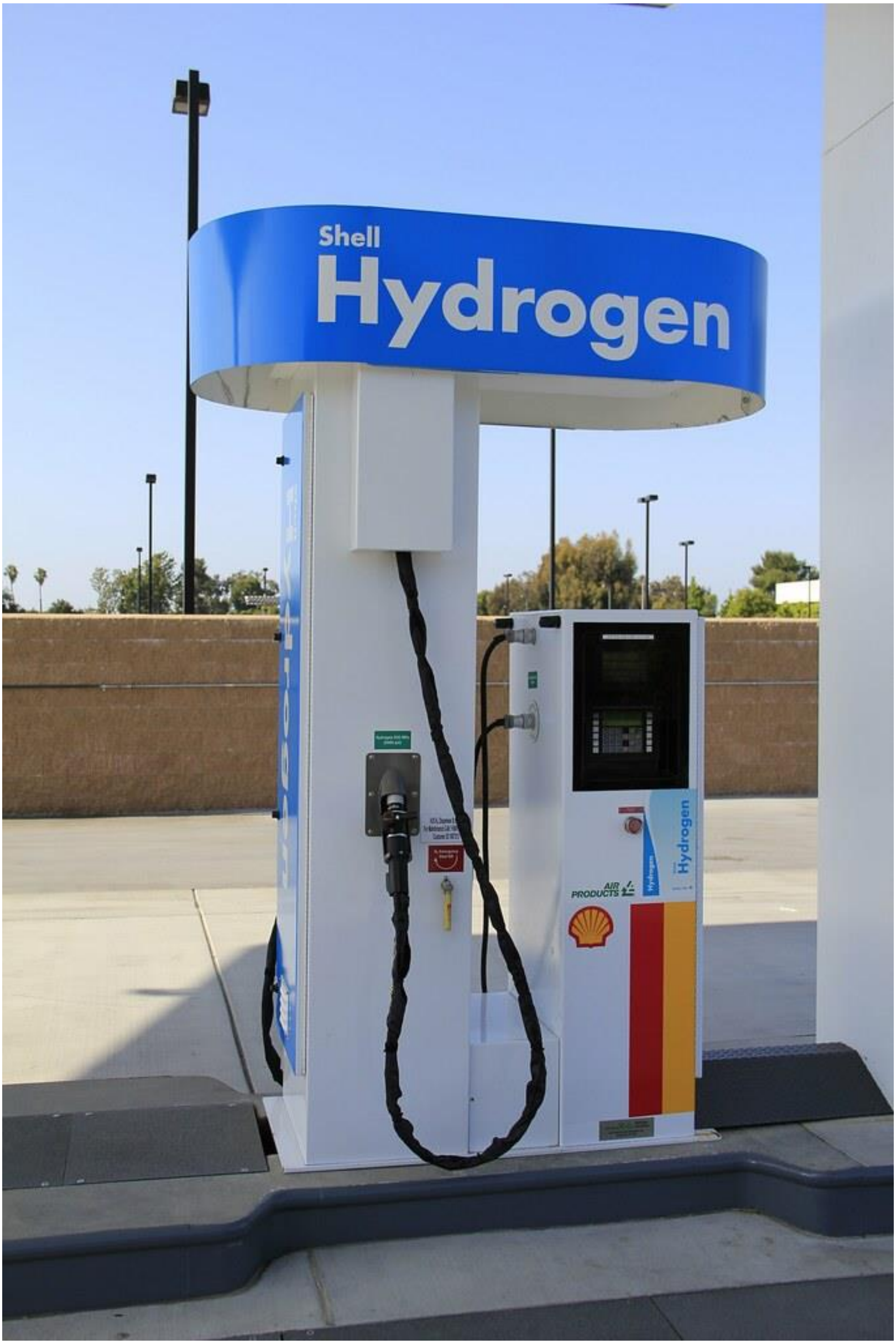

Shell
Hydrogen
AIR PRODUCTS
Hydrogen

Climbing the Hydrogen Ladder: Who reaches the top?

What is Hydrogen?

Hydrogen is typically categorised into four types based on the methods of production and their environmental impacts: Green, Grey, Blue, and Black.

- **Green Hydrogen** is produced through a process called electrolysis, where water (H_2O) is split into hydrogen and oxygen using renewable energy sources like solar or wind power. The only by-product is water, making it the most environmentally friendly option.
- **Grey Hydrogen**, produced via steam methane reforming, relies on natural gas as an energy source and generates carbon dioxide (CO_2) as a by-product, contributing to greenhouse gas emissions.
- **Blue Hydrogen** is also created using natural gas or coal, but unlike Grey Hydrogen, it captures and stores the resulting CO_2, mitigating some environmental harm.
- **Black Hydrogen** (produced through coal gasification) generates significant amounts of CO_2 and carbon monoxide, making it highly detrimental to the environment due to its reliance on coal and the lack of carbon capture.

(Dillman & Heinonen, 2022).

The problem...

Currently the transport sector accounts for over 25% of greenhouse gas emissions globally due to fossil fuel powered engines in cars, planes and maritime travel (United Nations, 2021). To be able to meet the COP21 goals set out by the UN in the Paris Agreement, the transport sector must make a change away from combustion engines (United Nations, 2024). Hydrogen fuel cell engines are beneficial as they produce clean and efficient energy which would keep the nation on track to net zero by 2050 (Department of Energy, 2024).

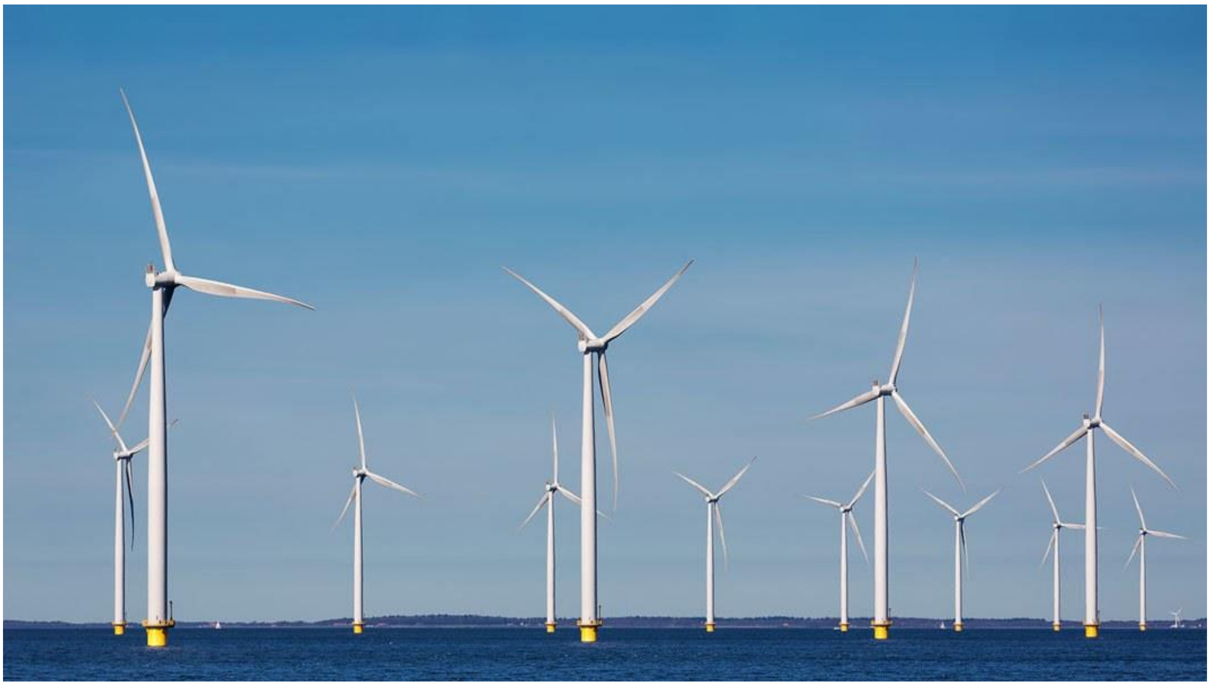
The Solution

Implementing hydrogen in the transport sector is crucial for addressing several sustainability challenges. Hydrogen-powered fuel cell vehicles (FCVs) offer a zero-emission alternative, reducing the carbon footprint of the transport sector, which is a major contributor to global greenhouse gas emissions. Unlike fossil fuel-powered vehicles, FCVs produce only water as a by-product, improving air quality and reducing harmful pollutants like nitrogen oxides (NOx). Additionally, hydrogen can be domestically produced from renewable sources, enhancing energy security and reducing reliance on fossil fuels.

Transitioning to hydrogen could play a key role in decarbonising the UK's energy sector. Once produced, hydrogen doesn't emit any greenhouse gas emissions as its only by-product is water (Dillman & Heinonen, 2022). The use of hydrogen would not only lower transportation emissions substantially, it would also help solve the energy crisis as if distributed correctly hydrogen would be a lot cheaper at a domestic level (Dillman & Heinonen, 2022).

The problem with the solution...

Distributive Justice



Distributive justice is the "spatial and temporal allocation of goods and ills across society" (Dillman & Heinonen, 2022) In the context of hydrogen transport, distributive justice is a key concern when considering who benefits from the transition to cleaner energy and who bears the potential risks.

Implementing hydrogen infrastructure will provide significant environmental benefits, but the costs associated with building this infrastructure could disproportionately impact lower-income communities through increased energy prices or a lack of access to affordable hydrogen-powered transport. As noted by Dillman and Heinonen (2022), distributive justice involves the "spatial and temporal allocation of goods and ills across society," highlighting the need for careful consideration of how hydrogen resources are distributed. Furthermore, energy justice emphasizes the importance of recognizing vulnerable groups and ensuring their inclusion in decision-making processes, as they may be ignored in the transition to hydrogen (Jenkins et al., 2017). To avoid exacerbating existing inequalities, it is essential that hydrogen policies are designed to ensure equitable access to benefits and minimize burdens on marginalized communities (Walker & Day, 2012).

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