HYDROGEN NETWORKS: NETWORKS OF THE FUTURE?

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Abstract

Hydrogen Networks are expensive and, at times, technically challenging to build. Yet, the regulation of hydrogen networks is in full swing across Europe, as hydrogen is key in energy policy agendas across the European Union. While the technical aspects of hydrogen usage and the transition to a hydrogen economy become increasingly clear, the legal framework that would be required to facilitate this transformation remains underdeveloped. This chapter briefly sketches the current state of the art when it comes to both EU hydrogen policy and the emerging EU's regulatory framework for hydrogen networks. The chapter also includes a brief example on how hydrogen networks are regulated in the EU's biggest Member State, Germany. It finds that, while legal frameworks are increasingly taking account of hydrogen networks, essential parts of the regulatory framework merely exist in draft form and/or require further elaboration in the years to come. Martha Roggenkamp's substantive works on the regulation of natural gas networks will remain an important focal point for the development of a legal framework covering the 'new world' of hydrogen networks.

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1 Introduction

Gas and the regulation of gas networks have been recurring themes in the academic career of Martha Roggenkamp. In fact, oil and gas pipelines have been the topic of her PhD thesis[2] and at the end of her career Martha came back to gas, albeit in a new form: hydrogen.[3] Her interest was intrinsically linked to her overarching interest in the regulation of energy networks, about which she published important pieces.[4] Over the years the author of this piece worked with Martha (and others) on various aspects of hydrogen regulation in the European Union, so this piece is hopefully of interest when it discusses the regulation of hydrogen networks in the EU. It proceeds in three steps. First, a brief overview of EU policy on hydrogen is provided. Second, a closer look at the emerging EU law framework on hydrogen networks is provided. Third, this piece subsequently provides a very brief sketch to the regulation of hydrogen networks in the EU's biggest Member State Germany to see how hydrogen network regulation could look like at the national level. The chapter concludes with some observations on the emergence of the regulatory frame for hydrogen networks.

2 EU Hydrogen Policy

The long-term strategic vision of the EU is to achieve climate neutrality (no net GHG emissions) by 2050.[5] Hydrogen is viewed by the European Commission as a key energy carrier to achieve these climate ambitions.[6] The European Commission issued a EU

2 Martha M Roggenkamp '*Het Juridisch Kader van Pijpleidingen in de Olie- en Gasindustrie*' (Intersentia, Cambridge 1999).

3 For instance when she became part of the Horizon 2020 project 'Store and Go' (www.storeandgo.info).

4 Such as Martha M Roggenkamp, Lila Barrera-Hernández, Donald N. Zillman, and Iñigo del Guayo '*Energy Networks and the Law: Innovative Solutions in Changing Markets*' (OUP, 2012).

5 Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions 'The European Green Deal', COM (2019) 640 final at 2.

6 European Commission 'Clean energy – an EU hydrogen strategy', available at: https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12407-A-EU-hydrogen-strategy (accessed 16 June 2020).

Hydrogen Strategy[7] and the 'Fit for 55'-package,[8] which are both part of the 'European Green Deal'.[9] The Hydrogen Strategy is coupled with an EU strategy on systems integration, which means linking the various energy carriers – electricity, heat, gas, and solid and liquid fuels – with each other and with the end-use sectors, such as industry, transport and energy infrastructure, as well as buildings.[10]

These strategies, taken together, provide a big economic boost for hydrogen in the EU (the Commission estimates that cumulative investments in hydrogen in Europe could be up to €180-470 billion by 2050),[11] but also aims to improve the integration of hydrogen into the EU's legal framework. The EU Hydrogen Strategy focuses, in terms of networks, on bigger pipelines at the transmission level (the distribution level is not really looked at in detail), but ideas on its development will be established by the so-called European Clean Hydrogen Alliance, in which public authorities, industry and civil society will collaborate.[12] In terms of end use, hydrogen is seen as an energy carrier that can help with 'greening' the energy sector, replace petroleum in the transport sector and be used in the heavy industry.[13]

This requires the development of large-scale networks. The idea of the EU Hydrogen Strategy is that existing gas pipelines can be used either to create a mingled stream via admixing of hydrogen into the natural gas grid or to repurpose these existing natural gas pipelines to dedicated hydrogen usage, creating hydrogen networks.[14] Given the focus on transmission pipelines, the Commission wants to influence the repurposing process via the European Network of Transmission System Operators for Gas (ENTSO-G)[15] and

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7 Communication from the Commission, 'A hydrogen strategy for a climate-neutral Europe' COM (2020) 301 final (hereinafter: EU Hydrogen Strategy) at 1 and 10-11.

8 As demonstrated by the attention that has been paid to this topic in the EU Commission's 'Fit for 55'- package proposal, see Communication from the Commission ' 'Fit for 55': delivering the EU's 2030 Climate Target on the way to climate neutrality' COM (2021) 550 final at 1, 8 and 9 (hereinafter: Fit for 55).

9 Communication from the Commission, 'The European Green Deal', COM (2019) 640 final at 6, 8 and 18.

10 European Commission, 'EU strategy on energy system integration', available at: https://ec.europa.eu/energy/topics/energy-system-integration/eu-strategy-energy-system-integration_en (accessed 16 June 2020).

11 EU Hydrogen Strategy 8.

12 Ibid., 8-9.

13 EU Hydrogen Strategy 1, 5 and 10.

14 Ibid., 2-3.

15 Important Europe-wide planning and operation roles are assigned to ENTSO-G. See Hans Vedder et al., 'EU energy law' in Martha M Roggenkamp et al. (eds.), *Energy Law in Europe* (3rd edn, Oxford University Press, 2016) para. 4.45.

its Ten-Year Network Development Plans (TYNDPs).[16] For pure hydrogen pipelines a new body shall be created that shall take over ENTSO-Gs functions in the area of pure hydrogen networks, the European Network of Network Operators for Hydrogen (ENNOH), which will be mentioned in the next section 3.2.

3 The EU Law Framework for Hydrogen Networks

3.1 Primary EU Law

Hydrogen developments are an integral part of the internal (energy and transport) market process. Hence, general principles governing the free movement of goods, services and capital will apply to hydrogen.[17] As in the case of natural gas, it can be assumed that hydrogen will qualify as a good, as hydrogen can be valued in monetary terms and can be the subject of commercial transactions. Similarly, the rules of EU competition law apply as anti-competitive behaviour needs to be avoided.[18] Of further relevance for the development of a hydrogen economy are the rules on State aid.[19]

3.2 Secondary EU Law

The secondary EU law framework for hydrogen networks is currently emerging and in flux. Considerably overhauls of the legal system have been achieved or are currently on their way. Relevant for the regulation of hydrogen networks is EU gas legislation, but, given the production of hydrogen via renewable electricity (e.g. Power-to-Hydrogen) and the possible uses of hydrogen as electricity storage medium (Hydrogen-to-Power), a broader framework consisting of the Renewable Energy Directive and the Electricity Regulation and Directive, etc. would need to be considered. This chapter, however,

16 EU Hydrogen Strategy 15.

17 See Articles 34-36 (free movement of goods), 56 (free movement of services) and 49 TFEU (free movement of capital).

18 See Article 102 TFEU and Merger Regulation (Council Regulation (EC) No 139/2004) and its implementing rules (Commission Regulation (EC) No 802/2004).

19 See Articles 107 and 108 TFEU and European Commission, 'Guidelines on State aid for environmental protection and energy 2014-2020' OJ C 200/01, which remain in force for now. More information can be found in Leigh Hancher, Adrien de Hauteclocque and Francesco Maria Salerno (eds.), *State Aid and the Energy Sector* (Hart Publishing, 2018).

merely focusses on pure hydrogen networks and will, thus, not discuss this further secondary law framework that is also relevant to hydrogen.[20]

On 15 December 2021 the European Commission published its so-called 'Hydrogen and Decarbonized Gas Markets'- package.[21] The package consists of a revised Gas Directive[22] (hereafter: RGD), a revised Gas Regulation (hereafter: RGR)[23] and a Regulation on the Reduction of Methane Emissions in the Energy Sector (hereafter: MER).[24]

The proposal of that package is only the beginning of a longer legislative process, as the package needs to be discussed with and resolved by the Council and the European Parliament. However, it is crucial in setting the tone and the main pillars concerning the future EU law framework for the regulation of hydrogen networks.

The new Gas Directive aims to create an EU-wide internal hydrogen market, for which pure hydrogen networks are of essential importance. National Regulatory Authorities are requested to support the creation of such an internal hydrogen market, inter alia by the promotion of cross-border hydrogen flows.[25] From a legal-technical point of view a crucial change occurs in the definitions of the Directive. Article 2 (1) and (3) RGD now differentiate between natural gas and gases (defined as natural gas and hydrogen). Accordingly, the Directive as well as the Regulation differentiate between rules applicable to natural gas on the one hand and gases more broadly defined on the other hand. This is a positive development, given that the applicability of the 2009 Gas Directive to hydrogen has been discussed controversially in the past.[26]

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20 Further information on the developments concerning these law frameworks can be found at Ruven Fleming 'Clean or renewable – hydrogen and power-to-gas in EU energy law' Vol 39, No 1 (2021) Journal of Energy & Natural Resources Law 43 – 63 (hereinafter: Fleming Clean or renewable) and constantly at www.energyandclimatelaw.blogspot.com [accessed 17/January/2021].

21 European Commission 'Commission proposes new EU framework to decarbonise gas markets, promote hydrogen and reduce methane emissions' available at: https://ec.europa.eu/commission/presscorner/detail/en/ip_21_6682 [accessed 17/January/2021].

22 European Commission 'Proposal for a Directive of the European Parliament and of the Council on common rules for the internal markets in renewable and natural gases and in hydrogen' (COM(2021) 803 final).

23 European Commission 'Proposal for a Regulation of the European Parliament and of the Council on the internal markets for renewable and natural gases and for hydrogen (recast)' (COM(2021) 804 final).

24 European Commission 'Proposal for a Regulation of the European Parliament and of the Council on methane emissions reduction in the energy sector and amending Regulation (EU) 2019/942' (COM(2021) 805 final).

25 Recital 119 revised Gas Directive RGD.

26 Fleming Clean or renewable at 52/53.

Before zooming in on the future regulation of hydrogen networks it is paramount to briefly say something on the bewildering terminology used for hydrogen throughout the package. In short. the European Commission has not been receptive to previous criticism concerning its hydrogen terminology. Instead of sticking to the usual 'colour-book' of hydrogen ('green' hydrogen, 'blue' hydrogen etc.)[27] the Commission decided some years ago to use fuzzier and blurring terms. Art. 2 (10) RGD uses the terminology 'low-carbon hydrogen' instead of 'green' or 'blue' etc. This is supposed to mean that the hydrogen content is derived from non-renewable sources, but from such non-renewable sources that meet a greenhouse gas emission reduction threshold of 70%. 'Low-carbon hydrogen' is now one form of 'low-carbon gases'.[28] Article 8 (2) and (4) RGD provides for a certification scheme and requires operators to demonstrate to National Regulatory Authorities that the required GHG-emission reductions (70%) have been met under a mass-balancing system. The same rules shall apply to imported low-carbon gases & hydrogen. Further definitions e.g. on 'clean hydrogen', a terminology that has been pushed by the European Commission in the past,[29] are not included in the RGD.

The proposal for a new Gas Directive brings about some key changes to the regulation of hydrogen markets and hydrogen networks. The new proposal is quite ambitious in terms of regulating hydrogen markets. Several Member States, like Germany and France, that already established their own rules for the regulation of hydrogen markets some months or more than a year ago (as will be discussed at section 4 below), will need to change their hydrogen market designs and bring them in line with the new EU gas rules by 1 January 2031.[30]

The core idea underlying the new design of hydrogen markets is to introduce main regulatory principles for hydrogen networks that are inspired by those currently applicable to the natural gas market but adapted to the development stage of hydrogen markets. This shall be done whilst providing guidance on future regulatory developments. What that means in practice for dedicated hydrogen networks is that a *hydrogen network operator* needs to be appointed, for hydrogen storage facilities a *hydrogen storage operator* and for hydrogen terminals a *hydrogen terminal operator*. Unbundling provisions for operators of dedicated hydrogen network operators are contained in articles 62-64 RGD and is mainly modelled on the unbundling options available to vertically integrated natural gas undertakings.[31] However, 1 January 2031 is a key date here, as this marks the

27 For an explanation on the colours see Ruven Fleming, 'Regulating Power-to-Gas in the Energy Union' (2018) 16(4) OGEL 1 at 2/3.

28 Art. 2 (11) RGD.

29 Fleming Clean or renewable 48.

30 Article 72 (1b), (7b) & (9) in conjunction with article 73 (1) RGD.

31 As made clear by recital 9 RGD.

end of the transition period[32] and from that day onwards the unbundling rules of Member States on Hydrogen Networks are supposed to be in line with the newly proposed EU law framework.

Access to hydrogen networks is of course key to third parties, as the networks are very expensive to build and risk becoming natural monopolies. Accordingly, there are provisions on Third Party Access to hydrogen networks, hydrogen terminals and hydrogen storage.[33] There is a completely new Chapter VII RGD on rules applicable to dedicated hydrogen networks which contains detailed provisions. The underlying rationale is to allow for Third Party Access to those networks, while not going as far in that as with Third Party Access to natural gas networks. To provide economic incentives and business cases to build hydrogen infrastructure in the first place, exemptions for hydrogen systems from Third Party Access can be established by national regulatory authorities. These exemptions can concern, to name but a few, closed and/or geographically confined hydrogen networks[34] or pre-existing hydrogen networks.[35]

The legislative proposal is paying special attention to cross-border gas interconnectors, as this piece of the network infrastructure is considered crucial for the functioning of a European gas market.[36] This is considered by the revised Gas Regulation (RGR). There are two types of provisions on interconnectors, some on pure hydrogen interconnectors and some on mingled streams (hydrogen admixture to natural gas streams). While the chapter focuses on pure hydrogen networks, it is worthwhile to spend some words on admixing as well, as this will be of relevance for the functioning of the future decarbonized gas market in Europe as a whole.

But first, pure hydrogen interconnectors will be discussed. Here, the EU Commission shall be empowered to adopt delegated acts in accordance with article 63 RGR with regard to the establishment of network codes concerning, inter alia, interoperability rules for the hydrogen network, including addressing interconnection agreements, units, data exchange, transparency, communication, information provisions and cooperation among relevant market participants as well as hydrogen quality, including common specifications and standardisation, odorization, cost benefit analyses for removing cross-border flow restrictions due to hydrogen quality differences and reporting on hydrogen quality.[37]

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32 See for instance recital 9 in conjunction with article 72 (1b), (7b) & (9), article 73 (1) RGD.

33 Art. 31-33 RGD

34 Article 48 RGD.

35 Article 47 RGD.

36 Article 53 RGD.

37 Article 54 (2) (b) RGR.

With a view to cross-border flow of mingled streams (hydrogen admixed to natural gas streams) that transmissions system operators shall be obliged to accept cross-border mingled gas streams with up to 5% hydrogen content from 1 October 2025 onwards.[38] This might have repercussions on sensitive gas storage facilities down the line, which are not yet able to tolerate that amount of hydrogen. Transmission System Operators must cooperate to avoid restrictions of cross-border flows due to differences in gas qualities.[39]

From a governance perspective, hydrogen networks are taken out of ENTSO-G's competence and a new EU body will be created, the European Network of Network Operators for Hydrogen (ENNOH).[40] It is supposed to, inter alia, establish network codes, adopt Ten Year Network Development Plans, etc., so essentially to serve similar purposes like ENTSO-G, just with a view to pure hydrogen networks.[41]

4 Germany: A Brief Case Study on Member State Practice

The above-described proposals for change of the EU legislative framework on pure hydrogen networks have been long-awaited by the Member States. At some point it was considered by some that the slow speed of the EU legislative procedure and the postponement of the presentation of the proposals by the Commission could have a hampering effect for the development of national hydrogen markets and dedicated hydrogen networks. Therefore Germany and other Member States took unilateral action and established legal frameworks on pure hydrogen networks prior to the EU. In the recent 2021 revision of the German *Energiewirtschaftsgesetz EnWG* (hereinafter: German Energy Act or EnWG), pure hydrogen networks and their regulation took center stage. While the scope of this chapter does not allow for comprehensive explanations on the numerous changes and adjustments that have been brought about by the German Energy Act 2021, at least a rough overview shall be provided here to indicate the direction that revised law has taken.

There used to be unclarity concerning applicability of the German Energy Act to hydrogen. While article 3 (19) EnWG old, featured hydrogen, the application was severely restrained by the fact that only hydrogen produced via electrolysis would fall under the scope of this German Energy Act. However, currently a mere 2-3% of hydrogen is produced via that route and about 97-98% of global hydrogen production is achieved via

38 Article 20 RGR.
39 Article 19 RGR.
40 Article 40 RGR.
41 Article 42 RGR.

different technologies.[42] An alternative seemed to be the classification of hydrogen as 'Biogas' according to article 3 (10) EnWG, but the requirement of production via electrolysis also applies here.

This uncertainty has not entirely been removed in the new German Energy Act of 2021, given that the new article 3 (19a) now also features a definition of gas that merely includes hydrogen produced via electrolysis or synthetic natural gas (SNG). However, by addition of chapter 2 (3b) to the Act the scope of the applicability of rules to hydrogen networks has been clarified. Articles 28j-28q EnWG now establish a completely new legislative framework for pure hydrogen networks in Germany. The first interesting feature of the new system is its design as an 'opt-in'-regulation. According to article 28j (1) in conjunction with (3) EnWG operators of pure hydrogen networks are entitled to select freely whether or not they want to become a regulated activity. Such an 'opt-in' may only be announced once to the National Regulatory Authority (*Bundesnetzagentur*) and there is no turning back.[43]

Articles 28j-28q EnWG contain the core of German Energy Act, but similar to the European legal framework, feature less strict competition law provisions, compared to the regulation of natural gas. The operators of a hydrogen network also need to be unbundled,[44] Third Party Access is provided with a view to both connection and access for third parties to hydrogen networks, etc.[45] However, connection is based on negotiated access.[46] At the same time access to the network is regulated by article 28o EnWG as well as the Hydrogen Networks Tariffs Ordinance.[47] The operators have to present a report on the status of the German hydrogen grid and its expansion every second year.[48]

For operators that decide to not go for the 'opt-in', there is, however, a minimum of regulation that applies to their networks, regardless. These are in particular parts 5, 7 and 8 as well as articles 113a-113c EnWG. These articles concern, inter alia, planning authorizations and trespass rights, certain competences and procedures of authorities that need to be complied with, and legal protection. Articles 113a-c EnWG are concerned with certain transitional provisions, like transition of natural gas pipelines into hydrogen pipelines in the Network Development Plan.

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42 International Energy Agency 'The Future of Hydrogen' (2019) 37, available at: https://www.iea.org/reports/the-future-of-hydrogen (accessed 1/11/2021).

43 Article 28j (3) EnWG.

44 Article 28m EnWG.

45 Article 28n EnWG.

46 Article 28n (1) EnWG.

47 Wasserstoffnetzentgeltverordnung (Verordnung über die Kosten und Entgelte für den Zugang zu Wasserstoffnetzen und zur Änderung der Anreizregulierungsverordnung).

48 Article 28q (1) EnWG.

5 Conclusion

Hydrogen, let alone the regulation of hydrogen networks, is a rather new topic for the EU. Integration into the EU's legal framework, albeit in process, is far from being complete. Overall, it can be assessed from the brief overview provided in this chapter, that the EU's legal framework on hydrogen networks is currently developing. As of today, however, it remains in its infancy and some 'teething'-problems are probably unavoidable. To the extent that a new framework crystallized already, its cornerstones seem to be minimum harmonization and an approach that leaves crucial points to the decision of Member States.

Hydrogen networks will be of fundamental importance to the future of energy systems in Europe and beyond. If this new energy carrier is not able to reach all parts of a country, the usage of hydrogen as a real option to 'decarbonize' our gas will vanish. For many years Martha worked on the regulation of energy networks. As a first, tentative assessment about the direction of hydrogen network regulation in the EU suggests that the mode of regulation will be developed along the lines of current network regulation for natural gas, Martha's work will still be of high relevance for the 'new' world of gas. Whether or not this will include 'strict' ownership unbundling or, considering the immense investment costs ahead that shall be shouldered by private parties, a more 'lenient' approach, remains to be seen.