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Agency for the Cooperation of Energy Regulators

NRA Survey on Hydrogen, Biomethane, and Related Network Adaptations

Evaluation of Responses Report

10 July 2020

EXECUTIVE SUMMARY

In December 2019, the European Commission presented the European Green Deal[1], an ambitious package of measures that should ensure that the EU meets its climate goals, while enabling European citizens and businesses to benefit from a sustainable green transition. In this transition, the gas transportation system would need to develop in a way which is consistent with the decarbonisation and climate neutrality objectives of the Energy Union. The Council of the European Union[2] noted that by 2050 "green gases" – mainly hydrogen (H2) and biomethane – could represent from 30% to 70% of total gas use.

One way in which the existing gas networks could contribute to this energy transition is via adaptation or repurposing of existing infrastructure, so that they could handle biomethane and admixtures of hydrogen and natural gas, or pure hydrogen injections. With this in mind, ACER performed a survey among national regulatory authorities (NRAs) aiming at identifying the status quo regarding the technical ability of the gas transportation system to accept such gasses. The survey did not cover infrastructure issues related to the re-purposing of the system to dedicated transportation of pure hydrogen.

The survey collected information from 23 NRAs on the current possibilities for admixing hydrogen and injecting biomethane, as well as on ongoing and planned network adaptations and investments that would allow the blending of hydrogen and the injection of biomethane in the existing gas transmission network. The scope of the survey is the transmission (TSO) level.

The results of the survey are compiled in the present Evaluation of Responses Report (Report). The Report provides a factual overview of national situations. It aims at collecting information on the technical readiness of European TSOs to accept hydrogen and biomethane in their networks as background information in support of future regulatory discussions and options for the development of the gas infrastructure in the European Union.

The Report information takes stock of national experiences in:

- Recently undertaken and planned hydrogen blending projects;
- Recently undertaken and planned projects for "dedicated" (100% pure) hydrogen networks;
- Current limits for the blending of hydrogen into the gas flow in gas transmission networks and at cross-border interconnection points;
- Foreseen national hydrogen blending targets and hydrogen strategies, if any;
- Views on the need to have a European-wide, regional or national approach to H2 blending limits and projects;
- Certain technical aspects related to hydrogen and biomethane injection: how injection is done, how injection points are determined, which are the responsibilities of the TSO regarding the connections of plants or flows of biomethane or hydrogen to their systems; and

[1] COM(2019) 640 final
[2] https://data.consilium.europa.eu/doc/document/ST-13854-2019-INIT/en/pdf

- The way in which the investments associated with such connections as well as how enabling the systems to flow the resulting mixtures are treated in network development plans.

Section 2 of the Report highlights the main findings on these topics, based on the responses received from NRAs, while Section 3 provides insights summarising the current status quo.

In 65% of Member States, the TSOs still do not accept the injection or allow H2 volumes into the gas transmission network. Germany reports the highest H2 concentration limit (up to 10%), applicable in some sections of its transmission network and under certain conditions. Nearly half of responding NRAs indicated an existing (or under development, or planned) H2 strategy in their Member States. The readiness of the gas transmission networks to accept hydrogen or biomethane, as well as the foreseen developments to enable such acceptance, are quite diverse across the European Union and, in some instances, apparently inconsistent. The status quo is one of a very early stage of development, mainly driven by pilot projects for the production and the injection of hydrogen and/or biomethane, with the latter more advanced than the former. These pilot projects are generally considered by promoters and regulators on a case-by-case basis in order to boost innovative solutions. The overall picture varies by region. For example, hydrogen injection and biomethane development in several countries in North-West and Central Europe seems to be more advanced in comparison to South Eastern Europe.

NRAs generally think that the harmonisation of hydrogen blending limits across the EU would be appropriate. The introduction of hydrogen and biomethane into the gas transmission networks needs to take into account the technical characteristics of the network and safety considerations, but at the same time should not be detrimental to cross-border gas trading and market integration. Overall, NRAs consider that hydrogen blending limits should be at least 2% by volume.

Some NRAs consider that hydrogen blending is likely to be a temporary or transitional solution, given the existence of a technical and economic ceiling on hydrogen concentration by volume that traditional gas infrastructure can handle. It may be preferable to create separate "pure" hydrogen networks, so that the economic value of hydrogen could be tapped in full. The development of pure hydrogen networks could go in parallel with the blending of hydrogen in the existing networks, depending on the specific market and network situation, and on the role that biomethane will play in the energy transition.

Possible EU-wide harmonised hydrogen blending limits may be needed in case different hydrogen blending limits constitute a barrier to cross-border gas flows. Accordingly, gas quality standards may need to be revised at EU level, in order to ensure system interoperability and unimpeded gas flow between Member States.

Regardless of the actual choice for a hydrogen concentration limit, some network adaptations are required in order to enable hydrogen injections. Metering equipment requires upgrades or chromatograph replacement in order to be able to measure hydrogen concentrations in the gas network. Gas turbines, compressor stations, compressed natural gas (CNG) tanks and some types of storage can only accept low hydrogen concentration (< 5%), and may also need retrofitting. These findings are generally in line with existing technical studies related to the injection of hydrogen into the natural gas grid[3]. Hydrogen injection facilities, as well as reverse

[3] See in particular, the CEN-CENELEC report from 2016, section 4.3, pp. 34-65

flow capacity at DSO level (i.e. from distribution to transmission network), may be also required to enable the injection of locally produced biogas, once upgraded to biomethane, into the gas transmission network at appropriate pressure. Apart from the network, end-user equipment may not accept a higher, or variable, concentration of hydrogen, which necessitates further detailed studies.

The study of the gas transmission network status quo in view of enabling hydrogen and biomethane injections shows that selected investments will be needed to gradually increase its ability to accept "green" gases. These types of new investments deserve greater attention in gas network development plans in order to properly identify investments needs and projects.

It seems that blending of hydrogen would not initially require major changes in the current market design and legislation. Gas quality issues may arise if very different admissible levels of hydrogen in the grid are established.

Technology developments, legal, regulatory, and network development efforts should go hand in hand in order to achieve an efficient and timely decarbonisation of the gas sector. ACER and NRAs will continue working together in exploring and applying regulatory options for this to happen in the most efficient way to the benefit of energy consumers.

https://publications.jrc.ec.europa.eu/repository/bitstream/JRC99525/sfem%20wg%20hydrogen_final%20report%20%28online%29.pdf#:~:text=Based%20on%20these%20key%20challenges%2C%20the%20SFEM%2FWG%20Hydrogen,working%20group%20fall%20within%20the%20scope%20of%20CEN

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Table of Contents

Executive Summary 2
1. INTRODUCTION 8
1.1 Scope 8
1.2 Objective 8
1.3 Timeline 8
1.4 NRA responses 8
1.5 Technical note 8
2. MAIN FINDINGS 9
2.1 H2 blending 9
2.2 100% H2 dedicated networks 12
2.3 H2 concentration in gases from non-conventional sources 13
2.4 H2 injection at TSO level 13
2.5 Biomethane injection at TSO level 14
3. PRELIMINARY INSIGHTS 16
4. QUESTIONNAIRE RESPONSES 18
4.1 H2 blending 18
Q1. Do TSOs accept the injection or allow H2 volumes into the gas transmission network in your MS? 18
Q2. Do gas quality standards in your Member State (MS) allow for H2 volumes? 20
Q3. Is it legally/regulatory possible to inject or allow H2 volumes into the gas transmission network? 22
Q4. What is the current maximum H2 concentration accepted by the TSOs in the natural gas transmission networks? 23
Q5. Is it the same H2 blending limit for all gas transmission networks in your Member State? 24
Q6. Which is the main justification to set up such a H2 limit in term of gas quality requirements at transmission level? 24
Q7. If applicable, has any problem / major incident been experienced in relation to the injection of H2 in the natural gas transmission network? 26
Q8. Are there are any incentives in the MS for TSOs to develop projects for H2 injection into the gas transmission system? 26
Q 9. Are you aware of H2 adaptations/investments blending projects in order to accept or increase H2 acceptance in gas transmission in your MS? 27
Q 10. Are there plans to increase the H2 acceptance into natural gas networks in your MS? 28
Q11. Are investments/adaptations foreseen in the current NDP to allow or increase the TSO acceptance of H2? 28

Q12. Is there a H2 blending target for the TSO? – specify in [% vol.] and target year .. 30

Q13. Is there a H2 limit for cross-border interconnection points (i.e. is it possible to import / export gas with H2 content)? 30

Q14. If H2 blending limits exist at the cross-border interconnection points, are H2 limits and developments coordinated with neighbouring MSs? 31

Q15. If the H2 blending limits are coordinated, are they part of Interconnection Agreements (NC on interoperability)? 32

Q16. Which is the competent authority to set H2 blending limits to be accepted by the TSO in your MS..... 33

Q 17. Which organisations should be involved in the process for setting H2 limits? 34

4.2 100% H2 dedicated networks..... 36

Q 18. Are there currently 100% H2 pipeline networks for industrial purposes in your MS? 36

Q 19. If yes, does a gas TSO/DSOs operate any of these H2 pipelines?..... 36

Q 20. If operated by a [DSO/TSO]: Are the H2 dedicated networks part of the regulated asset base?..... 37

Q 21. Is the H2 of these networks “green” –i.e. H2 produced from renewable sources via power-to-hydrogen (electrolysers)?..... 37

Q 22. Are there plans in your MS for developing 100% H2 pipelines/networks? 38

Q.23. Is there or under development or planned a H2 strategy in your Member State? 39

4.3 H2 content in gases from non-conventional sources..... 42

Q 24 Has the term gases from “non-conventional sources” been defined in your MS for the purpose of H2 limits? 42

Q. 25 Has your MS established a maximum content of H2 in gases from "non-conventional" sources introduced in your gas system? 43

4.4 Detailed questions on H2 injection at TSO level..... 43

Q 26. Is it possible to inject H2 directly in the gas transmission network or is it a "premix" necessary to inject a H2 blend within certain limits? 43

Q27 How are the injection points for H2 at TSO level determined? Is there coordination with electricity sector?..... 45

Q28 Who owns and operates the H2 production plants (i.e. electrolysers) in your MS? Are the H2 production plants (electrolysers) considered as part of the TSO assets? ... 45

Q29 How does the TSO guarantee stable H2 concentration in the transmission system? (stable gas blend quality)..... 46

Q.30 Are there obligations for network operators to publish actual and future available capacity for hydrogen injection into the gas transmission networks? 47

Q.31 Are there obligations for network operators to provide a connection point for hydrogen injection upon request by a network user? 47

4.5 Questions on biomethane at TSO level 49

Q.32 Is biomethane currently injected into the gas transmission system? 49

Q.33 Is there reverse flow (from distribution to transmission grid) and/or direct injection from biogas /biomethane plant? 49

Q.34 If there are biomethane injections into the gas transmission system, who operates the gas quality upgrading (from biogas to biomethane) and injection facilities? The TSO? 50

Q.35 Are investments/adaptations foreseen in the current NDP to allow or increase the injections of biomethane in the gas transmission system? 51

Q.36 Are there obligations for network operators to publish actual and future available capacity for biomethane injection into the gas transmission networks? 53

Q 37. Are there obligations for network operators to provide a connection point for biomethane injection upon request by a network user? 54

1. INTRODUCTION

1.1 Scope

ACER's Gas Infrastructure Task Force (GITF) is investigating necessary network adaptations and investments for allowing blending of hydrogen (H2) and injection of biomethane. For that reason, ACER carried out a survey among NRAs by using a questionnaire form containing 37 questions. A detailed review of the responses is provided in Section 4.

The survey focused on the readiness of national gas transmission infrastructure in European countries to allow H2 admixtures, 100% H2 dedicated networks, and biomethane injections. It also included some questions on transmission network adaptations needed in order to allow H2 admixtures and biomethane. The survey provides a snapshot of the status as of May 2020, and the situation may change rapidly, given the ongoing initiatives.

This survey collected relevant information from NRAs to:

- gather national experiences based on recent or foreseen H2 blending projects;
- gather national experiences based on recent or foreseen dedicated 100% H2 networks;
- review the current limits and technical capability for blending H2 into gas transmission network and cross-border points;
- reflect on the need to have a European-wide or regional approach towards H2 limits; and
- collect information on network adaptations to allow H2 admixtures and biomethane.

1.2 Objective

The results of the survey are expected to:

- Raise awareness among the NRA community and other stakeholders about the integration of Energy Transition goals into gas network development processes (National Development Plans - NDPs, Gas Regional Investment Plans - GRIPs, Ten-year Network Development Plan - TYNDP and selection of PCIs – Projects of Common Interest).
- Bring hands-on knowledge to regulatory discussions, especially about network adaptations and investments, with a focus on technical network issues rather than on regulatory policy options.

1.3 Timeline

The survey was circulated to NRAs in the GITF from April to 15 May 2020. Submissions received by 18 June 2020 are considered.

1.4 NRA responses

ACER received completed questionnaires from 23 of the 27 NRAs, which translates into a response rate of 85 %. Thus, the data allows for a representative overview of the readiness of national gas transmission infrastructure in Europe to allow the handling of new gases (H2 and biomethane).

1.5 Technical note

H2 concentrations or limits are expressed in volumetric terms (% H2 in % total gas volume in the transmission network, at 15 °C and 1 bar). Replies to some questions were obtained by

NRAs after contacting the TSOs in their Member States (MSs) to gather the information needed.

2. MAIN FINDINGS

This section contains the main findings based on the responses received from the 23 NRAs[4] having submitted questionnaires. Results show that in most MSs the TSO acceptance of H2 and biomethane is in an "exploration" phase. Where instances of H2 and/or biomethane injection into the gas transmission network exist, they are generally innovative pilot projects implemented in order to gain experience, knowledge, and insights.

Insights from industrial scale projects resulting in the injection of H2 and/or biomethane in gas transmission networks are not yet available in the European Union, what indicates the relatively early stage of deployment of these technologies. This status quo is important for understanding the answers received from the NRAs. The answers also provide some information on ongoing projects related to H2 blending, 100% H2 dedicated networks, and biomethane injection at transmission level.

2.1 H2 blending

Current H2 blending limits

Currently, 15[5] out of 23 NRAs (65%) report that TSOs in their domain do not accept the injection or allow[6] H2 volumes into the gas transmission network. **When H2 is explicitly accepted (Austria, France[7], Germany, Latvia, Slovakia, Spain, and Sweden), it is only possible at very low concentration by volume.**

In many MSs, TSOs are assessing the technical constraints and necessary measures to cope with different volume of H2 in the gas transmission network. The level of ongoing work in terms of studies and analyses differs across the European Union.

In order to enable H2 blending, investments are needed, in particular with respect to gas quality measurement systems. **In most MSs (18 out of 23, 78%), current gas quality standards do not mention H2 volumes[8].**

Germany reports the highest H2 concentration limit at gas transmission level (10%)[9], followed by France (6%), Spain (5%)[10] and Austria (4%). Four more countries allow for a more modest H2 concentration in their natural gas transmission networks: Lithuania (2%), Italy

[4] Austria, Belgium, Croatia, Cyprus, Czech Republic, Denmark, Estonia, France, Germany, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Netherlands, Poland, Portugal, Romania, Slovak Republic, Slovenia, Spain and Sweden submitted questionnaires. Bulgaria, Finland, Greece and Malta did not submit questionnaires and are not covered.
[5] Lithuania replied no acceptance of H2. However, it seems legally possible to inject H2 into the Lithuanian TSO system, although currently there are no such H2 injections.
[6] H2 may be present in imported gas, although not directly injected.
[7] Only in the frame of demonstration projects.
[8] In some countries (e.g. Italy) the absence of an explicit threshold for H2 in gas quality standards does not mean that the threshold is zero or that gas quality standards do not allow for H2 volumes: it simply means that H2 is not measured, while other gas parameters are.
[9] This limit is only allowed if no "sensitive" customer is connected to the network. e.g., if a natural gas filling station for vehicles is connected to the gas network, only 2% is permitted in the gas in the network.
[10] In Spain, 5% H2 concentrations are allowed in the "so-called" non-conventional gases, thus this figure does not represent the H2 blending limit at transmission level.

(1%)[11], Latvia (0.1%), Ireland (0.1%) and the Netherlands (0.02%). In Slovakia, there is no explicitly defined H2 limit; however, H2 can be present in imported gas (up to 2% maximum), but not directly injected into the network. **In more than 60% of MSs, the current H2 concentration limit is nil (0%).**

23% of the respondents (Austria, Latvia, Slovak Republic, Spain and Sweden) report that the same H2 blending limit applies to all gas transmission networks in their domain. Only Germany[12] and Poland[13] indicate that the blending limit is not the same for all of their gas transmission networks.

As regards the main **reasons to set a certain H2 concentration limit, gas quality requirements, safety and tolerances of end-use equipment are commonly cited**. Several respondents provided comments and explanations. In Belgium, the entire infrastructure, operational, legal, and regulatory framework is currently based on 0% H2 acceptance. In Denmark, network components - as identified by the TSO's own studies - have been proven to withstand at least 10% H2 blends. The main constraints identified in France relate to end-user appliance limitations on the consumption side, related to the sensitivity of specific industrial processes to the presence of H2, to natural gas vehicles (NGV) charging stations limits (2% H2 allowed) as well as to the technical tolerances of network components in the gas networks. In Italy, NGV, engine and turbine specifications (some of them allow concentration of up to 1% H2) are reported as limiting factors. Considerations related to the safe operation of underground gas storages are cited by Italy and Latvia. Sweden refers to safety concerns, end-user equipment, network components, industrial processes and natural gas as feedstock as factors limiting H2 concentration.

Several TSO have initiated discussions on the topic in collaboration with the relevant ministries and authorities, trying to find potential target H2 concentration limits.

Most of the **respondents do not report the existence at this time of specific incentives for TSOs to develop projects for H2 injection into the gas transmission system, with a few exceptions.** Belgium refers to the tariff setting regime (2020-2023) for the TSO, which contains incentives related to the connection of H2 and biomethane production and/or injection installations. Austria and Ireland refer to innovation allowances which TSOs may apply, for e.g. to H2 projects. However, several TSOs (in the Czech Republic, Denmark and Italy) are preparing innovative projects on private basis, in anticipation of future developments. In Italy, a consultation involving the NRA is currently underway and foresees possible incentives for P2G pilot projects, potentially including those allowing the injection of H2 into the network.

Future H2 limits and projects

More than half of the respondents (57%, 13 replies) are aware of adaptations and/or investment projects related to H2 blending, pursued in order to start accepting or increase H2 acceptance in the gas transmission network in their respective MSs. The same number of respondents reports plans to increase the H2 acceptance into natural gas networks for their respective MSs. **Belgium, Czech Republic, Germany, Italy, Portugal, Slovenia, Spain,**

[11] In Italy, 1% H2 concentration is allowed for biomethane injections, thus this figure does not represent H2 blending limit at transmission level. No specific threshold is set for injections, other than biomethane, provided the overall compliance with gas quality standards is ensured.
[12] In Germany, there are several gas transmission networks and several pilot projects.
[13] In Poland, there is no regulation setting H2 blending limits. Technical limits for H2 blending will be determined after an assessment of network by the TSO. Each gas pipeline in the network may have a different limit, depending on the materials and the age of the gas pipeline.

Sweden and the Netherlands report the existence of projects or the planning of projects aiming to increase H2 acceptance limits in their gas transmission network.

The survey looked at whether these investments and adaptations are foreseen in the current National Development Plans (NDPs), so that a more concrete picture could be obtained. **With the exception of Belgium, France and Slovenia, current NDPs do not foresee any investments or adaptations aiming to allow or increase the acceptance of H2 by the TSOs.** Belgium's NDP for 2020-2023, which is of an indicative nature, contains a program to adapt/invest in order to install chromatographs that are able to measure the H2 concentration in the transported gas. In Belgium, the level of H2 acceptance is not yet defined and the legal/regulatory framework (e.g. gas quality specifications) are under revision in order to allow the TSO to accept H2. France refers to a demonstration project allowed by the NRA, which aims at testing the readiness of the network components for H2 injection. However, these tests are done in a laboratory and not directly on the transmission network. Slovenia reports that studies and analyses are ongoing.

All respondents highlighted that there are currently no H2 blending targets for their TSOs, although in some MSs (Austria, Belgium, France, Ireland and Luxembourg) there are ongoing studies and discussions on possible blending targets. Some TSOs are promoting specific H2 blending targets (e.g. French TSOs promote a 10% blending target by 2030, in Austria a 10% volume target is under discussion).

Preliminary views on EU harmonisation on H2 limits

There are 16 NRAs (70% of total responses) reporting that no definite limit of H2 concentration exists for cross-border interconnection points. However, **Austria, Denmark, Germany, Latvia, Lithuania, Spain and the Netherlands (30% of respondents) report that a H2 limit is applied for cross-border interconnection points**. Obviously, both sides of the cross-border interconnection points have to allow H2 content before actual gas with H2 content could be transported. This means that **gas with H2 content can theoretically[14] be transported between the Netherlands – Germany - Austria and between Latvia and Lithuania, in both directions, according to the H2 limits applied in the gas transmission system**. However, most MSs which apply H2 concentration limits at cross-border interconnection points have no coordinated H2 limits and no activities to coordinate the limits with the neighbouring MSs. **Only Latvia reports the existence of cooperation among neighbouring MSs aiming to set H2 limits, and indicates that the coordinated H2 limits are already set in interconnection agreements.**

21 out of 23 NRAs (74%) agree, albeit to a varying extent, that H2 blending limits should be decided at EU level rather than at regional or bilateral level, given that cross-border gas flows should not be impeded by different H2 blending limits at transmission level, potentially impairing the interoperability of the gas networks**.** There are 9 NRAs that appear to agree on the setting of a H2 blending limit of at least 2% concentration. However, **3 NRAs (Austria, Germany and France), in addition to blending, stress also the importance of creating 100% H2 networks to optimise the economic value of H2**. **Priority should be given to direct use of 100% H2, while also making possible the development of H2 admixtures in parallel.**

Process and competent authority to define H2 blending limits

[14] This may also depend of the acceptance of H2 content at cross-border interconnection points, which is normally regulated in interconnection agreements.

In most MSs, the competent authority that sets H2 blending limits is a Ministry. NRAs are generally of the view that a wide range of organisations[15] should be involved in the process of setting H2 limits.

2.2 100% H2 dedicated networks

Belgium, France, Germany and the Netherlands report the existence of 100% H2-dedicated pipeline networks for industrial purposes, i.e. networks which connect several industrial sites[16]**.** These H2 pipeline networks are not operated by a TSO or a DSO, and are generally used to supply hydrogen to refineries, fertiliser plants and other industries. The great bulk of H2 currently produced is not "green"[17], i.e. it is not produced from renewable sources. H2 transported in the decided networks is produced from fossil fuels by steam reforming of natural gas and partial oxidation of methane (generally also from natural gas).

Details were provided by NRAs with 100% H2 dedicated networks present in their domain. In **Belgium**, there is a highly developed H2 pipeline network of more than 600 km, with cross-border connections to the Netherlands as well as to France. The H2 pipeline network serves to supply H2 for industrial processes (e.g. oil refineries) and is operated by H2 production companies (e.g. Air Liquide). The network operates at a pressure between 10 and 20 bar. The Antwerp Port region is an important industrial cluster for H2 production. In **France**, a 100% H2 pipeline network outside the regulated gas network is operated by a private company (Air Liquide) in the north of France, linking industrial sites in France and crossing the border with Belgium. In **the Netherlands**, there are several H2 pipeline networks supplying H2 for industrial processes, operated by private non-regulated companies. Currently one dedicated (closed) H2 network in the province of Zeeland is operated by a subsidiary of Gasunie. In **Germany**, 100% H2 networks currently are operated by non-regulated private network operators (Linde, Air Liquide).

19 respondents (83%) report that there are currently no plans for developing 100% H2 pipelines or networks. Only Germany, France, Poland and the Netherlands are planning to develop 100% H2 pipelines/networks, but it is not yet determined who will promote these projects (the TSO or non-TSOs parties). In Germany, it is not yet decided whether 100% H2-dedicated pipeline networks will be operated by a regulated TSO. The decision is subject to an ongoing political process. In the Netherlands, the gas infrastructure company (Gasunie, the mother company of the TSO - GTS) is involved in these activities. Based on the current regulation, the Dutch TSO is not allowed to operate a H2 pipeline or network.

11 NRAs (almost 50% of the respondents) report that a H2 strategy exists, is under development, or is being planned. This is the case in Austria, Belgium, Germany, Latvia, Portugal, Spain, France, Romania, Poland, the Netherlands and Sweden. Most existing H2 strategies are relatively recent; details are provided in the Annex (question 23). France, Germany, and the Netherlands have published a dedicated H2 strategy or vision, while several other NRAs report ongoing discussions regarding the role of H2, in particular in the context of

[15] Involving several of the following stakeholders: NRAs, Member States, Operators, Industry Associations, Consumer Associations, Manufactures, Standardisation Committees.
[16] Austria and Hungary also report the existence of dedicated H2 pipeline networks at oil refineries, but it is our understanding that internal H2 pipelines are common inside most refineries.
[17] In 2020, about 95% of hydrogen is produced from natural gas (steam reforming or partial oxidation methods) and coal (coal gasification), with the remainder being produced from biomass (biomass gasification or steam reforming, or biological conversion) and via water electrolysis.

the national energy and climate plans (NECPs), but also in recovery plans in the aftermath of the COVID-19 pandemic and the more ambitious decarbonisation targets currently being discussed.

2.3 H2 concentration in gases from non-conventional sources

The survey examined how "non-conventional gas" terminology is used across MSs. Some MSs[18] define biogas, or other gases produced from biomass or via other microbial digestion process, as "gas from non-conventional sources". This terminology is generally not applicable in other MSs. **19 out of 23 respondents (83%) indicate that the term "gases from non-conventional sources'' is not defined in their MS for the purpose of setting H2 limits**. Only Austria, Latvia, the Netherlands and Spain report that the term is defined. These MSs have also established a maximum concentration limit of H2 in "gases from non-conventional sources" that may be injected in their gas transmission system. In Italy, while there is no definition of "gas from non-conventional sources", a maximum content of H2 was introduced for biomethane.

2.4 H2 injection at TSO level

Most NRAs (16 out of 23, 70%) report that H2 injection into the gas transmission network is <u>not</u> possible. The remaining 7 NRAs indicate either that direct injection is possible (France, Germany and Sweden), or that injection is possible but in a "premix" of gases (Austria[19], Lithuania[20], the Netherlands and Spain). However, in Germany direct injection of H2 is only possible if the H2 is produced at power-to-gas (PtG) facilities. In Italy, quality standards do not prescribe a maximum amount of H2 for natural gas injections. However, since H2 concentration impacts major gas parameters (GCV, Wobbe index), meaningful concentrations of H2 in the injected gas are "de facto" not feasible, as they would render the gas quality unacceptable. Therefore, a producer who wants to inject H2 into the grid would have first to blend it with natural gas to make the resulting gas quality acceptable. In certain exceptional circumstances, the TSO can accept gas which does not comply with quality standards, based on a case by case assessment. In Latvia, direct H2 injection at TSO level is not possible due to technical features and there are no H2 injections points, but the regulations set out a maximum limit for H2 concentration, as part of limits for impurities in the natural gas composition.

Regarding **how the location of H2 injection points on the gas transmission network is determined** and the level of coordination with the electricity sector, which may be relevant to signal suitable locations for P2H facilities, several NRAs shared information. In Austria and Belgium, there are currently no specific provisions, but there are plans to formulate them in coordination with the electricity sector. In France, technical rules for the purpose are currently under definition and discussion. Zones for possible H2 injection will be determined by the gas network operators. In Germany, the operator of the H2 production plant decides on H2 injection points, and there is currently no coordination with the electricity sector. However,

[18] The Spanish regulation determines the following: gases from "non-conventional sources" introduced in the Spanish gas system should have a maximum H2 content of 5% mol. and minimum CH4 content of 90% mol. at 0ºC and 1 bar, where "no conventional sources" are biogas or other gases proceeding from biomass or other microbial digestion process.
[19] Depending from the quantity of injected H2 and the collecting pipeline. Direct injection is possible for small experimental plants.
[20] In Lithuania, it is legally possible to inject H2 in the gas transmission system. However, in practice currently there are no injections of H2 at transmission system level.

most MS have not yet started discussions on rules or principles for the location of H2 injection points.

In most MSs H2 production plants (i.e. electrolysers) are not owned and operated by TSO, and are not TSO's assets. **Most H2 electrolysers which are already in operation are pilot plants owned and operated by non-regulated commercial entities, sometimes in a partnership with the TSO.** Most respondents (Denmark, France, Germany, Netherlands, Portugal, Spain) noted that H2 production plants are not allowed to be TSO assets, nor are planned to be, in line with an understanding that unbundling rules apply and will apply to H2 production. However, the TSOs in Spain are developing pilot projects, mainly via subsidiary companies, and the TSOs in Austria have participated, together with other shareholders, in the construction of two experimental small plants. Sweden considers TSO co-ownership of H2 production plants and their integration in the TSO's assets. Country-specific details are available in the Annex (question 28).

Another issue relevant for the injection of H2 into the gas transmission network **is the management of the stability of the H2 concentration.** Most MSs do not face this issue, since H2 injection is not yet possible. Germany reports that TSOs need to check that the H2 concentration is stable, and that TSOs may refuse further injection if stability becomes an issue.

The issue whether an obligation exists to provide information in line with third-party access (TPA) rules for H2 injection was partially addressed in the questionnaire by **the question whether network operators are obliged to publish current and future available capacity for H2 injection** into the gas transmission network. No NRA reported the existence of such an obligation at this time, showing that this issue is seen as rather premature, given the status quo of actual H2 injections.

Only Germany reports the existence of an obligation for network operators to provide a connection point for H2 injection upon a request by a network user. The TSO is obliged to verify whether it is possible to inject H2.

Regarding H2 injection points and capacities, Portugal reports that in the new draft law for the gas networks it is foreseen that operators shall provide information about capacity for H2 (and other low-carbon gases) injection into the network at different points, as well as provide a connection upon request by a producer (if capacity is available).

2.5 Biomethane injection at TSO level

Unlike H2 injection, the injection of biomethane appears not to be problematic. This is not surprising given that biomethane has the same or very similar chemical composition as natural gas. **Reverse flow capacity** from the distribution to the transmission network may be required to enable the injection of locally produced biogas, once upgraded to biomethane, into the gas transmission network at appropriate pressure. In such cases, additional facilities are needed to enable the injection of biomethane into the transmission network, e.g. gas quality upgrading installations (i.e. from biogas to biomethane) and injection facilities. The investment associated with enabling such reverse flow is only needed when volumes of locally produced biogas and/or biomethane exceed the demand for these products within the distribution network (e.g. during the summer). **Another way to inject biomethane** into the transmission network **is by** using a **direct connection** between the biogas plant (in this case it is likely to be a large production plant) and the gas transmission network, including the necessary facilities for quality upgrading and injection.

The results of the survey show that currently **Denmark, France, Germany, Italy, Spain, the Netherlands and Sweden already have injections of biomethane into TSO systems. In**

addition to the MSs indicated above, Austria and Poland report that reverse flow from distribution to transmission and/or direct injection from biomethane plants is possible. The majority of respondents, however, report that reverse flow and/or direct injection is not yet feasible (13 out of 22, 59%).

Several NRAs provide additional comments on this topic. **Austria and the Czech Republic** report the existence of biogas injections at DSO level and mention that biogas producers are responsible for gas quality maintenance according to the requirements. The **Danish** TSO operates the injection plants, including gas compression. The biogas producers operate the upgrading plants that make biomethane from biogas. In **France**, the upgrading of biogas to biomethane is handled by the biogas producers. The TSO is responsible for the operation and the maintenance of the connection facilities, and monitors the quality of the biomethane before injection. In **Germany**, a biomethane plant owner who wants to inject into the network is responsible for gas quality. **Italy** reports that the owner of the biomethane plant is responsible for complying with quality standards, and that the TSO can interrupt injection if the quality does not meet the requirements. In **Spain,** the biomethane producer is also responsible for meeting gas quality standards for injection. In **Sweden,** the biomethane producer operates the gas quality upgrading facility, while the TSO operates the injection facility.

Overall, biogas producers are in most instances responsible for gas quality upgrading to biomethane prior to injection into the grid (Austria, the Czech Republic, Denmark, France, Germany, Italy, Latvia, the Netherlands, Spain and Sweden).

6 NRAs (Belgium, Denmark, Italy, the Netherlands, Slovenia and Italy) **report that investments/adaptations are foreseen in the current NDP in order to allow for (or increase) the injection of biomethane in the gas transmission system. In several instances, there are targets for biomethane injection capacities.** Detailed responses are available in the Annex (question 35).

Only **France reports the existence of obligations for network operators to publish actual and future available capacity for biomethane injection** into the gas transmission network.

15 NRAs (68%) report the existence of obligations for network operators to provide a connection point for biomethane injection upon a request by a network user. No such obligations currently exist in Belgium (at least not on TSO level), Portugal, Slovakia, Poland and Sweden. In **Denmark**, the obligation to provide a connection is for both the DSO and the TSO, with the cost distribution and the determination of connection point being regulated by the natural gas act. In **France**, network operators are obliged to provide a biomethane connection point (at DSO or TSO levels) in cases where the cost of this connection is below a given threshold. The 'right to inject' was adopted by a decree published in June 2019, and the French NRA introduced an injection tariff, which is valid for the new regulatory period from April 2020. In **Germany**, the natural gas network operator is obliged to check whether it is possible to inject biomethane. In **Hungary,** the biomethane producer must finance the necessary investment for the connection, while the technical conditions for that are defined by the TSO. The connection project can be managed by either the TSO or the biogas producer, but once the connection is commissioned, the TSO is the owner and the operator. In **Ireland**, the TSO is developing a blueprint for biomethane 'central grid injection' in order to enable the future construction of such facilities. A connection point must be provided by the TSO, as long as the connection request meets the relevant technical and economic requirements. In Italy, there is no reverse flow from DSOs to the TSO at this time, but there are direct biomethane injections in the TSO's network. In **Poland**, a biomethane plant which is connected to the network has to follow the rules defined by the TSO. In **Portugal**, according to draft legislation, operators shall provide information about capacity available for the injection of hydrogen and other low carbon gases (such as biomethane) into the network at different points, as well as

provide a connection point upon request by a producer (if capacity is available). Detailed information is available in the Annex (questions 36-37).

3. PRELIMINARY INSIGHTS

The responses of 23 NRAs regarding the readiness of gas transmission networks to accept H2 and/or biomethane, as well the foreseen developments to enable such acceptance, illustrate a status quo characterised by great diversity and, in some instances, inconsistencies. The ability of the gas transmission networks to handle H2 and biomethane injections varies greatly across the EU. It is also currently at a very early stage of development, being mainly driven by pilot projects for the production and the injection of H2 and/or biomethane, with biomethane apparently somewhat more advanced.

The NRAs generally support the harmonisation of H2 blending limits across the EU. The introduction of H2 and biomethane into the gas transmission networks should take into account technical characteristics of the networks and safety considerations but not hamper cross-border gas trading and market integration. Although the survey results were quite mixed in terms of minimum blending limits, they prompted further discussion amongst regulators. Through these discussions, **an overall support emerged amongst NRAs that blending limits should be at least 2% H2**. However, **further investigation is needed to consider the option of separate H2 networks vs. H2 blending**. One possible solution is to develop dedicated H2 networks (also via repurposing), open to third-party access and subject to relevant network codes while also developing in parallel the ability to accept H2 and biomethane in existing networks. H2 blending is likely to be a temporary or transitional solution, given the existence of technical and economic ceiling on H2 concentration by volume that traditional gas infrastructure can handle. It seems preferable to create separate 100% H2 networks, so that the economic value of H2 could be tapped in full. Such an approach would also consider the fact that some industries need pure hydrogen, as well as the need to retrofit end-user equipment to accommodate higher H2 blending limits (i.e. market area conversion from natural gas to H2 would be necessary).

Consequently, and in line with the general support expressed by NRAs for considering introducing EU-harmonised H2 blending limits, in case different H2 blending limits constitute a barrier to gas cross border flows, quality standards may need to be revised accordingly at EU level, in order to ensure system interoperability and unimpeded gas flow between MS, both key for preserving the internal gas market.

Regardless of the actual choice for a H2 concentration limit, essential network adaptations are required in order to allow H2 injections. Metering equipment requires upgrades or chromatograph replacement in order to be able to measure H2 concentrations. Gas turbines, compressor stations, CNG tanks and some types of storage can only accept low H2 concentration (< 5%), and may also need retrofitting.

Moreover, end-user equipment may not accept higher or variable quantities of H2, which necessitates further detailed studies.

Network readiness to start H2 injection deserves appropriate attention in network development planning. TSOs may get additional responsibilities in order to enable H2 blending, in particular in terms of dispatching and gas quality (blending quality) control in the system.

The responsibilities of TSOs regarding H2 production facilities deserve further attention at national and EU level.

As **long as biogas is upgraded to biomethane that meets natural gas pipeline specifications, interoperability and injection of biomethane are not an issue**. However,

gas quality upgrading facilities as well as injection facilities (the latter may include compression) are needed (along with the necessary investments) in order to enable reverse flow capacity from distribution to transmission network, in cases where biogas/biomethane are produced at DSO level. The role of the TSOs regarding these investments and the operation of the assets deserves further attention at national level in some MSs, and also at EU level.

Not surprisingly, the results of the survey show that **developments regarding the readiness of the gas transmission network to accept H2 and to allow the injection of biomethane are at an early, to a large extent experimental or pilot, stage**. This may be due to the absence of a clear policy direction that would steer the necessary regulatory framework for these alternative gases at national and EU level, and to the limited attention these network adaptations have received so far in gas network development plans. Technology developments, legal and regulatory, and network development efforts should go hand in hand in order to achieve an efficient and timely decarbonisation of the gas sector.

4. QUESTIONNAIRE RESPONSES

4.1 H2 blending

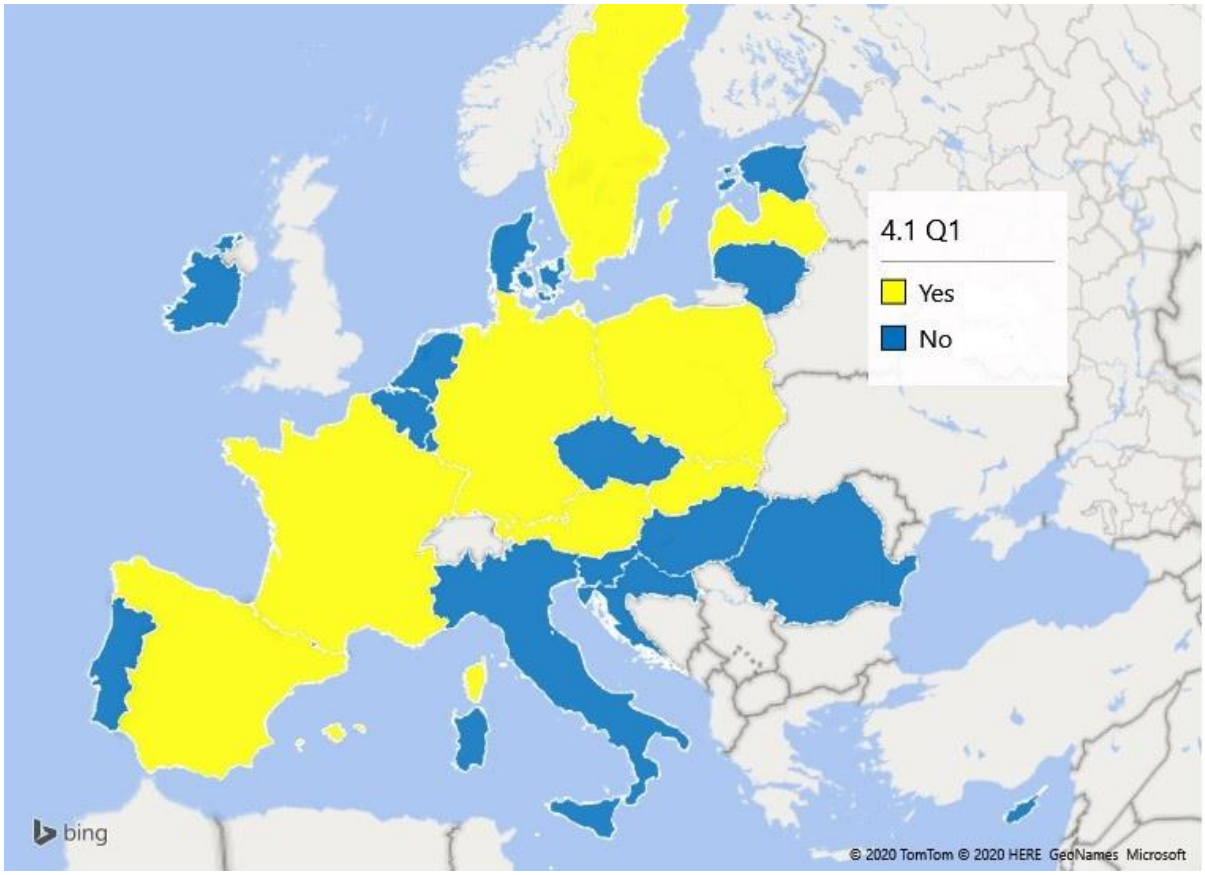
Q1. Do TSOs accept the injection or allow H2 volumes into the gas transmission network in your MS?[21]

Answers to Q1	Number	%
No	**15**	**65%**
Belgium		
Cyprus		
Czech Republic		
Denmark		
Estonia		
Hungary		
Ireland		
Italy		
Lithuania[22]		
Luxembourg		
Portugal		
Slovenia		
Romania		
Netherlands		
Croatia		
Yes	**8**	**35%**
Austria		
Germany		
Latvia		
Slovak Republic		
Spain		
Poland[23]		
Sweden		
France		
Grand Total	**23**	**100%**

[21] I.e. it is technically possible at this stage to inject or allow H2 volumes into the gas transmission network

[22] Lithuanian NRA replied no acceptance of H2. However, it seems legally possible to inject H2 into the Lithuanian TSO system, although currently there are no such H2 injections.

[23] Polish NRA replied yes. However, it later clarified that H2 blending has not happened in Poland yet. The TSO is assessing the possibility of H2 blending as well as the limits of H2.



Map, Q1. **Summary:** In most (65%) Member States (MSs), TSOs do not accept the injection or allow H2 volumes into the gas transmission network. In the following 7 MS, TSOs accept injection of H2 at TSO level: Austria, France, Germany, Latvia, Slovak Republic, Spain and Sweden. 15 NRAs provided comments related to this question.

Reporting NRA's Member State (*)	Textbox for comments Q.1
Austria	Up to now, just very low H2 quantities have been injected. For this reason, no premix was necessary
Belgium	Currently, the Belgian TSO does not accept the injection of H2 in the transmission network. However, feasibility studies as well as initiatives to revise the legal (e.g. gas law, gas quality) and regulatory framework (e.g. access code) are ongoing in order to accept H2 injections.
Cyprus	There is no gas market in Cyprus yet, therefore there is no gas transmission network and no TSO.
Denmark	Currently, it is not allowed to inject H2 into the transmission grid. However, the TSO will go into a dialogue with the relevant authority on the future possibilities.
France	A dedicated "injection working group" (including the regulator, French public administration, associations and gas operators) is working to define the rules and technical requirements for connection and injection. First technical studies are being conducted. There are already injections taking place at a very small scale in the frame of demonstration projects managed by the gas TSO.

Italy	For biomethane injections, a maximum H2 concentration of 1% vol. is allowed (Technical Rule UNI/TS 11537:2019). For other injections (e.g. H2), what matters is the potential impact on other quality standards. Recently, SNAM launched small-scale experimental projects for injecting up to 10% H2 blends into a portion of gas transmission network serving industrial customers.
Lithuania	Legally it is possible to inject H2 into transmission system, if the gas meets quality specifications.
Luxembourg	The TSO is assessing the technical constraints and necessary measures to cope with different volumes of H2 in the gas transmission network.
Netherlands	The current legislation (Gas Act) does not allow a Dutch TSO to accept pure H2 injection into the gas grid. At exit points, the limit in the high pressure grid is only 0.02 vol. %.
Poland	Technically it is possible, but Poland doesn't have specific regulations and did not stipulate specific H2 volumes.
Portugal	The conditions for receiving H2 into the gas network are not defined, although the Government is drafting that framework.
Slovak Republic	Eustream a.s., as the Slovak operator, allows max. 2% H2 in natural gas, provided that some investments are made into the measuring systems, related mainly to gas quality measurement. No customers are connected to the TSO network.
Slovenia	The transmission system is not yet ready for H2 injection. Studies and analyses are ongoing.
Spain	The legislation allows injection of non-conventional gases in the transmission network, as long as they comply with specific standards established in the Spanish Network Code. Although there is no specific legislation for H2, TSOs in Spain are developing some "pilot projects" for injecting H2 in the network. These projects were presented in the last IG meeting of the South Gas Regional Initiative.
Sweden	The Swedish TSO (Swedegas) follows the CEN recommendations and rules regarding H2 injection. Nordion Energy also supports the work from GEODE - The Voice of Local Energy Distributors across Europe.

Q2. Do gas quality standards in your Member State (MS) allow for H2 volumes?

Answers to Q2	Number	%
No	**18**	**78%**
Belgium		
Cyprus		
Czech Republic		
Denmark		
Estonia		
Hungary		
Ireland		
Italy		
Luxembourg		
Portugal		
Slovak Republic		
Slovenia		
Spain		
Romania		
Poland		

Netherlands		
Sweden		
Croatia		
Yes	**5**	**22%**
Austria		
Germany		
Latvia		
Lithuania		
France		
Grand Total	**23**	**100%**

Summary: In most (78%) Member States, gas quality standards do **not** allow for H2 volumes. In the following 5 MS, gas quality standards allow for H2 volumes: Austria, Germany, France Latvia and Lithuania. 17 NRAs provided comments related to this question.

Reporting NRA's Member State (*)	Textbox for comments Q2
Austria	OVGW Norm G31 of 2001 allows for max 4% mol.
Belgium	Gas quality issues are currently under revision in order to accept H2 in the Belgian transmission network.
Croatia	For now, the standard gas quality doesn't set min/max value for H2.
Cyprus	There is no gas market in Cyprus yet, therefore there are no quality standards defined yet.
Czech Republic	Technical standard for gas fuels quality testing states that 2 % mol. of H2 are possible. However, due to the fact that the Czech legislation does not impose as obligatory the measurement of hydrogen in natural gas, the TSO (also DSOs) is/are not legally obliged to measure hydrogen concentration or to declare it in gas quality certificates, from statistical point of view it appears that no H_2 "is present.
Denmark	The gas quality requirements set by the Danish Safety Technology Authority do not allow it.
France	Up to 6%. However, the regulatory framework will change, as a law on energy and climate was adopted in November 2019. Art. 52 allows the government to elaborate orders:1) defining the different types of hydrogen depending on its source of production; 2) allowing production, transportation, storage and traceability of hydrogen; 3) defining a support framework for low-carbon hydrogen and H2 from RES.
Hungary	It is not explicitly prohibited in the current regulation (Annex 11 of Government Decree 19/2009 (I. 30.) on the Implementation of the Provisions of Act XL of 2008 on Natural Gas Supply ('Natural Gas Law'), but it is not mentioned either.
Italy	At the moment, there are no specific standards concerning H2 injection into the gas grid. Concerning the injection of biomethane, a maximum H2 concentration of 1% vol. at standard conditions is allowed (Technical Rule UNI/TS 11537:2019).
Lithuania	H2 concentration should not be higher than 2 % mol.
Luxembourg	Gas quality is compliant with EASEE-gas recommendations, and in particular with the specifications of Common Business Practice “Gas Quality Harmonisation”.
Netherlands	Only “blends” are allowed, see Q1
Poland	Gas quality standards do not regulate specifically hydrogen, but there are general parameters for gas quality. Gas in the network must fulfil these standards.

Portugal	The conditions for receiving H2 into the gas network are not defined, although the Government is drafting that framework.
Slovenia	Currently, the law does not allow H2 volumes.
Spain	Not specifically, but the Spanish Network Code establishes standards for non-conventional gases in general.
Sweden	In Sweden, the TSO (Swedegas) follows the CEN recommendations and rules regarding H2 injection. Swedegas also supports the work from GEODE - The Voice of Local Energy Distributors across Europe".

Q3. Is it legally/regulatory possible to inject or allow H2 volumes into the gas transmission network?

Answers to Q3	Number	%
No	**17**	**74%**
Belgium		
Cyprus		
Czech Republic		
Denmark[24]		
Estonia		
Hungary		
Ireland		
Italy		
Luxembourg		
Portugal		
Slovak Republic		
Slovenia		
Romania		
Poland		
Netherlands		
Sweden		
Croatia		
Yes	**6**	**26%**
Austria		
Germany		
Latvia		
Lithuania		
Spain		
France[25]		
Grand Total	**23**	**100%**

Summary: More than 70% of NRAs answered that it is either not legally or regulatory possible to inject H2 volumes into their respective gas transmission networks. 6 countries (26%), on the other hand, responded that this is possible.

[24] The Danish Gas Act does not hinder the possibility of injecting H2 into the gas transmission network, but the Danish Safety Technology Authority does not allow it.
[25] In France, the regulatory framework for H2 injection apart from demonstration projects is still under elaboration.

Q4. What is the current maximum H2 concentration accepted by the TSOs in the natural gas transmission networks?

Between 0 and 20 % vol. at normal conditions

Member State	Max. value in % vol.	Comments
Austria	4	
Belgium	0	
Cyprus	0	
Czech Republic	0	
Denmark	0	
Estonia	0	
Germany	10	This limit is only allowed if no "sensitive" customer is connected to the network. e.g., if a natural gas filling station for vehicles is connected to the gas network, only 2% is permitted in the gas flowing in the network.
Hungary	0	
Ireland	0.1	
Italy	1	In Italy, 1% H2 concentration is allowed for biomethane injections. This figure does not represent H2 blending limit at transmission level. No specific threshold is set for injections, other than biomethane, provided the overall compliance with gas quality standards is ensured.
Latvia	0.1	
Lithuania	2	It seems legally possible to inject H2 into the Lithuanian TSO system, although currently there are no such H2 injections.
Luxembourg	0	
Portugal	0	
Slovak Republic	0	There is no explicitly defined limit. H2 could be present in imported gas, up to 2% maximum, but not directly injected.
Slovenia	0	
Spain	5	In Spain, 5% H2 concentrations are allowed in the “so-called” non-conventional gases, thus this figure does not represent H2 blending limit at transmission level.
France	6	Gas quality standards allow for up to 6% H2 concentration.
Romania	0	
Poland	0	
Netherlands	0.02	Dutch law does not allow a TSO to accept pure H2 injection into the gas grid. At exit points, the limit in the high pressure grid is 0.02 vol. %. H2 is allowed to be in the system after being injected as a premix.
Sweden	0	
Croatia	0	

Summary: Out of the 23 respondents, Germany has the highest H2 concentration limit (10%) under the conditions mentioned in the table, followed by France (6%), Spain (5%)[26] and

[26] In Spain, 5% H2 concentrations are allowed in the “so-called” non-conventional gases, thus this figure does not represent the H2 blending limit at gas transmission level.

Austria (4%). Four more countries allow for a more modest concentration of H2 in their natural gas transmission networks: Lithuania (2%), Italy (1%), Latvia (0.1%), Ireland (0.1%) and Netherlands (0.02%). Over 60% of MSs did not provide an answer or stated that H2 volumes are not possible, according to responses.

Q5. Is it the same H2 blending limit for all gas transmission networks in your Member State?

Case of multi-TSO countries or part of transmission networks with "pilot projects" on H2 injection

Answers to Q5	Number	%
No answer	**16**	**70%**
Belgium		
Cyprus		
Czech Republic		
Denmark		
Estonia		
Hungary		
Ireland		
Italy		
Lithuania		
Luxembourg		
Portugal		
Slovenia		
France		
Romania		
Netherlands		
Croatia		
No	**2**	**9%**
Germany		
Poland		
Yes	**5**	**22%**
Austria		
Latvia		
Slovak Republic		
Spain		
Sweden		
Grand Total	**22**	**100%**

Summary: 22% of respondents (Austria, Latvia, Slovakia, Spain, Sweden) noted that the same H2 blending limit applies for all gas transmission networks in their respective Member States. Only Germany and Poland (9%) answered that the blending limit is not the same for their respective gas transmission networks. 16 countries (70%) did not provide an answer to the question.

Q6. Which is the main justification to set up such a H2 limit in term of gas quality requirements at transmission level?

E.g. safety concerns, some end-user equipment cannot accept higher limits of H2, network components cannot accept higher limits, restrictions of industrial processes where natural gas is used as feedstock, etc.

Reporting NRA's Member State (*)	Justification
Austria	The reason is not explicitly stated. Presumably there are different reasons, e.g. related to explosion concerns, Wobbe index must stay within certain range appliance acceptance.
Belgium	The entire system - infrastructure, network management as well as contracts, legal and regulatory framework - are based on the 0% H2 acceptance requirement. This set-up is currently under revision.
Croatia	Main concerns are related to safety issues applicable to TSO equipment, gas storage operations, industrial sensitive equipment, gas specification requirements for fertilizer plants, and end-user appliances. There is a lack of comprehensive studies regarding allowable limits for H2 mixing in natural gas.
Cyprus	N.A.
Czech Republic	The issue is under investigation - technical committees and associations (TSO, DSO, industry) in collaboration with the relevant Ministry are discussing this topic trying to find potential concentration (the consensus of technical representatives is mainly on the level of 2 % vol.). Also, the new Energy Act is currently under discussion, it should contain the revised definition of "gas" including other (alternative) types of gases, which would allow to make legislative and practical changes in the system set-up.
Denmark	The main concern is related to safety and tolerances of end-use equipment. Our TSO has made studies of end-user tolerances. According to the TSO, the network components, by the TSO's own studies, have been proven to be able to handle at least 10 % H2 blending.
France	The main constraints identified by the French gas operators study (Technical-economic conditions for injecting hydrogen into natural gas networks, 2019) relate to the sensitivity of specific industrial processes, as well as natural gas vehicles (NGV) charging stations (2% H2 allowed) and end-users appliances on the consumption side, and technical acceptance for network components on the network side.
Estonia	N.A.
Germany	End-user equipment cannot accept higher limits of H2.
Hungary	
Ireland	
Italy	Main concerns relate to underground gas storages (it is still not clear how they would behave with higher concentrations of H2), gas-fuelled vehicles (for which components are approved for a concentration of 2% vol, see Rule UN ECE R110), engines and turbines (some of these are approved for a maximum concentration of 1% vol.).
Latvia	H2 limits are set based on safety concerns and on the possibility of network components to accept H2, including the potential impact on Inčukalns Underground Gas Storage facility and whether the end-users equipment is adjusted to the H2 standards.
Lithuania	The Ministry of Energy of the Republic of Lithuania is responsible for setting quality requirements.
Luxembourg	No regulatory framework is in place today. The TSO sees restrictions regarding the gas quality for end consumers, as end-user equipment and industrial process are not designed for gas containing H2. DVGW Standards related to gas quality applicable at TSO level set the H2 limits in the LU transmission grid.
Poland	All issues expressed above, like safety concerns, some end-user equipment cannot accept higher limits, should be taken into consideration.
Portugal	n.a.
Slovak Republic	As it is the main corridor for Russian gas to Europe, safety concern is important, lack of technical information, requirement of investment.
Slovenia	Legislation

Spain	Safety concerns and technical network limits.
Sweden	All of the above justifications limit the use of H2 in Sweden. E.g., safety concerns, some end-user equipment cannot accept higher limits of H2, network components cannot accept higher limits, restrictions of industrial processes where natural gas is used as feedstock, etc.

Q7. If applicable, has any problem / major incident been experienced in relation to the injection of H2 in the natural gas transmission network?

Not applicable or no experiences with H2 injection in all instances.

Q8. Are there are any incentives in the MS for TSOs to develop projects for H2 injection into the gas transmission system?

Reporting NRA's Member State (*)	Incentives in the MS for TSOs to develop projects for H2 injection into the gas transmission system
Austria	There are incentives for projects with an increased efficiency or innovative character; H2 projects could belong to this category.
Belgium	Yes. The tariff setting for the Belgian TSO in the period 2020-2023 contains incentives related to the connection of H2 and biomethane production and/or injection installations. https://www.creg.be/sites/default/files/assets/Publications/Decisions/B656G39FR.pdf
Croatia	Currently none
Cyprus	n.a.
Czech Republic	Not yet, however the TSO prepares an innovative project on private basis to test H2 limits and P2G devices. Funding on governmental basis might be possible - Action Plan Smart Grids (possibly some EU funding).
Denmark	No, but the TSO does it on its own initiative, to be prepared for future developments. Furthermore, the regulation gives the Danish TSO a general obligation to support and promote sustainable energy use.
Estonia	No
France	As of today, there are no incentives in the framework.
Germany	No
Hungary	No
Ireland	There are no incentives of this type. However, the TSO has an innovation allowance which allows it to invest in innovative projects with the potential to decarbonise the network and achieve other benefits. The allowance could be used for innovative projects related to hydrogen.
Italy	There are currently no regulatory incentives. A consultation is currently ongoing and foresees possible incentives for P2G pilot projects, potentially including those allowing the injection of H2 in the network.
Latvia	Currently there are no regulatory incentives. According to point 6.2 of Annex 4 to the National Energy and Climate Plan for 2021-2030, a study on de-carbonization of the gas network and on options for adapting the natural gas transmission system and the Inčukalns UGS to the input of RES - hydrogen and other gaseous fuels (non-methane) - should be carried out
Lithuania	No incentives.
Luxembourg	Currently no incentives are defined at MS level for specific H2 injection projects. Support schemes for H2 projects might be developed according to political priorities to fulfil national decarbonisation objectives.

Netherlands	No. Based on the Gas Act, GTS (TSO) does not have a legal task to transport H2. Therefore, GTS is not allowed to be involved in transporting H2. There is legislation under development that could incentivize network operators by allowing for experiments and setting a temporary task to transport H2.
Poland	N.A.
Portugal	No.
Slovak Republic	No. The role of the TSO is to secure the main corridor for the Russian gas transport to Europe and to secure deliveries to Ukraine. More than 90% of the transported gas through the TSO network is dedicated for other countries rather than Slovakia. The potential incentives could be considered for the DSOs.
Slovenia	No
Spain	No
Sweden	Swedegas follows closely the H2 blending project in Denmark with the TSO Eenrginet regarding H2 injection into the gas transmission system. In Sweden, there are today no any developed projects for H2 injection into the gas transmission system.

Summary: With the exception of 2 respondents (Austria and Belgium) all other 20 respondents (91%) highlighted that there are currently no incentives in the MS for TSOs to develop projects for H2 injection into the gas transmission system.

Q 9. Are you aware of H2 adaptations/investments blending projects in order to accept or increase H2 acceptance in gas transmission in your MS?

Answers to Q9	Number	%
No	**10**	**43%**
Austria		
Cyprus		
Denmark		
Estonia		
Hungary		
Ireland		
Latvia		
Lithuania		
Luxembourg		
Croatia		
Yes	**13**	**57%**
Belgium		
Czech Republic		
Germany		
Italy		
Portugal		
Slovak Republic		
Slovenia		
Spain		
France		
Romania		
Poland		
Sweden		
Netherlands		
Grand Total	**23**	**100%**

Summary: 13 NRAs (57%) answered that they are aware of H2 adaptations/investments in blending projects, while 10 of respondents (43%) were not aware of such projects.

Q 10. Are there plans to increase the H2 acceptance into natural gas networks in your MS?

Answers to Q10	Number	%
No	**10**	**43%**
Cyprus		
Denmark		
Estonia		
Ireland		
Lithuania		
Slovak Republic		
France		
Romania		
Poland		
Croatia		
Yes	**13**	**57%**
Austria		
Belgium		
Czech Republic		
Germany		
Hungary		
Italy		
Latvia		
Luxembourg		
Portugal		
Slovenia		
Spain		
Sweden		
Netherlands		
Grand Total	**23**	**100%**

Summary: 13 NRAs (nearly 60% of total respondents) reported plans to increase the H2 acceptance into natural gas networks for their respective MS.

Q11. Are investments/adaptations foreseen in the current NDP to allow or increase the TSO acceptance of H2?

Answers to Q11	Number	%
No	**20**	**87%**
Austria		
Cyprus		
Czech Republic		
Denmark[27]		

[27] Although not part of the NDP, the Danish Gas TSO is involved in several projects and studies looking at H2-blending and hydrogen infrastructure, i.e. technical and regulatory limitations, possibilities of joint infrastructure planning between power and gas TSOs. More information is available at Energinet's (combined Danish gas-power TSO) strategic plan for Power-to-X and hydrogen:
https://en.energinet.dk/About-our-reports/Reports/New-winds---strategy
https://en.energinet.dk/About-our-reports/Reports/Annual-Magazine-2020

Estonia		
Germany		
Hungary		
Ireland		
Italy		
Latvia		
Lithuania		
Luxembourg		
Portugal		
Slovak Republic		
Spain		
Romania		
Poland		
Sweden		
Netherlands		
Croatia		
Yes	**3**	**13%**
Belgium		
Slovenia		
France		
Grand Total	**23**	**100%**

Summary: With the exception of Belgium, France and Slovenia (13%), all other NDPs do not foresee any investments/adaptations for increasing the TSO acceptance of H2.

Reporting NRA's Member State	Q11. Are investments/adaptations foreseen in the current NDP to allow or increase the TSO acceptance of H2?	If yes, to which level of H2 and by when? Which type of investments/adaptations are foreseen?
Belgium	Yes	Level of H2 acceptance is not yet defined. The legal (gas law) as well as the regulatory framework are currently under revision in order to allow for the TSO's acceptance of H2. There is a need for a revision of the gas quality specifications as well. The TSO's NDP 2020-2023 (indicative) contains a program to adapt/invest in order to get chromatographs able to measure the H2 content in the transported gas.
France	Yes	The injection WG is working to define technical and contractual rules with the regulator and the Ministry, so there are no official H2 level targeted and no plans right now. CRE allowed the first step of an investment for the FenHyx project, which aims at testing the readiness of network components for H2

https://en.energinet.dk/About-our-news/News/2019/05/21/Danish-gas-system-able-to-store-wind-energy The Danish Gas Storage company is also looking into converting several salt caverns used for gas storage into hydrogen storage. Several commercial players are involved in the project. Please find some information following this link: https://energinet.dk/Analyse-og-Forskning/Analyser/RS-Analyse-April-2019-PtX-i-Danmark-foer-2030

		injection. These tests are done in laboratory and not directly on the transmission network.
Slovenia	Yes	Currently, studies and analysis are ongoing.

Q12. Is there a H2 blending target for the TSO? – specify in [% vol.] and target year

Reporting NRA's Member State (*)	Q12. Is there a H2 blending target for the TSO? – specify in [% vol.] and target year
Austria	Not officially. Discussion points to 10% vol.
Belgium	There is no target defined yet. However, the TSO is studying possible H2 blending targets.
Croatia	There is no target at the moment.
Cyprus	N.A.
Czech Republic	--
Denmark	N.A.
Estonia	No
France	French TSOs promote a 10% blending target by 2030.
Germany	
Hungary	
Ireland	No, there is no H2 blending target for the TSO at present. It is a strategic goal of CRU (Irish NRA) to increase the amount gas from renewable sources on the network but there are no specific plans related to hydrogen at this time.
Italy	There are no explicit blending targets for the TSO.
Latvia	There is currently no H2 blending target for the TSO
Lithuania	No.
Luxembourg	The TSO is currently assessing with neighbouring TSOs the impact of different % vol. H2 available on the IPs on the national transport and distribution infrastructure and end-customer applications. National H2 blending target should at least be aligned with % vol. delivered by neighbouring TSOs on the IPs.
Netherlands	No. In addition to Q11: GTS is not allowed to invest in hydrogen infrastructure under current regulations. Therefore there are no hydrogen-related investments in the NDP. GTS has made a first analysis of the investments that would be required to facilitate higher H2 vol. %. These mainly entail the replacement of certain gas quality measuring equipment.
Poland	No
Portugal	No
Romania	
Slovak Republic	No. The target could be set on the basis of the outcomes of the ongoing technical and financial analysis.
Slovenia	No
Spain	No
Sweden	No blending target. Swedegas follows the CEN standard for H2 injection as answered in Q2 above.

Summary: **All** respondents highlighted that there are currently **no** H2 blending targets for their TSOs, although in some MSs (Austria, Belgium, France, Ireland, and Luxembourg) there are ongoing studies and discussions on possible blending targets.

Q13. Is there a H2 limit for cross-border interconnection points (i.e. is it possible to import / export gas with H2 content)?

Answers to Q13	Number	%
No	**16**	**70%**
Belgium		
Cyprus		
Czech Republic		
Estonia		
Hungary		
Ireland		
Italy		
Luxembourg		
Portugal		
Slovak Republic		
Slovenia		
France		
Romania		
Poland		
Sweden		
Croatia		
Yes	**7**	**30%**
Austria		
Denmark		
Germany		
Latvia		
Lithuania		
Spain		
Netherlands		
Grand Total	**23**	**100%**

Summary: 16 out of 23 respondents (70%) noted that there is no H2 limit for cross-border interconnection points. Austria, Denmark, Germany, the Netherlands, Latvia, Lithuania and Spain (30%), however, stated that a H2 limit exists.

Q14. If H2 blending limits exist at the cross-border interconnection points, are H2 limits and developments coordinated with neighbouring MSs?

Answers to Q14	Number	%
No answer	**17**	**74%**
Belgium		
Cyprus		
Czech Republic		
Denmark		
Estonia		
Hungary		
Ireland		
Italy		
Luxembourg		
Portugal		
Slovak Republic		
Slovenia		
France		
Romania		

Poland		
Sweden		
Croatia		
No	**5**	**22%**
Austria		
Germany		
Lithuania		
Spain		
Netherlands		
Yes	**1**	**4%**
Latvia		
Grand Total	**23**	**100%**

Summary: 17 out of 23 respondents (74%) could not provide an answer to this question. Austria, Germany, the Netherlands, Lithuania and Spain (22%) responded that H2 limits and developments are not coordinated with neighbouring MSs. Only Latvia stated that there is cooperation.

Q15. If the H2 blending limits are coordinated, are they part of Interconnection Agreements (NC on interoperability)?

Answers to Q15	Number	%
No answer	**22**	**96%**
Austria		
Belgium		
Cyprus		
Czech Republic		
Denmark		
Estonia		
Germany		
Hungary		
Ireland		
Italy		
Lithuania		
Luxembourg		
Portugal		
Slovak Republic		
Slovenia		
Spain		
France		
Romania		
Poland		
Sweden		
Netherlands		
Croatia		
Yes	**1**	**4%**
Latvia		
Grand Total	**23**	**100%**

Summary: Only Latvia (4%) noted that H2 blending limits are part of Interconnection Agreements. No responses were received from other NRAs.

To what extent do you agree with following statements: 0 means I do not have a view, 1- I totally disagree, 2- I disagree, 3- I somewhat agree, 4- I agree, 5- I totally agree.

Reporting NRA's Member State (*)	• H2 blending limits should be defined at EU level	• H2 blending limits should be defined at regional level	• H2 blending limits should be defined at bilateral level between MS	• H2 blending limit should be at least 2% vol. in all MSs	• H2 should not be blended at all. Separate 100% H2 networks should be created to optimise the economic value of H2
Austria	3	0	1	5	5
Belgium	5	1	1	5	1
Croatia	5	2	2	0	3
Cyprus	5				
Czech Republic	4	5	2	4	0
Denmark	4	2	2	4	2
France	4	4	4	4	3
Estonia	0	0	0	0	0
Germany	4	1	2	0	3
Hungary	2	2	4	3	2
Ireland	3	3	3	0	2
Italy					
Latvia	3	5	0	3	0
Lithuania	0	0	0	0	0
Luxembourg	5	5	0	3	1
Netherlands	5	3	3	0	2
Poland	3	4	4	0	0
Portugal	3	4	2	5	1
Romania					
Slovak Republic	0	0	4	2	0
Slovenia	5	3	1	0	1
Spain	3	3	3	2	1
Sweden	5	0	0	0	0
Average [numeric]	***3.4***	***2.4***	***1.9***	***2.0***	***1.4***
Average [qualitative]	3- I somewhat agree	2- I disagree	2- I disagree	2- I disagree	1- I totally disagree

Summary: 17 out of 23 (74%) NRAs either somewhat agreed/agreed/fully agreed that the H2 blending limits should be decided at EU level rather than at a regional or bilateral level. 39% of respondents (9 out of 23) either somewhat agreed/agreed/fully agreed that the H2 blending limits should be at least 2%. Only 4 NRAs (Austria, Croatia, Germany and France) supported that H2 should not be blended, with the intention of stressing that pure H2 has a higher economic value as a commodity, rather than when blended in natural gas.

Q16. Which is the competent authority to set H2 blending limits to be accepted by the TSO in your MS

Q 17. Which organisations should be involved in the process for setting H2 limits?

Reporting NRA's Member State (*)	Q16. Which is the competent authority to set H2 blending limits to be accepted by the TSO in your MS?	[Textbox for comments]Q16	Q 17. Which organisations should be involved in the process for setting H2 limits?
Austria	Others	OVGW : Austrian association for the gas and water sector composed by 857 members divided as 21 Gas network operators 1 Storage Undertaking 1 Distribution area manager 260 Water suppliers 271 Undertakings in sector Gas- und Water 6 Organisations und Institutions 297 Private person	Operators; Industry Associations; Consumer Associations; Manufacturers; Standardisation Committees
Belgium	Ministry(ies)	Gas quality requirements are defined by a Royal Decree.	NRAs; Member States; Operators; Industry Associations; Consumer Associations; Manufacturers; Standardisation Committees
Cyprus	There is no competent authority	There is no gas market in Cyprus yet.	
Croatia	NRAs; Ministry(ies)		NRAs; Member States; Operators; Industry Associations; Consumer Associations; Manufacturers; Standardisation Committees
Czech Republic	Ministry(ies);Committee for Standardisation	Recommendations are made by working groups (members of technical committees (standards), associations, sometimes NRA) then submitted to the Ministry of Industry and Trade for discussion on implementation into legislation.	NRAs; Operators; Industry Associations; Consumer Associations; Standardisation Committees
Denmark	Ministry(ies)	The Danish Safety Technology Authority (Sikkerhedsstyrelsen)	NRAs; Member States; Operators; Industry Associations; Consumer Associations; Manufacturers; Standardisation Committees

France	Ministry(ies);Operators	Operators with administration (DGPR)	Member States; Operators; Industry Associations; Consumer Associations; Manufacturers; Standardisation Committees
Estonia	There is no competent authority		Operators
Germany	Ministry(ies);Others	Others: DVGW is the German member of the Standardisation bodies for the gas and water industries (DIN, CEN and ISO)	NRAs; Member States; Operators; Industry Associations; Consumer Associations; Manufacturers; Standardisation Committees
Hungary	NRAs; Ministry(ies)	System operators should also be involved in the discussion.	Industry Associations; Consumer Associations; Manufacturers; Standardisation Committees
Ireland	NRAs; Operators		
Italy	Committee for Standardisation		Operators; Industry Associations; Manufacturers; Standardisation Committees
Latvia	Ministry(ies);Operators		NRAs; Member States; Operators; Industry Associations; Consumer Associations
Lithuania	Ministry(ies)	The Ministry of Energy of the Republic of Lithuania	NRAs; Member States; Operators; Industry Associations; Consumer Associations ;Manufacturers; Standardisation Committees
Luxembourg	There is no competent authority	NRA and Ministry should assess the H2 limit in cooperation with operators	NRAs; Member States; Operators; Industry Associations; Consumer Associations; Manufacturers; Standardisation Committees
Netherlands	Ministry(ies)		Member States; Operators; Industry Associations; Consumer Associations
Poland	Ministry(ies);Committee for Standardisation		NRAs; Member States; Operators; Industry Associations; Consumer Associations; Manufacturers; Standardisation Committees
Portugal	Ministry(ies)		NRAs; Member States; Operators; Industry Associations; Standardisation Committees
Romania	Ministry(ies)		NRAs; Member States; Operators; Industry Associations; Standardisation Committees
Slovak Republic	Committee for Standardisation		NRAs; Member States; Operators; Industry Associations; Consumer Associations; Manufacturers
Slovenia	Ministry(ies)		NRAs; Member States; Operators; Industry Associations; Consumer Associations; Manufacturers; Standardisation Committees
Spain	Ministry(ies)		NRAs; Member States; Operators; Industry Associations; Consumer Associations; Manufacturers; Standardisation Committees

Sweden	Operators; Others	Others: the Swedish Energy Agency	Operators; Industry Associations; Consumer Associations; Standardisation Committees

In most of instances, the competent authority for setting H2 blending limits are Ministries, followed by Committees for standardisations. Operators and NRAs are mentioned in a few instances as Competent Authorities. NRAs are generally of the view that a wide range of organisations should be involved in the process for setting H2 limits.

4.2 100% H2 dedicated networks

Q 18. Are there currently 100% H2 pipeline networks for industrial purposes in your MS?

Answers to Q18	Number	%
No	**18**	**78%**
Cyprus		
Czech Republic		
Denmark		
Estonia		
Hungary		
Ireland		
Italy		
Latvia		
Lithuania		
Luxembourg		
Portugal		
Slovak Republic		
Slovenia		
Spain		
Romania		
Poland		
Sweden		
Croatia		
Yes	**5**	**22%**
Austria		
Belgium		
Germany		
France		
Netherlands		
Grand Total	**23**	**100%**

Comment: Only Austria, Belgium, Germany, France and the Netherlands (22%) reported the existence of 100% H2 pipeline networks.

Q 19. If yes, does a gas TSO/DSOs operate any of these H2 pipelines?

Answers to Q19	Number	%
No answer	**18**	**78%**
Cyprus		
Czech Republic		
Denmark		
Estonia		

Hungary		
Ireland		
Italy		
Latvia		
Lithuania		
Luxembourg		
Portugal		
Slovak Republic		
Slovenia		
Spain		
Romania		
Poland		
Sweden		
Croatia		
No	**5**	**22%**
Austria		
Belgium		
Germany		
France		
Netherlands		
Grand Total	**23**	**100%**

Summary: TSO/DSOs do not operate 100% H2 pipeline dedicated networks. Those networks are generally used for refineries, fertilizer plants and other industrial sites.

Q 20. If operated by a [DSO/TSO]: Are the H2 dedicated networks part of the regulated asset base?

Summary: respondents indicated that none of the H2 dedicated networks are part of the regulated asset base.

Reporting NRA's Member State (*)	[Textbox for comments]Q20
Austria	Inside refineries
Belgium	There is a highly developed H2 pipeline network in Belgium of more than 600 km with cross-border connections to NL as well as to FR. The H2 pipeline network serves industrial processes (e.g. oil refineries) and is operated by the H2 production companies (e.g. Air Liquide) at a pressure between 10 and 20 bar (diameter 25-30 cm). The Antwerp Port region is an important industrial cluster for H2 production.
France	A 100% H2 pipeline network outside of the regulated network is operated by the private company Air Liquide in the North of France. It links industrial sites in France and crosses the border with Belgium (map available on Air Liquide's website)
Hungary	Yes, for industrial use in refineries and fertilizer plants, but only inside the plant.
Netherlands	Based on current regulation, TSOs and DSOs are not allowed to be involved in these activities.

Q 21. Is the H2 of these networks "green" – i.e. H2 produced from renewable sources via power-to-hydrogen (electrolysers)?

Answers to Q21	Number	%
No answer	**5**	**22%**
Cyprus		
Hungary		
Italy		
Spain		
Romania		
No	**6**	**26%**
Austria		
Belgium		
Germany		
Latvia		
France		
Netherlands		
Not applicable	**12**	**52%**
Czech Republic		
Denmark		
Estonia		
Ireland		
Lithuania		
Luxembourg		
Portugal		
Slovak Republic		
Slovenia		
Poland		
Sweden		
Croatia		
Grand Total	**23**	**100%**

Summary: The H2 currently used in 100% H2 dedicated networks is not "green", i.e. is not produced from renewable sources via power-to-hydrogen.

Q 22. Are there plans in your MS for developing 100% H2 pipelines/networks?

Answers to Q22	Number	%
No	**19**	**83%**
Austria		
Belgium		
Cyprus		
Czech Republic		
Denmark		
Estonia		
Hungary		
Ireland		
Italy		
Latvia		
Lithuania		
Luxembourg		
Portugal		
Slovak Republic		
Slovenia		
Spain		
Romania		
Sweden		

Croatia		
Yes	**4**	**17%**
Germany		
France		
Poland		
Netherlands		
Grand Total	**23**	**100%**

Summary: A majority of 19 respondents (83%) stated that there are no plans for developing 100% H2 pipelines/networks. Only Germany, France, Poland and the Netherlands (17%) are planning to develop 100% H2 pipelines/networks. In Germany, there is an ongoing discussion as to whether such networks will be operated by TSOs. In the Netherlands, the TSO is not allowed to operate 100 % H2 pipelines under the current regulation.

If yes, will they be operated by the TSO?

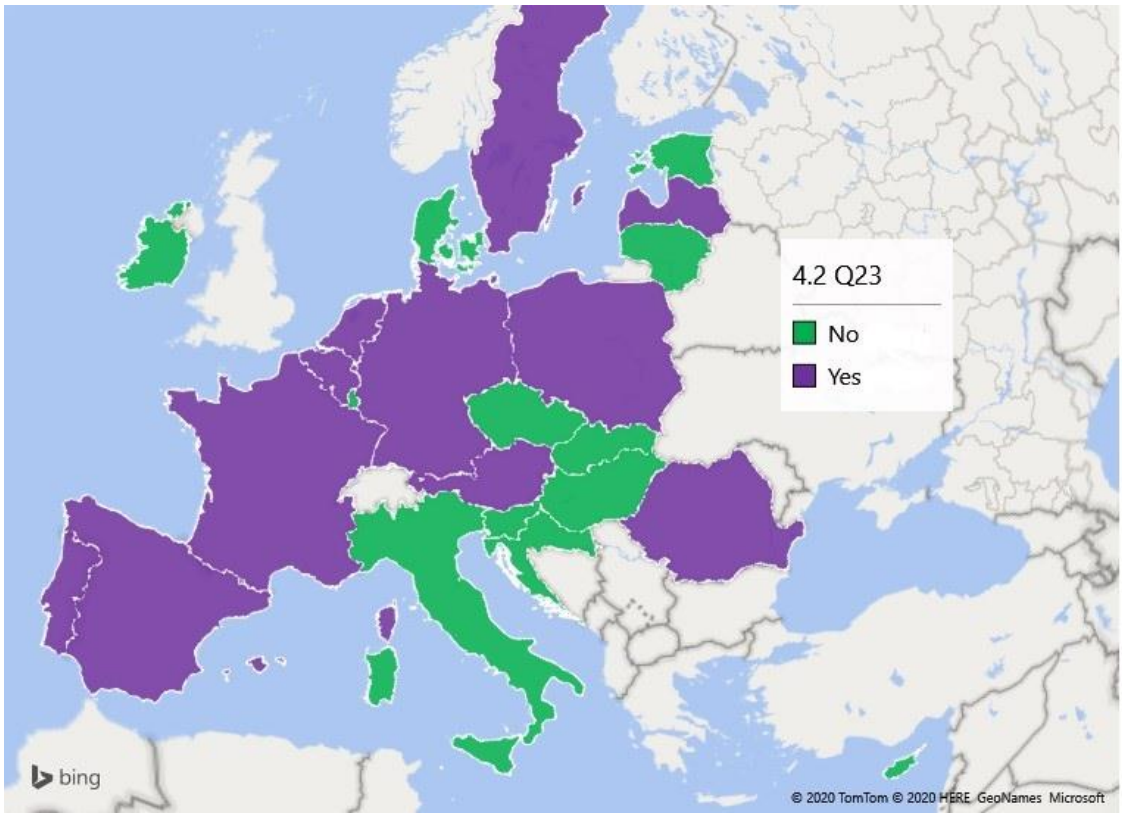
Reporting NRA's Member State (*)	If yes, will they be operated by the TSO?
Germany	That is not decided yet, political decision making process is still going on. Currently non-regulated private Network Operators own and operate 100% H2 networks in Germany (i.e. Linde, Air Liquide)
Netherlands	No. Based on current regulation the Dutch TSO is not allowed to operate a H2 pipeline/network. Note that the gas infrastructure company Gasunie (mother company of GTS) is involved in these developments.

Q.23. Is there or under development or planned a H2 strategy in your Member State?[28]

Answers to Q23	Number	%
No	**12**	**52%**
Cyprus		
Czech Republic		
Denmark		
Estonia		
Hungary		
Ireland		
Italy		
Lithuania		
Luxembourg		
Slovak Republic		
Slovenia		
Croatia		
Yes	**11**	**48%**
Austria		
Belgium		
Germany		
Latvia		
Portugal		
Spain		
France		
Romania		

[28] H2 strategies cover not only TSO H2 acceptance but also H2 production and other aspects.

Poland		
Netherlands		
Sweden		
Grand Total	**23**	**100%**



Map, Q.23. **Summary:** 11 NRAs (nearly half of all respondents) noted the existence (or under development or planned) of a H2 strategy in their Member State. H2 strategies are relatively recent. Out of the 11 NRA reporting a H2 strategy (existing or under development), 3 MSs (France, Germany, the Netherlands) have published a dedicated H2 strategy or vision, and 3 NRAs (Latvia, Portugal, Romania) have provided links to the National Energy and Climate Plans (NECPs) where H2 is expected to have a role in the energy mix. Sweden refers to a brochure from the Swedish Gas Association describing the strategy for hydrogen within the framework of the government initiative "Fossil-free Sweden", and in Spain the Ministry has opened a public consultation on renewable hydrogen.

Text box for comments. Please add a link if the H2 strategy is public.

Reporting NRA's Member State (*)	Text box for comments. Please add a link if the H2 strategy is public
Austria	https://www.bmlrt.gv.at/energie-bergbau/energie/Oesterreichische-Wasserstoffstrategie.html
Belgium	Belgium has currently no specific H2 strategy concerning the energy transition. However, at regional level, a focus on the hydrogen economy is expressed in a governmental agreement and there are several H2 projects (pilots) ongoing (e.g. in relation to offshore wind) which are supported by the government (regional).
Czech Republic	Not planned, but this issue is currently being discussed in connection with the new Energy Act and on a working group level with associations.
Denmark	There are no plans for a specific a H2 strategy, but the Danish politicians are currently developing a climate action plan and developing a new gas strategy. It is not settled yet whether H2 will be an element in either the climate action plan and/or the new gas strategy.
France	https://www.ecologique-solidaire.gouv.fr/sites/default/files/Plan_deploiement_hydrogene.pdf A national hydrogen plan was presented by the French government in June 2018. The framework should be clarified in the coming months, as the energy and climate act adopted in November 2019 allows the government to elaborate orders: 1) defining the different types of hydrogen depending on its source of production; 2) allowing production, transportation, storage and traceability of hydrogen; 3) defining a support framework for hydrogen produced from renewable energy or from low-carbon electricity through electrolysis.
Germany	National hydrogen strategy has been published by the German Federal Government: https://www.bmwi.de/Redaktion/EN/Publikationen/Energie/the-national-hydrogen-strategy.pdf?__blob=publicationFile&v=4
Hungary	While there is no dedicated H2 strategy yet in Hungary, the National Energy Strategy 2030 of Hungary (published in January 2020) supports the implementation of pilot projects concerning the different uses of H2 in the energy sector.
Ireland	Not at this time.
Latvia	Please see answer to Q8. National Energy and Climate Plan for 2021-2030 available: https://ec.europa.eu/energy/sites/ener/files/documents/lv_final_necp_main_en.pdf Additional there are Energy Development Guidelines for 2016-2020. Available at https://likumi.lv/ta/en/en/id/280236-on-the-energy-development-guidelines-for-2016-2020.
Netherlands	Recently (30 March 2020) the Ministry of Economic affairs and Climate published the Cabinet's vision on hydrogen. https://www.rijksoverheid.nl/documenten/kamerstukken/2020/03/30/kamerbrief-over-kabinetsvisie-waterstof
Poland	At the moment Polish Hydrogen Strategy is under preparation. The competent authority is Ministry of Climate
Portugal	The Government is developing new laws for H2 framework. The National Energy and Climate Plan 2030 draws the plan for H2 in the energy mix: https://apambiente.pt/_zdata/Alteracoes_Climaticas/Mitigacao/PNEC/PNEC%20PT_Template%20Final%202019%2030122019.pdf
Romania	The Government is developing new laws for H2 framework. The National Energy and Climate Plan 2030 draws the plan for H2 in the energy mix:

	https://apambiente.pt/_zdata/Alteracoes_Climaticas/Mitigacao/PNEC/PNEC%20PT_Template%20Final%202019%2030122019.pdf
Slovak Republic	No official strategy for now.
Spain	There is a National Plan for Energy and Climate which considers the promotion of renewables gases as a measure to attend to energy demand. The Ministry has started developing this measure with a public consultation on renewable hydrogen that is ongoing (https://energia.gob.es/es-es/Participacion/Paginas/DetalleParticipacionPublica.aspx?k=311).
Sweden	The Swedish Gas Association has a brochure describing the strategy of hydrogen within the framework of the government initiative Fossil-free Sweden. https://www.energigas.se/library/2778/gasbranschens-faerdplan-2.pdf

4.3 H2 content in gases from non-conventional sources

NOTE: Some MSs (e.g. Spain) define as gas from "non-conventional sources" biogas or other gases produced from biomass or via other microbial digestion process. This terminology is generally not applicable in other MSs. The survey intended to check how the terminology is used across MSs in this section

Q 24 Has the term gases from "non-conventional sources" been defined in your MS for the purpose of H2 limits?

Answers to Q24	Number	%
No	**19**	**83%**
Belgium		
Cyprus		
Czech Republic		
Denmark		
Estonia		
Germany		
Hungary		
Ireland		
Italy		
Lithuania		
Luxembourg		
Portugal		
Slovak Republic		
Slovenia		
France		
Romania		
Poland		
Sweden		
Croatia		
Yes	**4**	**17%**
Austria		
Latvia		
Spain		
Netherlands		
Grand Total	**23**	**100%**

NOTE: E.g. The Spanish regulation determines the following: gases from "non-conventional sources" introduced in the Spanish gas system should have a maximum H2 content of 5% mol. and minimum CH4 content of 90% mol., where "non-conventional sources" are biogas or other gases proceeding from biomass or other microbial digestion process. Quality standards definition is under review.

Summary: A majority of 19 out of 22 respondents (83%) answered that the term gases from ''non-conventional sources'' has not yet been defined in their MS. Only Austria, Latvia, the Netherlands and Spain (17%) noted that the term has been defined in their respective MS.

Q. 25 Has your MS established a maximum content of H2 in gases from "non-conventional" sources introduced in your gas system?

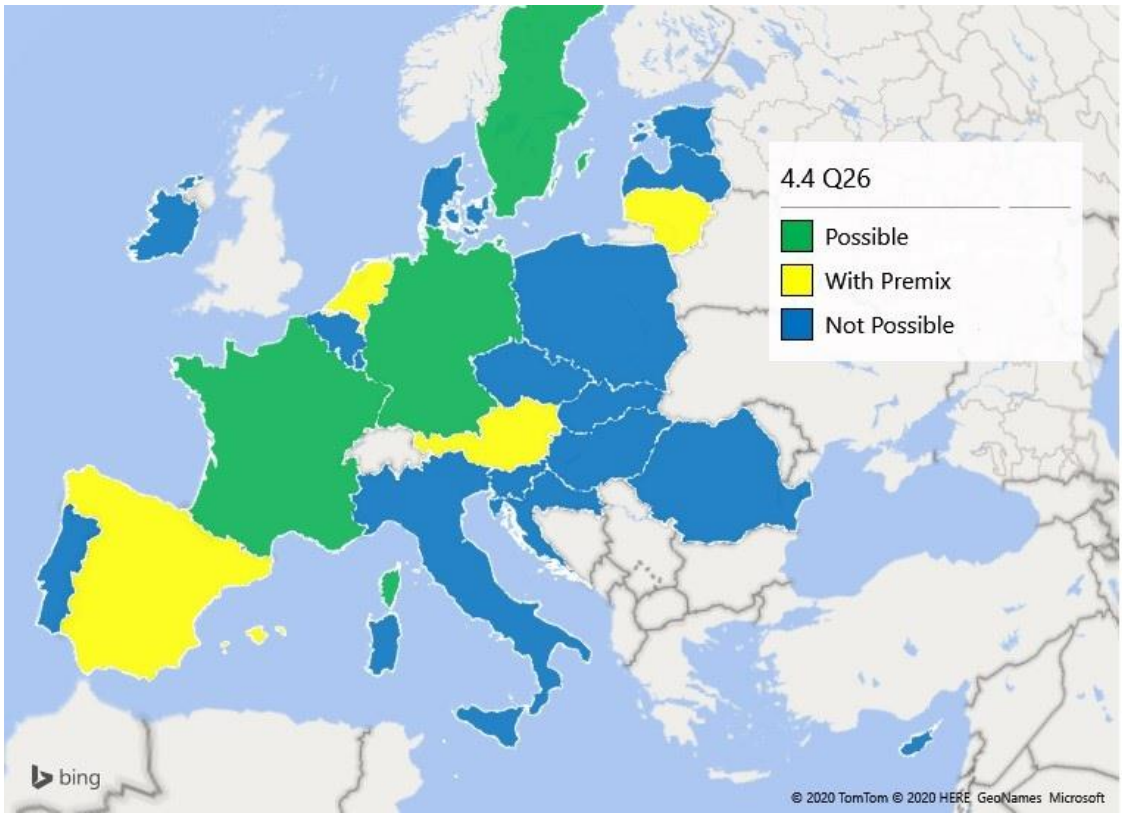
Answers to Q25	Number	%
No answer	**3**	**13%**
Ireland		
Italy		
Lithuania		
No	**16**	**70%**
Belgium		
Cyprus		
Czech Republic		
Denmark		
Estonia		
Germany		
Hungary		
Luxembourg		
Portugal		
Slovak Republic		
Slovenia		
France		
Romania		
Poland		
Sweden		
Croatia		
Yes	**4**	**17%**
Austria		
Latvia		
Spain		
Netherlands		
Grand Total	**23**	**100%**

4.4 Detailed questions on H2 injection at TSO level

Q 26. Is it possible to inject H2 directly in the gas transmission network or is a "premix" necessary to inject a H2 blend within certain limits?

Answers to Q26	Number	%
Direct H2 injection in transmission is possible	**3**	**13%**
Germany		
France		
Sweden		
Not applicable (H2 injection is not possible)	**16**	**70%**
Belgium		
Cyprus		
Czech Republic		

Denmark		
Estonia		
Hungary		
Ireland		
Italy		
Latvia		
Luxembourg		
Portugal		
Slovak Republic		
Slovenia		
Romania		
Poland		
Croatia		
Possible to inject H2 in a "premix"	**4**	**17%**
Austria		
Lithuania		
Spain		
Netherlands		
Grand Total	**23**	**100%**



Map, Q.26. **Summary:** The majority of respondents (16 out of 23, or 70%) answered that H2 injection into the network gas transmission is not possible. The remaining 7 respondents answered either that direct injection is possible (Germany, France and Sweden,) or that

injection is possible but with a premix of gases (Austria[29], Lithuania, the Netherlands and Spain).

Q27 How are the injection points for H2 at TSO level determined? Is there coordination with electricity sector?

Reporting NRA's Member State (*)	Q27 How are the injection points for H2 at TSO level determined? Is there coordination with electricity sector?
Austria	There are no provisions yet, but there are plans to have them in coordination with the electricity sector
Belgium	Not yet specified, under development. Will be likely in coordination with the electricity sector (e.g. offshore electricity production).
Denmark	N.A.
Estonia	N.A.
France	These technical rules are currently under definition and will be discussed in the Injection Working Group. A zoning of injection possibility will be established by the gas network operators according to network possibility and sensitive clients.
Germany	An operator of the hydrogen production plant who wants to inject H2 decides where he wants to inject. No coordination with electricity sector.
Latvia	Since the TSO does not accept the injection of H2 into the gas transmission network system, there is no necessity to determine H2 injection points and there is no coordination with the electricity sector at the moment.
Lithuania	N.A.
Luxembourg	Not applicable
Netherlands	There are no large scale electrolysers in operation yet. The Dutch TSOs for Electricity and Gas developed a system integration plan which addresses this topic.
Portugal	N.A.
Slovak Republic	not yet.
Spain	CNMC has no information about this; in any case, up to this date in Spain there are only pilot projects.

Q28 Who owns and operates the H2 production plants (i.e. electrolysers) in your MS? Are the H2 production plants (electrolysers) considered as part of the TSO assets?

Reporting NRA's Member State (*)	Q28 Who owns and operates the H2 production plants (i.e. electrolysers) in your MS? Are the H2 production plants (electrolysers) considered as part of the TSO assets?
Austria	There are very few H2 production plants. The most relevant one is the H2 production for a private client. Two other experimental plants are very small and built by an association of shareholders with the participation of the TSO.
Belgium	Not yet specified, currently under development. The role of the TSO has to comply with the Ownership Unbundling certification rules.
Denmark	The Danish TSO is not allowed to invest in electrolysers. All existing H2/Power-to-X activities are owned and operated by non-regulated commercial players. However, TSOs should be a part of the process of planning the optimal geographical locations of Power to Gas units, by providing valuable and transparent information regarding grid constraints and optimizing for socioeconomic benefits in relation to infrastructure developments.
Estonia	N.A.

[29] Depending from the quantity of injected H2 and the collecting pipeline. Direct injection is possible for small experimental plants.

France	With respect to the unbundling rules, CRE considers that these activities are intended to be carried out on an industrial scale by market players rather than TSOs. H2 production plants are currently not considered as part of the TSO assets
Germany	Private companies of different industry sectors own and operate. Electrolysers not allowed as part of the TSO's assets.
Latvia	There is a H2 production plant in Latvia, which is owned by the public transport operator (Rīgas Satiksme), for the use of H2 trolleybuses. There are currently no plans for H2 production plants as part of TSO assets.
Lithuania	N.A.
Luxembourg	Not applicable
Netherlands	Electrolysers are currently not planned to be part of the TSO assets (not a legal task of the TSO). The network company Gasunie is involved in several projects with regard to electrolysis, together with different partners.
Portugal	There are no such assets in the TSO. In principle, H2 production is a "gas production" which is forbidden be performed by the unbundled TSO. In the draft law for H2 injection, TSOs and DSOs might own blending facilities or other treatment facilities for low carbon gases.
Slovak Republic	N.A.
Spain	Pilot projects known by CNMC are being developed by TSOs, directly or via subsidiary companies.
Sweden	To be decided, but probably owned or co-owned with the TSO as part of the TSO assets.

Summary: The majority of respondents noted that H2 production plants are not allowed to be TSO assets, nor are they planned to be. Exceptions are Spain, whose TSOs are developing pilot projects (CNMC), Austria, whose TSOs participated together with shareholders in the construction of two experimental plants, and Sweden which is considering the integration of H2 production plants into the TSO assets.

Q29 How does the TSO guarantee stable H2 concentration in the transmission system? (stable gas blend quality)

Reporting NRA's Member State (*)	Q29 How does the TSO guarantee stable H2 concentration in the transmission system? (stable gas blend quality)
Austria	Currently, there is no such a problem. In any case, it depends on the quantity of H2 to be injected and on the receiving pipe and flows.
Belgium	Not yet specified, currently under development.
Denmark	N.A.
Estonia	N.A.
France	These technical rules are currently under definition and will be discussed in the Injection Working Group. However, GRTgaz has a multiyear plan to change analysers in its network and become able to detect H2.
Germany	TSOs need to check constantly if the H2 concentration in the system is stable and can deny further injection.
Latvia	Components and quality parameters of the gas at the entry points of the system shall correspond to the requirements set out in the national legislation. Measurements of gas quality in the system are carried out by TSO at all entry points. If gas delivered to the entry point does not correspond the gas quality requirements, the TSO shall have the right to refuse to accept and transmit the gas.
Lithuania	N.A.
Luxembourg	Not applicable
Netherlands	Not an issue at this moment, due to the low H2 limits in the Netherlands.
Portugal	N.A

Slovak Republic	N.A.
Spain	Metering stations monitor the gas quality in the network. In Spain, there are only a few pilot projects.
Sweden	Not for hydrogen. Established agreements are just as for injecting biogas into the TSO network.

Summary: Belgium and France note that technical rules on guaranteeing stable H2 concentration in the transmission systems are currently being developed.

Q.30 Are there obligations for network operators to publish actual and future available capacity for hydrogen injection into the gas transmission networks?

Answers to Q30	Number	%
No answer	**6**	**26%**
Cyprus		
Ireland		
Italy		
Lithuania		
Romania		
Poland		
No	**17**	**74%**
Austria		
Belgium		
Czech Republic		
Denmark		
Estonia		
Germany		
Hungary		
Latvia		
Luxembourg		
Portugal		
Slovak Republic		
Slovenia		
Spain		
France		
Netherlands		
Sweden		
Croatia		
Grand Total	**23**	**100%**

Summary: No NRA reported such an obligation.

Q.31 Are there obligations for network operators to provide a connection point for hydrogen injection upon request by a network user?

Answers to Q31	Number	%
No answer	**6**	**26%**
Cyprus		
Ireland		
Italy		
Lithuania		
Romania		

Poland		
No	**16**	**70%**
Austria		
Belgium		
Czech Republic		
Denmark		
Estonia		
Hungary		
Latvia		
Luxembourg		
Portugal		
Slovak Republic		
Slovenia		
Spain		
France		
Netherlands		
Sweden		
Croatia		
Yes	**1**	**5%**
Germany		
Grand Total	**23**	**100%**

Summary: Only Germany reported an obligation for network operators to provide a connection point for hydrogen injection upon request by a network user.

Comments related to Q 30 and Q 31

Reporting NRA's Member State (*)	Comments related to Q 30 and Q 31
Austria	Not applicable yet
Belgium	Not yet specified, currently under development.
France	Not at this point, but technical rules including capacity registry are currently discussed in the Injection Working Group.
Germany	The natural gas Network Operator is obligated to check whether it is possible to inject hydrogen.
Lithuania	As long as H2 is not injected into the transmission system, the requirements specified in Q30 and Q31 are not applicable.
Luxembourg	Not applicable
Netherlands	The injection of pure hydrogen is not allowed.
Poland	This case hasn't taken place yet. However, it is probable that this situation will emerge in the future.
Portugal	In the new draft law for the gas networks, operators shall provide information about capacity for hydrogen (and other low carbon gases) injection into the network in different points, as well as provide a connection point upon a request by a producer (if capacity is available).
Sweden	Regarding these questions, Swedegas supports the work from GEODE - The Voice of Local Energy Distributors across Europe.

4.5 Questions on biomethane at TSO level

Q.32 Is biomethane currently injected into the gas transmission system?

Answers to Q32	Number	%
No	**16**	**70%**
Austria		
Belgium		
Cyprus		
Czech Republic		
Estonia		
Hungary		
Ireland		
Latvia		
Lithuania		
Luxembourg		
Portugal		
Slovak Republic		
Slovenia		
Romania		
Poland		
Croatia		
Yes	**7**	**30%**
Denmark		
Germany		
Italy		
Spain		
France		
Netherlands		
Sweden		
Grand Total	**23**	**100%**

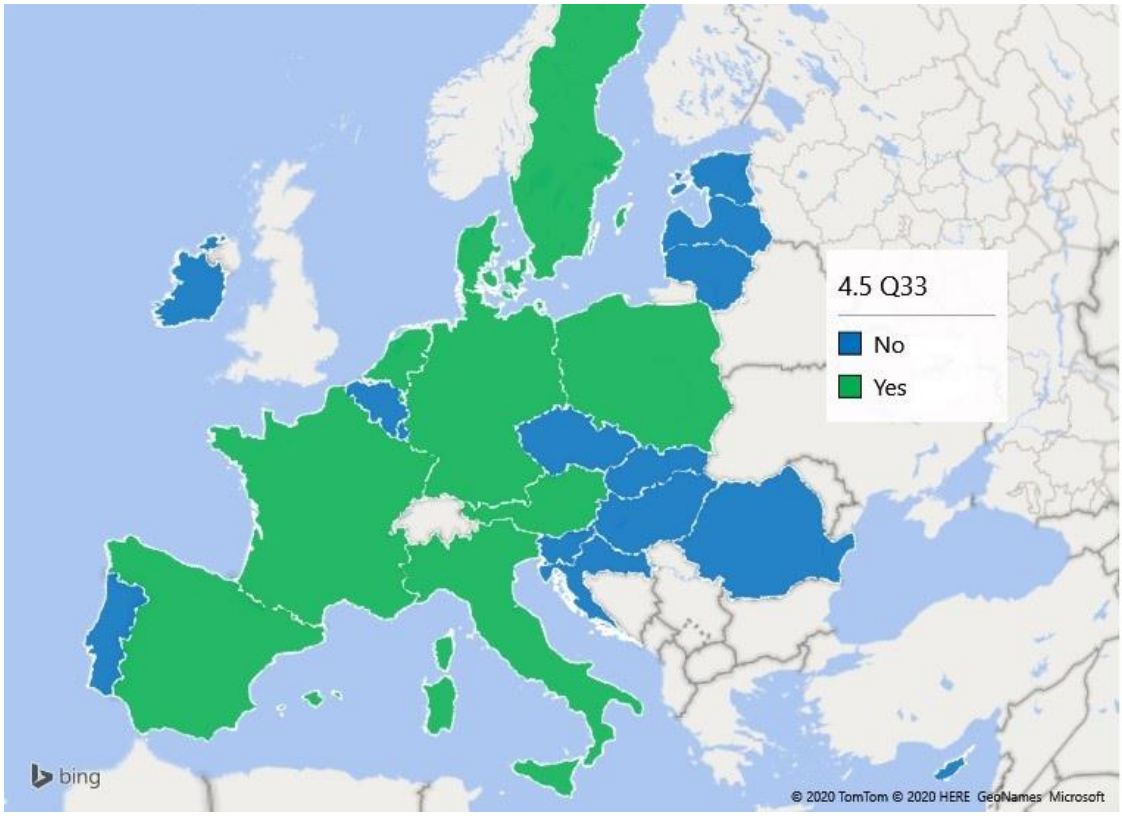
Summary: 7 NRAs (30%) confirmed that biomethane is currently injected at TSO level.

Q.33 Is there reverse flow (from distribution to transmission grid) and/or direct injection from biogas /biomethane plant?

Answers to Q35	Number	%
No	**14**	**61%**
Belgium		
Cyprus		
Czech Republic		
Estonia		
Hungary		
Ireland		
Latvia		
Lithuania		
Luxembourg		
Portugal		
Slovak Republic		
Slovenia		

Romania		
Croatia		
Yes	**9**	**39%**
Austria		
Denmark		
Germany		
Italy		
Spain		
France		
Poland		
Netherlands		
Sweden		
Grand Total	**23**	**100%**

Map, Q.33. **Summary:** 9 NRAs (39%) responded that reverse flow and/or direct injection from biogas/biomethane plants is possible. However, the majority of respondents (14 out of 23, 61%) noted that this was not feasible yet.



Q.34 If there are biomethane injections into the gas transmission system, who operates the gas quality upgrading (from biogas to biomethane) and injection facilities? The TSO?

Reporting NRA's Member State (*)	Q.34 If there are biomethane injections into the gas transmission system, who operates the gas quality upgrading (from biogas to biomethane) and injection facilities? The TSO?
Austria	There are injections at DSO level. Biogas producers are responsible for keeping the quality, according to ÖVGW G31
Belgium	Not yet specified, currently under development.

Croatia	For now, the injection of biomethane into the gas transmission system is not foreseen.
Cyprus	There is no gas market in Cyprus yet, therefore there is no gas transmission network and no TSO.
Czech Republic	One station is operated, but only on DSO level – the producer is responsible for quality upgrading (not only from biogas to biomethane, but other requirements exist), also injection. The DSO is responsible for odorisation.
Denmark	The biogas producers operate the upgrading plants from biogas to biomethane. The TSO operates the injection plants including compressors.
Estonia	N.A.
France	Upgrading of biogas to biomethane is handled by biogas producers. The TSO is responsible for the operation and maintenance of the connection facilities and monitors the quality of the biomethane before injection.
Germany	The biomethane plant owner who wants to inject into the network is responsible for the gas quality.
Hungary	-
Ireland	There are no facilities injecting biomethane into the transmission system at present.
Italy	It is a duty of the owner of the biomethane producer. In case the biomethane does not comply with quality standards, the TSO can interrupt the injection.
Latvia	The requirements for biomethane injection into the gas transmission and distribution network is determined in the Cabinet of Ministers 16 October 2016 rules No.650. According to the Regulations, the network user is responsible for the quality of biomethane injected.
Lithuania	Legally it is possible to inject biomethane into the transmission system, if it meets quality criteria. However, in practice we do not have biogas connected to the natural gas transmission system.
Luxembourg	Not applicable, as biomethane is only currently injected into the LU gas distribution system. Due to the small quantity of injected biomethane, no flow is currently possible from distribution to transmission systems.
Netherlands	No, the biogas producer.
Poland	The TSO is responsible for gas quality. It is technically possible to inject bio-methane into the transmission network, but we don't have such cases. The probability that bio methane will be injected into the transmission network is very low, because only big plants can be connected to the transmission network. The quality requirements for biogas and agricultural biogas are regulated in the distribution network code.
Portugal	No biomethane injections
Romania	No biomethane injections are made into the gas transmission system
Slovak Republic	N.A., as for biomethane this is managed by DSOs.
Slovenia	No biomethane injections into the gas transmission system are in place.
Spain	Not the TSO, the production company.
Sweden	The biomethane producer operates the quality upgrading and the TSO operates the injection facilities.

Summary: Most of the respondents noted that biomethane producers are responsible for gas quality upgrading. The injection is coordinated with the TSOs, who check the acceptance of biomethane in the transmission network.

Q.35 Are investments/adaptations foreseen in the current NDP to allow or increase the injections of biomethane in the gas transmission system?

Answers to Q35	Number	%
No	**16**	**70%**

Austria		
Cyprus		
Czech Republic		
Estonia		
Germany		
Hungary		
Ireland		
Latvia		
Lithuania		
Luxembourg		
Portugal		
Slovak Republic		
Spain		
Romania		
Poland		
Croatia		
Yes	**7**	**30%**
Belgium		
Denmark[30]		
Italy		
Slovenia		
France		
Netherlands		
Sweden		
Grand Total	**23**	**100%**

Summary: 16 out of 23 respondents (70%) stated that there are currently no planned investments/adaptations in the current NDP to allow or increase the injections of biomethane in the gas transmission system. Only Belgium, Denmark, France, Netherlands, Italy, Slovenia and Sweden (30%) foresee investments/adaptations in the current NDP.

If yes, to which level of injection capacity (% of annual gas consumption in the MS in terms of energy) and by when? Which type of investments/adaptations are foreseen?

Reporting NRA's Member State (*)	If yes, to which level of injection capacity (% of annual gas consumption in the MS in terms of energy) and by when? Which type of investments/adaptations?
Belgium	The TSO's NDP 2020-2023 (indicative) contains an indicative investment and budget for reverse flow from one DSO network to the transmission network. This NDP contains also indicative investments and budgets to connect biomethane production plants.
Denmark	Injected biomethane has currently (April 2020) reached 15% of annual gas consumption in Denmark. There is no capacity target, nor any maximum capacity.

[30] Injected biomethane has currently (April 2020) reached 15% of annual gas consumption in Denmark. There is no capacity target, nor any maximum capacity. The long-term goal is 100% renewable gas in the gas grid. By 2022, the Danish Energy Agency estimates that biomethane will reach around 25% of gas consumption. The TSO foresees investments in reverse flow plants, but is collaborating closely with the DSO to minimize these investments through network planning. The TSO is also looking into grid expansion where grid expansion enables green gas production and energy system transition in a cost effective way.

	The long term goal is reaching 100% renewable gas in the gas grid. By 2022, the Danish Energy Agency estimates that biomethane will reach around 25% of gas consumption. The TSO foresees investments in reverse flow plants (please see the comment below).
France	Investments in reverse-flow at distribution and transport levels will be needed. The last multi-annual programme for energy (published in April 2020) targets 6 TWh by 2023. The share of renewable annual gas consumption target defined in the energy transition law of 2015 is 10% in 2030.
Italy	Depending on scenarios provided by the TSO, between 5% and 11% by 2030 and between 16% and 18% by 2040. More conservative/realistic assumptions foresee 8% to 10% by 2040. In the NDP, only investments in biomethane connections are considered.
Netherlands	GTS expects up to 2 BCM of biomethane to flow through its pipelines by 2030. To accommodate this, GTS prepares to invest in biomethane 'boosters', which entails adding local compression to allow for increased injection in (regional) grids. However, actual investments are purely driven by concrete demand from biomethane producers.
Slovenia	Currently the studies and analyses are ongoing.
Sweden	The Swedish Gas Association Energigas presented its roadmap within the framework of the government initiative Fossil-free Sweden in 2045.https://www.energigas.se/library/2778/gasbranschens-faerdplan-2.pdf

Q.36 Are there obligations for network operators to publish actual and future available capacity for biomethane injection into the gas transmission networks?

Answers to Q36	Number	%
No answer	**2**	**9%**
Cyprus		
Romania		
No	**20**	**87%**
Austria		
Belgium		
Croatia		
Czech Republic		
Denmark		
Estonia		
Germany		
Hungary		
Ireland		
Italy		
Latvia		
Lithuania		
Luxembourg		
Netherlands		
Portugal		
Poland		
Slovak Republic		
Slovenia		
Spain		
Sweden		
Yes	**1**	**4%**
France		

Grand Total	23	100%

Summary: Only France stated that such obligations exist.

Q 37. Are there obligations for network operators to provide a connection point for biomethane injection upon request by a network user?

Answers to Q37	Number	%
No answer	**2**	**9%**
Cyprus		
Romania		
No	**5**	**22%**
Belgium		
Portugal		
Slovak Republic		
Poland		
Sweden		
Yes	**16**	**70%**
Austria		
Czech Republic		
Denmark		
Estonia		
Germany		
Hungary		
Ireland		
Italy		
Latvia		
Lithuania		
Luxembourg		
Slovenia		
Spain		
France		
Netherlands		
Croatia		
Grand Total	**23**	**100%**

Summary: 16 out of 23 respondents (70%) answered that obligations exists for network operators to provide a connection point for biomethane injection upon request by a network user. No such obligations exist for Belgium, Poland, Portugal, Slovakia and Sweden (23%). Cyprus and Romania provided no answer to the question.

Comments related to Q 36 and Q 37, capacity availability and connection points for biomethane injection.

Reporting NRA's Member State (*)	Comments related to Q 36 and Q 37
Austria	In general, everybody has the right to a connection to the DSO level. Also, there is an obligation for the DSO to provide an estimation of the costs for the connection to be paid by the party asking for the connection (such as biomethane producers).
Belgium	Not yet specified, under development.

Croatia	Q37: There is an obligation in a bylaw act whereby a DSO has to provide a connection point for biomethane injection upon request by a network user. The DSO shall approve the request if the connection point is done in a proper technical/safety manner and the biomethane specification is in accordance with the prescribed standard gas quality.
Czech Republic	No station is or will be soon connected to the transmission system, so the Czech TSO has no obligation to publish available capacity for BM injection. When this issue arises, it will be solved. The provision of a connection point for biomethane injection upon request is obligatory, based on the "decree on connection".
Denmark	Q36: The Danish TSO has no obligation but do publish monthly updated data on biomass injection at www.energinet.dk. Q37: The DSO and TSO have by law an obligation to connect biomethane plants upon request. Cost distribution and determination of connection point is regulated in the Natural Gas Act.
France	There is an obligation of network operators to provide a biomethane connection point in cases where the cost of this connection is below a given threshold. The connection will be to either the distribution or the transmission grid, depending which one has the lowest societal cost.
Germany	The natural gas Network Operator is obligated to check if it is possible to inject biomethane.
Hungary	Yes, but only for the entry point volume and quality measurement. The biomethane producer shall finance the necessary investment. The technical content is defined by the TSO. The project can be managed by the TSO or the producer. After realization the TSO will be the owner and the operator.
Ireland	Q 35: No specific investments of this type are mentioned in the current NDP. However, one biomethane central grid injection (CGI) facility is connected to a distribution system and the TSO is developing a blueprint for transmission biomethane CGIs to enable the future construction of such facilities.
Italy	Q37: subject to technical feasibility
Poland	Q 36 - There is no obligation to publish this information. If any plant wants to connect to the network, it has to follow the rules defined by the TSO. Quality of gas and the connection process are defined in the network codes.
Portugal	In the new draft law for the gas networks, operators shall provide information about capacity for hydrogen (and other low carbon gases) injection into the network at different points, as well as provide a connection point upon request by a producer (if capacity is available).
Slovak Republic	Not for the TSO, but DSOs are more involved via technical terms and conditions.

Textbox comments for any additional comments related to injection of biomethane not covered in previous questions.

Reporting NRA's Member State (*)	Text Box for any additional comments related to injection of biomethane not covered in previous questions
Denmark	The Danish TSO foresees investments in reverse flow plants, but is collaborating closely with the DSO to minimize these investments through network planning. The TSO is also looking into grid expansion where grid expansion enables green gas production and energy system transition in a cost effective way.

France	A "right to injection" was adopted in a decree published in June 2019, designed to address this issue. CRE took in November 2019 a decision on the implementation of the right to injection, which defines: - the rules of establishment of the prescriptive connection zoning (according to a techno-economic criterion comparing the volume of investments needed to the volume of production capacity estimated in the area : "I/V"); - the publication of indicative mapping of the areas eligible for reinforcements; - the treatment of pooled works (which benefit to several producers). The production project holders request of one or several operators for an estimate of the cost of connection to the grid and pay for the connection cost (these costs can be split between several sites). In addition, the project owners shall also pay for a portion of the network reinforcement cost, in order to reflect the CAPEX needed, according to the severity of the reinforcements needed, which is signalled by the I/V criterion. CRE also introduced an injection tariff in the new regulatory period (ATRT7) which started in April 2020, aiming at sending a signal to the project holders and in order to reflect the OPEX level incurred by the location of the project. CRE defined a 3-level tariff term depending on the level of costs incurred for the network operator, which is attributed to each project at the early stage of the process
Ireland	Further to Question 37, a connection point must be provided, so long as the connection request meets the relevant technical and economic requirements, such as those set out in the TSO/DSO's connections policy and the Code of Operations for the natural gas network.
Italy	Concerning Q33, there is no reverse flow, but there are direct injections in the transmission network.
Latvia	Q1. According to the agreement between the Estonian, Latvian and Lithuanian TSOs as well as the Cabinet of Ministers Regulations, the allowed volume of H2 in the transmission and distribution system is H2 (mol. %) ≤ 0.1. The chemical composition of natural gas contains hydrogen in a natural form but does not exceed 0.1 mol %. Currently, the TSO does not accept the injection of H2 into the gas transmission network. Before allowing injection of H2 volumes in the gas transmission network system, thorough research must be performed about H2 potential impacts on the gas transmission network system, and especially on the Inčukalns Underground Gas Storage Inčukalns UGS facility, in particular analysing effects of increased H2 concentration on the reservoir layer of the Inčukalns UGS and the exposed layer of clay. There is also a need for research into the assessment of impacts on end-user equipment, particularly in households, high-temperature and other industrial processes, which are currently not provided for in any of the planning documents. Q2. H2 standards are set in the Cabinet of Ministers Regulations of 16 October 2016 No.650 "Requirements for the introduction and transport of biomethane and gaseous transformed liquefied natural gas into a natural gas transmission and distribution system" and the Cabinet of Ministers Regulation of 7 February 2017 No.7 "Regulations Regarding the Trade and Use of Natural Gas". Please see in Latvian: (https://likumi.lv/ta/id/285189-prasibas-biometana-un-gazveida-stavokli-parverstas-saskidrinatas-dabasgazes-ievadisanai-un-transportesanai-dabasgazes-parvades-… and https://likumi.lv/ta/en/en/id/289031-regulations-regarding-the-trade-and-use-of-natural-gas). Value is: H2 (mol %) ≤ 0.1. The chemical composition of natural gas

	contains hydrogen in a natural form but does not exceed 0.1 mol%. Q11. The decisions regarding the introduction of H2 into the Latvian gas supply system, including the distribution system, and the carrying out of the necessary investments may be taken only after the performance of the research work referred to in Q1. Q12. There is currently no H2 blending target for the TSO. In view of the active process of regional gas market integration, it is envisaged to discuss the possibility to set the H2 threshold at least at regional level in Estonia, Latvia, Lithuania and Finland, and possibly not to compromise the bi-directional use of the Lithuanian-Polish interconnection, including Poland, and to ensure adequate investment in gas transmission and storage infrastructure. The threshold shall also be harmonized by interconnected natural gas TSO's of third countries in a mandatory manner. Q15. Please see answer to Q12. It is possible to take a decision on the setting of the H2 threshold for the introduction of H2 into the Latvian gas supply system only after carrying out the research work referred to Q1. At the same time, Latvian Gas transmission network system operator actively supports ENTSOG's position on the possibility of injecting H2 to 2% / vol. in the transmission network system. Q26. The TSO for the time being does not accept the injection of H2 into the gas transmission network. The gas TSO transports natural gas in the transmission system with a limited H2 content (less than 0.1 mol %) in accordance with the quality standard. At a first glance, presumably in order to reduce technological risks (e.g. changes in the fragility of the metal transmission pipelines in the vicinity of the entry point), it may be necessary to premix H2 with, for example, natural gas in the transmission system before injecting it into the transmission system. Q36&37. According to the Energy Law, in the area of operation of its licence and within the time period laid down in the licence, a system operator has a permanent obligation to ensure for system users and applicants access to energy transmission or distribution systems. The system operator shall fulfil the obligation according to the requirements of technical regulations and safety requirements. A natural gas transmission, distribution and storage system operator who has received a request from system users or applicants to provide information regarding access to the system and use thereof, shall provide such information in written form within 30 days. The Regulator shall approve natural gas system connection regulations developed by a natural gas TSO for biomethane producers, liquefied natural gas system operators and natural gas users, and natural gas distribution system connection regulations developed by a natural gas distribution system operator for natural gas users. So, the requirements to be fulfilled to connect to the gas transmission network system are defined in the Cabinet of Ministers 16 October 2016 rules No.650.

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