Written Evidence Submitted by Wales & West Utilities (HNZ0028)

Introduction

1) We are Wales & West Utilities – the gas distribution network and system operator keeping the gas flowing to heat homes, power businesses and keep the lights on for 7.5 million customers across Wales and south west England. We respond to gas emergencies, connect new homes and upgrade the gas network, making sure it's ready to deliver reliable, affordable and sustainable energy long into the future.

2) Our network acts as a large battery that stores and releases 58GWh of energy each day, equivalent to six million Tesla Powerwalls. The inherent UK gas system provides a seasonal storage capacity of 210TWh. The daily demand for energy from our own gas network ranges from 77GWh in the summer to 517GWh on a peak winter day. On cold days, over 80% of heat and power demand is provided through our gas network. In the evening on 16 June 2020, 70% of electricity generation in GB came from the gas grid.

3) In recent years we have also connected 19 biomethane sites to our network – enough capacity to supply 150,000 homes with green gas, or 750,000 homes using hybrid heating systems. With current capacity bookings for five new sites, this will rise to 180,000 homes, or 900,000 homes using hybrid heating systems.

4) We have seen a rapid increase in the number of flexible power stations connecting to our distribution network, with 42 connected at a total capacity of over 1.5GW. These integrate the gas and electricity distribution networks and support the increase in electricity demand from heat pumps and electric vehicles, whilst enabling renewable generation through backfilling for periods of low intermittent supply.

5) Currently we have four vehicle refuelling stations connected to our gas grid for both freight and bus fleets, with a fifth due to connect.

Responses to inquiry topics

- The suitability of the Government's announced plans for "Driving Growth of Low Carbon Hydrogen", including:
    - the focus, scale and timescales of the proposed measures

6) This is the first time hydrogen has been considered for its wider range of uses, but needs to be seen in an integrated way, i.e. the link between industry, buildings, transport and power generation. The focus, scale and timescales are about right for now and we welcome the commitment to industrial clusters and hydrogen for domestic use.

    - how the proposed measures—and any other recommended measures—could best be co-ordinated

7) As expected, a rush of organisations have been set up, but there is a risk of silos within the energy industry and government departments. A hydrogen 'team' is recommended to coordinate use, production, storage and transportation.

    - the dependency of the Government's proposed plans on carbon capture and storage, any risks associated with this and how any risks should be mitigated

8) CCS is clearly new to the UK, but not across the globe. The risk is worth taking as blue hydrogen produced via methane reforming (such as ATR) provides early opportunity for very low carbon heat at a competitive cost and earlier than other forms of renewable/low carbon energy.

    - potential business models that could attract private investment and stimulate widespread adoption of hydrogen as a Net Zero fuel

9) The RAB based model used within national infrastructure assets, such as energy networks, provides access to international funding and efficient operation.

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

10) Hydrogen trials are in their infancy; having only recently been provided funding to move from theory to practical application. Net Zero, which requires hydrogen at least as part of the mix, was only sanctioned by UK Government in 2019, and whilst funding has therefore now begun to flow, progress has been rapid. However; this late start to proving hydrogen has been used by its critics to dismiss its use, for example reports such as Absolute Zero. Its critics, however, have not addressed the issues with other technologies, such as seasonality, intermittency, cost and practicality.

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

11) The challenges are of course numerous with any pathway to Net Zero, but for hydrogen there are multiple challenges; each one appears to have a solution, but these solutions have yet to be stitched together in a coherent plan.

12) The Government can address these by rapidly announcing a number of whole systems trials, ideally based on an industrial cluster that can demonstrate the end-to-end use of hydrogen. An example is the South Wales Industrial Cluster. The partnership formed to progress this project propose the production of hydrogen via methane reforming, carefully balanced with the limited storage capability in the region; captured carbon shipped for permanent storage via tankers, a pipeline system designed to transport the hydrogen across the region and, most importantly, demand from industry, domestic/commercial heat, power generation and transport.

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

13) The South Wales Industrial Cluster, noted above, has outlined the infrastructure required and funding is being sought to provide the next level of detail. In addition, the South Wales Industrial Cluster proposes the use of Milford Haven as a hydrogen hub, supplying hydrogen to the South West of England, including Devon and Cornwall, in the 'Hydrogen Riviera' project based at the deep-water port of Plymouth. This project proposal opens the door for

a widespread ‘hub and cluster’ approach to reach other coastal locations that hadn’t previously been considered for a regional hydrogen supply.

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

14) The Energy Networks Association’s Pathways to Net Zero report (2019) completed a cost benefit analysis using complex whole energy system modelling to assess the lowest cost pathway to achieve Net Zero. It concluded that a predominantly hydrogen ‘balanced’ pathway was least cost and had the advantage of being least disruption to consumers:

    Microsoft Word - ENA_Gas decarbonisation Pathways 2050 EDIT.docx (wwutilities.co.uk)

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

15) Advantages:

    - able to meet seasonal heat demand and provide flexibility
    - low disruption for consumers
    - low capital costs for homeowner
    - low behaviour change for consumers

16) Disadvantages:

    - not ready at scale until 2030s
    - fuel costs relatively high

17) Solution – Hybrid Heating Systems (boiler plus small air source heat pump) or compact hybrid boiler (in one unit as a replacement to a standard boiler)

    - boiler component will be hydrogen-ready from 2025
    - low disruption
    - low capital costs
    - limited behaviour change
    - lowest heating bills – automatically selects lowest cost fuel
    - lowest carbon pathway – uses renewable electricity when available and gas (increasingly green) when not
    - a ‘hybrid first’ strategy for the 2020s = no regrets
    - see Guidehouse evidence report: [Benefits of Hybrid Heat Systems in a Low Carbon Energy System] (guidehouse.com)

Supporting evidence for Hybrid Heating Systems – ‘the third option’

Hybrid uptake:

18) Although heat pumps are communicated well as a technology ready to deploy now, the fact of the matter remains that the vast majority of homes are not suitable for them as a stand-alone system – they require significant intervention in insulation and changing over of radiators, pipework, and often installing underfloor heating and a water cylinder. The existing housing stock, even with all cost-effective energy efficiency measures undertaken, leaves many too hard to heat with an air source heat pump alone.

EPC	No. of Homes (England, Wales) 2019
A	29, 853
B	1,946,169
C	5,066,189
D	7,256,691
E	3,168,840
F	849,318
G	258,174

Source: MHCLG public EPC data, England and Wales, November 2019

19) Installing a heat pump in a hybrid system alongside an existing boiler system doesn't require upfront investment in building efficiency, like full heat pump systems do. A hybrid system only puts a minimal degree of behaviour change upon a household and retains the familiarity of a boiler and wet system. With two fuel sources, they optimise for lowest cost energy bills for consumers – and are able to use dynamic electricity pricing signals, like Octopus Agile. The Freedom Project explored this, and much more (summary report https://www.wwutilities.co.uk/media/3859/freedom-project-briefing-document.pdf and full report https://www.wwutilities.co.uk/media/3860/freedom-project-final-report.pdf).

20) With current mains gas and electricity fixed price tariffs, a heat pump in a hybrid will only be used about 10-15% of the time, but with dynamic prices, the heat pump competes against the boiler on price much more. This is being investigated by HyCompact (summary and registration document: https://www.smarternetworks.org/project/nia_wwu-066). HyCompact is trialling single-unit hybrid heating systems, where the heat pump is contained within the boiler.

21) Off gas grid homes using oil or LPG at a higher price than mains gas forces the heat pump to be used as much as possible, which is able to meet 80% of heat demand. These homes could use bioLPG as a back-up to fully decarbonise. The price of the fuel in these off-gas-grid homes is broadly similar to the cost of future hydrogen supply to customers on the gas grid – demonstrating that in homes supplied with grid hydrogen, a hybrid will make more efficient use of the gas. The volume of hydrogen for one home heated by a hydrogen boiler will be able to feed five homes using a hybrid heating system.

22) Removing a boiler and installing a heat pump-only system in most existing homes results in higher bills, regardless of how much insulation is added, due to the thermal inefficiency of the building and the resulting low coefficient of performance with an unfavourable fuel price compared to gas (the Flexible Octopus tariff which follows wholesale costs, currently 2.85p/kWh gas and 16.53p/kWh electricity). In a new homes example, Norwich built to the Passivhaus standard with an efficient gas boiler installation to provide for space heating and hot water demand, resulting in very low heating bills of £27-55 per year. See details here: https://passivehouseplus.ie/magazine/new-build/affordable-homes-scheme-reflects-rise-of-norwich-as-a-passive-hub.

23) For these collective reasons, hybrids are the fastest way of deploying heat pumps, which is recommended by the UKCCC as their Hybrids First principle, followed by decarbonisation of the remaining gas (see their 'Hydrogen in a Low Carbon Economy' report, and subsequent Housing and Net Zero reports). The UKCCC's Progress Report to Parliament in summer 2020 says:

"It [the forthcoming Buildings & Heat Strategy] *should be supported by tax or levy changes that favour low-carbon heating over fossil fuels and funding for capital grants (including for hybrid heat pumps) at a much larger scale than existing plans."*

"Hybrid heat pumps should be eligible under future schemes (unlike proposals in the recent BEIS consultation)."

"Policy should also drive early progress in the social housing and private rented sector and homes off the gas grid. However, to drive the rates of uptake required, owner-occupiers and on-gas-grid homes must also be included, emphasising the importance of hybrid heat pumps, which have fewer consumer barriers and generally lower upfront costs than heat-pump-only solutions."

https://www.theccc.org.uk/publication/reducing-uk-emissions-2020-progress-report-to-parliament/

24) Hybrids must therefore be supported to maximise heat pump uptake. Not supporting hybrids in future support for low carbon heat will lose the UK's leading foothold on the technology and software control; whereas supporting hybrids provides a global export market opportunity. Supporting hybrids will press the accelerator on net zero buildings; whereas not supporting them will be like keeping the handbrake on whilst trying to drive forward.

Hybrid installation costs:

25) Most of the costs involved in installing a heat pump are the building fabric retrofit costs (insulation, underfloor heating and changing of radiators and pipework). These are overcome by installing a heat pump as part of a hybrid. The intelligent controls in a hybrid system can essentially self-diagnose the cost-effective retrofit measures post-install. These can then be carried out in a whole-house approach so that further retrofit measures can be added in the future, if desired.

26) In the current immature market with low numbers of hybrids manufactured and deployed, a single unit hybrid system has a ~25% cost advantage (~£6,250) over a two appliance hybrid heating system (~£8,500), which includes a new boiler, heat pump, controls, metering, ancillary equipment, survey and installation. The costs of both types of hybrid systems are expected to reduce over time as the market matures, but that the single unit hybrid would maintain its 25% cost advantage. Expectations are that the mass market costs would be up to about ~£6,000 for a two appliance hybrid, which includes a new boiler, and up to about ~£4,500 for a single unit hybrid. These costs are not aggressively optimistic, so have the potential to outperform further.

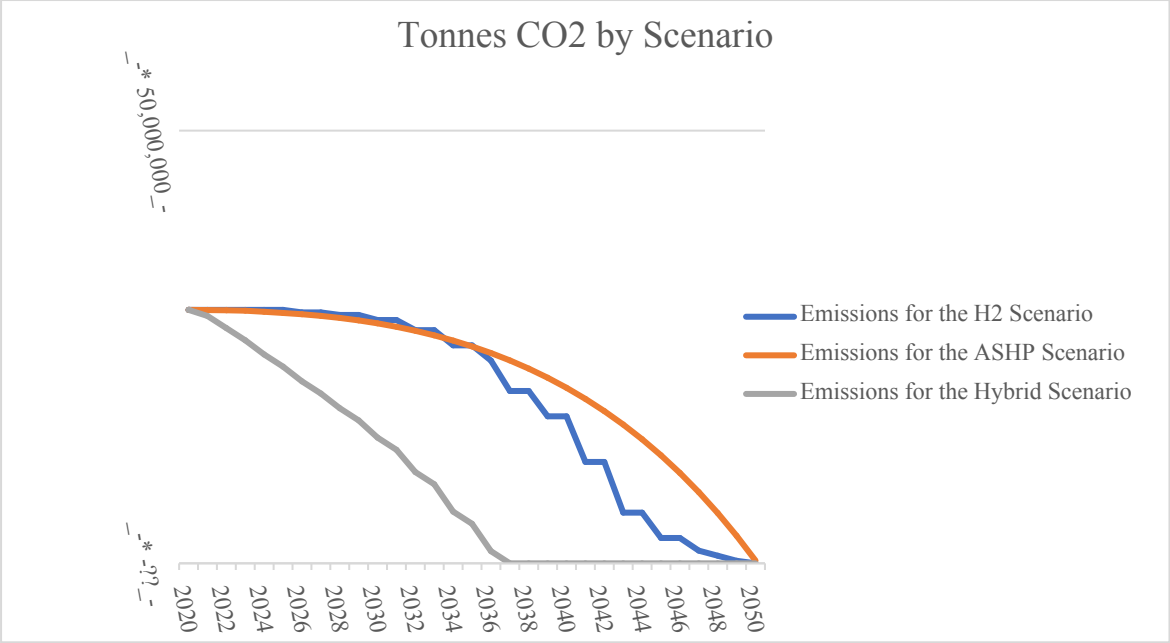
Role of hybrids in helping the UK reach the target of Net Zero emissions by 2050:

27) Hybrid heating systems offer the lowest cumulative carbon emissions on the pathway to 2050 compared to the alternative full electrification and full hydrogen vectors. They soak up intermittent renewable electricity when available and are backed-up by the decarbonising gas grid – a perfect flexible consumption for the announced ramp-up of offshore wind whilst

also enabling green gases to go 5x further – compounding the benefits of a future support scheme. This is already the case for biomethane, we currently have enough green gas capacity connected in our network to serve 150,000 homes – this multiplies to 750,000 homes if they use a hybrid heating system.

Pace of emissions reduction:

28) Impacted significantly by the rate of deployment potential for different technology solutions, the below graph shows the carbon emissions pathway for heat pumps, hydrogen boilers and compact hybrid systems boundary cases for a sample of 10,000 homes.



29) Freedom Project analysis of data pointed strongly that the heat pump in a hybrid doesn't work as hard as a heat pump in a stand-alone heating system and runs with a 25% increase in the Coefficient of Performance (a higher COP). As a result of having fuel switching flexibility, heat pumps in a hybrid can optimise to guarantee lowest whole-system carbon – with the ability to set a 'live minimum COP threshold' to avoid upstreaming more marginal emissions to the power sector than are saved in buildings – similar to the offshoring of emissions. The HyCompact project will be investigating this live minimum threshold in the hybrid controls. It is important that emissions from heating buildings is not considered and confined only to within the boundary of buildings but considers the whole-system carbon emission impact. If the heat pump in a hybrid is not operating efficiently enough, it will put additional demand on flexible electricity generation sources (domestic and interconnected coal and gas) that emit more carbon than the boiler would have done at the building level.

30) Hybrids reduce the Carbon Capture and Utilisation/Storage logistics for the portion of blue hydrogen in the future energy mix compared to full hydrogen heating systems, e.g. fewer CO_2 tankers from South Wales. This has been examined in detail in the HyHy Project (Hybrids with Hydrogen) where the county of Cardiff would require 70 CO_2 tankers/year for a full hydrogen solution and 35 CO_2 tankers/year for a full hybrid solution in a complete net zero energy system.

31) Hybrids work by feeding the boiler component with natural gas, natural gas with biomethane and hydrogen blends, 100% biomethane and 100% hydrogen. BEIS' internationally leading Hy4Heat Programme has developed the hydrogen appliances for

100% hydrogen conversion. A hybrid hydrogen heating system is due to be demonstrated in the Innovate UK PFTER funded 'Milford Haven: Energy Kingdom' project, in time to be used as a case study for COP26.

32) Hybrids enable an optimisation of GB investment for least cost across building fabric, domestic heating technology, networks and energy supplies. The Freedom Project also identified that they offer the highest value Fast Frequency Response via indefinite aggregated sub-10 second turn-off as they can switch to an alternative heat source to maintain uncompromised comfort and support a secure electricity system.

33) Hybrid flexibility avoids the expensive underutilisation of renewable generation, electricity storage and electricity distribution assets built to supply for full electrification during the coldest periods of the year. They help to build the lowest cost energy system making best use of existing assets for the distribution of net zero molecules and electrons from a variety of sources through the balanced use of our gas and electricity networks. The Freedom Project identified that this saving is valued at up to £15.2b/year.

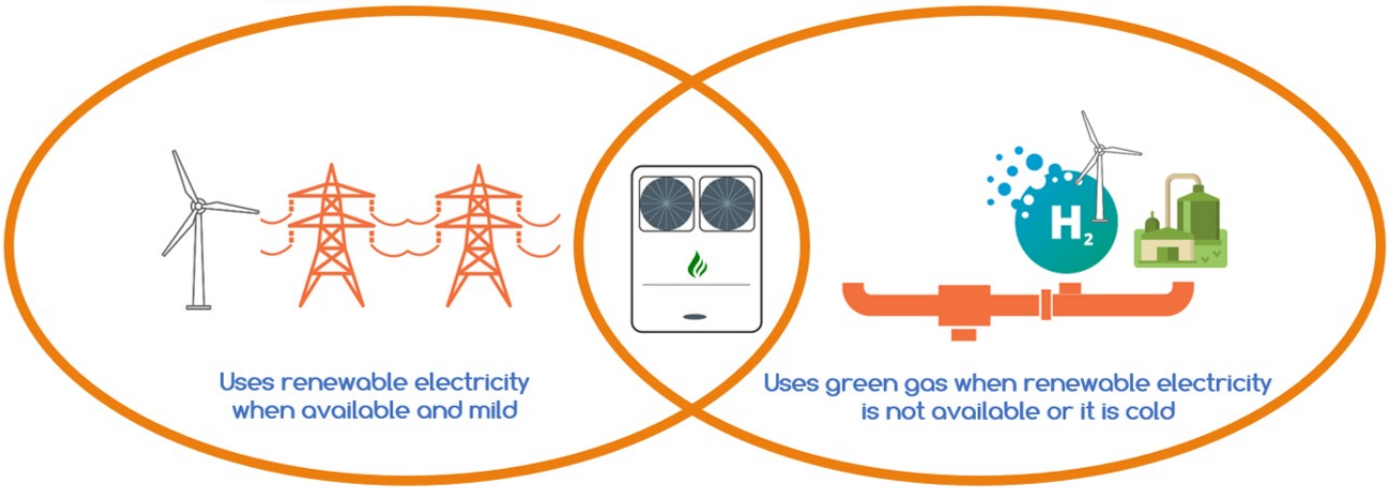
34) In the Energy Networks Association's Pathways to Net Zero report, which sets out a viable and optimal pathway to deliver net zero for buildings, industry, transport and power generation, hybrid heating systems become the dominant option for heating buildings, with 22 million homes with hybrid installations by 2050: Microsoft Word - ENA_Gas decarbonisation Pathways 2050 EDIT.docx (wwutilities.co.uk)

Skills:

35) Heat pump installation at any scale, whether hybrid or otherwise, needs a significant upskilling process of engineers to be able to retrofit them to the homes of yesterday and today and to include them in the new homes of tomorrow.

36) The next-generation compact hybrid systems, where the heat pump is contained within the wall-hanging boiler unit, overcome the upskilling problem since they can be installed by all current Gas Safe Registered engineers and, if scaling manufacturing with demand ramping, can be deployable at the same rate as gas boilers today (1.6 million per year). In these systems, the heat pump is fitted in the manufacturing process and therefore no F-Gas qualified engineers are needed – it is fitted in the same way as a normal gas boiler and enables an affordable 80% electrification of heat.

A compact hybrid heating system illustration:



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