



ADVISORY PANEL FOR FUTURE GAS GRIDS

RECOMMENDATION REPORT ►

FEBRUARY 2023

DISCLAIMER

The Recommendation Report was drafted by ENTSOG. It is based on the input of the Panel stakeholders participating in the meetings and in no way reflects the position of every individual stakeholder or of ENTSOG itself.

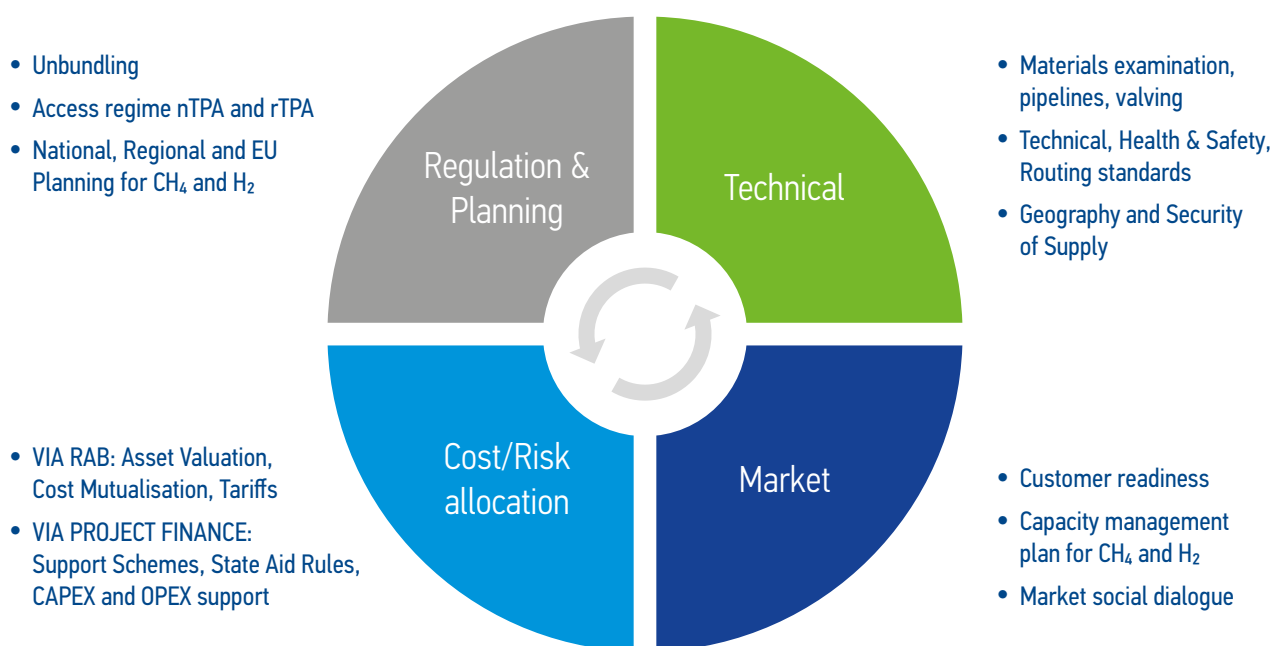
The following stakeholders took part in the Panel discussions: Eurogas, Hydrogen Europe, Gas Infrastructure Europe, Council of European Energy Regulators, International Association of Oil & Gas Producers, IFIEC, GEODE, GD4S, European Chemical Industry Council, Fertilisers Europe, European Heating Industry, Gas for Climate, European Federation of Energy Traders, European Engine Power Plants Association, EU Turbines, European Biogas Association, H2GAR, ENTSO-E, Marcogaz, GERG, EASEE-gas, Florence School of Regulation, Copenhagen School of Energy Infrastructure, Gassco, European Union Agency for the Cooperation of Energy Regulators and European Commission.

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1 INTRODUCTION

In January 2021 ENTSOG launched an Advisory Panel for Future Gas Grids with the purpose to ensure transparency and coordination between the entire value chain to transition to net zero emissions by 2050 and to identify practical challenges and solutions how to support transition also through the gas grids.



The Advisory Group meets on a quarterly basis and includes stakeholders along the entire value chain – from production, transmission and distribution, to end-use, as well as academia. The main focus is to discuss the market, technical, planning, regulatory and financing elements of how to repurpose the existing gas infrastructure for renewable and low-carbon gases including hydrogen and biomethane. External speakers from the European Commission and Council, as well as from regulators joined us in our discussions to exchange ideas. The result of these discussions is the creation of the Recommendation Report, which provides an overview of stakeholders' input on key elements needed to effectively establish this Repurposing Framework for gas grids.

The Recommendation Report 2021 focused on the Repurposing Framework and identified several technical, regulatory, planning, market and financing elements needed to repurpose the gas grids for renewable and low-carbon hydrogen.

The last Recommendation Report brought the following conclusions:

►► **Technical elements:** with the injection of renewable and low-carbon gases (including hydrogen, biomethane and syngas) into grids, technical challenges related to gas quality and asset repurposing (pipelines, valves, compressors, etc.) need to be dealt with. Technical and safety standards are currently updated by the industry in line with its knowledge and experience and interoperability between Member States and Security of Supply ensured. If not addressed, this could lead to increased costs and obstacles to develop a pan-European market. This process will need to ensure that end-users' requirements (in terms of gas quality and hydrogen purity) are fully considered.

►► **Market elements:** A market for hydrogen needs to be designed such that hydrogen can be traded seamlessly as a commodity and the differences in origin, of source and purity are properly valued. Lessons need to be learned from the development of the market for natural gas over the last 25 years and appropriate frameworks to manage costs and risks need to be created. This may include a need to consider flexible policy-measures, on the supply and demand side of the market, to kick-start its development. Market design should include rules on repurposing as well as management of the necessary transport capacities to optimise the utilisation and repurposing of the current gas assets.

►► **Regulatory and planning elements:** A barrier for kick-starting a hydrogen economy is the lack of a regulatory framework. Investor confidence can be enhanced if key regulatory principles are defined in advance. These principles include unbundling, the access regime (negotiated or regulated Third Party Access) and their application in the hydrogen market. On the planning side, as the energy system becomes ever more integrated and interlinked – and as national policies need to be compatible – a coordinated EU-wide planning approach for all energy carriers, including gas, electricity and hydrogen is essential.

►► **Financing elements (cost and risk allocation):** Transmission and distribution infrastructure has significant CAPEX costs. Hence, adequate financing will be needed – either via public or private finance. Consideration for where risks are allocated is required – recognising the different incentives this creates and the need for repurposing or adding new infrastructure, following a “no regret” approach. This may involve various tools at either national or European level (again recognising the need for cooperation) and/or various regulatory processes to transfer assets between asset bases. There are several tools and mechanisms available at EU level. Alternatively, transferring the gas assets into the hydrogen networks could be done via cost mutualisation. The European gas TSOs are actively working and willing to invest in repurposing, but there is a need to understand those new conditions.

In 2022, in view of the European Commission’s REPowerEU Communication and Action Plan the scope of the Recommendation Report includes also detailed focus on biomethane. The Advisory Panel participants discussed several aspects of how to best transition gas grids to reach the targets identified in the REPowerEU – 20 million tonnes of renewable hydrogen and 35 bcm of biomethane by 2030. The majority of stakeholders agreed that the existing gas infrastructure is ready to transport biomethane and is an important asset that can be repurposed cost-efficiently to transport hydrogen, asset that can be repurposed cost-efficiently to transport hydrogen, besides also some development of newly built infrastructure.

We believe that this report can provide concise and relevant input in the upcoming discussions and legislative process on the Hydrogen and decarbonized gas market package.

The Recommendation Report was drafted by ENTSOG and is based on the input of the Panel stakeholders participating in the meetings and summarises a variety of perspectives, it does not reflect the official positions of the companies or associations in the Advisory Panel but is based on the information and comments shared in discussions by their representatives.

2 BIOMETHANE

In 2022, in the REPowerEU Communication, the European Commission introduced the Biomethane Action Plan, setting out tools to scale up biomethane to reduce Europe's dependency on natural gas from Russia in a cost-effective way and at the same time contribute to an integrated net-zero energy system. The Communication included setting up a new Biomethane Industrial Partnership and financial incentives to increase production to 35 bcm by 2030. The Advisory Panel discussed throughout 2022 how to deliver the 35 bcm biomethane production target by 2030 and agreed there is urgency and need for massive scale up. The new target was welcomed by all stakeholders as a key enabler for the uptake of biomethane, as it provides for a crucial change from a situation where biomethane has been produced on a small scale and consumed locally, to a situation where the integration of biomethane becomes national, regional, and European. The discussion in the panel focused on regulatory, technical, and planning elements at both distribution and transmission level.

2.1 REGULATORY ELEMENTS

During the discussion it was acknowledged that the biomethane target of 35 bcm needs to be anchored in legislation at EU level – for example as in the Renewable Energy Directive. While nationally on Member State level, swift drafting of the Biomethane National Strategies at Member State's level with targets and milestones for biomethane is

key to ensure certainty and clarity. There is also need for a harmonised enabling framework for grid connection and grid reinforcement, specifically via the revised Gas Regulation and Directive. Support for cost-sharing for grid connection and a quick reform on permitting is crucial to enable the speedy development.

2.2 PLANNING ELEMENTS

The roll-out of biomethane on this massive scale would mean additional 5000 biomethane plants to be built and connected by 2030.¹ The stakeholders acknowledged this needs to be done quickly and with minimal cost to the consumers and society. Due to the decentralised production, the planning of the infrastructure is key – as matching of demand and supply is paramount for an efficient network. Stakeholders suggested planning via a bottom-up approach, initially focusing on an assessment of long-term biomethane production potential at regional level for Member States to see where the easiest connections can be made for biogas plants for DSO (distribution system operator) or TSO (transmission system operator) grids. This shall be followed by grid reinforcement plans at the local level and finally development of investment proposals

and implementation. The Advisory Panel highlighted that for efficient network planning there is a need for coordination and joint and long-term network planning in cooperation with TSOs and DSOs due to the complexity of the system with reverse flows and decentralised biomethane production. For example, in Denmark the production currently exceeds demand, hence there is need to use reverse flows to transport biomethane via the existing gas transmission grids to other end-users. Therefore, investments will be needed, specifically the buildup of reverse flow sites – these should be based on future assumptions and go hand in hand with development plans. Still these investments could be costly and would need to be assessed from a socio-economic perspective.

2.3 TECHNICAL ELEMENTS

On the technical side, the existing transmission and distribution gas grids are biomethane ready and can be used for transport of biomethane. Still, with future cross-border flows of biomethane there is a need to ensure coherent quality standards between Member States – as biomethane will travel across countries and there is an issue of fragmented gas quality standards for biomethane currently. One of the topics discussed is the need to find the optimal acceptance limit across the EU for oxygen. Hence, there is need for gas quality coordination for biomethane in the Gas Package and to reassess and update gas quality standards especially on the transmission and storage side. On the system operation side there will also be need for digitalization solutions to ensure

smooth management of the system with reverse flows and decentralized production of biomethane.

In conclusion, it was stressed that in order to achieve the massive scale up of the biomethane, there is need for coordination, joint planning of both TSOs and DSOs, sharing of best practices and building on each other's experiences, clear and enabling regulatory framework with anchoring the target in legislation for a speedy development of biomethane and to reach the 35 bcm biomethane production target by 2030.

¹ Source: [European Biogas Association](#)

3 REPURPOSING FRAMEWORK

In 2022 the Advisory Panel participants continued the discussion on the Repurposing Framework – on how to repurpose existing gas grids to transport hydrogen from a regulatory, planning, and financial perspective. It was agreed that the most cost-efficient way is to repurpose the gas grids, and to some extent develop new hydrogen grids.

In 2022, the REPowerEU Communication introduced the Hydrogen Accelerator with ambitious hydrogen targets – 10 million tonnes of renewable hydrogen to be produced and 10 million tonnes of renewable hydrogen to be imported by 2030. The Action Plan outlined steps needed to deploy hydrogen infrastructure for producing, importing and transporting 20 million tonnes of hydrogen by 2030 as well as total investment needs in the range of EUR 28–38 billion for EU-pipelines and EUR 6–11 billion for storage. To achieve this, timely planning of the infrastructure and enabling regulatory framework will be needed. In June 2022, the revised

Trans-European Network for Energy Regulation (TEN-E) was adopted, including eleven priority corridors covering different geographic regions in the field of electricity, offshore grid and hydrogen infrastructure. On the import side, the European Commission identified the need for development of three hydrogen import corridors: the Mediterranean, the North Sea and, as soon as conditions allow, the Eastern corridor with the Ukraine. The Advisory Panel stakeholders discussed in detail the regulatory, planning, market and financing elements which are needed to deliver on the targets and to develop the hydrogen corridors as outlined in REPowerEU.

3.1 PLANNING ELEMENTS

On the planning side, the Advisory Panel concluded that strategic thinking and cooperation among Member States is key to realise the development of the hydrogen corridors. The planning of the energy system will need to be designed in an integrated way as one system for all energy vectors including hydrogen, gas, electricity at both local (DSO) and European (TSO) level – also including storages, imports via the terminals and offshore infrastructure.

All stakeholders agreed that speedy development of a European Hydrogen Backbone (EHB) is key for cost-efficient scale-up of the hydrogen economy and that infrastructure development is based on the demand needs. Initially, it was outlined that the hydrogen corridors will connect local supply and demand centers in different parts of Europe, before expanding and connecting Europe with neighboring regions with export potential.² The European Hydrogen Backbone Initiative outlined this in their study: five corridors which span across both domestic and import supply markets.

During the discussion the point was raised that to ensure the development of each corridor by 2030, there is a need for clear and concrete actions now and need to combine

top-down EHB perspective with ENTSOG bottom-up planning such via the established Ten-Year Network Development Plan (TYNDP) process.

The Advisory Panel stakeholders agreed that the much-needed framework for a long-term holistic “one energy system vision” can be done via the Ten-Year Network Development Plan (TYNDP) under the Trans-European Network for Energy Regulation (TEN-E). The ENTSOs have already developed possible future scenarios and an Integrated Infrastructure Modelling for electricity and gas systems. These are aiming to tap into the existing and potential synergies (Gas to Power, and Power to Gas). Especially concerning the role of hydrogen as long-term storage for the electricity side, electrolyzers’ effect on avoiding curtailment of renewable electricity production, and the order of magnitude of dedicated hydrogen production. Concerning hydrogen infrastructure, it is already integrated in scenarios and the upcoming TYNDP 2022, which includes over 100 hydrogen investments directly connected to hydrogen: converting, injecting, transporting or storing hydrogen.

² Source: [European Hydrogen Backbone: Five hydrogen supply corridors for Europe in 2030](#)



Source: [European Commission, REPowerEU Plan](#)

ENTSO-G supported the discussion of the Advisory Panel with its inputs from the Clean Hydrogen Alliance and TYN-DP Framework aiming at integrating, bringing transparency and quantifying the emerging hydrogen value chain. To quantify the development of the H₂ infrastructure assets (transmission grids, distribution grids, storages, terminals), ENTSOG, together with GIE, Eurogas, GD4S, CEDEC, GE-ODE and in cooperation with EHB, finalized in December 2022 the mapping of hydrogen infrastructure projects in a [Hydrogen Infrastructure Map](#) based on the mandate from the 36th Madrid Forum. The map shows the possibilities of hydrogen infrastructure development in 2030, 2040 and 2050 per different region and Member State and confirms that repurposing of existing gas pipelines is the most cost effective and quickest way to develop the hydrogen grid of the future.

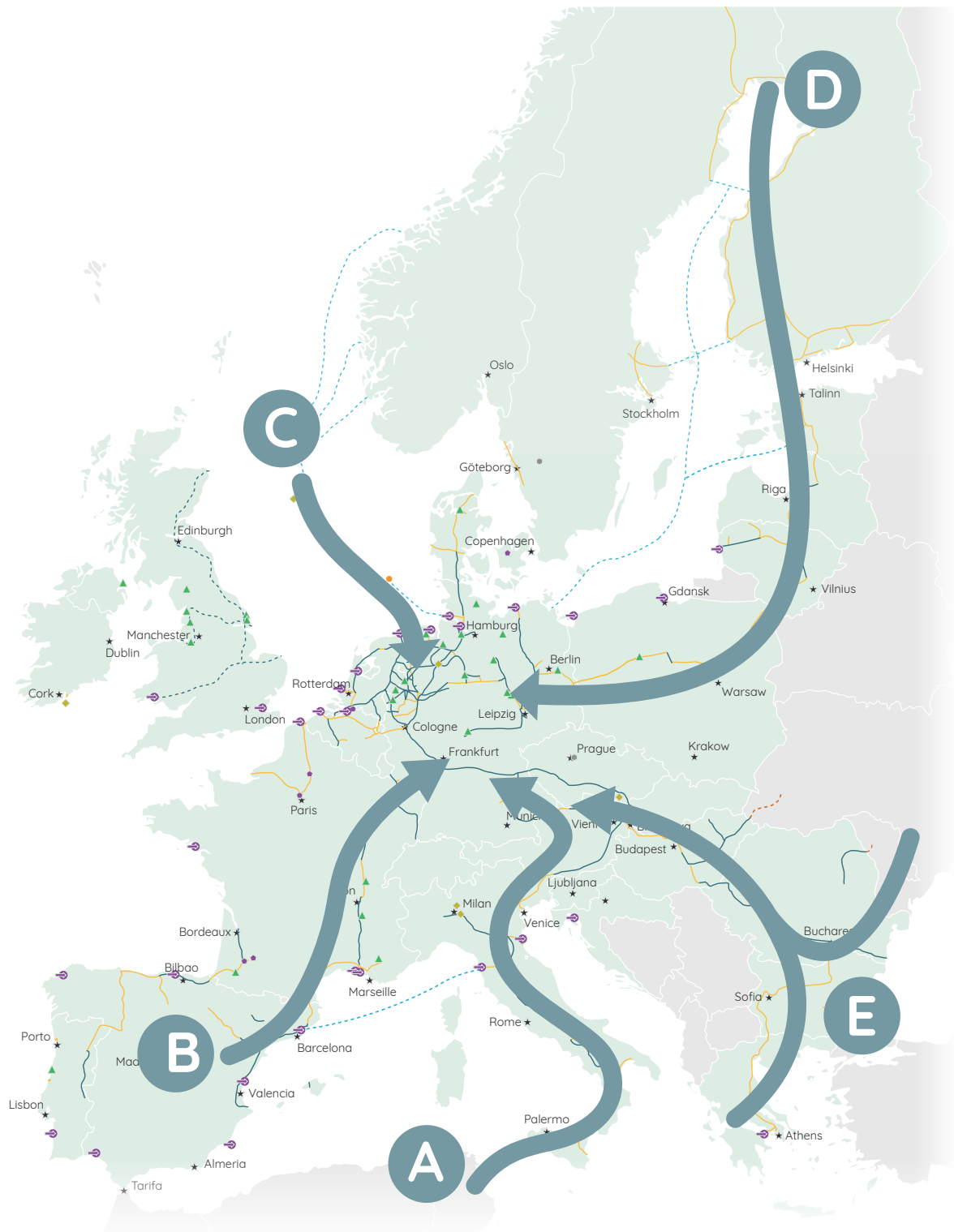
Concerning the development of the offshore network grids, stakeholders pointed to the revised TEN-E regulation, which outlines five offshore grid corridors (NSOG, BEMIP offshore, SW offshore, SE offshore, Atlantic offshore grids). It was raised that a holistic view across time, space and sectors is needed to reap the benefits of offshore renewable energy. ENTSO-E is working on an Offshore Network Development Plan, which will provide a high-level outlook on offshore generation capacities and grid needs, including needs for

interconnectors, hybrid projects, radial connections, reinforcements of national grids and hydrogen infrastructure within a “one energy system view”. Hence, integrated planning to unlock benefits of onshore and offshore infrastructure through cross-border infrastructure planning and coordination of maritime spatial planning at sea basin level was highlighted. To connect offshore grids to the onshore infrastructure (gas or electricity grid), ENTSO-E already looks at how to merge the Offshore Network Development Plan with the current Ten-Year Network Development Plan which is more mature, with the aim to provide a single network development perspective as such. Nevertheless, it was acknowledged that it will take some time. Some bottlenecks identified were long permitting procedures, as well as the need to ensure social acceptance based on cooperation with local authorities, regulators, and communities. Lastly, stakeholders identified the issue of generation peak load, which will be surplus to the electricity loads available.

Concerning imports, the REPowerEU Communication includes a target of 10 million tonnes of renewable hydrogen by 2030. Stakeholders agreed that ports and terminals will be crucial and serve as entry gates to Europe. Several ports have multicarrier strategies as hydrogen will be shipped in the form of hydrogen carriers such as methanol, ammonia, synthetic

methane or LOHC based on market needs (e. g. ammonia for fertiliser industry). The importance of a robust energy system to supply energy and feedstock, as well as a need for expansion capacity of infrastructure was raised. In addition, stakeholders see the need for diversified structure of hubs (ammonia) and LNG terminals (synthetic LNG comprising of H₂ and green CO₂). In terms of assets, cracking facilities for ammonia as well multimodal connections (rail, barges, etc) was raised as key. Several stakeholders raised the need for a level playing field of intra-EU and outside EU conditions.

In summary, ENTSOG informed the Advisory Panel members that it is coordinating on the topic of H₂ corridors with DG GROW via the Clean Hydrogen Alliance and DG ENER via the regional groups work under the PCI process. On the latter, ENTSOG supports DG ENER on collecting projects applying to the PCI selection process through ENTSOG's Project Portal, and for which ENTSOG will run the project-specific CBAs (Cost-Benefit-Analysis). ENTSOG, assessing any project indicating its intention to apply for the following PCI selection process independently of its maturity level already assesses



Source: [European Hydrogen Backbone](#)

a broader scope of projects, and it ensures fair treatment of any of the PCI candidates. Such approach is also welcomed by the European Commission in its Opinion on the 2nd CBA Methodology and previous PCI selection processes and will be continued. On the Clean Hydrogen Alliance, ENTSG launched

in Q4 of 2022 the qualitative analysis on how to practically develop H₂ corridors and to understand the regional differences between each H₂ supply corridor. The Learnbook Report will identify the potential of each H₂ supply corridor, list projects, identify bottlenecks and provide recommendations.

3.2 REGULATORY ELEMENTS

On the regulatory side, the main barrier for deployment of hydrogen projects is still the lack of clear regulatory framework. Although, the Hydrogen and Gas Market Decarbonisation package was presented by the European Commission in December 2021 – including a framework on how to regulate hydrogen networks – both the recast Gas Regulation and Gas Directive are still not adopted and at the stage of discussion by the co-legislators. In addition, the Delegated Act on Renewable Fuels of non-biological origin (DA on RFNBO) is missing, which is vital and necessary for assessing business cases and making final investment decisions as the Delegated Act provides clear framework, requirements, and criteria for RFNBOs.

Concerning other regulatory bottlenecks, several stakeholders also pointed out the need to simplify and shorten permitting procedures not just for renewable energy projects but also for hydrogen, and the missing certification.

Lastly, there is the missing regulatory framework for offshore grids. Although the new TEN-E regulation includes offshore networks, there are no offshore bidding zones, which creates investment insecurity.

3.3 MARKET AND FINANCING ELEMENTS

In terms of financing, stakeholders raised the need to bridge the financial gaps between the use of renewable & low-carbon hydrogen on one side and its derivatives compared to the fossil fuel alternatives. There is huge demand of CAPEX support for big infrastructure projects but also OPEX support for initiating first renewable hydrogen volumes. For investors, the main question raised was on how to minimise the initial risks, when there is no clear idea on the utilisation of the assets. Apart from the volume target, some stakeholders suggested the need for an infrastructure target to ensure that the corridors are in operation by 2030.

For investors, the main question was on to minimise the initial risks, when there is no clear perspective of the utilisation of the assets. To avoid the “chicken and egg” dilemma as infrastructure development does have long lead times. In this way, creating first parts of the corridors would provide stability and security for end-users, who need predictability in order to be decarbonised based on the REDIII targets.

At the EU level, there are several public schemes (CEF, IPCEIs, etc) looking at financing hydrogen infrastructure projects. On the private side, stakeholders mentioned that the short-term financing capacity of private investors is not up to the ambition that we have seen in the REPowerEU Communication. Hence, stakeholders stressed the clear need of a public subsidy framework to integrate long term development objectives. The question on the Hydrogen Investment Bank with 3 billion euros was introduced by European Commission in 2022, but stakeholders pointed to the missing clear processes and scope.

Concerning the purchasing of hydrogen, at the global level the green hydrogen will be vulnerable to fluctuations in prices due to swings in supply due to seasonal variability, inter-annual variability or potentially political instability from importing regions. To mitigate the variability of and disruptions to hydrogen supply there is need for diversification, investment into storage and potentially establishment of strategic reserve to ensure security of supply. Though for the reserve, the question was raised in what form this would take place (ammonia, methanol, etc), but stakeholders agreed that it is an interesting option to observe.

As there is no market and no price setting for the commodity, the single buyer model is complex but could bring off-takers and producers together and support the market ramp-up. One positive example mentioned was the setup of the H₂ Global mechanism which provides for de-risking the first investments, smaller off-takers can find the product they need. It was raised that similar initiatives at EU level with EU-size funds, which ensure that the industry will be supplied with necessary renewable hydrogen, would be welcome. In addition, long-term contracts were raised as a pre-requisite for off-takers.

In summary, stakeholders stressed that to reach competitiveness there is need for mass scale developments, which depend on security of demand, security of supply and open access infrastructure (pipes and storages). This would be the best basis to create a market.

4 CONCLUSION AND NEXT STEPS

The Advisory Panel's Recommendation Report summarises the shared perspectives of the involved stakeholders on the best ways to deliver on REPowerEU targets of 35 bcm of biomethane and 20 million tonnes of renewable hydrogen by 2030.

The discussion in 2022 focused on the scale-up of biomethane development and repurposing of existing gas grids to transport, distribute, store and import hydrogen. The Recommendation Report summarises a variety of perspectives, it does not reflect the position of every individual stakeholder nor ENTSOG, but it shows the scope and positions voiced during the debate.

The Panel will continue in 2023 with ENTSOG's work to promote and encourage the dialogue amongst stakeholders in a very dynamic energy landscape with the finalisation of several energy legislative files, such as Fitfor55 files and the Hydrogen and Decarbonised Gas Market package. ENTSOG

will continue to analyse planning, technical, market and financial elements necessary for the energy transition and for the inclusion of all renewable and low-carbon gases in the existing gas grids and discussion with end-users concerning their needs.

The main elements will focus on:

- ▶▶ Mapping the progress on the REPowerEU targets implementation:
 - ▶ Development of the Hydrogen Corridors and European Hydrogen Backbone
 - ▶ Development and scale-up of biomethane production and uptake in the existing grids via joint planning of TSOs and DSOs
- ▶▶ Mapping the views and engaging in discussion with the Panel stakeholders on implementation of the finalised legislative proposals, specifically Fitfor55 and – when adopted – also the Hydrogen and Decarbonised Gas Market package.
- ▶▶ Discuss the upcoming CCUS Strategy and the development of the CO₂ transport network.
- ▶▶ Engagement with end-users to understand their demand needs to deliver on their REDII targets.
- ▶▶ Security of Supply
- ▶▶ Financing and support schemes for the new hydrogen economy – Keep track of new financing options (Hydrogen Bank proposal, Net Zero Act and Sovereignty Fund, etc)
- ▶▶ Permitting – Clarification on what is needed for permitting of new projects (onshore/offshore)

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Publisher:

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