CEN briefing note: hydrogen

- **Hydrogen is mostly used to make fertiliser and purify oil, but has potential as a zero-emission fuel for transport, heating, and manufacturing.** There are several ways to produce hydrogen; some are more environmentally friendly than others. These different ways of producing it are given colours to differentiate them easily.
    - **Green:** Electricity produced by renewable sources (e.g. wind turbines and solar panels) is used to split water into oxygen and hydrogen gas.
    - **Blue:** Natural gas is heated with steam to produce a mixture of hydrogen and carbon monoxide. The emissions produced are captured at the end of the process and do not get released into the atmosphere.
    - **Grey:** Same process as blue hydrogen, but the emissions are not captured.
    - **Brown:** Pulverised coal is mixed with steam or oxygen to produce carbon monoxide, carbon dioxide, and hydrogen. The hydrogen is then separated and the other gases are sent off to be stored or released into the atmosphere.

Colour	Source	% of global production[1]	Environmental impact	Cost per kilo (2020)[2]
	Renewables	1%	Excellent	£2.40-5.90
	Gas	47%	Good	£0.90-1.60
			Bad	£0.50-1.20
	Coal	27%	Very bad	£1.50-1.90

Source: 1, 2

- **Hydrogen will be most useful for decarbonising heavy industrial processes such as steelmaking and ceramics.** Its use has been floated for other sectors, such as transport and heating, but the poor cost-benefit ratio and safety barriers of doing so make it less attractive.
    - **Industrial:** Manufacturing processes such as steel, chemicals and cement are considered 'hard to decarbonise' due to their large carbon footprint, the high heat they require, and their long and complicated investment timelines. Hydrogen could replace the chemicals made from natural gas currently used in manufacturing processes.
    - **Transport:** Liquid or gas hydrogen could be used as fuel for things like planes, ships, cars, and heavy goods vehicles. The value for money of using hydrogen for large vehicles, like planes and ships, is much better

than using it for smaller things like cars or trucks, which are far better off being electrified. This is due to the cost and difficulty of transporting and using hydrogen as fuel. In liquid form it needs to be kept at -250°C, which uses a lot of energy. In gas form it needs to be kept in large, heavy tanks, meaning comparatively little energy is stored as hydrogen for its load weight. Shipping and aviation require much larger volumes of fuel, so their cost savings stack up much better compared to cars and vans.

- **Heating:** Hydrogen gas is burned in a special boiler to heat water. This is one of the least cost-efficient ways to use hydrogen and is opposed by consumers on safety grounds.
    - ➔ The idea was floated of pumping hydrogen around in existing natural gas pipes, but this would require expensive upgrades to the system as hydrogen is much more prone to leak. Blending hydrogen in gas pipes could also lead to higher energy bills, with some estimates suggesting this could be as much as £192 more per year.
    - ➔ Opposition to hydrogen heating town trials in the UK came from residents worried about hydrogen appliances' higher risk of explosion or fire. Homes would need to have four-inch holes drilled in the walls to allow any leaked gas to escape. A better way to heat homes is to use heat pumps, which produce three times as much heat as electricity is needed to power them.

- **Hydrogen should not be considered the silver bullet for decarbonising energy: it is expensive and inefficient in most areas.** While useful for industrial processes, hydrogen is outcompeted by electricity when it comes to things like small transport, energy storage and heating. It is still unproven for being used at scale, which will see costs remain high for some time. Renewable and electric solutions are already much more mature with infrastructure in place and prices falling.
- **The cost of producing green hydrogen is expected to decrease significantly by 2050 due to a surge in demand and investment.** As countries scale up sustainable solutions to meet their climate goals, the price of producing a kilo of green hydrogen is expected to more than halve, putting it at a similar cost level to fossil fuel methods. The green hydrogen economy is set to be worth over £1 trillion by 2050.