

A future hydrogen economy?

There are big challenges, but when (if?) they are solved the pay-off will be huge

There is a lot of activity

National Grid is exploring the development of a UK hydrogen 'backbone', which aims to repurpose around 25% of the current gas transmission pipelines, creating a 2000 km hydrogen network.

Production methods

Produce H and CO₂ from methane and capture the CO₂

Split water into H₂ and O using electricity from windpower at night or from solar panels in hot countries

It is also possible to design bioreactors for large-scale hydrogen production using microorganisms

Transport by pipeline or cryogenic road, rail or barge tanker. Cost and leakage are issues. Can mix with oil to transport as a liquid and recycle the oil.

Problems with batteries

The battery in a Tesla S weighs half a tonne, leading to wear on the road and tyres, so producing very small particles that get into our lungs and waterways

Present batteries need cobalt, which is scarce and toxic and mined under conditions that often violate human rights

When the batteries begin to wear out, will there be disposal problems?

Buses with batteries: range perhaps 250 km, but only about half that if electrically heated, or if cooled in summer

Clean buses

Government has announced 4000 new clean buses, electric or hydrogen.

Hydrogen has twice the energy density of gasoline.

It can either be used in an internal combustion engine, but the burning converts the nitrogen in air to harmful nitrogen oxides.

It is much more efficient to convert hydrogen into electricity within a fuel cell. (The hydrogen–oxygen fuel cell was first introduced in 1932.)

Clean flight

Tourism is of crucial importance to many less-developed economies



The first fuel-cell flight of a commercial light aircraft took off from Cranfield in September

It flew for 8 minutes and reached 100 feet and 100 knots

BA, and also Airbus, are now working to extend to larger aircraft and longer flights, for commercial use by 2030 to 2035

Rail

Hydrogen needs considering for track that is not electrified. Unlike batteries, it can give a passenger train a range of a thousand kilometres per day.

The East-West rail link will not be electrified, on the grounds of cost.

Trains are running in Austria, Germany and Italy. In Britain 3 trains are under development.

Shipping

3% of global CO₂ emissions, plus sulphur dioxide, nitrogen oxides and particulate matter

Concerns about the space needed for cryogenic store of hydrogen.

Ammonia can be stored at room temperature. 10 times the energy density of a lithium-ion battery. Burning it is clean. But conversion will be very expensive.

Cars

Hydrogen-powered cars are already available from several non-European manufacturers

But sales will be few until there is a network of filling stations

And there will not be a network of filling stations until there are many cars ...

Steel smelting

- Smelting with coke responsible for 9% of global emissions
- Hydrogen can be used instead to remove the oxygen from the iron ore
- Pilots under way in Sweden, Germany and Austria

Heating of buildings

30% of UK emissions are from heating of buildings

2 semi-detached homes will open in April 2021 in Gateshead which will use 100% hydrogen for domestic heating and cooking

National Grid is experimenting with flows of hydrogen in its gas pipes at different concentrations of 2, 20 and 100%

Today's condensing gasboilers can run on 20% hydrogen. New boilers for 100% can be "hydrogen-ready".

UK government ambitions

- UK is aiming for 5GW of low carbon hydrogen production capacity by 2030 supported by a Net Zero Hydrogen Fund of £240 million. By 2030, the Government expects that there will be up to £4 billion of private investment in this area.
- A Hub in the Tees valley will provide a set of facilities for the production, storage and distribution of green hydrogen linked to a network of hydrogen refuelling stations that will service operational trials across transport modes in the period 2025-2030