
FREETHS

Hydrogen

What's all the buzz?

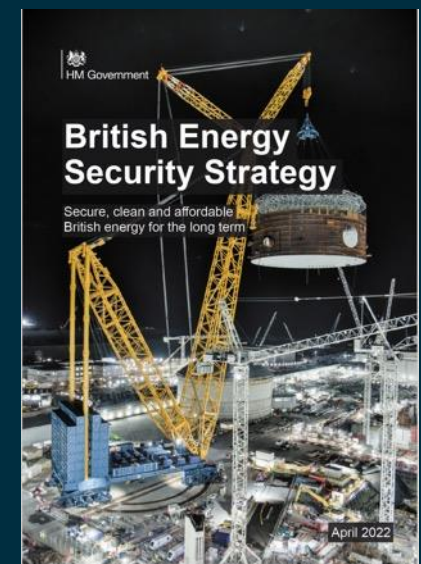
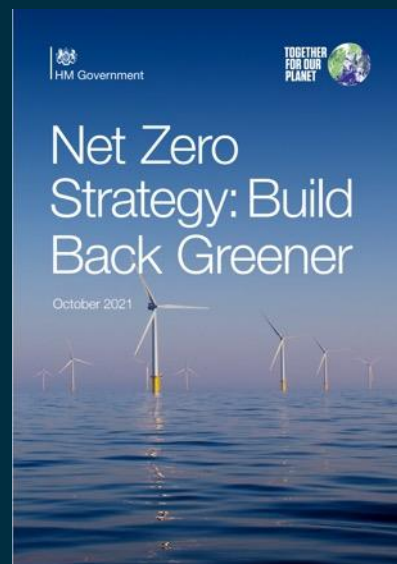
Liam O'Flynn – Senior Associate, Energy, Waste & Sustainability

Reece Ballett – Associate, Energy, Waste & Sustainability

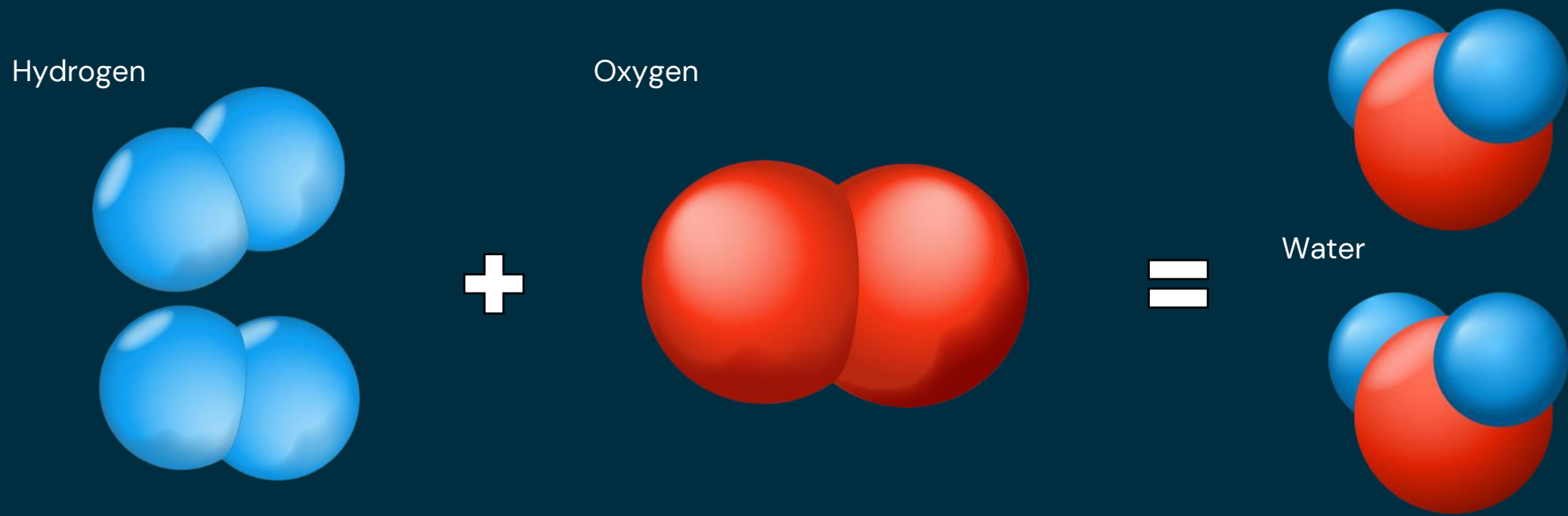
Presented by: **Clare King** – Partner and Head of Energy, Waste & Sustainability

UK's Net Zero Commitment

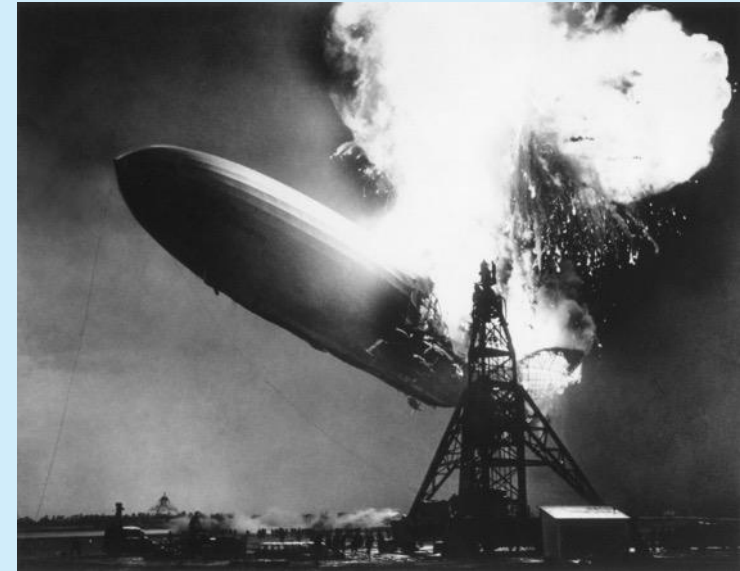
UK's commitment to net zero greenhouse gas emissions by 2050



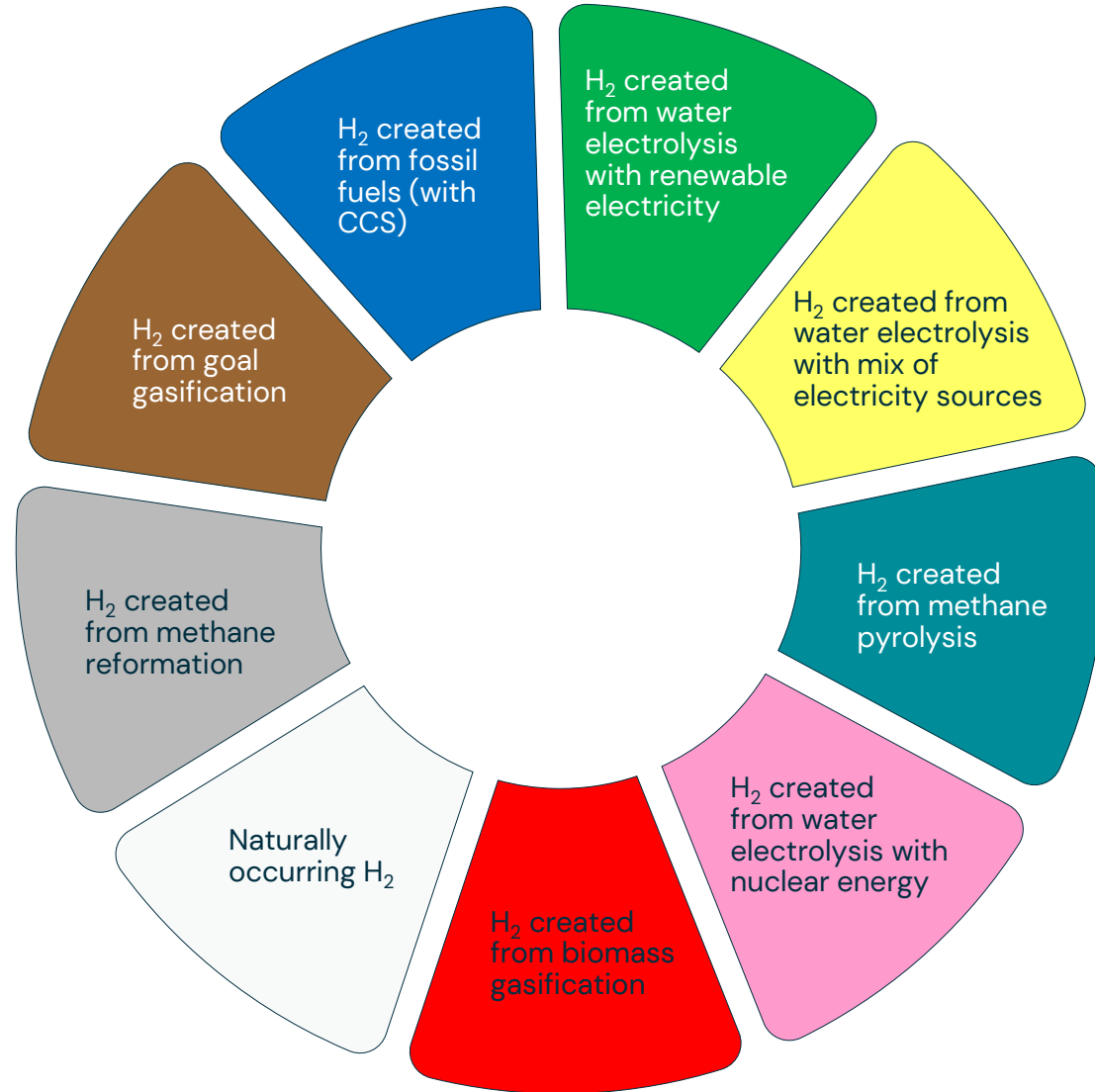
Properties of hydrogen



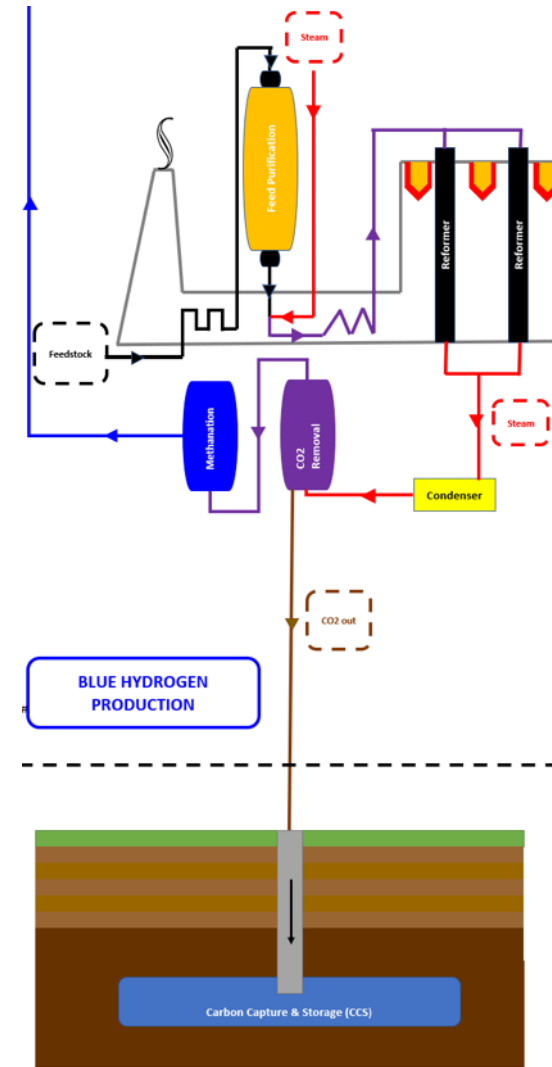
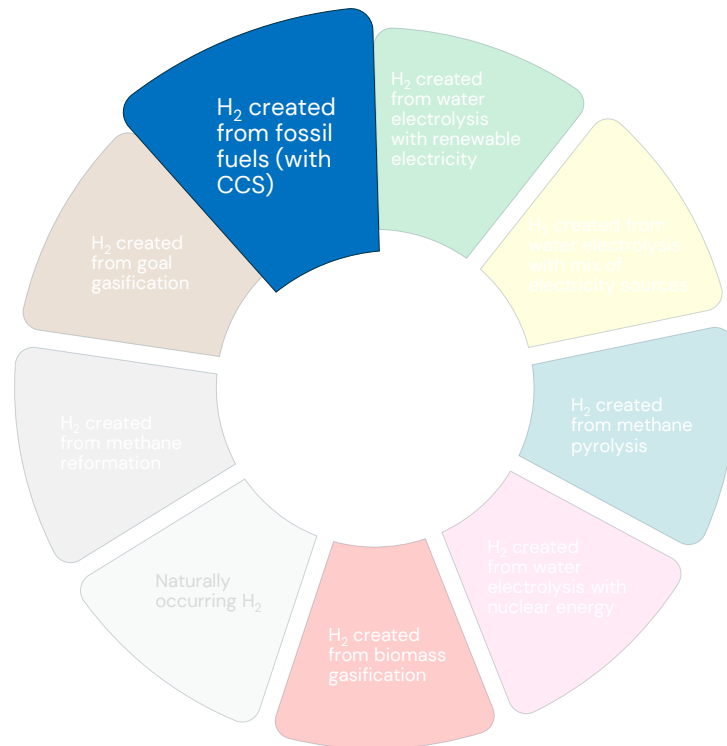
Current and historic uses of hydrogen



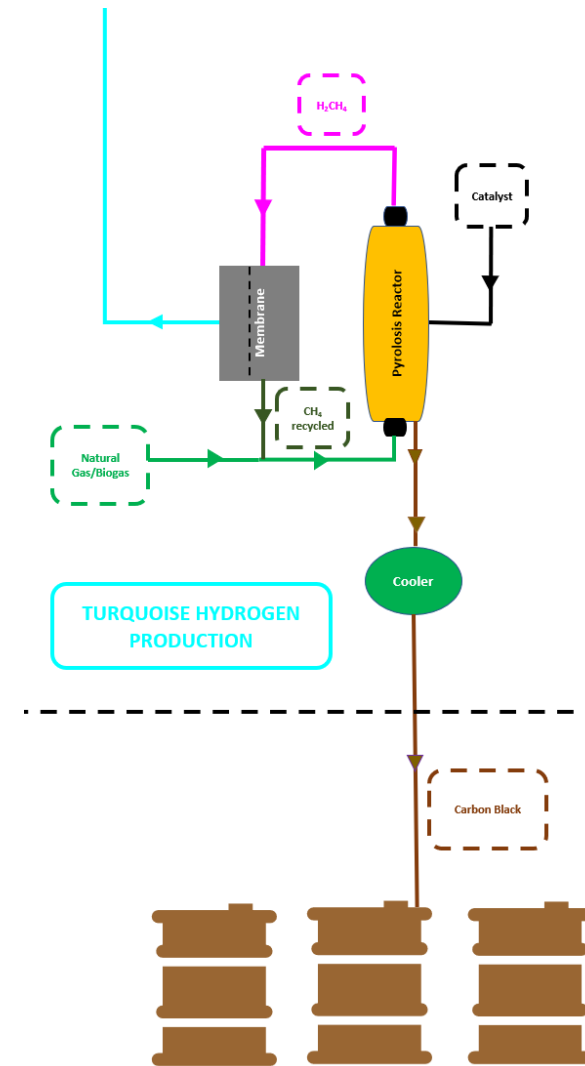
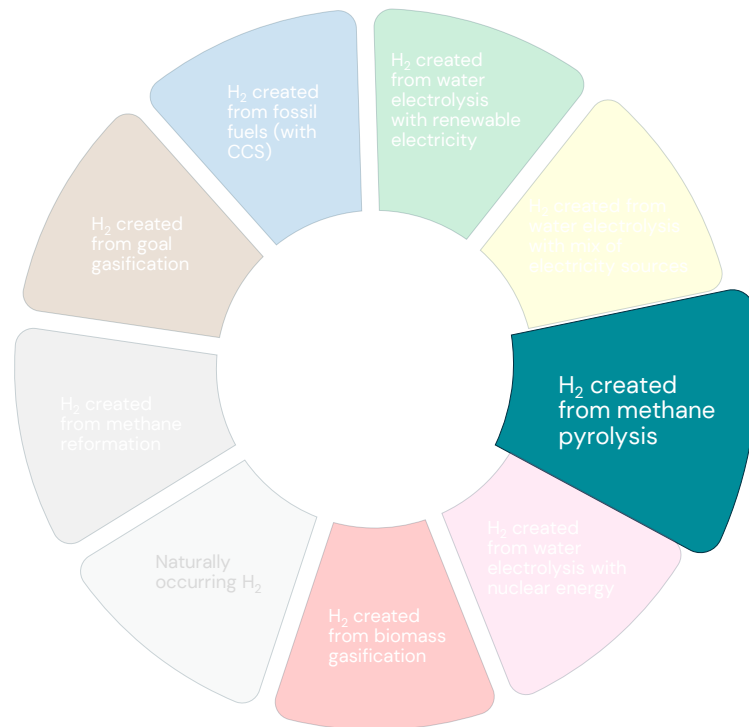
H₂ production 'rainbow'



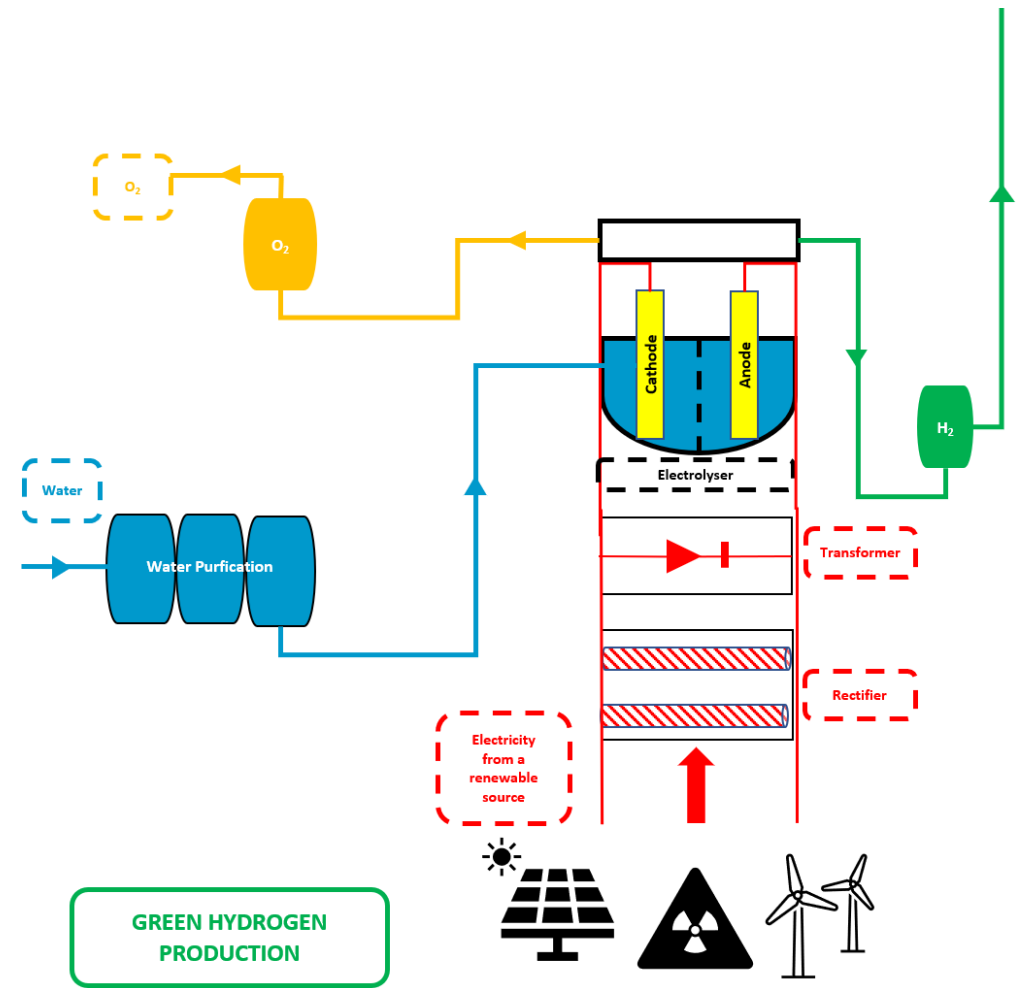
Blue hydrogen production



Turquoise hydrogen production



Green hydrogen production



Uses of hydrogen

Feedstock in industrial / chemical processes

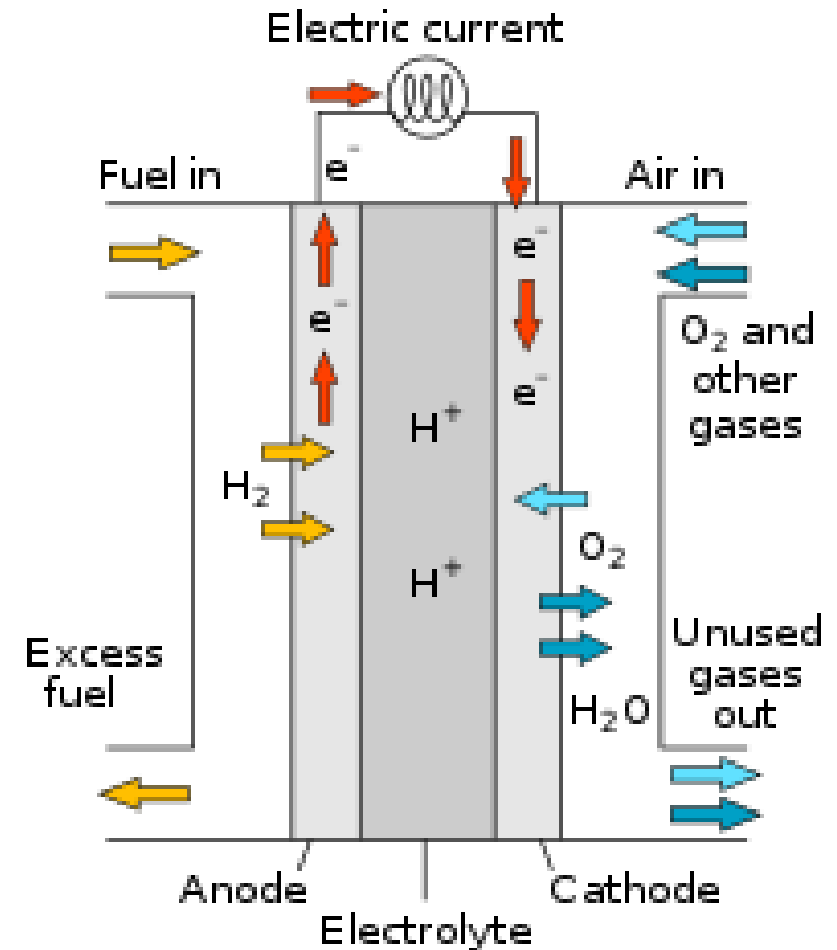
- oil refining, ammonia production (fertilisers), other chemicals, metallic ore extraction, food processing (hydrogenation of oils/fats to make e.g. margarine)

Fuel in combustion engines / boilers / turbines

Fuel in fuel cells

- convert chemical energy into electrical energy
- more efficient than combustion engines
- can produce electricity continuously with continuous supply of fuel and oxygen (cf. batteries)

Storage at all scales



Uses of hydrogen

Heating

Combustion in place of (or in combination with) natural gas (methane)

- existing vs new infrastructure / appliances
- blending in gas grid
- high temperature heat for industry

Transport

Fuel for combustion engines and fuel cells, feedstock for transport fuels existing vs new infrastructure / appliances

- road vehicles – HGVs, vans, buses, cars
- industrial non-road vehicles – forklifts, diggers
- rail, shipping, aviation, space exploration

Power generation

- back-up power for buildings / uninterruptible power supply (UPS) systems / combined heat and power (CHP)

Energy storage / system flexibility

- electrical energy converted to hydrogen through electrolysis then stored and used in transport or industry (power to gas) or electrified (power to gas to power)

Distribution of hydrogen

Pipelines

- Existing gas grid – blending
- New hydrogen networks – localised
- Interconnectors?

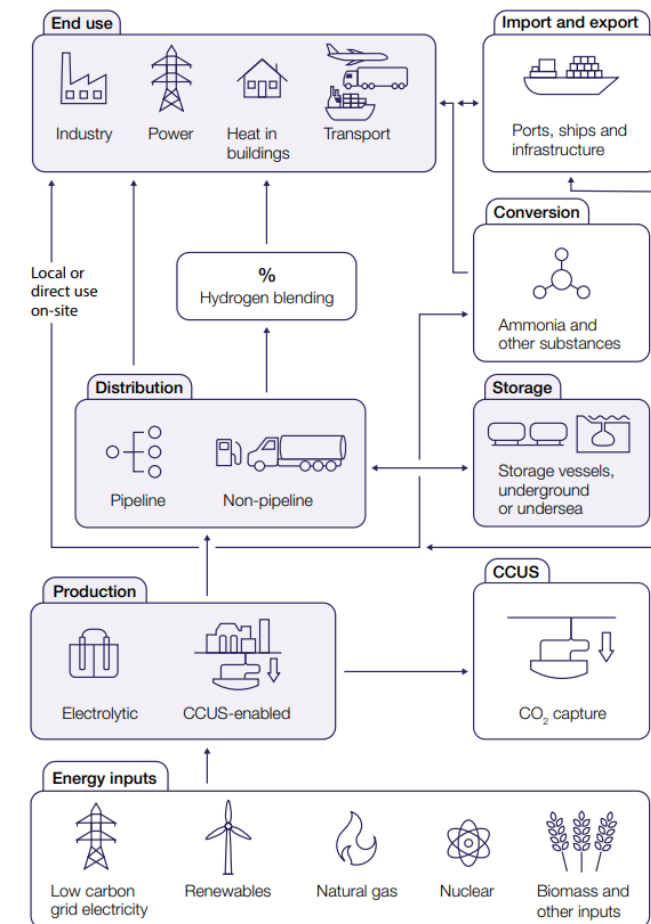
Non-pipeline

- Road, rail, marine transport
- In compressed gaseous or liquefied form

Storage

- Specialist tanks or storage vessels – stationary or mobile
- Salt caverns (underground) storage – potential to repurpose caverns currently used natural gas
- Depleted gas or oil fields (undersea) storage – require further testing to be used for hydrogen
- Hydrogen carriers (ammonia), liquid organic hydrogen carriers (LOHCs), cryogenic liquid, etc – more R&D required

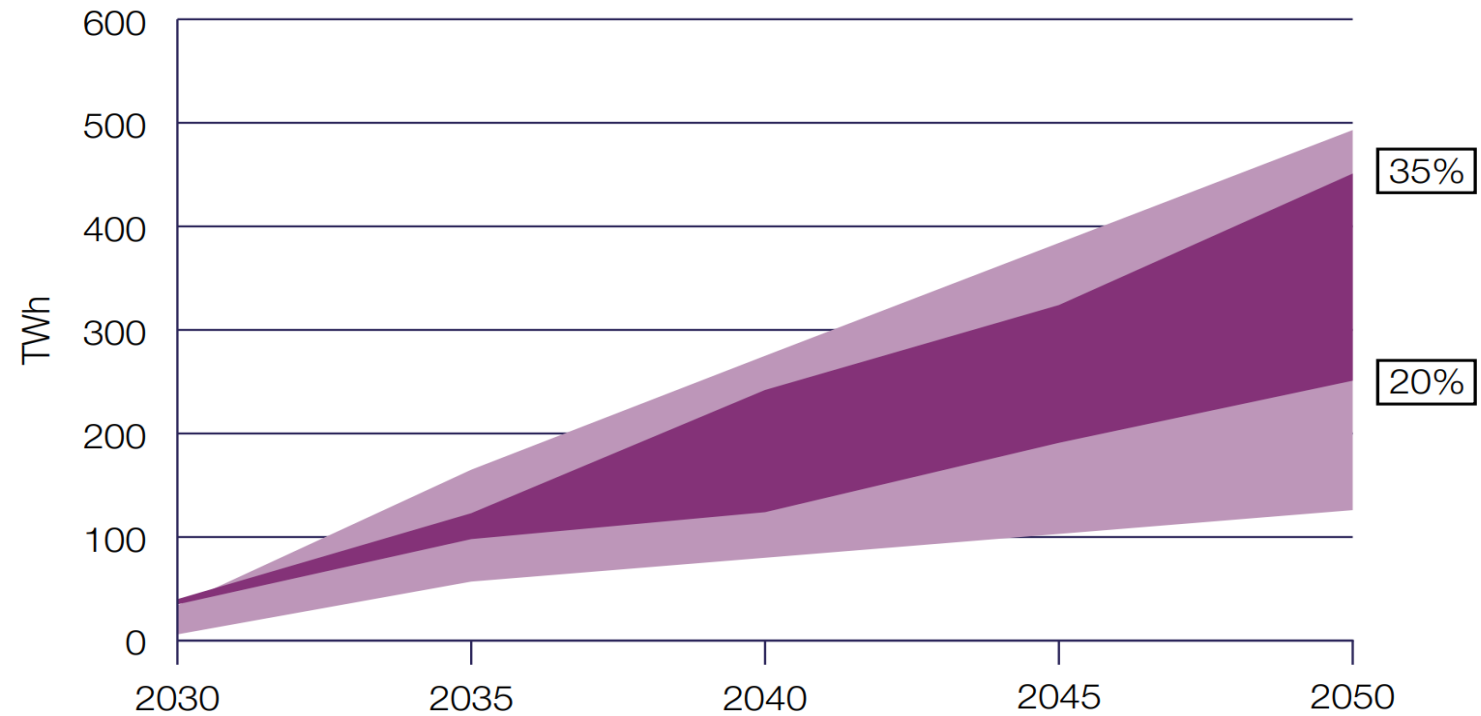
Figure 2: The hydrogen value chain



Source: UK Hydrogen Strategy
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1011283/UK-Hydrogen-Strategy_web.pdf

Future of hydrogen

Figure 1.2: Hydrogen demand and proportion of final energy consumption in 2050



% = hydrogen as proportion of total energy consumption in 2050

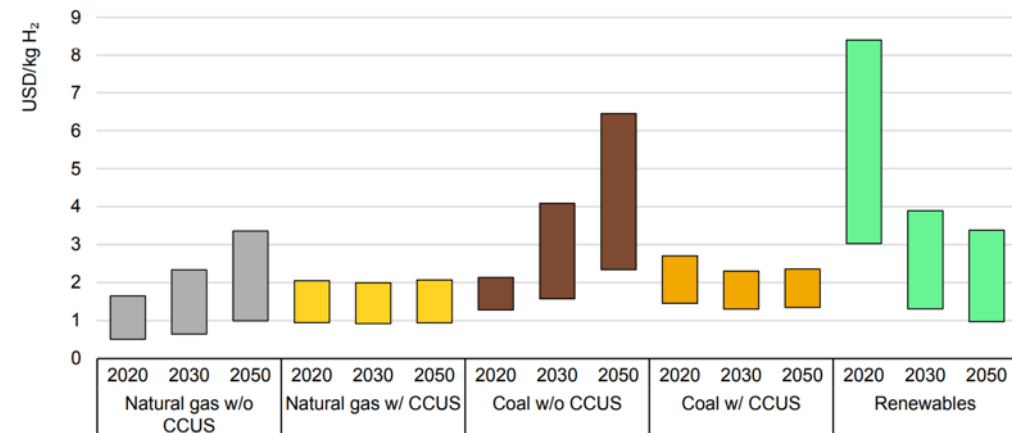
Source: UK Hydrogen Strategy https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1011283/UK-Hydrogen-Strategy_web.pdf

Barriers to hydrogen market: cost and regulation

Fuel	£ / kg
Natural Gas (Wholesale; June 2022)	1.09
Natural Gas (Wholesale; October 2021; average)	1.52
Natural Gas (Wholesale; January 2020; average)	0.39
Grey hydrogen (October 2021)	0.41 – 1.71
Blue hydrogen (October 2021)	0.82 – 2.28
Green hydrogen (October 2021)	2.45 – 6.53



Levelised cost of hydrogen production by technology in 2020, and in the Net zero Emissions Scenario, 2030 and 2050

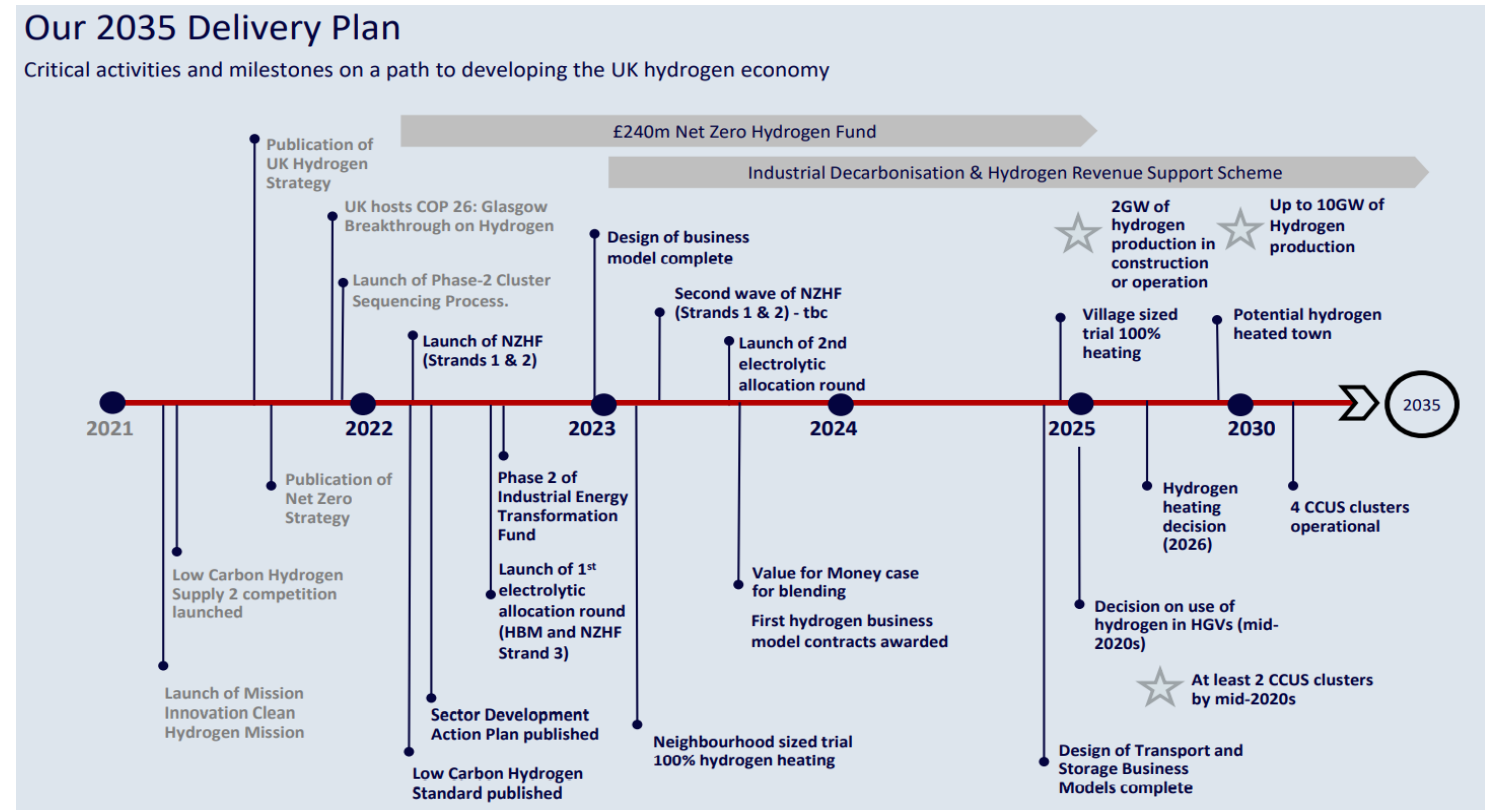


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Source: International Energy Agency: Global Hydrogen Review 2021
<https://iea.blob.core.windows.net/assets/5bd46d7b-906a-4429-abda-e9c507a62341/GlobalHydrogenReview2021.pdf>

Government plans

- How do we get people to invest in hydrogen projects?
- How do we provide certainty that investors will succeed?
- How can we be sure that those investments drive us towards net zero?



Source: Hydrogen Investor Roadmap https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1067408/hydrogen-investor-roadmap.pdf

Net Zero Hydrogen Fund

Aims

- Stimulate low carbon hydrogen production
- Bring down costs and risk to hydrogen market
- Stimulate future pipeline

Available Funding

- £240m from NZHF
- £26m from Industrial Hydrogen Accelerator
- £100m through Hydrogen Business Model

Applicable funded costs (“NZHF Strands”)

- DevEx
- CAPEX (outside Hydrogen Business Model)
- CAPEX for electrolytic projects
- CAPEX for blue hydrogen projects

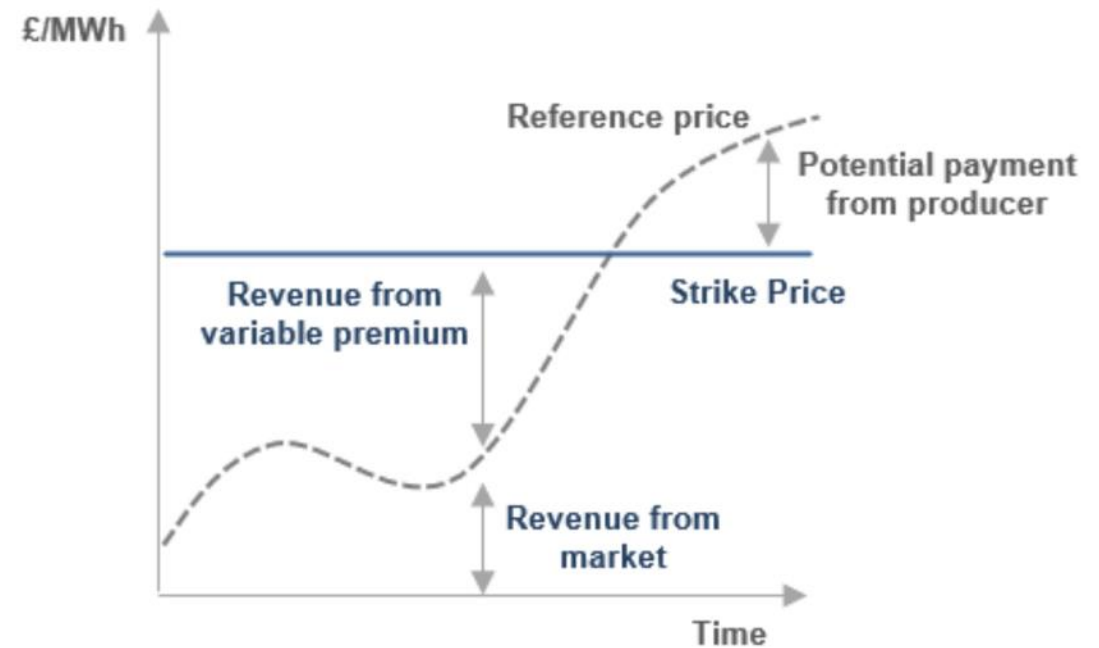
Hydrogen Business Model

Aims – to alleviate barriers to entry:

- Cost
- Regulation
- Technology risk
- Commercial risk
- Demand uncertainty
- Lack of infrastructure

Leans heavily on learnings from UK offshore wind

Figure 5: Variable premium



Source: Low Carbon Hydrogen Business Model: consultation on a business model for low carbon hydrogen
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1011469/Consultation_on_a_business_model_for_low_carbon_hydrogen.pdf

Low Carbon Hydrogen Standard

Aims

- Provide threshold of max GHG emissions acceptable to be classed as “low carbon” hydrogen
- Applicable to production only

Outcomes

- Threshold set: 20g CO₂ equivalent per megajoule of hydrogen produced (subject to change)
- Gateway for participation in NZHF and HBM
- Certificate scheme (mid-2020s)

Other hydrogen developments



So...hydrogen: what's all the buzz?!



Questions?

Contact us



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Next time...Hydrogen in transport

Thank you
