

Hydrogen Propulsion Manufacturing Vision Statement

Summary

Hydrogen is expected to play a key role in the UK's future energy system, supporting both energy security and our ambition to become a clean energy superpower. We will create the right conditions to enable the commercial manufacturing of hydrogen technologies in Britain, maximising UK content in the global transition to a decarbonised economy.

Hydrogen can be used in propulsion technologies and a wide range of applications across automotive, non-road mobile machinery, aviation, marine, and rail. We want the UK to be a leader in the design and manufacture of hydrogen propulsion systems across all transport modes, leveraging our competitive advantage as this technology reaches commercial maturity globally.

We will work with industry, trade unions, academia, and the public to develop an ambitious industrial policy, including for UK-based manufacturing of hydrogen propulsion systems. Our aim is to move quickly, capitalising on the UK's progress and competitive strengths to consolidate Britain's leadership in hydrogen technologies.

This will drive inward investment, helping to secure opportunities for UK companies and our skills base in the global supply chain, as well as providing wider economic benefits to all regions of the UK, enabling growth and securing prosperity.

Current state

We are entering a major global investment cycle, and the UK is well-positioned to capitalise on the multi-billion-pound growth opportunity presented by the global transition to hydrogen technologies. The UK holds a strong competitive advantage in hydrogen, thanks to its substantial offshore wind capacity, geomorphological features, and established skills, IP, and expertise across the supply chains, which growth is further enabled by a supportive investment and business environment.

Alongside initial production, transportation, and storage solutions, government programmes have supported the development and deployment of hydrogen systems across the transport sector. These initiatives include, but are not limited to:

- the Advanced Propulsion Centre R&D programme
- the Automotive Transformation Fund
- the Aerospace Technology Institute
- the UK Shipping Office for Reducing Emissions
- other programmes implemented in partnership with Innovate UK and UKRI

Evidence from funded projects demonstrated that hydrogen could represent a compelling proposition for transport decarbonisation. We will continue to leverage these and other programmes, where appropriate, in partnership with industry, to explore attracting further

investment in the manufacturing of hydrogen propulsion systems across all transport modes.

Challenges

Industry indicates that several global challenges impact the development, production, and deployment of hydrogen propulsion systems. For instance, unlocking UK deployment opportunities is essential to making the commercial case for investing in the manufacturing of these technologies in Britain. The Hydrogen Delivery Council (HDC) leads on some of these challenges, and the Hydrogen Propulsion Manufacturing Taskforce will work closely with the HDC to align activities and interdependencies.

Key challenges identified by industry include:

• Refuelling infrastructure availability

The scale deployment of infrastructure for refuelling hydrogen-powered aircrafts, land vehicles, and vessels requires a significant upfront investment with a likely low return due to limited initial infrastructure utilisation. However, hydrogen infrastructure roll out could enable further large-scale hydrogen applications in other sectors of the economy.

Safety standards

Standards aimed at storage, transportation and refuelling infrastructure, affect all modal applications, from certification and airworthiness requirements to maritime safety and on-road safety. Regulation is in some cases still developing, which has an impact on their potential deployment globally.

• Developing regulation

From emission and noise standards to rules of origin in free trade agreements, regulation is key to promote trade and investment in hydrogen propulsion technologies within the FTA regions. Greater cooperation in technology development and in the trade of IP and systems is required.

Energy costs

The cost of producing renewable hydrogen is heavily influenced by electricity prices. For hydrogen propulsion systems to be competitive, the cost of hydrogen fuel must be competitive with traditional fuels. Energy costs also influence the commercial case for deploying hydrogen refuelling stations.

Skills gaps

The industry needs engineers and technicians with the required knowledge to develop and manufacture hydrogen propulsion systems, alongside owners and operators. Along with the management of operational risks, reskilling will be required as new technologies are mainstreamed, alongside policies to attract talent and upskill the existing workforce.

Access to finance

Nascent hydrogen technologies face challenges securing viable access to finance or insurance products for customer performance guarantees. SMEs involved in developing hydrogen technologies find themselves at a disadvantage versus larger overseas competitors who enjoy the support of parent companies able to offer those guarantees.

Global hydrogen availability

The use of hydrogen, or other energy carriers based on it (e.g. ammonia), for international transport such as shipping faces considerable challenges in ensuring that refuelling infrastructure and low carbon fuel is available in every country to which the craft might travel. Early availability of such fuels for product development and testing is also an issue, affecting innovation investment.

• Other challenges

Issues partially linked to the above include the availability of electrolysers, the availability of affordable renewable hydrogen for R&D projects, long payback periods for the required investment, insurability of projects, limits in market volume due to the industry being still nascent, the availability of commercial offtakes, and business models still in the process of being finalised.

UK strengths and growth opportunities

The global opportunity in hydrogen propulsion is significant and could represent the next major step in decarbonising transport following the emergence of battery technologies. Recent innovation investments have highlighted the UK's strong competitive advantage in the design and development of hydrogen propulsion systems.

The UK boasts an internationally competitive innovation ecosystem, comprising leading exporting companies, significant R&D investment, a world-class academic base, and widespread technological expertise. This is further supported by a government-funded network of interventions designed to consolidate the UK's technological advantage. Below are a few examples where targeted investment has led to key developments:

Automotive

Thanks to significant investment in partnership between industry and government over the last decade via the Advanced Propulsion Centre and the Automotive Transformation Fund programmes, hydrogen technologies can help support decarbonising heavier vehicles, from trucks to buses. This is due to the comparative qualities of hydrogen systems in several use cases, including higher energy density, lower vehicle weight, greater range, rapid refuelling, and improved payload capacity.

Off road and other NRMM

The UK has a strong track record in developing hydrogen propulsion systems for off-road applications. Funded projects have demonstrated the UK's competitive advantage in these technologies, including in more demanding environments such as construction and

agriculture. Additional evidence has been provided by a recent industry report from the Hydrogen Delivery Council, which focuses on off-road applications.

Aerospace

In aerospace, HMG through the Aerospace Technology Institute (ATI) Programme supports R&D projects in aircrafts applications. The ATI set up a Hydrogen Capability Network focusing on infrastructure, skills, research and the commercial supply of hydrogen across the UK. The Network has been exploring how to accelerate the use of liquid hydrogen as a fuel source and develop the UK supply chain.

Maritime

The maritime industry is actively exploring hydrogen technologies as a viable alternative. The UK Shipping Office for Reducing Emissions has been supporting R&D and demonstration projects for various clean maritime technologies, including hydrogenpowered vessels and the associated refuelling infrastructure. These efforts are helping to incentivise investment in the UK's design, manufacture, and operation of zero-emission vessels for both domestic and international shipping.

Rail

The UK and other countries including Germany are leading the way with hydrogenpowered trains. Germany's Coradia iLint, the world's first hydrogen-powered train, has been in operation since 2018, and the UK has been testing similar technologies, for instance HydroFLEX, the first UK's first heavy rail hydrogen train, developed by Porterbrook.

Way forward

Further work is needed to better define the scale of the opportunity for investing in the UK manufacturing of hydrogen propulsion technologies across land, maritime, and air transport, building on synergies with hydrogen production in other sectors and developing a clear investment proposition for global markets.

A joint industry-government taskforce has identified a vision for the sector and will recommend how best to maximise investment opportunities for UK manufacturing of hydrogen propulsion systems. The taskforce will explore recommendations that will leverage existing initiatives across the advanced manufacturing policy landscape.

Timelines

• In **2024** we launched an industry taskforce, which will work together to identify an agreed vision for the sector, highlighting the steps to implement our ambitions.

• By **2026** the taskforce will recommend how best to maximise investment opportunities for UK manufacturing of hydrogen propulsion systems. These recommendations will consider:

- a. our manufacturing strengths,
- b. the potential of hydrogen propulsion systems across a number of applications, and
- c. potential technology developments to 2050.

• By **2035**, our ambition is for the UK to be an established global leader in the design and manufacture of hydrogen propulsion systems across all transport modes, enabling the rapid commercialisation and at scale deployment of UK content in such technologies around the world.

• By **2050**, hydrogen propulsion technologies are produced at scale in the UK on a commercial basis and are ubiquitous in hydrogen powered maritime, aviation, rail and automotive applications globally, where there is a clear commercial opportunity.

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