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Exploring hydrogen's role in decarbonising the UK's transport system

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Executive Summary

Hydrogen is expected to be an important strategic component to the full decarbonisation of transport globally, particularly where pure battery electric solutions are not suitable. This is particularly true for heavier transport applications, or where infrastructure constraints or refuelling times are critical. However, the hydrogen transport market remains nascent for many countries.

The UK has announced ambitious but feasible end of sale dates for all new non-zero emission vehicles [1] with 2040 set as a backstop. It is funding research, development and demonstration programmes which include battery and hydrogen fuel cell technologies to support the transition. Among the projects being funded is the Tees Valley Hydrogen Transport Hub. This is a £20m investment by the UK Government that aims to catalyse a critical mass of supply and demand to establish a hydrogen transport ecosystem, demonstrate commercial viability of hydrogen and promote relevant skills in the area.

Keywords: *hydrogen, infrastructure, demonstration, fuel cell vehicle, truck*

1 Introduction

In the United Kingdom the transport sector is the largest contributor of greenhouse gas (GHG) emissions, responsible for 24% of total domestic emissions of 405.5 million tonnes of carbon dioxide equivalent (MtCO₂e) in 2020, with the majority (91%) of those emissions coming from road vehicles (89 MtCO₂e). (Figure 1[2]). To meet legally binding GHG reductions targets, the UK must reduce the transport's reliance on fossil fuels and transition as soon as possible to 100% zero emission (at the exhaust) technologies.

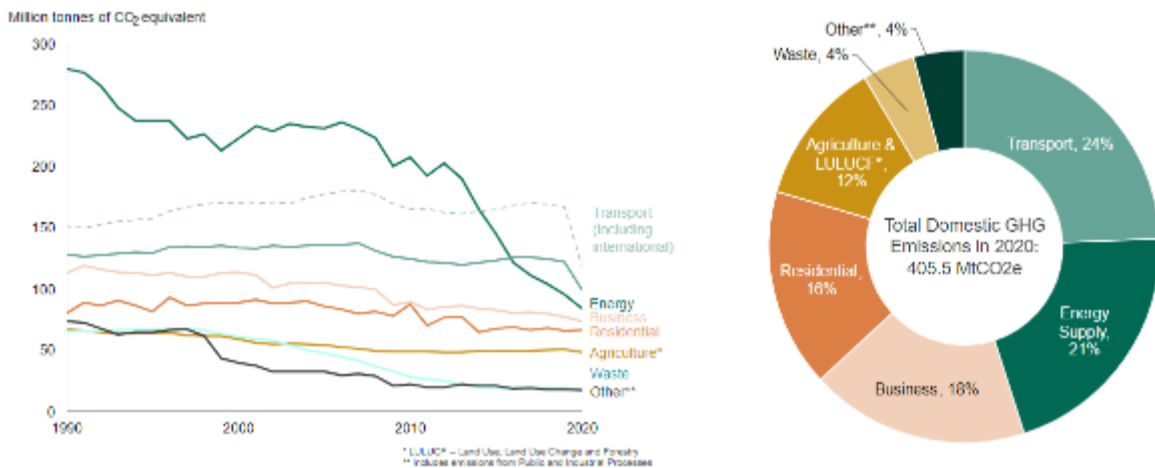


Figure 1 UK Greenhouse Gas emissions by sector [2]

In November 2020 the UK Government committed [3] to end the sale of new petrol and diesel cars and vans by 2030, and that all new cars and vans after 2035 will be zero emission at the tailpipe. In July 2021 the UK’s Transport Decarbonisation Plan [4] set out how we would meet our net zero commitments in each transport mode, including the role for hydrogen. Since 2019, the UK Renewable Transport Fuel Obligation has rewarded the supply of “green” hydrogen for transport when produced from additional renewable energy – making sure hydrogen used in transport delivers GHG emission savings.

The UK’s Hydrogen Strategy [4] brings together the UK’s hydrogen story, showcasing activity to-date and setting out an action plan for our hydrogen economy moving forward, including in the transport sector. The Energy Security Strategy [5] looks at the role of hydrogen in the UK’s future economy, highlighting it as an important part of our future domestic fuel supply and identifying where opportunities for growth and investment can be found. The strategy sets out Government’s intention to double our ambition for hydrogen production to up to 10GW by 2030, with at least half of this from electrolytic hydrogen.

1.1 Background

As part of its Net Zero Strategy [2], the UK committed to demonstrating multiple zero emission HGV technologies at scale on UK roads to determine their operational benefits, as well as this infrastructure needs. This is against the backdrop of the UK’s stated position of technology neutrality – the UK has set ambitious targets for zero exhaust emissions but has no pre-conceived technology preference for how they are achieved.

Heavy goods vehicles were the source of 19% [1] of UK domestic greenhouse gas (GHG) emissions in 2020 and are set to become a greater proportion of domestic GHGs as other areas of the economy continue to or begin to decarbonise. To support the uptake of new zero emission HGVs, associated infrastructure will need to be deployed at pace; this can only take place once an appropriate technology mix has been identified. The decision on future infrastructure technology will need to be made in the latter half of this decade (2025-2027) to ensure that sufficient infrastructure can be deployed to meet the UK’s announced end of new sales dates.

Whilst battery electric and hydrogen fuel cell technologies are vital to deploy in the 40-44 tonne weight category in the medium-term, legacy HGV fleets could benefit from low carbon fuel deployment in the short-term. HGV fleets with depot-based refuelling, particularly in logistics, construction, haulage, and quarry industry fleets which are hard to decarbonise in the short- and medium-term, can also see benefit from low carbon fuels. These fuels will be an interim measure before zero emission technologies can be deployed at scale.

2 Tees Valley Hydrogen Transport Hub programme

2.1 Background

It is hard to judge accurately how much hydrogen will need to be produced for transport needs, meaning suppliers are unable to make clear investment assessments. Furthermore, hydrogen infrastructure is reasonably lagging that of battery electric technologies given the position of each in the market; the UK currently has 35,300 public EV charging points and only 9 hydrogen refuelling stations serving 1 million and 452 vehicles respectively. If hydrogen is to find a place as a viable transport solution, it will need to scale.

As a nascent technology, it is unclear where, and to what scale, hydrogen will be used in decarbonising transport. The Hub will generate a strong evidence base to inform future policy and investment decisions.

The Hub offers a unique opportunity to address these challenges. Tees Valley region is a natural home for the UK's first hydrogen transport Hub. Indeed, more than 50% of the UK's current hydrogen production originates from the area. An existing network of hydrogen storage caverns and pipelines provide infrastructure while local demand helps to de-risk further investment and promotes diversified use cases. The region's expertise in hydrogen is further bolstered by a skilled workforce and a pipeline of future talent.

As UK companies spend proportionately more on hydrogen R&D than any other country, and the Tees Valley region has existing hydrogen infrastructure and expertise, the Hub is ideally placed to build on this.

2.2 Scope

The Hub launched in 2021 with seven trial projects, kick starting hydrogen transport activity across the region. These projects generated interest and developed early connections between hydrogen industry partners and end-users. Government provided £2.6m funding which was matched by £1.3m from industry to deliver vehicles including cars, buses, vans, medium-duty commercial vehicles, a forklift, a boat and an aircraft tug. Projects were supported by temporary refuelling infrastructure.

To deliver the next phase of the Hub, the UK Government announced further investment of £20m in October 2022. The overall aim is to scale up the use of hydrogen transport in Tees Valley. The Hub will help with the understanding of where hydrogen technology best fits in a decarbonised transport system. It is hoped that the Hub will act as a blueprint generating lessons to help other regions decarbonise transport, and will inform government policy and investment decisions as the UK accelerates towards becoming a net zero economy.

The Hub focuses on three core pillars of activity:

1. Hydrogen Demand from vehicles: Accelerating hydrogen demand to understand what works by building on 2021/2 pilots and through interaction with complementing projects and demonstrations.
2. Supply/Dispensing infrastructure: Investing in mobile and permanent hydrogen refuelling stations to support the demand from vehicles.
3. Skills and Training: Supporting and developing training with the aim of transitioning the local workforce to renewable technologies away from fossil fuel.

The UK Government will look for the following priority outcome performance metrics: reduction of greenhouse gas emissions and support for the creation of growth, jobs and skills.

The Hub funding is focussed in two areas. The first is aimed at attracting large refuelling stations and captive fleets, with a high funding ceiling to promote this. The second has a lower funding ceiling aiming to encourage more niche use cases with lower economies of scale; these projects have much to offer in terms of innovation and learning as, for example, these applications may also need more bespoke refuelling arrangements. Consortia are formed through partnerships between vehicle manufacturers, end-use fleet operators and businesses, logistics and refuelling providers, among others.

The focus of the Hub is on zero emission hydrogen technology. Hydrogen combustion engines are in scope for non-road transport applications such as aviation, maritime, and non-road mobile machinery such as construction vehicles. Projects are required to use electrolytic hydrogen generated from additional renewable energy from April 2025. While this is also encouraged pre-April 2025, due to the limited availability of

additional "green" or clean hydrogen in the UK, projects can use hydrogen which meets the UK's low carbon hydrogen standard (LCHS). To help with this transition, hydrogen supplied for transport from additional renewable energy is eligible for support worth up to £7.32 per kilogram under the Renewable Transport Fuel Obligation, higher than the LCHS reward.

The Hub is already creating significant levels of industry interest, with BP and Protium Green Solutions announcing their intentions to build large scale green hydrogen production in the area [7]. The UK Government continues to actively promote the work of the Hub to attract new private investment and clean growth into the area. To increase the benefits, the UK Government is working closely with Tees Valley Combined Authority (TVCA) to ensure there is corresponding support for skills. A further £300k has been announced to purchase equipment for local colleges, enabling them to offer hydrogen-specific courses.

3. Current position

Following the conclusion of the competitions, the Department will be making announcement on the winning projects. While the UK Government is not yet able to confirm the winning projects, it is likely that they will see deployment of a range of specialised hydrogen vehicles ranging from airport vehicles (such as runway sweepers and aircraft tow tugs) to refrigerated HGVs to cars and vans. The projects will have both private and publicly accessible Hydrogen Refuelling Stations (HRS) dispensing at either 350 or 700 bar.

4. Next steps

Once the announcements of the winning projects are announced, project partners will undertake detailed planning work.

References

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Presenter Biography



Nick has been Joint Head of the Office for Zero Emission Vehicles since July 2022, leading the UK government team supporting the transition to zero emission vehicles and the rollout of charging infrastructure. Prior to this, he was Deputy Head of Decarbonisation Strategy in the Department for Transport (DfT), including developing the 2021 Transport Decarbonisation Plan. Before DfT, he worked in Cabinet Office covering energy, environment and transport, and the Department of Energy and Climate Change.