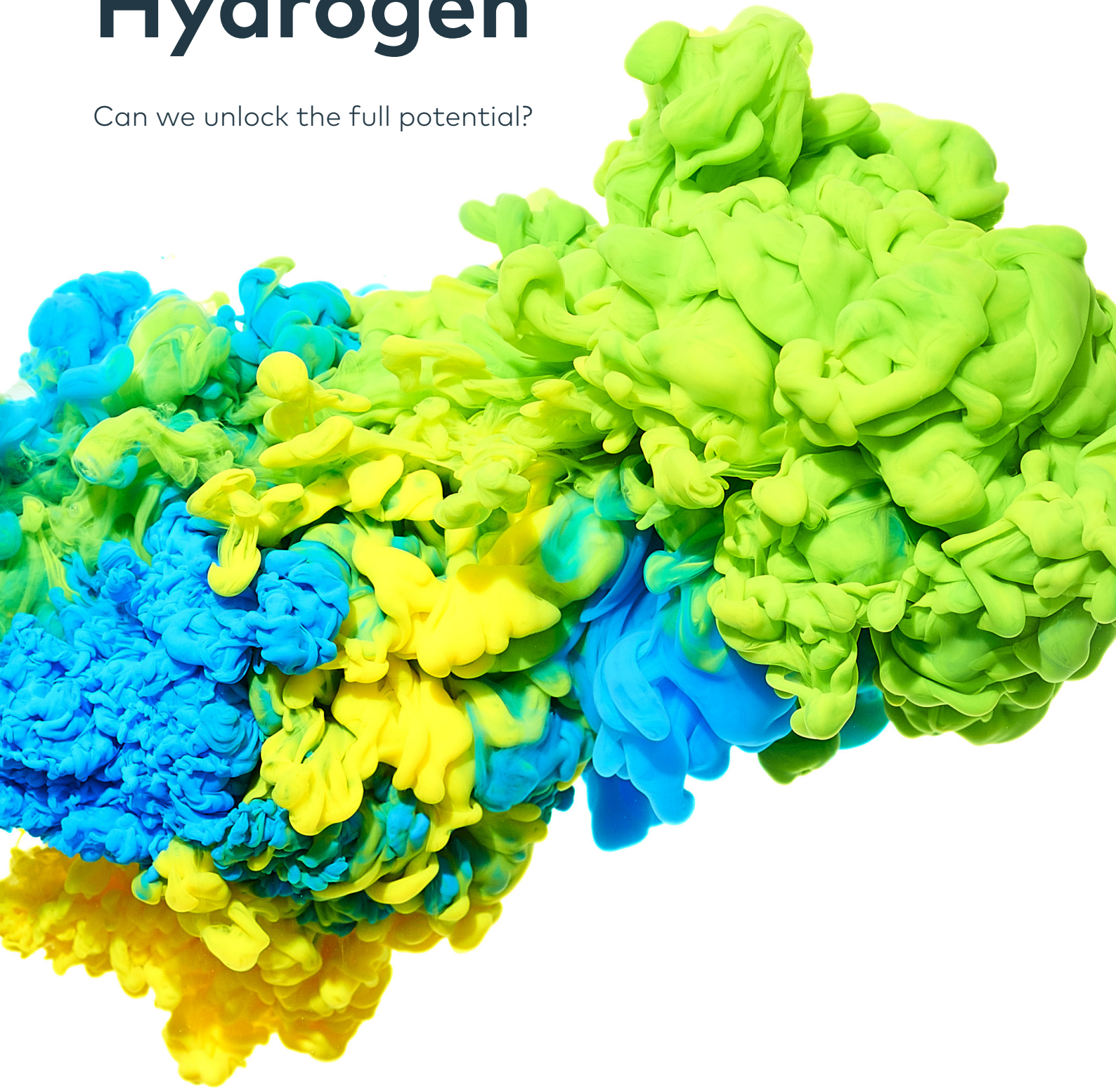
wood.

A Wood viewpoint:

Hydrogen

Can we unlock the full potential?



Significant potential

The most abundant element in the universe, hydrogen can have very strong clean energy credentials.

Hydrogen has the highest energy content of any* fuel we use today and yet, after combustion, it has zero emissions or pollutants, offering the potential to decarbonise several sectors. An International Energy Agency report highlights that recent developments have resulted in unprecedented momentum behind hydrogen solutions to help achieve a clean, secure and affordable energy future. Some believe hydrogen has the potential to help meet the Paris Agreement's commitment of reducing CO2 emissions by 60% by 2050.

Hydrogen can help wind, solar and other sources in the energy mix work together to ensure low emissions and smooth out the supply / demand gaps that many clean energy sources suffer from. Some countries and industries have already embraced the potential; next year in Japan, the 2020 Olympic Games are being called 'the hydrogen games' due to hydrogen providing the entire energy supply.

* U.S. Energy Information Administration

** The Hydrogen Council

Scotland is investigating the use of hydrogen for their ferry fleets. Australia is developing a national hydrogen strategy to become a major player by 2030. The US Space Program, NASA, has used liquid hydrogen to propel the space shuttle and other rockets into orbit while using hydrogen fuel cells to power the shuttle's electrical systems which in turn produces pure water that hydrates the astronaut crew.

The environmental impact and efficiency of hydrogen depends on how it is produced, electricity or heat can power the process but if the source of power is fossil fuel then the environmental benefits will only be realised if emissions are captured and stored.

Green hydrogen, as the name suggests, is created using renewable sources. Developed in this way, hydrogen becomes a more flexible fuel that can be stored for later use in much the same way as conventional petroleum sources. Fuel cells are often compared to batteries and they operate best on hydrogen. Power from a hydrogen fuel cell can drive all manner of motors from cars to freight trains – our whole ground transportation infrastructure could be revolutionised by hydrogen to eliminate transport emissions. It is estimated by 2030** up to 1.5 million taxis, 700k shuttles, and 4 million delivery trucks might be powered this way ensuring cities become cleaner and healthier.

Renewable sources like wind or solar cannot produce energy all the time, but their electric power can produce hydrogen that can be stored and transported, offering a more predictable supply. Hydrogen can be stored as either a liquid or a gas. Produced in large quantities it is usually pressurised as a gas then stored in caverns, gas fields, subsea infrastructure or mines before being piped to the consumer in the same way as natural gas.

With a strong hydrogen past, we have a good view on the future

At Wood, our experience in the opportunities and challenges of hydrogen is decades long. Our trailblazing process technology team are global market leaders and, for over 60 years, have been supplying steam reformer fired heaters that produce hydrogen by catalytic reaction. In more recent years, we are on a quest to see how we can harness new technologies that support global decarbonisation efforts through clean hydrogen.

Hydrogen can be a useful by-product from the carbon capture process, monetising the environmental activity. At the end of 2018, we were awarded a contract by the Oil and Gas Climate Initiative (OGCI) to provide concept designs for an industrial plant with carbon capture including delivering large volumes of clean hydrogen at low cost.

Wood is pioneering the use of hydrogen to decarbonise transport. Recently we were selected for funding from the UK Government to develop and prove our latest designs, ensuring that Wood continues to be at the cutting edge of clean hydrogen production. The project looks at the practical and economic feasibility of using island wind farms to produce zero-carbon green hydrogen fuel for ferries.

When hydrogen is used in an on-board fuel cell, the only emission is water vapour. If the project is successful, it will be the world's first sea-going green hydrogen ferry.

Wood is also exploring gas networks and how better to use hydrogen. For example, with 82% of the energy used to heat buildings in the United Kingdom supplied via gas networks, there are huge rewards to be gained in the decarbonisation of the domestic heating market. Wood is currently involved in engineering work and demonstration projects to prove the effectiveness of hydrogen in gas networks.

The International Energy Agency's report identifies several near-term opportunities and recommendations to scale up hydrogen, and the ongoing rapid reduction in the costs of wind, solar and electrolyser technologies is generating interest in the production of green hydrogen on a significant scale. This may be localised, where wind and/or solar resources can meet local energy needs through hydrogen for heating and transport. Interestingly, bulk production volumes may also become viable where transportation of hydrogen can be achieved more cost-effectively. This would then allow low cost green hydrogen to be exported from renewable rich locations such as northern Australia to centres of demand such as Asia.

Wood is currently active in six clean hydrogen studies and projects and the anticipation of how they could change our future is an exciting prospect.

There has been a real step change in thinking around hydrogen technology recently and Wood is dedicated to providing innovative solutions as we look at energy transition to meet industry and societal needs while protecting the environment.

A variety of options

A traditional way - hydrogen reforming technology

Hydrogen is found in many organic compounds, notably the hydrocarbons that make up fuels like natural gas, gasoline, propane and methanol. Apart from fossil sources, these compounds can be sourced from biomass and methane from waste processing plants. Hydrogen can be separated from hydrocarbons through the application of heat in presence of steam over a catalyst bed - a process known as steam reforming. Wood has significant experience in this space designated as grey hydrogen. A grey hydrogen scheme can be enhanced with the installation of carbon capture and storage systems enabling it to become what is known as blue hydrogen.

Our well-proven hydrogen production unit design has been continuously updated and improved to deliver the highest reliability of any reforming unit on the market. Our technology has been selected for more than 120 hydrogen and synthesis gas plants worldwide, with a total installed capacity of more than 3.5 million Nm3/h of hydrogen. We have a wide experience base, with feedstocks ranging from natural gas to naphtha, and plant capacities ranging in size from 3,000 to over 200,000 Nm3/h.

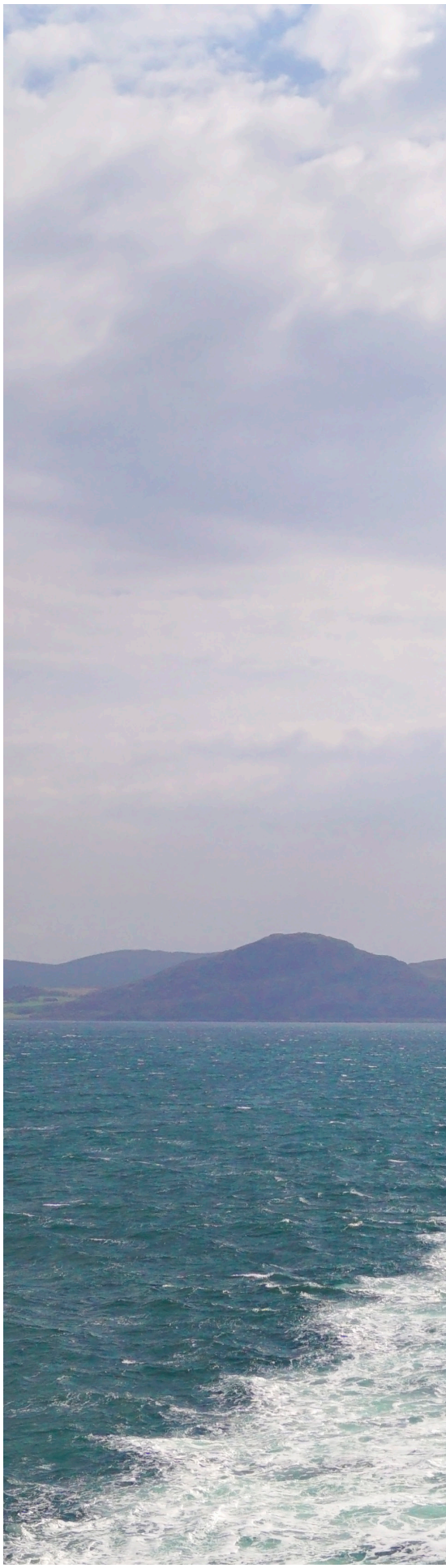
120+

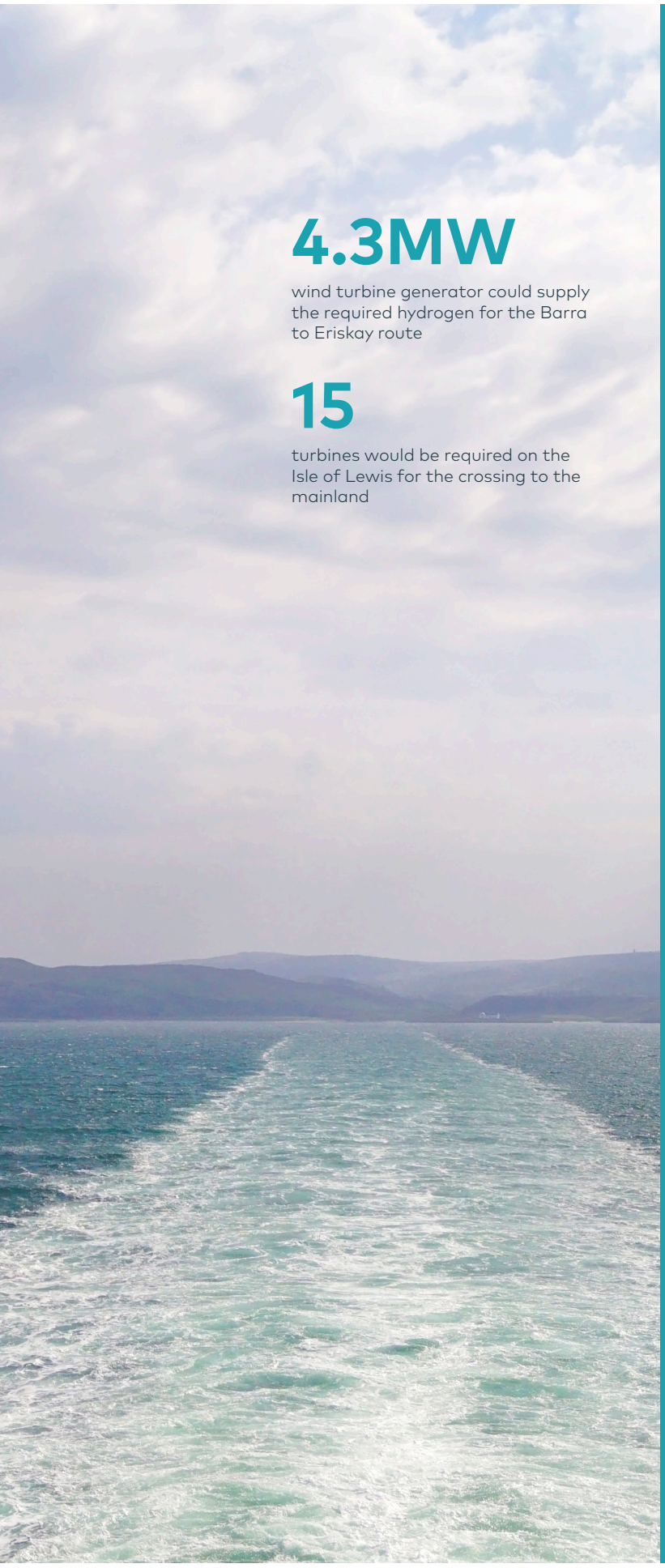
hydrogen and synthesis gas plants worldwide

Unique reformer design

Our unique Terrace Wall™ reforming furnace is characterised by a flat flame firing arrangement and sloped-wall radiant section design that enables long catalyst tube life (often in excess of 100,000 hours) and delivers the flexibility to extend a reformer's operating envelope. This often allows production of hydrogen in excess of the unit's design capacity, which may in turn deliver additional economic benefits.

Our reforming units can operate with ultra-low-NOx burners to meet tightening environmental emission standards worldwide. We can also extend our support developing detailed engineering, delivery of materials and construction, and a wide range of aftermarket activities like training to operators, assessment studies for existing hydrogen unit and hydrogen network, troubleshooting, unit performance monitoring, and CFD analysis.





4.3MW

wind turbine generator could supply the required hydrogen for the Barra to Eriskay route

15

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Moving towards a low-carbon transport solution with hydrogen

Ferries serving the Western Isles and West Coast of Scotland could soon be powered by hydrogen generated from onshore island wind power. The Scottish Western Isles Ferry Transport Using Hydrogen (SWIFTH2) project, was led by the Point and Sandwick Trust in collaboration with seven industry partners including Wood, and part-funded by the Scottish Government's Low Carbon Infrastructure Transition Programme.

The study assessed the feasibility of deploying hydrogen-powered passenger ferries on nine ferry routes serving the Western Isles. Various aspects including local available renewable energy resource, planning constraints, challenges associated with the production of hydrogen, and the refuelling requirements of each ferry route were studied.

They found that a single 4.3MW wind turbine generator could supply the required hydrogen for the Barra to Eriskay route, while 15 turbines would be required on the Isle of Lewis for the crossing to the mainland. The potential emissions savings from the replacement of the Barra to Eriskay and Stornoway to Ullapool routes with hydrogen vessels is estimated to be around 676 and 21,815 tonnes of carbon dioxide equivalent per annum respectively, a combined equivalent of taking nearly 5,000 cars off the road each year.

Wood's clean energy team played a key role in the project by coordinating the SWIFTH2 consortium, undertaking the feasibility assessments, and compiling the feasibility study report. Since the report's release, the study has featured in the UK Government Department for Transport Clean Maritime Plan 2019. The next phase of the project is to undertake detailed feasibility on two ferry routes and associated islands.

Contact us:

If you would like to discuss any of the points raised in this paper in more detail, then please get in touch.

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Wood. Powered by possible

The need for change has never been greater. In our industries, in the way we treat our planet, and in how we live.

To challenge the status quo we must be brave – it's having the courage to forge new answers. We're more than 45,000 inquisitive minds, on a quest to unlock solutions to the world's most critical challenges, across all of energy and the built environment.

United by our mission to create a sustainable future as the world evolves to a cleaner planet. Our bold spirit drives us to lead the charge, our actions transform challenges into solutions, and our curiosity keeps us pushing, innovating, making the impossible... possible.

Because we understand the time for talk is over. Because the world needs new answers to old challenges. Because at Wood, we are future ready, now.

For further information please go to:

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