

ROUTES TO NET ZERO

As countries strive for sustainability, zero emissions and cleaner living, the stage is set for another global industrial revolution. But this time it's green, finds **John Challen**

Cleaner shipping

Relating to the topic of 'jet zero and green ships' in the government's 10-point plan, Ricardo has been working with the Environmental Defense Fund, which supports the International Maritime Organisation. It is researching and studying the use of green ammonia to create hydrogen, which can be generated portside and used in various shipping applications.

This is a net zero fuel because it is created using renewable energy and, if the product is created in the port area, it doesn't have to be shipped elsewhere – it can be stored on the ship. In some cases, the projects that Ricardo has already undertaken are at the feasibility study stage, with reports of an anticipated reduction in shipping emissions by 20-50 per cent if the process was deployed globally.

Ricardo is now starting to work on the use of green hydrogen and green ammonia in marine propulsion systems.

Net zero heroes

A wide range of companies have worked with Ricardo to set out pathways for them to reach net zero carbon emissions. Offsetting – in the form of, say, planting trees – might seem an appealing option for some but, in reality, it's not as easy as it sounds.

In the case of Water UK, Ricardo worked with Mott MacDonald to develop a new route map that will create pathways to help the industry reach its emissions reduction goals by 2030.

The project team looked at the individual water businesses around the UK and identified pathways that would maximise freedom to achieve net zero in a way that helps the specific region as well as the industry as a whole.

Approaches used include different technologies, water sanitation and changes to how buildings are heated. In the pathways, scenarios are plotted to see by how much the grid decarbonises and the impact on the overall net zero goal.

Similar projects have been undertaken by Ricardo for the likes of the Scotch Whisky Association *[see page 26]*, Sustainable Wines, NHS Trusts in Scotland and Ministry of Defence facilities.



In November 2020 the UK Government set out a 10-point plan for its 'Green Industrial Revolution'. The goal of the ambitious initiative is for the country to (among other things) recover from COVID-19, support green jobs and set out a route to net zero.

The plan covers initiatives in a wide range of market sectors, including offshore wind, hydrogen, nuclear power, zero emissions vehicles and greener public transport. Also listed within the future blueprint are: greener ships and buildings; investment in

carbon capture; protection of the natural environment and green finance and innovation.

As a diverse organisation operating in many of those industries, Ricardo welcomed the plan and its objectives. It is keen to expand its work with government and industry to help achieve the goals, with the overall aim of getting to net zero emissions.

"Countries around the world had signed up to achieving net zero before 2050

but the reality is that their plans did not go far enough to achieve their goals," says Mike Bell, Ricardo's Group Strategy and Transformation Director. "We have seen that things aren't happening fast enough and, with COVID-19 and the need to stimulate the economy, governments around the world are putting their bets on the green recovery as part of their plan. It's a case of new jobs in new areas, rather than propping up legacy industries."

One of the biggest areas of focus within

Ricardo is decarbonisation – an initiative driven by factors such as EU regulations and the realisation that fossil fuels will not be a viable energy source for much longer. The UK has led the way in decarbonisation, not least in the electricity market, which has seen wind and solar taking an increasing share of the power mix.

When it comes to transport, there is the ongoing need to reduce the use of oil. "The UK's 10-point industrial plan has a big focus on transport and the greening

of transport and, as part of the jigsaw, there is a need to kickstart green energy generation," says Bell.

"If we are to use hydrogen to power vehicles, we need the infrastructure in place – unlike gas and oil, it isn't an untapped resource. We need to create it." At the moment 99 per cent of all hydrogen is generated from natural gas or coal gasification, so it's currently not 'green'. "If you've got a truck to run on hydrogen it's great because it only emits water, but we've →

Taking a global perspective

The UK government's 10-point plan is not an isolated example of strategic thinking on sustainability. The European Commission's European Green Deal, launched at the end of 2019, makes a headline commitment for the EU to be carbon neutral by 2050 – which will require overhaul of every major aspect of the European economy through a framework of regulation and legislation. It's an extremely ambitious and challenging agenda, criticised by some as little more than 'greenwashing', yet European Commission president, Ursula von der Leyen, believes it to be a strategy for growth "that gives back more than it takes away".

Elsewhere, China's 14th Five Year Plan, due to be announced in March, is likely to make climate change a central policy priority with aggressive plans for green and low-carbon development. The goals set out by President Xi Jinping at the United Nations General Assembly in September 2020 were for the country to reach peak carbon emissions by 2030 and become carbon neutral by 2060. Expect to see an emphasis on green finance, technological innovation and clean production together with an expansion of environmental protection industries.

Moving e-motors forwards

The move to electric vehicles requires major investment to develop the necessary components. In the case of electric motors, Ricardo is leading a consortium funded by Innovate UK that concentrates on the supply chain element.

The UK-ALUMOTOR consortium will leverage Ricardo's manufacturing expertise to deliver next generation sustainable electric motors and also look at the manufacture of power electronics equipment.

Post-Brexit, shorter supply chains are more important than ever and motors that power more than just transport are vital. They will be used in so many different applications.

Comprised of six partner companies, the consortium will develop and refine a design fit for manufacture in the UK, which meets the needs of requirements of stakeholders both in the UK and also beyond. Over the nine-month project, the partners will identify preferred manufacturing processes, suitable for volume production.

A geographically diverse supply chain will eliminate the need for scarce material resources associated with expensive machines and also disrupt established supply chain monopolies.

A class-leading e-motor will help the UK capture part of a market that is predicted to be worth £28.5 billion by 2025.

Digital developments

The drive for greater cost and operational efficiencies has never been stronger for vehicle manufacturers, especially when dealing with the effects of the pandemic. These factors have accelerated the need for digital engineering and data-driven products and services for Original Equipment Manufacturers. There is a need to reduce the time for product iterations through modelling, simulation and virtual calibration within the product development lifecycle and to optimise real-world performance.

Amey Consulting and Ricardo are working on a plan to combine engineering domain expertise with digital analytics and data science understanding. The overall goal is to develop and bring to market new digital and data products and services that support clean, efficient and integrated propulsion and energy solutions for global transport manufacturers.

The partnership helps to connect vehicle manufacturing to highway infrastructure design and maintenance through the use of digital analytics and data science. It also creates an opportunity to deliver benefits to road users and drive the decarbonisation agenda.

can generate lots of energy from wind and increasing use of solar, they are limited by time and natural resources. When there's no sun or wind, you've got nothing to back it up." The nuclear plus hydrogen option is to run nuclear plant as base load and convert some power to hydrogen when demand is low, such as evenings and weekends.

Bell firmly believes Ricardo has a big part to play in the UK's green future. "We want to be seen to be helping governments and organisations decarbonise and help achieve net zero," he says. "That's achieved by supporting policy work,

through the consulting side and onto engineering elements of the business. From a transportation perspective, the first main area we're looking at is the transition from the internal combustion engine to electrification. Then the focus will be on the move to full battery transport and also hydrogen in the more 'hard to decarbonise' applications."

As our global snapshot shows, Ricardo is involved in a wide range of projects that are helping industries, governments and organisations achieve their net zero carbon emission goals. 

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Looking ahead to COP26

The 2021 United Nations Climate Change Conference, known as COP26, is a key date in the green revolution calendar. Taking place in Glasgow in November, the event will see extensive discussion about carbon reduction solutions at local and international levels.

COP26 will also see the ratification of the Paris Agreement, when countries are resubmitting Nationally Determined Contributions (NDCs) for review. From the UK's perspective, the aim is to demonstrate itself as a leader on the world stage, following departure from the EU.

The company's expertise across relevant sectors also makes COP26 a landmark event for Ricardo. Look out for in-depth coverage in future issues of RQ.

A greener future for rail

» Decarbonisation challenges

Freight trains present the greatest challenges for rail decarbonisation: they are long, heavy, need 'go anywhere' capability and are typically powered by the most polluting fuel, diesel.

Ricardo has completed a policy study for the Rail Safety and Standards Board to look at options, including the use of electric, battery, hydrogen or biofuels, to find a way forward. The chosen power source had to be practical, given the heavy loads – and it proved a difficult question to answer. It would also require major investment in rail electrification, or a ready-made supply of the fuel near the network – as seen with diesel.

One option being investigated is whether the railway could carry hydrogen (or ammonia) onboard, reducing the need for extensive electrification.

Ricardo is currently looking for partners in the project who would be interested in exploring potential solutions.

» Electricity sourcing

Another project using capability from across the Ricardo business is with Riding Sunbeams. Network Rail is the single biggest user of electricity in the UK and also has key targets for decarbonisation.

The collaboration with Riding Sunbeams is developing the technical and commercial solutions to connect medium-scale solar photovoltaic plants – and maybe wind plants – directly to the railway. Located one to two kilometres from the railway, future rail systems will have direct access to affordable zero carbon electricity.

Feasibility studies have led to a small system being trialled at Aldershot station. Following this successful demonstration, Riding Sunbeams won a grant to take forward the first full-scale project of a four-megawatt site near Cuckmere, East Sussex. Ricardo is providing technical support to connect this solar plant to the Eastbourne to London line.

» On-track charging

Decarbonisation of the railway will not be straightforward, hence Ricardo is looking at a wide range of approaches. There are a number of hurdles such as the weight of batteries as well as storage and recharging limitations.

A concept called 'discreet electrification' could help overcome some of these issues: this allows battery powered trains to charge on the move. A battery powered train has a pantograph that is extended to overhanging electric wires and makes a connection. These wires would be placed every 50 to 60 kilometres and be around five km long. As the train passes through, it will recharge, to enable it to continue its journey without adding time to recharge at stations.

One advantage of this initiative is the ability to choose the quickest and cheapest five km along the route – thereby avoiding tunnels and level crossings. It is also the least disruptive measure to the rail network and can avoid areas of outstanding beauty.

→ generated much more CO₂ creating the hydrogen," reasons Bell. Ricardo has made no secret of its desire to become a world leader in hydrogen – see 'The power of H₂' feature on pages 20-22.

One subject highlighted in the 10-point plan that Ricardo isn't directly involved in is nuclear power, but Bell is ruling nothing out. "From an environmental point of view, people – not surprisingly – view nuclear with suspicion because, while it doesn't create CO₂, it has many other long-term legacy effects," he says. "I try to be more pragmatic about it because although we