Consultation response

Hydrogen Blending into GB Gas Distribution Networks

Response from Regen

October 2023

About Regen

Regen is an independent centre of energy expertise with a mission to accelerate the transition to a zero-carbon energy system. We have 20 years' experience in transforming the energy system for net zero and delivering expert advice and market insight on the systemic challenges of decarbonising power, heat, and transport.

Regen is also a membership organisation and we manage the Electricity Storage Network (ESN), the voice of the UK storage industry. We have 180 members who share our mission, including clean energy developers, businesses, local authorities, community energy groups, academic institutions, and research organisations across the energy sector.

Regen has produced a number of publications which are relevant to this consultation including:

- Building the Hydrogen Value Chain
- A Day in the Life of the 2025 Electricity System
- Response to the Hydrogen Strategy
- Regional hydrogen opportunity study
- The role of hydrogen in the industrial sector
- Hydrogen for Heat – 8 Critical Questions

Regen is also a member of the National Grid: Future of Gas steering group, which has working groups dedicated to future hydrogen market design and explores specific topics such as gas safety and quality.

Regen has conducted a number of regional Distribution Future Energy Scenario studies on behalf of electricity and gas distribution networks looking at the development of hydrogen production and consumption and the likely impact this will have on their networks. See for example: Net Zero South Wales.

Introduction

Hydrogen is set to play a critical role in enabling the UK economy to achieve net zero emissions. As well as providing a low carbon fuel for difficult-to-decarbonise sectors such as heavy transport, maritime, aviation and industrial processes, hydrogen could also play an important long duration system balancing role as a multi-vector fuel, using very low-cost electricity during times of over-supply to convert, store and transport renewable energy for applications across the energy system including grid balancing.

Regen's analysis of a net zero electricity system for 2035 shows that large scale green hydrogen production would integrate well with a high renewable energy system by providing a valuable use for low carbon electricity on days when renewable generation is high, and then providing hydrogen-fuelled dispatchable generation on days when generation is low. This dual function of hydrogen is critical both to exploit renewable generation and to provide system resilience. This role for power balancing has also been identified by the ESO, Climate Change Committee, DESNZ and the most recent National Infrastructure Assessment produced by the National Infrastructure Commission. The National Infrastructure Assessment also includes an annex setting out the strong case against the widespread use of hydrogen for heating.

There are strong arguments to support policy intervention to encourage innovation, develop new consumer markets and to accelerate investment in hydrogen production, storage and distribution assets. However, policy makers need to tread carefully and should not think of hydrogen as a direct replacement for fossil gas or akin to electricity, that can be supported through the same subsidy regimes.

Natural gas and electricity can, by-and-large, be considered as homogenous commodities: easily traded, fungible and with an easily discernible market price. The hydrogen sector, at least at this early stage of development, is better considered as a set of related but distinct markets and supply chains. Perhaps in the future an integrated hydrogen market will emerge, but this is by no means certain and will depend on the nature of its physical supply chain as well as its multi-vector tradability. Its complex value chain, as well as its relative market immaturity, requires a more strategic approach that focuses on nurturing consumer demand-led markets that will continue to drive innovation, carbon reduction and cost efficiency, and enable low carbon hydrogen to deliver its full economic and decarbonisation value.

Regen's response to the consultation has focused only on Question 3 on the strategic role of hydrogen blending.

Summary response

We agree with the consultation position that blending should not be a strategic aim in itself, for example as a route to decarbonisation of gas networks. It should only be considered to address hydrogen manufacturing investment risk.

- The government is right to consider policy measures to address the demand security (off-taker) risk that could delay hydrogen production investment.
- Hydrogen blending into gas networks could, under certain conditions, be an option to use as the off-taker of last resort.
- Hydrogen blending is not, however, the best use of hydrogen and would not help to develop hydrogen demand and the full hydrogen value chain, including for higher value applications in industry, power generation and transport.
- We agree, therefore, with the consultation position that blending should not be a strategic aim in itself, for example as a route to decarbonisation of gas networks. It should only be considered to address hydrogen manufacturing investment risk.
- Reliance on blending could also have the effect of locking in a dependence on gas network infrastructure which may not be available in the long term.
- This targeted role for blending has important policy implications, including that blending support should be temporary and set at a level where it would not displace other, more valuable, sources of hydrogen demand.

Hydrogen blending is likely to be costly and may not provide a complete offtake solution.

- Hydrogen blending is likely to be more complex and costly than has so far been assumed – costs include the technical costs of blending, and managing gas quality, plus the additional complexity blending will bring in areas like billing, contracts and trading arrangements. Most of these costs must be considered regret costs to provide a temporary solution.
- Blending is difficult, especially to maintain a consistent and reliable blend across the network geography and over time. It may be that blending is not so easy to deliver - this needs to be fully explored and independently verified.
- Hydrogen producers have expressed a concern that blending may be offered as a solution but that, in reality, it may be overly onerous and complex (for the producer) and may not be available at all times and locations.
- Cost, plus the risk that hydrogen injection is curtailed, would undermine its function to reduce off-taker risk and so encourage investment.
- One answer would be to provide hydrogen producers with a guaranteed right to blend with compensation for any injection curtailment. If this is not acceptable, because of the transfer of risk to networks and the consumer, this would beg the question of whether blending can address the underlying investment risk.

There is a risk that hydrogen blending will become a costly distraction which could also be misused to send the wrong message to consumers and investors that 100% hydrogen will be available for applications like home heating.

- Already a number of gas networks and gas boiler suppliers are claiming that 20% hydrogen blending is a target outcome of government policy and is a stepping stone to a 100% hydrogen network. This misleading communication needs to be addressed.

There are other, better solutions, that could address investment risk AND support the UK long term hydrogen strategy:

- **Develop hydrogen demand applications**: the best solution would be for the government to increase support to develop higher value demand applications within industrial clusters and in strategic industries that are most likely to require hydrogen in the future.
- **Build hydrogen storage**: support and accelerate investment in hydrogen storage to address both supply and demand balancing risks. Increasing storage may require earlier investment than the market would deliver but storage capacity will be needed and so this is not a regret cost. In fact, it would help to position the UK as a hydrogen leader.
- **Hydrogen for power generation**: an easier option to provide an offtake for hydrogen would be to encourage and accelerate investment in hydrogen-fuelled electricity generation. This could be through the conversion of existing generation plants to run on a fuel blend, hybrid turbines that are already available on the market or new hydrogen generators. Hydrogen generation will certainly be needed in the net zero energy system and is already below the deployment rates envisaged to achieve a net zero power system by 2035.
- **Establish a low carbon hydrogen offtake obligation for users of grey hydrogen**: there is already a significant demand for hydrogen in the UK for refining, chemicals and ammonia production. A cheaper and more effective solution may be to require grey hydrogen users to use low carbon hydrogen if it is available. This option may require price support but could be cheaper than blending.

Response to Question 3

Do you have any comments on our views of the strategic role of blending, as described in this chapter? Please provide evidence to support your response.

To a large extent this question is already answered in the consultation document. The consultation document states that: *"the primary strategic role of blending is not to decarbonise the existing gas network and facilitate a transition to heat decarbonisation"* and *"we believe that blending should only be a transitional option".*

This is certainly true. If the UK hydrogen strategy is successful, we would anticipate that only a small amount, or maybe zero, hydrogen would be blended into the gas network. If the UK hydrogen strategy is not successful, then there will be little hydrogen produced to blend. In either case, blending is not a pathway to decarbonisation but would be, at best, an interim and sub-optimal off-take solution.

Unfortunately, this limited strategic objective is not well understood and has been miscommunicated. A number of gas network and boiler manufacturers are already claiming that a 20% hydrogen blend is the target of government policy and that this is a stepping stone to a 100% hydrogen network in the future, which will then be used for home heating.[1]

Instead, the function of blending could be focused to address the security of demand (or off-taker) risk faced by early developers of hydrogen production. The consultation states that:

- *"If blending is supported and enabled by government, is to act as a reserve offtaker, to support the growth of the hydrogen economy whilst ensuring it does not 'crowd out' the supply of hydrogen to alternative end users who require it to decarbonise"*
- *"Blending may be able to play a role in managing the risk of hydrogen producers being unable to sell sufficient volumes of hydrogen, for example, if an offtaker (e.g. an industrial facility) is no longer able to buy hydrogen from the producer (known as "volume risk") impacting the production project's revenue."*
- *"Blending may also help to mitigate volume risks relating to development of hydrogen transport and storage infrastructure, for example if an infrastructure project is delayed."*
- *"This could help to reduce investment risk into hydrogen production and in certain circumstances may have the potential to lower production costs, as explored in the Economic Analysis section of this consultation."*

The clear implication of these statements is that if blending is used at all it must be limited, temporary and must not displace out other forms of demand. In other words, any revenue support given to hydrogen blending must be set at the absolute minimum level to ensure that it does not become an attractive option for producers.

[1] See for example https://www.britishgas.co.uk/the-source/greener-living/hydrogen-boilers.html

Recommendation 1

Support for hydrogen blending must not divert hydrogen from use in other applications which would be of high value and/or enable decarbonisation in hard to treat sectors.

- The level of financial support should be set low enough so that blending is a last resort option.
- The term of support must be limited to ensure that blending is a transitional arrangement.

The role of hydrogen

Regen recognises and supports the objective of addressing the volume risk faced by early producers of hydrogen. Hydrogen blending could be used as a last recourse, and temporary, option to address this risk. However, we believe that it poses and number of risks and could prove to be a very expensive option. We also believe that there may be better alternatives which would require less regret costs and would be more in line with the UK's future hydrogen value chain.

Blending, while providing an outlet for excess hydrogen, does not help to build a sustainable hydrogen value chain and future UK industry. As we highlighted in our paper on Building the Hydrogen Value Chain, and has been well documented by others in the industry, hydrogen needs to be targeted at high value applications (where it can begin to be cost competitive) and to those parts of the economy which will be the hardest to decarbonise.

We agree with the National Infrastructure Commission's assessment that hydrogen should and will have no role in domestic heating.[2] This is an important consideration for the future of the gas networks.

The imperative to target hydrogen use to high value applications is driven both by its cost and by the fact that its volume of supply will be limited. If we consider green hydrogen, as the most likely long term source, the UK is likely to manufacture somewhere between 100 and 150 TWh per year, using low cost "excess" renewable energy in a very high renewable energy scenario. To manufacture more than that would be possible, but would then require the use of baseload or dedicated generation capacity which would greatly increase hydrogen's marginal cost.

The UK therefore has the right strategy which is to focus on the development of integrated hydrogen clusters where production, storage and demand is developed together. This will also help to create the industrial applications, innovation and jobs that will help to offset and justify the level of policy support and intervention required. Paying producers to blend away a valuable fuel, paid for by consumers (or taxpayers), will not be a sustainable solution.

[2] NIC 2nd National Infrastructure Assessment 2023

Recommendation 2

The UK hydrogen strategy needs to focus much more on demand side development and the identification of key sectors for which hydrogen can provide a cost effective decarbonisation solution. Revenue support for hydrogen production should be coupled with support for demand side development and storage to ensure that the entire value chain is supported.

The cost and complexity of blending may be higher than currently understood

Just reading this consultation document reinforces the point that even blending small amounts of hydrogen into the network will be a costly exercise both in terms of the technical requirements and the challenge of establishing new trading, billing and quality control arrangements.

A previous study by National Grid[3] has highlighted the complexity of maintaining a consistent blend across network geographies and over time. This is less of an issue at very low blends (<2%) but at blends of 20% it would be essential to maintain a consistent blend for many commercial users.

There is a significant question whether enabling the entire network (transmission and distribution) to accept blended hydrogen is a cost effective strategy. It would make more sense to only introduce blending to those parts of the network that are likely to be converted to 100% hydrogen at a future date. At the moment, this is likely to be key parts of the transmission network.[4]

There is a concern among potential hydrogen producers we have spoken to that, while blending may be offered as an offtake solution, in practice it may be difficult and costly, and may be curtailed in some areas or at certain times. If injection curtailment is a likelihood, this would undermine the case for blending to support hydrogen production investment.

An option would be to provide a guarantee that blending will be available, equivalent to a firm injection agreement with networks. If this is not possible, because of the risks and costs associated with its commitment, that would beg the question of whether blending is the right option for a default off-taker.

Recommendation 3

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[3] Hydrogen Blends in the NTS A theoretical exploration
https://www.nationalgas.com/document/137506/download
[4] See Project Union and also the NIC 2nd National Infrastructure Assessment

There may be other, better, alternatives to provide a reliable hydrogen offtake.

There are a number of alternative options to support the development of hydrogen production with less regret cost and by using market based solutions that would be better aligned with GB's hydrogen strategy and the development of the future hydrogen value chain.

1) Hydrogen demand applications and integrated clusters

The best solution would be for government policy to focus on both production and to support the development of higher value demand applications within industrial clusters and in strategic industries that we expect to require hydrogen in the future.

Fundamentally, the long term future of hydrogen requires the creation of sustainable market with both supply and demand liquidity, supported by distribution channels and storage.

Unless blending and de-blending is a cost effective means of distribution to an end customer and user of hydrogen, which would be a market decision, then it is not helping to create a long term market.

2) Build hydrogen storage

We know that we will need more hydrogen storage in the future, and that storage requirements will include long term (seasonal storage) and short term logistical storage.

Energy markets typically underinvest in storage because the value of energy security (or in this case supply and demand security) is difficult to monetarise, and because storage investors face the risk of underutilisation.

There is a good therefore a strong argument that government policy should accelerate investment in hydrogen storage to address both supply and demand balancing risks.

Increasing storage may require earlier investment than the market would deliver but storage capacity will be needed and so this is not a regret cost. In fact it would help to position the UK as a hydrogen leader and give further confidence to hydrogen investors that the market is sustainable.

3) Hydrogen for power generation

Hydrogen for power generation (combining long term storage with low carbon dispatchable generation) has gained in prominence in recent months and is now seen as a critical part of the net zero power system. It featured in work done by Regen with the ESO to consider high and low generation days in the 'Day in the Life of the Electricity System 2035'. It has also been highlighted in recent reports by the Climate Change Committee and the National Infrastructure Commission.

A significant advantage of hydrogen generation coupled with green hydrogen electrolysis is that it can create both a demand and a supply of electricity. This can therefore help to balance generation over long periods when there may be excess power and power shortage.

The Day in the Life analysis suggests that by 2035 10-15 GW of hydrogen power generation capacity would be needed, alongside storage, interconnectors and CCUS. Already there are options to buy hybrid turbines that will run on a blend (e.g. hydrogen and methane) and the major turbine manufacturers (e.g. Siemens and GE) are planning to introduce 100% hydrogen models. There may also be opportunities to convert existing plant to run on a fuel mix of hydrogen and methane.

Support for hydrogen generation, probably starting with hybrid turbines, could be instigated through a reformed Capacity Mechanism which, under REMA proposals and recent consultations, is expected to begin to provide more revenue support for low carbon generation.

If hydrogen power generation was supported, with plants located near hydrogen production and storage, this would provide a ready demand for hydrogen with a very high degree of flexibility to level out supply/demand balances.

4) Establish a low carbon hydrogen offtake obligation for users of grey hydrogen.

There is already a significant demand for hydrogen in the UK for refining, chemicals and ammonia production. Estimates of hydrogen demand range between 10 and 25 TWh, which is about the hydrogen output that would be produced by 5 GW of hydrogen production capacity. This hydrogen is current grey hydrogen, produced from reformation of fossil fuels with very high carbon emissions.

It is understood that hydrogen used within refineries and used for desulphurisation, for example, is often produced within an integrated refinery process. However, to our knowledge, very little work has been done to understand how existing grey hydrogen could be converted to low carbon hydrogen either in terms of it technical production or business model.

A cheaper and more effective solution may be to require grey hydrogen users to use low carbon hydrogen if it is available. This option may require price support but may be cheaper than blending.

> **Recommendation 4**
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> Before embarking on a policy support measure for blending, consider alternatives options to provide a reliable demand offtake including support for storage, hydrogen power generation and replacement of grey hydrogen for existing demand.

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