The role of biomethane in future energy systems

Position paper focus:
Infrastructure development, sector integration and barriers to development

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Introduction

Biomethane plays an important role in ensuring the development of the future energy system. Together with other low-carbon and renewable molecules, biomethane as a renewable gas (as per the Gas Directive) already established and available on the European market, has the potential to replace part of natural gas supplies progressively. In the medium to long run, and can serve as a dependable supplement to other important renewable energy sources. The role of biomethane in the energy transition process facilitating a decarbonised future has been acknowledged by the European Commission in the REPowerEU Plan with an increased annual production target of 35 bcm by 2030. It is a role that GIE supports.

To facilitate cooperation among GIE members in achieving this target from the perspective of gas infrastructure operators, GIE last year established a dedicated Working Group on Biomethane (WG). Some GIE members are among the frontrunners of biomethane.

By sharing knowledge and experiences, the WG is focusing on two main pillars - Biomethane Infrastructure and Market design - as both elements are required to ensure the efficient and smooth acceleration of the production, transmission and

consumption of biomethane. Under these two pillars, the following topics should be addressed and developed:

1. Establish a level playing field across renewable energy sources.

2. Establish an EU-wide certification scheme accommodating cross-border trade in renewable gas.

3. Provide a fair regulatory framework for renewable gas technologies and connections.

4. Eliminate cross-border inhibitors by stimulating the industry to review quality and standards.

5. Raise awareness of renewable gas' necessity and benefits.

This discussion paper summarises the views of this WG on three important and mutually complementary topics related to the future role of biomethane–sector integration, infrastructure development and barriers to development.

Sector coupling and synergies with other sectors

The sustainable future of the European Energy system will require enhanced balancing mechanisms to integrate renewable energy sources into existing energy grids and maximise their cost efficiency. This will require a lean interaction, collaboration and operation across all involved production and consumption sectors. Pursuing climate goals also requires replacing fossil energy with CO2-neutral solutions in all energy production and consumption processes. The decarbonised and renewable molecules will play a key role in efficient integration of intermittent energy from wind and sun, into residential, transport, industry and commercial/trade sectors.

Biomethane offers the characteristics necessary to enable a swift and cost-effective energy transition as its production is renewable and its consumption can be modulated and programmed according to the final customers' needs, a unique advantage compared to the limited RESe possibility of flexible dispatch and storage. Furthermore, the existing infrastructure (mainly transmission, distribution and storage assets) can handle biomethane without any major new investments and practically without impacting consumption sectors or markets. Furthermore, biomethane as a flexible, renewable, controlled and dispatchable energy source can be used in transport and hard-to-abate industries as well as in power generation. As such, it contributes to decarbonising the heat, gas and electricity sectors.

Biomethane is also a working example of how the circular economy supplies secure and clean energy production through citizens and companies making a contribution on a local or even national level by being responsible in organic waste utilization. Moreover, biomethane also has following benefits:

a. It represents an alternative to natural gas in terms of characteristics and usability, and customers currently using natural gas do not need to change any of their equipment. It has a key role to play in sector coupling as a resilient, flexible, storable, and sustainable energy supply produced from a variety of sources (agriculture, household waste, wastewater, etc.).

b. It contributes to a sustainable and safe energy supply in Europe as it is mainly based on domestic production of Member States, contributing to the diversification of gas supply sources and to the circular economy.

c. It can be used in existing infrastructure without any major adaptation. It can be stored in the existing storage infrastructure and exploited when needed as a perfect natural gas substitute.

d. It can also be boosted by regionally produced hydrogen, which can be combined with the biogenic CO_2 resulting from biomethane production itself (biogas upgrading) to produce even more bio & synthetic green methane, thus boosting the production of domestic gases before the pure hydrogen infrastructure and end-users are ready. That perfectly responds to the increased flexibility needs in the electricity sector imposed to accommodate wind and sun as energy sources.

e. Residential and industrial infrastructure does not require any adaptation to replace natural gas with biomethane as a sustainable energy source, which is another key factor if new gases are introduced to the gas distribution networks.

In general, the use of biomethane in the buildings, transport and industrial sectors helps to reduce the peak electricity demand. It reduces the needed electricity generation capacity, as well as electricity system investments, which results in lower societal cost.

Infrastructure development

Biomethane can be injected into the existing gas grid, either at the transmission or distribution level, and thereby progressively replace or supplement natural gas by efficiently exploiting the entire gas infrastructure but also the market structure and rules currently in place for natural gas are directly applicable to biomethane. To store the biomethane in the natural gas storages is also possible.

Significant biomethane development could change the existing flows in the gas system. In some areas this will lead to more decentralised supply requiring changes to the current grid set-up leading to some additional adaptation costs for the networks and network operators. Solutions already exist in some countries and new solutions could be developed at a larger scale in the most cost-efficient manner, i.e. planning only the strictly required interventions on infrastructure and plants under a full-system perspective. Several European countries have shown the possibility of adapting networks to biomethane production in a reliable and competitive way. In any case, the challenges are significantly lower than those experienced in the electricity sector, where wind and solar electricity are the current major renewable sources. Compared to the electricity sector, the gas infrastructure has the key advantage of being already able to accommodate huge volumes of renewable molecules and move and store them towards consumption centres with limited costs. The required changes will demand network operators to provide bottom-up designs and a more flexible management and operation of their networks, which is achievable. While adjusting the infrastructure for biomethane, the operators also need to optimise system developments. For example, operators can prevent congestion within the network by placing boosters in some cases or planning new connections to biomethane plants. To make the placement of boosters or the new interconnection pipelines also future-proof, sometimes assets with higher capacity than currently needed must be used. Investing in such assets would lead to immediate additional costs, but if they are optimised for future development needs, they will bring medium-long-term economic and environmental savings. Therefore, these infrastructure operators' costs should be fully recognised by NRAs since including these additional costs in the tariff (e.g. for higher, forward-looking capacity) is the best option for the energy system as a whole (e.g. Dutch experience). So, to meet the 35 BCM target, there must also be more room (now and in the future) to optimise the overall system capacity by adopting a long-term and cost-efficient approach. An example of such new design requirements is the mapping of biomethane plants and the optimisation of productions and related grid connections. Indeed, knowing the correct position of existing and potential production plants, infrastructure operators will be able to optimise the development of the transmission networks to accommodate several biomethane plants by creating new shared sections of the grid and, thereby, ultimately facilitate biomethane scale-up.

The production of biomethane can also be directly used locally on the distribution system. In case of a larger-scale development of biomethane, where production exceeds local consumption, and when the production plants are not directly linked to storage infrastructure, this requires reversing gas flows from the distribution network into the gas transmission network to facilitate supply to a greater range of customers. In practice, this means that, when the biomethane production is higher than the consumption at local/regional level, it requires redirecting the exceeding volumes into the gas transmission network system in order to move gas flows beyond the local/regional area and facilitate biomethane supply to a larger range of customers located in other geographical locations either at national level or in other European countries. For instance, Denmark has already developed facilities to compress and remove odorant from the biomethane before transporting the gas from the distribution grid to the transmission grid and several reverse flow facilities have also been commissioned in France.

Such innovative network planning examples make sure that biomethane production can increase, which is beneficial to society in many respects such as maintaining security of supply, enhancing circular economy, and ensuring the green transition of the gas system. While bringing the biomethane to the consumers, where the highest value is present. When looking at the entire value chain, the expenses must also be viewed in light of the fact that the costs borne by the gas grid operators only account for a relatively small portion of the overall expenses necessary to produce biomethane and facilitate customers a transition to carbon neutral solutions.

Another development path could consider developing additional infrastructure and other facilities optimized and reduced via the above-mentioned design exercise (biomethane mapping and related infrastructure developments planning) with a potential for further costs reductions.

Allowing for cross-border flows of biomethane is another means of helping to reach the REPowerEU 35 bcm biomethane target. Network operators are prepared and already equipped to address this challenge, particularly considering natural gas history, where the industry has displayed an ability to adapt to significant flow modifications. Although biomethane complies with almost the same specifications as natural gas, moving local biomethane production to the national and European levels calls for congruent and harmonised views on gas quality (e.g. oxygen levels). The most recent iteration of the EU Hydrogen and Decarbonised Gas Market Package already refers to the subject. For biomethane to join the transmission system in significant amounts, it is desired and necessary that development in gas quality standardisation would take place beforehand. In order to ensure the desired growth in biomethane in REPowerEU, EU gas industry needs to decide on how best to handle the oxygen issue. This could be done by reducing the oxygen level in the biomethane or by removing it at sites that have specific requirements for lower oxygen e.g. storage sites somewhere in the gas system. Ideally, it should be done in the cheapest possible way for the gas

sector customers, a common solution for EU should be found, so that different oxygen limits do not hinder free trade of gas across borders.

Looking to the more distant future, we can see another carbon neutrality opportunity for infrastructure development, which is the integration of hydrogen into the grids. The pathway for hydrogen development is developing in EU member states at different paces and in different ways. There is yet no uniform approach. Some countries are planning to use the existing gas network, whereas others are seeking to develop dedicated hydrogen networks. Historically, some networks had significant amounts of hydrogen blends in their networks through the use of "town gas" which was generally manufactured from coal. This was replaced by natural gas over time, demonstrating that in terms of asset interchangeability and use, the increased use of hydrogen can represent a viable and efficient path.

Some network operators have identified that the combination of renewable hydrogen production and the use of the existing gas network could provide a way to maximise the renewable energy potential in the gas network and, more generally, in society. It is considered that networks will be able to accept hydrogen blends in percentages defined by national and European rules. Most of the development of the hydrogen market will be done thanks to a combination of repurposing of some gas networks and newly built hydrogen networks. The development of dedicated hydrogen clusters offers large energy users an early opportunity to decarbonise while de-risking such a transition. The development of hydrogen networks connecting clusters would provide users market access to large-scale renewable hydrogen and provide energy security and competitive supplies through the connection to larger international networks. This could be achieved mainly through repurposing existing gas pipeline networks and, in the future, as the European hydrogen backbone is developed, by repurposing the interconnectors to transport 100% hydrogen bi-directionally. Such an approach will require each network operator to undertake work to identify which networks will be converted to hydrogen and when with considerations being given to the roll-out of biomethane. Ultimately, the significant potential for biomethane means that it will have an enduring role in the future energy mix.

Barriers to development

There is a need for biomethane industry stakeholders to work together to identify and remove barriers that biomethane producers and consumers are currently facing. Meanwhile, market access opportunities and traceability must be improved, and clear trajectories toward the 2030 accelerated biomethane production targets of REPowerEU must be planned.

Before considering the barriers in detail conceptually, there are three clear advantages of biomethane which are often overlooked:

1) the recognition of the system value of biomethane: biomethane is more or less flat production and is storable, and thus always available, whereas RES electricity is intermittent, is much more difficult to store, and therefore not always directly available unless converted from molecules.
2) From an economic point of view and in particular when comparing and subsidising energy production techniques, all costs should be taken into account, i.e., not only production costs but also transmission costs and flexibility costs. Often, only production costs are taken into account, in which case biomethane can hardly compete with renewable electricity. However, the transmission costs for biomethane are almost zero, as existing infrastructure can be used, whereas transmission costs for electricity are quite expensive. Also, flexibility costs for electricity are much higher compared to biomethane. The difference between the two approaches is sometimes referred to as Enhanced Levelised Cost of Energy (ELCOE) versus Levelised Cost of Energy (LCOE). The difference between both in renewable electricity is significant, whereas with biomethane, it is negligible.
3) Biomethane production can create negative emissions, which we need to compensate for hard-to-abate sectors, renewable electricity cannot.

There are four categories of barriers to market development – economic, technical, regulatory and social.

Economic

- As a general rule, biomethane as a renewable energy source should be afforded the same support and recognition as other renewable energies, including in priority access, taxation, production and consumption supports. In other words, a level playing field should apply to biomethane.

- To accelerate the delivery of the 2030 biomethane production targets of REPowerEU, a policy framework including support for both the production and consumption of biomethane is necessary. More specifically, coordinated policy support should be provided by Member States to renewable gas as it is the case for renewable electricity.

- Historically, long-term support schemes have been used effectively to deliver significant renewable energy (mainly electricity) and associated infrastructure, thereby improving the security of supply, giving certainty to investors and, most importantly, providing price stability for consumers. EU Member States that have introduced such measures in the biomethane sector have successfully developed biomethane

industries, while in other EU countries, development has been difficult without long-term price-stabilizing support. In the longer term, subsidies will be reduced, and other mechanisms, such as tenders for biomethane, can be used.

- It is important to acknowledge that anomalies which do not recognise the full benefits of renewable gases act as barriers to development. E.g., where tailpipe emissions are assessed in transport rather than taking account of the full fuel life cycle emissions. The carbon emissions from the production of a kWh of electricity used in an electric vehicle can on occasion, exceed that of natural gas (let alone renewable gas). Measuring tailpipe emissions alone leads to inappropriate signals to consumers and the market. Appropriate measurement of energy production and utilisation end-to-end is necessary to properly account for emissions management.

- Where support is offered to electric vehicles, corresponding schemes supporting renewable gas in transport, particularly in the heavy goods vehicles sector, should also be available. More must be done on an EU-wide scale to encourage and facilitate the adoption of new transport solutions. Moreover, there are rules currently preventing some vehicles from accessing parking or ferry transport if they are using renewable CNG or LPG. This should be re-examined and only continued where there is clear evidence that it is necessary or appropriate. Such impediments to transition need to be addressed on an EU-wide basis.

- Recognition by EU Member States of biomethane in the EU ETS sector (accepting that some Member States have accounted for the benefits of biomethane via other means)

- There is a risk that the focus to date in some member states is too narrow. If the phrase "just transition" must have a meaning, then economically challenged businesses or individuals need to be allowed and encouraged to access renewable energy sources. For example, retrofitting businesses or homes can be very expensive and unattainable for some. Using renewable gases (such as biomethane) may mean that they do not have to retrofit now and avoid unnecessary or untimely investments. Renewable gases may facilitate some consumers to participate in the transition now without significant investments and may facilitate the postponement of upgrading of their premises/facilities to a more appropriate time. This benefit of renewable gas needs to be recognised.

- Support should mimic renewable electricity as far as possible as such an approach would make it more easily understood, easier to implement and, ultimately, also technology neutral. Similar to electricity support, long-term support arrangements for biomethane will stabilise the price and reduce financing risk/cost to both producers and users where Member States issue contracts for renewable electricity (PPA (Power Purchase Agreement) and/or CfD (Contract-for-Difference)), similar contracts should also be offered for renewable gas.

- Gas network/infrastructure operators need to show leadership and play an enabling role in supporting the implementation of REPowerEU's biomethane ambitions. Either an obligation on gas shippers and gas network/infrastructure operators to meet in 2030 a 10% target of renewable gas in their own gas consumption and use or decarbonisation targets for the gas infrastructure at member state level combined with clear support schemes by means of auctions or CfD would not be unreasonable.

Technical

- Currently, producers of biomethane are primarily rewarded for contributing to renewable energy targets via support or market-based mechanisms. The additional positive externalities that biomethane production delivers are, as a result, neither fully rewarded nor recognised. The biomethane industry, policymakers and regulators need to work closely together to fully recognize these benefits, prioritising organic waste and residue feedstocks, incentivising sustainable agricultural production and valorising biomethane co-products (digestate and biogenic CO2) as well as allowing the use of digestate as an organic fertiliser.

- The application of generic standards of gas across the EU is challenging as some countries have different requirements with respect to storage, odorisation etc. Where possible, similar standards should be deployed to facilitate greater cross-border trade.

- There are barriers to accessing feedstocks for biomethane producers. For instance, municipal waste may be incinerated rather than being used as feedstocks in a biomethane production plant where such waste could, alternatively, be channelled through digestors and converted into renewable energy, nutrient-rich organic fertiliser and pure biogenic CO2. Consideration should be given to channel waste, either municipal,

industry or agriculture towards anaerobic digestion facilities and how to best encourage this.

- Biomethane production is also reliant on feedstock in a way that other renewable energy sources such as wind and solar, are not. While feedstock supplies can be programmed more than wind and sun, this needs to be recognised, well-planned and possibly incentivised. In particular, the agriculture and food sectors in the EU need to be supported in amending their processes and practices to more effectively capture biowaste and operate within the circular economy, including support for biodiversity developments, waste management, digestate storage and handling, adoption of renewable fuel machinery and support for education programs in these sectors to adopt new practices.

- CO2 production or Hydrogen injection, where possible, utilising constrained renewable electricity to increase biomethane output and reduce overall costs to consumers, would benefit from support and broader deployment.

Regulatory

- A stable long-term regulatory framework covering both biomethane production and consumption is required in order to provide certainty to both consumers and potential investors in biomethane production plants.

- The length of the permitting process across EU Member States is challenging. The introduction of distinct timelines assigned to each stage of the permitting process would be beneficial. Aside from the obvious importance given to accelerated production ambitions, the delays or protracted permitting processes increase the costs, which eventually find their way to final consumers. This is not conducive to accelerating biomethane production or helping consumers transition to more sustainable solutions.

- The design and permitting process should be coordinated locally while following an overall strategy at the national level. The introduction of a maximum reviewing period for the involved authorities could also help to avoid delayed procedures. Identification of renewable go-to areas should also facilitate the permitting process. Biomethane training should be provided for the staff involved in permitting. Lastly, the appeal procedure to oppose the development of new projects should have

clearly defined deadlines or a maximum number of instances, to ensure project developers can have more clarity in the process.

- The concept of "right to inject" guarantees access to the gas network for the output of a biomethane plant, taking into account its economic feasibility of it and, thereby, enhancing the bankability of the project. The lack of a regulatory framework granting and an accelerated and possibly incentivised right to inject to developers is considered as a major barrier to investment in biomethane production.

- In terms of regulatory support, connection policies should not be punitive and should recognise externalities as well as the direct economic benefits of renewable gas. For instance, enhanced security of supply, lower cost of transition for customers to renewable solutions, displacing some synthetic fertiliser in agriculture, improved biodiversity and circular economy, more jobs and prosperity for rural areas, etc. should be given due regard in the regulatory process.

- Cost sharing with infrastructure operators for grid connections must be foreseen to incentivise the injections in the grids: these costs could be directly reflected in the tariffs for end users and spread across the whole customer base.

- The European Commission is proposing a design with tariff discounts for renewable and low-carbon gases (including biomethane) in the natural gas system in order to promote the production of these gases and prevent the increase in costs for final customers.

- GIE already has a position against the proposal of tariff discounts on the interconnection points as the proposed mechanism of tariff discounts goes against the basic idea of the EU gas market liberalisation, which is to remove qualitative and quantitative barriers for the trading of gases.

- Green Certificates/GOs should be implemented across all EU Member States through a harmonised recognition of the issuing schemes that facilitate GOs cross-border trading and biomethane valorisation and avoid double counting. Such a system will be needed to track progress towards biomethane production targets within REPowerEU. More generally, a robust system is needed to track biomethane injection into the grid and consumption from the gas grid. For example, ERGAR has presented proposals for such a system.

Social

- A lack of awareness in society at large and even within some industry sectors, (e.g. agriculture sector) of their potential contribution to biomethane production, both from a feedstock supply and renewable gas utilization perspective within their community make the adoption of this technology challenging in many EU member states.

- The challenges in permitting mentioned previously from a technical perspective also has a significant social dimension. An appropriate balance between individual rights to raise issues in relation to permitting and addressing the climate crisis must be struck. There is a need in many EU member states to adopt more objective permitting processes with defined timeline which would be fairer on all participants involved.

- Community engagement in the financial sense is also important. Greater community participation in renewable technologies where some financial reward is retained within the local community would make the transition to a sustainable future more acceptable. Consideration should be given by the Financial Sector to develop investment products that bring renewable products investment benefits to the local community, particularly where Member States provide support for such developments. For instance, where Government support is provided a portion of the investment is made available to the local community.

- Increased community education and engagement programmes and inclusion on new technologies in education programmes is necessary to inform people of the possibilities new technologies bring and the benefits they deliver.

Conclusion

In this paper, we explained what the yield of biomethane in sector integration is and what challenges and related homework need to be done with respect to infrastructure development. We have also highlighted some of the main economic, regulatory, social, and technical barriers to the development of accelerating European biomethane production.

Given its characteristics, biomethane can progressively replace natural gas, thereby ensuring swift, efficient and easy use of the existing infrastructure (including gas storage and end-user facilities). The production of biomethane is already established and can easily be expanded. Therefore, biomethane has and will have an essential role

in the short and medium term during the energy transition process as well as in the future energy system. However, various challenges need to be overcome, such as modification in gas flows, adjustment of gas quality standards and creation of a long-term regulatory framework covering both biomethane production and consumption. We are on a good track, but policymakers could accelerate on biomethane by addressing the barriers.

We, as gas infrastructure operators, will continue to cooperate with other relevant stakeholders to support the REPowerEU 35 bcm biomethane target. We will pursue the development of promising and cost-efficient new technologies to handle the flow of more biomethane in various gas infrastructures and actively participate in creating the needed regulatory framework market conditions and expanding gas quality standards. The gas infrastructure operators are open to considering legal obligations to ensure the delivery of the REPowerEU targets.