The future of public mass transit services: **Railways**

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ABOUT THE AUTHOR

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In the third of our series, **Paul Clifton** looks at the prospects for the UK's rail industry. The long-term aim of overcoming pollution needs to be put back on track in the wake of the Government's 'avoid public transport' mid-pandemic advice

The long-term view of the railway can be summed up in one word: decarbonisation. Being efficiently and sustainably green is public transport's trump card. But, in the medium-term, a second word should be added: uncertainty. And, short-term, consider a third: confusion.

The coronavirus pandemic has, temporarily at least, swept the rug from under the industry's feet. Government advice urging workers to travel by car rather than by public transport took the industry by surprise – to put it politely. Public transport and social distancing are mutually exclusive concepts. As long as passengers feel unsafe sitting next to strangers, our railways will struggle.

The franchising programme of the past 20 years is over. With working practices changing fundamentally and more people working from home more often, demand for the traditional season ticket may never be restored. The fares structure, already cracking and creaking, has become untenable.

Reform is not just essential; it is now inevitable.

Andrew Haines, chief executive of Network Rail, reflects on the impact of the pandemic, saying: "As a country, we will be in a radically different place economically. I think the case for change on the railway becomes even more powerful, unlocking the restrictions that franchising placed on us. We have to renew the way we run our railway.

"Otherwise, we miss the fundamental opportunity this crisis gives. Alongside a lot of challenges and some really tragic loss of life, there is an opportunity to renew our railway, and we have to seize that."

Nobody knows with any degree of certainty what the long-term effect of the Covid-19 lockdown might be on the shape of city centre employment. Or how many people will take advantage of less frequent commuting to further separate where they live from where they work.

"We didn't go into this crisis with the greatest of reputations, did we?" Haines admits. "We went into it with passenger satisfaction static, but with train service performance deteriorating. The Treasury believed we were inefficient.

"We had a franchising system that was broken. We had a level of service that was way below what it should be. Coming out of this, we have to resolve those issues."

The requirement to decarbonise public transport remains high up the agenda.

Largely unnoticed due to the pandemic, in spring the Department for Transport (DfT) published a report called *Decarbonising Transport: Setting the Challenge.*

While the UK has declared a climate emergency and signalled a date for the end of petrol and diesel car sales, the transport industry's response has been patchy and inconsistent. However, new diesel trains are still being built, designed for a 30-year life extending long after the sale of new diesel cars has been banned.

> **Using diesel will be as socially unacceptable as lighting a cigarette in a restaurant is today**
>
> **Dr Stuart Hillmansen, Birmingham University**

This appears to contradict Government aspirations in its decarbonisation strategy which points towards electrification as a primary solution.

Sir Michael Holden, rail consultant and previous holder of a string of the industry's most senior positions, describes the report as a "remarkable statement of intent", adding: "I think it is one of the most positive pieces of policy for the industry in recent years. It seems serious and it will lead the way to practical change."

ELECTRIFICATION

When the power comes from renewable sources, electricity is the cleanest form of propulsion. It is readily available, although not necessarily in the quantities required.

But the UK has already fallen some way behind other countries when it comes to the electrification of its railways. The average across Europe is around 60%; the UK is at 38%.

Dr Stuart Hillmansen, reader in Railway Traction Systems at Birmingham University, says: "The best way of powering dense services with high performance is electrification. That is a given. It connects trains to what is, in effect, a limitless source of energy. And it shifts decarbonisation into a different domain, so the rail industry can piggyback the National Grid's decarbonisation plan.

"There is a debate on the limit of electrification. It will go up quite significantly. But a lot of route miles will not have it. I grew up in Fishguard in west Wales. It gets four trains a day. A lot of our rail miles are serving towns and communities which don't have the population to merit busier services. These would never justify wiring; the value-for-money would be appalling."

Alex Burrows, director of the Birmingham Centre for Railway Research and Education, agrees.

"To electrify the whole network is unrealistic," he says. "Public funding could not be justified. Nor are we going to close parts of the railway. So, as we look to decarbonise the railway, we need alternatives to diesel to fill in the gaps."

The power issue has been complicated by the decision of several franchise operators to buy bi-mode electric-diesel trains in large quantities, including the Government-owned LNER's much heralded new Azuma stock. Such moves make the business case to electrify harder to justify.

Nevertheless, the Government's ▶▶

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2050 decarbonisation commitment means the industry has no choice but to come up with a strategy to eliminate diesel.

"Battery power has advanced enormously to the point where it is a tenable option for branch lines where trains can recharge at either end," says Holden.

"Let's take the most remote longer distance rural routes: Kyle of Lochalsh, the West Highland Line and the Far North Line. All are capable of battery operation with strategically positioned charging points where trains pass on the single lines. Fast recharging there, and a full charge at the ends of the lines. You could operate engineering trains on batteries, too.

"Otherwise, conventional electrification is the only game in town."

The key, Holden contends, is to set a viable programme to get from where we are today to where we want to be in 2050. By 2040 is not achievable, he warns, saying: "Nineteen years is too short a time to electrify the network. It requires a rolling programme that will allow a standard approach to the work, with big teams. All procurement and supply chain activity can de done to suit, with a long-term approach bringing the unit costs down to well below what they are today.

38%

of UK Rail networks are currently electrified

"It requires a joined-up rolling stock replacement strategy to go with it. If we do it now, we won't have to buy any more diesel trains once the current tranche is completed."

Hydrogen power is another option being considered by the Government, although Holden isn't so sure.

"You have to carry an awful lot of the stuff around with you, limiting space on the train," he says. "It is only ever going to be a bit-player on small rural branch lines."

Nevertheless, the Government is showing a keen interest.

The cleanest version is green hydrogen, generated by renewable energy sources without producing carbon emissions. It involves the electrolysis of water to produce hydrogen and oxygen. The cheaper alternative is grey or blue hydrogen. Globally, almost all commercial hydrogen production is from fossil fuels – 76% comes from natural gas and 23% from coal (mainly in China). For each tonne of hydrogen from these two sources, nine-12 tonnes of CO_2 are released.

A train powered by hydrogen is viable, according to the Birmingham Centre for Railway Research and Education. Working with rolling stock leasing company Porterbrook, it unveiled a converted Class 319 'Hydroflex' last year. Now it is working towards trials on the main line.

"Diesel is brilliant in terms of how much energy it stores per kilogramme," says Hillmansen. "You just need a 'bucket' to hold it. To carry energy as hydrogen is more complicated. But we think hydrogen fuel cells are better than batteries. If you want a battery train to do a significant mileage, you end up with a train that is mostly battery. There wouldn't be room for much else.

"There is talk of battery technology improving. A lot of people around the world are working on it. Batteries are going to develop incrementally over 10-15 years. The change won't be massive. So, it is unlikely that battery trains will be able to operate on extended routes. They won't run to Fishguard, for example.

"Hydrogen takes a lot of space. Maybe 10 times more volume is required to store it compared with diesel. But on some routes you can stick enough tanks on a train to get a decent day's duty cycle."

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Using electrolysis to create green hydrogen requires a great deal of energy. A lot is lost creating the hydrogen. More is used to compress it. It takes energy to get it onto a train. Then electricity is recreated from the hydrogen in the fuel cell, feeding it into the traction system. Estimates vary from losing two-thirds to three-quarters of the original energy during the process from source to point of use.

"But, if we produce the hydrogen from a green source – a wind turbine – then we can produce the electricity when the renewable source is there," says Hillmansen.

"That might be 3 o'clock in the morning in Scotland when it is really windy. You're making hydrogen from a source that would otherwise have been thrown away, anyway. Using the fluctuation in renewables makes a lot of sense and gives a zero carbon route to a portable fuel that can run a train."

More than four-in-five British people live in urban areas. Making transport sustainable within and between cities is the primary goal. When it comes to powering both road and rail vehicles into more isolated communities, is it reasonable for diesel to remain the practicable and affordable option?

Can we accept that a small proportion of today's total will always be fossil fuel-based?

Burrows says: "Our view is that we have to get all diesel off the rails. Electrification will never provide 100% coverage. We need the next best alternative. Hydrogen will form that in some circumstances, including as a range extender in a bi-mode system, so we can use discontinuous electrification."

Hillmansen adds: "One thing the Covid outbreak has shown us is that the air quality has been substantially changed by fewer vehicles moving. This has been, in a sense, a great big whole-society experiment in stopping burning fossil fuels. It has had a massive impact.

"Fast-forward 20 years – is it going to be acceptable for rail vehicles to be burning fossil fuels? Will customers accept rail being a polluter when other modes have solved that problem? No. Using diesel will be as socially unacceptable as lighting a cigarette in a restaurant is today."

Solent University analyses the emissions of different forms of transport by calculating the emissions produced when moving one passenger one kilometre.

Such calculations normally focus on just the moment of travel: you go somewhere, you burn fuel to get there. That's where rail always wins.

However, this ignores the greenhouse gas emissions from building and maintaining the vehicles, the infrastructure – such as tracks, stations and airports – and the production of the fuel.

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▲ **Kyle of Lochalsh is a line that might lend itself to battery-operated trains**

19 years

not an achieveable timescale to electrify the network

And that reveals a different picture. Accurate measurements for comparison need a whole-system approach, according to Dr Laurie Wright, senior lecturer at Solent University.

"Concrete is one of the most carbon-intensive products in the world: it requires so much energy to produce. That is offset by the resulting asset being in place for a very long time," he says.

"In rail travel, the climate effects are dominated by the emissions produced in building the infrastructure itself. If you have an established railway line, the journey on that line is clearly going to be greener than getting on a plane or driving on a motorway. If, however, you build HS2 to make that journey, the sheer volume of investment in infrastructure is so massive that you have to account for that as well. You can't just discount all that concrete and all that steel.

"When you do include it, rail is generally still better in environmental terms. But, it is not anywhere near as good as is sometimes claimed. It's about making the comparisons more valid. All modes of travel come with a cost to the environment."

STRUCTURE: WHO IS IN CHARGE?

With the Government stepping in to save the rail services due to the coronavirus crisis, is the system of passenger franchises now dead?

"I think so," says Network Rail boss Haines. "Franchising had all the semblance of being a Norwegian Blue parrot* before we got to Covid. It was clearly dying beforehand. Now it is actually dead. Covid provides such a high level of uncertainty of future revenue that I cannot in my wildest imagination see how any Government could negotiate a value-for-money deal with the private sector around revenue risk."

Agreement is voiced across the rail sector.

Mark Hopwood, managing director of Great Western Railway, says: "You can mess about with words and semantics over whether franchising is dead. Predicting the revenue in years ahead was a key factor in franchising. We can't do that now."

Mick Whelan, general secretary of the drivers' union Aslef, weighs in, saying: "Franchising has gone. It has not delivered. It didn't reduce fares or increase investment, or bring innovation: the three main thrusts of John Major's privatisation. But I've never been against the concession model, where a company delivers against a specification on performance, cleanliness, delivery of trains and so on. I think we will see more of that in future."

Meanwhile, Steve White, chief operating officer of Govia Thameslink Railway, says: "Franchising, where the business model of most operators is based on predicting future revenue, has been shown to import significant risk."

Unsurprisingly, given he operates the largest rail business in which the Government took that risk, he adds: "I strongly recommend the concession model, where the focus is on quality and service delivery." ▶▶

Even the umbrella organisation for the industry, the Rail Delivery Group (RDG), is unequivocal.

"Demand is unlikely to return to previous levels. Franchise contracts are, therefore, not sustainable," says its chief strategy officer Andy Bagnall.

"Some evolution of the current emergency measures is all but inevitable. We were already calling for a wholesale transformation of the system, with much greater use of concession contracts in urban areas. A crisis of this magnitude has accelerated the need for reform."

Maggie Simpson, director general of the Rail Freight Group, points out that while the railways may be debating with the DfT, "the conversation has moved to the Treasury".

People need to be aware of this changed dynamic when facing a recession.

"If passenger demand continues to be stressed, the Treasury interest in spending money on railways must surely be diminished. That matters to rail freight, too. If you are the minority operator on the network, and network spend is reduced, the operator will be affected," Simpson says.

"Freight is picking up better than passenger traffic – 80% and rising. But, the future is absolutely all about decarbonising. If the case for electrification is harder to make because of reduced passenger demand, we still need to keep making it.

"A lot of this feels like it was coming anyway. Just not all at once. And we can no longer pretend this is a privatised railway. So, freight and the supply chain are now the private sector anachronisms in a state-owned system."

The Government's emergency measures have assuaged some of the noise around franchising. Now the DfT needs to decide whether it wants to be in control of every operating decision on the railway.

Haines says: "I'm hoping it will conclude that it doesn't, because there is no evidence that sort of direct control will work well, given the nature of Government decision-making.

"What we mustn't have is a reduced railway at the end of this process. We need it for the decarbonisation agenda. We need it if we are serious about levelling up. We need it if the city centre nature of our economy is to continue."

WORKING FROM HOME

Life under lockdown will lead to permanent changes in ways of working. Research by employment lawyers Slater and Gordon suggests one-in-three people believe they are more productive when working away from an office. More than half of all office workers hope they will be allowed to work from home more in the future which has clear implications for train numbers.

"It's too early to sort the wheat from the chaff," says Holden. "We don't know how fast normal patterns or working life will return. A proportion of people will work from home at least part-time, so the number of people who use the trains to get to work will reduce permanently. By what percentage? That is the big unknown.

▼ As more people work from home the demand for season tickets is expected to decline

> **If we can't make the argument for mass transit and rail frieght now, then we never will**
> **Mick Whelan, Aslef**

"The immediate future for rail is dire. Whether the Treasury will be content to give rail such a favourable deal for a year or more remains to be seen: it will be concerned by the huge cost.

"Beyond that, in recovery, there will be a big push for improved air quality."

Hopwood adds: "There are three reasons why people travel by train – business, commuting and leisure. I don't think the arrival of Zoom or Microsoft Teams will undermine the leisure market, because people want to visit friends and family. But, for commuting and business travel, there will be changes.

"In some ways that could benefit the railway. We may need fewer trains that only run once in the morning peak and once in the evening, and which aren't required for the rest of the day."

Season tickets sales had already been declining, and now half the economy is working from home with no sign of this changing in the short-term.

It requires, according to RDG's Bagnall, a wholesale reform of the regulatory system that underpins the fares structure.

"We can now create pay-as-you-go in urban areas, with a weekly price cap to protect passengers," he says. "And, on long distance services, we can remove the artificial peak and off-peak boundary that creates crowding on the first shoulder-peak train.

Govia Thamelink's White says: "This pandemic has shown that working from home can be highly efficient. Some companies, such as Twitter, have already said they will never require staff to go back to a central place of work.

"Public transport helps to level up society. Lots of lower-paid people do not have cars. We have seen in the post-lockdown return of traffic, the first people coming back on the trains are on the inner suburban services. People doing jobs that cannot be done from home. If you give the railway a post-Covid role to level up society, you have to give flexible and smart ticketing solutions to a population that may now have different travel demands."

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The country has yet to learn how to spread demand to better match capacity. There is still a rush hour, and it still causes difficulties.

"When Amazon delivers to you, it gives you a time slot," says White. "When you go to your local supermarket, you look for a period when the queue is short. Management of demand will be important for the foreseeable future. Employers and schools need to think more flexibly about their start and finish times to avoid the saturation in the morning that was the previous norm. There is mutual benefit to the Treasury and to passengers if we can improve demand management across the industry."

Will people travel less? Or will commuters take advantage of travelling only two or three days a week, and swap their small, expensive urban homes for something more leafy further afield?

"We don't have the data yet," says Holden, "but there will be an argument that more lives have been saved through reduced pollution worldwide than lost through coronavirus. There will be a lot of pressure for a reduction in travel. Rail will benefit from the decarbonisation agenda. But it will take a year before people will happily travel on a crowded train. Things will get worse before they get better, and a lot of people will go by car, instead, in the meantime."

Aslef's Whelan strikes a more optimistic note: "There is never going to be a better time for rail than now. Coming after Covid, the mood music of the whole world is to move to a greener type of economy. If we can't make the argument for mass transit and rail freight now, then we never will. The desire to make transport more sustainable is there."

Bagnall adds: "A lower level of car use has given people a glimpse of a world with fewer carbon emissions. I think that could play to our strengths. The need for reform is greater this side of the crisis than it was beforehand."

WORKING FROM HOME

We are heading into the deepest economic recession most of us have known. We may soon call it a depression. It is unpredictable: who could have foreseen a Conservative Government taking on the running costs of all passenger franchises overnight? Or directly paying the wages of a quarter of the working population?

But, we do know this is not a temporary blip on the graph of railway growth.

Almost all commercial hydrogen is from fossil fuels -

76%

comes from natural gas and 23% from coal

Economic recovery will be measured not in months, but in years. Unemployment will rise and investment will fall. The changes will tilt where people choose to live and work. They will define this decade.

"We must hope the Government will want to come out of this with a long-term strategy," concludes Haines. "There is a big risk that in 2020 we will repeat the mistakes of 2010. At that point, politically, we forgot about climate change, because we were facing a financial challenge, and we lost most of a decade of climate change mitigation.

"If you're going to decarbonise the railway by 2050, the only remotely affordable or tolerable way to do that is to start sooner rather than later. If we miss out now, the opportunity cost will be massive, both in terms of supply chain efficiency and disruption to the running railway. Now is the time to be demanding innovation and investing in it." ST

** With acknowledgment to the Monty Python sketch.*

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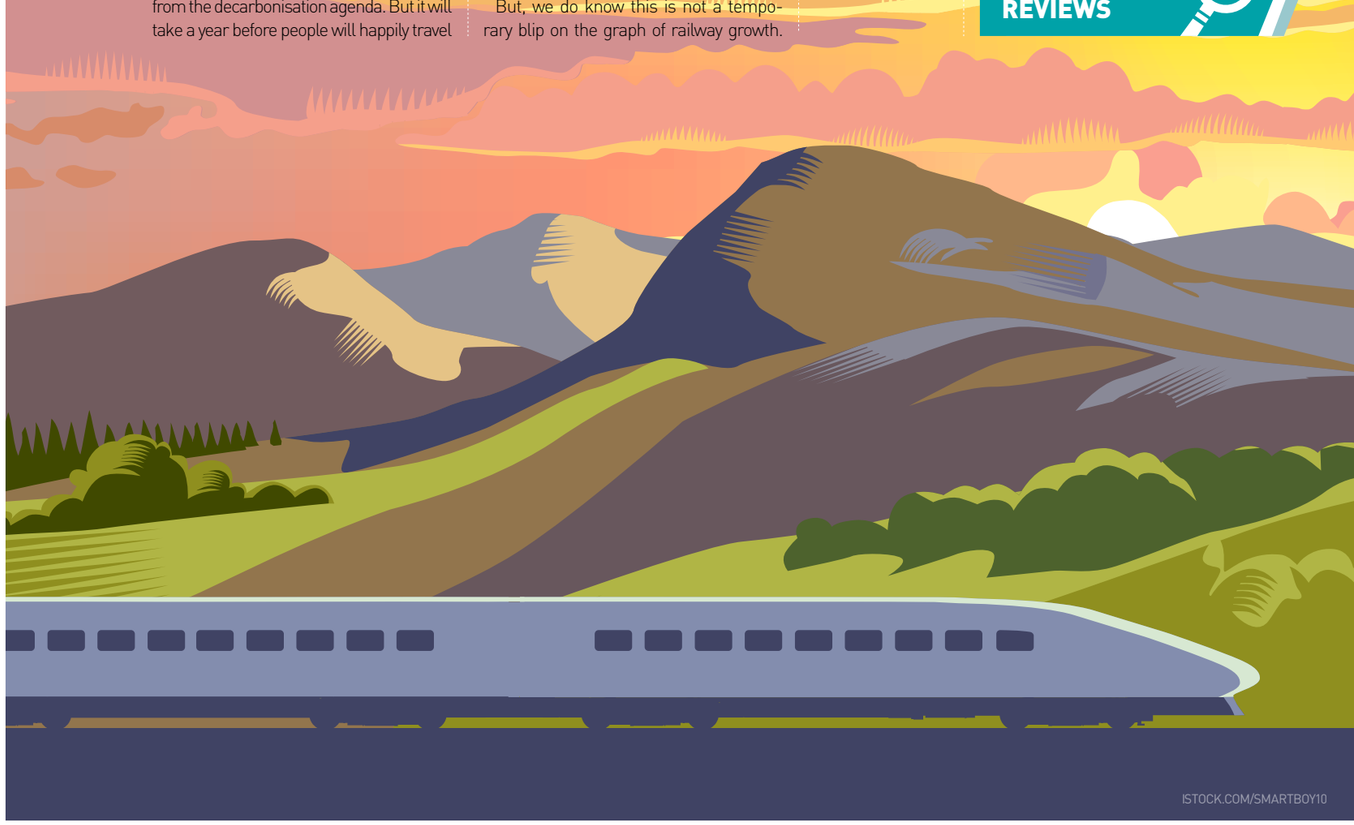

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