May 2024

Hydrogen UK

Hydrogen Import and Export: Unlocking the UK's hydrogen trade potential

Contents

Introduction

Hydrogen UK represents organisations across hydrogen production, transportation, storage, and end user interests, acting as a unified voice for the role of hydrogen in the UK. Our aim is to enable the UK to become a world leader in the application and service of hydrogen, to deliver excellence throughout the supply chain and create a globally attractive import and export market.

Membership of the Import and Export Taskforce includes:

- Air Products
- Baringa
- bp
- Cadent
- Centrica
- EET Hydrogen
- Equinor
- Exolum Venture
- Foresight Group
- Fortescue Future Industries
- Green Hydrogen Solutions
- Interconnector
- Johnson Matthey
- Kellas Midstream
- National Gas
- Net Zero Technology Centre
- Phillips 66
- RWE
- Slaughter and May
- Source Galileo
- SSE
- Uniper Energy

Executive Summary

Hydrogen trade is an emerging area of interest for hydrogen developers, end-users, traders and governments around the world. It can enhance system flexibility, energy security and clean growth, enabling decarbonisation at a lower cost and faster pace. Thanks to its competitive advantage in existing ports, terminals and interconnectors, the UK is well placed to be the European trade hub for hydrogen and its carriers. With its access to world leading offshore wind generation capacity and geological storage, the UK will almost certainly be a net exporter of hydrogen in the future, delivering economic value and creating jobs. However, hydrogen trade will not be a one-way process. In order to best position the UK as a future hydrogen trade hub, there could be value in investing in small scale hydrogen imports and exports to 'wet the pipes' and stimulate investment in infrastructure. Imports could also enhance our energy security as a part of a diverse energy mix and support demand whilst domestic production gets up to speed. Both imports and exports will be key to build supply chains and skills and enhance clean growth. With major European economies having established their hydrogen trade strategy, there is growing uncertainty as to how the United Kingdom will capitalise on its competitive advantage and position itself in the global hydrogen market.

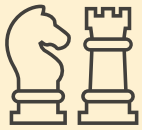
This is the first qualitative report released by Hydrogen UK's Import and Export Taskforce. This report aims to provide a high-level overview of Hydrogen UK's vision and recommendations, with subsequent reports exploring this topic in further detail.

The need for pipelines and hydrogen carriers

A wide range of technologies are available to transport hydrogen. For intra-European hydrogen trade, hydrogen can be compressed to high pressure and transported through pipelines at relatively low cost. 100% hydrogen pipelines are mature technology, with 1,600 miles already deployed in the United States. However, transporting hydrogen through pipeline, particularly over longer distances, can be challenging. Shipping compressed hydrogen could offer a viable alternative, but due to low energy density of gaseous hydrogen, it may not be cost-effective. For longer distance transportation, there are a number of alternative technologies available that can simplify and reduce the cost of transport. At extremely low temperature, hydrogen can be liquified and stored in cryogenic tanks, considerably reducing the required storage space. Alternatively, hydrogen can be bonded with other molecules to form hydrogen carriers, such as ammonia, liquid organic hydrogen carriers (LOHC) or metal hydrides. Hydrogen carriers have higher energy density, resulting in simpler fuel handling and less expensive shipping compared to compressed and liquified hydrogen. Some of the carriers, like clean ammonia or methanol, can also be used directly in industry, power generation and transport, without the need to 'reconvert' them to hydrogen. Hydrogen UK believes that all of these technologies will have an important role to accelerate decarbonisation and exploit the UK's renewable potential.

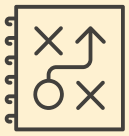
Hydrogen Trade Accelerators – Recommendations to Government

Future proof business model
To maintain agility, the design of the Hydrogen Production Business Model needs to be flexible and future proof.



Strategic planning
The NESO will be critical to maximise investment efficiency and energy security, and ensure a balance between domestic production and trade.

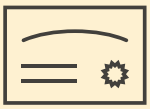
Allow sales to intermediaries
Allowing sales to risk-taking intermediaries under Hydrogen Production Business Model would build supply chain resilience and increase market liquidity.



Set out Government vision
Setting out Government vision on how hydrogen trade will develop in the short to medium term is key to unlocking investment.

Review decision on regulation
Secondary legislation should remain flexible, with eligible feedstocks being set in the allocation round guidance.

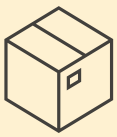
Coordination with the EU
To maximise the UK's hydrogen export potential, the deployment of hydrogen infrastructure needs to be coordinated with the EU.



Continue progress on certification
In addition to the LCHS, international cooperation is needed to reach mutual recognition of certification frameworks.

Support infrastructure
Ports, terminals, offshore and hydrogen pipeline infrastructure developers need support to carry out feasibility studies and prepare for the Net Zero transition.

Launch demand side support
Targeted demand side support would accelerate decarbonisation in energy intensive and hard-to-abate sectors.



Identify import and export opportunities
More research is needed on hydrogen supply and demand within the transitioning UK energy system while domestic production is built-out.

Hydrogen UK's vision of hydrogen trade

The UK at the heart of European and International hydrogen trade

The UK is well positioned to become a net exporter of renewable and low carbon energy. Whilst hydrogen trade is generally considered to be a one-way transaction, the UK needs to develop both import and export capabilities to become a net exporter of renewable and low carbon energy in the long term. This is because both imports and exports are critical for the UK to become an international hydrogen hub and an entry point for European imports from other low cost production centres globally.

Hydrogen exports will help:

1. Increase the domestic hydrogen production capacity,
2. Strengthen supply chains and skills (throughout the entire supply chain except for end-use),
3. Stimulate clean growth, and increase the UK's strategic importance as a trusted partner to supply low carbon energy to Europe, as highlighted in DESNZ's Hydrogen Production Delivery Roadmap.

Imports will have an important role to:

1. 'Wet the pipes' as domestic production is getting up to speed,
2. Strengthen supply chains and skills (throughout the entire supply chain except for production),
3. Accelerate decarbonisation, and enhance energy security as part of a diverse energy mix.

Our favourable geographical location and third largest LNG infrastructure in Europe (see Figure 1) already allow us to regasify and export North American and Middle Eastern LNG, supporting the resilience of both the UK and mainland Europe. Enabled by our extensive LNG and gas interconnector infrastructure, the UK was able to respond to the energy shock resulting from the Russia-Ukraine conflict and increase gas exports by over three times in 2022 compared to 2021.

Our LNG, LPG and liquid fuel infrastructures are not stranded assets. The limited European import infrastructure, long **lead time** for conventional LNG terminals and their compatibility with hydrogen and hydrogen carriers put the UK into a competitively advantageous position for hydrogen imports.

From an export perspective, the UK is already linked to several European countries by gas interconnectors. New-build and repurposed gas interconnectors could allow low cost and large-scale hydrogen exports to mainland Europe. While repurposing existing gas interconnectors could reduce lead time and **cost of hydrogen exports**, newbuilt hydrogen interconnectors will enhance resilience and increase hydrogen export capacity.

By capitalising on our advantage in existing infrastructure that could be repurposed for hydrogen carriers, the UK can secure and strengthen its position as a major European energy hub. In addition to unlocking jobs and clean growth, our role as a renewable energy land-bridge will provide flexibility to the grid and enhance energy security of the UK and wider Europe. Whilst the UK has all the necessary assets and capabilities to become an international hydrogen hub, first movers' advantage is critical. The UK has to secure hydrogen trading relationships and trade routes early-on, particularly in light of the competition from demand centres such as the European Union.

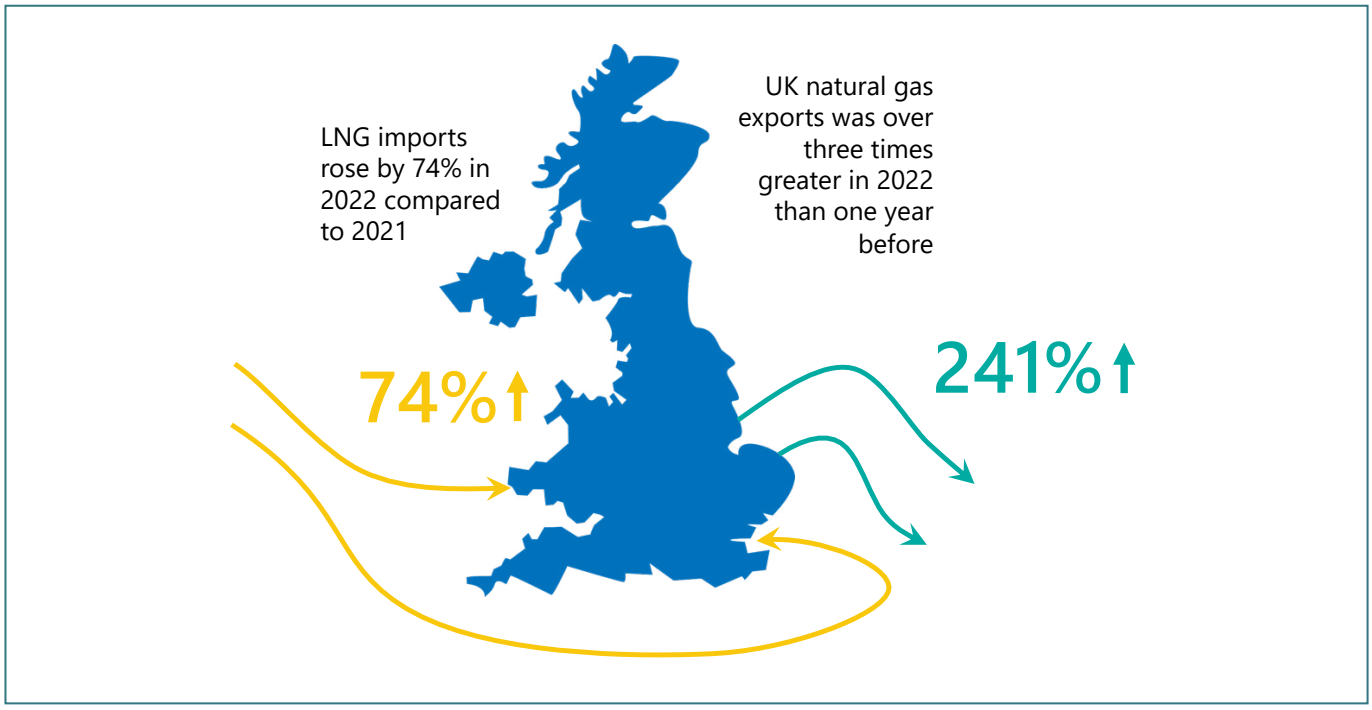


Figure 1: Both hydrogen imports and exports are needed - the UK as a land-bridge for LNG imports

Leveraging the UK's geology and renewables potential

The UK has vast renewable energy potential, most of which remains untapped. Our installed offshore wind capacity already accounts for **24% of the global offshore capacity**, with the capacity of solar, offshore and onshore wind generation potentially growing more than **fivefold by 2050**. Despite this competitive advantage, the electricity grid is already struggling to fully exploit our renewable resources. **2.3 TWh of wind energy was curtailed** in 2021 due to network constraints or lack of demand, costing costumers £507 million. The total curtailment cost was made up of £141 million in payments to renewable producers to shut down their generation and £429 million to alternative plants to compensate for curtailment. With increasing renewable deployment, it is estimated that nearly **23% of renewables could be curtailed** in 2035. Hydrogen production and export provide an opportunity to **reduce curtailment costs** and take advantage of excess and low cost renewable energy.

While the UK could sell some of the surplus electricity via interconnectors directly, hydrogen production and export opens the door to new and greater market opportunities. Despite efficiency losses at conversion, transporting energy via gas pipeline is **more efficient and cheaper** compared to high voltage powerlines. As highlighted by **Baringa's recent analysis**, developing hydrogen interconnectors is key to compete with other countries exporting hydrogen to mainland Europe. Given our hydrogen storage potential is leveraged, the UK could also store significant volumes of renewable energy, helping to balance the seasonal energy demand of European countries with no or limited geological storage capacity.

Like the UK's role as hydrogen hub, exporting domestically produced hydrogen will also unlock jobs and economic growth. The **Scottish Hydrogen Action Plan** estimates that a renewable hydrogen sector with a strong focus on exports could support up to 300,000 jobs and contribute up to £25bn to GVA by 2045, in Scotland alone. Hydrogen export would not only boost and grow the economy but would also put the UK at the forefront of decarbonisation, enabling it to support the decarbonisation of European countries that have limited access to low cost renewables or large scale geological hydrogen and CO_2 storage.

Hydrogen Backbone Link

The **Hydrogen Backbone Link report**, published by the Net Zero Technology Centre, suggests that electrolytic hydrogen produced in the UK could be cost competitive with hydrogen produced in other renewable-rich countries, such as Canada, Chile and the Middle East. The report assessed the techno-economic feasibility of repurposed and purpose-built offshore interconnectors between the UK and Germany. Despite higher hydrogen production cost, the lower cost of transporting hydrogen through pipelines would make Scotland and the rest of the UK well placed to meet a considerable share of Europe's excess hydrogen demand. The report also highlights that the technology needed is already well developed, with some investment still needed in compressor and valve manufacturing.

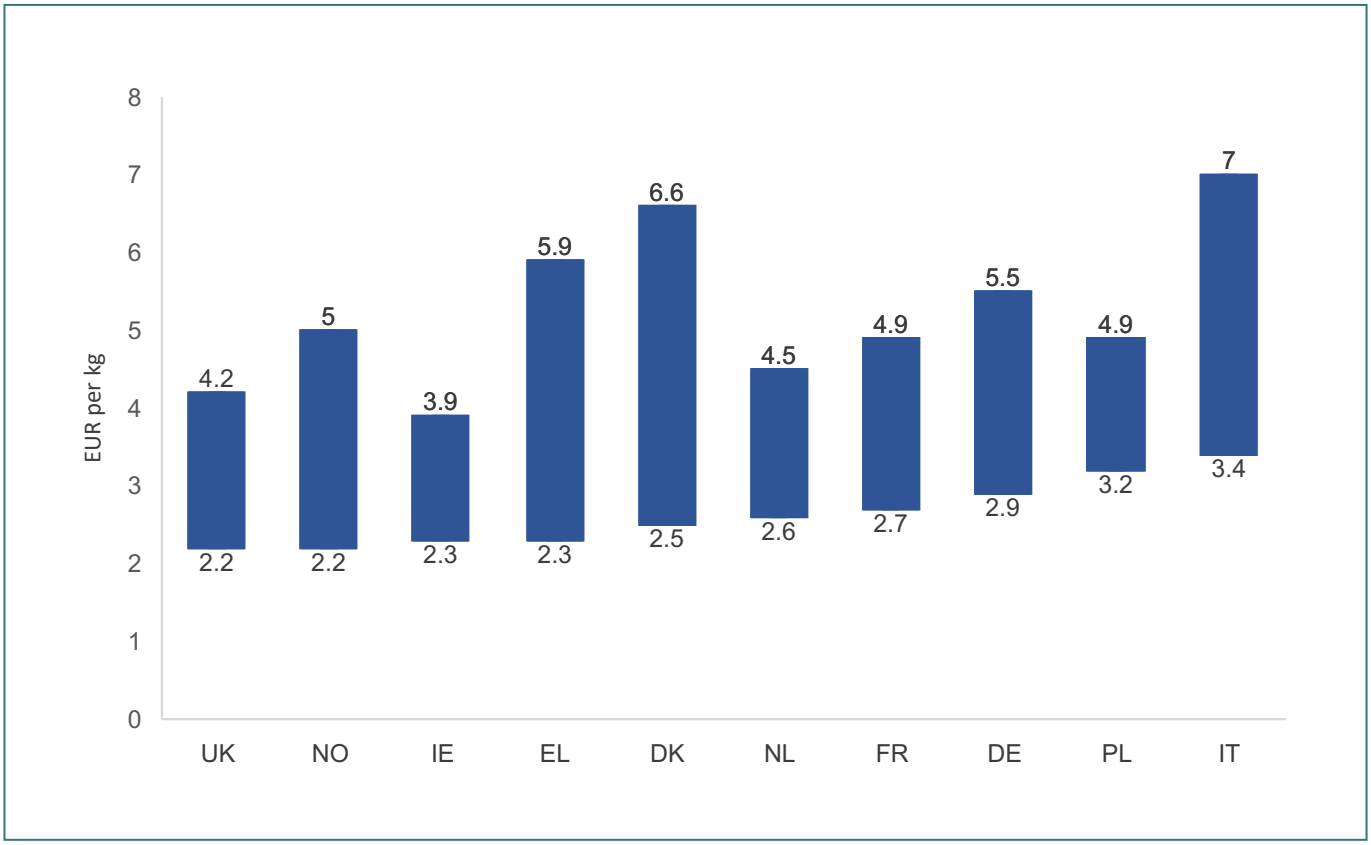
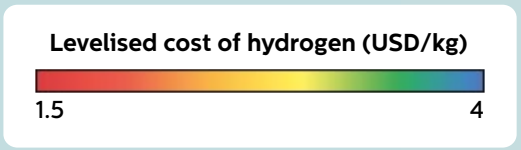


Figure 2: Levelised cost of hydrogen from onshore and offshore wind in selected countries
Source: Hydrogen Europe (2022) Clean Hydrogen Monitor 2022

Levelised Cost of Hydrogen

As the International Energy Agency's **recent analysis** illustrated, the United Kingdom has a competitive advantage in hydrogen production, with abundant renewable resources and relatively low Levelised Cost of Hydrogen (LCOH). This piece of analysis considered the most cost-optimal capacities for solar PV, wind, electrolysers, battery storage and curtailment.



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Democratising the global energy market

The structure of the global hydrogen market will be different to the existing fossil fuel market. Whereas any of the large suppliers could influence the prices and distort the global market for fossil fuels, demonstrated by the Russian invasion of Ukraine, the low carbon hydrogen market will consist of a great number of countries and suppliers, none of whom can shape the market on their own. As highlighted by a **recent CCC report**, the wider access to renewable energy and the greater competition in the global hydrogen market offers the UK an opportunity to diversify its energy supply across multiple countries.

64%

of global gas reserves are in just 5 countries

Moreover, hydrogen imports will form part of a diverse energy mix, with the UK relying on many alternative ways to close the initial gap between domestic hydrogen demand and supply, highlighted by the **Climate Change Committee**. As the UK is likely to meet the majority of its hydrogen demand through domestic production in the long term, the role of imports will be to accelerate decarbonisation, enhance flexibility and strengthen energy security. This is reflected in the most recent National Grid **Future Energy Scenarios**, with almost 32 TWh of hydrogen being imported in 2050 under Leading the Way Scenario.

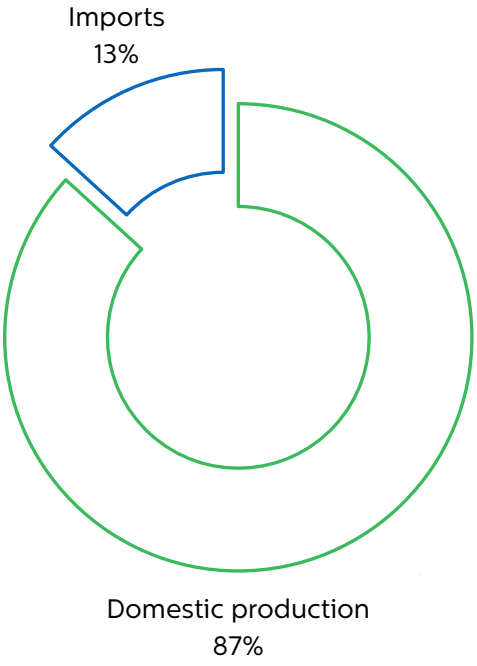


Figure 3: Domestic hydrogen consumption in 2050 under National Grid's Leading the Way scenario

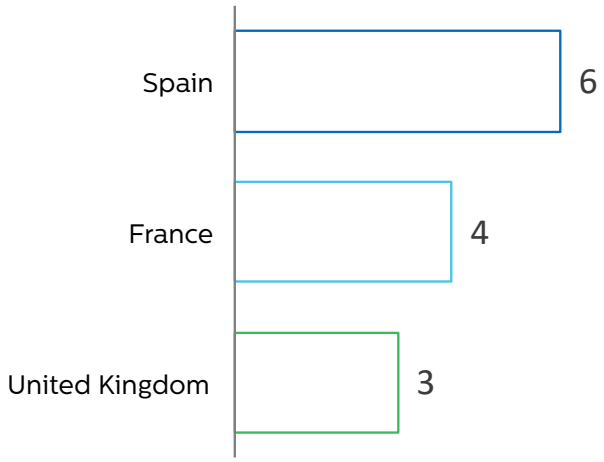


Figure 4: European countries with the most LNG terminals

Building supply chain resilience

Hydrogen exports and imports could also build domestic supply chain resilience. Despite not affecting domestic production, our early experience in importing will develop and stabilise UK supply chain in transport, storage and end-use by the time the domestic hydrogen economy matures. Although exporting hydrogen will not affect supply chain in the demand sectors, it will provide a great opportunity to help increase domestic production and build resilience in the rest of the supply chain. As hydrogen trade offers an opportunity to maximise UK content in our supply chain, UK plc could gain first mover advantage, allowing them to export their products, technology and expertise oversees.

Unlocking investment efficiency by leveraging existing capabilities

Finding the right balance between domestic production and hydrogen trade will allow the UK to meet net zero in the most cost-efficient manner. Importing hydrogen in the short-term, whilst domestic production comes online, will give our industrial heartlands, companies and households access to low-cost hydrogen and its carriers, reducing the investment required for meeting net zero. This investment saving will be mainly driven by the lower levelised cost of producing hydrogen in sunnier and windier countries and those with lower operational costs. The **Hydrogen Council** estimates that system capital expenditures associated with the energy transition could be 15% ($1.5 trillion) higher with reduced willingness to trade, with some countries forced to utilise expensive production methods instead of importing low cost alternatives. Investment efficiency could be further increased if existing infrastructure is repurposed for hydrogen trade. Repurposing existing natural gas pipelines could **cut investment costs by 50 to 80%** compared to building new hydrogen pipelines. Given our competitive advantage in existing LNG, liquid and gaseous fuel infrastructure, this is an area of great opportunity for the UK.

Accelerate decarbonisation

While hydrogen is critical for decarbonisation, it will take time until domestically produced hydrogen is commercially available in large volumes. This is due to the unavailability of T&S infrastructure and bottlenecks across the supply chain. There is a general uncertainty among potential hydrogen end-users as to how and when they will gain access to low-cost low-carbon hydrogen, ammonia and methanol at the required scale. As highlighted in the **CCC's 2023 Progress Report**, "meeting the demand for hydrogen across the UK's energy system is likely to require a substantial contribution from imported energy at least until the early 2040s". Hydrogen imports could offer a valuable alternative to offtakers who need hydrogen before domestic production gets up to speed and a nationwide infrastructure comes online. Strong domestic production complemented with imports offers a great potential to close the gap between domestic supply and demand in the short term.

State of play

Hydrogen Trade Strategy

Policy in the UK has made considerable progress, achieving key milestones in the past months. The most recent Hydrogen Strategy Update clearly signalled a strong support for hydrogen export. It is also confirmed that the North Sea Transition Authority (NSTA) will be responsible for licensing offshore hydrogen infrastructure projects. This decision is key to commission offshore hydrogen storage and build interconnectors, allowing the UK to export hydrogen to mainland Europe. Progress with international cooperation, like signing a **declaration of intent** on mutual recognition of international hydrogen certification schemes at COP28, also improves investment certainty.

However, the UK needs to maintain this momentum and provide more clarity on hydrogen trade strategy. To manage market expectations, the Government needs to set out its vision on how hydrogen import and export will develop over time.

Renewable Transport Fuel Obligation

Currently, there is one support mechanism which could stimulate hydrogen trade. Under the Renewable Transport Fuel Obligation (RTFO), some hydrogen and ammonia imports are eligible for support. While this is a good first step to decarbonise road, non-road and maritime transport, the differences between the hydrogen and biofuel industry mean that they face different market, policy and regulatory barriers. Due to the nascency of the hydrogen market, developers face higher revenue uncertainty and generally higher CAPEX cost, meaning that the level and the volatility of support that is available under the RTFO is not suitable to unlock the large-scale projects that are needed for hydrogen production and transport. The RTFO is a key mechanism to help decarbonise the transport sector, however importing low carbon hydrogen, ammonia and methanol for hard-to-abate industrial sectors and power generation remains without demand-side support.

Fuel	2018	2019	2020	2021
Hydrogen	0%	0%	0%	0%
Biomethane	96%	75%	87%	80%
Ammonia	Not eligible	Not eligible	Not eligible	Not eligible

Table 1: Share of imports in volume supported under RTFO (%)
Source: Department for Transport (2022) Renewable fuel statistics 2021: Final report

Hydrogen Production Business Model

The design of the UK's main and most significant hydrogen support mechanism, the Hydrogen Production Business Model (HPBM) does not currently support any form of hydrogen trade. From an export and supply chain perspective, the main barrier is that producers are not allowed to export or sell their hydrogen to risk-taking intermediaries. Allowing risk-taking intermediaries as an eligible offtake would unlock a number of supply chain opportunities and send a signal to industry to develop a stable and strong supply chain by the time the UK becomes a net exporter.

From an import perspective, neither imported hydrogen nor carriers as feedstock are supported under the HPBM. Under current proposals, hydrogen produced using fossil fuel imported from outside the UK would be eligible for revenue support, whereas low carbon hydrogen produced using low carbon hydrogen carriers imported from another country would be excluded from support. As no funding is available for imported low carbon gaseous or liquid hydrogen molecules, most hydrogen imported into the UK today is produced using fossil fuels with no emissions captured. It is important that HPBM remains future-proof and agile, and imported carriers as feedstock are not excluded through secondary legislation. The immediate priority of the UK should be to develop strong domestic hydrogen capabilities, but this should not distract us from wider, whole-system considerations. To ensure agility, the Government needs to identify the UK's import requirement and leave the door open to future hydrogen imports.

Direct use of hydrogen carriers

Whilst stimulating investment into 'reconversion' technologies, such as ammonia cracking and LOHC reformation, is increasingly needed to meet net zero targets, some end users will be able to use hydrogen carriers directly. Imported low carbon ammonia can be used directly as a feedstock or fuel in a range of industries, including fertiliser, refrigerant and explosive production, maritime transport and power generation. As the reconversion process is energy intensive, hydrogen carriers that are directly used have a generally higher round-trip efficiency and lower cost.

With the closure of the UK's last ammonia production plant in Billingham in 2023, the UK is now importing **100% of its ammonia** and **60% of its fertiliser** requirements, none of which is currently low carbon. Although the **Carbon Border Adjustment Mechanism** (CBAM), recently launched by the UK Government and coming into effect in 2027, will help to reduce the price gap between low and high carbon products, additional demand side support is needed to accelerate the decarbonisation of energy intensive industries. Hydrogen UK welcomes that clean ammonia qualifies as an eligible maritime fuel under the RTFO, but it is critical that the UK maintains momentum and provides adequate and stable support to other end use sectors of ammonia and methanol, such as fertiliser production and power generation.

The first movers in Europe

The **International Energy Agency** (IEA) estimates that 2.4 million tonnes of hydrogen export per year is planned to come online by 2026 globally. Looking to leverage this opportunity, many European countries are aiming to be among the first to gain access to low cost and low carbon hydrogen imports.

The European Commission recognised the value in a balance between domestic production and hydrogen imports in the **REpowerEU Plan**. By 2030, the EU is aiming to produce 10 million tonnes of hydrogen domestically, whilst also importing 10 million tonnes of electrolytic hydrogen from outside the EU. To enable the import of this volume, the European Commission strategically selected three major hydrogen import corridors that would form part of the continent-wide hydrogen pipeline network, the European Hydrogen Backbone. In addition to EU-level initiatives, Germany launched the first auction for electrolytic hydrogen under the H2Global double-auction programme in 2022. Germany's **updated hydrogen strategy** also confirmed that imports will play a significant role in their hydrogen economy, meeting 50%-70% of the estimated 95-130 TWh of domestic demand in 2030, and that there will be a role for both electrolytic and low carbon hydrogen. This strong government signal will be supplemented by a separate Import Strategy, to be published in early 2024. The Netherlands is also preparing its first auction which is due to take place in 2024. The European Union agreed in June 2023 to link the European Hydrogen Bank with the H2Global, meaning that any EU member state will be able to run their own tender in the near future, using the EU Hydrogen Bank's auction mechanics and infrastructure, and applying common EU standards.

International context – inconsistent hydrogen standards

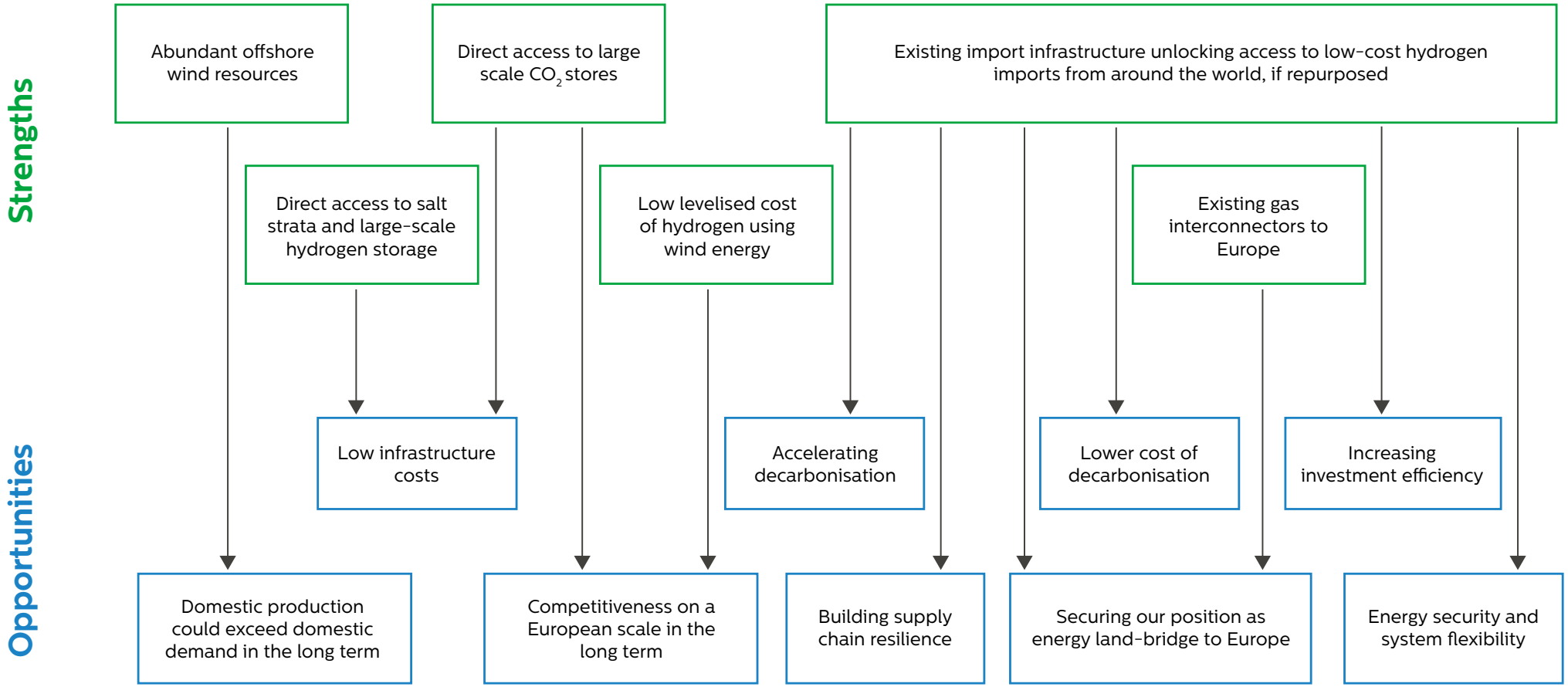
As hydrogen production and trade are areas of emerging interest, a wide range of supply and demand side support mechanisms have been proposed or launched worldwide. In the absence of comprehensive global cooperation, low carbon hydrogen schemes use different methodologies to measure greenhouse gas (GHG) intensity and have different definitions of how low carbon or sustainable hydrogen can be produced. With different production methods, chain of custody methods, GHG intensity, additionality and temporal correlation requirements, there is no to very limited consistency, slowing down the development of the global hydrogen market.

This lack of consistency has been highlighted by the **Hydrogen Champion report** and a recent **IEA report**. The IEA has been advocating for a harmonised and consistent hydrogen certification system which could minimise market fragmentation and further improve investment efficiency. COP28 was a key international milestone as the UK Government, along with 38 other nations, signed a Declaration of Intent on the mutual recognition of certification schemes for renewable and low-carbon hydrogen and its carriers. Hydrogen UK believes that the UK Government should maintain this momentum and continue progress on ensuring that the UK Low Carbon Hydrogen Certification and other international certification schemes are aligned or mutually recognised.

Scheme	Country	Scope	Production	GHG intensity
RTFO		Well-to-point of delivery	Renewable electricity, biomethane	4 kg CO2e per kg H2
Low Carbon Hydrogen Standard		Well-to-gate	Electricity, gas CCS, biomass and waste	2.4 kg CO2e per kg H2
RED II		Well-to-wheel	Renewable and low carbon electricity	3.4 kg CO2e per kg H2
Clean Hydrogen Investment Tax Credit		Well-to-gate	All	<0.45 kg CO2e per kg H2 for full support
H2Global		Well-to-point of delivery	Renewable electricity	3 kg CO2e per kg H2

Table 2: RTFO and LCHS compared to other low carbon hydrogen schemes
Source: IEA (2023) Towards hydrogen definitions based on their emissions intensity

UK Strengths and Opportunities



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Hydrogen Trade Accelerators

Set out strategic plan and adopt position on hydrogen trade

Strategic planning is critical to maximise investment efficiency, clean growth and sustainability gains. DESNZ and the emerging National Energy System Operator (NESO) must identify the optimal balance between domestic production, import and export to enhance energy security and decarbonise the energy system in a cost-efficient manner. Adopting a position and setting out the government's vision on hydrogen trade and specifying hydrogen import and export targets will unlock private investment and research by setting market expectations and enabling businesses to plan accordingly. Moreover, the roles of DESNZ and the NESO will be key to identifying ports, terminals, pipelines and other enabling infrastructure which could play strategic importance in accelerating hydrogen trade. To maximise the UK's hydrogen export potential, this strategic plan should be coordinated with hydrogen infrastructure development in the EU.

Optimise Hydrogen Production Business Model and target end users

Sufficient flexibility and agility should be built into the business model through secondary legislation. To enable the efficiencies provided by hydrogen trade, DESNZ must make two amendments to the initial design of the Hydrogen Production Business Model. Firstly, risk-taking intermediaries must be recognised as an eligible offtake option. This would give transport, storage and other midstream companies access to hydrogen, building up supply chain resilience by the time the UK is ready to be a net exporter of hydrogen.

Secondly, Hydrogen UK believes that Government should remove barriers to future hydrogen imports and exports. To enable hydrogen imports, DESNZ must review its decision to exclude hydrogen carriers from eligible feedstocks through secondary legislation and, instead, set out eligible production pathways in each allocation round guidance. This would allow ammonia cracking and other dehydrogenation methods to be recognised as eligible production methods in due course.

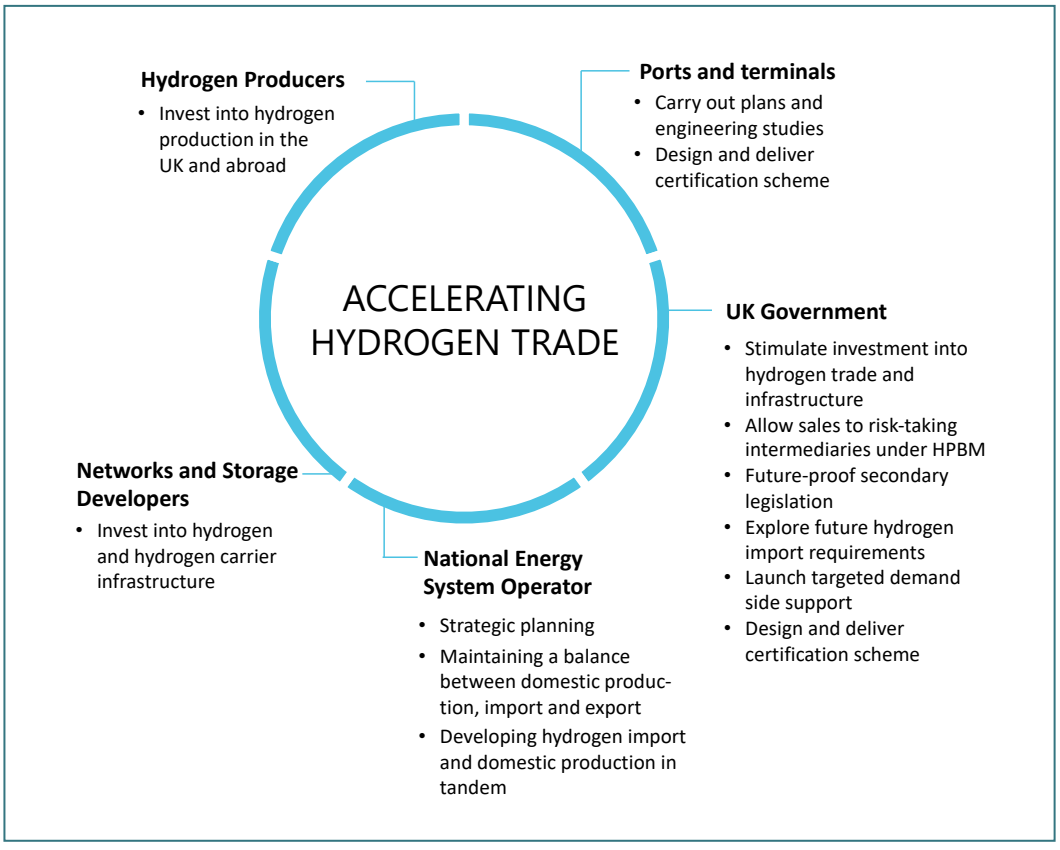
As noted in previous Hydrogen UK publications, demand side measures are key to building up a strong hydrogen economy. Providing specific end use cases with adequate and stable support would accelerate decarbonisation of energy intensive industries and hard-to-abate sectors wanting to use low carbon hydrogen, ammonia and methanol in the future, and stimulate investment into emerging technologies, such as new maritime technologies and ammonia power generation.

Support enabling hydrogen trade infrastructure

Repurposing existing liquid and gaseous fuel infrastructure is a low hanging fruit due to relatively low cost and short lead time. However, government support is needed to stimulate investment into first-of-a-kind (FOAK) infrastructure projects, create learnings and remove market barriers for future projects. Further support for repurposing existing infrastructure, such as pipelines, ports, LNG, LPG and liquid fuel terminals will allow them to carry out port plans and commission engineering studies to understand the hydrogen-ready technical requirements. In addition to essential terminal and port projects, the Hydrogen Transport and Storage business models need to take a technology agnostic approach and support offshore pipelines, hydrogen carrier network and storage projects once key regional projects are off the ground. The UK Government needs to provide more clarity on when offshore and hydrogen carrier T&S projects could become eligible under the business models. Building out import and export infrastructure as early as possible is key to build supply chain resilience and secure the UK's potential as a major European energy hub.

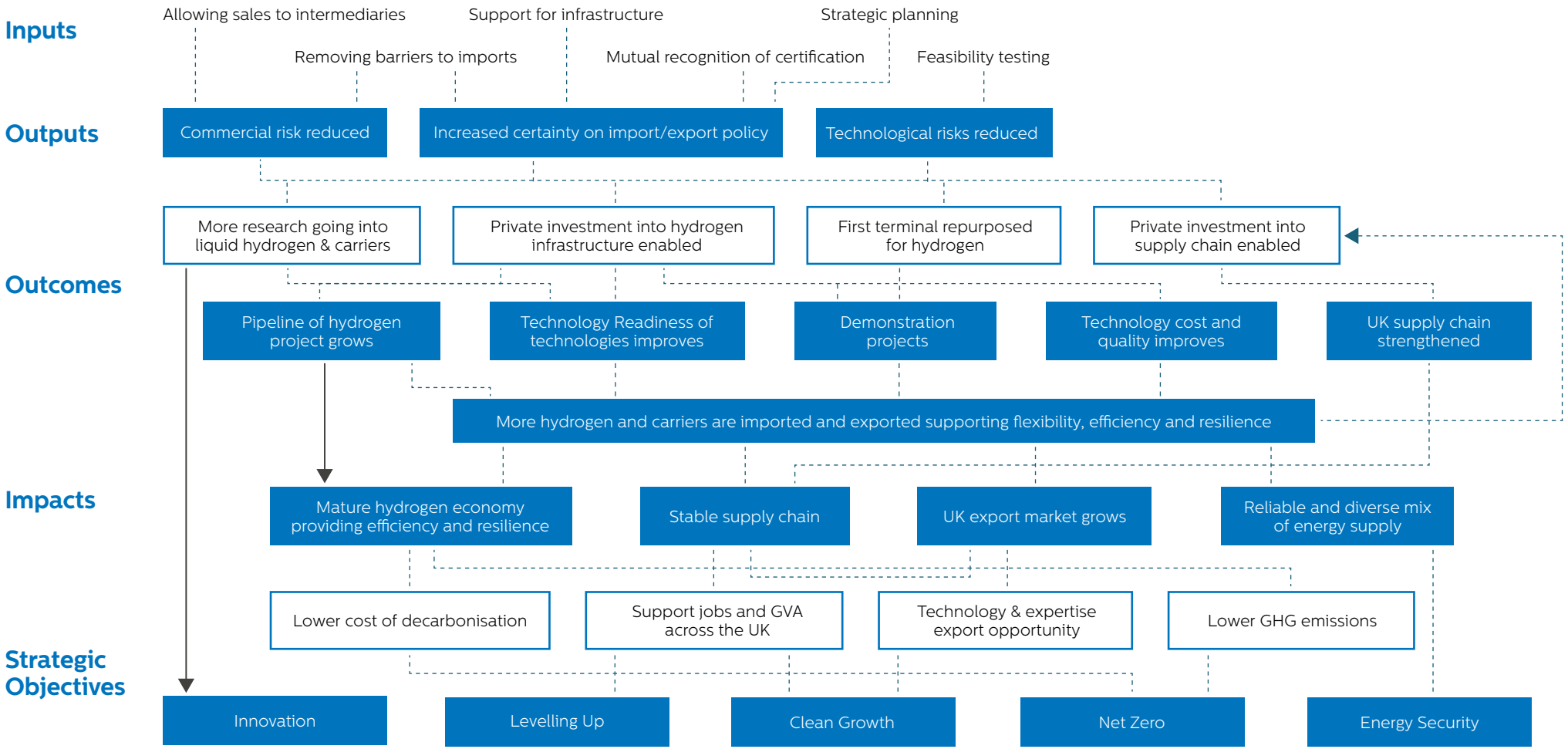
Mutual recognition of standards and certification system

To reduce administrative burden and build consumer trust, it is imperative that the UK Low Carbon Hydrogen Certification Scheme and other international standards are mutually recognised. Acknowledging the significant progress made at COP28, we believe that the UK needs to continue working with international organisations to mutually recognise and/or minimise deviations between the Low Carbon Hydrogen Certification Scheme and other major certification schemes. To enhance investor certainty, DESNZ needs to set out a roadmap of how and when harmonisation will be in place. Mutual recognition of certification and accounting framework will be key to avoid market fragmentation and duplication in regulation. Such administrative burdens could contribute to a global hydrogen market failure and increase the cost of decarbonisation.



Our vision as Theory of Change

A Theory of Change describes how change is assumed to come about through intervention. In the figure below, we illustrate how six government interventions could help overcome the market barriers of commercial and technological risks and investor uncertainty. The following outputs, outcomes and impacts could help Government deliver its broader strategic objective, like Innovation, Levelling Up, Clean Growth, Net Zero and Energy Security.



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