UKPIA Downstream Industry Hydrogen Fact Sheet

1936 The first methane reformer was commissioned in Billingham - producing hydrogen in a UK refinery. [1]

Did you know?

The refining sector is the largest producer and user of hydrogen in the world.[5]

Types of hydrogen production

Steam Methane Reforming (SMR) - the cheapest form of hydrogen production, in which natural gas is heated above 700 C. If used with Carbon Capture technology, this becomes "blue", zero-carbon emission hydrogen. [4]

Autothermal Reforming - uses purified oxygen from combustion as a heat source, meaning that the product's chemistry can be tailored for specific purposes.[3]

Catalytic Reforming - dehydrogenation during the oil refining process creates large amounts of hydrogen as a by-product, which is then often fed into other refining processes to increase efficiency.[2]

Electrolysis - is the process of using electricity to split water into hydrogen and oxygen. Depending on the source of the electricity used, this may be produced without carbon being emitted. [5]

Health and Safety

Hydrogen's very low boiling point and high flammability range means it is complex to move and store safely, requiring suitable controls and expertise. The downstream sector has a strong track record in this area, developed over decades of working with hydrogen and other volatile components such as natural gas.

Concerns around hydrogen safety can be overcome with a professional workforce and rigorous safety standards, of which standards the downstream sector currently upholds.

Working safely with dangerous chemicals

Many of the products refinery workers handle on a daily basis can cause serious injury or even deaths if poorly managed.

Through the process safety leadership network and with rigorous safety standards, the downstream industry has managed these chemicals and their complex safety issues securely for over 70 years.

For more information, download our Transition, Transformation, and Innovation Report:

ukpia.com/publications

Decarbonising Industry

Along with other technological advances such as increased sustainable fuel feedstocks, combined heat and power plants and refinery efficiencies - the refining sector is using hydrogen to help decarbonise the sector.

Industrial clusters will allow for greater collaboration between adjacent industries, with "green" and "blue" hydrogen sources both likely to be central to the further evolution of the sector. Refineries, as the largest producers and users of hydrogen will likely be a hydrogen hub, in the centre of industrial clusters in the UK.[6]

References

1) Chris Murkin and John Brightling, "Eighty Years of Steam Reforming", in *Johnson Matthey Technology Review*, 2016, 60, (4), page 263.
2) H. M. Aranil; M. Shirvanill; K. Safdarianlll; E. Dorostkar, "Lumping procedure for a kinetic model of catalytic naphtha reforming" *Braz. J. Chem.* Eng. vol.26 no.4 São Paulo Oct./Dec. 2009
3) Air Liquide, "Autothermal Reforming (ATR) - Syngas Generation", cited 22/03/2021, source.
4) US Department of Energy, "Hydrogen Production: Natural Gas Reforming", cited 22/03/2021, source.
5) Energy Institute, "A guide to Hydrogen", London, 2020, page 21.
6) HM Government, *Energy White Paper - Powering our Net Zero Future*, 2020, page 128.
7) UKPIA, *The Future of Mobility in the UK*, March 2021.
8) UKPIA, *Transition, Transformation, and Innovation: Our Role in the Net-Zero Challenge*, October 2020, page 12.

UKPIA

Downstream Industry Hydrogen Opportunities

Hydrogen in Transport[7]

Heavy Vehicles - The Hyundai Xcient fuel cell truck can travel 400 km with Hyundai already developing a truck with a 1000 km range.

Trains - Hydrogen-powered trains are already in service with a range of up to 600 miles meaning such trains may prove the long-term solution to the UK's 'unelectrifiable' rail.

Ships - The HySTRA hydrogen transport project, transporting liquefied hydrogen from Australia to Japan, may may demonstrate the viability of 'blue' hydrogen supply via long distance tanker.

Aircraft - Short flights may be served by hydrogen propelled aircraft, such as those recently announced by Airbus.

Cars - Hydrogen-powered cars are becoming more popular, especially in Germany where there are over 100 refuelling stations.

Hydrogen as a zero emission fuel

Hydrogen vehicles do not emit carbon dioxide from their tailpipes, only water

If the source of the hydrogen is "green" or "blue", this means significant GHG reduction benefits

"Blue" vs "Green" (or both)

Hydrogen that is a by-product of current refining processes is considered to be 'blue' only if the resulting carbon emissions are captured. Otherwise, it is considered to be 'grey' hydrogen, which is currently the most common type used.

"Green' hydrogen is produced through electrolysis, this process is only zero-emission when the electricity is generated by renewable energy sources - such as solar, wind or hydro electricity.

GHG emissions-wise, there is little to separate "blue" or "green" hydrogen types - however there is a significant different in the costs of production, and neither technology is currently produced at scale.

Hydrogen Case Study[8]

Using wind-generated electricity to make hydrogen for fuel at the Humber Refinery

Phillips 66 Ltd, ITM Power Trading Ltd, in collaboration with Ørsted and Element Energy, have developed the Gigastack project to:

- Develop a cluster-based approach using renewable electricity supplied from an off shore wind farm to generate hydrogen via electrolysis.
- Use green hydrogen to reduce refinery CO_2 emissions.

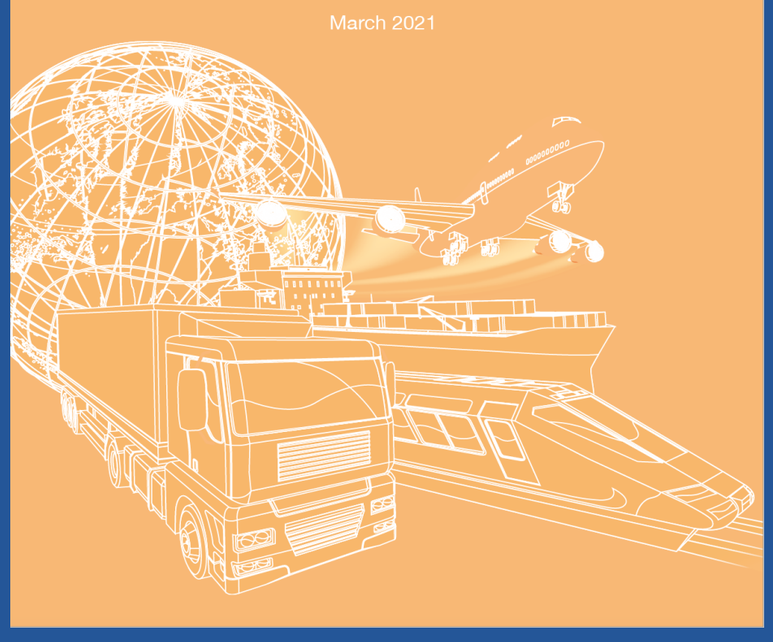
UKPIA - Hydrogen Policy Positions

Industrial Clusters - We welcome HMG's focus on the industrial cluster model - using CCUS and hydrogen technologies to decarbonise traditional emitters and look forward to working on the implementation of these projects.

Just Transition - Prepare the workforce for a Net-Zero economy early to reduce skills gaps, especially in CCUS and hydrogen and promote STEM subjects to students.

Technology Neutrality - Hydrogen is one technology of many required to meet Net-Zero, therefore government decisions must be made on the basis of cost per whole lifecycle emissions in order to decarbonise effectively, rather than choosing a single technology.

Systems-Based Approach - With the increased demand for hydrogen in the Net-Zero economy, consideration must be given to how this will impact entwined businesses and avoiding unintended consequences



For more information, download our Future of Mobility in the UK Report:

ukpia.com/publications

Contact Us:

Stephen Marcos Jones
Director-General

External Relations Team

Callan Tree
Communications and Government Affairs Specialist
callan.tree@ukpia.com

Policy Team

Seb Hirsz
Energy Transition Lead
seb.hirsz@ukpia.com

UKPIA ukpia.com

@uk_pia

/uk-pia