Written Evidence Submitted by SGN

(HNZ0061)

Executive Summary

SGN welcomes the opportunity to respond to this inquiry. SGN manages the network that distributes natural and green gas to 5.9 million homes and businesses across Scotland and the south of England, providing warmth to over 14 million customers. Our strategy and long-term plan to deliver net zero focusses on the replacement of the natural gas in our network with hydrogen and other green gases, enabling the decarbonisation of heat in our Scotland and southern networks by 2045.

We have recently secured funding for H100 Fife, the UK's first 100% green hydrogen heating demonstration in Levenmouth, Scotland.[i] This is a key national project that will:

- bring carbon-free heating and cooking to around 300 homes from the end of 2022
- provide compelling evidence of hydrogen's performance in a real-world domestic setting
- enable UK Government decisions on the role of hydrogen to decarbonise heat around 2024/25

Net-zero legislation will require low or zero carbon energy to supply all heat, industry, transport, and electricity demands. We believe this can only be achieved through an integrated whole system approach. Natural gas currently dominates heating due to the ability of the gas networks to store large volumes of energy and release it to meet peaks in heat demand – which are more than 4x peak electricity demands – in an efficient and affordable way.

Without the ability to store energy to meet high demands, a future net zero energy system will not be reliable or secure. The electricity grid's ability to satisfy heat demand during a winter cold spell is significantly restricted by the challenge of storing electricity at scale at an affordable cost. Currently, renewable electricity must be used to supply a demand, otherwise it is wasted. Converting renewable energy to hydrogen allows the utilisation of renewable energy from generators currently paid to turn off when supply exceeds demand.

A key aspect of decarbonising heating in line with net zero will be deliverability at scale and acceptance by consumers given the need to change the heating systems in each of the 30 million homes across GB. This means that while electric heat pumps may have a role to decarbonise buildings like those off the gas grid, we believe a hydrogen ready boiler supplied by a gas network - which is already being upgraded to become hydrogen ready - offers the optimum route to decarbonise heat at the scale required with the lowest levels of disruption and most value for customers and UK plc.

The UK has the opportunity to create the world's first zero carbon gas grid as part of the green recovery from COVID-19. However, other countries (e.g. Germany and Australia) are already pushing ahead, so there is a significant cost of inaction.[ii] Establishing a world leading hydrogen economy in the UK could deliver:

- 221,000 Jobs and £176bn of private sector investment across the UK[iii]
- A major contribution to our Net Zero targets across power, heat, transport, and industry
- the decarbonisation of heat in the least disruptive way with the lowest up-front costs for consumers
- Create new UK-based green industries and a whole new supply chain

Our key asks of Government to enable industry to invest in hydrogen technologies in the UK and drive the next stage in scaling hydrogen solutions are:

1. For the upcoming UK Government hydrogen strategy to build on the 5GW production target in the 10-point plan if the UK is to compete in the international race to develop hydrogen; The UK holds world class advantages in hydrogen production, distribution and application but other countries like Germany are moving ahead.
2. The transfer of gas quality standards from the Gas Safety (Management) Regulations (GS(M)R) legislation to an IGEM industry standard. Future changes to this standard could allow the safe increase of the volume of hydrogen allowed in the gas network from the current 0.1% to 20% which can be safely used in existing appliances. Blending can stimulate demand ahead of conversion to 100% hydrogen.
3. Policy support and regulatory flexibility to allow for at scale trials to follow on from our H100 Fife community trial which starts in 2022. This will provide the evidence on hydrogen as a zero-carbon heating fuel and enable government heat policy decisions in the mid-2020s;
4. Changes to building regulations to mandate that all future boilers are 'hydrogen-ready' once the current prototypes become commercially available; This would utilise the 1.6 million a year gas boiler replacement cycle to ready households for conversion to hydrogen in the 2030s.
5. The development of incentive mechanisms and business models for blue and green hydrogen to allow investment and for hydrogen production to realise the same cost reductions as seen for offshore wind.

Answer to specific questions

1. The suitability of the Government's announced plans for "Driving the Growth of Low Carbon Hydrogen", including:

- **the focus, scale and timescales of the proposed measures;**
- **how the proposed measures—and any other recommended measures—could best be co-ordinated;**
- **the dependency of the Government's proposed plans on carbon capture and storage, any risks associated with this and how any risks should be mitigated; and**
- **potential business models that could attract private investment and stimulate widespread adoption of hydrogen as a Net Zero fuel;**

Hydrogen heat trials

1. Dramatically reducing the 20% of UK emissions that come from home heating will be critical to deliver on the UK's target for net zero greenhouse gas emissions by 2050. As the UK Government has said, there is not yet the evidence to determine the role of hydrogen heating to achieve this most economically and effectively at the scale required.

2. Hydrogen heating trials like H100 Fife are critical to deliver the evidence on hydrogen as a clean net zero heating technology to enable Government heat policy decisions around 2024/25. Hydrogen has the potential to deliver net zero heating at a lower upfront cost and disruption for customers compared to electric heat pumps.

3. The gas networks are halfway through a 30-year programme to replace old metal pipes with hydrogen-ready plastic ones. Hydrogen boilers will provide heat in the same way as traditional natural gas boilers without the need to install larger radiators, a hot water tank and the extra insulation required for electric heat pumps.

4. Our H100 Fife project community trial funded by Ofgem and Scottish Government will demonstrate 100% green hydrogen heating in 300 homes in Levenmouth from 2022. The £81 million allocated for further hydrogen heating trials in the spending review will be critical to deliver the ten-point plan aim for a hydrogen heated village/town by 2025/30 respectively. There is also a need to ensure trials and R&D in gas networks business plans are fully supported by Ofgem's final RIIO-2 regime from 2021.

5. Should H100 Fife phase 1 prove successful it will be ideally placed to scale up to 1,000 homes in phase 2 and industrial and transport applications in phases 3 and 4. The role out of blue hydrogen production from industrial clusters will provide a route to decarbonise heat as well as transport and industry. Our Aberdeen Vision project is looking to utilise hydrogen produced from natural gas brought onshore at the St Fergus Gas terminal and blend 20-100% into our Aberdeen gas network. The associated Acorn CCS project is the most advanced in the UK and could be up and running by 2023-24.

Hydrogen production

6. We welcome the ambition for 5GW hydrogen production capacity by 2030 in the UK Government's ten-point plan but believe with the right incentives in place the UK has the potential to do far more than this. Scotland has set itself a target for 5GW by 2030 so the UK as a whole could be targeting over 10GW according to recent analysis by the UK Hydrogen Taskforce.

7. There is a need for coordination between stimulating demand and supply – lots of government focus is on the supply side at the moment – blending up to 20% hydrogen in the gas grid can be a key component of generating demand and creating a market for hydrogen ahead of conversions to 100% hydrogen. When blending up to 20% hydrogen with natural gas in the network, there is no need to change pipes or appliances. This is currently being demonstrated by the Hydeploy trials on private then public sections of the gas network.[iv]

8. A key enabler to hydrogen blending is to update rules around the quality of gas that is allowed to be transported within the GB networks. The Gas Safety Management Regulations (GSMR) in UK legislation currently allow only 0.1% hydrogen by volume. Moving schedule 3 of GSMR out of UK legislation to an industry standard managed by the Institution of Gas Engineers and Managers (IGEM) will result in a more flexible standard that can be adapted as the safety of adding more hydrogen is evidenced by trials. This change is being worked through by the Department for Work and Pensions (DWP) as the responsible department for the Health and Safety Executive (HSE). It is crucial the promise to consult on this in summer 2021 does not lapse to enable the ten point plan target to enable a wider rollout of 20% hydrogen blending across GB.

Hydrogen demand

9. The UK Government's Hy4heat programme has developed hydrogen ready boilers that are like for like replacement for natural gas boilers. These models can run on natural gas initially and be converted in under an hour to run on 100% hydrogen when the local network is converted. They can deliver the on-demand central heating customers are used to, but, when hydrogen is used in a boiler it produces zero carbon emissions.

10. Hydrogen-ready boilers could be installed in most homes by the 2030s just by utilising the natural 1.6 million a year churn cycle of boiler replacement when they reach the end of their natural life. Initial estimates are that initial hydrogen ready models would be around £50 more expensive than traditional gas boilers, but they could be cost-competitive when produced at scale.

11. We have been calling on the government to mandate that all new boilers installed from 2025 or earlier should be hydrogen ready. The Energy White Paper commitment to consult on this is therefore a welcome step forward. Manufacturers Worcester Bosch and Baxi have prototype hydrogen-ready

boilers that they are ready to produce if given the market signals by Government. This should be progressed as a priority by government in 2021 as a no regrets step to prepare homes for net zero heating.

12. We believe both blue and green hydrogen will be needed to deliver net zero. We welcome the forthcoming hydrogen strategy is to set out a twin track approach to developing both. Getting the CCUS business models for hydrogen finalised as soon as possible is critical for any blue hydrogen production and meeting the UK Government's aim of four low carbon clusters by 2030 and a net zero cluster by 2040. We believe BEIS should be ambitious and finalise hydrogen business models by the end of 2021, rather than 2022 as currently proposed.

2. The progress of recent and ongoing trials of hydrogen in the UK and abroad, and the next steps to most effectively build on this progress;

13. UK has led the way in the early stages of research and the development of hydrogen heating. A multi-year coordinated industry-wide programme of work is underway to establish it is technically possible, safe and convenient to replace natural gas (methane) heating with hydrogen. Our H100 Fife trial is the critical project to demonstrate hydrogen heating in a community and build on the feasibility and offline trials carried out to date.

H100 Fife

14. We have recently secured funding for the UK's first 100% hydrogen heating demonstration in Levenmouth, Fife. This is a key national project that will bring carbon-free heating and cooking to around 300 homes from the end of 2022. The project will provide compelling evidence of hydrogen's performance in a real-world domestic setting to enable UK Government decisions on a further rollout of hydrogen heating to decarbonise heating in line with net zero targets.

15. The clean gas will be produced locally, by a dedicated electrolysis plant powered by a nearby offshore wind turbine. The project will be the first of its kind to use a direct clean power supply to produce hydrogen for domestic heating, putting the Fife town at the forefront of the green energy revolution. The network will be new and will run past 1,000 homes with customers participating in an opt-in basis. The project will assess customer appetite for hydrogen heating as a low disruption solution to lower their heating emissions.

16. H100 Fife follows a multi-year programme of work under the H100 feasibility project to demonstrate to the Health and Safety Executive (HSE) that 100% hydrogen is as safe or safer than the current methane natural gas.

Industrial clusters

17. Early production of hydrogen at scale is likely at industrial clusters where industry can use blue hydrogen from the reformation of natural gas with CCUS to decarbonise. These locations will also offer opportunities to decarbonise local transport and heating using hydrogen. Our Aberdeen Vision project is looking to take blue hydrogen from the St Fergus Gas Terminal and use it in our Aberdeen gas network – initially a 20% blend ahead of a potential conversion to 100% hydrogen. But none of this can go ahead without the UK Government finalising business models for CCUS.

18. The Acorn project at St Fergus is the most advanced in the UK and could be up and running by 2023-24 with the right frameworks in place from Government. We are involved in the NECCUS-led initiative which has been awarded funding under the Government's Industrial Challenge to develop the roadmap for North East Scotland to be the UK's first net zero industrial zone. Finalising the business

plans for hydrogen and CCUS is critical to avoid industry moving abroad or the significant change to many industrial processes that would be required if they were to be electrified.

19. We would like you refer you to the Energy Networks Association (ENA) submission for a list of other UK-led hydrogen trials that are underway.

3. The engineering and commercial challenges associated with using hydrogen as a fuel, including production, storage, distribution and metrology, and how the Government could best address these;

20. Our H100 Fife project will look to provide evidence of the production, storage, distribution and metrology of the use of hydrogen in a purpose-built network in Levenmouth from 2022. Testing to date has not indicated there are any challenges in any of these areas that cannot be overcome in a similar way to how the challenges associated with using natural gas as a fuel are managed today.

21. Work as part of the ENA's Gas Goes Green programme has shown that with the right incentives to scale up production, green hydrogen could realise a similar cost reduction trajectory as seen for offshore wind and be cost competitive with natural gas by 2030. It is therefore important that the cost of producing low carbon hydrogen today for small scale trials is not seen as a barrier in a way that it was not in the early days of offshore wind. Prompt investment in a domestic hydrogen economy can unlock £89bn of net savings to customers by 2050 in addition to the economic value to UK plc of a domestic hydrogen industry.[v]

22. **Production –** getting enough clean hydrogen produced to meet the demand in areas where the gas network is converted to hydrogen is a key challenge. We believe the UK can deliver more than the 5GW target for 2030. Allowing up to a 20% blend in the gas network is key to generate demand. Producing green hydrogen from renewables via electrolysis will enable us to make the most of our renewable energy resources, and, a solution to the increasing problem of renewables being curtailed (paid to not generate) when electricity supply exceeds demand. Hydrogen can be stored like natural gas in order to deliver heat when it is most needed in winter. BEIS finalising business models for CCUS is the key challenge for blue hydrogen production – other countries like Norway have demonstrated any engineering challenges of CCUS can be overcome.

23. **Storage –** storage will a crucial to any future net zero energy system. Without the daily and interseasonal storage and flexibility provided by the gas network system today, there wouldn't be the means to provide customers with heating on the coldest days. Despite the advances in battery technologies, electricity can still only be economically stored in small quantities for short periods. Hydrogen would still allow customers to benefit from linepack storage within the gas network in a similar way to natural gas. Because of the different characteristics of hydrogen, only around 1/3 as much can be stored as linepack so extra storage would be needed. This could be in above ground steel tanks – like the ones we will be using for the H100 Fife project – or geological storage in salt caverns. We believe a RAB-model could deliver the required investment in hydrogen storage that the market hasn't been able to deliver for natural gas.

24. **Distribution –** the distribution network will be ready to transport hydrogen thanks to the ongoing programme to replace old metal gas mains with plastic hydrogen ready pipes which is due to end in 2032. The BEIS Hy4heat programme has shown pipework inside homes will be safe for hydrogen and will not need to be replaced. National Grid's HyNTS project is looking to evidence the high-pressure transmission system could be used for up to 100% hydrogen, contrary to a perception this is not possible.

25. **Metrology –** domestic hydrogen meters have been developed under the Hy4heat project and we will be deploying these on our H100 Fife trial. These can take into account the different energy content and density of hydrogen. We would like to see a continuation of the Hy4heat programme to develop

metering solutions for commercial and industrial applications. Metering solutions across the gas system will also need to be developed for example when hydrogen is transferred between different parts of the value chain i.e. production, transmission, distribution and end use.

4. The infrastructure that hydrogen as a Net Zero fuel will require in the short- and longer-term, and any associated risks and opportunities;

26. Over 70% of our gas distribution network is hydrogen-ready thanks to the 30-year Iron Mains Replacement Programme that will continue until 2032. Despite the difference in densities and energy content between methane natural gas and hydrogen, the pipes are the right size to transport hydrogen because we can safely adjust the pressures the networks operate at.

27. There is an opportunity to utilise the established regulatory framework the gas networks operate within to finance the investment required to transition to hydrogen. There is a precedent for this in the way the current Iron Mains replacement programme is paid for through the network element of energy bills.

28. The UK has world-class advantages in its ability to produce green hydrogen from its world leading offshore wind resource, blue hydrogen from its indigenous oil and gas production assets and expertise, and distribution as a result of having one of the most extensive and efficient gas networks in the world. This offers not just opportunities to decarbonise the UK but for the UK to be at the forefront of a future international market for hydrogen as well as skills and expertise.

5. Cost-benefit analysis of using hydrogen to meet Net Zero as well as the potential environmental impact of technologies required for its widespread use;

A balanced approach is optimal

29. A balanced approach to delivering net zero of utilising low carbon gases and electricity has been shown to be the optimal way to decarbonise Great Britain's energy system and reach net-zero emissions. ENA's report 'Pathways to Net Zero' shows that the Balanced Scenario is lower cost than the scenario where all heating is electrified by £13bn/year.[vi]

Value of a hydrogen economy

30. Establishing a world leading hydrogen economy in the UK could deliver 221,000 Jobs and £176bn of private sector investment across the UK. Creating greater support for hydrogen in the UK, such as implementing a hydrogen strategy and by mandating hydrogen ready replacements for old gas boilers, will help establish that.

Impact on customers

31. Hydrogen can minimise the upfront costs to customers to move to low carbon heating. Hydrogen ready boilers are expected to cost no more than £50 more than a traditional boiler today, so they offer an affordable as well as less disruptive option for most customers. Many households will be unable to afford the £26,300 estimate the CCC have made of the average cost to switch a house to an electric heat pump.[vii]

32. Ultimately green hydrogen can allow us to maximise our renewable energy resources and utilise electricity currently curtailed at a cost of £650m to energy bill payers over the last decade. With the right incentives to scale up production, green hydrogen could realise a similar cost reduction trajectory as seen for offshore wind and be cost competitive with natural gas by 2030.

6. The relative advantages and disadvantages of hydrogen compared to other low-carbon options (such as electrification or heat networks), the applications for which hydrogen should be prioritised and why, and how any uncertainty in the optimal technology should be managed.

33. The Committee on Climate Change (CCC) and other experts agree the UK's net zero targets cannot be met in a cost-effective way through electrification of heat and using heat pumps alone. This is because:
    - Peak heat demand in winter is 4x peak electricity demand so repurposing the gas network for hydrogen reduces the investment needed in generation and reinforcement of the power grid
    - The space constraints and thermal properties of our housing stock mean that for the majority a heat pump alone can't deliver the heat needed without disruptive and costly retrofit measures
    - A key aspect of decarbonising heating in line with net zero will be deliverability at scale and acceptance by consumers given the need to change the heating systems in each of the 30 million homes across GB. This means that while heat pumps may have a role to decarbonise buildings like those off the gas grid, other technologies like hydrogen for which the evidence base is being built have the potential to be the dominant future net zero heating technology.

34. SGN are of the view that a hydrogen ready boiler solution supplied by a repurposed gas network which is already built to meet peak heat demand in winter, offers the optimum route to decarbonisation of heat with the lowest levels of disruption and most value for customers. However, where hydrogen boilers are used in hybrid systems alongside heat pumps, this can significantly reduce the levels of disruption to the floors and interiors of homes, and the cost and disruption associated with the requirement to significantly upgrade the electricity distribution networks to cope with large numbers of stand-alone heat pumps operating at peak times.

(January 2021)

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[i] https://www.sgn.co.uk/H100Fife
[ii] https://www.bmwi.de/Redaktion/EN/Publikationen/Energie/the-national-hydrogen-strategy.html
[iii] http://www.element-energy.co.uk/wordpress/wp-content/uploads/2019/11/Element-Energy-Hy-Impact-Series-Study-1-Hydrogen-for-Economic-Growth.pdf
[iv] https://hydeploy.co.uk/
[v] https://www.energynetworks.org/assets/images/Resource%20library/FINAL_Hydrogen%20cost%20to%20customer_SENT.pdf
[vi] https://www.energynetworks.org/assets/images/Resource%20library/ENA%20Gas%20decarbonisation%20Pathways%202050%20FINAL.pdf
[vii] https://www.theccc.org.uk/wp-content/uploads/2019/02/UK-housing-Fit-for-the-future-CCC-2019.pdf