Unite response to the Public Accounts Committee Call for Evidence on Decarbonising Home Heating

1. Introduction

1.1. This submission is made by Unite, the UK's largest trade union with over one million members across all sectors of the economy, including, manufacturing, financial services, transport, food and agriculture, construction, energy and utilities, information technology, service industries, health, local government, and the not-for-profit sector. Unite also organises in the community, enabling those who are not in employment to be part of our union.

1.2. Of particular relevance to this submission, Unite represents almost 31,000 engineers and technicians in the Energy and Utilities sector carrying out every task from the most menial to the most highly skilled engineers and scientists in the country within the nuclear energy industry.

2. Observations

2.1. Unite believe that there is a dire need to act swiftly and decisively to tackle climate change while ensuring that the public are provided with the ability to heat and light their homes without having to pay more than 10% of their income to do so[1].

2.2. There are solutions but these require resources in terms of trained engineers to fit and maintain the equipment and enough electricity and hydrogen. The Committee on Climate Change (CCC) has warned that hydrogen supplies will primarily be consumed to balance the grid due to the unpredictable nature of renewable energy. As highlighted by the CCC[2] "*reduced baseload nuclear energy results in a shortfall in generation that must be addressed by the use of flexible capacity technologies*". These flexible options are mainly the use of hydrogen in old natural gas power stations despite the creation of nitrous oxides (like di-nitrous oxide N_20) which will result.

2.3. There are only 25 years to achieve this transformation to turn 31 million homes and every business and mode of transport to be Net Zero before 2050, and to continue this net carbon negative future to undo any damage caused by the Paris 1.5ºC target[3] overshoot before the century is out.

2.4. Given the age profile of the energy industry, and the duration of this challenge, it will not be long before replacement engineers will be required due to natural wastage. Unite is calling for a Just Transition as defined by the UN's International Labour Organisation (ILO).

2.5. Given the scale of the challenge we need to utilise every opportunity and not place all our eggs in one basket. Unite firmly believes in the use of a diverse range of methods to produce energy where nothing can be overlooked, and we equally support the use of heat pumps and hydrogen boilers. All greenhouse gasses need to be included not just Carbon Dioxide (CO_2), with a particular focus on methane (CH_4) and N_2O as they are the next most common and gasses with a far greater warming potential[4]. While this may make calculations more complex, it will provide a better picture of which industries to support and discourage.

2.6. The installation of a heat pump takes on average 3 people and 3 days but can return up to 7 watts of heat energy for every 1 watt of electricity. The additional demand may require the mains supply to be upgraded,

[1] Government Definition of fuel poverty.

[2] Link to the CCC's report into Net Zero Poer and hydrogen Requirements for Flexibility

[3] This refers to the goal of keeping global warming to below 1.5ºC above the average levels found between 1850 and 1900, as set out at the UNFCCC COP21 talks in Paris. All the experts agree that we will exceed this level and hence now risk permanent damage to the ecosystem causing the release of natures vast stores of greenhouse gasses. The belief is that as long as we do not exceed 2.0ºC of warming we may still bring us back from the abyss.

[4] According to the IPCC methane (CH4) is 56 times as powerful and Nitrous Oxide (N_2O)is 280 times as powerful as CO_2 in warming the planet over a 20 year policy window.

which would be necessary anyway to enable home EV charging. Hydrogen boilers are less resource intensive to install but creates N_2O as well as water. The replacement of the boiler with hydrogen boilers requires all pipework to be replaced with plastic[5] from the source to burner to stop leaks. It also requires the network to be set up to supply hydrogen. There are simply not enough engineers and not enough time to train enough apprentices to fit every property with a heat pump, so we must use both options. Of course, if we are using Hydrogen boilers there will be the need to capture and store the equivalent volume of CO_2 from the atmosphere to offset the N_2O emissions.

2.7. Renewable energy sources like tidal stream and nuclear power could provide the UK with the much-needed energy security so these are key, for base load generation. During the transformation we should not ignore others as a way to ensure the lights stay on at UK plc. such as battery or hydrogen storage of excess generation. Currently excess generation is mainly stored by pumping water uphill for later release through a hydro-electric facility. Other options include Pink or Yellow Hydrogen[6] with the gas converted back to electricity via an array of hydrogen fuel cells. The use of fuel cells produces not just drinkable fresh water supplies and electricity but also "deoxygenated air" which would make an ideal replacement for CO_2 fire extinguishers. A more experimental solution to electricity storage is open loop ROC CO_2 batteries[7] which uses materials that are two orders of magnitude cheaper than lithium batteries.

2.8. Equally there needs to be a platform to provide the energy to where it is needed. This is where grid improvements and hydrogen for mobile solutions becomes critical. In Great Britain the national grid needs updating to more easily cope with the supply from renewable and less centralised generation. Despite the announcement of over £58 billion on upgrades[8], these will not deliver connectivity to some renewable generation for several years or more and are in the main a maintenance programme, rather than some grand upgrading plan. Of the announcements were just a few extra miles of power lines and the upgrading of 275 kV lines to 400kV. This includes lines running from Northern Scotland to Kent, from North to South in Wales and six high voltage DC offshore links which are not due for completion until 2030 at the earliest. Equally, if the natural gas network is to be repurposed to deliver hydrogen, this too needs to be upgraded to line or remove all metal pipes[5].

2.9. In Northern Ireland the Electricity and Gas supply was never privatised and is heavily linked to the networks in the Republic. Unlike Great Britain where 85% of households obtain their heating from natural gas, in Northern Ireland the vast majority obtain their heating burning heating oil[9]. Therefore, to convert Northern Irish homes to hydrogen boilers will require more than just the replacement of mains gas with mains hydrogen.

2.10. Due to the level of future demand, Unite believes that the supplies of hydrogen need to come from the full spectrum of sources. If this causes greenhouse gasses to be released, there needs to be enough carbon captured and stored from the atmosphere to offset the impact[10]. Unite supports the development of new technologies including the use of pyrolysis to extract hydrogen from hydrocarbon sources such as sewage, municipal waste and even fossil fuels if this generates black carbon powder instead of CO_2.

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[5] The metal pipes need to be replaced as hydrogen can form metal hydrides by disassociating the proton nucleus from its electron and sliding the proton into the metal's crystalline structure. This makes the metal brittle and more likely to leak. This process is reversable with the application of a little heat, making hydride storage an ideal way to store hydrogen, as a room temperature solid.

[6] See Appendix 1 for a description of what is meant by the different colours of hydrogen.

[7] This utilises captured CO_2, in a battery whose storage capacity is only limited by size of tanks storing the carbonated water and Bromine. On discharge of these batteries the batteries if there is variance of the pH instead of create bicarbonate. Traditional methods to create this substance which is not just used in baking but also in industry as a cleaner, as part of animal feed etc. Current methods of creating bicarbonate produces 3 tins of CO_2 for every one of bicarbonate. See Journal of Power Sources 31st May 2021 This idea has won a string of prizes for its usual take on CO_2 mineralisation

[8] National Grid's £54 billion investment plan announced in 2022 and the £58 billion update announced in March 2024

[9] According to the 2021 census Less than a third has a mains gas supply. 49.5% of homes were solely heated by fuel oil, 3.3% of homes were in part electrically heated. 747,560 homes (61.7%) had regular fuel oil deliveries and 113,506 (14.8%) homes were burning coal or wood for heating and almost 2,000 homes did not have central heating.

[10] if a tonne of N_2O is released a minimum of 280 tonnes of CO_2 needs to be captured and stored from the atmosphere. This is in addition to carbon captured from factories.

2.11. To reiterate, Unite believe in the utilisation of every available mode of energy generation and the utilisation of every technology which can achieve the goal of a path to Net Zero whilst keeping the lights on. In 2023 according to the Office for National Statistics[11] the total electricity demand was 310.0 TWh but the UK only produced 285.6 TWh relying on neighbouring countries to supply the shortfall. This highlights how we cannot afford to overlook any opportunity to generate more electricity especially given the near future loss of so much nuclear generation capacity. Unite believes we cannot afford to put all our eggs in one basket especially, if we do not know if that technology can deliver what we need when we need it.

2.12. The rate of climate change surged alarmingly between 2011-2020, which was the warmest decade on record,[12] which is worrying climate scientists[13]. This has been linked to a rapid increase in the concentration of methane which could be from natural sources due to the planet reaching a tipping point. As a result, we need to show the world that it is possible to break free of generation the relationship between energy and greenhouse gas emissions. As the birthplace of the industrial revolution, which is blamed for the rapid growth of climate change, we need to led another industrial revolution, showing how to reverse that trend. This needs to employ industrial methods to capture, utilise, store and mineralise CO_2, enough volume to stop additional industrial CO_2 releases and offset the emissions of other greenhouse gasses. However, a lot of industries believe in the ability to offset, yet almost no progress in actually building the capacity to capture CO_2 from the atmosphere or extract it from sea water etc. Nor is there enough investment into the additional electrical generation to power this activity.

2.13. If we are going to burn hydrogen in homes to decarbonise heating and thus produce small volumes of N_2O per heat source, we need to capture and store at least 280 times that volume in CO_2. We can avoid some of this by using heat pumps, but we are running out of time and currently will not have enough skilled engineers trained to fit them. As a result, we need investment into skills, electricity generation, Carbon Capture from the atmosphere capacity and importantly enough equipment to supply 31 million homes with heat. Of course, in addition to this is the need for replacement heating in industry.

2.14. The task ahead is enormous but with investment in the right places it can be done, if there is the will and the support from government and if we stop the talking and start acting on building the capacity and staff education needed. Unite believes this is why a Just Transition is so important; we do not have the time to lose skilled staff who may only need a conversion course.

Simon Coop
National Officer
Energy and Utilities
Unite House
128 Theobalds Road
Holborn
WC1X 8TN

For further information please contact
Colin Potter, Research Officer in the Unite the Union.

[11] According to the ONS Quarter 4 Energy Trends data
[12] World Metrological Organisation, The Global Climate 2011-2020: A decade of accelerating climate change
[13] According to NOAA's 2023 Annual Climate Report the rate of warming since 1982 is more than three times as fast: 0.36° F (0.20° C) per decade as all previous records.

Appendix 1 Rainbow of Hydrogen Production Methods

Hydrogen is a colourless gas that burns with a very pale blue, almost colourless, flame when pure. The colour therefore, does not refer to the actual colour of the gas produced or the colour of the flame but the name given to differentiate between different methods of production or extraction.

Colour	Method to generate hydrogen
Green,	Normally used to describe the electrolysis of water or ammonia, to create hydrogen, the term also includes any other method that creates hydrogen, without creating or releasing any greenhouse gasses.
Yellow,	The electrolysis of water or ammonia using renewable energy as a way of storing generated electrical power. This is the method which is to be used on deep sea floating wind turbines platforms and could also be used on renewables awaiting grid connections to provide a return on investment while on the National Grid's waiting list.
Pink,	The electrolysis of water or ammonia using Nuclear Generation as a way of storing generated electrical power generation. This is also referring to a method of returning the power back to the grid by passed the gas through a bank of hydrogen fuel cells as and when required. As there is no combustion there is no release of any greenhouse gasses not even N_2O or NO_X and the exhaust deoxygenated air can be used to replace CO_2 as a fire extinguisher.
Grey,	The production of hydrogen using **Steam Methyl Reformation**, where natural gas passes through a chamber filled with steam, in a two-stage catalytic process. The steam breaks the methane into large quantities of hydrogen but also Carbon Monoxide, which then reacts further thanks to a catalyst to release CO_2 and some more hydrogen. The process is not perfect causing some unreacted methane and other hydrocarbons gasses, to escape into the atmosphere. $CH_4 + H_20 \Rightarrow CO + 3\ H_2$ $CO + H_20 + 206\ kJ/mol \Rightarrow H_2 + CO_2$ The reaction is endothermic, requiring heat to be supplied to the process for reactions in the temperature range 700–1,000°C. In general, the heat source is provided by combustion of up to 41% of the methane feedstock, causing 24% reduction in product energy content compared to the feedstock. There is also a requirement for large volumes of water compared to other methods.
Brown,	The production of hydrogen, using gasification, where carbonous materials like municipal or industrial, carbon-based waste, is heated into a gas. The gas is then treated in a method the extracts hydrogen, usually Steam Methyl Reformation. The method releases large volumes of Carbon Dioxide and other greenhouse gasses into the atmosphere but does reduce volumes going to landfill.
Black,	The production of hydrogen by using gasification of coal or oil, by heating it strongly in the absence of air to create "Coal Gas", sometimes known as "Town Gas" or "Syn Gas" = a mixture of Carbon monoxide and Hydrogen. By-products from the production process can included coal tars and ammonia. The process causes the release of large volumes of CO_2 and other greenhouse gasses into the atmosphere.
Blue,	The production of hydrogen using either the Brown, Black or Grey methods above but where the gasses that would otherwise be vented to the atmosphere are passed through an amine solution to extract and capture the CO_2 for later utilization, disposal via mineralization or long-term CO_2 storage/disposal. Sadly, the amine solution cannot also extract the other greenhouse gasses and unreacted methane that can still end up in the atmosphere.
Turquoise,	The production of hydrogen from a fossil fuel or carbonous material, such as anaerobic digestion methane, or the gasification of waste, where that material is then turned into carbon powder and hydrogen.

	One method achieves this by bubbling the Syngas or hydrocarbon gas source through hot liquid metal. Another uses pyrolysis (super critical heating of a substance to break the molecular bonds and release the elements in their natural state) by passing the gas or other material through an electric plasma in the absence of air. Early experiments allowed unreacted methane to escape but hydrogen separation can ensure any escaping gas can be recycled. While this remains largely experimental there have been examples of deployment in Germany[14] where it is used to turn sewage into drinkable water and hydrogen, plus carbon powder that can be used to manufacture anything from carbon fibre to industrial diamonds or Graphene nanotubes, using a high frequency electrical plasma[15]. Other experimental methods use an Isothermal Ceria Redox Cycle powered by concentrated sunlight.
White, sometimes called Gold	Naturally-occurring geological hydrogen found underground, normally discovered as the by-product of industrial processes such as drilling for oil or natural gas extraction (fracking). As with any drilling or mining there can be pockets of radioactive substances unearthed too.

[14] Innovator Graforce claim that their method of methane electrolysis only needs 10 or 20 kWh from wastewater to make 1 kilogram of hydrogen, as opposed to water electrolysis, which takes 50 kWh/kg of hydrogen.

[15] This can be used to purify water and produce valuable gasses sorted via membranes as has been deployed by Graforce as the world's first plant for the generation of hydrogen from wastewater (3,000 l/h) on the premises of Berliner Wasserbetriebe at the Waßmannsdorf treatment plant.