A Short Guide to...

Nuclear-Enabled Hydrogen

NATIONAL NUCLEAR LABORATORY

The Energy Context

To reach net zero carbon emissions by 2050 we will need to completely transform the way we produce and consume energy – at home and within industry. It is impossible to overestimate the scale of the challenge facing countries around the world, to achieve our global net zero ambitions.

Hydrogen is widely viewed as the most viable solution to decarbonising our energy system in areas where low-carbon electricity may not be able to. This includes domestic and industrial heating and fuel for the transport sector, such as shipping and aviation.

By using existing technologies, the UK can already produce low-carbon, nuclear-enabled hydrogen but we can innovate further to deliver clean hydrogen at scale and at a competitive price.

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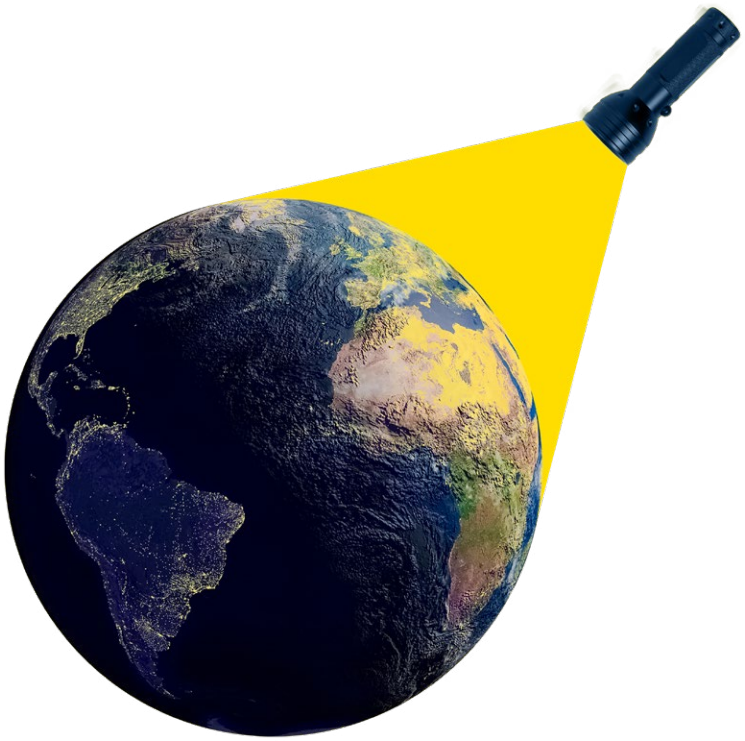
The UK Policy Landscape

In August 2021 the UK government launched its **UK Hydrogen Strategy**. This set out plans to scale up our hydrogen economy to achieve its ambition for 5GW of low-carbon hydrogen production capacity by 2030. Building on this in April 2022 the government published its **British Energy Security Strategy**, which announced an expectation to double this ambition up to 10GW by 2030.

With today’s technology, around 3GW of nuclear power could meet the whole of the UK’s current hydrogen demand. As we look to decarbonise further, hydrogen demand is set to skyrocket.



Why Hydrogen?

Hydrogen provides us solutions for decarbonisation as a replacement for natural gas.

This means it is more easily integrated into hard-to-decarbonise areas of our economy such as aviation, heavy industry, shipping, and public transport.

Hydrogen can also be used to help heat our homes, by making adjustments to our existing grid networks and boilers.

It is currently only produced at scale in the UK through carbon-intensive Steam Methane Reformation, so new and different technologies like nuclear are needed to decarbonise our supply.

Today we produce around 25TWh of hydrogen, none of which is low-carbon. By 2050, the UK government forecasts between 240 and 500TWh will be needed from low carbon sources.

Production Methods from Nuclear

Low-carbon nuclear hydrogen is produced using existing methods as well as new and advanced nuclear technologies. These are delivered using three key processes:

- Direct Electrolysis: a conventional technique ready to be deployed today that uses electricity to split water. If the electricity is from a low-carbon power source such as wind or nuclear, the resultant hydrogen is also low-carbon

- High Temperature Steam Electrolysis: a near-term innovation that makes use of advanced nuclear's higher outlet temperatures. For example from a High Temperature Gas Reactor (HTGR) to achieve greater efficiencies and lower costs

- Thermochemical Water Splitting: an advanced option which again makes use of nuclear's high temperatures and offers even greater efficiencies

Next Steps

As the hydrogen economy moves forward at pace, NNL and others across the nuclear sector are working with partners and policymakers to ensure the benefits of low-carbon, nuclear-enabled hydrogen are widely understood.

This includes identifying the actions required across five key areas to unlock this opportunity in the near term: economic, technical, regulatory, policy and finance.