The Institution of Engineering and Technology

Transitioning to hydrogen

Assessing the engineering risks and uncertainties

The UK is investigating supplying hydrogen to homes and businesses instead of natural gas by "repurposing" the gas network. It presents a major engineering challenge which has never been done anywhere else in the world. Experts from a cross-professional engineering institution (PEI) working group have assessed the engineering risks and uncertainties and concluded **there is no reason why repurposing the gas network to hydrogen cannot be achieved**. But there are several engineering risks and uncertainties which need to be addressed. The report's key conclusions and recommendations are that we:

What is being done in the UK?

The report highlights **20 ongoing projects** looking at various aspects of hydrogen production and use. Detailed case studies of these projects and their contributions to various issues can be found in the report.

Progress CCuS infrastructure - CCuS (carbon capture, utilisation and storage) infrastructure is essential to the bulk production of hydrogen.

Deploy critical new technology - New technologies will need to be deployed for which there is limited experience. "Learning by doing" is essential to ensuring robust cost and performance data.

Prepare a transition programme - This needs to include sufficient detail to ensure the identification of critical path items and their associated uncertainties. Assumptions will need to be underpinned by evidence and where evidence is not available, it will need to be sought.

Develop skills and plan resources - Transitioning to hydrogen will require a broad range of skills and resources. Mobilising these resources will necessitate commitment from many parties.

Fund the programme - The transition programme will require substantial investment over many years. A stable funding regime needs to be assured, underpinned by central and local government policy in conjunction with Ofgem and other regulatory parties.

What are the engineering risks and uncertainties?

Hydrogen experience is limited to industrial applications only and there are no examples of networks anywhere in the world supplying 100% hydrogen to homes and business. **To make a significant contribution to meeting the UK's 2050 GHG (greenhouse gas) target, large-scale deployment to homes and businesses would need to be implemented over the next 30 years**. This is ambitious, and so any decision to proceed will need to be sufficiently compelling to compensate for the lack of experience and comparatively short timescale. The report identifies 15 core questions that need to be addressed.

The full 'Transitioning to hydrogen' report is available to read at **www.theiet.org/hydrogen**

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Why hydrogen for heating?

Although natural gas has helped reduce the UK's CO_2 emissions by displacing coal and oil (which produce around twice as much CO_2), it is now the largest source of carbon emissions in the UK.

40% of electricity generation is from gas

85% of homes are heated by gas

50% of the energy used for industry and businesses is from gas

When combusted, hydrogen produces no CO_2, therefore offering the prospect of a low-carbon alternative to natural gas. Repurposing the existing gas network to pure hydrogen could contribute significantly to the decarbonisation of the UK and reducing the current dependency on natural gas.

Hydrogen allows much of our existing gas infrastructure to be used

Most of the local "iron mains" gas network will have been replaced with polyethylene pipe by 2030, which can be used with hydrogen. This means **most of the necessary street works would have already been done**.

Hydrogen can be used by industry, businesses and homes

Existing gas boilers in the home will need to be replaced but this can be facilitated by future sales of "hydrogen-ready" gas boilers, which can be readily converted to hydrogen. Many industrial applications should be able to convert from gas to hydrogen, although others may require blending with biomethane, for example.

Hydrogen can be produced in large volumes

Production from gas reforming has been used by industry for years, but a by-product is CO_2, which needs to be captured and stored. Modern reforming technology can have high CO_2 capture, but experience is limited. Hydrogen can also be produced from electrolysis but the power would need to come from renewable energy sources, which is likely to be higher cost.

Can I keep my domestic gas appliances?

Natural gas boilers **will** need to be replaced with one that is hydrogen-ready, but existing hot water pipework, radiators and hot water storage could still be used.

Hydrogen compares well with other low-carbon heat technologies

The diagram below compares the primary heating technologies suitable for large-scale retrofit deployment against several criteria. While the comparison is subjective and generalised, it is not meant to indicate that one form of heat technology is "better" than another. Instead, it is designed to illustrate the different features and highlight the potential benefits of hydrogen. A full explanation can be found in the report.