Written Evidence Submitted by Unitrove

(HNZ0072)

THE ROLE OF HYDROGEN IN ACHIEVING NET ZERO

THE NEED FOR MARITIME HYDROGEN INFRASTRUCTURE

- This document has been written by Unitrove in response to a call for evidence by the UK Government concerning "*The role of hydrogen in achieving Net Zero*" with a specific focus on the UK opportunities for the maritime sector.

- The UK government's net-zero ambitions for shipping are outlined in "*Point 6: Jet zero and green ships*" of the *Ten Point Plan for a Green Industrial Revolution*, which describes how: "*We are already running hydrogen ferry trials in Orkney and due to launch a hydrogen refuelling port in Teesside, as we seek to revitalise our ports and coastal communities.*"

- Unitrove is focussed on decarbonising the global maritime sector and believes the delivery of hydrogen as a marine fuel will complement electric-charging and other zero-emission fuels such as ammonia, liquid organic hydrogen carriers (LOHC), and sodium borohydride.

- Unitrove is most notably working to build the world's first liquefied hydrogen (LH_2) bunkering facility for fuelling zero-emission ships. The company also plans to build the world's first liquefied-to-compressed gaseous hydrogen (L-CGH_2) bunkering facility.

- Widespread deployment of large-scale hydrogen infrastructure is necessary to deliver a zero-emission future. This requires support from the government both in terms of investment and stricter regulation to increase hydrogen's competitiveness amongst existing fossil-fuels.

ENVIRONMENTAL IMPACT OF SHIPPING

- According to the Fourth IMO GHG Study, the amount of greenhouse gas emissions from shipping have increased from 977 million tonnes in 2012 to 1,076 million tonnes in 2018. This equates to an increased share of shipping emissions in global anthropogenic emissions from 2.76 % in 2012 to 2.89 % in 2018.

SOCIAL IMPACT OF SHIPPING

- According to leading research from the University of Delaware, ship pollution causes around 400,000 premature deaths and 14 million cases of childhood asthma every year, and the 200 worst polluting ships produces more sulphur than all the world's cars.

ZERO-EMISSION DILEMMA FOR SHIP OPERATORS

- Ships investments are extremely capital intensive. The average life of large ship can be anywhere between 20 to 40+ years, meaning that some vessels procured today anticipate operating beyond 2050. Any such carbon-based fuelled vessel newbuilds are potentially at risk of becoming a stranded asset in future.

- Zero-emission solutions are thus being considered for ships that have traditionally used heavy fuel oil (HFO) for propulsion, and the widespread availability of zero-emission bunkering infrastructure is essential.

- Most ship operators believe the cost of hydrogen fuel and technology is too high to invest in its future. Today, hydrogen fuelling infrastructure for ships is non-existent, and there will be no drive for zero-emission ships without zero-emission bunkering infrastructure.

General Trends in the Maritime Sector

- So far, the trend has been to switch to using low sulphur fuel oil (LSFO) or to install 'scrubber' technology for removing harmful exhaust components. However, this is not seen to be a long-term solution with a route to zero emissions.

- Most ship operators will do the bare minimum necessary to meet legal obligations. The risk of being a first-mover is extremely high due to the high capital costs and slim margins involved. The path of least risk is to align with what competitors are doing.

- Some innovative operators have turned to liquefied natural gas (LNG) for propulsion of their vessels to try and reduce emissions. However, LNG remains a carbon-based fuel and so can only ever be regarded as a 'transition fuel'.

Status of the Maritime Sector

- The IMO 2020 regulation mandates a maximum sulphur content of 0.5 % in marine fuels globally to help restrict sulphur oxide (SO_x) emissions.

- Proposals are being made to implement a new Energy Efficiency Existing Ship Index (EEXI) designed to enforce the reduction of carbon intensity of vessels. However, this is not likely to help shipping to achieve the IMO target of 50 % emissions reduction by 2050.

- Norway is currently leading the race for the development of the world's first ferry powered by liquefied hydrogen, which is due to be ready in late 2021. Japan built the world's first liquefied hydrogen carrier, Suiso Frontier.

HYDROGEN MARINE FUEL OPTIONS

- Liquefied hydrogen (LH_2) is a cryogenic flammable gas with a mass density of 71 kg/m³ which is −253 °C under ambient pressure conditions. Liquefied hydrogen is generally stored in a vacuum-insulated cryogenic vessel and has traditionally been used as a rocket propellant.

- Compressed gaseous hydrogen (LH_2) is a highly pressurised flammable gas. Typically, the pressures are 350 bar, 500 bar, and more recently 700 bar.

- Liquefied hydrogen has a higher volumetric energy density than compressed gaseous hydrogen but has a lower volumetric energy density than both liquefied natural gas and traditional fuel oils. This is an important consideration it has an impact of the size of the vessel's fuel tank (which takes up valuable cargo space).

- Ammonia (NH_3) is widely seen as a long-term zero-emission fuel for ships due to its relatively high volumetric density, ease of handling, comparatively low technology cost, and the ability to use existing infrastructure. However, it is highly toxic.

- Liquid organic hydrogen carriers (LOHC) such as perhydro-dibenzyltoluene (18H-DBT, $C_{21}H_{38}$) and methylcyclohexane (MCH, $CH_3C_6H_{11}$) are liquid-based innovations that have a high hydrogen-carrying density with the ease of handling.

- Sodium borohydride ($NaBH_4$) allows hydrogen to be carried in a solid powder form.

FINAL REMARKS ON HYDROGEN AND THE UK GREEN RECOVERY

- The UK has legislated to ensure that the net UK carbon account for the year 2050 is at least 100 % lower than the 1990 baseline as part of an Amendment to the Climate Change Act 2008.

- Hydrogen will be required to achieve net-zero emissions for decarbonisation of hard-to-abate sectors such as shipping, aviation, and petrochemical industry.

- The UK is yet to release its National Hydrogen Strategy whilst other nations have already published theirs. Germany has committed € 9 billion, and both France and Portugal each have committed € 7 billion of investment in hydrogen to 2030. The UK has only so far pledged moderate amounts of investment into hydrogen.

- The UK is due to host the COP26 in November 2021. The UK government will need to demonstrate how the wider society can benefit from the Green Recovery without poorer communities being left behind.

- The UK has left the European Union and the transition period is due to end on 31 December 2020. The UK government will need to demonstrate how it will support regions such as Teesside (that were predominantly in favour of Brexit) in post-Brexit Britain.

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