Written Evidence Submitted by National Grid (HNZ0038)

National Grid sits at the heart of Britain's energy system, connecting millions of people and businesses to the energy they use every day; and we recognise that we have a crucial role to play in developing solutions to make the transition to a clean economy, in which nobody is left behind. Meeting the government's net zero ambitions will require delivery at both scale and pace – and achieving the target will require a 'whole system' approach, looking across different sectors of the economy, as well as balancing national and regional needs. We believe that the transition to a decarbonised economy will require a diverse mix of technologies and solutions, with hydrogen and low carbon gases playing an important role as part of this – including to support the decarbonisation of transport, power, heat and industry. We support the rapid development of a hydrogen economy to support the UK's net zero ambitions.

The Prime Minister's 10-Point Plan rightly highlights that the UK is already a world leader in investigating the use of hydrogen in achieving net zero[1]. Unlocking the potential of hydrogen as a clean energy solution requires significant pace and as the government recognises in the Energy White Paper, "action is needed now to enable hydrogen to be deployed flexibly in the future."[2] National Grid believes it is crucial to focus on innovation, commercialisation and trials at scale to inform policy decisions in the early 2020s. We are investing and innovating to understand options to drive down costs for consumers and in this position paper, we set out our current views on the steps that could unlock the potential of hydrogen at this time, based on current evidence. As the government also considers the approach to economic recovery following the COVID-19 pandemic, there is a potential for the UK to become a world-leading net zero economy, exporting low-carbon energy solutions in a global market and creating employment and supply chain potential in the UK.

Executive Summary

- Hydrogen and low carbon gases have a role to play in enabling net zero by supporting the decarbonisation of multiple sectors such as transport, industry, power and heat. It could be an important option in high carbon, energy-intensive sectors, such as industrial processes, where existing alternatives may not present a viable economic or cost-effective option to decarbonise.
- National Grid has undertaken initial analysis on the feasibility of transporting hydrogen in our existing high-pressure gas pipeline network. Our early research, led by the Health and Safety Laboratory, concluded that it is technically feasible to transport hydrogen in the gas National Transmission System (NTS). As part of our HyNTS FutureGrid project, we will begin construction of a physical trial network of a hydrogen transmission system in April 2021, using decommissioned gas assets, so that we can demonstrate the safety case and any modifications required to transport up to 100% hydrogen in the NTS.
- The UK Hydrogen Strategy must be brought forward according to the Spring 2021 timetable set out by Government. A clear and ambitious strategy, backed by targeted funding to support early stage projects, and development of investable business models for hydrogen, would signal to the local and international investment community the UK's commitment to develop a low-carbon hydrogen economy.
- Enabling policy and regulatory frameworks will also be crucial for the commercialisation and scale up of hydrogen, and will require clear alignment between government and relevant regulators This should include developing a technology-neutral policy approach to hydrogen to support different types of hydrogen production technologies and applications.
- Carbon capture usage and storage (CCUS) can support the production of low carbon hydrogen by removing and permanently storing carbon associated with the production process. Government now needs to finalise business models at the earliest opportunity, ahead of the 2022 date stated in the 10-Point Plan, to provide the best possible chance of achieving its target of two CCUS clusters by the mid-2020s and four clusters by 2030.

[1] HM Government (2020), Ten Point Plan for a Green Industrial Revolution

[2] BEIS (2020), Energy white paper: Powering our net zero future

This position paper represents the views of National Grid Gas plc (NGG) which owns and operates the high-pressure gas National Transmission System (NTS) in England, Scotland and Wales; National Grid Electricity Transmission plc (NGET) which owns the high voltage transmission system in England and Wales and National Grid Ventures (NGV), which owns and operates energy businesses in competitive markets in the UK and US, which include electricity interconnectors, the Grain LNG storage terminal and National Grid Metering. Following the business separation of the Electricity System Operator (ESO) from NGET, its views are not represented in this position paper.

1. The role and potential uses of hydrogen in delivering a net zero economy

The CCC has identified hydrogen as a credible option in the next stage of the UK's energy transition[3]. Low carbon hydrogen can be produced through a range of methods, including from fuels such as natural gas or biofuels with CCUS, or from electricity (electrolysis) generated from renewables such as wind or solar. As we seek to exploit the potential of hydrogen, it is important to develop a technology-neutral policy approach to support different types of hydrogen production technologies and applications.

- Low carbon hydrogen from fuels (e.g. natural gas or biofuels) can be produced by combining technologies such as steam methane reforming (SMR) or autothermal reforming (ATR) with CCUS technology. The combination with CCUS results in a low carbon hydrogen, by removing and permanently storing carbon associated with hydrogen production through these methods.
- Low carbon hydrogen from electricity is produced via a process called electrolysis. This involves using electricity generated directly from low carbon energy sources through the electricity grid to split water into hydrogen and oxygen.

A range of different solutions will be needed across the economy to help deliver a net zero economy. Hydrogen, and the different technologies used to produce it, will have a role to play, alongside options such as electrification. Hydrogen could be an important option in high carbon, energy-intensive sectors, such as industrial processes, where existing alternatives may not present a viable economic or cost-effective option to decarbonise. This is backed up by the CCC which highlights that decarbonising the different needs of the industrial base will require technologies that include electrification options, hydrogen and carbon capture and storage[4]. In addition, hydrogen also offers the potential to manage the uncertainty of renewable generation against demand. It could also play a key role in decarbonising the transport, industry, power and heat sectors.

To help deliver net zero, the National Infrastructure Commission (NIC) has recommended a trial of hydrogen production with Carbon Capture and Storage (CCS) by 2023, along with a trial of hydrogen to heat 10,000 homes by the same date, as well as wide scale testing of heat pumps[5]. In a similar vein, the Committee on Climate Change (CCC) expects a major expansion of low-carbon electricity and hydrogen supplies to power the mass take-up of low-carbon solutions[6] to underpin the transition to net zero. This demonstrates the consensus on the need to develop and deploy hydrogen opportunities to support the UK's ambition to achieve net zero by 2050. Therefore, we welcome the ambitions in the Prime Minister's 10-Point Plan[7] which commits to a Hydrogen Neighbourhood in 2023, moving to a Hydrogen Village by 2025, with an aim for a Hydrogen Town before the end of the decade and developing 5GW of low carbon hydrogen production capacity by 2030.

Transport

It is important to consider the different technology options, such as electrification and low carbon gas, that can support the decarbonisation of the different forms of transport. For example, hydrogen could provide options to public transport, freight and commercial vehicles. Opportunities could involve hydrogen produced via electrolysis at re-fuelling stations for light transport, buses and heavy goods vehicles.

In relation to HGVs, there are many studies which single out either a hydrogen or electrification solution as the most efficient way to decarbonise them, but it is likely that successful decarbonisation will require a blend of solutions that includes both hydrogen and electrification.

Industry and power generation

Hydrogen could support emissions reductions in industry and power through several options. These could involve blending hydrogen with natural gas or converting industrial sites or power plants to run on 100% hydrogen. This is especially relevant to industries that currently use natural gas in their processes, as low carbon hydrogen could be an

[3] Committee on Climate Change (2018), Hydrogen in a low-carbon economy
[4] Committee on Climate Change (2020), The Sixth Carbon Budget - The UK's path to Net Zero
[5] National Infrastructure Commission (2020), Net zero: Commission recommendations and the net zero target
[6] Committee on Climate Change (2020), The Sixth Carbon Budget - The UK's path to Net Zero
[7] HM Government (2020), Ten Point Plan for a Green Industrial Revolution

efficient alternative to help with decarbonisation. Large individual users may have relatively steady demand, and opportunities to manage the fluctuation in demand could be met by options such as small-scale hydrogen storage tanks or pipe 'linepack' (this is the amount of gas within the National Transmission System at any time).

More broadly, the CCC and NIC have both cited the importance of developing industrial clusters, incorporating different types of industry and power generation. Hydrogen could play an important role as part of this, alongside CCUS, to support larger scale industrial decarbonisation. CCUS decarbonises the hydrogen production process by removing and storing carbon emissions generated during the production process.

National Grid is working in partnership with industry as part of the Zero Carbon Humber consortium, which is exploring the opportunity to deploy CCUS technology and the development of a hydrogen economy within the biggest industrial cluster in the UK. This project has the potential to become the world's first net zero carbon industrial cluster, helping to protect 55,000 existing skilled jobs while establishing a platform to create thousands of new jobs in the Humber.

Heat

Delivering net zero will require reducing emissions from the way we heat our homes. Around 85% of the UK's 28 million homes currently use gas for heat. A diverse range of solutions will likely be needed, including both electricity and low carbon gas options alongside energy efficiency measures, to achieve this.

Trials and innovation are already taking place across the industry to explore the options for low carbon heating, across different fuels and technologies, including 'blends' of hydrogen and natural gas, and the potential for 100% hydrogen for domestic heating. Hydrogen and hydrogen ready boilers, which the CCC has recommended should be the only option from 2025, are already under development and could play a role alongside other low carbon options to reduce emissions from domestic heating.

Case Study: Project Cavendish – Hydrogen for London and the South East

Located on the Isle of Grain, just 30 miles from central London, Project Cavendish is seeking to develop an 'at scale' supply chain for the production, transport and use of low carbon hydrogen. Tying in with the significant amount of energy infrastructure in the area, hydrogen would initially be used by the neighbouring power stations to decarbonise their fuel supply whilst also being blended into the existing gas networks. As demand and the production facility increases in size and scale, this would be followed by wider hydrogen use cases – including industrial, heat and possibly transport – through a dedicated hydrogen pipeline between the Isle of Grain and London.

Other Opportunities

With a high level of government ambition, hydrogen has the potential to help the UK to become a world-leading net zero economy, exporting low-carbon energy solutions in a global market and creating UK employment and supply chain potential. The UK is already one of the leading countries with respect to the research and trial of hydrogen transportation through transmission and local distribution pipelines. There could be other economic opportunities to pursue in the UK from hydrogen developments such as:

- CCUS technology to facilitate bulk hydrogen production;
- dedicated renewables (such as offshore wind) producing hydrogen via electrolysis, with hydrogen piped to the beach at scale;
- hydrogen-compatible turbines for industrial processes (e.g. power generation, compressors); and
- use in different forms of transportation such as buses, HGVs, marine and light passenger aviation.

2. Demonstrating the feasibility of hydrogen in transmission networks

Hydrogen is a clean energy solution that has the potential to enable net zero, in place of the use of unabated natural gas, while helping to manage peak for decarbonised heating. Currently, gas networks transport three times the energy that electricity networks do[8]. Transporting hydrogen in pipelines could create similar flexible benefits that 'linepack' currently provides in the gas networks to respond to demand.

Against this backdrop, National Grid launched 'HyNTS', a programme of work to identify the opportunities and challenges of transporting hydrogen within the gas NTS. The 'Feasibility of Hydrogen in the NTS' study conducted by the Health and Safety Laboratory (our first hydrogen project in the 'HyNTS' programme) explored the repurposing of existing gas transmission assets to transport hydrogen and has had positive initial results. The project has shown that it is technically feasible to transport hydrogen in our pipelines. We continue to undertake several projects to demonstrate the safety and feasibility of hydrogen as a clean energy solution. For example, the 'Aberdeen Vision' project aims to

[8] BEIS Press Notice (2020), UK Energy Statistics, 2019 & Q4 2019

demonstrate the commercial viability of injecting 2% hydrogen into the NTS. The project also aims to provide a case for constructing a new 100% hydrogen pipeline between St Fergus and Aberdeen that would initially supply the Aberdeen network with a hydrogen blend of up to 20%, increasing to 100%, following a complete network conversion to hydrogen. Furthermore, we recently received funding from the regulator Ofgem for our HyNTS FutureGrid project.

Case Study - HyNTS FutureGrid

The 'HyNTS FutureGrid' project aims to test transmission network assets with flows of hydrogen blends between 20-100% at GB transmission pressures for the first time. The project intends to work in conjunction with Northern Gas Networks' ongoing H21 project at Spadeadam. NTS assets, which are due to be decommissioned early in the RIIO-2 regulatory period (2021 – 2026), will be reconstructed to create a test network that can be used to answer some of the fundamental questions on safety and operation of a converted network, and inform later research requirements, such as through the Government's Hydrogen Grid Research and Development Group. Connecting this system to the existing H21 distribution network facility will help prove that a complete beach-to-meter network can be decarbonised, thereby supporting the Hydrogen Grid R&D goal to develop a comprehensive programme for the hydrogen transition.

3. Enabling the commercialisation and scaling up of hydrogen

Hydrogen has an important role to play in supporting the UK's net zero goal. However, the CCC highlights it "will need to shift from being a theoretical option to a commercial reality" for it contribute to decarbonisation[9]. Government funding to date has been effective in stimulating options for hydrogen production and innovation downstream of the meter through projects such as Hy4Heat – projects which are unlikely to have been funded by private investment alone due to the investment risk and high initial costs. However, to accelerate the commercialisation and scale up of hydrogen further support is needed from Government. In particular, Government intervention to support technology and commercial development in the early adopter sectors and areas of the country will be crucial to stimulating the wider hydrogen economy and market, but this must be done with a clear exit strategy to prevent a reliance on Government subsidy. We would encourage Government to:

Develop a UK Hydrogen Strategy: As part of its Green Deal Recovery plan, the European Union (EU) has committed to a number of actions that will help kick-start the scale-up of clean hydrogen and published its Hydrogen Strategy with an aim to achieve 40GW of green hydrogen production by 2030. We have also seen a number of countries come forward with hydrogen strategies backed by hydrogen targets and significant funding, such as Germany releasing its national hydrogen strategy in June 2020, which is backed by €9bn in funding. The UK government has now committed to bring forward a UK Hydrogen Strategy in spring 2021 which will be a positive development. A clear and ambitious strategy would signal government commitment to hydrogen and provide a to boost investor confidence to support commercial solutions, thereby unlocking the private capital needed to drive a hydrogen transition for the UK.

Understand implications of international developments: Understanding how the hydrogen market, and supporting policy and regulatory frameworks, are being developed at an international (especially European) level will be important to understand best practice, but also on the basis that significant developments on hydrogen in the European Union will potentially have a direct impact on the UK's ability to trade gas with the EU. It will also be important to understand developments at Member State level. As the EU policy framework develops, the UK and National Grid will need to engage with EU actors to ensure that EU policies are as far as possible compatible with UK policies in this area.

Provide enabling policy and regulatory frameworks: Government policy and regulatory frameworks are crucial to enabling the commercialisation and scaling up of hydrogen. An example from which lessons can be learnt relates to the offshore wind cost reduction programme, which was implemented to exploit the economic opportunity from this renewable energy source. A similar approach could be taken to support hydrogen production from renewables (electrolysis) and other technologies. Hydrogen will be an important area for Government to provide clarity on as part of the Strategy and Policy Statement that it will consult on later this year. Government also has an opportunity to provide policy and regulatory support by mandating the use of hydrogen ready boilers by 2025, which the CCC has recommended. Some manufacturers are already progressing development in this area, such as Worcester Bosch and Baxi, who have recently revealed hydrogen ready boilers. We welcome the commitment from government in the Energy White Paper to consult on this in 2021[10].

[9] Committee on Climate Change (2020), Policies for the Sixth Carbon Budget and Net Zero

Support innovation through funding Front End Engineering Design (FEED) studies: To unlock the potential of hydrogen as a clean energy solution requires a focus on innovation and trials across the whole energy system, to inform policy decisions in the early 2020s which facilitate the commercialisation and deployment of low carbon infrastructure. Crucial to this will be the development of business models. Pending the development of these models, it is important that hydrogen projects continue at pace, including through funding being provided to support FEED studies.

Finalise CCUS business models before 2022. CCUS technology has an important role to play in delivering net zero and with realising the potential of hydrogen – the CCC described the technology as "a necessity, not an option"[11]. As mentioned elsewhere in this paper, CCUS decarbonises the hydrogen production process by removing and storing carbon emissions generated during the production process. In recognition of the importance of CCUS, the Government consulted on potential business models and set out its 'minded to' position in August 2020 and provided a further update at the end of the year. The Government has now also shown an increase in its ambition by increasing the CCUS Infrastructure Fund to £1bn and committing to four industrial CCS clusters, instead of two, which we support. If we are to see hydrogen production scaled up in a commercial way, it will be important for Government to finalise business models at the earliest opportunity, ahead of the 2022 date stated in the 10-Point Plan to provide the best possible chance of achieving its target of two clusters by the mid-2020s and four clusters by 2030.

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[10] BEIS (2020), Energy white paper: Powering our net zero future

[11] Committee on Climate Change (2019), Net Zero - The UK's contribution to stopping global warming