ACER
European Union Agency for the Cooperation of Energy Regulators

OPINION No 08/2022 ON THE REVIEW OF GAS AND HYDROGEN NATIONAL NETWORK DEVELOPMENT PLANS TO ASSESS THEIR CONSISTENCY WITH THE EU TEN-YEAR NETWORK DEVELOPMENT PLAN

Annexes:

III - Hydrogen, Biomethane injections, and Related Network Adaptations

16 December 2022

1. INTRODUCTION

1.1 Scope and Introduction

This survey collected information from NRAs on the readiness of national gas transmission infrastructure in European countries to allow H2 admixtures, 100% H2 dedicated networks, and biomethane injections. The survey:

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

The survey provides a snapshot of the status as of August 2022, following a similar survey carried out two years ago[1]. The current report includes responses from 26 NRAs, three more (Bulgaria, Greece and Malta) than in 2020.

This document aims to:

- raise awareness among the NRA community and other stakeholders about the integration of Energy Transition goals into gas network development processes; and
- 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.

Results show that in most MSs the TSO acceptance of H2 and biomethane continues in an "exploration" phase. Little progress is observed in the last two years. Where H2 and/or biomethane injection cane be injected into the gas transmission networks, this is possible due to pilot or demonstration 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 widely available in the European Union. The answers also provide some information on ongoing projects related to H2 blending, 100% H2 dedicated networks, and biomethane injection at transmission level.

The NRAs responses to the questionnaire are presented in the section below.

[1] ACER Report on NRAs Survey on Hydrogen, Biomethane, and Related Network Adaptations, published on 10 July 2020.
https://www.acer.europa.eu/Official_documents/Acts_of_the_Agency/Publication/ACER%20Report%20on%20NRAs%20Survey.%20Hydrogen%2C%20Biomethane%2C%20and%20Related%20Network%20Adaptations.docx.pdf

1.2 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. QUESTIONNAIRE RESPONSES

2.1 H2 blending

Q1. Do transmission system operator(s) accept the injection or allow H2 volumes into the gas transmission network in your Member State?

Answers to Q1	REPORTING NRA'S MS	Number	%
Yes	Austria, Germany, Italy, Spain, Sweden	**5**	**19%**
No	Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, France, Greece, Hungary, Ireland, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Romania, Slovak Republic, Slovenia, Portugal	**21**	**81%**
Grand Total		**26**	**100%**

Summary: In most member states (81%, 21 instances), the TSOs do not accept the injection or allow H2 volumes into the gas transmission network. There is no significant change in comparison to the 2020 report (65%)[2].

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

Answers to Q2	REPORTING NRA'S MS	Number	%
Yes	Austria, Croatia, Czech Republic, France, Germany, Italy, Lithuania	**7**	**27%**
No	Belgium, Bulgaria, Cyprus, Denmark, Estonia, Greece, Hungary, Ireland, Latvia, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovak Republic, Slovenia, Spain, Sweden	**19**	**73%**
Grand Total		**26**	**100%**

Summary: In most Member States (73%, 19 instances), gas quality standards do **not** allow for H2 volumes. Also here, there is little progress in comparison to the 2020 report (78%)[3].

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

Answers to Q3	REPORTING NRA'S MS	Number	%
Yes	Austria, Croatia, Cyprus, Denmark, France, Germany, Italy, Portugal, Spain	**9**	**35%**

[2] In Italy, the TSO accept the injection or allow H2 volumes into the gas transmission network in 2022, while not accepting or allowing it in 2020.
[3] In Croatia, Czech Republic and Italy gas quality standards allow for H2 volumes in 2022, while not allowing it in 2020.

No	Belgium, Bulgaria, Czech Republic, Estonia, Greece, Hungary, Ireland, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Romania, Slovak Republic, Slovenia, Sweden	**17**	**65%**
Grand Total		**26**	**100%**

Summary: More than 60% of NRAs answered that it is either not legally or regulatory possible to inject H2 volumes into their respective gas transmission networks. 9 countries (35%), on the other hand, responded that this is possible.

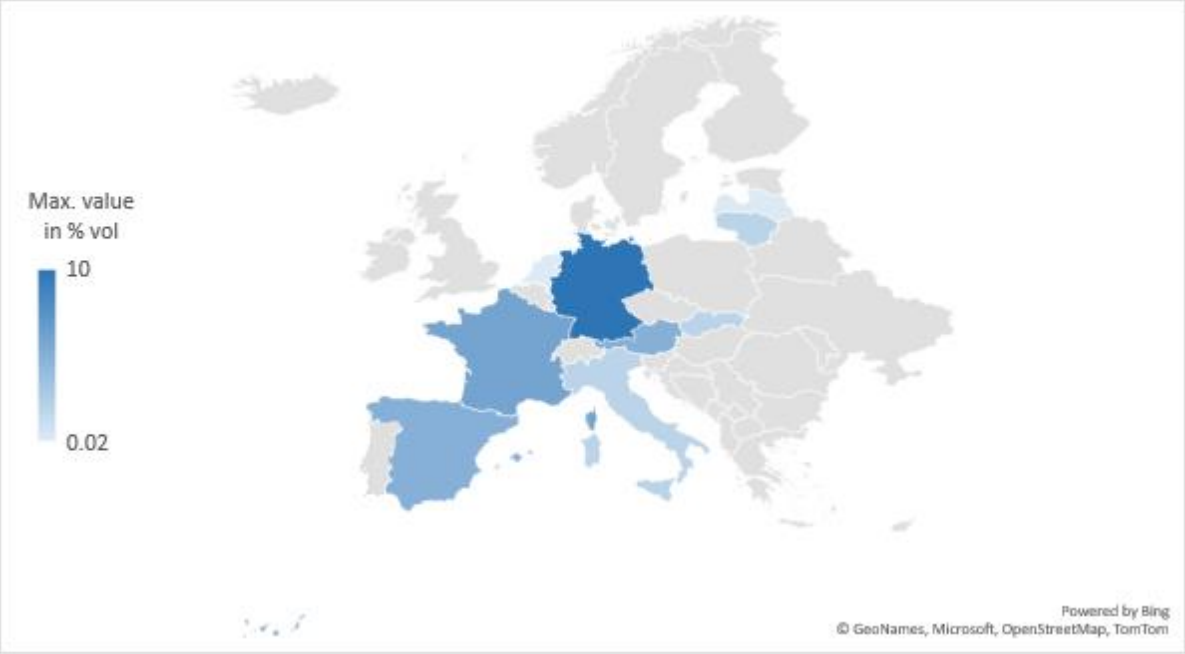
Q4. What is the current maximum H2 concentration accepted by the TSOs in the natural gas transmission networks?

Between 0 and 20 % vol. at normal conditions

Reporting NRA's MS	Max. value in % vol	Comments
Austria	5	The Austrian Gas Quality Standard G B210 is based on the European standards ÖNORM EN 16726, ÖNORM EN 16723-1 and summarises additional requirements which were previously contained in the ÖVGW guidelines G 31 "Natural gas in Austria" and G B220 "Regenerative gases". With the lower limit value of the relative density of 0.555 according to ÖNORM EN 16726, hydrogen contents of approx. 3-5 % are possible, depending on the gas composition. Increase of 1% since 2020
Belgium	0	
Bulgaria	0	
Croatia	0	
Cyprus	0	There is currently no legal framework or regulation for hydrogen blending in the gas transmission. The publication of the first NDP might provide more clarity on hydrogen related issues from the gas TSO.
Czech Republic	0	Technical standard for gas fuels quality testing shows that a H2 concentration of 2 % mol is possible, but the H2 concentration in transmission system (also distribution) is not measured, therefore no H2 "appears to be present" and accepted.
Denmark	0	
Estonia	0	
France	6	
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.
Greece	0	
Hungary	0	Currently there is no formal limit for acceptable hydrogen levels – the general rules regarding contaminants apply, therefore no meaningful hydrogen volumes are allowed.
Ireland	0	Gas Networks Ireland (GNI), the Irish gas TSO, are currently testing blended hydrogen totals of 2-20% being injected in the gas network.
Italy	2	

Latvia	0.1	In 2021 Latvian gas TSO established a hydrogen steering group in cooperation with neighbouring operators (Lithuania, Estonia and Finland) and developed a study on the introduction of hydrogen into existing gas infrastructure. This answer represents quality characteristics of gas transported in the natural gas transmission and distribution system (hydrogen content should be ≤ 0,1 mol %).
Lithuania	2	t seems legally possible to inject H2 into the Lithuanian TSO system, although currently there are no such H2 injections
Luxembourg	0	There is no legal framework in place today. In case of future requests, the situation will have to be assessed.
Malta	0	This section is not applicable to Malta since there is no transmission system. Current gas power plants in Malta can technically accept 10% H2 with minor adaptations
Netherlands	0.02	
Poland	0	
Portugal	0	In 2020, blending was not possible in Portugal and the transmission system is not yet ready for H2 injection. A max quota was defined by the Transmission Network Regulation (5% vol. by 2025 and 10% to 15% vol. by 2030 of other gases) and studies are ongoing.
Romania	0	
Slovak Republic	0	The transmission system is not ready for H2 injection. Studies and analysis are ongoing
Slovenia	0	The transmission system is not yet ready for H2 injection. Studies and analysis are ongoing. According to the Energy Act, H2 injection into the transmission system is possible, but the system operating instructions do not yet allow it.
Spain	5	The answer to Q4 is 5% for 0 ºC and 1 bar (not at normal conditions).
Sweden	0	In Sweden the TSO Nordion Energy 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.

Map 1: Maximum H2 concentration accepted by the TSOs in the natural gas transmission networks



Note: H2% limits are max. level for some sections. E.g. in DE, 10% is only allowed if no "sensitive" customer is connected (NG filling station); in IT, the H2 % is in biomethane injections; in ES, 5% is allowed for "non-conventional" gases. See report for details

Summary: Out of the 26 respondents, Germany has the highest H2 concentration limit (10%) under the conditions mentioned in the table, followed by France (6%), Spain and Austria (both 5%). In comparison to 2020, blending is now legally possible in Portugal; the H2 blending limits increased in Austria and Italy. Over 60% of respondent NRAs did not provide an answer or stated that H2 volumes are not possible, according to responses.

Q5. Does the same H2 blending limit apply 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	REPORTING NRA'S MS	Number	%
Yes	Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, France, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Poland, Portugal, Romania, Slovak Republic, Slovenia, Spain, Sweden	**20**	**77%**
No	Croatia, Estonia, Germany, Greece, Malta, Netherlands	**6**	**23%**
Grand Total		**26**	**100%**

Summary: 20 respondents (77%) noted that the same H2 blending limit applies for all gas transmission networks in their respective Member States. 7 countries (27%), on the other hand, answered that the blending limit is not the same for their respective gas transmission networks.

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. This is consistency with the replies to the 2020 report.

Reporting NRA's MS	Justification
Austria	The limit is given by the standard G B210 which derives from CEN Standard 16726. We cannot exclude that TSO networks can transport more H2
Belgium	The whole 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.
Cyprus	Not applicable.
Czech Republic	No national technical study has yet been conducted. Therefore, the status quo remains, 2% concentration will be allowed without problem, but still hydrogen is not measured as it is not gas per legislation. The Czech Gas Association, in cooperation with the TSO, is studying this topic and assessing the technical readiness of the transmission system as well ensures cooperation on technical rules adaptation.
Denmark	Safety concerns, restriction of blending limits for industrial processes where natural gas is used as feedstock
Estonia	N.A.
France	The main constraints identified by the French gas operators study (Technical economic conditions for injecting hydrogen into natural gas networks, 2019) relate to sensitivity of specific industrial processes, as well as natural gas vehicles (NGV) charging station (2% H2 allowed) and end-users appliances on the consumption side.
Germany	End-user equipment (industrial customer) cannot accept higher limits of H2.
Hungary	Currently there are no H2 producers who would want to inject H2 into the TSO's network. However as due to the prospective changes of EU gas regulations such needs may arise in the near future, the TSO initiated a project investigating the possible requirements and technical limits of H2 injection.
Ireland	The gas network is not currently set up to take H2 onto the system. Testing on a range of blending totals is currently underway
Italy	The 2% limit is a precautionary value chosen so as to preserve the underground gas storages and acceptance limits of end-users. It is meant to allow, as soon as possible the injection of H2 in the current gas networks, granting at the same time the maximum levels of security for users, population and the environment.
Lithuania	The Ministry of Energy of the Republic of Lithuania is responsible for setting quality requirements.
Luxembourg	No regulatory framework in place today. The TSO sees restrictions regarding the gas quality for end consumers. End-user equipment and industrial process are not designed for gas containing H2. This is to be reassessed with practices of neighbouring countries and with technical characteristics of the pipelines
Netherlands	In support of a separate H2 network with pure hydrogen.
Poland	There is no regulation regarding the possibility of H2 injection in the gas system.

Portugal	The national hydrogen strategy and the Transmission Network Regulation have defined quotas for H2 blending for 2025 (5%) and 2030 (10 to 15%). Studies are ongoing for concrete injections in the future.
Spain	Safety concerns and technical network limits
Slovakia	Not applicable. The transmission system is not ready for 2% injection. There is no regulation regarding the possibility of H2 injection into the system.

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.

Q 8. Are there plans to increase the H2 acceptance into natural gas networks in your MS?

Answers to Q8	REPORTING NRA'S MS	Number	%
Yes	Belgium, Bulgaria, Croatia, Czech Republic, Germany, Hungary, Ireland, Italy, Lithuania, Luxembourg, Poland, Slovenia, Spain, Sweden	**14**	**54%**
No	Austria, Cyprus, Denmark, Estonia, France, Greece, Latvia, Malta, Netherlands, Portugal, Romania, Slovak Republic	**12**	**46%**
Grand Total		**26**	**100%**

Summary: 14 NRAs (54%) reported plans to increase the H2 acceptance into natural gas networks for their respective MS. There is no significant change towards the 2020 results (57%).

Q9. Are investments/adaptations foreseen in the current NDP to allow or increase the TSO acceptance of H2?

Answers to Q9	REPORTING NRA'S MS	Number	%
Yes	Belgium, Croatia, France, Germany, Hungary, Italy, Lithuania, Portugal, Slovenia	**9**	**35%**
No	Austria, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Greece, Ireland, Latvia, Luxembourg, Malta, Netherlands, Poland, Romania, Slovak Republic, Spain, Sweden	**17**	**65%**
Grand Total		**26**	**100%**

Summary: The NDPs in most countries (65%) do not foresee any investment/adaptations for increasing the TSO acceptance of H2. Since 2 years ago, 6 additional NDPs -Croatia, France, Germany, Hungary, Italy, Lithuania, Portugal- also foresee investments/adaptations to allow or increase the TSO acceptance of H2 in their NDPs. The number of NDPs covering investments/adaptations for H2 acceptance increase from 3 (13%) in 2020 to 9 (35%) in 2022.

Reporting NRA's MS	Comment on Q9. If selected Yes to investments/adaptations in the NDP to allow or increase the TSO acceptance of H2, which type of investments/ adaptations are foreseen? To which level of H2 and by when?
Belgium	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 the TSO acceptance of H2. There is a need for the revision of the gas quality specifications as well. The TSO NDP 2021-2030 (indicative) contains a program to adapt/invest in order to get chromatographs able to measure the H2 content in the transported gas.

Croatia	Respecting the guidelines from the EU gas sector decarbonization policy and the Croatian strategy for hydrogen until 2050 (Official Gazette, No. 40/2022), the development of future decarbonized infrastructure will be planned respecting the following guidelines: • all larger gas interconnection and transmission pipelines that are planned in the next ten-year period will be developed as hydrogen-ready: • planning and reconstruction of gas nodes, safety and measuring equipment for receiving and mixing decarbonized gases into the gas transmission system will begin. This includes the development of a "smart gas network", which includes advanced digital systems and components, control systems, sensor technologies, devices for gas flow and quality management (construction of compressors, gas flow control circuits, reconstruction and equipping of chromatographs, etc.), which would allow for interactive and intelligent monitoring, measurement, quality control and management of the reception and transmission of decarbonized gases • in accordance with the plans of neighbouring TSO's, in the period between 2030 - 2040, the existing interconnections will be repurposed for hydrogen transmission, • all larger urban centres will be supplied with hydrogen, and in the period 2030 - 2050, the entire 75-bar system and the 50-bar system towards Varaždin and Osijek, and potentially towards Vukovar and Virovitica will be repurposed for the reception and transmission of hydrogen, while it is predicted that it will be possible to supply other areas with local production of biomethane • after 2040, the existing location of the UPP terminal will be repurposed for receiving decarbonized gases, and a new evacuation infrastructure will be built as necessary, • potential new corridors for the transmission of decarbonized gases from Eastern Europe and the countries of the southern and eastern Mediterranean to Central Europe will be developed, • reconstruction of inactive pipelines and development of new pipelines with the aim of developing three transmission clusters for CO2 capture and storage.
France	R&D projects (Jupiter 1000, FenHYx)
Germany	It is required that new infrastructure projects are planned already H2-ready.
Hungary	There is an ongoing project by the TSO which investigates the requirements of H2 blending. Any possible changes in the regulations regarding H2 acceptance are subject to the results of this study and to the provisions of the Decarbonisation Package.
Italy	Several studies and experiments are currently ongoing, some of them have been started with the support of the Ministry of Ecological Transition. Concerning the main gas TSO, since April 2019 Snam experimented the blending of 5% hydrogen into existing natural gas pipelines to feed two industries; between 2019 and 2020, the same gas network has been tested for the blending of 10% hydrogen. Currently, pilot projects are ongoing to test the direct injection in the network of H2 produced from renewable sources (solar and power to H).
Portugal	Mainly compressor substitutions at the UGS and studies in the transport network. The aim is to transport H2 blends from 10 to 15% vol. by 2030
Slovenia	The planned new pipeline HU-SI will allow transport of up to 100% H2.

Some NRAs report investments, studies and pilot projects to increase the acceptance of H2 blending (Belgium, France, Hungary, Italy, Portugal), the existence of guidelines for the development of future decarbonized infrastructure (Croatia) and requirements to have new gas infrastructure as hydrogen ready (Germany, Slovenia).

Q10. Is there a H2 blending target for the TSO? – specify in [% vol.] and target year

Reporting NRA's MS	Is there a H2 blending target for the TSO? - specify in [% vol.] and target year
Austria	max 5% H2 by 2025, if the draft EU regulation will be confirmed. A blending target is not foreseen at the moment.
Belgium	No
Cyprus	Not specified - no NDP published yet.
Czech Republic	No
Denmark	No
Estonia	No
France	No
Germany	No
Hungary	No
Ireland	No, not yet decided, GB is expected to blend hydrogen into their system from 2025,and Ireland would have to prepare as systems are interconnected
Lithuania	Until 2030, it will be studied to inject up to 10 % green H2 into the existing gas transportation system
Luxembourg	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 customers applications. National H2 blending target should at least be aligned with %vol delivered by neighbouring TSOs on the IPs.
Poland	10% vol. by 2030
Portugal	10 to 15% vol by 2030
Slovak Republic	No, but ongoing discussions (e.g. max. 5% by 2025)
Slovenia	No
Spain	No
Sweden	No blending target. Nordion Energy follows the CEN standard for H2 injection as answered in Q2 above.

Summary: Most countries do not have an H2 blending target for the TSO, while Poland (10%) and Portugal (10-15%) have a target by 2030.

2.2 100% H2 dedicated networks

Q 11. Are there currently 100% H2 pipeline networks for industrial purposes in your MS?

Answers to Q11	Reporting NRA'S MS	Number	%
Yes	Belgium, Czech Republic, France, Germany, Poland, Portugal	6	23%
No	Austria, Bulgaria, Croatia, Cyprus, Denmark, Estonia, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Romania, Slovak Republic, Slovenia, Spain, Sweden	20	77%
Grand Total		**26**	**100%**

Q11.1 If selected Yes, does a gas TSO/DSO(s) operate any of these H2 pipelines?

Answers to Q11.1	Reporting NRA'S MS	Number	%
No	Belgium, Czech Republic, France, Germany, Poland, Portugal	6	100%

Grand Total		**6**	**100%**

Q11.2 If selected No, are there plans in your MS for the development of 100% H2 pipelines/networks?

Answers to Q11.2	Reporting NRA'S MS	Number	%
Yes	Croatia, Denmark, Greece, Hungary, Lithuania, Malta, Netherlands, Slovak Republic, Slovenia, Sweden	10	50%
No	Austria, Bulgaria, Cyprus, Estonia, Ireland, Italy, Latvia, Luxembourg, Romania, Spain	10	50%
Grand Total		**20**	**100%**

Summary: 6 member states report the existence of 100% H2 pipelines, as compared to 2 in the 2020 report. TSO/DSOs do not operate 100% H2 pipeline dedicated networks. Those networks are generally used for refineries, fertilizer plants and other industrial sites. In 9 out of the 20 countries that do not operate 100% H2 pipeline dedicated networks, there are plans their development.

Reporting NRA's MS	Comment on the plans for the development of 100% H2 pipelines/ networks. Are they planned to be operated by the TSO?
Croatia	Yes, they are planned by the TSO.
Denmark	The future operator of the hydrogen system is undecided
Greece	All new Transmission pipelines are designed to be compatible with 100% H2 flow. For example, west Macedonia transmission pipeline is planned to operate initially with natural gas and transition to 100% H2 in the future.
Hungary	The National Hydrogen Strategy foresees the development of hydrogen networks by 2040, however it includes no details on their operation or their ownership structure.
Malta	The Melita TransGas Pipeline project PCI 5.19 will be 100% hydrogen ready and will transport 100% hydrogen when it will be market available. Market studies in this respect are being carried out by project promoter.
Slovenia	The planned new pipeline HU-SI will allow transport of up to 100% H2. It is planned to be operated by the TSO.
Sweden	There are plans for greenfield H2 pipelines to facilitate decarbonization of energy-intense industries, at an initial stage in northern Sweden

Q.12. If operated by a [DSO/TSO]: Are the H2 dedicated networks part of the regulated asset base?

Reporting NRA's MS	Comment on Q12. Textbox for comments
Austria	Not at the moment
Belgium	There is highly developed H2 pipeline network in Belgium of more than 600 km with cross-border connections with the Netherlands and France. 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.

Croatia	All larger gas interconnection and transmission pipelines that are planned in the next ten-year period will be developed as hydrogen-ready.
Czech Republic	Available in local industrial clusters - hydrogen is not a gas according to legislation - no requirement to have licence for gas distribution.
Estonia	Only studies for potential future development of H2 networks
Hungary	There are no dedicated H2 networks yet, beyond industrial sites (use in refineries and fertilizer plants)
Ireland	This is amongst options being considered by government in development of hydrogen strategy
Italy	The latest Snam NDP presents a proposal for the development of an H2 pipeline (almost 2 800 km) from North to South of Italy.
Netherlands	Future H2 networks will be developed by a separate entity from the gas TSO
Poland	H2 networks are existing mainly in large industrial plants in the steam reforming process of hydrocarbons, where hydrogen is used in industrial processes i.e. in reduction and hydrogenation processes, in refinery during hydrotreating, hydrocracking, reforming, in the food industry in hardening processes, in the metallurgical industry to iron ore reduction.
Portugal	Private, local and non-regulated networks
Slovak Republic	n.a.

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

Q.13. Which type and volumes of H2 are expected to be transported?

Reporting NRA's MS	Q13 Which type and volumes of H2 are expected to be transported?
Austria	Not analysed yet in the context of NDP
Belgium	Not yet specified.
Croatia	In the next ten-year period all the necessary analyses will be carried out and studies and projects will be made, which will elaborate in more detail the development concept for hydrogen in gas transmission network
Cyprus	Not able to assess
Czech Republic	Not available - nowadays probably grey hydrogen, in future possibly green hydrogen - private projects ongoing.
Denmark	100% green
Estonia	N/A
Germany	no estimation at hand. 100% green H2 is perceived as favourable.
Greece	No estimates are currently available
Ireland	Yet to be decided
Italy	According to the National Hydrogen Strategy Preliminary Guidelines (Nov. 2020), H2 is going to account for 2% of final energy consumption by 2030 and to 20% by 2050.
Lithuania	10 % green H2 until 2030
Poland	Not able to assess at current development stage
Portugal	Not assessed.
Slovak Republic	to be defined

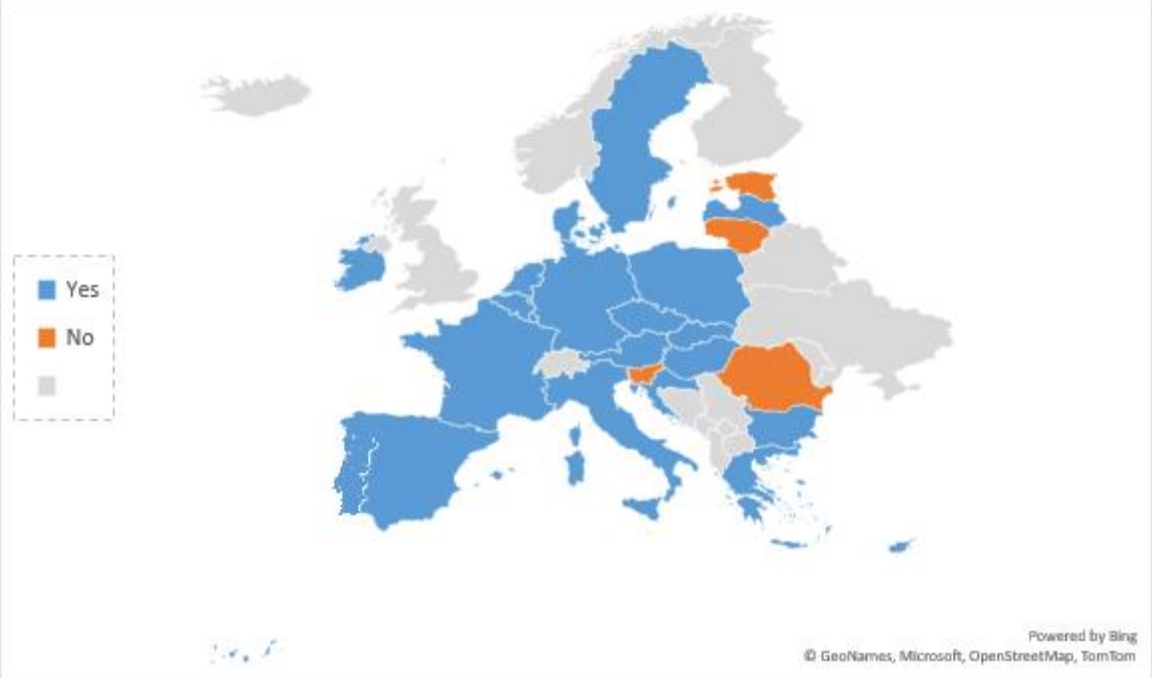
Sweden	100% green produced with electrolysis from domestic electricity generation, primarily hydro and wind.

Most respondent NRAs were not in a position to assess which type (green, grey or blue H2) of H2 and associated volumes are expected to be transported.

Q.14. Is there an H2 strategy (either under development or planned) in your MS?

Answers to Q14	REPORTING NRA'S MS	Number	%
Yes	Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Luxembourg, Netherlands, Poland, Portugal, Slovak Republic, Spain, Sweden	**21**	**81%**
No	Estonia, Lithuania, Malta, Romania, Slovenia	**5**	**19%**
Grand Total		**26**	**100%**

Map 2: Existent, under development or planned H2 strategy, per Member State



Summary: 21 NRAs noted the existence (or under development or planned) of a H2 strategy in their Member State. In 2020, 11 NRAs reported a H2 strategy, what means during last 2 years 10 new MS have come up with H2 strategies. Out of the 21 NRA reporting a H2 strategy (existing or under development), 13 MSs have published a dedicated H2 strategy or vision, and 2 NRAs have provided links to the National Energy and Climate Plans (NECPs) where H2 is expected to have a role in the energy mix. The strategy in Sweden has not been decided yet by the government, but there is a draft suggestion. Denmark published a government's strategy for a so called Power-to-X (PtX) where H2 plays a central role. Compared to 2020, there is a significant increase of dedicated H2 strategies/ visions (from 3 in 2020 to 13 in 2022)

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

Reporting NRA's MS	Comment on Q14. Please add a link if the H2 strategy is public
Austria	https://www.bmk.gv.at/themen/energie/energieversorgung/wasserstoff/strategie.html
Belgium	in Dutch: https://d3n8a8pro7vhmx.cloudfront.net/tinnevanderstraeten/pages/133/attachments/original/1635844064/H2_strategie_NL.pdf?1635844064 in French: https://d3n8a8pro7vhmx.cloudfront.net/tinnevanderstraeten/pages/133/attachments/original/1636365530/H2_strategie_FR.pdf?1636365530
Bulgaria	https://energy.ec.europa.eu/system/files/2020-06/bg_final_necp_main_en_0.pdf
Croatia	https://narodne-novine.nn.hr/clanci/sluzbeni/2022_03_40_492.html
Czech Republic	https://www.mpo.cz/assets/cz/rozcestnik/pro-media/tiskove-zpravy/2021/8/Vodikova-strategie_CZ_G_2021-26-07_2.pdf
Denmark	https://ens.dk/sites/ens.dk/files/ptx/strategy_ptx.pdf
France	https://www.economie.gouv.fr/plan-de-relance/mesures/strategie-nationale-developpement-hydrogene-decarbone
Germany	https://www.bmwk.de/Redaktion/DE/Publikationen/Energie/die-nationale-wasserstoffstrategie.html
Greece	Long Term Strategy 2050 – LTS: https://ypen.gov.gr/wp-content/uploads/2020/11/lts_gr_el.pdf
Hungary	https://kormany.hu/dokumentumtar/magyarorszag-nemzeti-hidrogenstrategiaja
Ireland	Consultation closed, no strategy in place yet
Italy	https://www.mise.gov.it/images/stories/documenti/Strategia_Nazionale_Idrogeno_Linee_guida_preliminari_nov20.pdf
Latvia	https://www.conexus.lv/search?searchQ=hydrogen
Luxembourg	Climate national plan 2021-2030 (https://mea.gouvernement.lu/dam-assets/energie/energie-renouvelable/Plan-national-integre-en-matiere-d-energie-et-de-climat-du-Luxembourg-2021-2030-version-definitive-traduction-de-courtoisie.pdf) See pages 97-98
Netherlands	https://www.rijksoverheid.nl/actueel/nieuws/2021/06/30/staatssecretaris-yesilgoz-zegerius-zet-eerste-stap-voor-ontwikkeling-landelijk-waterstofnet
Poland	https://www.gov.pl/web/klimat/polska-strategia-wodorowa-do-roku-2030
Portugal	https://www.dgeg.gov.pt/media/5eac1vcd/resolu%C3%A7%C3%A3o-do-conselho-de-ministros-n-%C2%BA-632020.pdf
Slovak Republic	https://www.mhsr.sk/uploads/files/YBN0ndkU.pdf
Spain	https://energia.gob.es/es-es/Novedades/Paginas/publicacion-hoja-de-ruta-del-hidrogeno-apuesta-hidrogeno-renovable.aspx
Sweden	The strategy is not yet been decided by the government, but there's a draft suggestion. https://energimyndigheten.a-w2m.se/Home.mvc?ResourceId=206531

Q.15 Are there obligations for network operators to publish actual and future available capacity for hydrogen injection into the gas transmission networks?

Answers to Q15	REPORTING NRA'S MS	Number	%
Yes	Portugal, Slovak Republic	**2**	**8%**

No	Austria, Belgium, Croatia, Cyprus, Czech Republic, Denmark, Estonia, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Netherlands, Poland, Romania, Slovenia, Spain, Sweden	**22**	**92%**
Grand Total		**24**	**100%**

Reporting NRA's MS	Comment on Q15
Belgium	Not yet specified, currently under development.
Czech Republic	There is no obligations for network operators to publish actual and future available capacity for any of the gases - applicants can always inform by asking or applying for connection.
Ireland	Irish government currently developing hydrogen strategy, no obligations set on network operator currently in this regard
Latvia	See the answer to question 5 on this section of this survey.
Portugal	Not done for the moment

Summary: Only Portugal and Slovak Republic reported obligations for network operators to publish actual and future available capacity for hydrogen injection into the gas transmission network (in 2020, no NRA reported such an obligation).

2.3 Questions on biomethane at TSO level

Q.16 Is biomethane currently injected into the gas transmission system?

Answers to Q16	REPORTING NRA'S MS	Number	%
Yes	Denmark, France, Germany, Hungary, Ireland, Italy, Netherlands, Spain, Sweden	**9**	**35%**
No	Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Estonia, Greece, Latvia, Lithuania, Luxembourg, Malta, Poland, Portugal, Romania, Slovak Republic, Slovenia	**17**	**65%**
Grand Total		**26**	**100%**

Summary: 9 NRAs (35%) confirmed that biomethane is currently injected at TSO level (same number of member states as 2020).

Q.17 Are there examples of reverse flows (from distribution to transmission grid) and/ or direct injection from biogas/ biomethane plants into the transmission system?

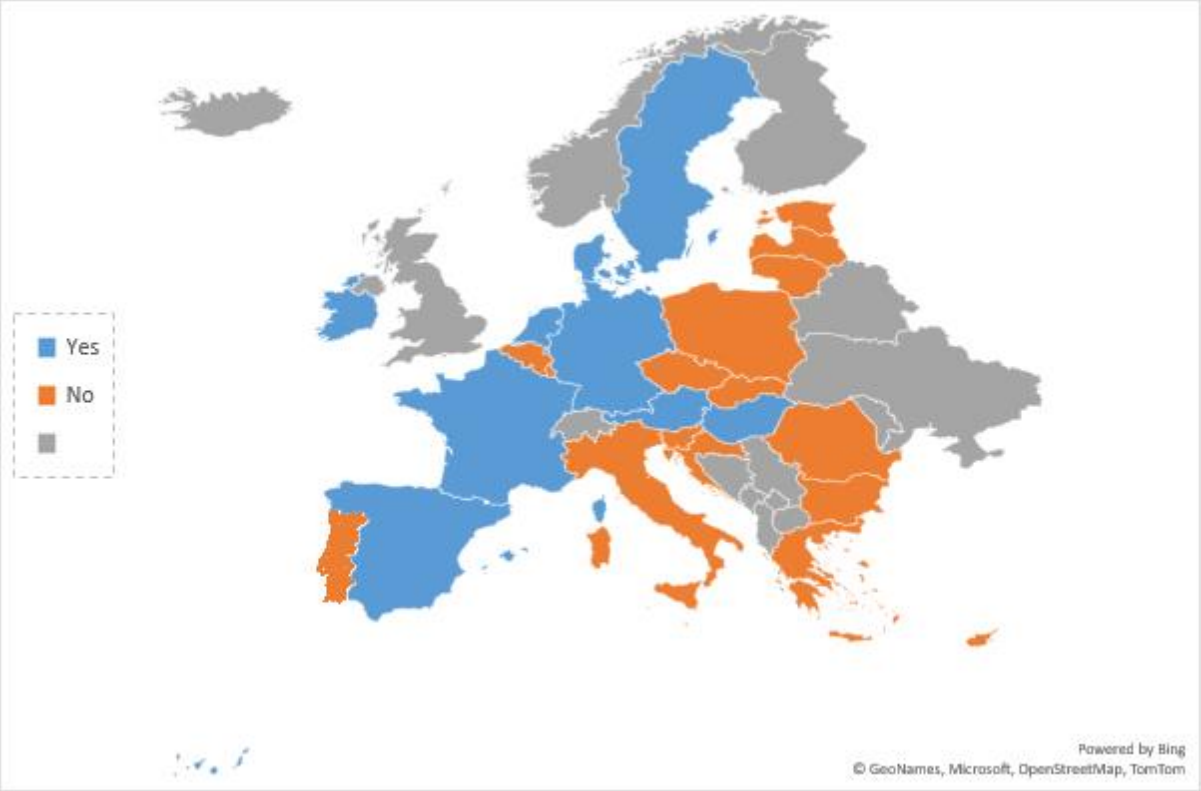
Answers to Q17	REPORTING NRA'S MS	Number	%
Yes	Austria[4], Denmark, France, Germany, Hungary, Ireland, Netherlands, Spain, Sweden	**9**	**31%**
No	, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Estonia, Greece, Italy, Latvia, Lithuania, Luxembourg, Malta, Poland, Portugal, Romania, Slovak Republic, Slovenia	**17**	**69%**

[4] There are reverse flows from the distribution grids to the transmission but no injection from biogas/biomethane plant into the transmission system

Grand Total		**26**	**100%**

Summary: 9 NRAs (38%) responded that reverse flow and/or direct injection from biogas/biomethane plants is possible. However, most respondents (17 out of 26, 65%) noted that this was not feasible yet. The picture is very similar to the 2020 review.

Map 3: MS with reverse flows (from distribution to transmission grid) and/ or direct injection from biogas/ biomethane plants into the transmission system



Q18 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 MS	Q18 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?
Denmark	Biomethane facilities
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	Responsible for the gas quality is the operator of the specific facility.
Hungary	The TSO. There is however only a single biomethane facility in the country which is connected to the national gas network. It injects gas at DSO level. The biomethane is not injected physically into the TSO's system, it is taken into account through a virtual reverse flow.
Ireland	The owner of the facility
Italy	The producer is responsible for the gas quality upgrading.
Netherlands	The biogas producer
Spain	Not the TSO, the production company

Sweden	The Biomethane manufactor operates the quality upgrading and TSO operates the injection facilities.

Most of the NRA 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.19 Are investments/adaptations foreseen in the current NDP to allow or increase the injections of biomethane in the gas transmission system?

Answers to Q19	REPORTING NRA'S MS	Number	%
Yes	Belgium, Denmark, France, Ireland, Italy, Latvia, Lithuania, Netherlands, Slovenia, Sweden	**10**	**38%**
No	Austria, Bulgaria, Croatia, Cyprus, Czech Republic, Estonia, Germany, Greece, Hungary, Luxembourg, Malta, Poland, Portugal, Romania, Slovak Republic, Spain	**16**	**62%**
Grand Total		**26**	**100%**

Summary: 16 out of 26 respondents (62%) 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.

Q.20 Are there obligations for network operators to publish actual and future available capacity for biomethane injection into the gas transmission networks?

Answers to Q20	REPORTING NRA'S MS	Number	%
Yes	France, Ireland, Lithuania, Portugal	**4**	**17%**
No	Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Germany, Greece, Hungary, Italy, Latvia, Luxembourg, Netherlands, Poland, Slovak Republic, Slovenia, Spain, Sweden	**20**	**83%**
Grand Total		**24**	**100%**

Summary: 4 countries (namely France, Ireland, Lithuania and Portugal) stated that there are obligations for network operators to publish actual and future available capacity for biomethane injection into the gas transmission networks.

Q 21. Are there obligations for network operators to provide a connection point for biomethane injection upon request by a network user?

Answers to Q21	REPORTING NRA'S MS	Number	%
Yes	Austria, Bulgaria, Czech Republic, Denmark, Estonia, France, Germany, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Netherlands, Portugal, Slovak Republic[5], Slovenia, Spain	**18**	**75%**
No	Belgium, Croatia, Cyprus, Greece, Poland, Sweden	**6**	**25%**
Grand Total		**24**	**100%**

Summary: 18 out of 24 respondents (75%) answered that obligations exists for network operators to provide a connection point for biomethane injection upon request by a network

[5] At distributor system operator (DSO) level.

user. No such obligations exist for Belgium, Croatia, Cyprus, Greece, Poland, Slovak Republic, Sweden.

Comments related to Q 19-21, capacity availability and connection points for biomethane injection.

Reporting NRA's MS	Comments related to Q19 - Q21
Austria	Obligations of network operators to provide a connection point for biomethane injection upon request are possible just if the local DSO reject the application and the TSO do not rise technical reasons against it.
Belgium	There are biomethane injections on DSO level but not yet surpluses which need a physical reverse flow into the TSO network.
Czech Republic	Q20 - TSO is required to connect everyone interested – if the biomethane plant considers connection, the TSO must allow it and inform the applicant about available capacities.
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 has the lowest societal cost. 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 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
Germany	Biomethane has to be prioritized over regular gas. The TSOs/DSOs have the legal obligation to connect biomethane operators and their facilities to their network. Rare exemptions are possible.
Hungary	To Q21: If the biomethane fulfils the gas quality requirements, it is handled no differently from any other domestic gas producers.
Ireland	Gas Networks Ireland commissioned the first renewable gas grid injection facility in 2019, and it was officially declared an Entry Point in May 2020. Gas Networks Ireland now facilitates direct grid injection projects through a connection policy framework. Direct injection of anaerobic digestion facilities are also supported under the Gas Networks Ireland Connection Policy. As of July 2021, over 180 expressions of interest were received from potential developers. Article 23 of the most recent Renewable Energy Directive (RED II) states that “each Member

	State shall endeavour to increase the share of renewable energy in that sector by an indicative 1.3% as an annual average calculated for the periods 2021 to 2025 and 2026 to 2030, starting from the share of renewable energy in the heating and cooling sector in 2020 expressed in terms of national share of final energy consumption", therefore this will drive a mandatory minimum of 1.3% annual increments of Biomethane which would oblige a minimum of 1.6 TWh/yr by 2030.
Latvia	Regarding question 21: the TSO is obliged to provide everyone with a connection point if there is available capabilities in the system The necessary investment costs are borne by the user. Regarding question 19: Investments are planned, but they are not included in the NDP, because there is currently no NDP for gas transmission system in Latvia. It is planned that the first NDP will be developed and approved in 2023.
Poland	Biomethane capacity is included in the NDP in the peak demand balancing analysis. The network operator obliged to prepare a detailed NDP implementation report containing information about the development of biomethane in the latest period.

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

Q.22 Please elaborate on, if any, relevant changes / updates during the last 2 years regarding Hydrogen, Biomethane and Network Adaptions (questions Q1 - Q21)

Reporting NRA's MS	Changes / updates during the last 2 years regarding Hydrogen, Biomethane and Network Adaptions (questions Q1 - Q21)
Belgium	The EU energy transition is currently overshadowed by the short-term actions needed to safeguard natural gas supplies. The substitution of RU gas and the need of increase import capacity from other gas sources (and a change of flow patterns from East to West) raises the important question whether new investments are still compatible with the energy transition goals.
Czech Republic	Injection pipelines of biomethane producers can be sold to a DSO, who operates it and includes it into RAB. A detailed methodology is not available at the moment
Greece	A process of updating the regulatory framework to include provisions regarding hydrogen and biomethane production, distribution and transmission is currently under way. Additionally, the DSOs are performing relevant pilot projects. These include projects related to both hydrogen and biomethane distribution. Furthermore, the TSO has presented initial plans to the NRA for a future hydrogen network.
Italy	The 2% limit for H2 blending has been recently set by the Decree 3 June 2022 of the Ministry of Ecological Transition. Lgs. decree 199/2021, aimed at transposing directive (UE) 2018/2001, establishing that: - information on biomethane production must be included in NDPs, and the regulatory authority will have to amend its regulation in this regard; - the regulatory authority has to define the criteria so as to optimize the procedure for the connection of biomethane production to the grid (taking into account at the same time the possible connection to the grid of other renewable gases, such as H2).
Lithuania	No changes/updates in the last 2 years
Portugal	Defined by Decree-Law 62/2020 of 28 August available at https://www.dgeg.gov.pt/media/5eac1vcd/resolu%C3%A7%C3%A3o-do-conselho-de-

	ministros-n-%C2%BA-632020.pdf and Transmission Network Regulation (Dispatch 806-C/2022 of 19 January – available at https://agnatural.pt/folder/documento/ficheiro/730_Despacho%20n.%C2%BA%20806-C_2022.pdf
Spain	Spanish Hydrogen Strategy foresees an installed capacity of 4 GW electrolysers by 2030 and different milestones in the industrial, mobility and electricity sectors for the period 2020-2030. An intermediate target (estimation) between 300-600 MW installed capacity of electrolysers for 2024 is set. In the 2030-2050 period the hydrogen technologies should reach maturity and be widely deployed. Spanish Biogas Strategy sets a minimum target for the production of biogas of 10.41 TWh/year by 2030. In the transport sector, biogas and biomethane will contribute to achieve the Spanish objective of 28% utilization of renewable energies in transport in 2030 and the EU objective of 3.5% advanced biofuel use in transport in 2030. A system of guarantees of origin for renewable gases and hydrogen are included in the legislation and is under development. Spanish roadmap for biogas can be consulted at https://energia.gob.es/en-us/Novedades/Paginas/consejo-ministros-aprueba-hoja-ruta-biogas.aspx
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