



ZERO BALANCING

The 26th Conference of the Parties summit (COP26) will be hosted in partnership between the UK and Italy and held in Glasgow from 31 October to 12 November. **Mike Bell**, Ricardo's Group Strategy and Transformation Director, introduces this landmark event and explains how its priorities resonate with Ricardo's vision.

Overleaf, we explore UK and overseas climate change initiatives in which Ricardo has been involved and look at new energy management technologies helping towards net zero emissions.



The forthcoming UN Climate Change Conference will be attended by the countries that signed the United Nations Framework Convention on Climate Change (UNFCCC) – a treaty that came into force in 1994. COP26 is expected to create new initiatives for delivering climate action globally. As host, the UK will take the lead in negotiating new climate commitments. The COP26

President, Alok Sharma, announced five key priority areas last year:

- » **Adaptation and resilience:** 'Helping people, economies and the environment adapt and prepare for the impacts of climate change.'
- » **Nature:** 'Safeguarding ecosystems, protecting natural habitats and keeping carbon out of the atmosphere.'
- » **Energy transition:** 'Seizing the massive

opportunities of cheaper renewables and storage.'

- » **Accelerating the move to zero-carbon road transport:** 'By 2040, over half of new car sales worldwide are projected to be electric.'
- » **Finance:** 'We need to unleash the finance which will make all of this possible and power the shift to a zero carbon economy.'

These priorities resonate well with Ricardo's mission. Our business is actively contributing to each of these areas, from our heritage in automotive through to our environmental practices operating in critical areas impacting climate change.

Support for developing economies

Energy transition is an exciting area and we have numerous projects running. We are collaborating with AFC Energy, a leading provider of hydrogen power generation technologies, to develop products and services that will directly support energy transition. And as explained on pages 17-21, we are targeting renewable and sustainable energy management for key infrastructure, such as introducing solar to power rail networks and the development of hot air turbine technology.

We have provided the UK Government and the European Commission with policy support on road transport options to achieve zero tailpipe emissions and conducted life cycle assessment to understand the total climate and environmental impact of road vehicles. We are also supporting the Mexican Government with its plan to reduce greenhouse gas emissions in the freight sector. It is critical we do not leave developing economies behind, hence we are helping Bangladesh to access finance to invest in new electric vehicles as part of the UK Partnering for Accelerated Climate

Transitions programme, which was featured in the Summer 2021 edition of RQ.

Our automotive divisions are actively supporting customers on their electrification journey. We have experience in power electronics, machines and drives, as well as batteries. Our work is not just with vehicle manufacturers: we recently won a contract with LS Automotive Technologies to develop a state-of-the-art high voltage DC-DC converter to power the low voltage network in an electric vehicle.

Hydrogen fuel cells will also play a part – more likely in long-haul and off-highway vehicles. As an example of our expertise, we have assisted Toyota in the design, testing and development of several Class 8 heavy duty zero emissions fuel cell electric trucks from our Detroit campus.

Rising to the global challenge

The delay in COP26 by a year has meant key international agreements and decisions have been postponed, which is obviously concerning. However, we now have the benefit of the Sixth Assessment Report from the Intergovernmental Panel on Climate Change (IPCC)¹, which brings us up to date (the last one was published in 2014) on the current state of climate change through the consensus of international scientists.

We also have the change in sentiment from many governments in response to the COVID-19 pandemic, with stimulus

programmes aimed at building green economies.

The IPCC report, published in August, is not the easiest of reads but it contains many stark findings and is certainly a call for action. For example, in 2019, atmospheric carbon dioxide concentrations were higher than at any time in at least two million years and concentrations of methane and nitrous oxide were higher than at any time in at least 800,000 years. Global surface temperature has increased faster since 1970 than in any other 50-year period over at least the last 2,000 years.

A successful COP26 is critical for all of us. For many people, COVID-19 has refocused priorities and caused individuals and governments alike to pay closer attention to the environment. The UK is showing leadership on the world stage with COP being held for the first time on our shores. It is a truly global challenge, and Ricardo is rising to the challenge of supporting governments and clients around the world to meet the Paris Agreement goals to keep the rise in global temperature below 2°C, with eyes on a 1.5°C limit.

ukcop26.org

¹ipcc.ch/assessment-report/ar6

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MIKE BELL



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THE WORLD AT ONE

The Paris Agreement of December 2015 charted a new course in the effort to combat global climate change. This legally binding international treaty was adopted by 196 parties at COP21 in Paris and required countries not only to make commitments but to progressively strengthen them. Its goal is to limit global warming to well below 2°C, and preferably

to 1.5°C, compared to pre-industrial levels.

Ricardo supported policymakers from more than 15 countries to put forward ambitious but fair climate commitments (known as Intended Nationally Determined Contributions or INDCs) that reflected each country's development goals. A country's INDC is converted to a Nationally Determined

Contribution (NDC) when it formally ratifies the Paris Agreement.

Since COP 25, held in Madrid in December 2019, Ricardo's multidisciplinary teams have continued to support more than 20 countries with the delivery of climate change projects and implementation of their NDCs.

Our map highlights some of the locations where Ricardo has been involved, with projects including national plans for medium- and long-term climate adaptation planning; climate finance plans to enable countries to raise investment from public and private sources; and specific action plans for sectors such as energy and transport.

- 1 KENYA:** Ricardo supported Kenya's INDC process, including cross-departmental consultation within government and with key stakeholders; data collection; and analysis of the mitigation and adaptation options to be considered within the INDC. Ricardo's teams also drafted the INDC itself.
- 2 NAMIBIA:** Support in collecting private sector data for the country's GHG inventory.
- 3 NIGERIA:** Support for Nigeria to produce its INDC, including determining a reasonable mitigation contribution and assessing the potential mitigation benefits of measures aimed at climate adaptation.
- 4 ZAMBIA:** Review of the GHG inventory for energy (coal), transport and waste as part of Zambia's NDC update, as well as analysis to identify the costs of implementing the adaptation component of its INDC.

Ricardo worked with the C40 Cities Climate Leadership Group to support nine African megacities in delivering their country's Paris Agreement goals



- 8 PALESTINE:** As the basis for Palestine's NDC, Ricardo developed a comprehensive national GHG inventory; assessed the mitigation potential of sources and sinks across all sectors; and developed the country's national adaptation plan, including a systematic identification of vulnerabilities and adaptation options.

- 9 CHINA:** Ricardo hosted a study tour by a delegation from the China Electricity Council to discuss estimating and reporting installation-specific GHG emissions.

- 10 NEPAL:** Ricardo's review of Nepal's GHG inventory focused on agriculture, forestry and other land use, supported by a programme of training and technical support for improvements.



Tropical deforestation causes warming locally, regionally and globally, while changing rainfall by altering the movement of heat and water

- 5 CHILE:** Ricardo reviewed Chile's GHG inventory and delivered a programme of training and technical support for improvements. Work also included the design of a carbon budgets framework and an agreed design for measuring progress both against the carbon budgets and towards Chile's NDC targets.
- 6 COLOMBIA:** As well as reviewing Colombia's GHG inventory, Ricardo's teams delivered technical assistance to the country's Government on how to align emerging carbon market opportunities under Article 6 of the Paris Agreement with its NDC implementation strategy.
- 7 MEXICO:** Ricardo reviewed the country's GHG inventory component of its INDC.



Standing room only at COP21 in Paris as Ricardo was supported at a side event by countries for which it had delivered INDCs



One in three people across Africa face water scarcity as climate change makes rainfall more erratic

- 12 BANGLADESH:** Ricardo reviewed the country's GHG inventory and delivered a capacity-building workshop on how to improve it. The company also supported Bangladesh's INDC process with a review of projected emissions, potential mitigation options and scenarios; and a study of the synergies between mitigation and adaptation and economic development, including the potential impacts on gender and alleviation of poverty.

- 11 BRUNEI DARUSSALAM:** Work for this small equatorial country on the northern coast of Borneo identified the most suitable mitigation and adaptation options for its INDC; analysed cross-sector options involving energy, transport, waste, forestry, land use and health; and included a high-level vulnerability assessment to confirm the areas most at risk from future climate changes.

THE LANGUAGE OF CHANGE

Carbon sink

Anything that absorbs more carbon from the atmosphere than it releases. Forests are natural carbon sinks, taking carbon out of the atmosphere through photosynthesis. Likewise, the world's oceans absorb a large amount of carbon dioxide from the atmosphere.

Greenhouse Gas inventory

This is an accounting of seven greenhouse gases (GHGs) emitted to or removed from the atmosphere during a given period: carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF₆) and nitrogen trifluoride (NF₃).

Reporting of national inventories is part of the management and monitoring of GHG emissions by the United Nations Framework Convention on Climate Change (UNFCCC). Ricardo has operated the UK Government's emissions inventory programme and GHG reporting for more than 30 years, earning recognition from the UNFCCC for its completeness. The company also supports countries through direct compilation of their national inventories; by helping them establish their own compilation systems; and by developing their inventory reports.

Nationally Determined Contribution

The Paris Agreement requested each country to outline and communicate its post-2020 climate actions, known as a Nationally Determined Contribution (NDC). This is a country's chance to translate its climate goals into the policies, financial commitments and measures by which emissions are reduced and climate resilience enhanced. NDCs are established independently by countries or regional groups of countries and are non-binding. However, they are set within a binding framework designed to ratchet up climate action over time. NDCs are expected to be updated on a five-year cycle.



Ricardo's work with Bangladesh included the impact of climate mitigation measures on alleviation of poverty



NET BENEFITS

Negative emission technologies have an increasingly important part to play in the quest for net zero. RQ reports on a collaboration between Ricardo and Bluebox Energy to design a community-scale greenhouse gas removal system.



Some industries are almost impossible to decarbonise completely. If we are to achieve net zero, residual emissions from the likes of cement, chemical and steel manufacturing need to be counterbalanced by the active removal of CO₂ from the atmosphere. This is where negative emissions technologies (NETs) come in – to ‘suck’ greenhouse gases out of the air to compensate for their ongoing release within the most challenging sectors.

What level of negative emissions is needed? Estimates for the UK vary from 30 to 130 megatons of CO₂ per year, the equivalent of between 10 and 37 per cent

of current annual emissions.

There is, however, Government recognition of the potential value of NETs, with up to £100 million of innovation funding and a £1 billion carbon capture, utilisation and storage (CCUS) fund. The latter will equip two of the UK’s major industrial clusters with infrastructure for capturing, transporting and storing CO₂ by the mid-2020s, with two more clusters targeted by the end of the decade.

Maximising carbon capture

Since 2014, Hampshire-based Bluebox Energy has been developing ultra-low

carbon combined heat and power (CHP) solutions for homes, business parks and agriculture. CHP is an energy-efficient technology that generates electricity and captures the heat that would otherwise be wasted to provide thermal energy.

Bluebox Energy’s technologies include a new method to convert heat to electricity using a hot air turbine which takes in filtered air and compresses it in a turbo-compressor. This air is heated using energy from a hot gas stream, such as flue gas from the combustion process. The hot pressurised air then passes through the turbo-compressor and power turbine to produce electricity.

The electrical output from the turbine generator is converted to grid power in a dedicated inverter. The air emerging from the power turbine is still at a temperature of around 400°C so can be used for heating, steam production or direct drying.

In 2019, Ricardo and Bluebox Energy began to explore the potential of biomass pyrolysis as an ultra-low carbon solution. Biomass is renewable organic material such as wood and crop waste; pyrolysis is the decomposition of that organic material at a high temperature in an inert atmosphere.

The charcoal that results, known as biochar, can be used as animal feed or to enrich soils. The carbon in the biochar is very slow to break down, which means the carbon it absorbed from the atmosphere while it was still biomass is locked up for hundreds or even thousands of years.

As Jonathon McGuire, Chief Executive Officer of Bluebox Energy, explains: “This project perfectly combines the expertise of Bluebox Energy and Ricardo. First, we had Bluebox Energy’s concept of capturing 50 per cent of CO₂ in biochar (resulting from pyrolysis using a hot air turbine CHP system) with the other 50 per cent released into the atmosphere. Second was Ricardo’s belief that most of the 50 per cent emitted could also be captured using chemical absorption.

“Achieving this would allow us to capture 90 per cent of the remaining emissions and, as a result, increase the overall CO₂ capture to 95 per cent of total emissions.”

Attracting carbon credits

A current drawback of most negative emission technologies is that they are only considered viable for large-scale emission sources such as power and industrial plants. Earlier this year, however, Ricardo and Bluebox Energy won funding through the Net Zero Innovation Portfolio to design a greenhouse gas removal system that could operate at a community scale.

Known as BIOCCUS, the system works by taking sustainably sourced waste wood from domestic timber production and then processing it in three ways: producing biochar; generating heat and power; and capturing and storing the CO₂. The technology captures up to 95 per cent of the CO₂ absorbed by the trees; commercially marketable biochar can be used in farming; and the CO₂ can be deployed for low-carbon concrete. All of which attract valuable carbon credits that can be traded.

This first phase of the project



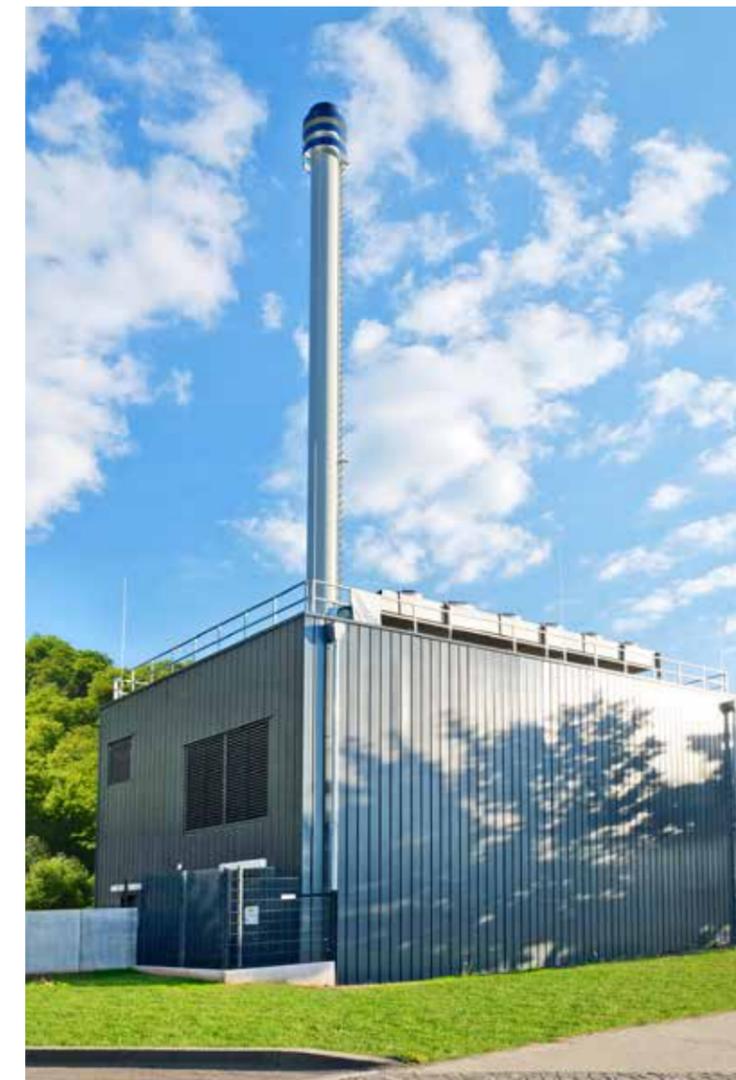
“We can achieve negative emissions while generating revenue streams for industry and local communities”
Dr Gareth Milton, Ricardo

lasts until December 2021 and could potentially lead to the consortium being selected to develop a prototype and demonstrate the technology between 2022 and 2024. Ricardo is leading the design of the CO₂ capture system.

“Ricardo is aiming to become a world leader in integrating carbon capture with pyrolysis-based CHP systems for community-scale applications,” says Dr Gareth Milton, Chief Engineer with

Ricardo Automotive and Industrial EMEA Division.

“This system shows how we can achieve negative emissions while generating revenue streams for industry and local communities through waste heat and sequestered carbon products. What’s more, an organisation could use decarbonised or net-negative CHP technology to improve its own environmental impacts. [📄](#)



Negative emissions technologies ‘suck’ greenhouse gases out of the air to compensate for their ongoing release within the most challenging sectors