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Europe leads the charge to replace diesel traction

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THE European railway industry is embracing the challenge to develop alternatives to diesel traction with gusto as the European Union pushes for a major reduction in pollution and carbon emissions as part of its policy to help prevent catastrophic climate change. Britain has already set the bar high by announcing that it wants to eliminate diesel traction by 2040.

THE European railway industry is embracing the challenge to develop alternatives to diesel traction with gusto as the European Union pushes for a major reduction in pollution and carbon emissions as part of its policy to help prevent catastrophic climate change. Britain has already set the bar high by announcing that it wants to eliminate diesel traction by 2040.

Rail has long enjoyed an environmental advantage over other modes, and in particular air and water transport, in that an electrified railway can run on any fuel. This means rail can benefit immediately from the switch away from electricity produced by burning fossil fuels to renewable sources such as hydro, wind or wave power. Indeed, Dutch infrastructure manager ProRail boasts that all the electricity used to power trains in the Netherlands comes from green, renewal energy.

In an ideal world, railways would push to electrify as much of their networks as possible. After all, electric traction offers many benefits over diesel. Electric trains are generally cheaper to buy, operate and maintain than their diesel counterparts. They have superior rates of acceleration, which translate into journey time reductions thereby helping to increase the appeal of rail travel. With regenerative braking, energy is fed back into the grid, which reduces power consumption.

While the gradual switch to dual-mode trains, especially in Britain and France, is helping to reduce the amount of diesel operation on electrified lines, bi-mode trains are more expensive to buy, operate and maintain than either straight diesel or electric trains as they have more kit and are therefore more complicated and heavier. Unfortunately, in Britain the introduction of bi-mode trains is being used by the government as a justification for not electrifying more lines.

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While there is scope to electrify more lines, particularly in Britain, Germany, and eastern Europe, it is unlikely that many more countries will emulate Switzerland and reach total electrification. The key objective should be to maximise the amount of traffic being operated by electric traction, and electrification projects should match the predominant train service pattern, to maximise the benefits of electrification.

As most European main lines are electrified, diesel operation prevails on secondary and branch lines where traffic and therefore

revenue is relatively low, which makes it harder for railways to justify expensive investment in electrification. Hence the push to develop alternatives to electrification which require less capital investment.

Two main strategies are being pursued: battery and hydrogen power, both of which have their advantages and disadvantages. According to Mr Mike Muldoon, head of business and marketing with Alstom UK & Ireland, who was speaking at last month's Railtex exhibition in Birmingham, there is no single solution to power trains without electrification. "Hydrogen is not a silver bullet for decarbonisation of rail, but it is a weapon in our armory," Muldoon told delegates.

Hydrogen does not exist in its natural state and must be released from other molecular forms. Most hydrogen is produced from fossil fuels by releasing carbon. Using carbon capture, use and storage can make hydrogen low carbon, whereas using biomass provides a carbon-neutral route to production, while using renewable energy sources are carbon free.

Muldoon pointed out that hydrogen traction requires 3kW of electricity to deliver 1kW of power to the rail, and a hydrogen train requires fuel storage eight times the volume of a diesel train's fuel tank. "A battery train demonstrated in 2015 showed that a 7.2-tonne battery pack could deliver electrified-comparable performance for 77km," Muldoon said.

A battery to match the performance of Alstom's iLint hydrogen train would weigh 33 tonnes. And while battery technology is developing rapidly, it is only likely to play a minor role in future railway traction. Perhaps the most promising prospect for battery power is on dual-mode battery-electric trains where the battery powers the train for a

short distance beyond the wires. However, battery rapid-charging points at frequent intervals, or at the end of a line, would extend the range of a pure battery-electric train.

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As we reported in April, there are around a dozen battery-electric and hydrogen passenger projects in Europe, either involving the conversion of existing trains or new build.

Last month Rhine-Main Transport Authority (RMV) awarded Alstom and Infraserv Höchst a €500m contract to supply 27 hydrogen fuel cell Coradia iLint trains to replace DMUs on four regional lines north of Frankfurt-am-Main from 2022. The first two Coradia iLint trains have been in regular passenger service in Lower Saxony since September 2018, and 14 trains should be in service from 2021. Muldoon says the first Alstom Breeze hydrogen trains, converted from existing EMUs, could be in service in Britain by the end of 2022.

A study by Roland Berger for the European Commission says there is significant market potential for fuel cells and hydrogen (FCH) technology, and that by 2030 one in five new rail vehicles in Europe could be powered by hydrogen. The technology should complement electrification and enable a “complete decarbonisation transformation in rail.”

The study found that FCH trains can perform to the same standard as diesel and have the potential to become a cost-effective alternative in the near future, especially in areas where the cost of producing hydrogen is cheap, such as Scandinavia. The report

says that while battery-powered trains may appear more cost-effective, they come with operational constraints resulting from their highly route-specific tailored battery configurations.

The good news is that rail has several potential options for curtailing the use of DMUs or eliminating them altogether and a lot of effort is going into developing sustainable solutions which is already starting to bear fruit.