How Hydrogen Can Help
UKHA Fact Sheet Number 1

UNITED KINGDOM HYDROGEN ASSOCIATION

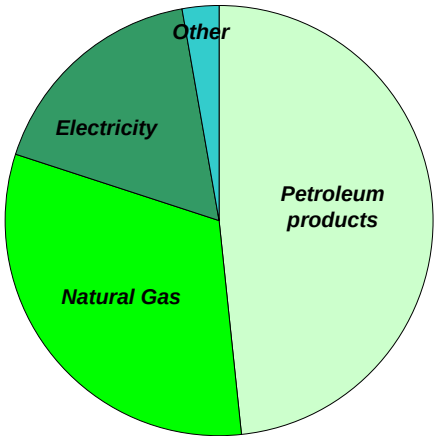
CHALLENGES FOR THE ENERGY SECTOR

There are a number of challenges facing the energy sector. On a global scale, climate change and security of supply issues must be addressed against a backdrop of increasing population and economic development and rising demand for energy around the world. In the UK, indigenous primary energy resources are diminishing at the same time as affordable, available and low carbon energy is required. This fact sheet outlines how hydrogen can play a role in addressing these important energy issues.

Energy supplies are essential for social wellbeing and economic development, but there are costs associated with producing, delivering and using this energy.

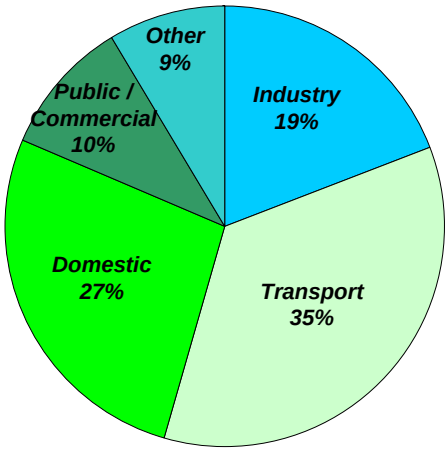
In the UK, a range of primary energy sources are utilised to meet our energy demands. Fossil fuels (oil, natural gas and coal) provide the vast majority of our energy, with other sources such as nuclear power and renewable energy (wind, hydroelectric, biomass) also contributing.

Although there are a range of primary energy sources, the UK is currently reliant upon three main energy vectors (carriers): petroleum products, natural gas and electricity to deliver energy to the end user.



Energy Vectors
(Source: BERR DUKES report)

Petroleum products such as gasoline, diesel and kerosene are widely used in transport applications, and fuel oils are used for heating and power generation; natural gas is supplied to industry and homes where it is mainly used for heating or for central power generation; electricity is used for lighting and to power appliances.



Energy Demand by Sector
(Source: BERR DUKES report)

CLIMATE CHANGE

It is widely accepted that anthropomorphic emissions of greenhouse gases such as CO2 are contributing to global warming, and that a 'business-as-usual' energy scenario could lead to catastrophic climate change by the late 21st Century. To mitigate this risk, new sources of energy and new ways of using existing resources need to be developed. Measures such as increasing renewable energy production and improving energy efficiency are important, and technologies such as CO_2 capture and storage and advanced nuclear power are also being developed.

One of the key drivers for the development of hydrogen energy technologies is its ability to play a role in mitigating climate change. The complete combustion of hydrogen in oxygen produces only water and heat. In a fuel cell hydrogen and oxygen are combined catalytically to generate electricity. Importantly, when using hydrogen in this way, no CO_2 is produced at the point of use and the reaction product, water, is benign in terms of its effect on health and the environment.

Because hydrogen is an energy vector (carrier) rather than an energy source, the method used to produce hydrogen is critical to its viability as a low-carbon solution. Renewable energy, biomass and nuclear power can be used to produce hydrogen with no net CO_2 emissions, and could therefore form part of a zero carbon energy system. Alternatively, hydrogen production from fossil fuels, for example in Integrated Gasification Combined Cycle (IGCC) plants could feasibly be economically coupled with CO_2 capture and storage to increase our low carbon energy options.

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ENERGY DIVERSITY

It is recognised that a diverse energy system is important to mitigate risks associated with cost and security of supply. A diverse energy system shields consumers from fuel price volatility and reduces the risk of energy shortages if particular energy sources become unavailable.

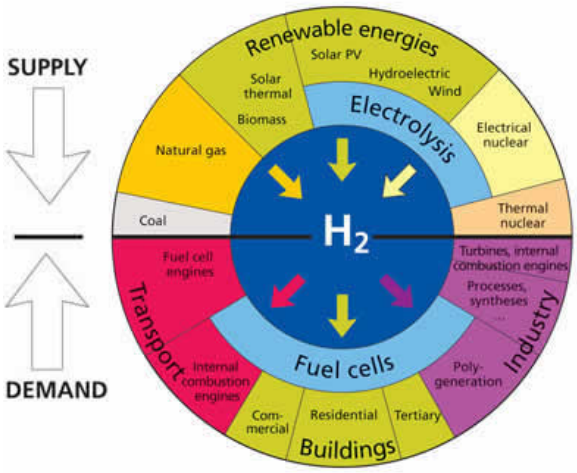
Adding hydrogen to the UK's energy system would add to the diversity of the energy mix. Hydrogen is especially beneficial because it can be sourced from a wide range of raw materials (water, fossil fuels and biomass) and produced using virtually any source of power (fossil, nuclear, wind etc). Hydrogen can be produced at large, centralised production plants or at small, distributed facilities. In addition, hydrogen applications can bridge across various demand sectors – fuel cells, for example, can be used to supply power and heat for buildings, transportation and domestic use.

SECURITY OF SUPPLY

A secure and reliable supply of energy underpins economic development and a high quality of life. The current dependence on fossil fuels raises two concerns with respect to energy security. Firstly, fossil fuels are finite in nature and will not be able to satisfy energy requirements forever. Worldwide demand for oil in particular could outstrip supply within a decade or two. The second issue is that reserves of oil and natural gas are concentrated within a small number of countries, many of which are located in politically unstable areas of the world. Reducing dependence on imported oil is already the major driver for the development of hydrogen energy in the US and Japan.

The ability of hydrogen to improve energy security results from the variety of ways that can be used to produce it. There is therefore scope to employ indigenous power to produce hydrogen, which can then be used in fuel cell vehicles or in combined heat and power fuel cells within buildings, thus reducing dependency on imported oil and natural gas.

Hydrogen also has the potential to act as an energy store, balancing supply and demand. Storage in dedicated vessels or in pipelines would enable hydrogen to buffer between supply and demand in a similar way to how natural gas is stored today.



Source: European Commission

AIR QUALITY

While climate change is a very high profile environmental issue, emission regulations regarding local air pollutants are becoming increasingly stringent for power generators and vehicles. Emissions of hydrocarbons, carbon monoxide, nitrogen oxides, sulphur dioxide and particulate matter must be minimised to improve local air quality and reduce harmful effects on health and the environment.

The only reaction product generated from hydrogen fuel cells is water, which is benign. Consequently, there is a significant advantage of employing fuel cells in areas of high population density, especially for transport. In addition, since they have no moving parts, fuel cells are quiet, meaning that noise pollution is also reduced.

SUSTAINABILITY

The long-term target is to develop energy supplies that are sustainable, i.e. supplies that satisfy our demand for heat, power and transportation without adversely affecting the ability of future generations to meet their own needs. The 'hydrogen economy' has been proposed as a future sustainable energy system which uses hydrogen as the primary energy carrier. In this scenario all hydrogen would be low carbon - produced from renewable sources or de-carbonised sources, to provide low-carbon energy; and where CO_2 is captured from biomass, further reducing CO_2 emissions. In recent years the first steps towards such a system have been made with significant research and development ongoing in this field. However, a continued development and demonstration effort is needed to establish hydrogen energy as a sustainable solution before the hydrogen economy vision can be achieved.

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