Written Evidence Submitted by Shell UK (HNZ0059)

1. Introduction

1.1. Shell UK Ltd (Shell)[1] welcomes the opportunity to respond to the Science and Technology Committee's call for evidence, given hydrogen's widely acknowledged crucial role in enabling the UK to reach Net Zero by 2050, and Shell's own involvement in the development of a hydrogen economy.

1.2. Shell has had a home in the UK since 1897, currently employing around 6,000 skilled staff in this country. Globally, Shell is organised into four separate businesses: Upstream, Downstream, Projects & Technology, and Integrated Gas & New Energies. All four businesses operate in the UK, making a vital contribution to its energy security and economy. In addition, Shell Energy Europe Ltd, based in London, is a leading trader of energy commodities, including gas, power, and environmental products.

1.3. Shell fully supports the goal of the Paris Climate Agreement and the UK's 2050 net-zero target, and, in April 2020, Shell announced that it aims to be a net-zero emissions energy business by 2050, or sooner if possible, in step with society and with our customers.[2]

1.4. We believe hydrogen could play a significant role in the transition to a clean and low-carbon energy system. Shell is part of several initiatives to encourage the adoption of hydrogen.

1.5. In Germany, Shell is part of a joint venture called H2 Mobility which aims to develop a nationwide network of hydrogen refuelling stations for fuel cell electric vehicles. Through this partnership, around 40 Shell stations offer hydrogen alongside other fuels. In the USA, Shell has eight hydrogen filling stations in California and is currently working in partnership with Toyota, with the support of the State of California, to further develop its hydrogen refuelling network beyond 50 stations. Here in the UK we also have an initial three hydrogen refuelling stations.

1.6. Shell is also actively evaluating options to produce clean hydrogen at scale. In Germany, we are constructing a world-leading 14MW electrolysis plant at our Rhineland refinery. In the Netherlands, Shell is part of the NorthH2 consortium seeking to develop the world's largest green hydrogen production facility, which could lead to gigawatts of Dutch offshore wind being built purely for the manufacture of green hydrogen. Here in the UK, we are partners in several

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[1] The companies in which Royal Dutch Shell plc directly and indirectly owns investments are separate legal entities. In this submission "Shell" and "Shell Group" are sometimes used for convenience where references are made to Royal Dutch Shell plc and its subsidiaries in general.

[2] More details on the announcement are available here. It is important to note that as of 8 January, Shell's operating plans and budgets do not reflect Shell's Net-Zero Emissions ambition. Shell's aim is that, in the future, its operating plans and budgets will change to reflect this movement towards its new Net-Zero Emissions ambition. However, these plans and budgets need to be in step with the movement towards a Net-Zero Emissions economy within society and among Shell's customers. Also, in this submission we may refer to Shell's "Net Carbon Footprint", which includes Shell's carbon emissions from the production of our energy products, our suppliers' carbon emissions in supplying energy for that production and our customers' carbon emissions associated with their use of the energy products we sell. Shell only controls its own emissions. The use of the term Shell's "Net Carbon Footprint" is for convenience only and not intended to suggest these emissions are those of Shell or its subsidiaries.

CCUS projects, one of which is the Acorn project, which aims to create a major hydrogen and CCUS hub at St Fergus in Scotland. Shell UK is also supporting the South Wales Industrial Cluster and Project Cavendish, which is exploring ways hydrogen could be produced, stored, or imported at the Isle of Grain in Kent.

1.7. We have chosen to answer questions and/or provide evidence only where we feel our experience is relevant or useful for the Committee. Many reports have been published into the possible routes to scale, impact on emissions, and cost trajectories of hydrogen which we do not intend to add to and with which we broadly agree.[3] The Climate Change Committee's (CCC's) Net Zero Report and recent 6th Carbon Budget Advice make clear that in all scenarios there is significant green and blue hydrogen (henceforth referred to as clean hydrogen) in the UK energy system, and that Carbon Capture, Utilisation, and Storage (CCUS) is 'a necessity not an option' in getting to that large scale, while electrolysis scales more slowly due to the initial cost differences and also the limited availability of spare clean electricity before the 2040s.[4]

2. The Role of Clean Hydrogen

2.1. The CCC show that low carbon gases (clean hydrogen and biomethane) will be needed, in conjunction with electrification where possible and energy efficiency, to decarbonize large parts of the energy system which are hard to electrify and thus hard to abate, namely heating, industry (in particular energy-intensive sectors like chemicals, refining, steel, and cement), and heavy-duty transport. It can also be used as a storage vector for renewable electricity, or as clean, dispatchable, peaking power for when renewables aren't producing. The use of hydrogen could, in the CCC's scenario, increase tenfold to 270TWh by 2050.[5] This requires a massive scale-up of clean hydrogen production, use, and infrastructure.

2.1.1. In industry, there is already significant demand for hydrogen in the UK, mainly in oil refining and chemicals and fertiliser manufacturing. This is predominantly "grey" and would be the simplest place to start growing the uptake of clean hydrogen, given the processes involved would remain the same, with only the source of the hydrogen changing. Other industrial sectors (e.g. steel and cement) have various energy- or heat-intensive processes and these will likely need an energy-dense gaseous fuel; electrification alone likely will not provide enough energy.

2.1.2. In transport, we expect electric vehicles to be the dominant powertrain for light-duty vehicles, but hydrogen is likely to play a significant role for heavy-duty vehicles (including buses), trains, aviation, and shipping given the energy density needed for these sectors and the difficulties with using heavy batteries and the need to refuel rapidly.[6]

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[3] See, for instance, Department for Business, Energy, and Industrial Strategy, *Energy Innovation Needs Assessment, Carbon capture, utilisation, and storage sub-theme* (2019), available here and BEIS, *Energy Innovation Needs Assessment: Hydrogen* (2019), available here; Navigant, *Pathways to Net Zero* (2019), available here; and Hydrogen Council, *Path to hydrogen competitiveness: A cost perspective* (2020) available here.
[4] Climate Change Committee, *Net Zero Technical Report* (2019), available here and *Sixth Carbon Budget* (2020), available here.
[5] Ibid
[6] For shipping, see, for instance Shell & Deloitte, *Decarbonising Shipping: All Hands On Deck* (2020), available here.

2.1.3. In heating, while new-build homes can be targeted relatively easily through regulation on developers (Shell supports the proposal that no new homes should be fuelled by fossil fuels from 2025), a range of solutions are likely to be required for existing homes, responding to local conditions and consumer preferences. There is a potential role for hydrogen boilers, but also for electric heat pumps (including hybrids, which could switch between gas or hydrogen and power) and for district heating. Hydrogen for heating has potential advantages in that it could be delivered through much of the existing local gas network; likely requires less behaviour change from consumers than pure heat pumps, as a hydrogen boiler and central heating system would more closely mirror those of today's natural gas systems; and (whether as the sole fuel source or in combination with electricity in a hybrid system) would help meet the UK's high winter heating demand (more than five times higher than electricity) without a significant expansion of renewables generation that might be underutilised in the summer.

2.2. Whilst several promising innovation projects are examining the potential for hydrogen's production and use in UK, in Shell's view greater policy and regulatory clarity is required to bring forward more significant and scalable prospects. A number of other countries and regions, such as Australia, Germany, the Netherlands and the EU, have published, or are planning soon to publish, hydrogen strategies to provide investors with a clear sense of how policymakers will unlock investment in all parts of the hydrogen value chain. In our view a UK hydrogen strategy is also required rapidly, given the UK will likely be competing against other jurisdictions for innovation and deployment capital. Shell UK therefore welcomes the Government's commitment to publishing a UK hydrogen strategy in 2021 and is working with BEIS on it as a member of the Hydrogen Advisory Council.

2.3. Such a strategy should encompass both "green" and "blue" hydrogen: in Shell's view, all forms of clean hydrogen will be needed to deliver the UK's 2050 Net Zero target, although likely with blue hydrogen initially providing the greater scale. In addition, such a twin-track approach would enable the UK to take advantage of its potential in both offshore wind and CCUS. Supporting both production methods could enable the UK to become, over time, a net exporter of hydrogen, including to EU markets, where there is likely to be a shortfall in indigenous production.[7]

2.4. The UK is already the largest offshore wind market in the world, giving it a potential competitive advantage in green hydrogen. However, in the medium term, i.e. to meet the UK's Net Zero target, the role of UK green hydrogen at scale will be challenging because of the existing offshore wind build rate already required: the CCC's modelling indicated that if all hydrogen were produced via electrolysis this would increase electricity generation by over 305 TWh (i.e. tripling demand).[8] Given electricity use is already estimated to double by 2050 to 610 TWh from around 300 TWh in 2019, and that this requires at least 95GW of offshore wind,[9] it is

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[7] EU Commission, *A hydrogen strategy for a climate-neutral Europe* (2020), available here.
[8] Climate Change Committee, *Hydrogen in a Low-Carbon Economy* (2018), available here.
[9] CCC, *The Sixth Carbon Budget*.

not expected that a significant amount of hydrogen will come from electrolysis until the electricity system is more decarbonised, although it shows great promise for the future.[10]

2.5. In the UK, blue hydrogen is more likely able to provide the scale and cost-effective approach needed to start decarbonizing hard-to-abate sectors. In addition, CCUS and blue hydrogen production will be important in securing a just transition for workers, communities, and regions of the UK where the offshore oil and gas industry or other energy intensive industries are major employers. Ensuring these sectors can thrive in a low carbon way must form part of both the 'levelling up' agenda and the transition to net zero emissions. What's more, existing expertise in the offshore and subsurface areas in the oil and gas sector could be redeployed to deliver new technologies such as CCUS and offshore wind.

2.5.1. According to BEIS' Energy Innovation Needs Assessment, CCUS investments could plausibly support around £4 billion in GVA and nearly 50,000 jobs by 2050. Bringing forward these investments would help create jobs and growth, particularly in industrial heartlands in Scotland, Teesside, Humberside, and Merseyside.[11]

2.5.2. According to Oil and Gas UK, up to 30,000 North Sea jobs could be lost due to the drop in oil prices seen by Covid-19 – around 20% of all North Sea workers.[12] Such job losses would have a significant impact not only on people and communities (especially in Scotland), but also on UK energy security, given the continued need for hydrocarbons as the UK transitions to net-zero. Consistent with the government's objective to maximise economic recovery while supporting the sector's transition to net zero, the government could seek to maintain domestic energy supply in the current low oil price environment while transitioning towards a clean energy future by planning now for the reuse of critical infrastructure and redeployment of key personnel into blue hydrogen production with CCUS.

2.6. We further note that not all countries will be able to deploy CO_2 storage and offshore wind production at the UK's potential scale, and few have as rich a CO_2 storage base as the UK in the North Sea and the East Irish Sea.[13] That richness of resource, when combined with existing academic and industry expertise, provides the UK with a competitive advantage in CCUS and blue hydrogen and an opportunity to deliver zero-carbon industrial clusters.

2.7. To conclude, we believe a twin-track approach is needed to produce hydrogen at scale in the near to medium term (via CCUS), and lay the foundations for the development of green hydrogen for the future, as offshore wind resource becomes available and as government and industry action reduces the costs of electrolysers. Any government strategy should set out a clear pathway to realise the potential of various production methods.

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[10] CCC, *Hydrogen in a low-carbon economy*.
[11] BEIS, *Energy Innovation Needs Assessment, Carbon capture, utilisation, and storage sub-theme*.
[12] Oil and Gas UK, *Business Outlook 2020: Activity and Supply Chain* (2020), available here.
[13] E.g. Professor Stuart Haszeldine OBE - Professor of Geology and Carbon Storage at The University of Edinburgh, has said "*In geological terms the Central North Sea is as near to perfect as you will find anywhere in the world when it comes to offshore sub-surface storage of CO2*": Building a Storage Hub in the Central North Sea, 2015, Link

3. The route to implementation

3.1. In our view, two substantial challenges for the implementation of clean hydrogen are affordability, requiring cost reduction to be achieved by scale in the supply chain, and a synchronized development of supply and demand, requiring coordination across the value chain. The ongoing work by BEIS on business models for CCUS and clean hydrogen provides an opportunity to overcome these challenges, and industry would endorse a swift conclusion to that work alongside the fully-fledged strategy cutting across government departments. Shell UK is looking forward with anticipation to responding to the BEIS consultation later this year on business models for hydrogen.

3.2. Any strategy should include long-term goals and milestones for both blue and green hydrogen. It should align the policy mechanisms needed to create the conditions for the synchronized scaling up of demand in key sectors, supply of it, and infrastructure enabling it. Alongside other policy mechanisms such as a strong carbon price, consideration could be given to demand-side measures and capital support to industries for the use of clean hydrogen in specific hard-to-abate sectors, particularly in the shorter term. Shell believes the specific policy support will vary by sector, but examples could include raising the blending limit up to 20% hydrogen by volume into the natural gas grid or, for transport, zero-emission mandates for fleets, manufacturers, etc., supplemented by grants or subsidies to manufacturers or purchasers of hydrogen-powered equipment.[14]

3.3. Investing in clean hydrogen at the speed and scale required by the transition to net zero in the UK requires a policy framework that differentiates between the potential for each sector of end use; stimulates large-scale production; creates and accelerates demand in key sectors; and helps overcome the cost gap between blue, green and grey hydrogen, and natural gas. Shell would like to contribute with the following recommendations:

3.3.1. **Time-limited, bespoke support** for both upfront investment and ongoing operational costs may be needed for the first few industrial scale production projects and associated infrastructure until production levels of clean hydrogen achieve critical levels.

3.3.2. **A time-limited, competitive support scheme for the production of clean hydrogen, for example a Contracts-for Difference (CfD) framework**, to provide long-term price certainty (c.10 years) for investors, underwriting risk and reducing the cost of capital, which will in turn bolster green investment at scale, drive innovation, and drive down prices. The sooner this is achieved, the sooner the benefits to decarbonisation can be realised. As such, it will be important that a potential support scheme is time limited, lowering consumer costs at the earliest possible stage and mitigating against the potential risk of market distortions.

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[14] For instance, an expansion of funding streams like the Industrial Energy Transformation Fund for industrial fuel switching, or subsidies for the purchase of hydrogen-powered transport vehicles.

3.3.2.1. In the case of offshore wind, the CfD framework has provided a robust and predictable signal to drive down prices (when combined with early innovation funding, sectoral deals, and time-limited fiscal support) and bolster innovation investment. The wind industry's target of reaching £100/MWh was achieved four years early, and the last auction in 2019 saw clearing prices well below expectations, with capacity secured at £40/MWh.[15] In addition, the structuring of the CfD process as a series of regular auctions has given manufacturers the confidence they need to invest in innovation, scaling up and improving wind turbine technology. These lessons could be readily applied to a CfD for clean hydrogen supply. Learning from the power market and the negative impact on liquidity from multiple support schemes which reduce incentives to go to the market, it will be important that the design of a scheme for clean hydrogen production does not undermine the formation of a robust carbon price in the market, and does not remove or reduce the incentive to engage in the commercial space.

3.3.3. Currently, the decarbonization potential of blue hydrogen is not recognized under the **Renewable Transport Fuels Obligation**, while there are also unnecessary limitations for green hydrogen producers. Eligibility criteria for the scheme mean that green hydrogen producers can only claim certificates if the electrolysis uses power being produced on site, rather than procured, e.g. through power purchase agreements (PPAs). The future revision of this policy should recognize and incentivise all forms of clean hydrogen as compliance options, either as intermediate in refining processes or as final fuel, provided they meet a minimum greenhouse gas emissions savings threshold.

3.3.4. A feasible early use case for clean hydrogen is in bus fleets, where government could partner with public bus operators, hydrogen bus manufacturers, and hydrogen suppliers to build a small number of hydrogen hubs for buses. This would decarbonise public transport, contribute to air quality improvements, and simultaneously stimulate demand for clean hydrogen and hydrogen vehicles (including those manufactured in the UK), and commencing large-scale supply.

3.3.5. The scaling up of a hydrogen economy could further benefit from a market for tradeable **Guarantees of Origin** (GOs) which includes all types of clean hydrogen and includes GHG reduction information to enable comparison of the environmental impact of different types of molecules. Implementing the EU Renewable Energy Directive (RED II), or the relevant sections of it, into UK legislation will ensure that UK GOs for hydrogen can be accepted in Europe, which will facilitate a wider market for UK hydrogen and drive further green investment.

3.3.6. Rigorous impact analysis and stakeholder consultation should be carried out to assess potential changed to **gas network infrastructure** regulations to support the injection of hydrogen into the existing gas grid, starting with an increasing blend up to 20% (seen by

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[15] Advisory Group on Costs and Benefits of Net Zero: *Report to the Committee on Climate Change* (2019), available here: https://www.theccc.org.uk/wp-content/uploads/2019/05/Advisory-Group-on-Costs-and-Benefits-of-Net-Zero.pdf

the gas distribution network operators as the maximum limit for hydrogen blending[16]), and testing the feasibility of a 100% hydrogen gas grid. Policy and regulation should also support the development of dedicated hydrogen infrastructure, including along core transport network corridors. It should also include support for common infrastructure for CO_2 and hydrogen networks, as well as support for all modes of transportation and storage of CO_2.

3.3.7. Market design: There is a need to align with the European Union on the key principles for establishing a market design framework for hydrogen which supports the development of an integrated and competitive EU/UK market for hydrogen. Key elements of a such a framework should be:

- The unbundling of network related activities from activities that can be open to competition, such as production and sales of hydrogen. This is an important step to create a level playing field between market participants engaging in commercial competition;
- Non-discriminatory third-party access (TPA) to network infrastructure to ensure competitors can play in the hydrogen market without the need to build their own network infrastructure; and
- Transparent and non-discriminatory tariffs for access to networks to ensure tariffs reflect efficient costs and do not create a barrier to trade.

3.4. Together, measures like these could a) bolster industry's confidence in the UK environment for hydrogen; thereby b) stimulating the synchronised supply of and demand for clean hydrogen; and c) accelerating the creation of a low-carbon industry for which the UK has competitive advantages, creating jobs and growth across large parts of the country.[17] In the context of the need to stimulate an economic recovery, to 'build back better', and to transition to net zero, hydrogen with its associated industries is, as the Prime Minister's 10 Point Plan argues, a crucial place to start.

(January 2021)

[16] Frontier Economics, *Hydrogen blending and the gas commercial framework* (2020), available here: https://www.energynetworks.org/newsroom/pump-prime-britains-hydrogen-revolution-with-new-grid-target-says-new-report.

[17] See, for example, Element Energy, *HyImpact Series. Hydrogen in the UK from technical to economic. A summary of four studies assessing the role of hydrogen in the UK net-zero transition* (2019). Available here.