North West Hydrogen Alliance

A Hydrogen Mobility Roadmap

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While great strides have been made to decarbonise electricity supplies in the UK, the biggest contributor to climate change is the transport sector. Analysis by the Committee on Climate Change (CCC) showed that in 2017 transport accounted for 28% of all greenhouse gas emissions in the UK. The transport sector also has a significant impact on air quality with many local authorities taking action to reduce the level of roadside nitrous oxides (NOx). Data published by the CCC shows that transport emissions, including international aviation, have increased by 14% since 1990 and it argues that current government policies are insufficient to deliver the required reductions in emissions.

There is appetite to change. Research by the North West Hydrogen Alliance (NWHA) in 2019 showed that 69% of people believe it is important for every UK household to move away from fossil fuelled cars. Electric vehicles will be a huge part of the solution but while the take up of domestic electric cars is growing, the rest of the transport sector faces a bigger challenge.

Towards the end of 2019, Cadent, a founding member of the NWHA, brought together leading industry figures as part of its HyMotion project, to set out a roadmap for using hydrogen to decarbonise transport. The event brought together various businesses that are already working to deliver hydrogen transport projects in the UK along with hydrogen producers, local authorities and other key stakeholders.

This report summarises the findings of the workshop and sets out some practical steps that could enable hydrogen vehicles to become an attractive choice in the North West.

**Opportunities for hydrogen in the transport sector**

The Government’s ‘Road to Zero’ strategy sets out objectives to electrify cars and reduce emissions from heavy goods vehicles (HGVs) through policies such as subsidising electric charging infrastructure and ending the sale of diesel and petrol cars (with a recent announcement bringing the date forward to 2035). The CCC has stated, however, that the proposed measures do not go far enough and has identified hydrogen as one potential solution.

This is not a case of electric vs hydrogen vehicles. If the UK is to meet its ‘net zero’ commitments it will need both. While the roll out of electric cars is significantly ahead of hydrogen cars – largely due to the current lack of available low-cost, low-carbon bulk hydrogen production and refuelling infrastructure – there are other applications to which hydrogen is better suited.

Hydrogen offers significantly longer running distances and faster refuelling than electric batteries and is therefore ideal for long haul transportation – particularly ‘back to base’ vehicles such as waste trucks which do not depend on a network of hydrogen refuelling stations (HRS). Table 1 presents a comparison of the benefits and challenges of hydrogen and electric vehicles.

<table>
<thead>
<tr>
<th>Table 1: Hydrogen Vs Electric Vehicles</th>
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<tr>
<td><strong>Electric</strong></td>
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<tr>
<td>SPEED OF REFUELLING</td>
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<tr>
<td>DISTANCE ON SINGLE CHARGE/TANK</td>
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<tr>
<td>AVAILABILITY OF FUEL</td>
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<td>AVAILABILITY OF VEHICLES</td>
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The current long duration of battery recharges rules out many forms of transport

At the present time, cars will travel 150-250 miles per charge, but current battery weight means they are unsuitable for HGVs

Growing network of charge points, but this is creating problems for power networks

Various cars to choose from, buses and trains readily available, with HGVs and ships in development
In addition to road transport, hydrogen offers a significant opportunity to decarbonise the rail sector, particularly where electrification is not feasible. Alstom is now running hydrogen-fuelled trains on commercial routes in Germany and is planning to deploy fleets of its newly designed ‘Breeze’ hydrogen train in the UK, which would be serviced out of its maintenance and innovation centre in Widnes. Furthermore, a consortium led by Porterbrook will shortly demonstrate its ‘Hydroflex’ hydrogen trains on several routes in the UK.

There is also huge potential for hydrogen to contribute to the decarbonisation of the marine sector. Greenhouse gas emissions from shipping in Europe are equal to the carbon footprint of a quarter of passenger cars.\(^1\) While historically Government has focused on air quality impacts from road vehicles as the main source of pollution, other emitters, including shipping and ports are now being asked to play a larger part in delivering clean air for all. Most major ports are now working on Air Quality Plans, driven by guidance published by the Department for Transport (DfT).\(^2\) While these are not yet mandated to contain any firm targets for improvements in air quality, they are acting as an initial driver for potential changes in relation to shipping fuel, port energy use (for example on-site heat and power requirements), fuelling of forklifts and onsite fuelling of HGVs.

More widely, use of hydrogen vehicles in place of those fuelled by petrol and diesel has the potential to significantly improve air quality on roads. Hydrogen vehicles emit only water vapour and warm air and so widespread adoption would avoid emissions of harmful NOx and particulates, which can impact on human health.

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What’s already happening in the North West?

Cadent launched its HyMotion report in June 2019, which evidenced the benefits of supplying hydrogen using pipeline networks. Cadent is seeking partners for demonstration projects that provide learning on the distribution of hydrogen for mobility via networks. Such demonstrations will include showing that, by including relatively simple ‘upgrading’ equipment, pipeline networks can deliver hydrogen to the purity specifications required by fuel cells.

Assuming moderate uptake of hydrogen vehicles in 2030, supported by hydrogen from HyNet (the UK’s leading hydrogen and carbon capture project located in the North West, led by Progressive Energy) available from 2025, as shown in Figure 1, over 0.3 million tonnes of CO₂ emissions could be avoided, a total which would likely grow significantly in the subsequent years.

https://hynet.co.uk/app/uploads/2019/06/15480_CADENT_HYMOTION_PROJECT_REP.pdf
The deployment of hydrogen in the transport sector is not without its challenges; however, in the North West, the right framework exists to enable deployment.

Where will the hydrogen come from?
Hydrogen production is already happening in the North West. INOVYN has been producing hydrogen at its Runcorn Site for over one hundred years as a co-product of the chlor-alkali manufacturing process. The company has the potential to supply hydrogen equivalent to fuelling 1,000 buses and is seeking sufficient levels of demand to justify infrastructure investment. BOC has an existing steam methane reforming (SMR) plant in St Helens that will supply hydrogen to Liverpool’s bus fleet. The Liverpool City Region Combined Authority is also undertaking a planning exercise for suitable locations for its Zero Emission Refuelling Centres (ZERCs), which will include hydrogen fuelling. In the longer term, these will be supplied with hydrogen generated by the HyNet project. HyNet has recently received £7M of Government funding to undertake detailed engineering of the UK’s first Low Carbon Hydrogen Plant at Essar Oil UK’s Stanlow refinery in Ellesmere Port.

How will it be transported?
From the mid 2020s, hydrogen will be distributed by new pipeline networks deployed by Cadent as part of the HyNet project. In addition to supplying vehicles, these pipelines will also supply hydrogen for industrial heat and to power stations, along with a blend injected into the existing gas network to decarbonise households and the commercial sector. The use of pipelines is critical to unlocking the potential for low cost, low carbon hydrogen available at multiple fuelling locations across the North West.

Costain’s Manchester office, along with National Grid, Cadent, Northern Gas Networks, SGN and Wales & West Utilities is leading a feasibility study looking at the ability to utilise the existing gas transmission and distribution networks to transport hydrogen as a ‘blend’ with natural gas. Hydrogen would then be ‘de-blended’ to meet fuel cell quality standards.

How do we get to critical mass?
Initial projects supported by hydrogen from Runcorn and St Helens will demonstrate that new hydrogen vehicles can operate safely and reliably in the North West. At the same time Cadent will look to demonstrate that pipeline networks can deliver the required level of purity of hydrogen. This will pave the way for far greater deployment as soon as hydrogen is available more widely from HyNet.

### Figure 1: Potential CO2 reduction from hydrogen vehicles in the North West to 2030

![Bar chart showing potential CO2 reduction from hydrogen vehicles in the North West to 2030](image)


### Rising to the challenge

The deployment of hydrogen in the transport sector is not without its challenges; however, in the North West, the right framework exists to enable deployment.
Why the North West?

The North West is poised to be the leading region for the development of a decarbonised, hydrogen-based energy market for the UK. It already features all the necessary components to develop a hydrogen economy — thriving industry, an existing skilled workforce in respect of engineering and construction projects, industry-based training schemes, city regions that collaborate, as well as natural and industrial assets.

Benefits of the North West include:

Key infrastructure such as the Manchester Ship Canal and the Port of Liverpool offer gateways to hydrogen transportation; operational hydrogen production facilities are primed to deliver; and existing pipelines can be repurposed.

Geologically, Cheshire is one of the few places in the UK where major underground gas storage in salt caverns has been delivered, paving the way for potential hydrogen storage, which is already done at scale elsewhere.

Esteemed universities, and a wealth of innovative research companies, mean the region can deliver new hydrogen technologies. With academia working side-by-side with industry, the North West’s institutions can equip the next generation of skilled workers to support the hydrogen economy.

Offshore reservoirs in the East Irish Sea can store carbon dioxide (CO₂) produced from hydrogen production. Carbon Capture Utilisation and Storage (CCUS) is essential technology to help the UK in its fight against climate change. CCUS can capture up to 95% of the CO₂ emissions associated with producing hydrogen from natural gas.
A roadmap to delivery

While the Government has placed the adoption of hydrogen firmly at the centre of its Industrial Strategy⁴, Table 2 shows that the current policy mechanisms are simply not in place to support mass roll out of hydrogen vehicles.

Table 2 identifies the key roadmap activities required from Government – and related actions by industry – to enable widespread deployment of hydrogen vehicles.

### Table 2: Industry and Government actions required to deliver hydrogen vehicles

<table>
<thead>
<tr>
<th>Sub-sector</th>
<th>Government Action</th>
<th>Industry Action</th>
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<tbody>
<tr>
<td><strong>Cars</strong></td>
<td>Continue commitment to zero emission vehicles and continue to incentivise hydrogen vehicles after electric vehicles no longer require subsidy. Local Government to introduce zero emissions zones.</td>
<td>Manufacturers to continue development of hydrogen cars and supply them to UK market.</td>
</tr>
<tr>
<td><strong>Buses</strong></td>
<td>Quickly amend rules associated with the Bus Service Operators Grant (BSOG) to incentivise hydrogen use.</td>
<td>Manufacturers to continue development of hydrogen buses and supply them to UK market.</td>
</tr>
<tr>
<td><strong>HGVs</strong></td>
<td>Set standards to decarbonise HGVs and introduce a subsidy for zero emission vehicles.</td>
<td>Development of industry consortium to promote introduction of vehicles to UK market.</td>
</tr>
<tr>
<td><strong>Trains</strong></td>
<td>Drive introduction of first fleets through appropriate funding and residual value mechanisms to support investment.</td>
<td>Cross sector co-operation to generate viable fleet operation business cases supported by train operators.</td>
</tr>
<tr>
<td><strong>HRGs</strong></td>
<td>Continue funding of HRGs in strategic locations.</td>
<td>Continue build-out of 350 and 700 bar refuelling networks. Encourage open access to reduce costs for all users.</td>
</tr>
<tr>
<td><strong>Supply &amp; Distribution of hydrogen</strong></td>
<td>Introduce support for low carbon hydrogen networks for both heat and transport. Ofgem to enable construction of hydrogen networks under RAB.</td>
<td>Continue to develop HyNet North West and proposed North East and Scottish hydrogen networks.</td>
</tr>
</tbody>
</table>

Source: Adapted from Cadent (2019) HyMotion: Network-supplied hydrogen unlocks low carbon transport opportunities, June 2019

In addition to the above roadmap actions, there is a quick and easy win for hydrogen cars, buses and HGVs. The DfT has the power to immediately amend the current guidance to the Renewable Transport Fuel Obligation (RTFO) to provide meaningful, simplified support for renewable hydrogen produced by electrolysis. Furthermore, this support could be extended to trains and ships via planned legislative changes in 2021-22 and include a clear statement of intent to support low carbon hydrogen, as will be produced by HyNet, from 2025. Such moves would provide a clear and strong driver for both manufacturers and fleet operators to take the necessary investment decisions to really kick-start the hydrogen transport revolution.

### Conclusions

- This is not a case of electric vs hydrogen vehicles. If the UK is to meet its ‘net zero’ commitments and improve local air quality it will need both. While the roll out of electric cars is significantly ahead of hydrogen cars – largely due to the current lack of available low-cost, low-carbon bulk hydrogen production and refuelling infrastructure – there are other applications to which hydrogen is better suited.

- Hydrogen currently offers significantly longer running distances and faster refuelling than electric batteries and is therefore ideal for long haul transportation – particularly ‘back to base’ vehicles such as waste trucks – and for use in the rail and marine sectors.

- There are a series of actions which Government and industry need to take to enable widespread deployment of hydrogen vehicles.

- One quick and easy win is amending the current Renewable Transport Fuel Obligation to include renewable (or ‘green’) hydrogen as a vehicle fuel and include a clear statement of intent to support low-carbon hydrogen, as will be produced by HyNet, from 2025. This will provide a strong driver for manufacturers and fleet operators to make the necessary investment decisions.

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HM Government (2018) The Clean Growth Strategy: Leading the way to a low carbon future, April 2018  