Written evidence submitted by Cadent Gas (DHH0012)

Dear Sir/Madam

BEIS Select Committee – Decarbonising heat in the home inquiry

Please find below written evidence submitted by Cadent Gas Limited to the BEIS Select committee inquiry on Decarbonising heat in the home.

Cadent Gas Limited

Cadent is the largest UK gas distribution business and manages four of the eight networks.
Our combined network delivers gas to 11 million homes and businesses in the North West of England, the West Midlands, the East of England (including the East Midlands and East Anglia) and North London. In total, our pipes stretch over 80,000 miles.

Hydrogen and decarbonising home heating

Over 23.5m homes (83%) are connected to the gas network, the majority of which are heated via a fossil-gas boiler. As such, the gas network should be viewed as a strategic national asset that can be repurposed to decarbonise home heating with hydrogen and green gas.

While the UK currently lacks a clear hydrogen strategy, hydrogen is expected to play a key role in delivering Net Zero. All net zero modelled scenarios (e.g. Future Energy Scenarios[1] and Committee on Climate Change[2]) suggest a form of gas is needed to achieve net zero within the 2050 timeframe. Fossil fuel derived natural gas must therefore be replaced by a low/zero carbon gas. This means the production of 'Green Gases', such as hydrogen, biomethane and bio-SNG are needed at scale in order to provide decarbonised heat for homes in the future.

Over the past few years, we have been exploring if and how the network could be used to deliver green gases such as biomethane and hydrogen both safely and feasibly to enable the achievement of net zero. Cadent have committed to supporting the creation of the world's first zero-carbon gas grid in the UK, working closely with the Energy Networks Association (ENA) under the Gas Goes Green programme, by ensuring that the gas grid is ready to replace natural gas with hydrogen and biomethane, based on an independently authored and peer reviewed pathway.

Yours sincerely

Steve Fraser
Chief Executive Officer

http://fes.nationalgrid.com/media/1409/fes-2019.pdf

[2] https://www.theccc.org.uk/publication/net-zero-the-uks-contribution-to-stopping-global-warming/

1. What has been the impact of past and current policies for low carbon heat, and what lessons can be learnt, including examples from devolved administrations and international comparators?

1.1 Heating of buildings currently accounts for approximately one third of UK carbon emissions and previous attempts to improve the energy efficiency of homes in order to reduce emissions have fallen short. Programmes such as the ECO and Green Deal demonstrate the major challenges engaging homeowners with energy efficiency measures, most of whom will avoid disruption at all cost.

1.2 There are lessons to be learned from previous schemes. We know that homeowners place substantial emphasis on minimising disruption to their homes and up-front costs, therefore grant-type support could be effective (which has been acknowledged by the way the Renewable Heat Incentive is evolving) and also, a more targeted approach to roll-out could help take up. Working on a hyper-local level with Local Authorities and key stakeholders could ensure a wider take up of measures and ensure homeowners are properly educated and guided through the process.

2. What key policies, priorities and timelines should be included in the Government's forthcoming 'Buildings and Heat Strategy' to ensure that the UK is on track to deliver Net Zero? What are the most urgent decisions and actions that need to be taken over the course of this Parliament (by 2024)?

2.1 There is a high degree of overlap and inter-dependency between the Buildings and Heat strategy and the upcoming Hydrogen strategy. Whilst we envision that hydrogen technology and appliances will play a key part in the Buildings and Heat Strategy, with hydrogen-ready boilers, there are a number of policy enablers that will need to feature in the Hydrogen strategy in order to facilitate hydrogen technology to be deliverable as part of the Buildings and Heat strategy.

2.2 Building momentum for hydrogen now requires a step-up in policy and regulatory support along the whole hydrogen value chain, from upstream (to support hydrogen production and drive cost reduction) through the midstream (to create a hydrogen-ready distribution networks) to the downstream (to stimulate end-user demand for hydrogen).

2.3 At the highest level, and in line with other countries (e.g. Germany, Netherlands, Japan) where a balanced future energy scenario containing a mix of green gas and electrification for domestic heating are used, and where hydrogen development is further progressed, support for a hydrogen economy starts with the UK Government commitment to the need for significant levels of hydrogen in the energy system. This could take an initial form of a target for hydrogen production in the short to medium term, and does not necessarily need to be linked to specific end use. The policy levers could then follow.

2.4 The following table summarises the areas where policy and/or regulatory support is most needed. They should sit within a coherent hydrogen strategy, which should itself sit within the UK's overall Net Zero strategy.

Table 1. Summary of key policy and regulatory options to develop a hydrogen economy

Value chain element	Goal	Key policy/regulatory options

Upstream (production)	Incentivise investment in hydrogen production (and associated infrastructure) and accelerate cost reduction	• Develop regulated asset base (RAB) models for hydrogen infrastructure investments (including CCUS facilities, storage facilities and dedicated hydrogen and CO2 pipelines), with ownership competed through a 'direct procurement' model • Extend RAB model to hydrogen production facilities; or alternatively establish new contracts for difference (CfDs) for hydrogen production (with separate schemes for blue and green hydrogen, given current cost disparity and the desire to incentivise both blue and green hydrogen production) • Grant fund large-scale green hydrogen demonstration programme to accelerate cost reduction in electrolysis
Midstream (distribution)	Create hydrogen-ready distribution network	• Align RIIO-GD2 settlements to enable gas distribution networks (GDNs) to make 100% of the network hydrogen-ready, starting with regions close to planned hydrogen industrial clusters • Update Gas Grid Code and safety regulations to enable both the blending of hydrogen (and other low-carbon gases) and discrete 100% hydrogen networks
Downstream (use)	Stimulate and support end-user demand for hydrogen	• Establish region-specific, technology-agnostic Low Carbon Obligations defining heat decarbonisation goals and trajectories – placing the onus on Local/City Authorities to establish their preferred heat decarbonisation strategy • Mandate hydrogen-ready for boiler sales by 2025 (with the flexibility to run on 100% hydrogen, 100% natural gas or blends) • Add hydrogen to existing policy such as the Renewable Transport Fuel Obligation

2.5 Some of the options presented above are essentially ready to be implemented, such as updating the Gas Grid Code and safety regulations and mandating hydrogen-ready boilers. Other options are currently at an earlier stage of development and require considerable further work, such as assessing the relative merits of RAB and CfD models for incentivising hydrogen production; and establishing the exact design of a Low Carbon Obligation.

2.6 Based on the work underway to prepare the gas networks to transport hydrogen, we recommend a policy of allowing blending of 20% hydrogen into the gas grid by 2027, when projects such as Hynet come online, in order to immediately reduce the carbon intensity of gas and provide a valuable baseload demand to continue to stimulate large-scale hydrogen production.

3 Which technologies are the most viable to deliver the decarbonisation of heating, and what would be the most appropriate mix of technologies across the UK?

3.1 Heating for buildings can be decarbonised in several ways, including hydrogen, electrification/heat pumps and district heating networks. All three technologies will likely play a role, although there is currently no clear consensus on the optimum mix.

3.2 Multiple studies including ones recently published by Navigant and Imperial College have concluded that a balanced energy system incorporating hydrogen is likely to have the lowest whole system cost. This balanced energy approach mirrors the international approach which include green gases and electrification for domestic heating. Navigant concluded that whole system costs would be £13 billion cheaper per annum for a balanced scenario versus full electrification (see Figure 1). Imperial College concluded that a balanced scenario would be £4 billion per annum cheaper than a full electrification pathway and £36 billion cheaper than a full hydrogen pathway.

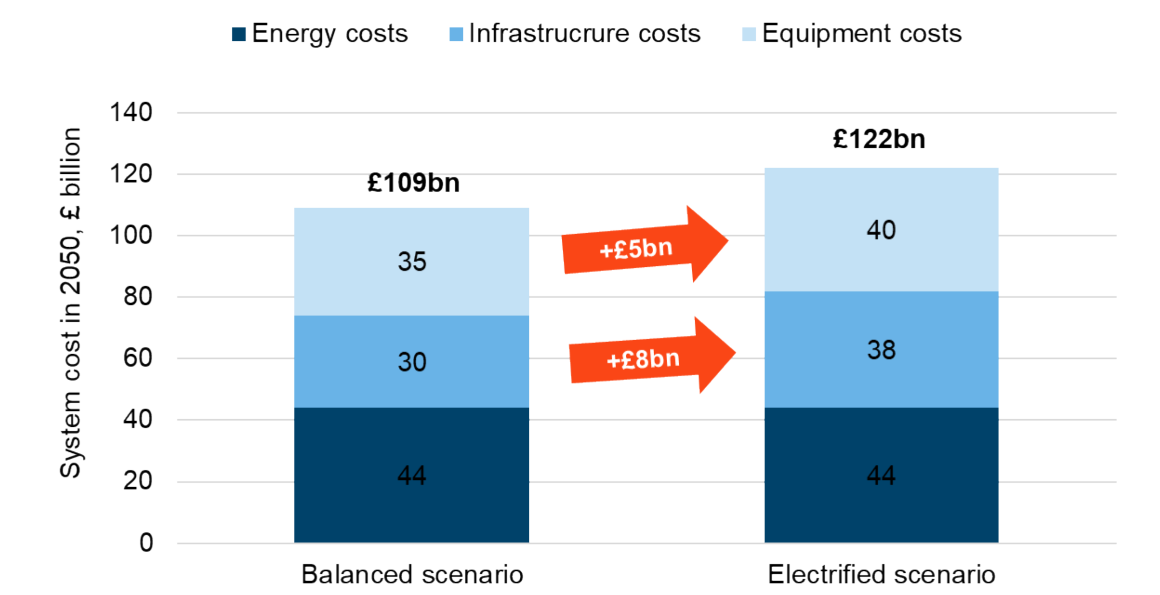
While the precise assumptions and conclusions differ by study, the underlying cost drivers are consistent. In particular, lower costs in balanced energy systems are primarily driven by the reduced need for reserve dispatchable power generation capacity, the reduced need to reinforce electricity distribution networks and the lower cost to convert some homes to hydrogen and hybrid heating solutions than standalone heat pumps.

The £13 billion delta between the balanced and electrification scenarios in the Navigant study breaks down as follows:

- £5 billion higher equipment costs, primarily due to increased cost of standalone heat pumps in the full electrification scenario. Interestingly, Navigant chose not to factor in additional costs for deep energy efficiency retrofits in the electrification scenario, which could have added a further £9 billion to system costs (which would have increased the delta between the balanced and electrification scenarios from £13 billion to £22 billion).

- £8 billion higher infrastructure costs, primarily due to increased electricity network reinforcements and the greater need for reserve dispatchable power generation capacity in the full electrification scenario.

Figure 1. Whole energy system cost for balanced and electrified scenarios



Source: Navigant

Broader system costs

3.2 The single biggest reason that a balanced energy system incorporating hydrogen has a lower system cost than a fully electrified system is the impact hydrogen has on the broader energy system's flexibility and, in particular, its ability to cope with demand spikes.

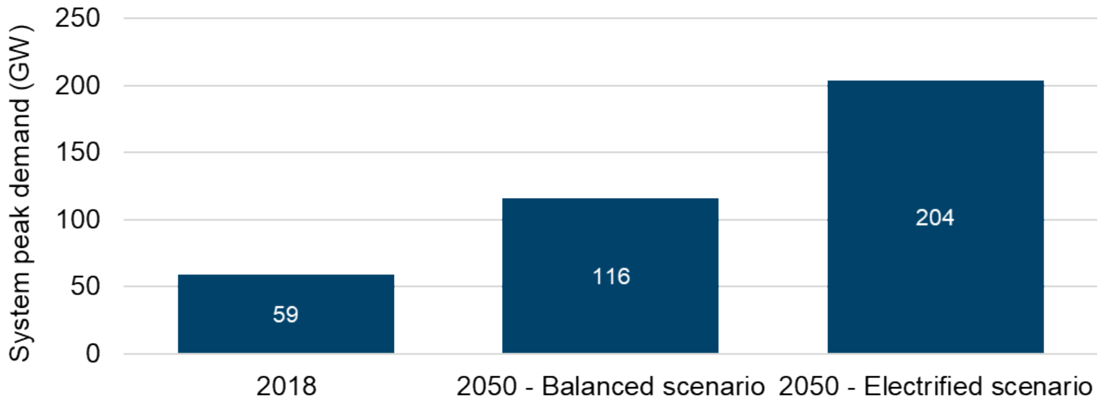
The UK energy system is notable for its large seasonal fluctuations in demand: at present, peak winter energy demand is around five times higher than annual average demand, largely driven by heating on the coldest days. While improvements in home insulation and demand side response will help reduce seasonal fluctuations in future, winter peaks will nevertheless remain.

The UK's increased reliance on electricity in any future energy system means electricity peak demand will inevitably increase, regardless of hydrogen's role in the system. However, the increase will be considerably less in a balanced scenario where hydrogen plays a role in buildings heating, because this reduces the reliance on electricity to meet peak heating demand:

- In a balanced energy system where hybrid heating solutions incorporating hydrogen boilers alongside electric heat pumps are the dominant solution, system peak demand could increase from 59 GW today to 116 GW in 2050.
- In a fully electrified system where the majority of buildings are heated using standalone heat pumps, system peak demand could increase from 59 GW today to 204 GW in 2050, around 75% more than in the balanced scenario.

As a result, annual energy system infrastructure costs in a fully electrified scenario are £8 billion higher than in a balanced scenario, driven by more dispatchable (reserve) power generation capacity needed to meet peak demand and greater need to reinforce the power distribution network needed to cope with peak demand.

Figure 2. Comparison of electricity peak demand in 2050 in different scenarios



Source: Navigant

3.3 Converting to electric heat pumps could be much costlier (an air source heat pump costs £9-11k to install, versus c.£2k for a new boiler) and is more disruptive. Electrifying heat would also require a massive and disruptive expansion of the electricity infrastructure as the gas network currently supplies four times more energy at peak in the coldest winters[1] than the electricity network. This issue of peak demand is then further compounded as the performance of air source heat pumps declines in cold, peak demand conditions, often requiring the use of further electric resistive heating. Hydrogen boilers can generate significantly higher temperatures than heat pumps, which makes them better suited to heating poorly insulated buildings (which are also often hard and costly to retrofit to higher energy efficiency standards). 70% of homes in the UK are still below EPC – C, equivalent to 19 million homes[2].

3.4 The **Hy4Heat** programme has made significant inroads into exploring compatibility of hydrogen in homes and businesses, both establishing the critical safety evidence for any transition and

1 https://d2e1qxpsswcpgz.cloudfront.net/uploads/2020/03/ukerc_bn_decarbonisation_heat_local_gas_demand_vs_electical_supply_web.pdf

2 https://www.green-alliance.org.uk/reinventing_retrofit.php

the development of both domestic, industrial and commercial hydrogen appliances. In comparison to other low carbon technology developments within the BEIS Energy Innovation Programme such as small modular nuclear reactors, for which there is £180m[3] allocated, the investment of £25m in Hy4Heat has been relatively small for a sector that represents a third of the UK's emissions. Whilst the programme has been effective the government has lacked the ambition to plan for large scale customer trials and the natural progression to roll-out as would be expected. The necessary technical and engineering understanding has now been delivered and the regulatory and public support which enable the findings to be exploited at scale needs to quickly catch up. Investment at a scale comparable with other low carbon technologies is now needed along with a much more closely integrated approach with Ofgem. Immediate clarity is required regarding which infrastructure, such as new pipelines should be funded by gas consumers and therefore regulated by Ofgem and which should be funded by other means.

4 What are the barriers to scaling up low carbon heating technologies? What is needed to overcome these barriers?

4.1 A major factor currently affecting scaling up of low carbon technologies is the lack of certainty from government and the absence of a holistic heat strategy and hydrogen strategy. These strategies will be crucial in order to ramp up roll out of these technologies.

4.2 As mentioned previously, there is a reluctance from homeowners to engage or invest in new technologies. Boiler replacement is a time- critical purchase, usually done when a current boiler ceases to function, leaving little time to research options available. There is also a disruption element to be considered when looking at heat pumps, which negatively impacts on consumer choice.

4.3 In order to overcome this challenge and properly educate consumers as to the choices available, a major, national awareness campaign is needed, discussing choices available and what decisions can be made now to assist in the transition. This should incorporate lessons learned from previous campaigns, such as smart meter roll-out and the digital switchover.

Blending hydrogen as a first step

4.4 Blending hydrogen into the gas network provides an immediate means to reduce the carbon intensity of gas without requiring the users to make changes. The HyDeploy[4] project is demonstrating that levels of 20% by volume (7% by energy) can be achieved in the gas distribution network without requiring changes to appliances. If expanded across the UK, this equates to 29TWh of hydrogen. The National Grid Transmission is also commencing work on assessing the feasibility of blending into the transmission network[5].

4.5 The HyNet industrial cluster plans to deliver blends of hydrogen and natural gas to around 2 million households as well as commercial and industrial users from the early phases of the project with potential for further expansion to other nodes on the gas distribution network.

4.6 Blending will only be a temporary-step towards decarbonisation because the end-point is a shift to 100% hydrogen. However, enabling blending would give confidence to producers that there was demand and enable early bulk hydrogen production, developing hydrogen infrastructure, and building associated supply chains. To support blending, a regulatory regime would need to be established that supports blending also allows retailers to sell this additional 'green gas'.

Conversion to 100% hydrogen

4.7 Due to the merits of using a gas-based vector for consumer heating, including the opportunity provided by its mature gas network, consideration is being given to the conversion of the gas

[3] https://www.gov.uk/guidance/energy-innovation#beis-energy-innovation-programme
[4] https://hydeploy.co.uk/
[5] https://www.hsl.gov.uk/media/1298380/09.%20antony%20green.pdf

network to full hydrogen. This was initiated by the original H21 programme, the H21 North England project and is developing further through the H21 NIC programme and BEIS's HyHeat project. This programme is establishing the developments required for gas users to use 100% hydrogen. Boiler manufacturers such as Baxi and Worcester Bosch are actively developing 'hydrogen-ready' appliances. The H21 North of England programme predicts an increase of hydrogen demand through 100% conversion to 194TWh by 2050[6].

5 How can the costs of decarbonising heat be distributed fairly across consumers, taxpayers, business and government, taking account of the fuel poor and communities affected by the transition? What is the impact of the existing distribution of environmental levies across electricity, gas and fuel bills on drivers for switching to low carbon heating, and should this distribution be reviewed?

5.1 This will be challenging but it is vitally important that customers, especially vulnerable customers, are protected.

5.2 Progressive taxation could be an option, especially because low carbon heating solutions will vary by postcode and some homeowners will end up with solutions that help to reduce the overall energy system costs for UK Plc, but which might nevertheless incur higher up front installation costs and ongoing running costs for the homeowner.

5.3 It should be noted also that even in high electrification scenarios, there remains a high demand for gas for flexible, reliable, dispatchable power generation to secure the increasingly intermittent power grid.

6 What incentives and regulatory measures should be employed to encourage and ensure households take up low carbon heat, and how will these need to vary for different household types?

6.1. The immediate mandating of installation of hydrogen-ready boilers by 2025 would give confidence to the industry and help to prepare households for a hydrogen-switchover which could take place in 2030. Current estimates suggest 1.3m boiler replacements per year so the sooner hydrogen-ready solutions are fitted, the sooner households will be ready for hydrogen supply.

6.2 Similarly, straightforward grant funding for switching over. Complicated incentives, similar to the Green Deal incentives, simply won't work. Educating consumers as early as possible regarding the options available, and simplifying the incentive mechanism should help take-up.

7 What action is required to ensure that households are engaged, informed, supported and protected during the transition to low carbon heat, including measures to minimise disruption in homes and to maintain consumer choice?

7.1 There is overall a low awareness for hydrogen and low-carbon heating technologies and their role in a net zero economy, and the Government have largely been engaging via industry groups and specialists on the topics. However, it is positive to see that there are several progressive local councils who are setting their own net zero agenda and exploring how hydrogen specifically can meet their goals. In establishing the safety aspects of hydrogen, more collective communication is needed to drive demand for hydrogen with a substantial national campaign informing customers of the need to move away from natural gas and the role hydrogen can play, ensuring both the economic and safety messages are promoted throughout. Cadent have recently written to Government to call for a language

[6] H21 North of England, November 2018 pp23

change, referring to a ‘phase out of fossil-gas boilers and phasing in of hydrogen-ready boilers’ in order to pre-empt some of this required communications work.

8 Where should responsibility lie for the governance, coordination and delivery of low carbon heating? What will these organisations need in order to deliver such responsibilities?

8.1 In order to ensure a comprehensive roll out, whilst maximising consumer engagement, it’s possible a new delivery body will need to be established, given the scale and complexity of the transition. Current estimates suggest 20k homes per week will need to be transitioned over the next 20years in order to hit the Net Zero target.

8.2 Local Authorities also have a key role to play. They need to be properly resourced and supported to develop high quality Local Area Energy Plans which both reflect the local context but also contribute to the overall target for the UK as a whole.

November 2020