ACER
European Union Agency for the Cooperation of Energy Regulators

CEER
Council of European Energy Regulators

When and How to Regulate Hydrogen Networks?

"European Green Deal" Regulatory White Paper series (paper #1)

relevant to the European Commission's Hydrogen and Energy System Integration Strategies

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Introduction

This European Green Deal Regulatory White Paper provides the views of Europe's energy regulators, represented by ACER and CEER[1] on when and how to regulate the hydrogen networks in the future.

On 8 July 2020, the European Commission published its EU Hydrogen Strategy[2], explaining why hydrogen is a key priority to achieve the European Green Deal and Europe's clean energy transition. The EU Hydrogen Strategy includes a roadmap for building a hydrogen economy in Europe over the next decades up to 2050. The roadmap foresees a gradual transition with a phased approach for scaling up production[3] of, and demand[4] for, hydrogen. It is expected that the EU Hydrogen Strategy will stimulate an EU-wide development of the hydrogen sector. In its Strategy, the European Commission states that a condition for the widespread use of hydrogen as an energy carrier in the EU is the availability of energy infrastructure for connecting supply and demand[5]. The actual infrastructure needs for hydrogen will ultimately depend on the pattern of hydrogen production and demand and on the transport costs.

The future development of infrastructure for the transport of hydrogen raises questions about the possible need to regulate this infrastructure. It should be noted that the current situation for discussing possible regulation for the transport of hydrogen is very different from the situation when regulation for gas and electricity networks was introduced. In the latter cases, when regulation was introduced, gas and electricity networks were already in place in most Member States, while

[1] ACER is the European Union Agency for the Cooperation of Energy Regulators. See www.acer.europa.eu. CEER is the Council of European Energy Regulators which is the European association of energy national regulatory authorities, see www.ceer.eu.

[2] European Commission Communication on a Hydrogen Strategy for a Climate-Neutral Europe, COM/2020/301 final. Hereafter: EU Hydrogen Strategy.

[3] The EU Hydrogen Strategy focuses on the development of renewable hydrogen production and outlines three phases:

- From 2020 to 2024, at least 6 GW of renewable hydrogen electrolysers shall be installed with a production of up to one million tonnes of renewable hydrogen per year;
- From 2025 to 2030, at least 40 GW of renewable hydrogen electrolysers shall be installed with a production of up to ten million tonnes of renewable hydrogen per year;
- From 2030 to 2050, renewable hydrogen technologies should reach maturity and be deployed at large scale across all hard-to-decarbonise sectors.

[4] The EU Hydrogen Strategy focuses on the development of demand in industrial applications and mobility. In the first phase, the current use of carbon-intensive hydrogen in the petrochemical industry shall be replaced by renewable and low-carbon hydrogen. In the second phase, hydrogen would support zero-carbon industrial processes in the sectors that are hard to decarbonise, such as steel, cement, etc. In transport, hydrogen is considered as a promising option where electrification is more difficult.

[5] Hydrogen can be transported via pipelines as well as via non-network-based transport options, e.g. trucks or ships docking at adapted LNG terminals.

hydrogen infrastructure and market still need to be developed. However, a future hydrogen market can benefit from the experiences of European regulation of gas and electricity markets.

Currently, network infrastructure for the transport of pure hydrogen is not covered by Gas Directive 2009/73/EC[6], as the natural gas system does not include pipelines or network infrastructure dedicated to the transport of pure hydrogen.

Regulation is a policy tool used to address a market failure. In the case of network infrastructure, the market failure is generally determined by the presence of a natural monopoly that is considered an essential facility. Under the essential facilities doctrine, infrastructure needs to be regulated if the following conditions apply: control of the facility by a monopolist; the competitor's inability to practically or reasonably duplicate the essential facility; abuse of dominant position, in the form of denying competitors access to the facility. In particular, regulation is applied when general competition law is insufficient to address the possible abuse of dominant position. Under competition law, abusing a dominant position is forbidden and is addressed only ex-post by fines and/or commitments by the dominant undertaking. However, in network sectors, generally the risk of abuse of dominance is considered too high to be dealt with only under general competition law, as the corrective ex-post actions are considered to act too slowly. Therefore, if the owner/operator of a hydrogen network is considered to have a monopolistic dominant position potentially leading to an abuse, regulation is needed, as the monopolist could foreclose market entry to potential competitors and/or charge unfair prices.

The aim of this White Paper is to deepen the understanding on this topic and to assist the European Commission in assessing various options as part of the preparation for a legislation on hydrogen and energy system integration[7]. In particular, this paper will look at:

- The circumstances under which regulating hydrogen networks is needed;
- How to treat existing hydrogen network infrastructure;
- How to address regulatory challenges related to the repurposing of gas infrastructure for dedicated hydrogen transport.

This White Paper focuses on the need for the possible regulation of dedicated pure hydrogen networks: therefore, it neither addresses the blending of hydrogen into the gas infrastructure[8] nor other areas in relation to the development of hydrogen[9].

This paper takes the EU's strategies on Hydrogen and Energy System Integration as the relevant starting point for deciding on the regulatory framework for hydrogen networks. The present paper does not evaluate the EU strategies, but builds on the likelihood that they will materialise with the proposed timing, thereby coming to specific recommendations.

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[6] Directive 2009/73/EC of the European Parliament and of the Council of 13 July 2009 concerning common rules for the internal market in natural gas and repealing Directive 2003/55/EC, Article 1, paragraph 2 states in fact that *The rules established by this Directive for natural gas, including LNG, shall 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.* While pure hydrogen transport is not subject to the Gas Directive, hydrogen production can be considered to be subject to it since a certain amount of hydrogen can be safely blended into the gas infrastructure.

[7] European Commission Communication on Powering a Climate-Neutral Economy: An EU Strategy for Energy System Integration, COM/2020/299 final.

[8] Blending of hydrogen into the gas network is addressed in ACER's 2020 Report on NRAs Survey: Hydrogen, Biomethane, and Related Network Adaptations.

[9] Other aspects are covered in other ACER/CEER papers, in particular: ACER/CEER Position on Revision of the Trans-European Energy Networks Regulation (TEN-E) and Infrastructure Governance, 19 June 2020; a White Paper on the regulatory treatment of power to gas (forthcoming); and a CEER-only White Paper on long-term storage (forthcoming).

Overview of Regulators' Key Recommendations

When addressing the regulation of hydrogen networks as part of a proposal for energy system integration, ACER and CEER recommend consideration of the following issues:

1. *Consider a gradual approach to the regulation of hydrogen networks[10] in line with market and infrastructure development for hydrogen*

The need for regulatory intervention for hydrogen network infrastructure will depend on how the hydrogen sector will evolve, including the need for transport of hydrogen. In particular, if the hydrogen network shows characteristics of a natural monopoly and can be considered an essential facility, where hydrogen producers and consumers need access to a hydrogen transport facility that is difficult to duplicate, there is a structural risk of an abuse of market power[11] that would need to be addressed.

2. *Apply a dynamic regulatory approach based on periodic[12] market monitoring*

This includes an assessment of the market structure and, in particular, of the market circumstances that increase the risk of abuse of dominant position by hydrogen network owners. National Regulatory Authorities (NRAs) should monitor when possible regulation of hydrogen networks should kick in, based on pre-defined EU-wide principles. The governance of this dynamic regulatory approach might be inspired by the model of the existing EU regulation of telecommunications, which has proven its value in dealing in a flexible yet predictable way with changing market circumstances, allowing NRAs to evaluate regularly the need and appropriateness of regulatory interventions.

3. *Clarify the regulatory principles from the outset*

In order to provide certainty to (potential) investors, there should be clarity on when the regulation should kick in, depending on the outcome of the monitoring activity, and regarding the general principles that will be applied to the future European regulation of the hydrogen sectors (in particular unbundling, third-party access, transparency, non-discrimination, monitoring and oversight by the relevant NRA).

4. *Foresee temporary regulatory exemptions for existing and new hydrogen infrastructure developed as business-to-business networks*

Clarify the regulatory framework from the outset for private hydrogen networks that are constructed as business-to-business networks[13]. Temporary exemptions to future regulation[14] may be explicitly foreseen in the forthcoming EU legal framework, avoiding that point-to-point pipelines are unnecessarily impacted, while ensuring that those exemptions are given under the same EU regulatory framework.

5. *Value the benefits of repurposing of gas assets for hydrogen transport*

Regulators recognise that repurposing gas assets for the transport of hydrogen may have benefits for both gas and hydrogen end users. This should be assessed on a case-by-case basis by cost benefit analyses (CBAs), taking into account all relevant factors. As a first step, the role of the National Development Plans (NDPs) of gas network operators could be extended to identify also assets that could be converted to hydrogen.

6. *Apply cost-reflectivity to avoid cross-subsidisation between the gas and hydrogen network users*

In the case of repurposing gas assets, these assets should be removed from the regulatory asset base (RAB) of the gas network operators. They should be valued, as a reference, based on their specific value in the RAB at time of transfer, taking into account the depreciation applicable to these assets. This avoids users paying twice for the same network assets.

1. Consider a gradual approach to the regulation of hydrogen networks in line with market and infrastructure development for hydrogen

Assessing the need for regulation of networks requires: i) examining whether a natural monopoly[15] exists, or is likely to exist, on the relevant market for transport of hydrogen for which the infrastructure is considered an essential facility; and ii) assessing whether under these market circumstances there is a risk of an abuse of dominant position by the owner of the facility. In particular, if there are vertically integrated entities which own the infrastructure and use it to supply the hydrogen they produce, they could preclude potential competitors from accessing the infrastructure in order to consolidate their own market position[16]. If there is no indication of a risk of abuse of dominant position, there usually is no need for network regulatory intervention.

In light of the above, the future need for, and scope of, regulation of hydrogen networks will depend on how consumption and production of hydrogen will spread, and if hydrogen pipelines for transport over longer distances will emerge. If parties request access to a monopoly hydrogen transport infrastructure, as foreseen in the EU Hydrogen Strategy, the market might evolve to situations in which abuse of a dominant position might become an actual risk.

However, the development of hydrogen infrastructure is still at an early stage and it is uncertain how it will evolve in practice. In addition, national market conditions may evolve differently between Member States as the development of a hydrogen sector may occur at different speeds. Therefore, flexibility is needed to decide when the implementation of possible network regulation should kick in. ACER/CEER advocate for a gradual approach to the regulation of hydrogen networks in line with market development.

2. Apply a dynamic regulatory approach based on periodic market monitoring

Careful market monitoring and analysis, based on agreed EU-wide indicators carried out at a national level by the NRA, can help to keep track of the development of the hydrogen sector and provide the evidence for a dynamic approach to regulatory action. Based on a periodic market analysis and possible complaints from market parties, the relevant NRA should decide, using pre-defined EU-wide criteria, if market intervention should kick in based on the general principles mentioned in Recommendation #3. In addition to monitoring, active industry involvement in the hydrogen sector can offer insights to anticipate changes. A consistency check at a European level would ensure that these analyses are applied similarly across the EU.

The governance of this dynamic regulatory approach for hydrogen infrastructure might be inspired by the concept used in the existing EU regulation of the telecommunications sector[17], which gives NRAs the power to intervene in a flexible and timely manner as a reaction to market dynamics. On a regular basis, regulators assess if an operator is found to be dominant, i.e. has significant market power (either individually or jointly), in which case a specific regulatory obligation, proportionate to remedy the identified problem, must be imposed ex ante. Despite the significant differences between

[10] E.g. hydrogen pipelines in their nascent stage when they are still isolated and not interconnected.
[11] Or of market abuse under REMIT.
[12] Every two years at most.
[13] This might be especially relevant for existing dedicated hydrogen infrastructure (e.g. in Germany, the Netherlands, Belgium and the north of France).
[14] For instance, comparable to Articles 28 and 38 of Directive 2009/73/EC and Articles 7 and 38 of Directive (EU) 2019/944 of the European Parliament and of the Council of 5 June 2019 on common rules for the internal market for electricity and amending Directive 2012/27/EU.
[15] A natural monopoly exists if the cost structure of the network creates economies of scale whereby it is economically more efficient if the transportation service is provided by one, instead of more players.
[16] Even if there is no natural monopoly by definition, such a risk is also present when the use of a facility is considered essential to other market players to perform their economic activity.
[17] Directive (EU) 2018/1972 of the European Parliament and of the Council of 11 December 2018 establishing the European Electronic Communications Code (Recast).

the telecoms system and hydrogen networks, including the different market circumstances and competitive situation, which justify the need for possible different regulatory solutions, ACER/CEER believe that the governance used in telecoms regulation might be a suitable example to explore for designing a dynamic regulatory approach for hydrogen networks.

3. Clarify the regulatory principles from the outset

ACER/CEER advocate that general regulatory principles which have delivered benefits to consumers in the European energy market should also apply in a future European regulatory framework for hydrogen transport (in particular: unbundling, third-party access, transparency, non-discrimination, monitoring and oversight by NRAs and ACER). This will enable future cross-border transport of hydrogen and facilitate a possible future European internal market for hydrogen.

These general principles for the future European regulation of hydrogen infrastructure should be clear from the outset: providing certainty and sufficient predictability regarding the type of network regulation that will kick in, and under which market circumstances, will help market participants in their investment decisions. ACER/CEER agree with the statement in the EU Hydrogen Strategy which suggests that providing clarity over future rules will avoid sunk investments and the costs of ex-post interventions later[18].

In this regard, possible regulation and its governance could be developed with reference to the framework in place for the transport of natural gas, including basic principles such as:

- The network being operated by a regulated entity that remains neutral;
- A clear governance structure for monitoring and oversight of the regulated entity by the relevant authority (the NRA);
- Unbundling rules to remove the incentive for vertically integrated undertakings to discriminate against competitors as regards access to the network, with a preference for ownership unbundling as a structurally sound approach;
- Transparency on information relevant for making efficient network investments decisions;
- Ensuring that the network infrastructure will be accessible to all network users on a transparent and non-discriminatory basis, based on third-party access (TPA) rules; and
- Consumer protection rules in case the energy carrier is directly used by households[19].

How to apply those principles to the hydrogen sector will depend on how this sector develops. If the developments in hydrogen demand and supply develop characteristics similar to those of natural gas, the regulatory framework for hydrogen network infrastructure will necessitate addressing similar issues, and the experience from EU gas regulation can be used. However, beyond technical differences and differences in market evolution between the gas and hydrogen sectors (e.g. there may be less need to address security of supply issues for hydrogen than for gas since the upstream market will be less concentrated than in the case of natural gas), an additional challenge will be to apply these principles in an integrated energy system perspective. Therefore, additional considerations will be needed to not 'simply' copy-paste the current gas regulation to hydrogen. For example, the type of unbundling chosen for the gas network operator may not be the most appropriate option for a hydrogen network operator, considering the possible differences among the two sectors and the prevailing market circumstances in a further integrated energy system.

[18] The EU Hydrogen Strategy states: *Third-party access rules, clear rules on connecting electrolysers to the grid and streamlining of permitting and administrative hurdles will need to be developed to reduce undue burden to market access.*
[19] This principle will become relevant if and when hydrogen is consumed by household consumers, which is not likely to be the case before phase 3 of the EU Hydrogen Strategy.

4. Foresee temporary regulatory exemptions for existing and new hydrogen infrastructure developed as business-to-business networks

At present, local hydrogen networks have already been developed in several regional clusters, with a focus on the chemical industry. These hydrogen pipelines and networks are usually operated by the hydrogen suppliers and are financed by the suppliers themselves or ultimately by the customers supplied.

To facilitate the development of new hydrogen infrastructure initiatives in specific circumstances comparable to such industrial clusters, the possibility for these types of private hydrogen infrastructure initiatives should remain open. If specific network regulation of hydrogen infrastructure kicks in, temporary exemptions to these new rules for the transport of hydrogen should be possible and could be comparable to the ones already in place for direct lines and closed distribution networks in the current Gas and Electricity Directives[20].

As long as such local private hydrogen infrastructure is operated and used similarly to the current situation (e.g. point-to-point connections between production and demand) and there are no signs of discrimination or abuse of market power, there is likely no need to bring these local private hydrogen networks into a regulated regime. This will probably be the case in phase 1 of the EU Hydrogen Strategy, where the focus is on making hydrogen production sustainable and on expanding the current local hydrogen networks. This means that such lines would fall only under the general competition law provisions.

However, if new demand and supply develops and creates a need for wider hydrogen transport in that geographical area, or if these local hydrogen networks become a crucial part of a larger hydrogen network (connecting different parts of the networks), then there are reasons to consider these local infrastructures as an essential facility with a possible risk of abuse of dominant position. In these circumstances, they should be regulated and hence exemptions to the regulated system should no longer be granted. The market monitoring activity referred to in Recommendation #2 should be designed to offer timely insights to address this issue.

5. Value the benefits of repurposing gas assets for hydrogen transport

The EU Hydrogen Strategy points out that repurposing and re-using parts of the existing natural gas infrastructure may provide an opportunity for a cost-effective energy transition in combination with (relatively limited) newly built hydrogen dedicated infrastructure.

In this context, ACER/CEER recognise that the repurposing of 'redundant' gas assets for the transport of hydrogen can be beneficial to both gas and hydrogen end-users in cases where there is an identified need for hydrogen infrastructure. This should become clear from a cost-benefit analysis (CBA) approach, taking into account that repurposing of the gas infrastructure comes at a cost as well. The re-use of existing pipelines may have the benefit of being quicker and cheaper than building new hydrogen pipelines. In addition, if pipelines that are not needed anymore for the transport of gas are retrofitted for hydrogen, there is a saving in decommissioning costs on the gas sector side, allowing them to no longer be a sunk cost for the gas network operator. This could particularly be applied to parts of the current natural gas transportation system where parallel pipelines are available.

As part of a whole system optimisation[21], there will be a need for a balanced consideration of constructing new pipelines for the transport of hydrogen versus the repurposing of (parts of the)

[20] The Gas Directive states in Article 36 e) on new infrastructure: *the exemption must not be detrimental to competition or the effective functioning of the internal market in natural gas, or the efficient functioning of the regulated system to which the infrastructure is connected.*

[21] There are several ways to decarbonise the energy system, the use of hydrogen is one of them. The whole system optimisation should consider all possible options.

existing gas infrastructure which might become obsolete in the future. Identifying which part of the gas network could be used for the transport of hydrogen requires an assessment of needs of the gas network (also considering the need for security of supply) as well as of the hydrogen network.

A significantly improved CBA methodology[22], potentially developed in the context of the amended TEN-E Regulation, consistent with the electricity CBA methodology and subject to ACER approval, should be applied to decide whether or not to decommission an asset, accounting for its benefits as gas infrastructure as well as of re-purposing it for transportation of hydrogen[23]. In addition, accounting for CBA-based valuations, with respect to decommissioning, neighbouring authorities and stakeholders should be consulted where their markets may be affected.

From a hydrogen perspective, initial market demand for transportation of hydrogen should indicate the need for hydrogen transport. A CBA methodology could be a valuable instrument for the development of hydrogen infrastructure, irrespective of the operator (regulated or non-regulated), to value social benefits and to help identify if the re-use of gas infrastructure is the most efficient alternative compared to building a new network infrastructure or other ways of transporting hydrogen.

The above process is part of broader infrastructure development and planning, which by definition is forward looking; it takes time to develop (repurpose) the possibly needed infrastructure. From an energy system integration perspective, there is a need for a coherent approach across sectors for infrastructure planning. As a minimum, there should be good coordination and synchronised timing between the gas and electricity NDPs, also taking into account hydrogen developments, so that all information given in the different plans is consistent. Here, it should be pointed out that hydrogen and electricity transport companies are potential competitors, as both means could be used to transport energy from one place to another. This implies that those entities should not have decisive influence over investment decisions; instead, they can put forward investment proposals to show how effectively and efficiently they could address such needs. As a first step, the role of the NDPs of gas network operators could be extended to also identify assets that could be converted to be used for the transport of hydrogen.

6. Apply cost-reflectivity to avoid cross-subsidisation between the gas and hydrogen networks in case of repurposing gas assets

In case of repurposing gas network assets, these assets should be removed from the RAB of the gas network operators. Unbundling rules should be applied in order to avoid the possible risk of cross-subsidies between users of the gas network infrastructure and of the hydrogen network infrastructure by, at least, separating activities, RABs, and costs (accounting unbundling) between the entities that own and operate the hydrogen infrastructure and the entities that own and operate the gas infrastructure.

In this context, ACER/CEER recommend taking into account the principle of cost reflectivity. Cross-subsidisation between users of different networks should be avoided, since it is not likely that all gas network users will become hydrogen networks users, or at least not at the same time. The implementation of this principle might require adaptations if, in the context of an actual integrated energy system, the benefits of the use of a network become cross-sectoral and therefore the impact of the separate networks on the whole energy system should be taken into account collectively[24]. Until then, if it is considered necessary to develop hydrogen infrastructure before demand and supply

[22] See also ACER-CEER Position Paper on Revision of the Trans-European Energy Networks Regulation (TEN-E) and Infrastructure Governance, 19 June 2020. ACER should be conferred the powers to approve the ENTSOs' proposal on the cost benefit analysis (CBA) methodology, and to request amendments by the ENTSOs, or directly amend it after consulting the ENTSOs.
[23] European Energy Regulators' Overview Paper, "The Bridge Beyond 2025 Conclusions Paper", 19 November 2019. As mentioned in this paper, the CBA methodology needs to be adapted to ensure that sustainability (including climate) effects of new investments are properly taken into account.
[24] Benefits for the gas system do not include the compensation the gas network operator will receive for selling the assets.

of hydrogen is fully developed, ACER/CEER recommend using cost-recovery instruments that avoid cross-subsidisation[25].

If the new owner of the repurposed assets is part of the same entity as the gas network operator, then there should be separate RABs and costs. This would ensure that users of each network only bear the costs for the network they use. When assets are transferred to a new regulated hydrogen network operator, these assets should become part of its RAB. If the assets are bought by a non-regulated entity, any loss for the users of regulated (gas) networks should be avoided.

When transferring the infrastructure assets to a newly regulated network operator (or to the gas network operator but with accounting unbundling), the depreciation applicable to these assets needs to be taken into account. It should be avoided that users pay twice for the same network assets. Therefore, these assets should be valued based, as a reference, on their specific value in the RAB at the time of transfer.

Relevant ACER/CEER Papers

1	European Energy Regulators' Overview Paper, "The Bridge Beyond 2025 Conclusions Paper", 19 November 2019
2	ACER-CEER Position Paper on Revision of the Trans-European Energy Networks Regulation (TEN-E) and Infrastructure Governance, 19 June 2020

[25] In this context, it should be kept in mind that at this stage that the production and consumption of hydrogen is still rather limited and needs to be stimulated before it develops to meet the indicated targets in the EU Hydrogen Strategy. To avoid the risk of stranded hydrogen infrastructure assets before they are even used and the sunk costs being carried by society, ACER/CEER advise policy makers to be cautious with supporting the development of hydrogen infrastructure - newly built or repurposed from gas infrastructure - as long as the actual development of demand and supply of hydrogen is still to be proven.