SIEMENS

Smart Financing and the road to zero

Green transport, hydrogen, electric vehicles, and the critical role of smart finance

Hydrogen
– Hot air, or hot stuff?

Much is made of the electrification of the UK's transport system. Large arterial railway routes have seen huge investment in electrification[i]. The Government has recently launched a challenge (and funding) for a UK town to establish the country's first all-electric bus system. At the same time, power generators and oil companies are busy creating their future by investing in renewables[ii].

However, there is a quieter, but no less significant revolution happening in another area of clean transport – namely, hydrogen fuel cell vehicles. These vehicles have no waste product other than water vapour, are quick to refuel and have a range between refuelling of hundreds of miles (for a bus, typically 200-250 miles[iv]). The process of electrification has an ongoing investment in infrastructural development and will undoubtedly end up serving the larger part of our transport power needs. Travel outside of arterial routes, long-haul, tricky terrain – all these situations may make hydrogen fuel cell the powertrain of choice. Of course, in a hydrogen fuel cell, the clean burning compressed gas is converted first to electricity and then powers the bus, train or even aircraft or ship engine[v]. So the likely mainstream solution may be hybrid vehicles that can either take electric power from a direct source, or generate it from hydrogen combustion.

At all events, the exact balance between grid-based electric power and hydrogen-based electric power is yet to be determined. Now, however, that the UK Government is sitting firmly behind hydrogen in its Green Industrial Revolution policy[vi], both are likely to play a significant role in our rail and road transport of the (near) future.

> *"UK-made hydrogen buses are ready to hit the streets today. We already have hydrogen buses in London, and 20 of Wrightbus' world-leading double deckers will be added to this later this year. We also have orders from Aberdeen, with many other areas becoming interested in our technology in the UK and across the world[iii]."*
>
> **Jo Bamford, Chairman, Wrightbus**

How much is hydrogen happening?

The importance of a hydrogen-fuelled future is neatly summarised by the European Union's Mobility and Transport unit, which notes[vii], **"Hydrogen and fuel cell technologies were identified amongst the new energy technologies needed to achieve a 60% to 80% reduction in greenhouse gases by 2050, in the European Strategic Energy Technology Plan presented along with the Energy Policy Package."** A political commitment does not, however, always translate into widespread implementation. Other hard evidence is available though. The stockmarkets now expect big things for hydrogen with, for instance, one hydrogen manufacturing technology company's share price increasing more than six-fold since the beginning of 2020[viii].

As with any transport network, the big issue for mainstream implementation is the fuel supply infrastructure. There are currently just 10 operating H-filling stations in the UK[ix] – mostly in the South East. This needs massive expansion. To move matters along, the UK Government has devoted a £90m fund for the Hydrogen Supply Programme[x]. One major area of infrastructure development may well be around catalysis units powered by renewables – which produce and store H2 on-site at the refuelling point (petrol station, bus station, train station depot). If this is successful, concerns over transporting a highly volatile fuel under pressure could be overcome. One oil company is already running such generation units in Cobham and Beaconsfield[xi]. An associated big issue – environmentally – is that most hydrogen is produced using fossil fuels – usually extraction from natural gas through exposure to high temperature steam[xii]. For the fuel to considered a renewable, it needs to be created through electrolysis, itself driven with renewable power such as solar or wind.

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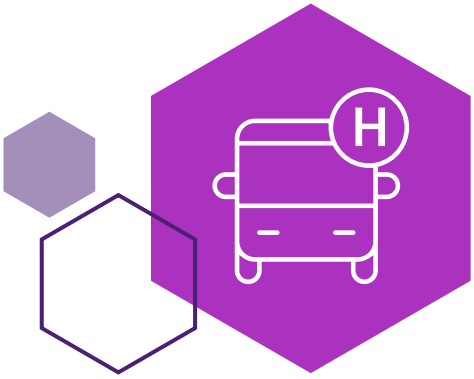
> European Union's Mobility and Transport Unit

Focus on hydrogen buses



In fact, the breakthrough for hydrogen appears to be mainly happening in the field of rail and bus transport. Although not necessarily high in mind for the general public, hydrogen buses have been in testing mode for some time in the UK and are backed by strategic initiatives at the EU level. To be sure, two manufacturers[xiii] have a H-car on the market in the UK, and hydrogen trains have been launched in Europe[xiv] with a rollout plan. Indeed, the Department for Transport gave £750,000 to the HydroFLEX project, run by the University of Birmingham and rolling stock leasing company Porterbrook, to bring the first hydrogen train to UK main lines[xv]. Nevertheless, bus transport appears to be the most mature modality to date. As one motor industry European CEO noted[xvi], **"We need scale for hydrogen to be successful. To find scale I think heavy commercial vehicles and buses will be the first phase of hydrogen application in Europe."**

It is worth reviewing progress to date of hydrogen in the UK and European bus network.Hydrogen buses have been running routes in London since 2015 - 8 hydrogen buses on the RV1 route with 5 refuelling stations ran for eight years clocking up over a million miles. The world's first hydrogen-powered double decker buses are to be working in Aberdeen this year[xviii], assuming no interruption from the COVID-19 crisis. This follows the city's successful JIVE sponsored hydrogen bus project. Glasgow has also announced hydrogen bus initiatives within its overall clean transport investment plan[xix]. Wrightbus is now making the case for a £500m package from the government's National Bus Strategy fund to help stimulate the UK's hydrogen industry and support its plans to build at least 3,000 hydrogen buses by 2024[xx].

Across the region, the EU's JIVE (Joint Initiative for hydrogen Vehicles across Europe) has seen orders from TfL and Birmingham[xxi]. According to the European Joint Initiative, 300 H-buses will be in 22 European cities by the early 2020s. In parallel, Europe's MEHRLIN project is seeking to establish a network of refuelling stations to serve bus fleets in Europe (including the UK).

> *"For Northern Ireland, hydrogen could help fuel a clean, cutting edge economic recovery. We are uniquely placed to use renewable electricity to produce green hydrogen. This would make use of the wind that is available when the demand for electricity is lower[xvii]."*
>
> **Dianne Dodds, Northern Ireland Minister for the Economy**

Balancing hydrogen with electric – a symbiosis

As noted earlier in this research insight, hydrogen will inevitably have a symbiotic relationship with pure electric power. Hydrogen offers, after all, several possible advantages. Fuelling speeds are as quick as diesel. The fuelling infrastructure can piggy-back existing fossil fuel stations and points. And the range from a full tank is measured in many hundreds of miles. Of course, the eventual balance between electric and hydrogen buses is uncertain. Were battery technology to advance rapidly, then the range of a single charge might radically change. Fuelling speed would then become less of an issue – especially as the patterns and habits of electric vehicle (EV) recharging become second nature in our personal and business lives. Where space is at a premium (city centres), then grid-charging will most likely be the favoured option – on both cost and safety grounds. Distributed, 'in situ' production of hydrogen will undoubtedly be favoured over road haulage of the fuel. Nevertheless, hydrogen technology remains a strong option for off-grid routes, some rural environments and long-distance journeys.

What is abundantly clear is the fact that grid-powered and hydrogen-powered EVs will rapidly replace fossil fuel engines. Electric vehicles have far fewer moving parts and therefore offer a cost-of-ownership advantage over time because of their massively reduced maintenance costs. It is not surprising then, that a massive investment has already gone into electric and hybrid vehicle fleets.

The picture with rail is mixed: the Rail Delivery Group's Investment Report 2020 notes that 70% of rail journeys are now on electrified lines; yet only 40% of rail routes are currently electrified, meaning that many long-distance journeys cannot be completed entirely on electrified rail. Whilst further electrification of many major routes remains a priority, there are parts of the network where this could be prohibitively expensive and /or disruptive. Therefore trains that can run wholly or partly on hydrogen will become an important part of the solution for passenger journeys. For example, parts of the Cross Country route from Aberdeen to Penzance could prove very difficult to electrify and therefore it is likely that procuring hybrid hydrogen-electric rolling stock to replace existing diesel trains would be the most cost-effective use of scarce public resources.

Turning to public road transport, 2018 saw the European electric bus market increase 48% compared to 2017, 2019 saw a tripling in the number of electric bus registration in Western Europe[xxii]. London currently has more than 200 electric buses making it Europe's largest electric bus fleet[xxiii]. This will continue to grow in the early 2020s and beyond as Transport for London (TfL) receives delivery of a further 78 electric double-deck buses, which will carry around 18.5 million passengers across the capital each year[xxiv]. Nationwide, organisations representing more than 95% of the UK's bus industry have pledged to only invest in low-emission vehicles from 2025, over concerns surrounding climate change and air pollutio[xxv] .

UK Local authorities can now apply to become the UK's first all-electric bus town, setting the 'gold-standard' in environmentally friendly public transport, Transport Secretary Grant Shapps announced in early 2020[xxvii]. The winning area will receive up to £50 million to help pay for a brand-new fleet of electric buses, reducing emissions and cleaning up the air in their community.

Major producer Alexander Dennis has recently announced a vision for the transformation of buses in the United Kingdom which could see at least 10,000 new low, ultra low and zero emission buses in service within the next 4 years, the first of them hitting the road before the end of the year to maintain the benefits of lower pollution and better air quality towns and cities have experienced during the coronavirus lockdown[xxviii].

In short then, we can expect to see investment in electrification continue, but a hybrid approach, which combines electric with hydrogen, is seen by most policymakers and interest groups as the most cost-effective green transport strategy for both road and rail[xxix].

"We believe fuel cell technology has the potential to complement Optare's award-winning battery electric vehicle range. We can see applications for fuel cells on inter-urban routes in temperate climates..."[xxv]

Graham Belgum, CEO, Optare Group

Sustainable
financing on the road to zero

All this planned development of hydrogen and electric fuelled transport is well and good – but the question remains, how is it to be financed? The COVID-19 crisis has put enormous pressure on the Exchequer and, in any case, public capital is usually focused on pilot projects than full roll-out. However, transport infrastructures are greedy for capital – capital that the public purse cannot – or is reluctant to – afford. Now, the pandemic fiscal support programme and its inevitable aftershock on the economy and the national finances will make public capital finding even less available across the board.

Most green policymakers and consultants agree that private sector finance is critical to the creation of green, smart public services and cities[xxx]. Rail development in the UK has hard-wired private finance into its public strategies, noting its objective from 2017 to **"Build a bigger and better railway for the country by investing more than £50 billion in the next decade, of which £11.6 billion is from the private sector[xxxi]."** Accordingly, Siemens is directly pushing the hydrogen issue: it is one of 40+ companies that have written to the Chancellor calling for clearer hydrogen strategy; collectively the companies have stated themselves ready to invest £1.5 billion in hydrogen fuel projects.

To give readers a sense of the carbon emissions benefit for conversion of the national bus fleet to grid-powered and/or hydrogen-powered EVs, this insight paper has modelled the carbon reduction gained from converting just 25% of the current fleet. The chart on the right illustrates the benefits gained and underlines the importance of harnessing private sector capital to fund these acquisitions so that daunting capital expenditure is converted into a manageable monthly payment which does not tie up (or freeze) precious public funds.

The UK Bus Fleet: grid-powered or hydrogen-powered EVs – the carbon benefit of 25% conversion

Region	Tonnes CO_2 saved over 5 Years
North East	15,343
North West	34,326
Yorkshire and the Humber	27,057
East Midlands	16,954
West Midlands	29,185
East of England	15,787
London	196,045
South East	31,095
South West	19,409
England	385,201
Scotland	33,876
Wales	9,087

Smart finance for hydrogen

In the light of economic pressures, private sector finance is essential to the great 'green project'. So what does that financing support need to look like? And where will it come from? It is possible to draw up a short profile of the key private sector finance community.

First, it will tend to come from financiers who have an intimate understanding of the technology and its applications/benefits in real life.

This allows financing arrangements to be created that are financially (as well as environmentally) **sustainable**. They will look at the cash flow profile of each transport organisation and flex financing periods, low-start arrangements, financing structures, etc, in order to create schemes where payments allow the organisation to flourish and not become overburdened.

The most appropriate financiers will also tend to have a track record of commitment and expertise in the area, whether that is financing the infrastructural development of smart cities, or a deep existing involvement in electric vehicle and charging infrastructure finance.

To this point, the most expert financiers will have a strong involvement with the providers of green transport technology, embedding financing options as a fundamental part of the technology provider's value proposition. The green transport sector will rely on a healthy supply side that is highly competitive, but also commercially sustainable, and smart finance plays a key role in making that possible. A healthy and strong supply chain ensures reliable supply, and the ability to provide added value to the buyside transport companies and – ultimately – their customers (us, the citizens!).

Finally, these financiers will tend to offer a range of **financially sustainable** financing methods which address the multiple needs of green transport development. This will include finance to acquire the vehicles; finance that funds the development of charging or fuelling infrastructures; and financing that allows existing networks to continue to run as new ones are tested and set up, but without having to pay for both at the same time. In big schemes, some financiers may even be prepared to build in targets that include environmental outcomes – such as improvement in air quality or energy consumption.

"There's a real momentum growing behind hydrogen fuel-cell buses, which look like an essential complement to EVs with their rapid fuelling and long-distance range. But we are in a time of constrained capital, so harnessing private finance to acquire these vehicles is increasingly viewed as an essential part of the value proposition."

Brian Foster, Head of Industry Leasing, Siemens Financial Services

➜ **Find out more about Siemens finance solutions for UK businesses**

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