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by email

Cadent
Your Gas Network

Dear Sir / Madam

The Second National Infrastructure Assessment: Baseline Report

Thank you for the opportunity to respond to your call for evidence regarding the proposed market-based mechanism for low carbon heat.

Cadent owns and operates four of the eight gas distribution networks in the UK. Our pipes carry gas to 11 million homes, schools, hospitals and businesses in the North West of England, the West Midlands, the East of England and North London. As an organisation at the centre of the UK's energy transition, we stand firmly behind the UK's commitment to deliver net zero by 2050.

We are therefore pleased to see the Commission's proposed Assessment emphasises the importance of tackling climate change through infrastructure investment. It may feel as though 2050 is a long way off however the reality is that unless we invest today, we will not get there.

One of the technologies we will need as part of our future low carbon mix is hydrogen. Without it we will not decarbonise industry or heavy transport; significant parts of residential and business heat and hot water demand risk remain continuing to be supplied by fossil fuels; and our power system will lack the flexibility necessary to remain in balance at least cost. In short, without hydrogen will be no net zero.

Investors stand ready to build the infrastructure necessary to deliver the hydrogen we will need, yet barriers to unlocking this investment remain, putting at risk not just our delivery of net zero but also the potential jobs and economic growth it would bring. Specifically, there is:

- An opportunity to be more ambitious;
- A lack of a robust commercial model;
- Insufficient support for blue hydrogen projects;
- An opportunity to use blending to accelerate hydrogen deployment; and
- A need for an early hydrogen ready appliance mandate.

These issues are explored in more detail below. Detailed answers to the consultation questions asked are also set out in Appendix One of this letter.

An opportunity to be more ambitious

Investors stand ready to invest in the hydrogen infrastructure the UK needs. This would not only support our efforts to get to net zero but also secure highly skilled and highly paid jobs for people across the UK, particularly in our industrial heartlands. Whilst we welcome the Government's Hydrogen Strategy it is notably less ambitious than comparative strategies in places such as France, Germany, the US and China[1].

We face a choice as a nation about where the hydrogen we will use is produced and where the assets that make it are manufactured. The UK has failed to fully capitalise on the growth of solar, wind and battery technology; this should not be allowed to happen with the emerging hydrogen economy. There is however a risk that without further ambition investment will flow to other markets in the EU and around the world.

Government could secure this jobs and growth opportunity through increasing the ambition in the Hydrogen Strategy, for example by doubling the current 2030 target to 10GW.

A lack of a robust commercial model

Key to unlocking investment in hydrogen infrastructure is the establishment of the commercial models and frameworks necessary to support hydrogen production assets. Private investors are standing ready to invest today here, and whilst the Government's proposals for hydrogen commercial models are welcome, we are concerned at the pace of delivery. It is essential Government move quickly to ensure these investments do not go to other countries who are moving faster than the UK to implement commercial models.

Insufficient support for blue hydrogen projects

Given the relative cost profiles, and the need to make progress on decarbonisation during the fifth and sixth carbon budget periods, hydrogen infrastructure will need to include both blue and green assets. Whilst the Industrial Decarbonisation Hydrogen Revenue Support scheme announced last year was a welcome boost to the development of green hydrogen, the lack of similar support for blue hydrogen schemes is a concern which must be addressed. Doing so would be a big step forward in tackling emissions, would spur on the UK supply chain and - following COP26 - would highlight the UK as a world-leading example in industrial decarbonisation.

An opportunity to use blending to accelerate hydrogen deployment

Blending hydrogen with methane in the existing gas grid to 20% volume would create an 'anchor load' for hydrogen producers, giving them the demand certainty they need to invest now in hydrogen infrastructure. It would also cut emissions equivalent to removing 2.5m cars from our roads without consumers having to make any changes to how they use either heat or hot water. Government should accelerate the policy decisions necessary to support blending.

A need for an early hydrogen ready appliance mandate

1.7m fossil gas boilers are installed each year. Even if the Government hit their target of 600k heat pump installations a year by 2028 we will still be installing nearly twice as many boilers in customers' homes than heat pumps. These boilers can either continue to be fossil gas boilers at risk of stranding, or they can be hydrogen-ready and capable of being easily converted to run on a pure hydrogen supply at some future point. To do this would not lock the consumer in to a particular decarbonisation pathway, however it would maintain optionality and the prospect of earlier decarbonisation and less disruption in areas which will eventually see hydrogen replace methane. An early, world-first decision to mandate hydrogen ready over fossil boilers would

[1] The UK is targeting 5GW of hydrogen production by 2030. By contrast, France has a 6.5GW target and Germany has a 10GW target. The investment pipeline for hydrogen production projects to 2030 in the UK is already at a potential 11GW.

ensure manufacturers commit their investment into UK factories, protecting jobs and creating global export opportunities.

These points are expanded on below. Answers to the specific questions asked within the consultation are then provided within Appendix One of this letter. If you would like to discuss any of the points raised in this submission, or have any questions, please do not hesitate to contact me.

Yours faithfully

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Head of Energy Transition

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Appendix One – Detailed answers to consultation questions

1. Do the nine challenges identified by the Commission cover the most pressing issues that economic infrastructure will face over the next 30 years? If not, what other challenges should the Commission consider?

Reaching net zero is the single largest challenge facing humanity today. Achieving it in the UK will require significant amounts of investment in the coming years. It is therefore right that the Commission's proposals for the second Assessment give this such prominence.

The Government has set a target of decarbonising the power sector by 2035. This will require an estimated 118GW of renewable generation capacity to be built, up from 38GW today[2]. Deploying and connected this generation will also require large investments in our power networks, and the inherent intermittency of wind and solar generation assets creates a further need for signification volumes of flexibility – both demand and supply side – to balance the system. Whilst a proportion of this flexibility will not require new infrastructure much of it will, in the form of energy storage (for example batteries and hydrogen), clean back up power plant (for example hydrogen and gas with carbon capture) and new interconnectors.

The decarbonisation of heat will require a range of technologies to be deployed at scale. Most analyses to date agree with the argument that future home heating will be provided through a mixture of heat pumps, hybrid systems, hydrogen and heat networks. The question is therefore over the eventual mix of these technologies in the future system. Whilst it is not possible to answer this question with confidence in 2021, we support the current focus on electrifying homes and businesses today where that makes sense whilst simultaneously investing in the hydrogen infrastructure we will need for those homes and businesses where the cost, disruption or consumer preference make hydrogen a more viable solution.

As well as playing an important role in the decarbonisation of power and heat, hydrogen will also have a crucial role in decarbonising industry, particularly for those sectors that rely on high-temperature production processes such as chemicals, glass, cement, food, drink and steel. Progress is being made here, for example through the industrial cluster infrastructure deployment seen in projects such as HyNet and East Coast Hydrogen. But more is needed if we are to decarbonise all industrial clusters. Whilst we welcome the recent Government announcements of funding for the two projects above, support for *all* schemes capable of delivery should be provided.

The diversity in the low carbon technologies we will deploy in the coming years also creates a specific problem around planning. New low carbon infrastructure investment will be needed in both the gas and power networks. Without a clear view on the future demand mix however, it is difficult to know precisely how much is needed where, and when – and still invest ahead of demand. There is therefore an urgent need to move beyond today's approach of planning in silos and adopt whole systems planning processes that jointly consider the needs of power and gas networks alongside local and regional decarbonisation plans.

Finally, we agree with the focus on improving the energy efficiency of buildings. Approximately 80% of all homes that will exist in 2050 have already been built. Although we recognise there has been growing focus on improving energy efficiency levels in recent years, the energy performance of buildings remains relatively poor with 61% of the housing stock rated as EPC Band D or below. For households in fuel poverty, this figure is as high as 90%[3]. This is not simply a barrier to deploying the low carbon technologies we need, but also a factor in wider societal issues such as poverty and well-being.

Improving the energy efficiency of our buildings should therefore be a national infrastructure priority. We support an approach that ensures the fabric of buildings is made as energy efficient as economically possible. In the belief that the investment needed to bring this about will happen,

[2] Cornwall Insight
[3] English Housing Survey

we expect a significant reduction in the volumes of either electricity or low carbon gases that will be needed to heat homes in the future.

This will require significant effort, equivalent to retrofitting 1.30 million homes each year. By way of comparison, the current Energy Company Obligation (ECO) scheme is currently focused on Fuel Poor households and targets approximately 0.75m homes in the three plus years from December 2018 and March 2022. Government has already recognised the need to scale up the level of ambition and has proposed increasing the annual ECO budget from £640m to £1000m. This is insufficient on its own however, and much more will be required if we are to rise to this challenge.

2. What changes to funding policy help address the Commission's nine challenges and what evidence is there to support this? Your response can cover any number of the Commission's challenges.

We recognise and welcome the funding Government have announced in support building hydrogen infrastructure. These announcements lack ambition however and both place the UK behind key international competitors and limit our ability to meet the Commission's challenges.

Key to this is establishing the commercial models and frameworks needed to unlock investment in hydrogen production and distribution infrastructure. Private investors are standing ready to invest today in the hydrogen infrastructure we will need. The Government's proposals for hydrogen commercial models are welcome, however we are concerned at the pace of delivery. It is essential Government move quickly to ensure these investments do not go to other countries who are moving faster than the UK to implement commercial models.

Given the relative cost profiles, and the need to make progress on decarbonisation during the fifth and sixth carbon budget periods, hydrogen infrastructure will need to include both blue and green assets. Whilst the Industrial Decarbonisation Hydrogen Revenue Support scheme announced last year was a welcome boost to the development of green hydrogen, the lack of similar support for blue hydrogen schemes is a concern which must be addressed. Doing so would be a big step forward in tackling emissions, would spur on the UK supply chain and - following COP26 - would highlight the UK as a world-leading example in industrial decarbonisation.

Similarly, whilst we welcome the Government's decision to fund the industrial decarbonisation projects in the North West and the Humber, funding is necessary to support *all* credible projects in Cluster Sequencing Process. This means central Government funding for the Acorn project in North East Scotland, and support in developing the schemes for other industrial clusters across the country.

5. What are the main opportunities in terms of governance, policy, regulation and market mechanisms that may help solve any of the Commission's nine challenges for the Next Assessment? What are the main barriers? Your response can cover any number of the Commission's challenges.

Without hydrogen there will be no net zero. We therefore need to simultaneously enable investment in hydrogen production and demand. There are several opportunities to do this.

Enabling investment in hydrogen production

- We know we will need significant amounts of investment in new production and large-scale storage infrastructure if we are to supply the volumes of hydrogen required. The Hydrogen Strategy sets out the Government's ambition and a high-level plan for how we will get there. What is now urgently needed is more detail around these plans and business models required to unlock investment in large scale storage facilities and related infrastructure. Doing this will provide a signal to those private investors already standing ready to invest as well as encouraging industrial consumers to switch fuels.

- Governments around the world are already supporting their own domestic producers in efforts to drive down the cost of green hydrogen. The US' Energy Earthshot Initiative

has a target of reducing green hydrogen production prices to $1/kg by 2030[4] for example, with the aim of making the US a leader in the provision of low carbon hydrogen production equipment. The UK has the skills and capabilities to capture this globally significant market instead, with a prize of tens of thousands of jobs and economic growth[5] should we do it. This opportunity can be realised by tailoring green hydrogen funding within the Net Zero Hydrogen Fund to accelerate delivery of green hydrogen schemes and support UK-based electrolyser manufacturers. This will encourage competition, reduce costs, increase efficiencies and ensure sufficient UK-made electrolyser manufacturing capacity is available.

- Given the need for both blue and green hydrogen, we support the Government's intention to set a rigorous Low Carbon Hydrogen Standard to ensure consumers can have faith that any hydrogen produced is genuinely low carbon. The design of this standard needs to be finalised as soon as possible and be complemented with the introduction of tradeable certificates of origin for both blue and green hydrogen production.

- The Renewable Transport Fuel Obligation (RTFO) is one the biggest barriers to, and therefore opportunity for the stimulation of, private investment in hydrogen today. Many of the early adopters for hydrogen are likely to be operators of buses, heavy goods vehicles and other fleet solutions. As designed however, the RTFO doesn't allow for zero carbon hydrogen produced by either nuclear power or the annual reconciliation of green hydrogen using Renewable Energy Guarantees of Origin. This should be addressed.

- Biodegradable waste is a potential feedstock for hydrogen yet remains under-utilised today. 6.6m tons of biodegradable waste was sent to landfill across the UK in 2019[6], enough material to produce nearly 11TWh of hydrogen, equivalent to approximately 40% of today's total production. Investors stand ready to invest in waste to hydrogen infrastructure projects however cannot easily access this feedstock. The issue could be addressed by raising or fixing the value of waste feedstock provided for hydrogen production, thus supporting decarbonisation of hard-to-abate sectors.

- Finally, there is a need for an over-arching body overseeing the implementation of net zero policy, ideally reporting directly to Number 10, at arms' length from other areas of Government, and with a cross-department remit. This would co-ordinate policy efforts across Government, mitigating the political risk faced by investors.

Enabling investment in hydrogen demand

- Blending hydrogen with methane in the existing gas grid to 20% volume would create an 'anchor load' for hydrogen producers, giving them the demand certainty they need to invest now in hydrogen infrastructure. It would also cut emissions equivalent to removing 2.5m cars from our roads without consumers having to make any changes to how they use either heat or hot water. Government should accelerate the policy decisions necessary to support blending.

- 1.7m fossil gas boilers are installed each year. Even if the Government hit their target of 600k heat pump installations a year by 2028 we will still be installing nearly twice as many boilers in customers' homes than heat pumps. These boilers can either continue to be fossil gas boilers at risk of stranding, or they can be hydrogen-ready and capable of being easily converted to run on a pure hydrogen supply at some future point. To do this would not lock the consumer in to a particular decarbonisation pathway, however it would maintain optionality and the prospect of earlier decarbonisation and less disruption in areas which will eventually see hydrogen replace methane. An early, world-first

[4] A US Department of Energy initiative.
[5] BEIS analysis of the Energy Innovation Needs Assessment (EINA) already suggests potential to support over 9,000 jobs by 2030, and up to 100,000 jobs by 2050
[6] Defra

decision to mandate hydrogen ready over fossil boilers would ensure manufacturers commit their investment into UK factories, protecting jobs and creating global export opportunities.

- All gas networks, including Cadent, have recently submitted proposals to run the Government backed trial to convert an entire village to hydrogen. However, instead of picking a winner Government should enable *all* applications to progress, building a large evidence base from which to base future heat policy decisions on.

- Government has announced £355m of funding for 4000 UK-manufactured zero-emission buses. At least 50% of these should be hydrogen, supporting investment from UK based bus manufacturers in the supply chain, each of which already makes hydrogen buses. In parallel, Government could introduce short-term subsidies to bring forward other likely use cases for hydrogen in transport, including trucks, trains, planes, refuse vehicles, non-road mobile machinery (NRMM) including construction and port equipment. The combined fuel demand from these vehicles will stimulate major, additional, investment in hydrogen production.

8. What are the greatest risks to security of supply in a decarbonised power system that meets government ambition for 2035 and what solutions exist to mitigate these risks?

A power system that is mostly supplied by renewable power in 2035 is a necessary and important step towards the delivery of net zero. The intermittency of wind and solar power generation however means there are limits to how much demand can be electrified. It also creates an important role for flexibility on both the supply and demand side. This is particularly true when you consider that sunless and windless periods of time occur in the UK reasonably frequently and can last for days at a time.

It will therefore be vital that we design the future system for peak demand and not average demand. This means ensuring energy systems can meet heat and power demand in even the peak periods that occur in a 'one in twenty year' type event. A good example of these extreme events was seen in March 2018, known as the 'Beast from the East' event, when temperatures remained very low for a sustained period. Consumers consequently demanded more heat and gas demand peaked at 214 GW. For context this is more than four times the peak electricity demand at the same time. It is also eight times more than average summer gas demand and one and a half times more than average winter gas demand.

Our own experience backs this up. Gas demand on our network can be as much as nine times that needed on a cold winter day as that on warm summer's day. If the comparison is made using hourly gas demand extremes, the multiple rises to 18. While deploying energy efficiency and demand response measures in the future will reduce the overall amount of heat consumers need during these extreme events, mitigating some of this effect, the future energy system will still need to accommodate significant peaks.

This is complicated by the fact that periods of high heat demand in winter are more likely to correlate with periods of low solar and wind electricity output. In short, the middle of winter is when we are more likely to see periods of low sunlight and low wind. In a future electricity system with high levels of renewable generation, supply may therefore already be tight – even accounting for material growth in flexible power and heat assets such as batteries and demand side response.

This issue will be addressed by investing in a system where hydrogen meets a proportion of heat demand, given the gas network's ability to act as an effective store of energy. Indeed, the gas network today provides approximately 100TWh of flexibility each year[7], something that would cost hundreds of millions of pounds to replicate in the power system alone. For these reasons, it is clear the UK will need to invest in sufficient infrastructure to meet a proportion of heat demand with hydrogen.

[7] University of Birmingham: https://zenodo.org/record/5846323#.YfgLTBrP1jE

This is not to say we will not also need power system flexibility. We will. On the supply side we will need significant new volumes of clean peaking plan, fuelled with either hydrogen or natural gas and fitted with carbon capture and storage technology. On the demand side we will also need large scale investment in smart products, home energy storage solutions and time of use or dynamic retail pricing. Key to unlocking this will be creating simple, liquid and open markets for all sources of flexibility, replacing today's fragmented and illiquid markets.

9. What evidence do you have on the barriers to converting the existing gas grid to hydrogen, installing heat pumps in different types of properties, or rolling out low carbon heat networks? What are the potential solutions to these barriers?

One of the merits of hydrogen in a future energy system is that we can re-use a significant amount of the gas network – a gas network which is already there and that customers have already paid for. Like other gas networks operators, we have been replacing old iron mains with polyethylene pipe for the last 40 years. Although the project was originally established to replace ageing cast iron pipework, this work is effectively now making the extensive lower pressure gas network better for carrying hydrogen.

Today approximately 72% of our network has been replaced with plastic. By 2032 this number will be 92%. This is not to say that the gas network needs to be entirely plastic in order to carry hydrogen safely and effectively. Indeed, we are working with the HSE to establish just what mix of materials are compatible with 100% hydrogen across a range of situations.

Projects such as HyDeploy[8] are central to demonstrating how we can safely convert the existing gas network to hydrogen. This work is detailed, rigorous and in-depth, testing every possible aspect. Whilst much of the work to overcoming barriers lies in completing these projects and trials, there are also barriers where intervention is needed to overcome them.

Central to this will be ensuring the regulatory and market frameworks take account of the work required today to ensure hydrogen is going to be available when we need it tomorrow. Today, the regulatory system is characterised by planning gas and electricity systems in silos. It is vital that we move beyond this and start considering energy investments from a whole systems point of view so that it is clear which parts of the gas and power networks need what investment.

There is also a need for the co-ordination of local area plans for decarbonisation, led by a body that can ensure that we do not deliver a patchwork of easy solutions without considering the impact on the whole system or of harder to decarbonise buildings. This will underpin choice as well as support future town by town conversion strategies that work for local areas.

Heat pumps will play an important role in the decarbonisation of heat, and Cadent welcomes recent Government efforts to address the barriers to their deployment. They are expensive, with installed prices of at least £7,250 today[9], excluding any consequential upgrades to either building fabric or heat distribution systems necessary for them to operate at the required comfort levels and cost. When these factors are considered, installed heat pumps can cost several times this amount. This is money most customers simply do not have available. It is therefore right for Government to seek to address this issue through capital grants under the Boiler Upgrade Scheme.

As above, we will need a range of technologies to get to net zero. It will therefore be important to ensure that these capital grants are targeted at homes where heat pumps make the most sense and not at those homes where hydrogen will be a cheaper future option.

A further barrier to heat pump deployment is the disruption of the install process. Fossil boilers are typically replaced when they break down, meaning the replacement heating system is often a distress purchase. Heat pump systems need to be properly designed and sized to ensure good operation. They may require the installation of a new hot water tank which may or may not easily fit in the existing home. They may require new energy efficiency measures to be simultaneously

[8] https://hydeploy.co.uk/
[9] CCC assumption. Real-world installations may cost more.

installed and may require changes to pipework and / or the heat distribution system. A typical heat pump installation may therefore take between 3 and 5 days to complete, during which time the customer could be left without adequate heating or hot water. It will be important that ways to mitigate this disruption can be identified if heat pump demand is to be increased.

We are also aware there is a lack of skilled heat pump installers in the UK today. There are approximately 1,000 heat pump installers in the UK today installing around 40,000 heat pumps each year today. To achieve the Government's target of 600,000 heat pump installations per year by 2028 we will need to increase the number of trained installers by around thirty times[10]. There is no clarity yet however on how or whether this can be achieved.

Finally, both hydrogen and heat pumps have a fundamental barrier to overcome in that they are both likely to cost consumers more over the lifetime of the system than a fossil gas boiler does today. The capital costs of heat pumps are currently high in comparison to gas boilers, and there is a fear due to the unfamiliarity with the system that it won't perform as planned and result in higher electricity bills as a result. Similarly, while hydrogen boilers are expected to have low upfront costs, the running costs could be high if the hydrogen fuel isn't subsidised until production scales and enable hydrogen price reduction.

In the absence of long-term financial benefits to the individual consumer, we will need to identify other ways to encourage people to take the decision to replace their fossil gas boilers. This must start with a conversation on why a change is needed, the options available, the practical implications of those options and what financial support will be made available to them over what period.

10. What evidence do you have of the barriers and potential solutions to deploying energy efficiency in the English building stock?

Energy efficiency is one of the most cost-efficient ways to reduce carbon emissions, often with very short payback periods. The capital costs of energy efficiency measures remain a barrier today however, with many customers unable to afford even basic insulation upgrades. We were disappointed to note the recent Heat & Buildings Strategy failed to address this issue.

There are also many consumers who could afford energy efficiency upgrades, but who are not sufficiently engaged to do so. We therefore agree with those who argue for a range of incentives and penalties designed to stimulate demand from this 'able to pay' sector. These could include tighter requirements on landlords to ensure their properties reach a certain EPC level, or requirements on mortgage providers to incentivise investment in their building stock through differentiated mortgage rates.

11. What barriers exist to the long term growth of the hydrogen sector beyond 2030 and how can they be overcome? Are any parts of the value chain (production, storage, transportation) more challenging than others and if so why?

We are committed to ensuring the gas network will be ready to transport hydrogen from sources of production to places of demand. As above, the focus therefore should be on bringing forward the investment necessary in the infrastructure around the network, for example in production and storage assets, and creating 'anchor demand' for example through industrial fuel switching incentives and blending mandates.

[10] As per evidence to the BEIS Select Committee from Ian Rippin, MCS, 9th February 2021