL GAS TYPES

The obstacles described above can only be countered by creating a uniform framework for the financing of gas networks of all kinds, which at the same time also enables a **gas type spanning financing**. However, it would be advisable to modify the regulations on tariffs accordingly.

Regulatory aspects of decarbonisation

Further aspects of regulation may be postponed. Nevertheless, for the **transition period** certain assumptions have to be made now. For the purpose of this paper, the focus is on the future regulation of the gas infrastructure. In any case, in the beginning the availability of quantities of hydrogen (or other green gases) in the system is crucial.

PRIORITY FEED-IN

With regard to climate resilience, a fundamental debate is taking place as to whether the approval of blue hydrogen – produced by Carbon Capture and Storage (CCS) or Reuse (CCU) – in a network access model of the future gas infrastructure will have negative effects. This applies similarly to hydrogen from other sources; the only undisputed point is that green hydrogen – produced from renewable electricity by electrolysis – is always welcome.

The above concept for a future gas type spanning regulation does not want to anticipate the (political) discussion on this issue but the question which gas type should be used does not arise in a system which is not yet able to transport exclusively green gases. In the meantime, any form of hydrogen can be used for the market ramp-up; for example, hydrogen from sources identified as inappropriate may be displaced from the networks later; there is relevant experience from the electricity sector.

As a result, this dispute can be resolved by granting priority feed-in to renewable energies, subject to the condition that green hydrogen and other gases are defined as renewable energy according to the Directive (EU) of the European Parliament and of the Council of 11 December 2018 (**RED II**). To the extent necessary, the Member States shall therefore examine, in accordance with Article 20(1) RED II, the need to expand the existing gas infrastructure to facilitate the feed-in of gas from renewable sources. The concrete form of the feed-in priority is therefore a matter for the national legislator. In particular, in the event of a lack of network capacity, the regulatory authority has to answer the question how to comply with the provisions of Article 20(1) RED II and how priority feed-in is to be implemented if several renewable gas suppliers compete with each other.

GUARANTEES OF ORIGIN (CERTIFICATION)

According to Article 19(2), subsection 1, first sentence RED II, the Member States shall ensure that a guarantee of origin is issued upon request by a producer of energy from renewable sources. Such guarantees of origin may be issued in accordance with Article 19(7), sentence 1(b)(ii) RED II and are also explicitly issued for gas, including hydrogen.

With regard to their obligation under Article 20(1) RED II, the network operators are faced with the question, among other things, whether and to what extent the “green property” of hydrogen can be verified by guarantees of origin and whether they are obliged to grant priority feed-in in any case if the producer feeding hydrogen into the grid

submits guarantees of origin. From the final customer’s perspective, a system of guarantees of origin could also serve the purpose of guaranteeing the origin of green hydrogen on the basis of transparent and non-discriminatory criteria.¹⁸

In accordance with Article 19(2), subsection 6, RED II such legal effects of the guarantees of origin *are expressly not granted*. At present, guarantees of origin within the meaning of RED II can only certify the material use of hydrogen, so that guarantees of origin play a role at the level of production and manufacture, especially in steel production, rather than at the level of network operation. Hence, this question is not primarily relevant for the transportation, distribution and the infrastructure.

Protection of end-use customers

The conversion of end-use applications plays a key role in the conversion of a network, for example from natural gas to hydrogen. In addition to the transport level, which can be expressed in the regulated system as the right to network access, an appropriate solution must be found with regard to dealing with new and existing customers of the network operators, who for their part have certain requirements for the quality of the gas provided or the type of gas used.

Although the volume of (natural) gas is usually measured to determine consumption, the energy content of the gas supplied is billed. In the event that the applications remain the same, the integration of different gas qualities in separate networks is not impossible. This has been demonstrated, for example, by experience with

the conversion from L-gas to H-gas. Therefore, final customers are in need of protection to the extent that they have made long-term investments (e.g. in heating systems or industrial applications) in reliance on a particular gas supply. Or in other words: Inventory Protection is highly relevant for end-use customers.

The starting point in European law is here Article 3(2) Gas Directive 2009. It allows Member States to impose obligations on undertakings operating in the gas sector which may relate, inter alia, to security, including security of supply, regularity, quality¹⁹ and price of supply. Furthermore, such obligations shall be clearly defined, transparent, non-discriminatory and verifiable and shall ensure equal access of Community gas undertakings to national consumers.

¹⁸ Moreover, this is not a new issue, as this question already arises for biogas (and is likely to be solved if expansion is planned in the future).

¹⁹ Gas quality also plays a role in technical operational safety as part of general safety within the meaning of Article 3(2) Gas Directive 2009, according to which, under Article 8 Gas Directive 2009, Member States or their regulatory authorities shall publish criteria for technical operational safety and for connection to the gas network. With regard to gases from renewable sources Article 20(2) RED II refers to Article 8 Gas Directive 2009.

According to Article 1(2) Gas Directive 2009, the above-mentioned general conditions apply also to mixed gas networks. However, the above-mentioned regulations are not applicable to pure hydrogen networks so that there is currently no adequate protection for (future) end-use customers of such networks in terms of inventory

protection. Particularly with a view to the goal of a single European internal energy market a **gas type spanning protection of property for end-use applications** is necessary. However, Article 3 (2) Gas Directive 2009 should be designed in such a way that it applies to all types of gas.

Summary and proposed solution

The current EU regulations do not prevent the operation of hydrogen networks for the purpose of admixture. These mixed networks are covered by Article 1(2) Gas Directive 2009 and are thus already integrated into the current EU regulation framework.

However, the situation is different for pure hydrogen networks. The operation of pure hydrogen networks as such does not, *de lege late*, preclude the rules on unbundling and market access. Nevertheless, the expansion of pure hydrogen networks and thus the development of a hydrogen infrastructure in general **is practically impossible to implement and realize**. This is because the EU legal framework currently does

not allow the expansion of pure hydrogen networks, as this is not in line with demand. A further obstacle is that the natural gas network operator cannot finance the construction or expansion of a pure hydrogen network with tariffs/network fees paid by the natural gas network users.

Therefore, **the Gas Directive 2009 needs to be adapted** in such a way that it no longer refers exclusively to natural gas but also **refers to other gases such as hydrogen**. In addition, the subsequent legislation should be explicitly limited to natural gas. As there is still a European internal market for natural gas, such legislation is still necessary.

