

Opportunities for hydrogen and fuel cell technologies to contribute to clean growth in the UK

White Paper Summary



This white paper examines the opportunities for hydrogen and fuel cell technologies to contribute to clean energy growth in the UK.

We assess the strength of the sector using a range of metrics, and recommend actions to help develop an export-focused hydrogen and fuel cell industry.

A Potential future markets

The UK Government and UK Committee on Climate Change have identified several key roles for hydrogen and fuel cells in the future.

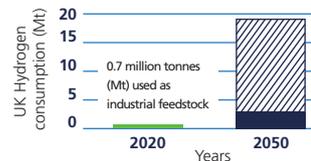
Fuel cells could power heavy-duty **trucks and buses**, and even cars and trains.

Hydrogen could be used:

- To heat homes and offices using the existing **gas networks**.
- In industry: **Iron and steel, chemical feedstocks**, and other high-temperature processes.
- To **Integrate renewables** for energy storage and flexible peak generation.

B Future hydrogen consumption in 2050

UK hydrogen consumption is expected to increase from 0.7 million tonnes (Mt) each year at present to 3–19 Mt by 2050.



2050
Estimated 500 Mt global hydrogen market.

C Producing Hydrogen in the UK

Today, hydrogen is produced at industrial natural gas sites, with high carbon dioxide (CO₂) emissions.



In the future, low-carbon hydrogen can be produced via...



Advanced reforming technology producing **blue hydrogen** from natural gas, with most CO₂ emissions captured by carbon capture and storage (CCS).



Electrolyser technology using renewables to produce **green hydrogen**, which is highly flexible and stores hydrogen by capturing excess generation.

D A key barrier is the lack of a hydrogen supply

Short-term solution
A refuelling station network to enable use fuel cell cars. Hydrogen produced on-site using electrolyzers.

Long-term solution
Large-scale production of hydrogen with delivery by **pipelines** to refuelling stations, homes and industry.

UK's strengths in hydrogen and fuel cell value chains

We surveyed 196 companies across the full hydrogen and fuel cell supply chain.*

Main findings

66% 66% export goods/services into the growing global market.

60% 60% have joint R&D programmes with the EU, and 33% with North America.

The majority work with UK universities because they have broad expertise and produce world class research.

Key barriers to innovation and growth

Access to finance: Finance for growth is considered easier to access in North America and East Asia.

A very small UK market: Fuel cells market-ready, but costs need to be reduced further through scaling-up production. The market for bulk hydrogen is expected to grow over the coming decade.

Shortage of skilled labour: The UK is perceived to have a shortage of suitable employees for the H₂FC sector, compared to competing countries.

Opportunities and benefits for the UK

The UK can build on the world-class fuel cell technologies developed by these companies, taking a lead in developing a low-carbon hydrogen economy as an export industry.

Short-term in replacing combustion engines:

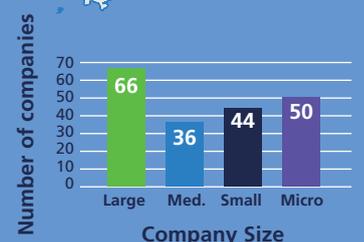
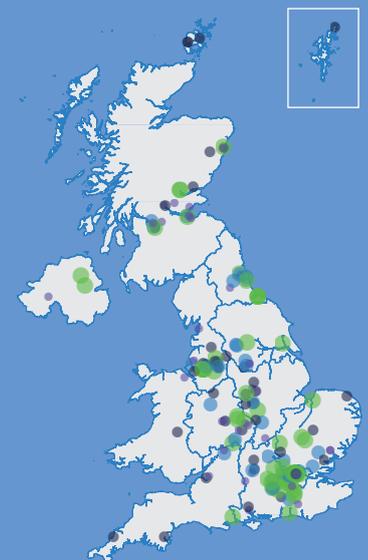
For example, using fuel cells in heavy-duty vehicles (e.g. HGVs or buses). The UK is already testing fuel cell bus fleets.

Long-term in using hydrogen in heating and industry:

Creating an early market could enable the UK to develop a new export industry.

Supporting fuel cells would future-proof the UK's automotive industry in case fuel cells take a prominent role beside battery vehicles.

This key manufacturing sector currently supports 856,000 jobs has a £85 billion turnover, and exports 80% of its vehicles (2017).



*Data based on 32 responses

Opportunities for hydrogen and fuel cell technologies to contribute to clean growth in the UK

Recommendations: Actions to encourage hydrogen and fuel cell innovation



Fostering UK Markets

The UK market for fuel cells is very small compared to the global market, and this is a barrier to innovation for UK companies. There is an opportunity for the UK to create the first market for bulk low-carbon hydrogen, with the aim of creating a future export industry.

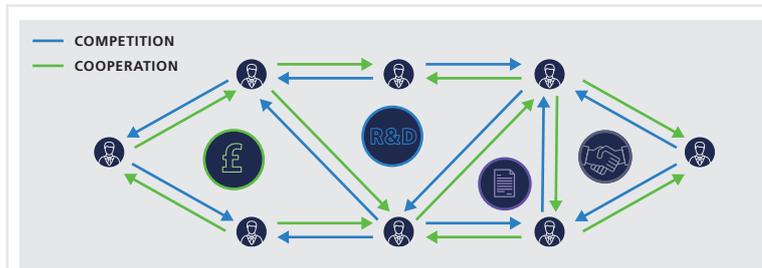
- 01** Use **public procurement and subsidies** to create a market for fleets of vehicles. Identify niches using business cases that account for the benefits of no air pollution and low noise.
- 02** Create a **national refuelling station network** for public and private use.
- 03** Examine opportunities to use **low-carbon hydrogen** in oil refining, ammonia and methanol production, steelmaking, & elsewhere, as part of the new Industrial Strategy Challenge Fund decarbonisation challenge.
- 04** Create a **green hydrogen standard scheme** for the UK to enable the value of green and blue hydrogen to be recognised by the market.



A Strategic Vision

We need to coordinate UK industrial development and innovation funding over the long-term, and to introduce a more active engagement process. This strategy would ideally treat hydrogen and fuel cells separately, and balance domestic needs and export opportunities.

- 05** Develop a **hydrogen strategy** to plan for a UK hydrogen economy. Identify opportunities to export both hydrogen technologies and green hydrogen fuel.
- 06** Develop an **electrochemical strategy** covering domestic and export opportunities for battery, fuel cell and electrolyser innovations.
- 07** In each strategy, **coordinate innovation funding** from UKRI and the UK Government, to see how it is best invested between industry and academia, accounting for skills needs in the sector.
- 08** Create a **"Hydrogen Partnership"** to accelerate a shift to hydrogen energy systems in the UK and to stimulate opportunities for businesses.



A Vibrant Innovation Ecosystem

A strong sector requires a sufficiently large skilled and innovative workforce, a diverse range of companies that interact both through competition and cooperation. It also needs sufficient funding and other support to underpin R&D, an appropriate regulatory and institutional framework, and a demand for products.

- 09** Study what would constitute **critical mass** in the hydrogen and fuel cell sectors, in terms of industry and academic capacity, and the skills and knowledge base.
- 10** Consider creating a **"Hydrogen Institute"** focusing on the future use of hydrogen in the energy system.
- 11** Consider creating an **"Electrochemical Institute"** to support fuel cell and electrolyser development, working closely with the Faraday Challenge.
- 12** Ensure there are mechanisms for UK researchers and companies to continue and **build on existing collaborations with European counterparts**, and to access European markets.

Download the full white paper from: www.h2fcsupergen.com/opportunities-for-hydrogen-fuel-cell-clean-growth-uk