Immingham Green Energy Terminal

Issue Specific Hearing 1 (ISH1) Strategic Overview of the Proposed Development

Tuesday 20 February 2024 (pm)

Agenda Item 3: Applicant's Presentation as requested by the Examining Authority (ExA)

Structure of the Presentation

- Introductory comments
- Need for the Proposed Development
- Statement by Associated British Ports (“ABP”)
- Statement by Air Products (BR) Ltd.
- Components of the NSIP and Associated Development
- Comparison with other liquid bulk port developments
- Operation of the NSIP
- Operation of the Hydrogen Production facility:
  - Hydrogen Production: Step-by-step description during operation
  - Low Carbon certification
- Forecast of other users and jetty related activity
- Construction programme and phasing, operation and decommissioning

Introductory comments

Need for the Proposed Development

Statement by ABP

Statement by Air Products

Components of the NSIP and Associated Development

Component of NSIP (Work No.1)	Component of Associated Development (Work Nos. 2 – 10)
New in-river berth adjacent to the main navigation channel of the River Humber, including:	Jetty access road (Work No. 2)
• A jetty, consisting of an approach trestle, approximately 1.1km in length, leading up to one berth, including loading platforms and berthing and mooring dolphins with link walkways	Ammonia storage tank and associated, buildings, plant and infrastructure (Work No. 3)
• Jetty access ramp making landfall above mean high water mark	Underground culvert beneath Laporte Road connecting Work Nos. 3 & 5 (Work No.4)
• Topside loading and unloading infrastructure, including ancillaries	Hydrogen production facility and associated buildings, lant and infrastructure (Work No.5)
• Pipes, pipelines and utilities and associated works	Underground pipelines, pipes, cables linking (Work Nos. 3 & 7)
• Local raising flood defence	Hydrogen production, storage and distribution facility (Work No. 7)
• A capital dredge of the berth pocket to -14.5m below Chart Datum	Temporary construction lay down areas adjacent to Queens Road (Work No. 8) and Work No. 2 (Work No.9)
	Temporary modification of overhead lines and removal of highway signage (Work No. 10)

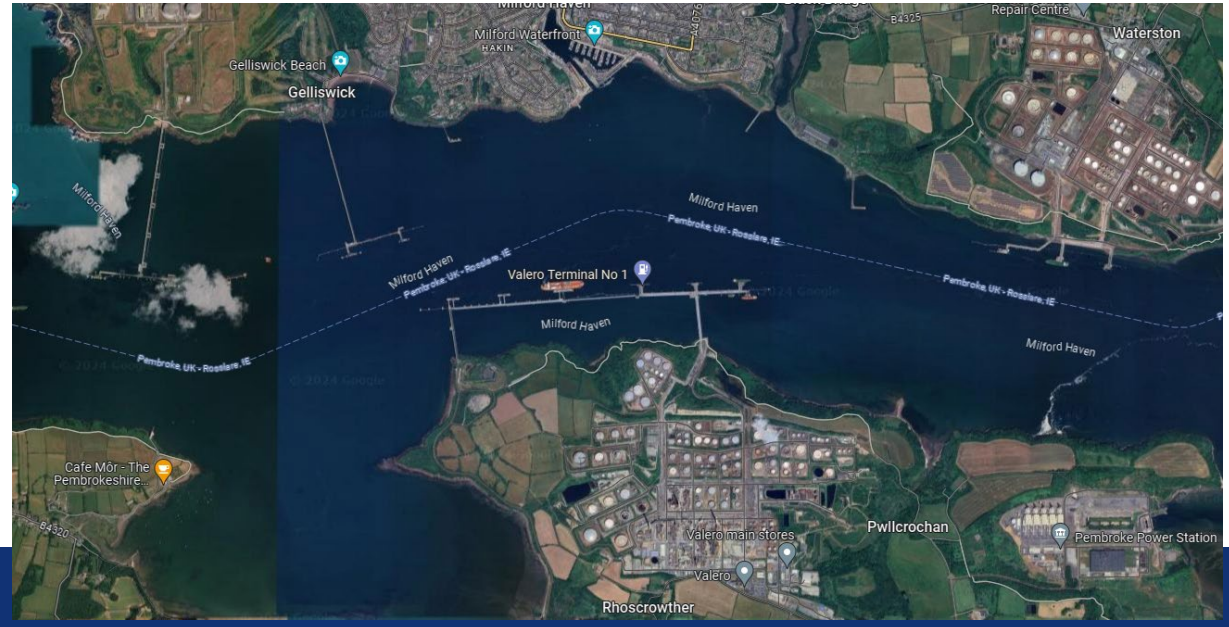
Comparison with other liquid bulk port developments

Immingham Oil Terminal

- 1 Liquid Bulk Jetty, approx. length 900m
- 7 Liquid Bulk Berths
- Max. Vessel Size, LOA 366.0m, Draft 13.1 (max)
- Landside storage facility (8ha)
- 8 km long pipeline connecting IOT with Prax Lindsey Oil Refinery and Phillips 66 Humber Refinery – combined 400ha (27% of UK refining capacity)

Milford Haven

- 4 Liquid Bulk Jetty's
- 14 Liquid Bulk Berths, largest in excess of 950m in length,
- Max Vessel Size (at Valero), LOA 365m, Draft 16.1m
- Storage capacity at Valero alone – 85,000,000 (bbl) in 52 tanks
- Largest jetty connects to South Hook LNG Terminal (One of Europe's largest handling 20% of UK gas demand)



Comparison with other liquid bulk port developments

Fawley Oil Terminal

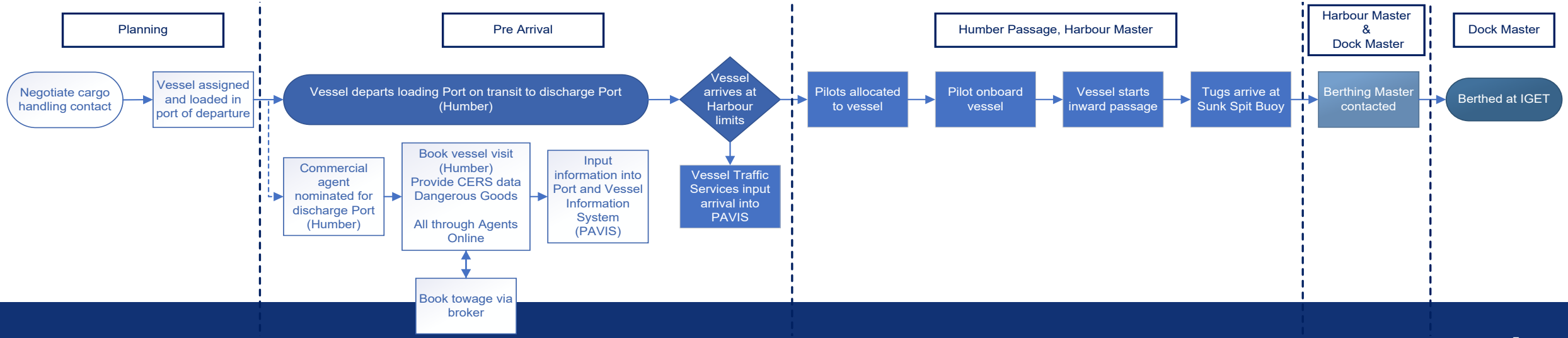
- 2 Liquid Bulk Jetty's, length approx. 450m
- 9 Liquid Bulk Berths (Jetty Head in excess 1,500m long)
- Max Vessel Size, LOA 368m Draft 14.9m
- Serving 506 ha Fawley Refinery
- 20 % of UK Refinery Capacity

Operation of the NSIP

The below flow chart aims to outline the typical operations involved in of one of the 34,000+ vessel movements on the Humber each year.

Passage Operations

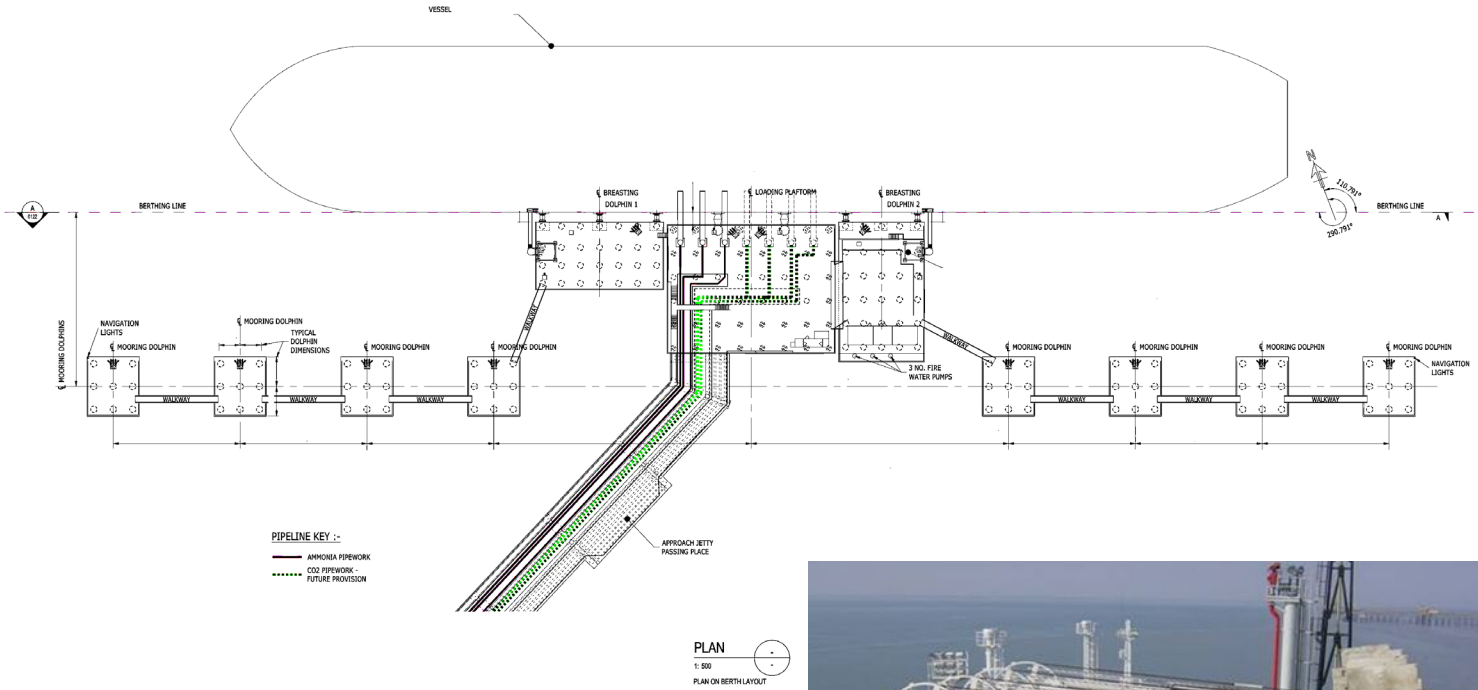
- The ships agent makes bookings for tugs, pilot and passage,
- The ship makes contact with Vessel Traffic Services (VTS) ahead of arrival – and will be ordered to anchor or be allowed to continue passage,
- On continuing as a passage plan vessel, the Pilot boards the ship via launch to guide the vessel to berth.



Operation of the NSIP (Cont.)

Berthing Operations

- The Berthing Master is contacted to oversee the final docking process, and the vessel continues its inward passage under the guidance of the Harbor Master & Dock Master.
- During the berthing process, tugs and pilots will assist the vessel to ensure it is safely and correctly positioned along the jetty. The crew on board and port personnel coordinate to secure the vessel.
- Once safely alongside, the Deck Officer and Air Products will manage the discharge of cargo. This will commence with the connection of the Marine Loading Arms at the jetty head.



How is green hydrogen produced and transported?

1 Clean Energy Generation

Renewables such as solar and wind generate electricity.

2 Green Hydrogen Production

Renewable electricity splits desalinated water to produce green hydrogen.

3 Processing

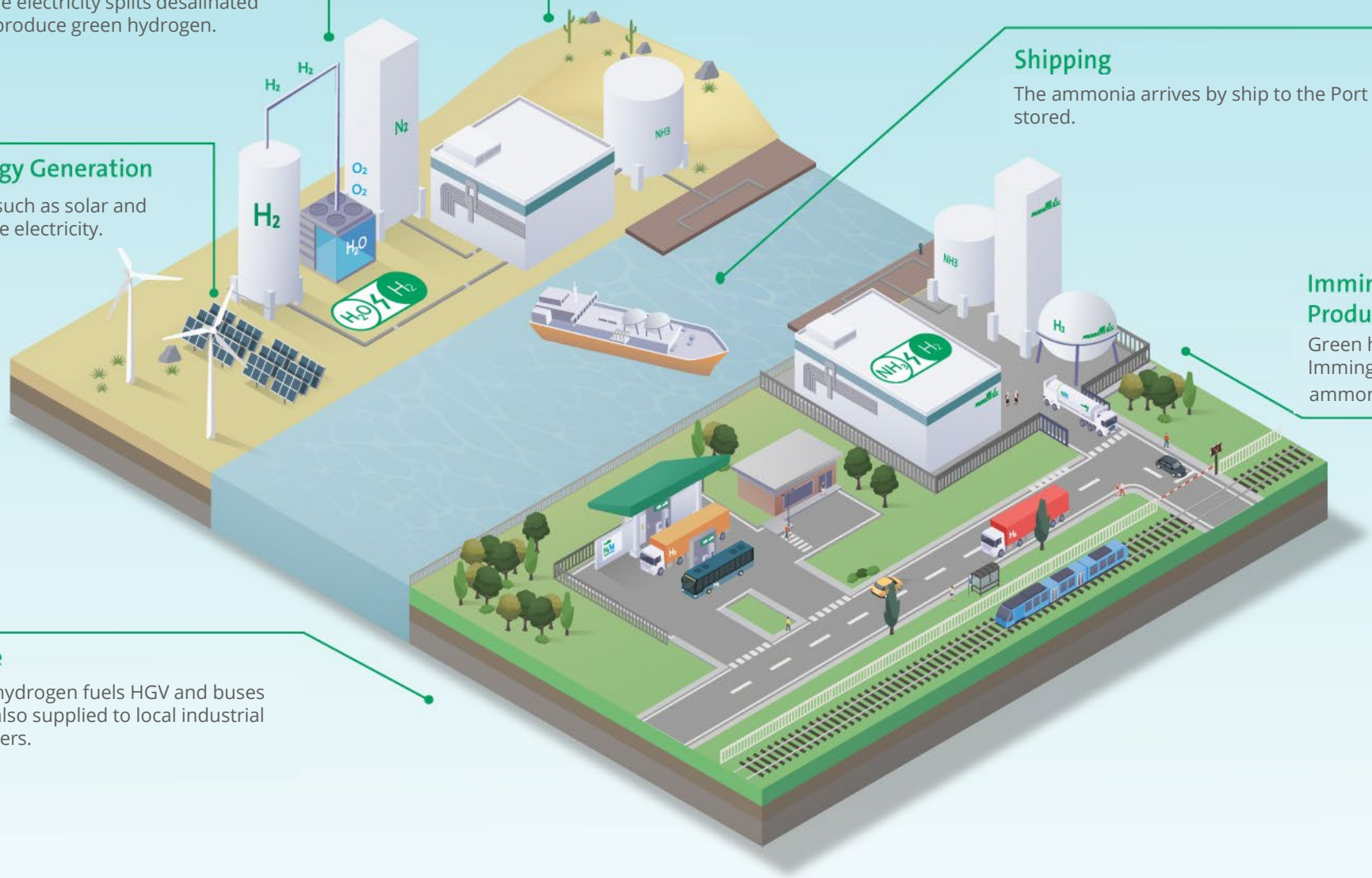
Ammonia is produced from Green hydrogen and nitrogen

4 Shipping

The ammonia arrives by ship to the Port of Immingham, where it is stored.

5 Immingham Green Hydrogen Production Facility

Green hydrogen is produced in Immingham, using the stored ammonia, and is then distributed to users.



Immingham

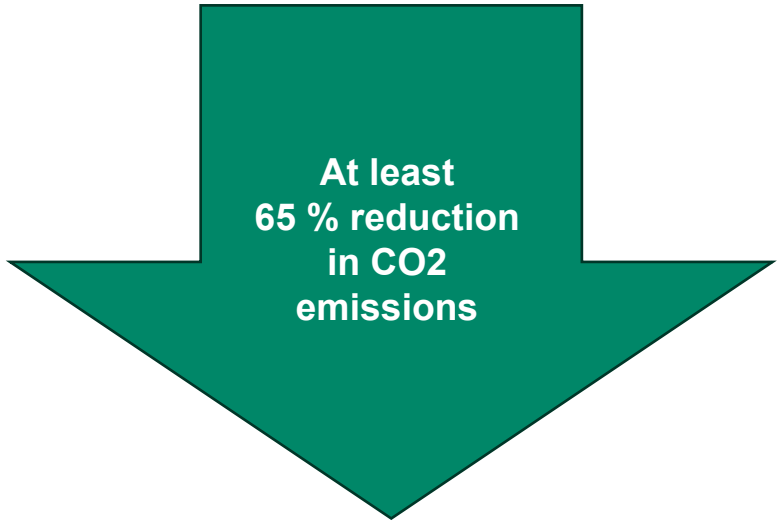
6 Usage

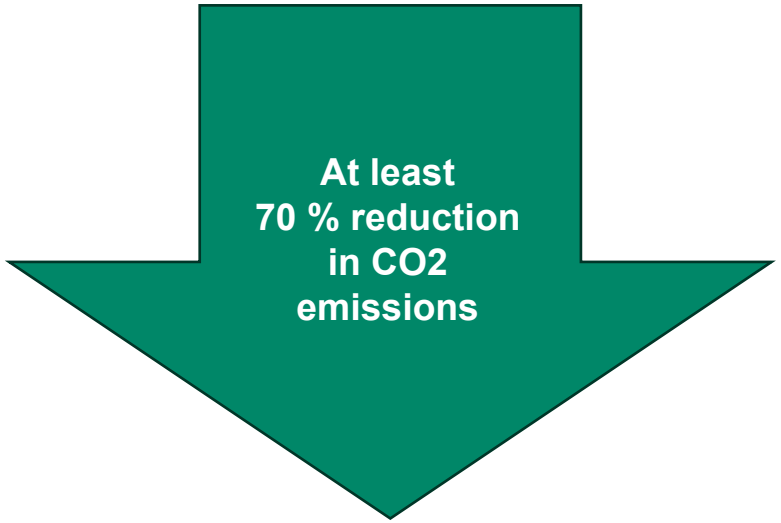
Green hydrogen fuels HGV and buses and is also supplied to local industrial customers.

H2fM®
Hydrogen for Mobility

Overall benefit of hydrogen produced by the project

Diesel equivalent (94 gCO2e/MJ)	Gas equivalent (67 gCO2e/MJ)



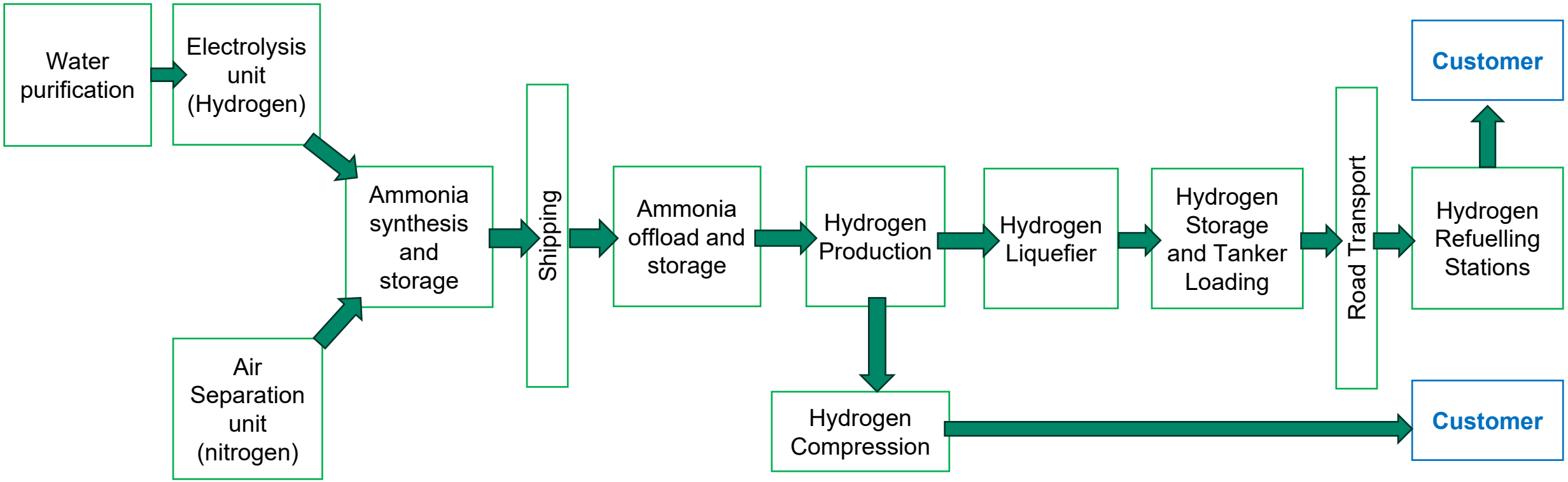


Transport Hydrogen (32.9 gCO2e/MJ)

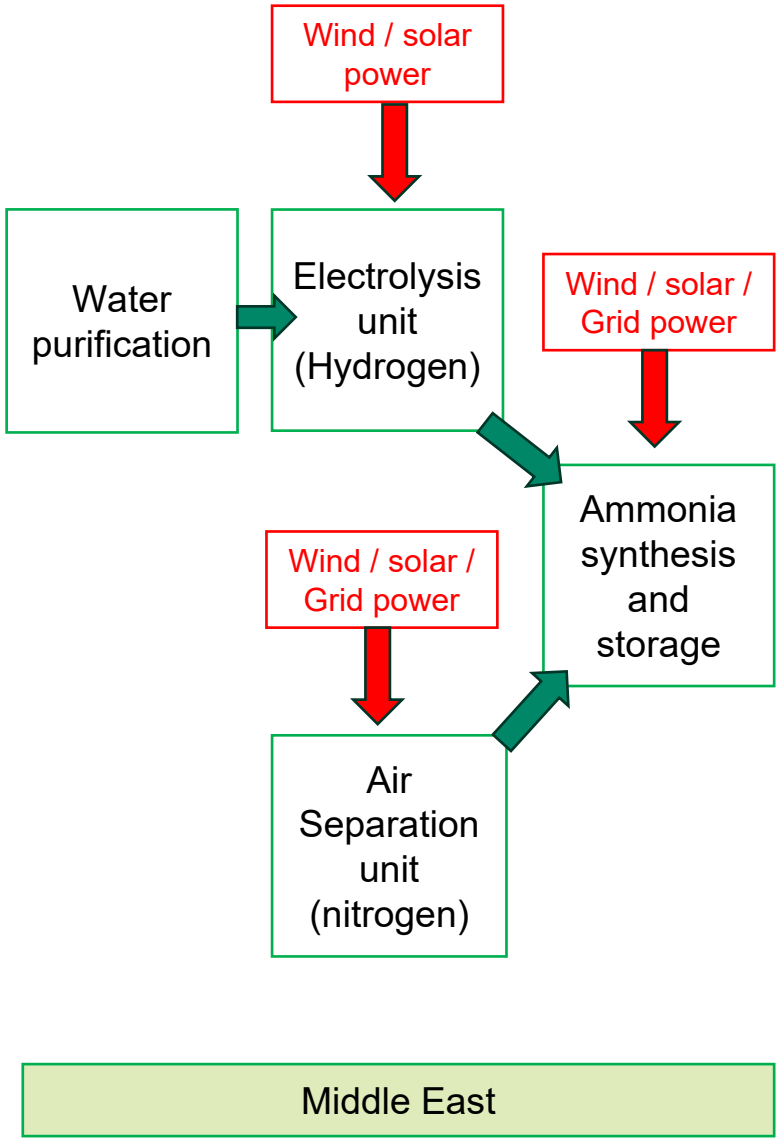
Industrial Hydrogen (20 gCO2e/MJ)

The green credentials of the process is expressed in terms of carbon intensity which refers to the life-cycle emissions of greenhouse gases from the fuel supply chain. It is expressed in units of carbon dioxide equivalents per megajoule of fuel (gCO2e/MJ).

Hydrogen Production: Step-by-step description



Creation of green ammonia in the Middle East



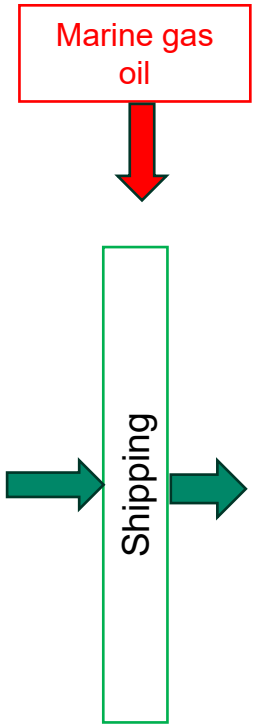
The generation of hydrogen molecules through electrolysis is entirely from renewable power.

- This process accounts for about 3% of the overall Carbon intensity of the final green H2
- There is CI contribution from areas such as catalysts, lubricating oils, water treatment etc

The generation of nitrogen and ammonia uses renewable power but also some electrical power from the local grid.

- This is due to critical equipment not being able to tolerate any fluctuations in electrical supply.
- This accounts for about 9% of the overall Carbon intensity of the final green H2 product

Shipping



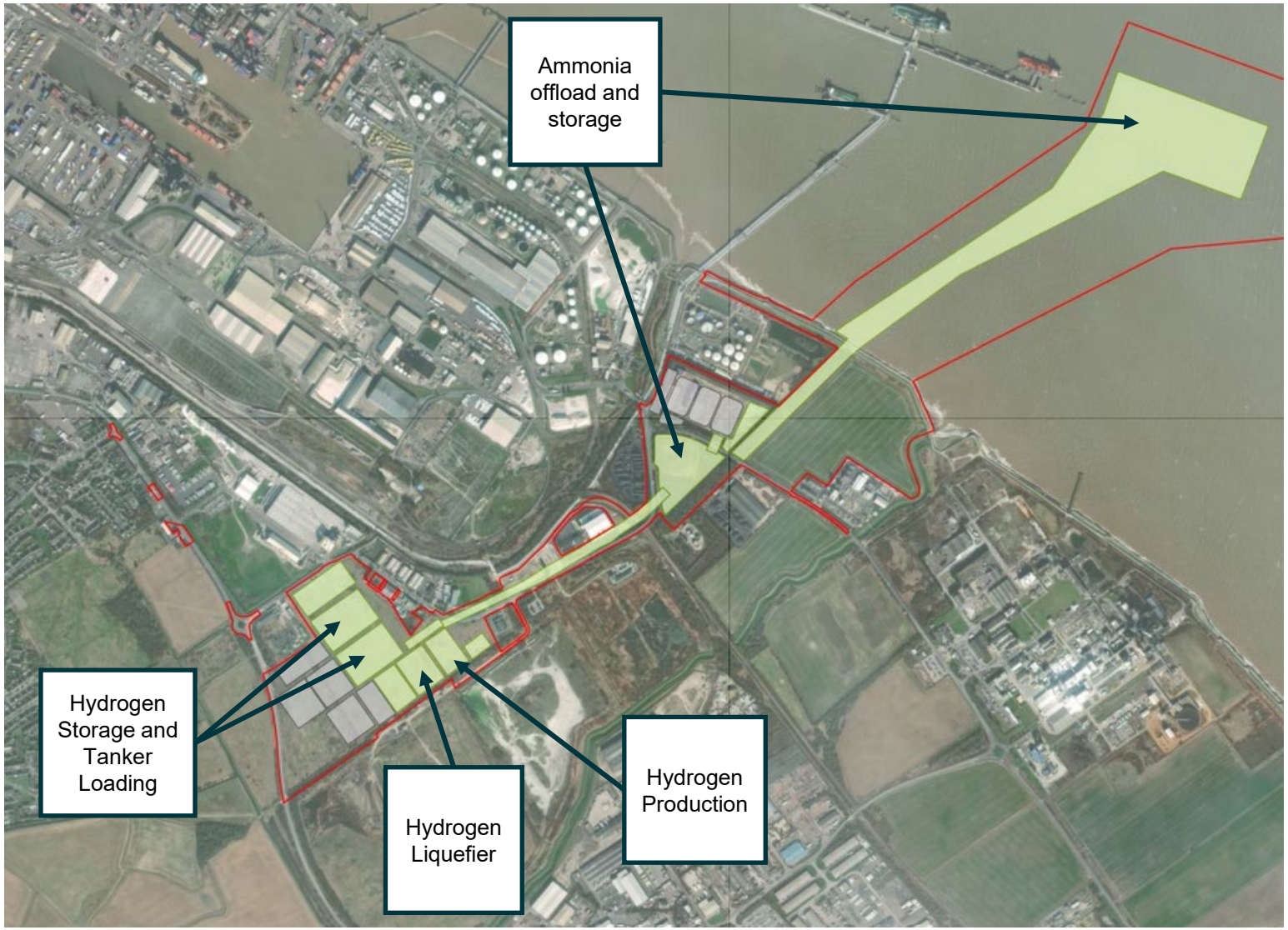
Middle East to Europe

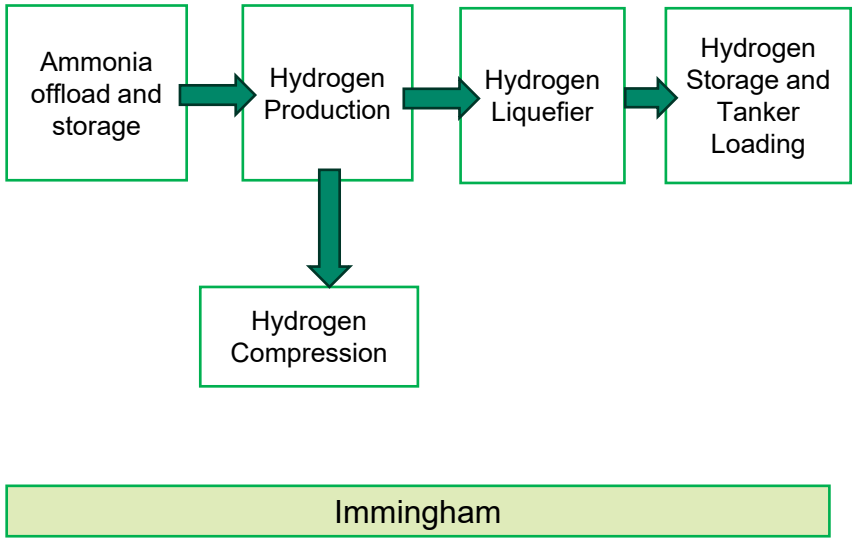
- VLGC vessels will be used to transport refrigerated liquid ammonia to Europe (Immingham, Rotterdam and Hamburg initially)
- These will be vessels (up to 230m long) or specific ammonia carrier ships of which some are now in construction

Green credentials

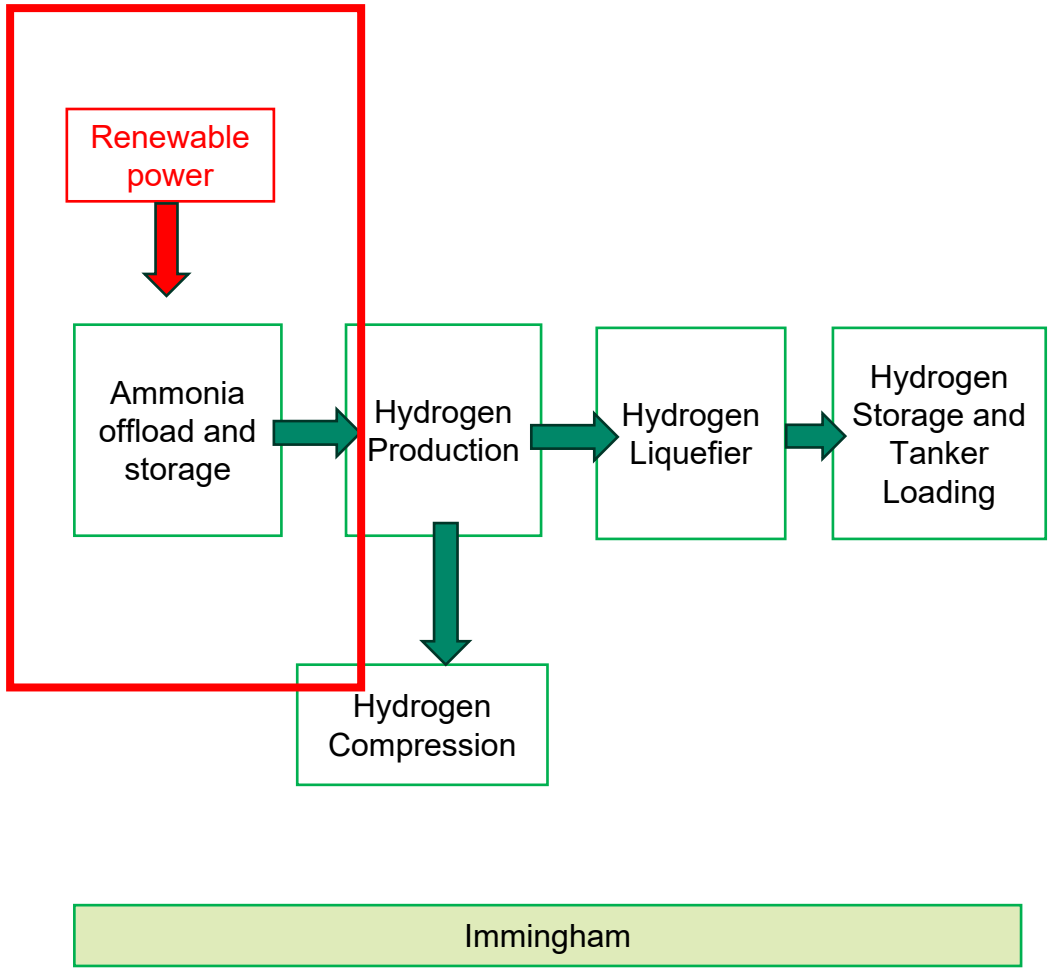
- Currently these ships are powered by marine gas oil.
- Shipping accounts for about 14% of the overall Carbon intensity of the final green H2 product
- Future technology improvements and regulations in the shipping industry means shipping emissions is expected to reduce
  - First Ammonia fuelled engines expected to be on market in 2024 (MAN) and new ammonia carriers are likely to be the first users of his technology. Expected that 1st ammonia-fuelled vessels to be operational in the second half of this decade
- UK Government has set legally binding Co2 emission reduction for shipping as part of its 6th Carbon Budget and net zero 2050 legislation

Immingham process layout





Ammonia storage

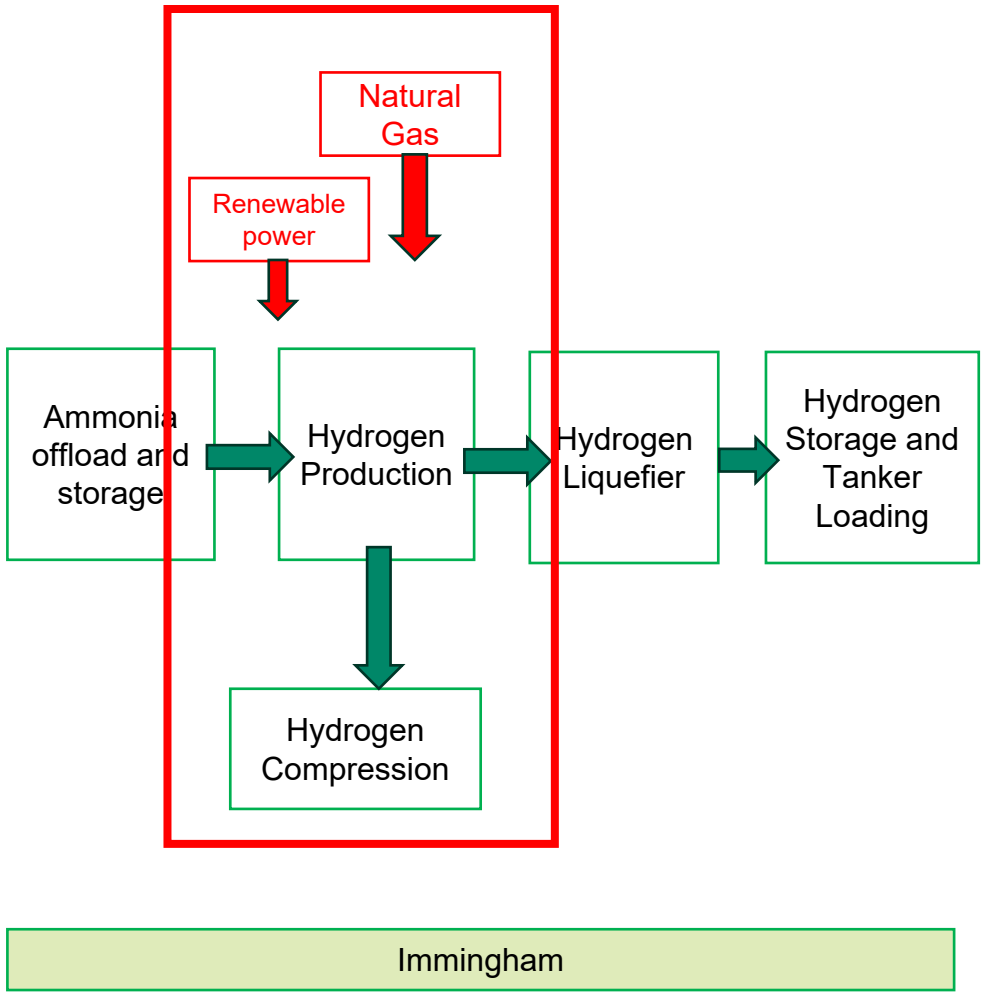


- Ships will dock at the IGET jetty in Immingham and offload liquid ammonia, using ships pumps, via above ground pipelines (Work No 1 and 2) into the large storage tank in Work No 3
- Prior to offloading, NH3 will be circulated through the pipelines to cool them down. Offloading will take about 24 hours
- The ammonia will be kept in liquid form at -33C and a vapour recovery process unit will compress / liquify any vapour from the tank
- This area is supported by utility and safety systems (flare, instr air, fire water, emergency generator etc)
- Ammonia is pumped to the hydrogen production units (located in Work 7 for phase 1)

Green credentials

- Ammonia storage accounts for about 4% of the overall Carbon intensity of the final green H2 product

Hydrogen production

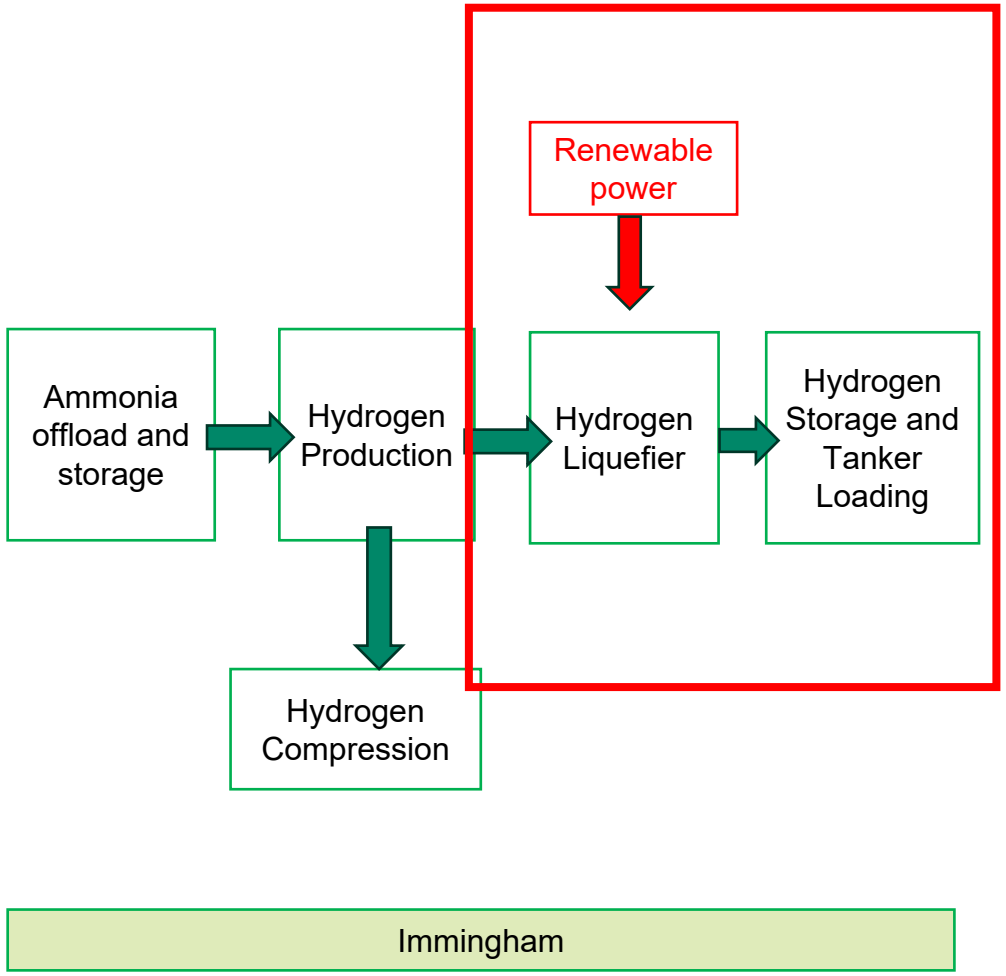


- Ammonia is split into H2 and N2 by heating the ammonia in a gas fired furnace with catalyst to assist the reaction.
- The produced H2 is then purified in a separate process unit. The nitrogen is released to atmosphere
- The design is optimised to minimise energy requirements (re-use of spare heat)

Green credentials

- Currently natural gas is used in the process
- Hydrogen production accounts for about 37% of the overall Carbon intensity of the final green H2 product (33% due to gas and 4% due to power)
- Future process improvements may allow use of hydrogen as a firing gas either wholly or partially

Hydrogen Liquefier

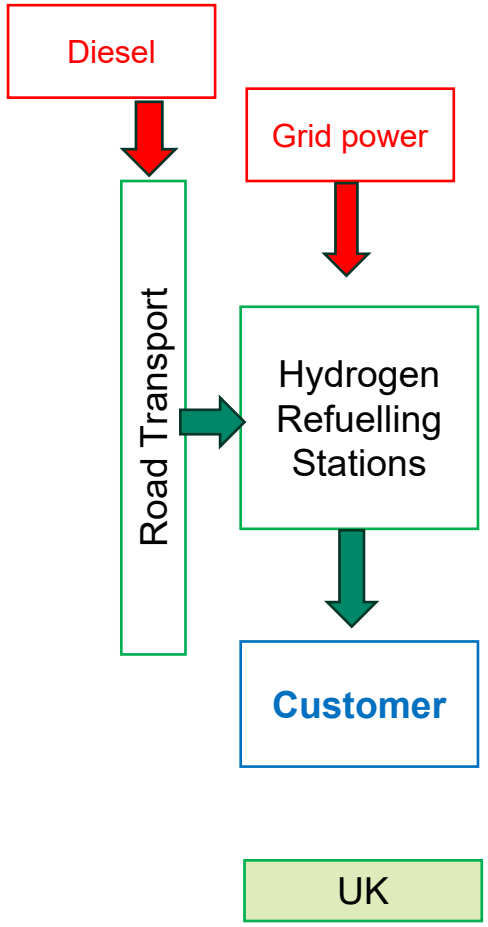


- Gaseous hydrogen is further purified and refrigerated to liquid form in the H2 liquefier process unit. This is done by a series of compression, cooling and expansion sequences.
- The liquid hydrogen is stored in long horizontal vessels from where liquid hydrogen is loaded into road tankers

Green credentials

- Hydrogen liquefying accounts for about 15% of the overall Carbon intensity of the final green H2 product.
- Power will be purchased from a renewable source through a renewable power purchase agreement

Hydrogen refueling stations

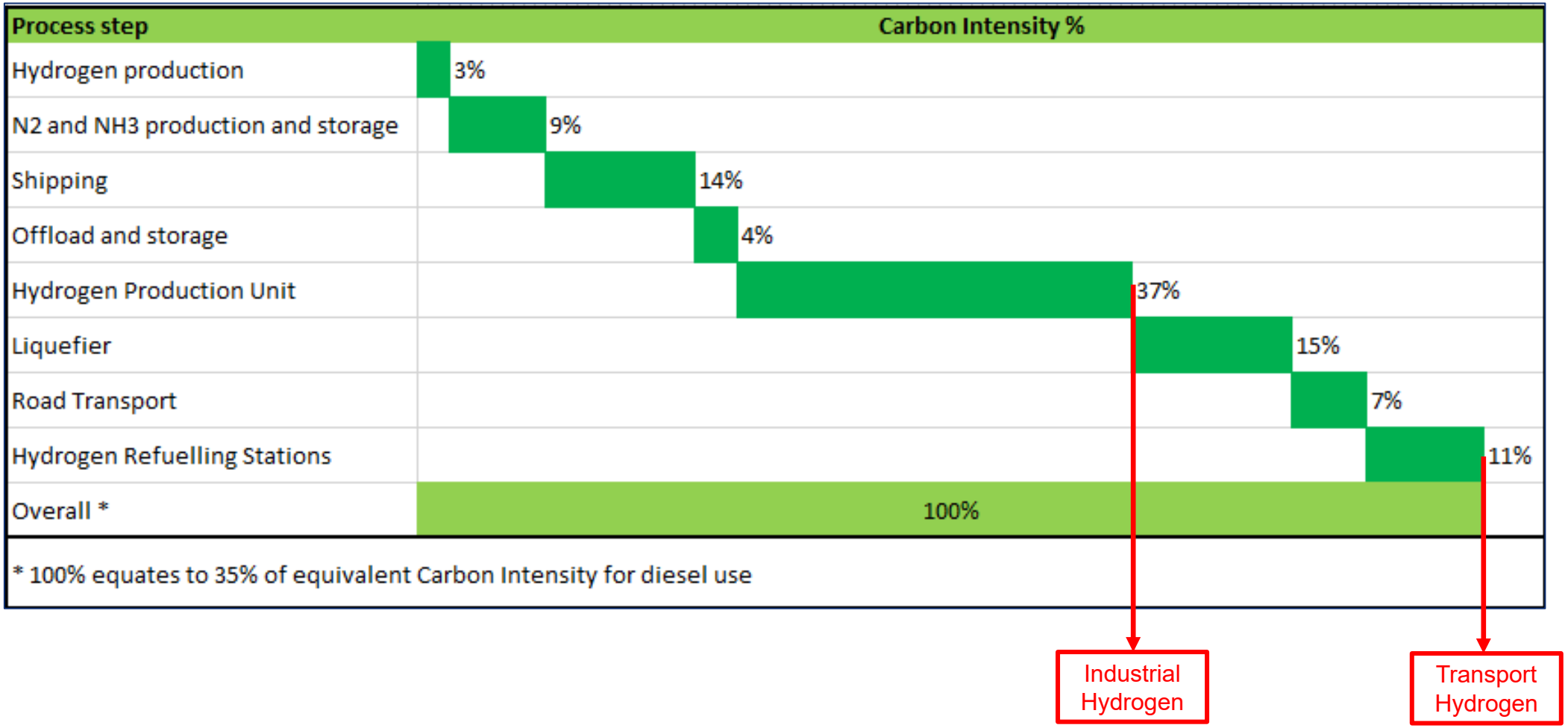


- Liquid hydrogen will be transported by road tanker to hydrogen refuelling stations (HRS) where the hydrogen will be stored and loaded into HGV as the end user.

Green credentials

- Current assessment is that transport is by diesel HGV but Air Products will convert its road tanker fleet to hydrogen power as soon as manufacturing and legislation enables this
- Road transport accounts for about 7% of the overall Carbon intensity of the final green H2 product.
- Hydrogen Refuelling stations accounts for about 11% of the overall Carbon intensity of the final green H2 product.

Carbon Intensity of each stage



Low carbon certification

A separate written response will be provided (against Q1.3.3.4) explaining the current standards and obligations for certification of low carbon hydrogen, how they function and are secured.

The key standards related to green hydrogen are:

- **The Renewable Transport Fuel Obligation Order (RTFO)**
- **UK Low Carbon Hydrogen Standard**

Transport hydrogen (for HGV):

- Compliance with the **RTFO** requires a carbon intensity of less than **32.9 grCO2e/MJ** for its full supply chain from production to the fuelling point (Hydrogen Fuelling station).
- This is about 35% of the equivalent value for diesel
- The Air Products green hydrogen for road transport will meet this threshold

Industrial hydrogen (for pipeline customers):

- Compliance with the **UK Low Carbon Hydrogen Standard** requires a carbon intensity of less than **20 grCO2e/MJ** for its full supply chain from production to user.
- This is about 30% of the equivalent value for natural gas
- The Air Products green hydrogen for industrial use will meet this threshold

Forecast of other users and jetty related activity