Can electricity fully decarbonise road transport?

Vehicle transport should be a simple sector to decarbonise. New models of electric vehicles (EVs) are constantly being introduced, and charge points are appearing across road networks. But is electrification a silver bullet solution? *Jennifer Johnson* looks at some alternative technologies.

If recent policy targets and pledges by automakers are to be believed, the full electrification of road transport in Europe could be complete before the middle of this century. In its roadmap to achieving net zero emissions by 2050, the UK's Committee on Climate Change (CCC) recommended that all new cars and vans in the country are electric, or low carbon by some other means, by 2035. However, the CCC has emphasised that an earlier switchover is preferable, in part to improve air quality.

Automakers themselves appear to be gearing up their EV offerings in line with increasingly stringent Europe-wide decarbonisation targets. Honda, for instance, has announced ambitions to make all of its EU vehicle sales electric by 2025. Meanwhile, BMW has vowed to have 25 electric car models on sale in 2023 – two years earlier than it had previously planned. Over half of these vehicles will be fully electric.

This flurry of EV production activity comes after the EU adopted strict new vehicle emissions targets earlier this year. The bloc is now working towards cutting CO2 emissions from cars by 37.5% and CO2 emissions from vans by 31% by 2030 from a 2021 baseline. When the new targets were announced at the end of last year, the European Automobile Manufacturing Association (ACEA), the lobby for the European auto industry, expressed serious concerns about whether they are achievable.

'Indeed, [the targets] will require a much stronger market uptake of electric and other alternatively-powered vehicles than is currently proving possible,' said Erik Jonnaert, the ACEA's Secretary General. 'All our member companies will continue to invest in their portfolios of alternatively-powered cars and vans, but there are still several obstacles putting the brakes on widespread consumer acceptance, such as affordability and the lack of a sufficiently dense network of recharging and refuelling infrastructure.'

The tension between forward-looking emissions targets and existing levels of EV uptake is growing more obvious all the time. Electric vehicles in Europe currently have a market share of around 1.5%. Suffice it to say, this figure will have to increase rapidly if battery technologies are going to be single-handedly responsible for decarbonising road transport. Though policymakers and industry appear to have placed their bets on EVs already, the question remains: is it also necessary to deploy other low carbon technologies to hit emissions targets?

Biofuels

The UK's biofuels industry believes it has a role to play in the medium-term decarbonisation of road transport. Motorists already use biofuels – perhaps unknowingly – as part of blends available on forecourts nationwide. Standard unleaded fuel can contain up to 5% bioethanol, while regular diesel can contain up to 7% biodiesel. This doesn't mean that all petrol contains biofuels, just that fuel companies which supply at least 450,000 litres of fuel a year are required by law to ensure a certain percentage of their products are derived from renewable sources.

The Toyota Mirai is one of the few hydrogen fuel cell vehicles available in the UK today.
Photo: Toyota

The government's Renewable Transport Fuel Obligation (RTFO), first introduced in 2008, sets the volume benchmark for renewable fuels in the UK. Last year, policymakers increased the biofuels volume target from the existing 4.75% to 9.75% by 2020 and finally to 12.4% by 2032. However, biofuels advocates are keen to see this goal made more ambitious – especially in the years before vehicle electrification is widespread.

'The biofuels industry is facing a perception problem, which is that everyone is understandably excited about genuine zero-emissions technologies,' said Dickon Posnett, Director of Corporate Affairs at Argent Energy, the firm widely credited with pioneering the large-scale commercial production of biodiesel in the UK. 'There is a lot of money going into these over-the-horizon solutions, and there is a danger that we aren't focusing on what we can do now. In terms of greenhouse gas emissions, the more we do now, the less we have to do tomorrow.'

While biofuels are referred to as a 'renewable' transport solution, there are still emissions associated with burning them in vehicle engines, albeit far fewer than their fossil fuel equivalents. There is also considerable debate about the true carbon savings that can be achieved with first generation biofuels – which are produced from food crops – in part due to concerns about land use.

Growing a feedstock, such as maize, on a large-scale is incredibly energy intensive. The process requires the use of fertiliser and harvesting equipment before the crop is transported to a refinery and converted into fuel. However, a 2017 study by the Royal Academy of Engineering found that some second-generation biofuels, made from dedicated energy crops or wastes, have considerably lower carbon footprints than conventional fossil fuels.

In some instances, the report said that biofuels made from waste stalks and corn cobs could have net-zero overall emissions. It's widely agreed among biofuels producers that the use of wastes as feedstocks is the most sustainable way to produce either bioethanol or biodiesel. Argent Energy, for one, utilises tallow and food waste, among other sources, to create its biodiesel. According to Posnett, there's even a case to be made for capturing the cooking oils and fats that infamously coagulate in urban sewers for use in biofuel production.

'We've hardly tapped the surface for that type of biodiesel because no one really knows how much grease is out there in our sewer systems,' he explains. 'There could be anywhere between 100,000 and 300,000 tonnes. At the moment, we're importing 30,000 tonnes of that type of feedstock from America every year and we're not getting it from the UK because of various regulations. But we will tap into it.'

Last year, the NGO Transport & Environment published its Roadmap to Decarbonising European Cars, in which it claimed that sustainable advanced biofuels would make a 'finite' climate contribution as 'the sustainable feedstocks are limited.' It's now up to industry and policymakers to decide whether the case for biofuels is strong enough to ramp up production and use in the years to come.

Hydrogen fuel cells

Hydrogen is another as-yet-untapped source of emissions reductions for road vehicles. At present, there is just one hydrogen-powered vehicle model on sale in the UK, the Toyota Mirai, and at a cost of £66,000, it's likely to appeal to only the most eager of early adopters. Hydrogen fuel cell vehicles contain a hydrogen tank that can be refilled with pressurised hydrogen at specially-equipped service stations within a matter of minutes.

The sole by-products created when hydrogen is passed through the fuel cell are heat and water vapour, meaning that fuel cell vehicles have virtually zero harmful tailpipe emissions. As a point of comparison, it can take between 30 minutes and 12 hours to fully charge an electric vehicle, depending on the size of its battery and the speed of the charging point. But as of July 2018, there were just 13 hydrogen filling stations in the UK, with only four of them in operation north of London.

For the vast majority of UK consumers, buying and running a hydrogen-powered vehicle is not practical. But if the country develops an industrial-scale hydrogen economy, in which hydrogen is used to replace fossil gas, fuel cell vehicles might suddenly become a much more viable option. Hydrogen is presently being tipped by policymakers as the best option for the long-term decarbonisation of heat in the UK, which could open the door for its adoption in other sectors.

'To achieve net zero by 2050, the CCC said you will need to have hydrogen in the gas grid, and therefore it will be ubiquitously available,' predicts Amanda Lyne, Chief Executive of the UK Hydrogen and Fuel Cell Association. 'If that is the case, then hydrogen will be used for transport applications that would not otherwise be able to be decarbonised.'

Before hydrogen infrastructure can be rolled out in the country's homes and service stations, industry must figure out how to produce it in a sustainable way. Today, hydrogen is made for the chemical industry using the carbon-intensive process of steam methane reforming. Emissions from this method will have to be captured and stored if hydrogen is to be a low carbon solution in either heating or transport.

Alternatively, hydrogen can be produced via the process of electrolysis powered by renewable electricity. Either option, Lyne says, will require significant amounts of infrastructure investment before it's economic and scalable. In practical terms, this means that government must subsidise the creation of the first hydrogen production facilities, as well as associated distribution infrastructure. And there's little time to waste.

'What the hydrogen industry needs is absolute commitment from government,' she says. 'Industry is saying that it will want some help in the early parts of this process because there is no capital infrastructure that exists today, and it will take us 30 years to build it. Therefore, there is now a need for levels of support.'

Much depends on the uptake of electric vehicles in the next decade. Huge effort and behavioural change will be needed from the automotive industry, utility companies and motorists to drive the shift towards electrification. In the meantime, policymakers might wish to take a look at other low carbon technologies that can reduce emissions. Decarbonising transport may ultimately require more than a 'plug-and-play' approach.

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