Hydrogen Networks and Markets Team
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22 November 2022

To whom it may concern,

Consultation Response: Hydrogen transport and storage infrastructure

Scottish Renewables is the voice of Scotland's renewable energy industry. Our vision is for Scotland leading the world in renewable energy. We work to grow Scotland's renewable energy sector and sustain its position at the forefront of the global clean energy industry. We represent over 320 organisations that deliver investment, jobs, social benefits and reduce the carbon emissions which cause climate change.

Our members work across all renewable energy technologies, in Scotland, the UK, Europe and around the world. In representing them, we aim to lead and inform the debate on how the growth of renewable energy and hydrogen can help sustainably heat and power Scotland's homes and businesses.

Business model support will be key to the development of hydrogen transport and storage infrastructure and Scottish Renewables welcomes the opportunity to provide our view on the proposals outlined in this consultation. In considering the development of hydrogen transport and storage infrastructure, we would urge BEIS to take a holistic approach. This means ensuring transport and storage business models are integrated with production business models as well as that the development of onshore and offshore infrastructure, with these considered as a whole rather than in isolation. This will require BEIS to set out clearly how it expects hydrogen to be used, the infrastructure that will be required to enable this and how it envisions development moving from 'growth' to 'steady state' phases.

It also means accounting for the significant uncertainty that still exists about the future policy and regulatory landscape. As far as possible, BEIS should provide clarity on the policy and regulatory framework that will support the development of hydrogen infrastructure in order to provide confidence to investors. Where this is not possible, such as with the outstanding strategic decisions on blending and the role of hydrogen in heating, BEIS should make sure decisions taken now are compatible with the possible outcomes of future decisions.

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We set out our detailed responses to the consultation questions below and we would like to highlight the following points:

- Business models must account for geographic variation in hydrogen development across the UK. For example, much hydrogen production in Scotland will be sited in remote areas close to renewable electricity generation. These projects will have different transport and storage requirements to projects sited in industrial hubs.
- Scottish Renewables has a preference for a Regulated Asset Base (RAB) design for both transport and storage business models. However, we also feel that a Cap and Floor model has merits and should be taken forward for further consideration.
- As far as possible the Hydrogen Business Model/Net Zero Hydrogen fund should support vehicular transport and storage co-located with production in order to limit the scope of infrastructure that transport and storage business models are required to support thus making designing them simpler.
- We believe a private ownership model for hydrogen networks is most appropriate. However, regardless of the ownership model chosen, regulated or negotiated third party access to hydrogen infrastructures must be guaranteed by the regulations for hydrogen producers.
- We believe Ofgem is the most suitable organisation to provide regulatory oversight given its role in regulating electricity and natural gas infrastructure. We believe the LCCC would be the most appropriate counterparty to contractual mechanisms.
- We see a role for a Strategic Planner and believe the Future Systems Operator would be best placed to perform this role. In the short term, BEIS could continue leading in this area.
- The decision on blending hydrogen into the existing gas network will be key to the development of initial hydrogen projects and clarity on this decision should therefore be provided as soon as possible.

Scottish Renewables would be keen to engage further with this agenda and would be happy to discuss our response in more detail.

Yours sincerely,

Andrew MacNish Porter
Policy Manager – Economics and Markets
Scottish Renewables

CONSULTATION QUESTIONS

General Considerations

1. Do you agree with Government's analysis and vision for hydrogen network evolution through the different phases as described? Please explain your answer and provide any relevant evidence.

Scottish Renewables broadly agrees with the analysis and vision for hydrogen network evolution as set out in the consultation document.

2. Do you agree with these key design principles for the transport and storage business models? Please explain your answer and provide any relevant evidence.

Scottish Renewables broadly agrees with the key design principles set out in the consultation.

However, whilst we understand why transport and storage business models are being treated separately from production business models, we would emphasise the importance of a holistic and coordinated approach when developing each business model. This holistic approach should also apply to the development of onshore and offshore hydrogen infrastructure. Whilst the consultation focuses on onshore infrastructure, we would argue that the development of offshore and onshore infrastructure needs to be considered as a whole to arrive at efficient solutions.

We also feel that the consultation positions the UK primarily as an importer of hydrogen and fails to fully recognise the opportunities for export. Taking account of export opportunities is particularly important as the longer the delay the greater the share of the export market that will be lost to international competitors. For example, the development of offshore pipelines to Germany should be viewed as a strategic priority.

Another factor that must be accounted for is the geographic variation in the pathways to hydrogen development. We note that the consultation focuses on connecting the industrial locations which may transition to hydrogen. This is not particularly applicable to Scotland as many of the twelve regional hydrogen hubs which have been identified in Scotland are not attached to industrial centres.

Business model design must therefore reflect the different routes to hydrogen development in different areas of the UK and be based on a strategic view of which hubs need to be

connected at a national level both onshore and offshore. This will require business models to be capable of supporting the strategic development of the wider hydrogen network as well as smaller localised projects.

Hydrogen Transport Infrastructure

3. In your view, do you agree we have correctly identified and characterised the market barriers facing the development and operation of hydrogen pipelines and a hydrogen network? Are there any other market barriers we should be considering? Please explain your answer and provide any relevant evidence.

We agree with the market barriers as identified in the consultation and how they have been split according to duration.

The initial market barriers (demand and supply uncertainty, limited user base and high capital costs) will be faced from the outset by private developers of localised networks. A national rollout of transport and storage infrastructure will encounter its own set of barriers, including network infrastructure, creating a natural monopoly. Clarity must therefore be provided on the enduring policy and regulatory regime governing larger networks as the required private investment will not be delivered without investors knowing what the future regulatory system for the wider hydrogen network is going to be.

As per our answer to Question 2, we would add that an uncoordinated approach to developing transport, storage and production business models threatens to be a barrier by exacerbating the risk posed by demand and supply uncertainty. Another barrier is the 2026 decision regarding the role of hydrogen in decarbonising domestic heating. If blending is allowed in existing pipelines, then there are significant outstanding questions regarding the management and monitoring of this process, such as where hydrogen would be inputted, how input would be measured, and how project developers would be compensated.

Given the considerable impact these decisions will have on future demand, it heightens the uncertainty surrounding investment decisions which must be taken now. Business models must therefore be ‘future proofed’ by ensuring the different potential outcomes of future policy decisions are factored into their design.

4. In your view, have we set out the main business model design options, or are there others that should be considered? Please explain your answer and provide any relevant evidence.

Scottish Renewables does not think there are any other business model design options which should be considered.

Scottish Renewables' preferred option is a RAB model for both the growth and steady state phases because it provides long-term stable and predictable investment recovery trajectory. However, we feel a Cap and Floor design could also have merits and therefore should also be taken forward for further consideration. The CfD, long-term capacity booker, co-investment by government and merchant model options should be discounted.

As a general principle for business model design, we believe that as far as possible the Hydrogen Business Model/Net Zero Hydrogen fund should support vehicular transport and storage co-located with production. This will limit the scope of infrastructure that transport and storage business models are required to support and thus make designing them simpler.

5. In your view, do you agree that uncertain demand and supply and limited user base will be the predominant barriers in a growth phase of hydrogen network development? Please explain your answer and provide any relevant evidence.

Yes, we agree. There is a fundamental 'chicken-and-egg' problem of progressing production and offtake projects that need to be connected by larger-scale transport and storage. Adding to the challenge is the fact that electrolysers are likely to locate in areas of high renewable electricity production (northern Scotland, for example) whereas demand is likely to be centred around industrial hubs in populated areas. These projects will therefore only go ahead if there is a clear commitment to the transport (and storage) system.

6. In your view, which business model design options do you consider may be suited to address the barriers in a growth phase? Please explain your answer and provide any relevant evidence.

We support a RAB model in the growth phase as well as the steady state, with additional external funding to cover the low number of initial customers who would otherwise pay excessive network charges.

7. In your view, are there any interim measures that we should be exploring to support the development of early hydrogen pipelines ahead of a hydrogen transport infrastructure business model being available? Please explain your answer and provide any relevant evidence.

Direct devex or capex support should be provided for low/no regret projects where investments need to begin before the Business Model is available in 2025 so they can be online before 2030.

The consultation document is primarily focusing on developing pipeline transport and not sufficiently considering road transport. This could be a useful interim measure and would

also help to reduce costs in the initial stages of the hydrogen economy. Vehicular transport should be supported with HBM/NZHF support were possible.

8. In your view, is a RAB model, based on the natural gas RAB design, likely to be the most suitable business model during a steady state, or would another business model design be more appropriate? Please explain your answer and provide any relevant evidence.

Scottish Renewables agrees a RAB model is the most suitable business model design option during a steady state. A RAB model for hydrogen which uses the existing framework for natural gas in the medium-term will allow the industry to move quickly and will avoid unnecessary complexity. The parameters of the existing RAB model for natural gas could be tweaked in the interim to create a distinction/subset between hydrogen and natural gas, allowing for the discrete treatment of hydrogen.

9. In your view, is there a need for compatibility between a business model for a growth phase and a business model for a steady state, and how should this be managed? Please explain your answer and provide any relevant evidence.

Yes. Compatibility between different stages of development must be ensured to avoid creating uncertainty for investors. BEIS should also provide more clarity on what it sees as being the threshold between phases.

10. In your view, is there a need for compatibility between a business model for hydrogen and a business model for natural gas, and how should this be managed? Please explain your answer and provide any relevant evidence.

Scottish Renewables is of the view that there must be compatibility between the business model for hydrogen and a business model for natural gas. Subject to the policy decision in 2023 on blending, the hydrogen strategy is based (at least in part) on the re-utilisation of existing natural gas networks to transport either blended or pure hydrogen. Reusing existing assets avoids high upfront costs, long lead times and disruptions required to build dedicated pipelines. Enabling this approach necessitates compatibility to manage the transition away from dedicated natural gas pipelines into blended and then 100% hydrogen pipelines without unnecessary delays or regulatory uncertainties.

11. In your view, are there any other considerations we should take into account? Please explain your answer and provide any relevant evidence.

No.

12. In your view, what ownership arrangements do you think are likely to be suitable for hydrogen networks? Does this depend on the chosen business model and/or phase of network evolution? Please explain your answer and provide any relevant evidence.

The ownership arrangements will vary depending on the location and size of the transport infrastructure. Large-scale onshore networks should be built by the gas distribution networks and National Grid Gas Transmission with clearly defined provisions available to producers/users to access it and understand the costs. Offshore transport will likely require dedicated midstream infrastructure owners to pump the hydrogen gas produced offshore into onshore gas networks. We therefore believe private ownership is most suitable. However, regardless of the ownership model chosen, regulated or negotiated third party access to hydrogen infrastructures must be guaranteed by the regulation for hydrogen producers.

13. In your view, is an external funding mechanism needed in a growth phase of network evolution? If so, at what stage of market and network evolution might it no longer be required? Please explain your answer and provide any relevant evidence.

Yes. An external funding mechanism is needed to account for volume risk, particularly in the growth phase as the customer base is not sufficiently large and the market will remain immature for some time.

14. In your view, if needed, what are your views on possible approaches to funding a potential external subsidy mechanism? Please explain your answer and provide any relevant evidence.

In the context of rising gas prices and the current cost-of-living crisis, any additional indirect costs being passed on to consumers through household bills would be deeply unpopular. Funding for a potential subsidy mechanism should not come from consumers' bills but from general taxation.

Using levies to fund the CfD scheme in the power sector makes sense because the costs fall on consumers. However, demand for hydrogen will be industrial and transport sectors in the short term (subject to the UK Government's decision on heat in 2026). We do not think it appropriate that domestic consumers subsidise these sectors directly.

15. In your view, how may other onshore hydrogen pipelines, including pipelines transporting hydrogen through a carrier, develop in the UK? Please explain your answer and provide any relevant evidence.

The best carrier to transport hydrogen is not yet known. As mentioned in the consultation, end-use sectors, such as maritime, may use ammonia as a direct fuel instead of hydrogen. With regards to ammonia, it is important to highlight the safety and toxic risks of transporting this molecule with pipelines.

We expect pipelines transporting hydrogen carriers (e.g. synthetic fuels, ammonia) to develop on a smaller scale in the medium term at the earliest as these markets emerge. Due to hydrogen having significantly less energy content per volume than other energy carriers, it makes it difficult/expensive to move around without pipelines. It is therefore likely that production for export will likely be located near the coast where it can be exported and/or small scale, point-to-point pipelines near airports/ports for aviation and maritime use.

16. In your view, is a business model required for the development of other onshore pipelines for hydrogen and, if so, how might a business model for onshore pipelines transporting hydrogen as a gas be adapted for this? Please explain your answer and set out the specific market barriers that a business model would be required to address as well as providing any relevant evidence.

No comment.

17. In your view, how may offshore hydrogen pipelines develop in the UK? Please explain your answer and provide any relevant evidence.

There is a clear opportunity for green hydrogen production to integrate with offshore wind, with many developers opting to co-locate electrolysers in their wind projects. This is because green hydrogen can allow better management of electricity supply and demand, provide new routes to market, help mitigate price cannibalisation and avert grid congestion and/or allow an offshore wind project to partially begin operation while waiting for a grid connection.

For example, the availability of a grid connection is a significant risk to the schedule of most ScotWind projects (almost 28GW in total). As such, they will be either reliant on the scale up of grid development or need to develop alternative revenue streams, including producing green hydrogen. This allows these projects to come online faster while they wait for a grid connection or alleviates the need for some grid development altogether. However, if more offshore projects incorporate hydrogen production this will of course increase the need for hydrogen transport and storage infrastructure at the same time as reducing the need for grid development.

18. In your view, is a business model required for the development of offshore hydrogen pipelines and, if so, how might a business model for onshore pipelines transporting hydrogen as a gas be adapted for this? Please explain your answer and set out the specific market barriers that a business model would be required to address as well as providing any relevant evidence.

As mentioned in our answer to Question 2, the development of onshore and offshore must be considered holistically and therefore business model support for onshore and offshore pipelines must be aligned.

19. In your view, how may vehicular transport for hydrogen develop in the UK? Please do include any other vehicular transport we may have missed. Please explain your answer and provide any relevant evidence.

Hydrogen mobility is likely to be expanded through corridor networks, aggregating supply from various production facilities, likely centred around key early adopter offtakes to then supply to further customers once the network is established and hydrogen adoption is de-risked. These corridor networks will have transport and storage requirements falling within the “smaller scale” category. As mentioned in our answer to Question 4, we believe that the Hydrogen Business Model/Net Zero Hydrogen Fund should support smaller transport and storage collocated with production to limit the scope of projects that transport and storage business models will have to be designed to support.

20. In your view, is a business model required for vehicular transport and, if so, how might a business model for onshore pipelines transporting hydrogen as a gas be adapted for this? Please explain your answer and set out the specific market barriers that a business model would be required to address as well as providing any relevant evidence.

No comment.

Hydrogen Storage Infrastructure

21. What do you consider to be the key technical barriers associated with the development of particular approaches to storing hydrogen which should be considered? Please explain your answer and provide any relevant evidence.

Salt caverns and depleted oil & gas fields each have distinct technical barriers. For salt caverns, key technical barriers include the availability of salt fields and long lead times. For

depleted oil and gas fields key technical barriers include the larger proportion of cushion gas needed for slower withdrawal rates, and possible contamination by hydrocarbons.

Another key technical barrier is the lack of good design standards. Existing standards are too conservative and not suitable for building at scale. Work must therefore be done to develop a practicable set of design standards.

We note that line pack, which is natural gas being stored in the piping distribution system itself, has been omitted as a potential hydrogen storage solution. We would argue that it should be included as part of a holistic approach to business model development as high-pressure line pack storage is an efficient method of storing hydrogen. However, large networks will be needed to provide a material amount of storage capacity.

Lined rock shaft hydrogen storage systems are a new storage technology that has also been omitted from the list of potential storage solutions. Lined rock shafts store a medium to large amount of hydrogen (100 to 120 tonnes) at pressures of 200bar. Shafts can be sunk in varied geologies and the system is therefore not limited to certain areas in the same way natural storage solutions such as salt caverns are. The ability to provide a mid-scale solution is vital and it is a segment which is poorly served by existing solutions, between the salt caverns (very large) and metal vessels (limited capacity). As such, it is well suited to the requirements of the industrial hydrogen hubs around which most of our hydrogen economy will be based. Lined rock shafts are particularly relevant in areas of the UK (which is to say, the large majority of the UK, including all of Scotland where many of the hydrogen hubs will be based) where there are no or limited salt deposits and there are few geological structures suitable for current hydrogen storage technologies.

We also note that the list of storage solutions is very regionally specific in terms of the geological storage solutions that will be available in different locations. Scotland has relatively few salt caverns suitable for storing hydrogen, for example.

As well as the existing technical barriers, there are also significant legal barriers applying to many of the potential storage solutions identified in the consultation. For example, we are not aware of any legal framework that applies to the storage of hydrogen in porous rock anticlines. It is also important to note that the legal system in Scotland is different to the system in England and Wales so there needs to be careful consideration of the prevailing legal position and what needs to be changed to facilitate the storage of hydrogen in geological structures.

We would caution too that large-scale storage can be used in a few different situations, both of which would have vastly different business cases. This distinction has not been made in the consultation document. Two of the most useful reasons for using hydrogen for storage

are to balance supply and demand and to store renewable energy which can then be turned back into electricity and used to balance the variability of renewables.

22. In your view, have we correctly identified and characterised the key market barriers facing larger-scale hydrogen storage infrastructure, and in particular its deployment by the late 2020s? Please explain your answer and provide any relevant evidence.

We agree with the market barriers as set out in the consultation document.

Additionally, any underground energy storage will involve long lead times with requirements such as geotechnical surveys and environmental impact assessments which will represent a barrier to market development.

We would also mention the need for design and performance standards to be developed and updated to reflect the storage of hydrogen underground and at scale. Without proper oversight, there is potential for unregulated activity to raise serious safety concerns and lead to considerable reputational damage to the hydrogen economy.

As well as the uncertainty over the future policy and regulatory environment, there are difficulties posed by the policy and regulatory environment as it exists currently – for example, the difficulty in getting a grid connection and the additional challenges involved in getting consent for co-located projects.

23. Do you agree that volume and revenue risk stemming from demand uncertainty represents the main barrier to the deployment of storage infrastructure? Please explain your answer and provide any relevant evidence.

Yes. This risk will be more acute for large projects than for small projects.

24. Do you agree that Government should develop a dedicated business model for hydrogen storage (subject to value for money and need) and that it should be designed to be technology-neutral? Please explain your answer and provide any relevant evidence.

Yes. We agree that a dedicated business model will be required to support the development of storage infrastructure and that the business model should be designed to be technology neutral.

25. Do you agree that business model support should focus on larger-scale storage, or is there a need to provide further support for small scale storage? Please explain your answer and provide any relevant evidence.

Yes, business model support should focus on larger scale storage.

Small scale storage will be used primarily for managing demand and supply variations in end-to-end projects. These are the kind of projects that will come through in the short term so we believe it is most appropriate to ensure the production business models allow for the development of small scale storage. We do not believe a separate business model should be developed for small scale storage.

26. In your view, who are likely to be users of hydrogen storage infrastructure and which group, or groups, might be best placed to provide revenue to storage owners? Please explain your answer and provide any relevant evidence.

The answer to this question will depend largely on the future regulatory framework. In the short term it will typically be smaller projects that involve producers supplying hydrogen directly to consumers. As for large scale storage in the longer term this is unlikely to be the case and instead will be producers supplying the market. At this stage it will depend on how the market is designed to function and the regulatory framework that supports it.

27. Do you agree with our initial view that a storage infrastructure business model should support providers of hydrogen storage infrastructure (as opposed to users of storage infrastructure)? Please explain your answer and provide any relevant evidence.

Yes.

28. What are your views on possible approaches to funding a potential subsidy mechanism? Please explain your answer and provide any relevant evidence.

In terms of rising gas prices and the current cost-of-living crises, any additional indirect costs being passed on to consumers through household bills would be deeply unpopular. Funding for a potential subsidy mechanism should not come from consumers' bills but from general taxation.

Using levies to fund the CfD scheme in the power sector makes sense because the costs fall on consumers. However, demand for hydrogen will be industrial and transport sectors in the short term (subject to the UK Government's decision on heat in 2026). We do not think it appropriate that domestic consumers subsidise these sectors directly.

29. In your view, have we correctly identified the main parties whose needs any storage business model will need to account for, and have their needs been correctly outlined? If not,

what additional needs should be accounted for? Please explain your answer and provide any relevant evidence.

We agree that parties and their likely needs have been correctly identified. However, we would emphasise again that transport and storage infrastructure needs to be developed in parallel according to similar timeframes.

30. In your view, have we set out the main business model design options, or are there others design options, or variants, that should be considered? Please explain your answer and provide any relevant evidence.

We agree with the design options identified and do not think there are any additional options that should be considered.

31. In your view, are any of the business model design options set out above more suited to supporting particular types of storage infrastructure than others? Please explain your answer and provide any relevant evidence.

No comment.

32. In your view, which business model design options would be most suitable to address the identified market barriers? Please explain your answer and provide any relevant evidence.

As with transport business models, we believe that RAB and Cap and Floor design options should be taken forward for further consideration. Our preference would be for a RAB model as it provides the long-term revenue certainty that will be key to unlocking investment and it is a model that is understood by industry. A Cap and Floor has the advantage of potentially allowing for an easier transition to projects trading on a merchant basis once the market is sufficiently established.

33. In your view, which organisations are best placed to carry out the roles of economic regulator/counterparty/administrator that would be required to implement the business models set out above? Are there any other roles that you consider may be required? Please explain your answer and provide any relevant evidence.

We believe Ofgem is the most suitable organisation to provide regulatory oversight given its role in regulating electricity and natural gas infrastructure. We believe the LCCC would be the most appropriate counterparty to contractual mechanisms.

However, we would emphasise the need for both organisations to be alive to the differences and particular features of the hydrogen landscape which distinguish it from the other areas with which these organisations are more familiar. Simply replicating approaches which are used elsewhere is unlikely to be successful. Any body performing the role of regulator/counterparty/administrator must appreciate that hydrogen production and storage is at an early stage of development and is yet to progress down its cost curve like other more mature technologies have.

34. In your view, are there any early interim measures that we should be exploring to support the development of the first hydrogen storage projects, ahead of a hydrogen storage business model being available? Please explain your answer and provide any relevant evidence.

As with transport infrastructure, we see a strong case for financial support and bespoke business model support so these projects (which have long timescales) can progress and take FID in time to be available by/before 2030.

Strategic Planning

35. In your view, should the build out of hydrogen transport infrastructure evolve through either a) a solely a market-led approach, b) a form of strategic planning, or c) neither? Please explain your answer and provide any relevant evidence.

See answer to Question 38.

36. In your view, should the build out of hydrogen storage infrastructure evolve through either a) a solely a market-led approach, b) a form of strategic planning, or c) neither? Please explain your answer and provide any relevant evidence.

See answer to Question 38.

37. In your view, if strategic planning was to be implemented for hydrogen transport infrastructure what form should it take? a) central network planner, b) coordinated approach, c) evolved approach, d) a blend of strategic planning and market-led approaches, or e) none of the above? Please explain your answer and what this approach might look like in a UK context.

See answer to Question 38.

38. In your view, if strategic planning was to be implemented for hydrogen storage infrastructure, what form should it take? a) central network planner, b) coordinated approach, c) evolved approach, d) a blend of strategic planning and market-led approaches, or e) none of the above? Please explain your answer and what this approach might look like in a UK context.

There could be benefits in the role of a strategic planner, as a general oversight function to steer and correct e.g. co-location where the market does not do that. We are however conscious that many of the key features of the hydrogen market (e.g. CCUS clusters, offshore wind seabed leasing) already operate on a competitive allocation framework for price support, some of which is factored on location.

For solar projects, onshore geography is key not only from a technical perspective but public acceptance e.g. around BMV agricultural land, which may or may not be fully aligned with the hydrogen economy from a strategic planning perspective.

It would be important to ensure that the strategic planner did not stifle competition and increase the cost to consumers unnecessarily, and that there were appropriate mechanisms in place to ensure that the systems already in place remained workable. For example, many offshore wind farm locations are identified based on complex ecological considerations. The strategic planner would have to consider that when considering locations for hydrogen development. We're also conscious of the potential for adding an additional level of bureaucracy and consents required.

39. Further to your answers to questions 35 – 38 above, in your view, is it important for there to be alignment between the ways in which hydrogen transport infrastructure and hydrogen storage infrastructure are built out and, if relevant, the form of strategic planning involved? Please explain your answer and provide any relevant evidence.

Yes. The buildout of transport and storage infrastructure should be aligned and coordinated through strategic planning taking account of the concerns outlined above.

40. Considering onshore and offshore hydrogen transport and storage infrastructure, do they have specific characteristics, or wider interactions with other infrastructure, which may mean the different infrastructure types favour a market-led approach or a form of strategic planning? Please explain your answer and provide any relevant evidence.

As already mentioned, offshore infrastructure must not be omitted when developing transport and storage business models, especially considering the 28GW of ScotWind projects

currently under development. Storage and transport infrastructure will be very important once these projects are completed.

41. In your view, are there any factors, other than those listed above, that should be considered if a strategic planning approach was to be adopted? Please explain your answer and provide any relevant evidence.

No comments.

42. If the UK were to create a central network planner role for hydrogen, would the FSO (if it is established by the Energy Bill) be best placed to take this role on? If not or if the FSO is not established, is another organisation more suited to the role or would a new body need to be created? If yes, in your view what temporary solution could be implemented prior to the FSO taking on the role? Please explain your answer.

We expect the Future Systems Operator would be best placed to take on the central network planner role for hydrogen. In the short term, BEIS could continue working on this area.

43. In your view, what role could the strategic planner have in the provision of business model support? How would this role change under different strategic planning approaches? Please explain your answer and provide any relevant evidence.

The strategic planner could provide regular/annual advice to the government about priority projects to receive business model support.

44. In your view, should government seek to identify "low or no-regrets" and/or systemically important projects to prioritise their development if possible? If so, how might such projects be identified and how might the best be prioritised? Please explain your answer and provide any relevant evidence.

Yes. Prioritising the early development of low/no-regrets projects will be a key enabler of further development of transport and storage infrastructure.

Regulatory Framework

45. In your view, are the existing market framework and industry commercial arrangements for hydrogen optimal for supporting the development of hydrogen transportation and/or storage infrastructure? Please note we are seeking your views on the whole existing market framework and industry commercial arrangements, including any possible gaps, and not just matters relating to the Gas Act. Please explain your answer and provide any relevant evidence.

This question is difficult to answer currently as the hydrogen economy is being developed at speed. However, we must balance speed of delivery with dealing with arising concerns over who controls the market. Current gas market arrangements could be adopted by the hydrogen market to help speed up delivery.

A few areas of concern were highlighted by members such as the need for third-party access in future, hydrogen needing its own uniform network code and perhaps needing its own RIIO3 process.

46. If you answered 'No' to the previous question, how do you think this should be addressed:

a. Through amendments to the existing market framework / industry commercial arrangements?

b. Through the replacement of aspects of the existing market framework / industry commercial arrangements (for example, with new arrangements that are specifically designed for hydrogen)?

c. Through a different approach?

No comments.

47. Further to the regulatory areas set out below, in your view, is the existing onshore non-economic regulatory framework optimal for supporting the development of a rapidly expanding UK hydrogen economy?

No comments.

48. If you answered 'No' to the previous question, how do you think this might be addressed (regulation/standards/guidance, etc.)? Please explain your answer and provide any relevant evidence.

No comments.

49. In your view, is the existing regulatory framework for the non-pipeline transportation of hydrogen optimal for supporting the development of a rapidly expanding UK hydrogen economy?

There is an existing applicable framework, but it is unlikely to be optimal for a rapidly expanding UK hydrogen economy. The Gas Safety (Management) Regulations (GSMR) 1996 require any transporters of gas, including hydrogen, to submit a safety case to the Health & Safety Executive (HSE) identifying hazards and risks and how they are controlled. However, the Regulations are only applicable to the transportation of gas through pipelines.

The applicable regulations for transporting hydrogen by road would be The Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations 2009. These regulations apply to the carriage of dangerous goods, including hydrogen, by road and rail and places general duties on everyone with a role in transporting the goods. These Regulations are highly prescriptive and complex.

50. If you answered 'No' to the previous question, how do you think this might be addressed (regulation/standards/guidance, etc.)? Please explain your answer and provide any relevant evidence.

Applicable regulations already exist. Straightforward guidance must be provided to enable all parties in a logistics supply chain to be able to understand their own obligations and how they fit with a broader safety regime.

Careful consideration and analysis will need to be undertaken as to how workable the 2009 regulations are in the anticipated hydrogen transport scenarios. For example, the small load and limited quantity exemptions should be worked through to identify if they are appropriate in relation to hydrogen. The highly prescriptive nature of these regulations may have the effect of prohibiting some companies from entering the market or being able to transport other than via a pipeline (following the GSMR requirements above instead). Whilst the complex and thorough nature of the regulations should provide public reassurance and an effective safety regime, it will also be a challenge to monitor and enforce in a rapidly expanding hydrogen market.

51. In your view, are the current NSIP and TCPA regimes optimal for supporting the development of a rapidly expanding UK hydrogen economy?

There are different planning regimes across the UK, for example, the Scottish Government has just laid a revised draft of National Planning Framework 4 (NPF4) which does cover hydrogen transport and storage infrastructure. The different planning regimes need to be aligned.

There is a lack of detailed policy support, for example, the draft National Policy Statements do not detail specifics regarding hydrogen. These need to be updated with current net-zero targets and aligned with the Hydrogen Strategy.

There should be clear detailed support at the national and local planning policy level for hydrogen, across the whole UK.

As a minimum, such support should include:

- An established needs case for all types of energy-related hydrogen projects in the light of net zero targets.
- A permission in principle and strong presumption in favour of granting consent for hydrogen developments.
- Clear guidance for consenting authorities to afford greater weight to the importance of net zero and the climate change emergency in planning decision-making.
- Clear guidance for consenting authorities to afford greater weight to the benefits of all hydrogen technologies considering the growing impacts of climate change.
- Removal of barriers to consenting hydrogen development such as low COMAH thresholds or piecemeal consenting routes.
- Policy consistency at national and local levels and across devolved administrations.

<u>Hydrogen storage:</u>

Underground hydrogen storage may fall within the TCPA or NSIP regimes depending on relevant thresholds (TCPA up to 43m^3 capacity / 4.5m^3 flow rate per day) and are likely to attract the need for COMAH or hazardous consents. In relation to the former, it may be necessary to review current COMAH thresholds for Hydrogen which may be very low.

<u>Hydrogen pipelines:</u>

The use of permitted development rights may be possible if the scope and threshold are appropriately extended.

52. If you answered 'Yes' to the previous question, please explain which elements you think are conducive to the development of the hydrogen economy. If 'No', please explain how you think they might be improved (e.g., a dedicated hydrogen NPS). Please explain your answer and provide any relevant evidence.

Both regimes are well understood and proven to be effective. The TCPA regime is suitable for smaller scale projects, as it reduces the costs associated with NSIP applications. The

NSIP regime is suitable for large scale projects although currently, only pipelines over a certain length qualify as an NSIP.

The Secretary of State has made section 35 directions (e.g. on Cory Decarbonisation Project) to enable hydrogen infrastructure for production to be included as an NSIP. Guidance on section 35 directions for hydrogen infrastructure may be helpful, setting parameters for when hydrogen infrastructure is likely to be regarded by the Secretary of State as of national importance. This would allow developers to decide whether to apply as an NSIP or proceed under the TCPA route (which may depend on the financial model associated with the development and timescales).

53. In your view, is the existing environmental regulatory framework optimal for the future hydrogen economy?

No.

54. If you answered 'No' to the previous question, how do you think this might be addressed? Please explain your answer and provide any relevant evidence.

There needs to be clarity on permitting. Also, there needs to be more detail from the network companies over strategic or anticipatory investment in reducing carbon and grid enforcement in relation to hydrogen.

55. Further to the regulatory assessment set out above, in your view, is the existing offshore non-economic regulatory framework optimal for supporting the development of a rapidly expanding UK hydrogen economy?

No comments.

56. If you answered 'No' to the previous question, how do you think this might be addressed (regulation/standards/guidance, etc.)? Please explain your answer and provide any relevant evidence.

No comments.

Hydrogen Blending

57. To what extent might lead times for hydrogen transport and storage infrastructure limit the scale of hydrogen production capacity in the early years of the hydrogen economy? If applicable, can this be quantified for your project (e.g. in terms of production volumes, load factors, etc.)?

Lead times for infrastructure may be impacted by a lack of demand locally. Developers may need to have good pipeline connections to be able to access the hydrogen market. This will constrain smaller developers.

58. Do you see a potential for blending in helping to address this challenge by providing a route to market as a reserve offtaker? For how long do you expect this role for blending may be required? Please explain your answer and provide any relevant evidence.

Hydrogen blending should not negate the need for 100% decarbonisation of pipelines, and, as such, it is a viable stepping stone to full decarbonisation. For example, blending in certain rural areas which are finding it hard to decarbonise, could help to encourage transition in those areas. Some areas, by their nature, could be targeted for blending to increase offtake and reduce the amount of curtailed wind.

We agree that blending could be a potential reserve offtaker and fast-tracking blending into existing networks could be an effective way to accelerate the early development of hydrogen production and use. However, there are many complications surrounding this, as it will not be as simple as substituting hydrogen for biomethane, for example, and being included in the Green Gas Support Scheme.

The safety case for blending has also yet to be more widely disseminated. The research project HyDeploy from Keele University undertook to demonstrate the safety of hydrogen being blended into a small private gas network. It successfully reported that hydrogen can be blended at up to 20% into natural gas networks with no adverse effects for users.

There is still uncertainty over whether blended gas would work in end use appliances, and what impact blending would have on the calorific value of gas, which is linked to billing systems.

Industry is deeply concerned about demand, however, and blending would provide some certainty. It would also be a valuable stepping stone to wider consumer acceptance of hydrogen.

Environmentally speaking, hydrogen blending can help to reduce the carbon intensity of gas. However, there are issues around reliability and consistency and these need to be addressed. Blending can provide valuable early stimulation to the hydrogen market, but it

should be ensured that this does not come at the price of slowing the transition to 100% green hydrogen or undermine hydrogen's perception as being a clean fuel.

59. Do you think that new transport infrastructure for 100% hydrogen may be required solely for the purposes of blending? If applicable, what scale of 100% hydrogen transport infrastructure would your project require to reach the GB gas networks (at distribution or transmission level)?

No comments.

60. Do you think that a reserve offtaker (e.g. blending) could help stimulate growth in hydrogen demand, by providing potential offtakers with more confidence to switch to hydrogen? If so, for how long might this be beneficial? What alternative measures could be enacted to help stimulate growth in hydrogen demand? Please explain your answer and provide any relevant evidence.

Demand is of critical importance so having blending as a reserve offtaker would provide certainty and a route to market in the early years of the hydrogen economy. However, as we have set out in our answer to Question 58, there are several other factors which will need to be considered.

61. Do you agree with our assessment of the range of options to address demand volatility? In addition to these measures, do you think a reserve offtaker (e.g. blending) could have value in managing producer volume risk caused by volatile demand? Please explain your answer and provide any relevant evidence.

We believe that having blending as a reserve offtaker would have value, in that it would be a more consistent requirement than, for example, transport.

However, there needs to be feasibility studies and pilot projects to prove whether blending is economically viable and safe.

Blending would be beneficial for volume risk. However, demand volatility and systemic issues need to be addressed with the main hydrogen business model, such as needing to identify the end-use of the hydrogen being produced. It is not credible to expect hydrogen developers to commit to 10 – 15 years of a specific offtake.

Hydrogen export, especially to the EU and Germany, is a credible solution to demand volatility.

62. If you believe a reserve offtaker would be beneficial for the hydrogen economy, are there any alternative reserve offtakers that could fulfil this role instead of, or in combination with, blending? Please explain your answer and preferred reserve offtaker(s) with supporting evidence.

An alternative reserve offtaker could be co-location with power generation, utilising line pack as a storage solution.

63. In addition to those mentioned in this chapter, do you see any benefits and/or risks associated with blending? Please explain your answer and provide any relevant evidence.

Blending offers lower transport and storage costs in the near term, driving down the level of public subsidy required to create a market for low carbon hydrogen and/or costs to consumers. Blending also effectively creates a national market for hydrogen if producers and consumers are able to contract in a similar way to how green gas is currently traded/sleeved. However, there will be geographic locations, such as the Highlands of Scotland, which are unable to benefit from hydrogen blending as they are not on the gas grid.

Benefits and risks relate to de-blending and whether business models are required for that and who pays. It would also have to be ensured that decisions concerning blending are factored into the strategic planning of hydrogen development.