THE OXFORD INSTITUTE FOR ENERGY STUDIES

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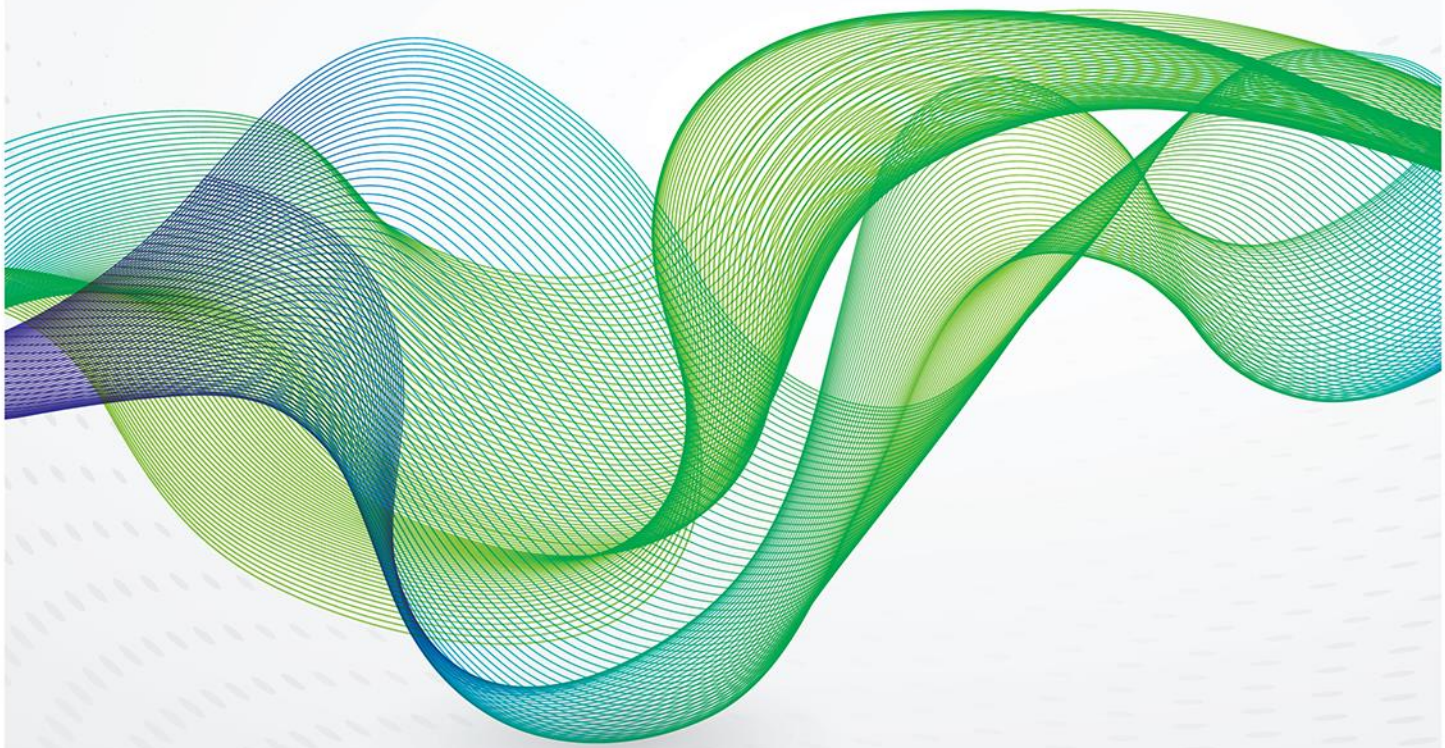
# The Future of Gas Networks

# Key Issues for Debate



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## Introduction

The Oxford Institute for Energy Studies has identified the role of gas networks as being one of the key issues arising from its work on the future of gas. With this in mind the Institute held a brainstorming workshop for Gas Programme Sponsors on "The Future of Gas Networks" to examine decarbonisation plans and the impact of the potential growth in the use of renewable and decarbonised gases in Europe. Participants included representatives from nine European gas network companies (both transmission and distribution), technical experts in decarbonisation, regulators, government officials and academics.

This note summarises the discussion in the form of key issues for debate and outlines some proposed next steps.

The workshop resulted in seven key issues for debate:

1. **The major gas networks recognise the need to prepare for, and facilitate, decarbonisation.**
2. **The route to decarbonisation can take many forms, though hydrogen is likely to feature in most networks. In larger countries solutions are likely to be regional rather than national.**
3. **There are a number of pilot projects and targets/aspirations for 2050 – there is less clarity on how the targets will be achieved or on who will lead.**
4. **Regulation is a key issue. In most countries existing regulatory objectives may need changing in order to align with government decarbonisation aspirations and the achievement of targets.**
5. **There is a lack of consensus on whether and how market models might need to adapt.**
6. **Detailed stakeholder analysis – and in particular customer attitudes – will be required.**
7. **There are a range of important technical issues including standardisation, data quality and transparency, verification and certification to be considered.**

## Context

These messages are explained in more detail below. Before this, and in order to provide some context, a brief summary of the conclusions from the Future of Gas[1] paper with particular reference to network issues follows.

The principal assumption underpinning the work is that governments in the main EU gas markets (Germany, Italy, France, Spain, UK, Belgium and The Netherlands) will remain determined to meet the COP21 targets. However, the choices which national governments, and regional and municipal authorities and companies will make – and the criteria which they will employ to make them – will differ within, as well as between, countries. The current model of gas markets transporting a homogenous product through a unified network will change significantly post-2030, which means there will not be a single European narrative but a range of narratives.

If the gas industry is to maintain anything resembling current demand levels, there will be a need for very substantial volumes of hydrogen from reformed methane with carbon capture and storage (CCS). Neither of these technologies have been developed on a large scale, and commercial scale projects

[1] See Stern, J. (2019). 'Narratives for Natural gas in Decarbonising European Energy Markets'. OIES Paper NG 141. Oxford: OIES. https://www.oxfordenergy.org/wpcms/wp-content/uploads/2019/02/Narratives-for-Natural-Gas-in-a-Decarbonisinf-European-Energy-Market-NG141.pdf?v=79cba1185463 and Stern, J. (2017). 'Challenges to the Future of Gas: unburnable or unaffordable?'.OIES Paper NG 125. Oxford: OIES.https://www.oxfordenergy.org/wpcms/wp-content/uploads/2017/12/Challenges-to-the-Future-of-Gas-unburnable-or-unaffordable-NG-125.pdf

will have to be committed to, probably before 2025, to demonstrate the feasibility of a long-term decarbonised gas business model.

These developments will have different impacts on the different parts of the value chain. Networks in particular face an existential threat unless they can maintain existing throughput while simultaneously adapting to a decarbonised product. A range of future network models could include:

- Separate but integrated national networks covering electricity, hydrogen and zero or low carbon methane,
- Separate regional networks or
- A single methane network with an increasing blend of either hydrogen or biomethane (or both).

In addition, it is also likely that the prevailing European regulatory framework will need to change dramatically. This could include rebundling certain activities, incentivising the transportation of low carbon gases, and prioritising decarbonisation over competition.

## The key issues for debate

### *1. The major gas networks recognise the need to prepare for, and facilitate, decarbonisation.*

European gas networks recognise that business as usual is not a long-term option – in the words of one delegate, "the message has got through" that decarbonisation could present an existential crisis. Some are already facing difficulties as the share of renewables grows and volumes of natural gas transported decline whilst costs increase.

Whilst their existing role is almost certain to change, there is a continuing opportunity to remain in the business of transporting gaseous substances – whether it is biomethane, hydrogen, or carbon dioxide as part of a CCS scheme. Distribution networks, in particular, will likely play an important role in transporting gaseous fuels to household and commercial users though some aspects of the transmission network may find it difficult to retain a role as the pattern of flows changes.

In addition, the role of storage and cross border interconnectors is likely to change significantly in future. Storage facilities (including LNG import terminals), which in many countries have huge capacity, could be repurposed to store hydrogen or, if they are located offshore, CO2 and could be an important asset in balancing seasonal flows. The role of cross-border interconnectors, and indeed, cross-border trade in gas is less certain.

Most studies assume that 100 per cent electrification is highly unlikely and would be significantly more expensive than an electricity and gas decarbonisation pathway, though a role for gas cannot be guaranteed unless some of the key issues are addressed. In any event, linkage with the electricity system (also referred to as sector coupling) is likely to become more important. The electricity sector has effectively been turned upside down as a result of increasing renewables and this has made matching supply and demand far more complex; similar disruption is quite possible in the gas sector.[2]

### *2. The route to gas decarbonisation is likely to take many forms though hydrogen is likely to feature in most networks. In larger countries solutions are likely to be regional rather than national.*

The three main market sectors for gas in Europe are domestic and commercial heating, industrial process load, and power generation. Leaving aside the latter, which already has a relatively clear

[2] See Honore, A. and Sen, A. (forthcoming), Gas and Renewables in the Future Electricity Mix: Friends or Foes? Oxford: OIES.

decarbonisation pathway, there are a wide range of decarbonisation options in the heating and industrial load markets.[3]

There are multiple pathways for decarbonising gas.[4] The most frequently mentioned are:

- Biogas/biomethane
- Bio-SNG via gasification
- Power to gas
- Hydrogen from methane (either via methane reforming plus CCS or methane cracking)

Biomethane and hydrogen are likely to feature in most networks though proportions may differ between and possibly within countries. Biomethane presents the most technically feasible (and practical) short-term option for decarbonisation though there is a range of views regarding cost-effectiveness and scalability. Furthermore, many biogas projects may develop outside the existing gas transport infrastructure.

Longer term hydrogen from renewable sources (green hydrogen) is likely to play the most significant role with hydrogen blended into existing methane flows a possible intermediate step. In some regions with large renewable electricity production there is already excess electricity production compared with local demand. This gives the greatest potential for power to gas and will lead to closer sector coupling. Some gas network companies have already started working with their electricity counterparts to develop an integrated infrastructure outlook.

The use of CCS as part of a hydrogen development will be determined in part by the availability of suitable storage facilities and, perhaps more importantly, the degree of public acceptance. In some countries (for example, Germany and Italy) there is strong opposition to CCS.

The likelihood of different regions and countries pursuing alternative routes to decarbonisation could lead to unintentional consequences for transnational gas flows and the increased fragmentation of the existing European network. Flows could be restricted, for example, due to the percentage of hydrogen allowed into transmission lines varying between countries. This also has implications for the certification of gas as described below.

### *3. There are a number of pilot projects and targets/aspirations for 2050 – there is less clarity on how the targets will be achieved or on who will lead.*

As noted above biomethane has moved beyond the pilot project stage in most countries though the other technologies have not. Examples of pilot projects[5] around Europe include:

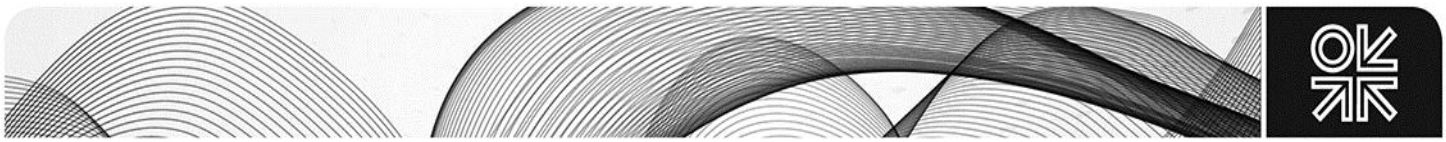
- P2G in France (Jupiter 1000)
- H2M Magnum in The Netherlands
- Hynet NW
- Biogasification in Austria, Sweden, UK, The Netherlands and France

Some governments have established targets for 2050 and a number of network companies have expressed confidence that there is sufficient potential for all gas to be renewable by this date. However,

[3] See Honore, A. (2019), Decarbonization and industrial demand for gas in Europe, OIES Paper NG 146. Oxford: OIES. https://www.oxfordenergy.org/wpcms/wp-content/uploads/2019/05/Decarbonization-and-industrial-demand-for-gas-in-Europe-NG-146.pdf?v=79cba1185463

[4] See Lambert, M. (2017). 'Biogas: A significant contribution to decarbonising gas markets?'. OIES *Energy Insight 15*, Oxford: OIES. https://www.oxfordenergy.org/wpcms/wp-content/uploads/2017/06/Biogas-A-significant-contribution-to-decarbonising-gas-markets.pdf.

[5] The Institute is collaborating with the Sustainable Gas Institute to assess actual progress in deploying a range of renewable gas technologies and a report will be published later in 2019



many decarbonisation projects are still in the planning stage so it is too early to determine what the likely costs will be. It is likely that a range of feasible and tested options will need to be in place by 2025 if a realistic business model (including CCS) for future gas grids is to be delivered.

Nevertheless, it is presently not clear how these targets will be achieved nor on who should take the lead in developing a realisable plan. There is, in some countries at least, a sense that networks and producers are each waiting for the other to lead. Unbundled networks may not have the strategic capability to act and are also seen as low risk, fixed return businesses that may not attract high-risk investors.

There is little appetite for a top down strategy to come from the EU though it is recognised that the gap between actual and projected progress in reaching emission targets is likely to widen fairly quickly. The lack of overall direction in achieving decarbonisation remains a key concern.

### *4. Regulation is a key issue. In most countries existing regulatory objectives may need changing in order to align with government decarbonisation aspirations and the achievement of targets.*

In most countries existing regulatory objectives need aligning with government decarbonisation aspirations. Existing regulatory models based on network unbundling and competition in supply are not likely to be suitable for scoping future relationships and, in some cases, are already presenting difficulties in setting up pilot projects.

Safety regulations are also restricting progress and some have argued for a 'regulatory-free zone' to allow projects to be developed.

At an EU level, the regulatory approach will also have to be adapted. The Third Energy Package prohibits network companies from participating in energy production and this could rule them out of participating in any renewable gas, including P2G, projects. There is, however, some debate over whether what is essentially the conversion of electrons to molecules would be interpreted as production of new energy, and also whether renewable gas can genuinely be considered to compete with fossil gas. Even if this participation is allowed, network companies would not be able to own the hydrogen produced without a change in the law, or possibly with time-limited derogations granted by the Commission to allow a certain number of demonstration/ small scale projects to be developed. Possible alternatives include an independent hydrogen exchange or, when the derogations expire, the projects to be sold by the TSOs who are then compensated for the investments they have made.

There are signs that national regulatory objectives are being constrained by the development of European Network Codes and there may need to be some exceptions from the harmonisation principles. Further issues include how flows from DSOs to TSOs based on biomethane inputs might be handled and whether the hub-based approach to determining gas flows could survive.

### *5. There is a lack of consensus on whether and how market models might need to adapt.*

At present it is not clear what shape the underlying business model for a decarbonised gas market might take – if indeed such a business case exists. The costs of various technologies may fall but without a clear incentive (probably linked to a carbon price) profitable projects are difficult to envisage. There is also a case for a more holistic approach to investment appraisal. For example, incremental spend on the gas grid to take renewable hydrogen could require less capital investment than that required to upgrade the electricity transmission system to decarbonise heat.

The present lack of commerciality for projects has led to a reluctance from network companies (and other players both upstream and downstream) to commit to even pilot projects without some form of state support. This in turn raises the question of whether governments should, or will need to, "pick winners" by promoting particular decarbonisation pathways or if a more market-based approach could be adopted.

The model used to promote offshore wind projects in the UK could present a way forward whereby commercial firms could bid to undertake decarbonisation projects or a TSO could tender out electrolysis services. Other alternatives include a carbon tax or mandated restrictions on the amount of unabated methane allowed into a network.

There is some concern that allowing networks to allocate regulated revenues towards developing projects in a relatively risk-free environment could result in higher cost outcomes. Some questioned whether consumers or network users would be happy to fund such an approach.

### *6. Detailed stakeholder analysis – and in particular customer attitudes – will be required*

Understanding the views of the various stakeholders – customers, network users, investors, and government – is still at a relatively early stage. Customer attitudes are a particular area requiring further work. In some, though by no means all, countries there is likely to be strong resistance to having hydrogen in their gas supply.

### *7. There are a range of important technical issues including standardisation, data quality and transparency, verification, and certification.*

The most important of these are likely to fall into the following categories:

Gas quality – this includes issues relating to both biomethane and transitioning to a hydrogen network. Blending of biomethane from a range of different sources could become increasingly challenging. The degree of hydrogen in a network has implications for the operation of compressors, meters, and appliances as well as end uses such as transport. At present there is a wide range of allowed proportions of hydrogen into the gas network between countries.

Certification – there is a wide (and confusing) range of terminology so it will be necessary to have a standardised definition of gas types and this will have to be coupled with systems means whereby gas sources (including gas imports) can be certified and verified with guarantees of origin. This in turn raises the question of who is responsible for certification at different stages of the value chain – producers or networks – and what audit mechanisms will be required, especially for imported gas. There is also the related issue of the quality of data regarding pipeline assets.

Inter-Operability – this would include gas flows between countries as well as within countries at both the DSO/TSO level and between two or more networks operating with different gas combinations. This also has security of supply implications.

Network codes and ancillary agreements - as noted above these are likely to require substantial review and amendment.

## Next Steps

It is clear that the role of gas networks in the context of decarbonisation is a key issue. The Institute plans to examine the implications in more detail, looking in particular at:

- Alternative routes to decarbonisation
- The status of pilot projects in Europe
- The role of regulation and how it might need to be adapted, particularly in relation to unbundling and certification
- What a viable business model for a decarbonised network might look like
- The views of stakeholders
- The key technical issues and their impact

The Institute will be consulting with interested stakeholders to assess the interest in, and priority attached to, each of these topics and will be publishing further papers in due course.