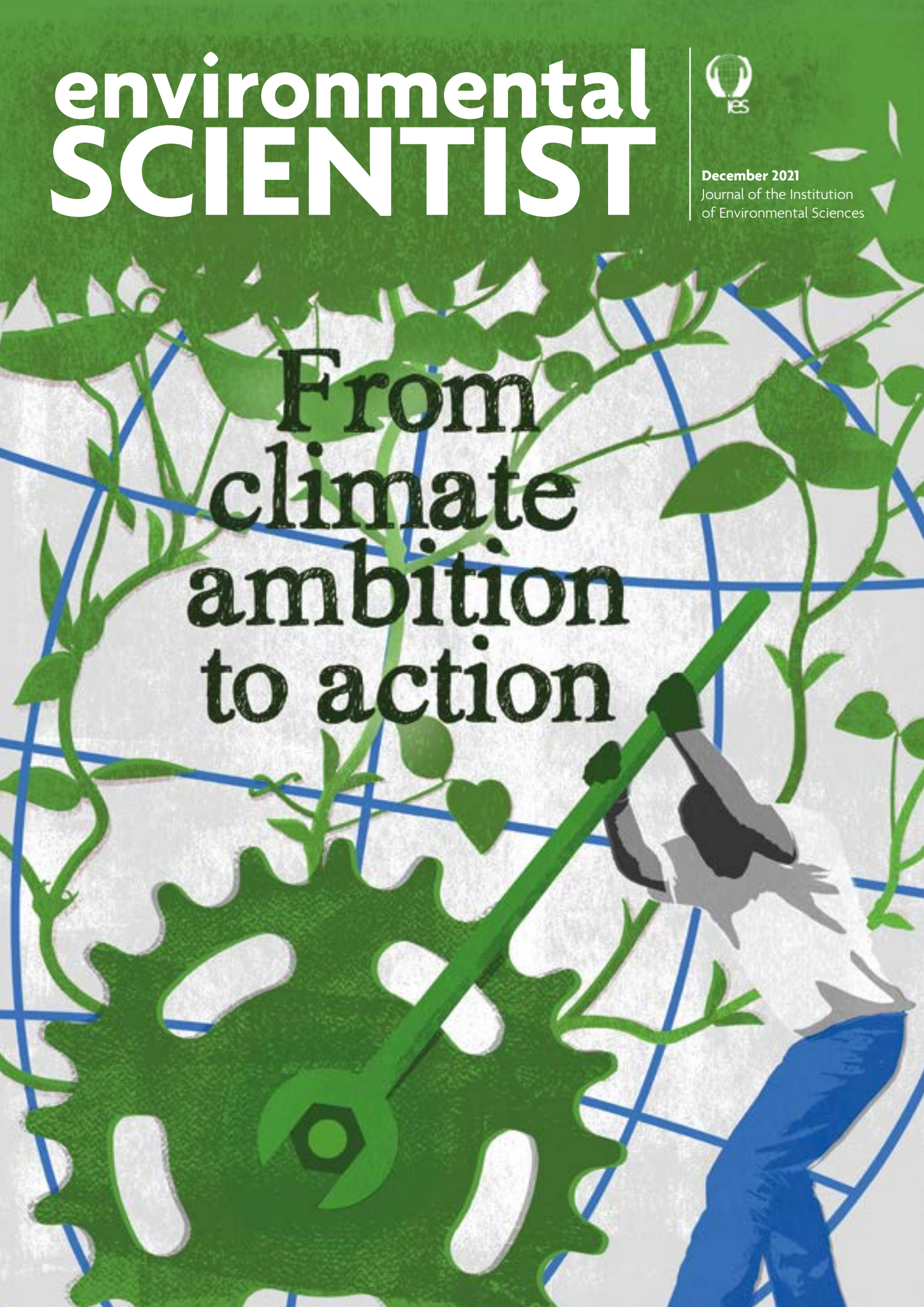
environmental
SCIENTIST

December 2021
Journal of the Institution
of Environmental Sciences

From climate ambition to action



EDITORIAL

How can we keep to 1.5?

The Glasgow Pact agreed at the end of intense negotiations during COP26 has kept alive the idea of limiting global warming to 1.5 °C. But only just. The pledges made so far by governments under the bottom-up Paris Agreement – the nationally determined contributions (NDCs) – do not nearly put us on a pathway that would limit warming to 1.5 °C. But the Glasgow Pact requests governments to come back with strengthened pledges before COP27 in November 2022. The hope is that these will close the gap between aspiration and will.

The Intergovernmental Panel on Climate Change (IPCC) released a special report on global warming of 1.5 °C in 2018.[1] The conclusions were stark even then, and three years have passed without any downward trend in emissions. The conclusions of the report therefore need to be strongly emphasised: carbon dioxide accumulates in the atmosphere and, without immediate action, the options to limit warming to 1.5 °C will expire.

The report was clear about what would be needed: a run-down of fossil fuel use, especially unabated coal for electricity generation, which would essentially need to reach zero by mid-century; a rapid upscaling of investment in renewable energy and energy efficiency; transformation in all human systems – urban, industry and transport, including the electrification of energy use; changes in land use, recognising potential impacts on food security, biodiversity and ecosystem services; and the application of techniques to remove carbon dioxide from the atmosphere. Different balances between these options are possible. But the powerful message is this: none of them can be neglected.

The report also assessed a low-energy demand scenario, that is one with low levels of energy use, starting to explore how changes in consumption and lifestyle could contribute to emissions reduction and avoid some of the need for carbon dioxide removal in the long term. The IPCC special report on climate change and land took this further,[2] assessing how changes throughout the food system, including reduced food waste and dietary choices, could contribute to climate action. This report also paid greater attention to the role of nature-based solutions (ecosystem-based approaches). The next report from IPCC Working Group III, due out at the end of March 2022, will dive deeper into consumption and lifestyle choices with an entire chapter devoted to demand, services and social aspects of mitigation.

The challenge of limiting warming to 1.5 °C involves rapid social and economic change, which will affect specific industries, communities and social groups. At COP26, an increasing emphasis was placed on a *just* transition, taking account of justice and equity. The concept, once applied almost exclusively to an exit from coal, is now finding a wider application. This includes addressing the needs of those who derive their livelihoods from the land. This again will receive attention in the forthcoming IPCC Working Group III report.

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environmental SCIENTIST
The journal of the Institution of Environmental Sciences
Volume 30 No 4 | ISSN: 0966 8411

The environmental SCIENTIST provides a platform to discuss key issues within the environmental sciences, hosting original articles written by professionals, academics and experts working across the sector.

The views expressed in the journal are those of the authors and do not necessarily reflect IES views or policy.

COP26, Glasgow, November 2021

INTRODUCTION

David Viner asks whether it will be an event and a time that will resonate positively for years to come.

Will COP26 be like COP21 (Paris, 2015)? Or will it be more of a COP12 (Nairobi, 2006): another attempt at setting the groundwork for future COPs and providing a platform for many ambitious yet unqualified commitments made by governments and businesses. Success or failure? This will be judged upon how many commitments are adhered to and ultimately the impact upon the rising atmospheric concentration of carbon dioxide in the atmosphere. And the key commitment is the declaration to phase down coal.

This issue of the environmental SCIENTIST reflects the breadth of activity that is undertaken at the COPs and, importantly, the involvement of environmental scientists at the heart of key aspects of decision-making across the scientific, policy and business communities. Underpinning the COPs – the prerequisite and essential requirement – is the robust scientific evidence that is epitomised by the review process of the International Panel on Climate Change (IPCC).

SOME BACKGROUND

The science on climate change is clear, exceptionally clear. We have known about the key component parts for more than 150 years: radiative forcing gases (John Tyndall, 1860s); increasing concentrations of atmospheric pollutants and the greenhouse effect (Svante Arrhenius, early 20th century); long-term climate changes (Milutin Milankovic, 1920s); measurements of changes of greenhouse gas concentrations (John Keeling, 1950s); and, with the construction of the global data curve by the world-famous and heroic scientists at the Climatic Research Unit at the University of East Anglia during the 1980s, the jigsaw was complete.

The latest report of Working Group I of the IPCC is one of the reports of the IPCC's Sixth Assessment, known as AR6. Yes! The sixth! (The First Assessment was published in 1990, two years after the establishment of the IPCC.) So how has the scientific knowledge around climate change developed over the last 30 years? The simple answer is a great deal: the depth, volume, coverage and breadth of the research reviewed by the IPCC has increased exponentially.

INTRODUCTION

These are the headline statements in the AR6:

'It is unequivocal that human influence has warmed the atmosphere, ocean and land. Widespread and rapid changes in the atmosphere, ocean, cryosphere and biosphere have occurred... The scale of recent changes across the climate system as a whole and the present state of many aspects of the climate system are unprecedented over many centuries to many thousands of years... Human-induced climate change is already affecting many weather and climate extremes in every region across the globe. Evidence of observed changes in extremes such as heatwaves, heavy precipitation, droughts, and tropical cyclones, and, in particular, their attribution to human influence, has strengthened since AR5 [the fifth assessment report, produced in 2013].'[1]

This is a profound assessment of the current state of climate change knowledge building upon the previous assessments, each one being an improvement on its predecessor. If we look at how these statements have changed, should we be surprised that the global response to address climate change has not followed? The answer is yes. In 1990 the First Assessment Report of the IPCC already stated:

'Emissions resulting from human activities are substantially increasing the atmospheric concentrations of the greenhouse gases carbon dioxide, methane, chlorofluorocarbons (CFCs) and nitrous oxide. These increases will enhance the greenhouse effect, resulting on average in an additional warming of the Earth's surface. Under the IPCC Business-as-Usual (Scenario A) emissions of greenhouse gases, a rate of increase of global mean temperature during the next century of about 0.3 °C per decade (with an uncertainty range of 0.2 °C to 0.5 °C per decade), this is greater than that seen over the past 10,000 years. This will result in a likely increase in global mean temperature of about 1°C above the present value by 2025.'[2]

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'DANGEROUS' CLIMATE CHANGE

At the Earth Summit in Rio de Janeiro in 1992, governments agreed the United Framework Convention on Climate Change (UNFCCC). Its key objective was the 'stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system'.[3] Thirty years ago the term 'dangerous' was accepted by the governments of the world in relation to climate change. A key factor of debate at the time was whether the 'human fingerprint' could be detected on changes in the climate systems. In 1995 this was categorically answered by the Second Assessment Report (AR2): 'The balance of evidence suggests that there is a discernible human influence on global climate'.[4]

This short but enormous statement confirmed what was then still thought of as a possibility. It also drew attention to the fact that the damages caused by climate change could be attributable to people or organisations. As the scientific evidence regarding humans' role in driving climate change kept growing, and an increasing number of academic studies driven by the environmental science community started to address the impacts of climate change, it became possible to quantify what dangerous climate change looked like. With the publication of the Third Assessment Report (AR3) in 2001 and the inclusion of the iconic burning embers diagrams, 'dangerous' was defined as being a temperature increase of more than 2.0 °C above the pre-industrial temperature. The key headline statements from the AR3 were:

'Increasing confidence in climate models and the burning embers reasons for concern and two degrees... Nevertheless, confidence in the ability of these models to provide useful projections of future climate has improved due to their demonstrated performance on a range of space and time-scales.

Anthropogenic forcing is dominating natural forcing... There is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities. The risks of adverse impacts from climate change increase with the magnitude of climate change.'[5]

URGENCY AND SCALE

As every day passes without discernible action, the atmospheric CO_2 concentration continues to increase, committing the world to ever-higher temperatures and subsequent damaging impacts of climate change. In 2015, when the global community agreed to limit global mean temperature rise to less than 2.0 °C and, if possible, to 1.5 °C, the atmospheric CO_2 concentration was 401 parts per million by volume (ppmv); at the time of writing (November 2021), the concentration has risen to 415 ppmv. With the current global mean temperature rise being approximately 1.1 °C, the window to keep the rise at less than 1.5 °C is rapidly closing. Even so, the impacts and negative changes (e.g. species extinction, destruction of human cultures and traditions) will be irreversible. This is the tragedy of the horizon – that collectively we will not see the changes and the irreversible damage until they occur.

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Therein lies the issue: as every day passes the urgency should become greater as the challenge across all will increase. However, this has not yet embedded itself in the collective approach and results from the negotiations at the COP(s). Unless emissions are rapidly decreased and global emissions peak in the next few years, then we will see ever-increasing costs associated with climate impacts.

As discussed, the IPCC defined dangerous climate change as 2.0 °C above pre-industrial levels. The Paris Agreement, driven by pressure from the world's most at-risk countries, tightened this to 1.5 °C above pre-industrial levels. From a scientific perspective, what is now required to tackle climate change, both from a mitigation and resilience perspective, is urgency and scale. To meet the Paris Agreement the scientific community has stated that coal needs to be phased out by the end of the 2020s, oil by the end of the 2030s, and that gas must only be used as a standby fuel supported by carbon capture and storage. This, therefore, needs current renewable technologies (e.g. solar, wind and hydropower) to be delivered at a global scale and new technologies (e.g. hydrogen and tidal) to be urgently established.

Even with the successful deployment of clean technologies, we are still at an elevated level of climate change – one that can be categorised as dangerous now, insofar as people are dying, species are becoming extinct, ecosystems being severely degraded and risks across the world are increasing. To address the risks from climate change, resilience and adaptation measures are needed across all areas of the globe for both natural and human systems. To tackle the mitigation and resilience aspects of climate change, huge financial capital will need to be deployed – much more than the often-cited US$100 billion.

THE ROLE OF ENVIRONMENTAL SCIENTISTS

Climate change is a multifaceted issue that requires the application of knowledge from every discipline. Environmental scientists have been at the heart of the climate change science community from the outset and our skills are increasingly needed as new sectors of the economy are required to address climate change and implement plans to address physical and transition climate risks. Most notably, the financial sector requires our skills and problem-solving abilities to ensure that the correct transition plans are implemented and that products that claim to be green can be rated in a systematic evidence-based manner. Currently, there is a dearth of experience across many sectors and an increasing need for environmental scientists to become more involved in tackling climate change in the commercial sectors of the economy, as businesses step up to solve the climate crisis.

For example, many organisations now require assessments of the physical impacts of climate change on their business or physical assets. This requires climate change risk assessments (CCRAs) to be undertaken. Practitioners need to be conversant with the outputs from climate models, observational climate data and how current climate and future changes will impact the asset and or the operations of the business. This requires skillsets that are highly suited to environmental scientists who have a deep understanding of climate, environment and societal issues.

COP26 has provided many points of optimism, with a range of commitments to address climate and environmental impacts. Unfortunately – and I write this as a naturally optimistic person – this positivity has to be tempered with reality. The reality that we are already committed to long-term irreversible changes in the climate system, which poses challenges that will require radical solutions, the rapid mobilisation of finance and the will of everyone to come together to prevent more harm and repair the existing damage. ES

David Viner started his career at the world-renowned Climatic Research Unit at the University of East Anglia, at which he is now a visiting professor. He has been involved with the IPCC since 1992, and is a Co-ordinating Lead Author for AR6. David is a member of the UK Natural Environmental Research Council's Scientific Committee and is an honorary lifetime member of Friends of the Environment for his services to the countryside. David is currently an Associate Director at the Green Investment Group at Macquarie, leading the team ensuring that investments are aligned to the global green transition. He has published more than 100 peer-reviewed papers and reports.

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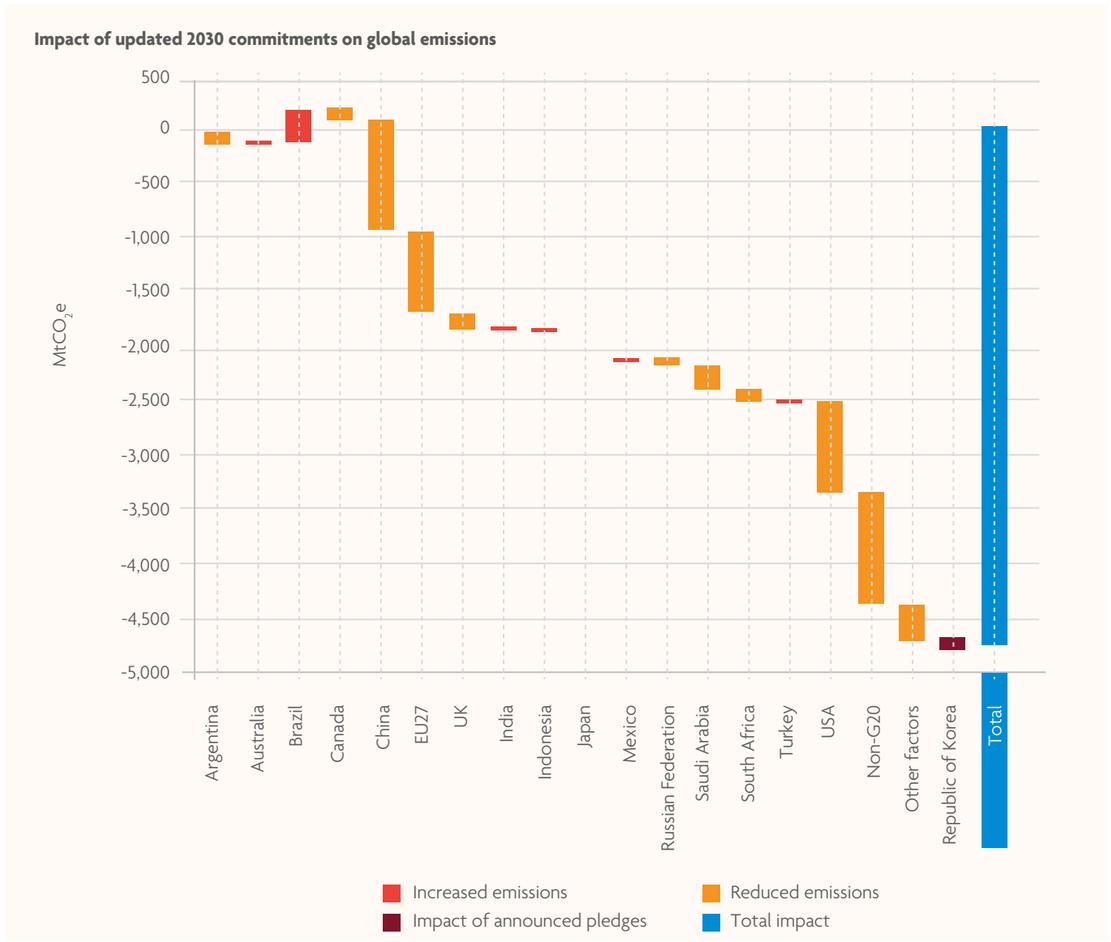
Unpacking the outcomes of COP26

Raphaëlle Vallet analyses the achievements and disappointments of the 26th Conference of the Parties that signed the United Nations Framework Convention on Climate Change (UNFCCC) in 1994.

COP26 came with a backdrop of climate disasters in 2021. More than 50 hurricanes, cyclones and extratropical storms hit the globe this year, some of which reached record northern latitudes. Extreme flood events forced more than 1 million people to relocate, and killed 300 people in China, more than 180 in Europe and 180 in India. Heatwaves caused more than 465 excess deaths in Canada, more than 600 in just two states in the USA and up to 800 in the UK. Siberia saw record temperatures of up to 48 °C, causing widespread wildfires. Pakistan and the United Arab Emirates reached wet-bulb temperatures of 35 °C, at the limit of what healthy adults can survive. Russia experienced the largest wildfire in its history, while thousands of people were displaced by wildfires in the Mediterranean.[1] Brazil experienced its worst drought in 91 years and Madagascar suffered its worst drought in more than 40 years – causing the United Nations to state that the country is on the brink of experiencing the world's first climate-change famine.[2]

▶ **Youth Climate Activist Elizabeth Wathuti speaks at the COP26 opening ceremony. (© Karwai Tang/UK Government. Retrieved from https://www.flickr.com/photos/186938113@N07, used under Attribution-NonCommercial-NoDerivs 2.0 Generic license [https://creativecommons.org/licenses/by-nc-nd/2.0])**

FEATURE



▲ **Figure 1. Preliminary update of the impact of unconditional 2030 pledges (NDCs and other pledges) on 2030 global emissions compared with the first round of NDCs.[5] (Source: 2021 United Nations Environment Programme)**

'Right now, as we sit comfortably here in this conference centre in Glasgow, over 2 million of my fellow Kenyans are facing climate-related starvation. In this past year, both of our rainy seasons have failed, and scientists say it may be another 12 months before the waters return again.... Our animals and people are dying.... Please open your hearts. If you allow yourself to feel it, the heartbreak and the injustice is hard to bear.'

ELIZABETH WATHUTI, YOUTH CLIMATE ACTIVIST, KENYA AT COP26[3]

The stakes were high at COP26 – described by the USA's climate envoy John Kerry as our 'last best hope' – and many described the event as the world's last chance to limit global warming to 1.5 °C.[4]

MIXED PROGRESS ON NDCS

COP26 was a significant moment in global climate diplomacy, being the first use of the Paris Agreement's five-yearly ambition-raising cycle, where all countries were tasked with submitting updated Nationally Determined Contributions (NDCs), which set out targets and plans to reduce their domestic emissions. Most developed countries announced NDC enhancements before the conference, and they were joined by middle-income and vulnerable countries, while others, including major economies, only made small reductions, or even weakened their commitments (see **Figure 1**).

Emissions under the conditional NDC and pledge scenario are estimated at 48 $GtCO_2e$ annually; that is 9–15 $GtCO_2e$ more than is needed for a 2 °C goal, and 24–29 $GtCO_2e$ more than for a 1.5 °C goal.[5] In its first report under the Sixth Assessment Report, the International Panel on Climate Change (IPCC) warned that keeping global warming to 1.5 °C by 2100 required cutting emissions by 45 per cent by 2030 from 2010 levels. Instead, current NDCs would cause emissions to *rise* by nearly 14 per cent over that same period.[6]

'Failure to provide enough critical funding to small island nations is measured in lives.... This is immoral, and it is unjust.... I ask you, what must we say to our people, living on the frontline in the Caribbean, in Africa, in Latin America, in the Pacific, when both ambition and, regrettably, some of the needed faces at Glasgow, are not present? What excuse should we give for the failure?'[7]

MIA MOTTLEY, PRIME MINISTER OF BARBADOS, COP26

New countries, including 17 of the G20 countries, have made net-zero commitments. Since COP26, 90 per cent of the world economy is now covered by a net-zero target – up from only 30 per cent at the start of 2020. Most countries with net-zero targets are yet to publish detailed plans for how they will achieve them,[5] and Climate Action Tracker deems that 73 per cent of countries' net-zero targets are inadequately planned and designed.[8]

THE FINANCE COP

After a rocky start during World Leaders Summit in the first two days of COP26, the private sector took centre stage on Finance Day. Most notably, more than 500 financial services firms under the Glasgow Financial Alliance for Net Zero (GFANZ) agreed to align US$130 trillion – 40 per cent of the world's financial assets – with the goals of the Paris Agreement.[9]

This is an important acknowledgement from the financial sector of the crucial role they have to play in making the global transition to a net-zero economy happen: recent analysis by Vivid Economics estimates that private capital can deliver around 70 per cent of the investment required for a global transition to net zero.[11]

'The core message today is that the money is there, the money is there for the transition.... Companies that have plans in place to reduce the emissions, will find the capital, those who don't won't.'

MARK CARNEY, UN SPECIAL ENVOY ON CLIMATE ACTION AND FINANCE, COP26[10]

Regulators and policy-makers are taking notice too. Through the work of the Network for Greening the Financial System, established in 2017 to bring together central banks and supervisors from around the world on climate issues, 38 central banks have committed to carry out climate-related stress testing of the financial system. In addition, 33 central banks and supervisors have committed to issuing guidance on climate-related financial risks.

The UK announced at COP26 that asset managers, regulated asset owners and listed companies will be required to publish transition plans in line with the UK's own net-zero commitment.[12] This follows an earlier announcement to make climate disclosures mandatory for the 1,300 largest UK-registered

companies.[13] For these companies to properly meet these requirements, they will require their own supply chains and partners to follow suit and we can expect these rules to naturally trickle down across the real economy.

THE GLASGOW CLIMATE PACT

COP26 ended with a global agreement to accelerate action on climate: the Glasgow Climate Pact, signed by 197 countries. They agreed to keep the goal of limiting global warming to 1.5 °C alive, and recognised that this would require a 45 per cent reduction in emissions by 2030 from 2010 levels. One of the most important element of the agreement, and a significant update from the Paris Agreement, is that NDCs will now be updated every year instead of every five years.

Developed countries took more responsibility on climate finance, with a commitment to at least double their provision of finance for adaptation to developing countries from 2019 levels by 2025. Developed countries have expressed their 'deep regret' about missing the US$100 billion climate finance target in 2020, and have pledged to meet it every year until 2025. The Pact recognised the need to increase the mobilisation goals beyond US$100 billion in future.

One hundred countries also signed an agreement to reduce methane emissions by 30 per cent by 2030, an initiative led by the EU and the USA. Separately, China and the USA pledged to boost climate cooperation on methane reduction.

ENERGY TRANSITION IN THE SPOTLIGHT

One of the headline-grabbing elements of the Pact was a last-minute change made to the text on coal in power generation, which now refers to a 'phase*down*' rather than a 'phase*out*'.[14] The change was made at the request of China and India, where coal provided 62 per cent and 71 per cent of power generation and around 2.5 million and 3.6 million jobs, respectively, in 2020.

In light of this, 23 nations made new commitments to phase out coal power, including Chile, Egypt, Indonesia, Nepal, Poland, Singapore, South Korea, Spain, Vietnam and Ukraine. In a new Global Coal to Clean Power Transition Statement, countries committed for the first time to phasing out existing coal plants and to not building or investing in new coal power.[15]

Banks and financial institutions also made commitments at COP26 to end the funding of unabated coal. Prior to COP26, China, Japan and South Korea had also promised to end overseas coal financing, which essentially means the end of significant public international financing for coal power. In addition, a group of 25 countries (including Canada, Denmark, COP26 partners Italy, and the USA) signed a joint statement committing to ending international public support for the unabated fossil-fuel energy sector by the end of 2022 so as to prioritise support for the clean energy transition instead. Collectively, this could shift an estimated US$17.8 billion a year in public support out of fossil fuels into the clean energy transition.[16]

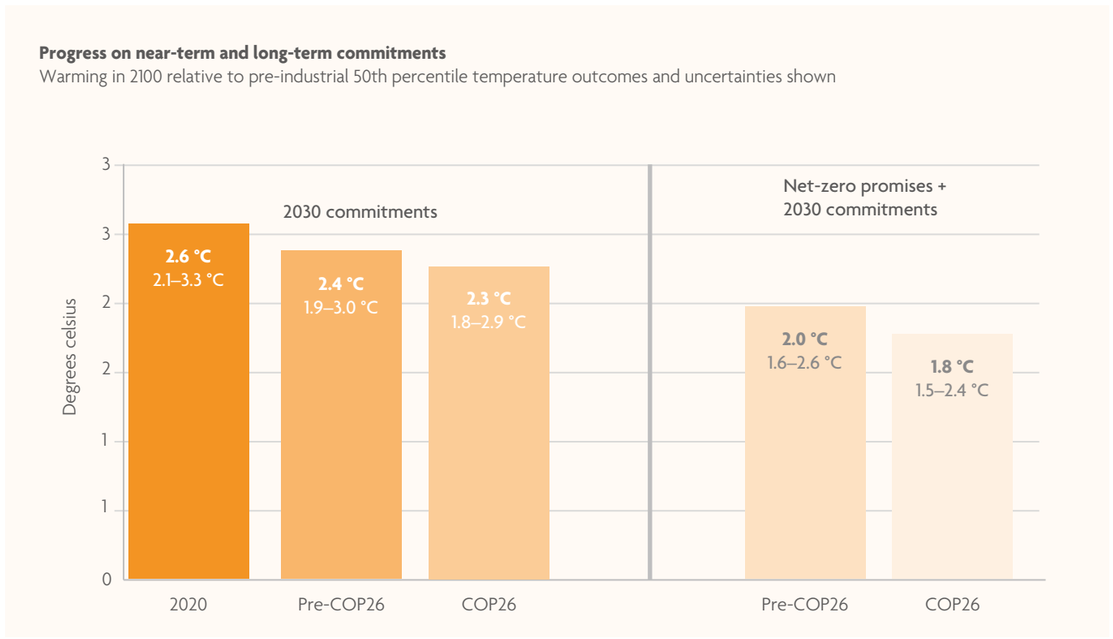
France, Germany, the UK, the USA and the EU announced a US$8.5 billion package of grants and concessional finance over 3–5 years to accelerate the retirement of coal plants and the deployment of renewable energy in South Africa. This could help South Africa lead the way among coal-dependent countries in demonstrating how to achieve a fast and fair transition towards clean energy.

'South Africa has consistently argued that developed economies must support a just transition in developing economies. [This] represents a first-of-its kind partnership to turn these commitments into reality, and a model for similar forms of collaboration globally.'

CYRIL RAMAPHOSA, PRESIDENT OF SOUTH AFRICA, COP26[17]

ENABLING CARBON MARKETS

After six years of negotiations, the Paris Rulebook, which sets out in detail how countries will operationalise the Paris Agreement, was agreed in full. The spotlight was on Article 6 of the Paris Agreement, which relates to carbon markets. This agreement will effectively create a global price for climate mitigation by enabling the trade of price-differentiated carbon offsets tied to projects in a variety of sectors and geographies. Rules were agreed upon to avoid risks of double counting and to bring more transparency to the voluntary market. Bilateral offset transactions will need to be sanctioned by the UN and will require a corresponding adjustment in the emissions-reduction requirement of the country that sells the unit. The agreement also excludes offsets issued before 2013, which reduces the risk of old offsets with lower



▲ **Figure 2. The contribution of NDCs (2030 commitments) and net-zero pledges to limiting global warming.[18] (© Carbon Brief, using projections from UN Environmental Programme, International Energy Agency, Climate Action Tracker and Climate Resource)**

environment credentials undermining the efforts under the new regime.

These new rules may help unlock trillions of US dollars of investment in forest protection and clean energy, especially in developed countries.

BAD COP OR GOOD COP?

The International Energy Agency and others modelled the impacts of all commitments made at COP26 and showed that they would achieve 1.8 °C of warming – much closer than we have ever been to reaching 1.5 °C, though this will not happen through 2030 commitments or the detailed plans put forward in NDCs (see **Figure 2**).

COP26 left a lot to be hopeful about, including:

- A finalised Paris Agreement Rulebook;
- A specific acknowledgement of the need to decrease the use of coal and other fossil fuels;
- The vast majority of the world's major economies signing up to net-zero pledges;
- Agreement to report on progress and update plans on an annual basis; and
- The impressive involvement of the financial services sector.

But for now these commitments are just that – commitments, and this was called out by activists.

CHANGING MOMENTUM

The window to limit global warming to 1.5 °C has nearly shut. While COP26 was hailed as the last moment in time to land a global deal on climate, it should not be forgotten that COPs are only platforms for global dialogue and agreement on climate action – they are not designed for shaping domestic policies or agreeing specific actions. There is no process under the Paris Agreement for guiding or negotiating individual countries' NDCs. Instead, they are an opportunity for heads of state to meet, with equal weight given to all countries in the world, no matter the size of their economies.

However, new dynamics not seen in previous COPs played out at COP26. Negotiations on a single text generally lead to the lowest common denominator being adopted by all countries – this year's most prominent example being the change from phasing out to phasing down coal. However, many states did not accept this and made separate deals – so we saw the emergence of separate agreements on coal phase-outs, the end of fossil-fuel financing, deforestation and methane emissions.

FEATURE

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The move by the largest corporations and financial institutions to take serious action on climate is a game changer. Flows of finance are not only aligning with policies – increasingly they are pushing policies and regulation to become more stringent. Going forward, the world's largest investors have opened themselves to scrutiny from their shareholders, clients and partners – and have warned governments that they will hold them to account, too.

'Finance is an excellent feedback loop – if there is a gap between a country's ambition, its policies and the markets being enabled, they will be called out in real time as companies will be reporting on their progress on an annual basis.'

MARK CARNEY, UN SPECIAL ENVOY ON CLIMATE ACTION AND FINANCE, COP26[19]

2022 looks promising for maintaining the momentum. Germany is the president of the G7, with the full weight of the EU behind it to push for maximum ambition on climate. Indonesia is chairing the G20, and has already said that it intends to put climate action at the heart of its agenda. COP27, hosted by Egypt, will continue to put the voice of developing countries and the most vulnerable people at the heart of the agenda – and is the start of yearly assessment cycles for countries on their commitments, pushing governments to demonstrate real results. ES

Raphaëlle Vallet leads on climate policy and strategy at Green Investment Group (GIG), including on advising business, governments and corporate clients on the net-zero transition and nature-based solutions. She was seconded to the Climate Champions team one day a week to provide finance-specific advice for 15 months before COP26. She is a former UK government policy official and continues to hold advisory positions in the UK and Scottish governments.

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FEATURE

Sustainable consumption

Justin Bishop explores the challenge of decoupling economic growth from environmental degradation.

Since the 1970s, global gross domestic product (GDP) has increased 3.8 times, based largely on a 3.2 times increase in the consumption of natural resources. In recent years, 80 per cent of our annual energy was derived from fossil fuels;[1] 92 per cent of our annual global water footprint was attributed to agricultural products;[2] and 85 per cent of all direct natural resources consumed annually comprised biomass, mineral and non-mineral ore.[3] Natural resource use has accompanied large-scale changes in land use: from 1960 to 2019, 32 per cent of the Earth's land surface changed from its natural state, with the majority of these changes used to support agriculture (crops and livestock).[4]

Material consumption was decoupled relatively[5] from economic growth from 1970 to 2000,[1,3] with some coupling returning from 2010. Relative decoupling arises when both GDP and material consumption are growing, but GDP grows faster. This resource intensity or footprint, in economic terms, masked the 3 per cent annual growth in material consumption between 1970 and 2017. GDP is the most widely used measure of economic activity, but it is not a measure of the economic, environmental or social dimensions of wellbeing. Consequently, using GDP as a proxy for wellbeing continues to lead to incorrect policy decisions.[6]

MEASURING HUMAN IMPACT

The planetary boundary, ecological footprint and human-appropriated net primary productivity (HANPP) concepts are measures of the impact of human activity on the biosphere. Climate change and biosphere integrity are core planetary boundaries, through which the other boundaries operate.[7] Biodiversity underpins the provision of ecosystem goods and services, which are the natural functions on which we place value. Examples include temperature moderation and cleaning of air, water and soils. The ecological footprint measures the Earth's ability to meet our demand for energy, food and raw materials and its ability to absorb the wastes associated with this demand. Since 1970, the Earth has been in ecological overshoot: by 2017, we were exceeding global biocapacity by more than 1.7 times.[8,9] HANPP manifests as resource extraction and land-use change: in 2005, we appropriated 25 per cent of all net primary productivity,[10] resulting in destroyed habitats and reduced biodiversity, which threatens the provision of the very ecosystem services upon which we depend. Genetic biodiversity is one of the control variables for biosphere integrity and is considered at high risk.

Ensuring sustainable consumption and production patterns[11] in this 'decade of action' requires us to turn around in nine years a global economy built on the appropriation of natural resources over many decades.

Concepts of strong and weak sustainability address our approach to natural resources: weak sustainability implies natural and human capital are substitutes, while strong sustainability asserts natural capital and human capital are not substitutes, and therefore irreplaceable. The 'very strong sustainability' concept suggests the preservation of natural capital must be achieved through stabilisation of material flows.[12] This equates to an 'absolute'[5] decoupling of material consumption from improving economic and social wellbeing. Absolute decoupling is the situation where resource use falls, independent of the change in GDP.

PROJECTED TRENDS

Currently, material extraction and processing accounts for more than 67 per cent of global greenhouse gas emissions.[13] In the coming decades, the Organisation for Economic Cooperation and Development (OECD) expects structural changes to large economies, including technology improvements to reduce the material intensity in manufacturing and a move away from material-intensive activities to services. Even so, global material use is still expected to increase by 50 per cent, from 111 billion tonnes in 2020 to 167 billion tonnes in 2060.[13] Therefore, more action is needed to stabilise material flows at current levels to achieve both 'very strong sustainability' and the net zero ambitions of the Paris Agreement.

Achieving absolute decoupling is challenging because an increasing population implies less material available per person. At the same time, per-capita material consumption continues to rise even in those countries with a very high human development index, suggesting there is no income level at which material use has stabilised or reversed.[14] Some countries, such as Japan and the UK, have a low direct material consumption per capita. However, these economies are service orientated, based on the use of materials in the production of goods occurring elsewhere.[15,16] The continued growth of material consumption with human development is an important observation as human development has slowed and levelled off with increases in GDP per capita and other aspects of economic and social development.

We know agriculture has large land and water footprints, the impacts of which are expected to increase with adoption of biofuels at scale. The UN's International Resource Panel sustainability scenario requires bioenergy be limited to bioenergy with carbon capture and storage with no other biofuels allowed. Moreover, crop-based biofuels need to be eliminated by 2020 and deforestation needs to be net zero by 2030.[17]

Beyond agriculture, decoupling economic growth from material consumption requires that we accept that:

- Most of the natural resources we can afford to extract and use sustainably are already circulating in the world economy – the challenge is maintaining the value of these materials by extending their service life such that they not only meet our current needs, but our future ones also; and

- Not all material is reusable or can be used indefinitely. Therefore, the aim should be to extract those natural materials that can provide service for the longest time, and only as fast as other materials leave the system to maintain no net change in consumption.

The implementation of this position needs to account for unintended consequences and problem shifting, termed 'environmental leakage', such as the shift from biomass to non-metallic ores or the boosting of waste volumes to justify primary resource extraction.

CHANGING ATTITUDES TO WASTE

The waste hierarchy provides a useful framework for prioritising our use and ultimate disposal of natural resources when all intermediate value steps have been exhausted.[18] In the first instance, preventing waste means both producing fewer goods and using less material in each good produced. Much effort is spent in the design of goods to meet a primary objective; a similar amount of effort is needed to identify and capture the end-of-life opportunities for those goods.

FEATURE

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Converting natural resources to economic goods involves processes to upgrade the material to meet its intended function. Reusing the material in this upgraded form extends this added value to new applications. Recycling, usually down-cycling, involves degrading the immediate value of the material such that new energy and resources are required to upgrade it again. Down-cycling is contrary to the aim of preserving materials in their upgraded form for the longest time; however, down-cycled material can reduce the need for virgin resources and the associated environmental impacts. Similarly, energy recovery from unrecyclable waste can reduce the need for production of electricity and heat from other sources.

The plastic bag ban in the UK and Ireland is a good example of policies to reduce the demand for material at the end of the supply chain. Key to the success of this policy was the presence of alternatives that reduced the need for significant consumer behaviour change.[19]

Extended producer responsibility (EPR) measures are an extension of the polluter pays principle where producers are obliged to internalise the environmental impacts of products across their life cycle.[13] These measures include direct taxes on the product, obligations for recycling and disposal fees. Further EPR measures include cap-and-trade systems which recognise an upper limit on sustainable resource extraction. They encourage resource efficiency to minimise both the waste generated from existing products and the amount of material needed for new ones. For example, Iceland was successful in boosting its cod stocks through a combination of caps on catches, tradeable quotas and resource taxes that were introduced gradually to mitigate negative impacts on the economy.[19]

It is more difficult to design effective policies for resources that are used extensively throughout the global economy. EPR measures in the form of regulation have proven effective in setting the boundaries of sustainable consumption, while market-based measures have driven both absolute and relative decoupling by allowing firms to innovate within these regulatory limits. In all cases, policies to drive absolute decoupling need to balance effectiveness with acceptance, particularly where consumer behaviour change is fundamental to the policy success.[19] Moreover, coordination is needed across the net-exporting and net-importing countries in recognition of global supply chains and to mitigate problem shifting.[13]

SIGNIFICANT CHALLENGES REMAIN

The global economy has been built on the unsustainable, large-scale use of natural resources and production of waste. These activities continue to drive our ecological footprint, pushing the core planetary boundaries of biosphere integrity and climate change. The optimistic, best estimates of decoupling material consumption from economic growth do not go far enough to achieve the ambition of 'very strong sustainability'.

Decoupling economic growth from environmental degradation requires us to maintain upgraded materials in circulation for as long as possible to minimise both waste and the need to extract new natural resources. Achieving this sustainable consumption has not only the direct benefits of preserving habitat to support diversity and reducing greenhouse gas emissions associated with extraction and processing, but also the indirect benefits of enhancing the land-based carbon sequestration potential.

There are good policy examples where some absolute decoupling has been achieved in specific economic sectors. However, a significant challenge remains to design dematerialisation policies that are effective into the long term at total economy scale. ES

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Circular economy practice on a small island

Kripa Dwarakanath, Daniella-Louise Bourne and **Kirsty Platt** examine the opportunities for waste management on Guam.

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CASE STUDY

Islands face distinct challenges and vulnerabilities through issues such as finite land, resource pressure, limited economic diversity and climate change. A perfect example of this sits isolated in the western Pacific Ocean: the US territory of Guam. Guam's nearest neighbours are the Federated States of Micronesia, located more than 900 km away. The Philippines lie more than 2,500 km away and Japan more than 2,600 km from Guam. At only 48 km long and 6.5–19 km wide, this small island is home to an incredible 178,306 people.[1]

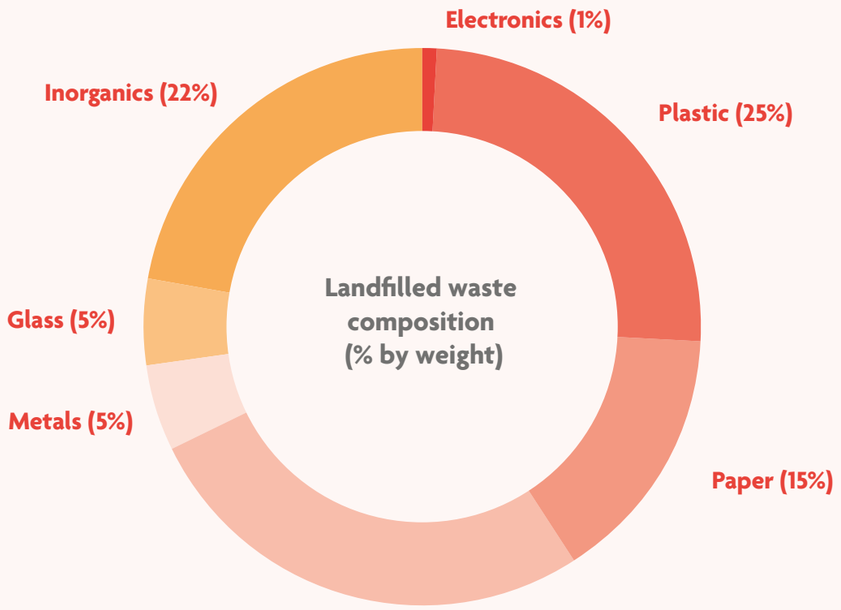
Since the 1960s, Guam's economy has been supported primarily by tourism and the US military. Approximately 1.2 million tourists arrived in Guam each year prior to the pandemic, generating approximately US$1.4 billion.[2] In island economies, the tourism sector often generates significant economic and social benefits,[3] yet it has also been responsible for negative environmental and social impacts.[4] For example, products to service the tourism industry must be imported but the resulting waste is left behind in the finite island area. This is frequently the result of a linear economy model (take–use–dispose), which leads to the over-exploitation of resources[5] and unsustainable levels of waste[6] – the latter being an issue that is an ongoing struggle for Guam.

Circular economy, which uses waste as a resource rather than disposing of it, provides a perfect solution, which must be complemented with sustainable consumption practices. Circular economy directly supports various United Nation Sustainable Development Goals (SDGs). Whether the aim is to reduce food waste (SDG 12), marine pollution (SDG 14), or ineffective waste management (SDG 11), the golden link is the circular economy. Guam's issues demonstrate the urgency of implementing circular economy, and the clearly defined boundaries of the island make it perfect for testing how to make circular economy a reality. This case study demonstrates that circular economy solutions require a combination of technical, partnership networks and strong supporting government policies for successful implementation and outcomes.

ZERO WASTE GUAM

Guam set up a Zero Waste Working Group in late 2019 to formally set out its policies and approach to waste management that recognised the need to consider waste as a resource. Most importantly, it recognised that solutions to environmental issues must be linked to the social dimensions of jobs and networks to create sustainable communities. Zero waste is a cornerstone in the current's administration environmental policy.[7]

Jacobs (a global solutions provider offering consulting, technical, scientific and project delivery for the government and private sectors) are supporting Guam in their zero waste journey, initially by providing technical expertise.



▲ **Figure 1. The percentages (by weight) found in the landfilled waste characterisation study. (© Jacobs, 2020)**

THE ISSUE: FINITE LANDFILL AREA

Guam's solid waste is currently sent to the Layon Landfill, which underwent a US$30 million expansion to open a third cell in July 2021, after the first two cells were projected to run out of space. Siting the Layon Landfill was extremely difficult because of the limited availability of land in Guam. The pressure on small islands is exacerbated by global policies that are reshaping the flow of recyclable material around the world. For example, recycling programmes worldwide were impacted by unprecedented disruption in January 2018 by the Chinese National Sword policy, which resulted in more stringent quality parameters for recyclable materials. This increased the level of effort needed to process recyclables but lowered the amount paid for clean and processed material. Navigating the new recyclable market has impacted the options available to Guam. Therefore, the Zero Waste Working Group in Guam concluded that the life span of the Layon Landfill site can be expanded only by adopting zero waste and circular economy principles. The aim was therefore not limited to diverting waste resources from landfill, but also to repurpose them.

WASTE CHARACTERISATION

A key aspect of repurposing waste as a resource is to assess it. In partnership with Zero Waste Guam, government agencies and private businesses, Guam is a step closer to their circularity goals by collecting data, visualising, mapping and analysing the material and waste flows on the island. For their key waste characterisation study, approximately 12.7 tonnes of waste was sorted and categorised, as shown in **Figure 1.**

The implementation of Guam's Zero Waste Plan has led to big data analytics to support good governance, green economic development, climate change mitigation, and more recently, incorporating opportunities for social equity and inclusiveness.

Inspired by the work presented during the 2019 Pacific Islands Environment Conference, the study included a brand audit component: plastic bottles were removed and recorded by brand and/or manufacturer to identify the sources and proportions in the plastic streams (see **Figure 2**). The study showed that 90 per cent of the bottles were from global brands, the biggest count

▲ **Figure 2. Implementing the Zero Waste Initiative: waste sorting, weighing and categorisation. (© Jacobs, 2020)**

being from Nestlé. There is hope that these findings will leverage deeper discussion with responsible brands to collaborate on sustainable solutions to their single-use plastic packaging materials.

The findings from the waste studies carried out to date have also catalysed action from private entities, For example, demand for glass recycling was identified to be economically viable, and as such a private business on the island has set up a glass pulverising operation to enable reuse of glass for construction materials such as pipe bedding and construction applications. This is a positive step forward for the island to meet its Zero Waste Targets while creating jobs and maximising circular opportunities to reuse waste streams.

However, this is just the beginning. By outlining an integrated overview of the different waste streams, the island's community can further target their efforts towards actualising a sustainable and circular economy based on current and comprehensive data. Multisectoral partnerships led by First Gentleman Jeff Cook, Chairman of the Guam Zero Waste Working Group and Conchita SN Taitano, Executive Director, with the technical support of Jacobs, have led to demonstration projects that focus on three key initiatives:

- Food waste recovery;
- Biosolids composting; and
- Greening roadways infrastructure.

FOOD WASTE RECOVERY

Guam's 2020 Environmental Protection Agency study revealed that an estimated 20,000 tonnes of food waste are generated annually from three main sectors: grocery stores, hotels and restaurants. This is enough to feed 20,000 people (12 per cent of Guam's population) three meals a day for a year. Food is an important social issue, since nearly a third of the population was recorded as eligible for food assistance programmes as recently as 2014. Furthermore, 20,000 tonnes of carbon dioxide equivalent (CO_2e) could be reduced if this food were diverted to composting or anaerobic digestion.

Though there are some pre-existing frameworks for food diversion in Guam, there is scope to do more. With hotels, grocery stores and restaurants having indicated interest in more diversion, and non-governmental organisations (NGOs) including Salvation Army Lighthouse Recovery Centre and the Kamalen Karidat soup kitchen providing an existing framework, there is real potential for such operations to be scaled up to provide greater social value.

Redistributing food from hotels into community spaces is increasing around the world, through informal networks, NGOs, social media messaging and apps such as OLIO. As much as these networks can broker socially enabled circular economy, in the absence of social interaction, there are examples from other cases in the world where recipients may question the quality and state of the perishable food they receive. This is eliminated in the Food Waste Recovery initiative, which upholds food safety, and a new programme is being developed with the Guam Department for Health and Social Service (DPHSS), Food Safety Program, Department of Environmental Health, in compliance with the Guam Food Code.

Collaboration is key to transition to a resilient, circular economy, and in this respect the hotel chain Hyatt is partnering with the Salvation Army and the DPHSS to start the food recovery programme. This in turn will lead to the development of a working model for other hotels and non-profits to generate less food waste and lead to more food being recovered and donated to the island population in need, thereby supporting UN SDGs.

▲ **Figure 3. A constructed compost demonstration pile featuring aeration pipes to promote microbial growth. (© Jacobs, 2020)**

BIOSOLIDS COMPOSTING

Biosolids are also a significant source of wastes on the island. Guam operates seven wastewater treatment plants, with the two largest producing up to 9,000 tonnes of primary sludge and wastewater solids annually. Currently all locally produced wastewater solids are untreated and landfilled at Layon at a disposal cost of US$171 per tonne,[8] causing both an economic and an ecological burden. Owing to population rise, the production of these solids is forecast to increase to more than 14,000 tonnes per year by 2025. The problems of limited landfill space and the projected increase in waste can be dealt with together by looking at circular solutions that add social benefit to the island.

Following examples from other communities across the USA, Jacobs helped guide a partnership of public agencies and private companies in the setup and operation of a biosolids composting demonstration project (see **Figure 3**). Raw wastewater solids were mixed with wood chips generated from wooden shipping pallets then placed on an aeration plenum of perforated piping for ventilation. The demonstration project produced 15.29 m^3 of compost that passed the time, temperature and testing requirements to meet the U.S. Environmental Protection Agency requirements for Class A, Exceptional Quality biosolids product, approved for unlimited use. The next steps are to perform trials under controlled conditions to test and evaluate the risk of using the compost for crop production compared to conventional methods in agricultural and garden plots.

If trials prove successful, biosolid composting has the potential to provide many benefits. Reusing biosolids can reduce waste to landfill by 10 per cent, reducing disposal costs for the Guam Water Authority. The resulting product can provide a valuable soil additive which boosts soil quality, plant growth and crop production for about a quarter of the cost of chemical fertiliser. In turn, this provides opportunities for private enterprises to provide employment for the local community and conduct the composting and use of the compost products, including unwanted green waste and wooden pallets, which will mitigate the spread of invasive species that have decimated the island's coconut trees. Overall, the diversion of this single waste stream can create a domino effect of positive environmental, social and economic benefits.

RECYCLED ROADS: TECHNICAL INNOVATION

Guam has 250 km of roads and 1,380 km of village streets, with the length of village streets continuing to grow. Road building provides an immediate opportunity to recycle materials that would otherwise be disposed in Guam's landfill or hardfills (where materials such as soil, clay, bricks and concrete are disposed of). The Greening Roadway Infrastructure Initiative[9] involves researching and developing the policies and procedures necessary to advance Guam's Zero Waste Goals by encouraging the use of recycled materials, including reclaimed asphalt pavement and recycled concrete aggregate.

Reclaimed asphalt pavement can be used in multiple ways for road construction, and recycled concrete aggregate from demolition can be reprocessed to replace virgin aggregate in paving applications also diverting the aggregate from landfill. In most cases, the cost of using both these materials in infrastructure construction applications is lower. Whilst upfront costs can be greater, the savings are realised throughout the pavement life cycle of 20–50 years versus the cost of new reconstruction.

Jacobs is also working with The Dow Chemical Company on a demonstration project using recycled polyethylene with a proprietary polymer mixed into asphalt binder for paving. This study is now going through more trials with a view to a wider roll-out of the application.

A VISION FOR THE FUTURE

Since 2013, Guam has made strides to realise its ambition to close the loop by shifting to regenerative production practices and effectively managing resources before they reach Layon. This Zero Waste Plan has highlighted projects that demonstrate a more circular approach and can be applied elsewhere, especially on Pacific islands and in remote communities.

Successful circular economic applications on islands have the potential to scale to other isolated communities through knowledge sharing, communications and outreach activities. These should be supported by a global network of circular islands and indigenous communities in which best practices, awareness and education of a circular economy can be spread amongst peers.

There are also a range of business benefits – significant cost savings from the reuse of materials and the reduction of waste for waste processing. Lowered emissions result from fewer waste disposal journeys and material goods imports (often by diesel-powered ship). Perhaps most significant is the environmental benefit of viewing waste as a resource. Reuse preserves the natural and cultural heritage that could otherwise be threatened by rampant waste disposal.

Enabling a circular economy, in which material reuse to infinity, is possible through a combination of factors such as government intervention (policies), networks (industries and community partnerships), technical expertise and knowledge sharing (scaling up or amplifying). New technical solutions will inevitably create opportunities for new types of jobs, which must be integrated into a plan for transformation from a linear to a circular economy. A holistic approach that incorporates the social dimensions of skills and employment, communities' participation and knowledge sharing along with environmental improvement is therefore essential for successful circular economy outcomes in an island community, and in all contexts globally. ES

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Ocean–climate ambitions within the current international framework

Beth Siddons and **Kathryn Collins** explore the context for action on this vital but sometimes overlooked aspect of the global climate.

There is an urgent need to better recognise and prioritise the critical role of the ocean in the context of climate-change impacts and solutions on the international stage. Despite a strong body of scientific evidence highlighting that urgent need, there is still work to be done to strengthen ocean–climate action within the United Nations Framework Convention for Climate Change (UNFCCC) and other multilateral frameworks.

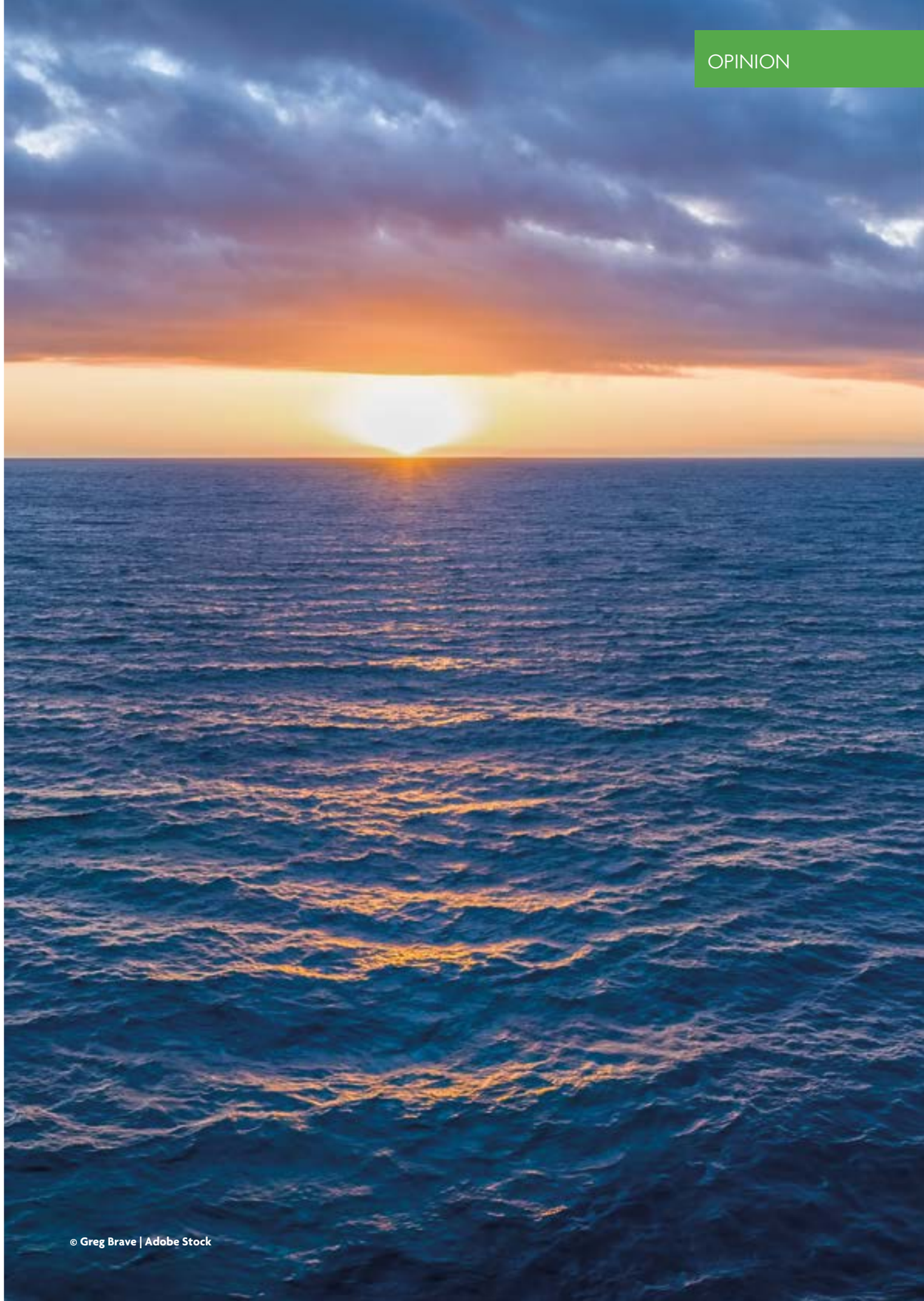
In this opinion piece, based on analysis in the run-up to COP26, we consider the international framework in which ocean–climate action sits. The decisions made at COPs are not made in isolation, and understanding the international context is important in order to understand the challenges of reaching broad consensus in this crucial area of climate action.

THE NEED FOR ACTION

The ocean is critical to the regulation of our climate and is also a critical buffer for climate change.[1] It has absorbed more than 90 per cent of excess atmospheric heat and more than a quarter of CO_2 emissions caused by human activities. Because of this, the ocean is warming and becoming more acidic, global mean sea levels are rising, oxygen levels in the ocean are decreasing, and there is an increase in extreme weather events. In turn, the ocean's ability to provide vital ecosystem services, such as food security, livelihoods, coastal protection, and continuing climate regulation and carbon sequestration, is being compromised.

In 2019, the findings of the Special Report on the Ocean and Cryosphere in a Changing Climate (SROCC)[1] from the Intergovernmental Panel on Climate Change (IPCC)

OPINION



OPINION

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highlighted the severe and wide-ranging consequences of climate change on the ocean and the cryosphere. The report emphasised the imperative need for urgent, coordinated and ambitious progress towards long-term greenhouse gas emissions reductions if the world is to minimise irreversible climate-change impacts on ocean ecosystems and processes.

There is little doubt that the single most important action that can be taken on a global scale to halt the impacts of climate change on the ocean is the rapid, sustained, economy-wide reductions of greenhouse gas emissions. However, there is growing recognition of the significant role the ocean can play in providing both mitigation and adaptation solutions to the current climate emergency.

There has been increasing advocacy by the ocean–climate community (both state and non-state actors), who are strongly engaged in efforts to drive ambition for ocean action in relation to climate change. In doing so they aim to shift the focus of the ocean–climate narrative and to progress beyond the perspective of the ocean as merely a victim of the far-reaching consequences of climate, to one that emphasises the very real potential of ocean-based solutions to climate change to provide adaptation and mitigation wins. To realise this potential, it is critical that international frameworks are fit for purpose to drive ocean–climate ambition and enable the implementation of ocean-based solutions to climate change. To do this, ocean–climate considerations must be sufficiently represented and integrated within broader climate action as well as within ocean-based initiatives such as the drive towards a sustainable blue economy.

While the legislative, governance and policy interventions required to facilitate and regulate the implementation of ocean-based climate actions are enacted at a national and/or regional level (e.g., marine spatial planning, marine protected areas, fisheries management, coastal development), the over-arching international framework must:

- Provide consistent evidence-based imperatives, measures and guidelines to promote a coherent and collaborative international response toward realising ocean–climate ambition;

- Create the enabling framework (including provision of the means of implementation) needed to equitably and sustainably facilitate transposition of international commitments to national governance and support implementation; and

- Be inclusive and representative, taking a whole-of-society approach.

The strength of scientific evidence on the role of the ocean as both a buffer to climate change and as a victim of the impacts of climate change, and the vast potential it offers for mitigation and adaptation solutions, provides a compelling narrative on the need for the ocean's role to be fully considered in an ambitious and urgent response to the climate emergency. To fully leverage that narrative, and to realise that potential as part of efforts to meet the Paris Agreement goals, requires consistent representation and articulation of ocean–climate considerations across the complex architecture of the UNFCCC, and prioritisation of where such efforts can be applied most effectively.

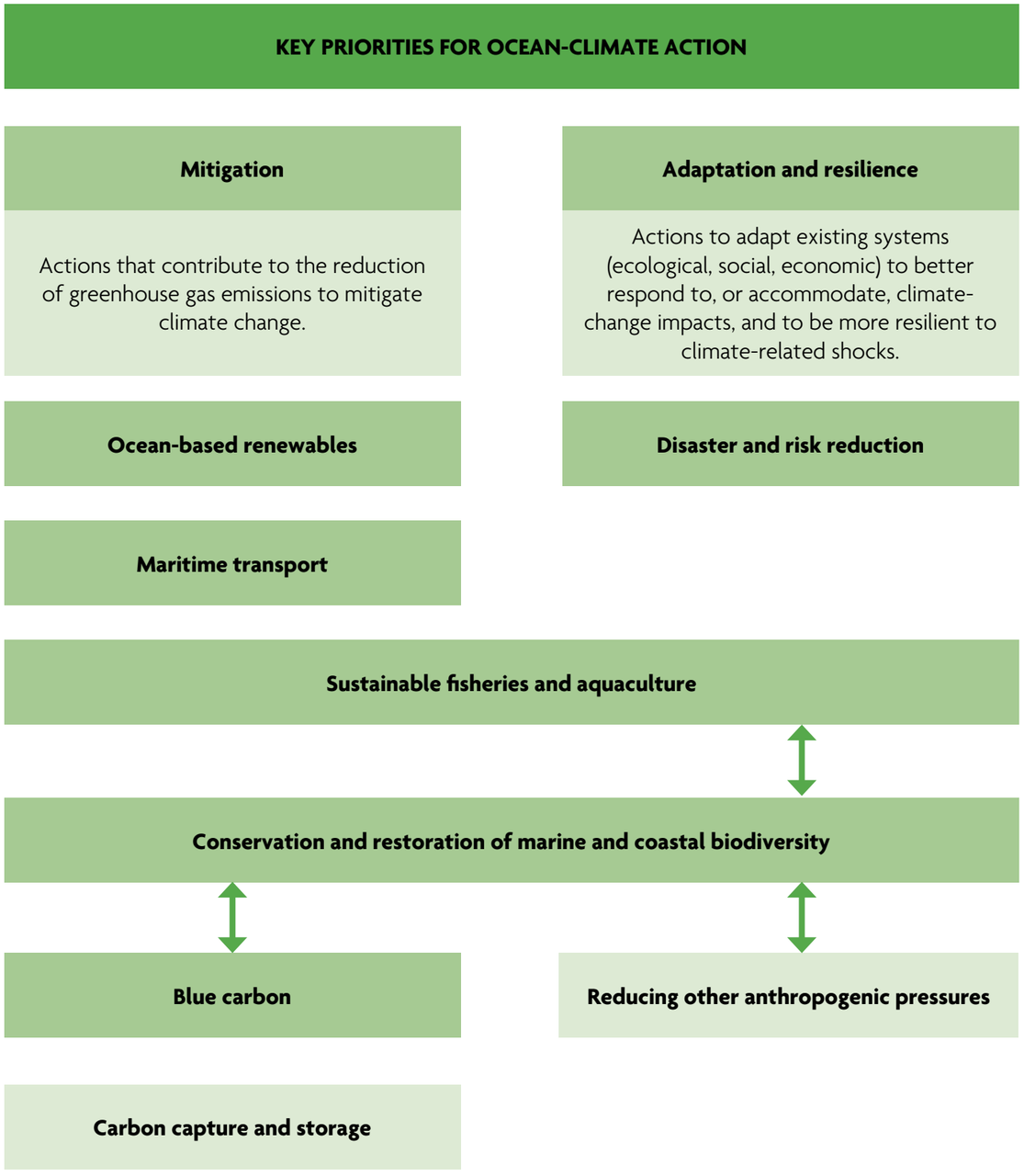
OCEAN UNDER THE UNFCCC

Consideration of the ocean within international climate negotiations has significantly increased in recent years. COP25 in 2019, known as the 'the blue COP' due to its focus on the ocean, requested that the chair of the Subsidiary Body for Scientific and Technological Advice (SBSTA) convene a dialogue on 'the ocean and climate change to consider how to strengthen mitigation and adaptation in this context'.[2] The request was largely due to considerable engagement and advocacy by the informal Friends of Ocean and Climate group, which was initiated under the COP23 Ocean Pathway to encourage discussion between interested Parties and non-state actors towards increasing the role of the ocean under the UNFCCC.

The calls to improve the integration of ocean considerations and strengthen action on ocean-based solutions under the UNFCCC sits within a wider landscape of increasing international ocean ambition and a growing recognition of the intrinsic, yet often complex, links between the ocean, climate change and biodiversity agendas. Ocean action is also central to the potential synergies and multiple benefits that can be achieved by taking coherent action to address climate change and biodiversity loss together.

Key international ocean-related initiatives include:

- Calls for the inclusion of a '30by30' target of 30 per cent of the global ocean in marine protected areas (MPAs) and other effective conservation measures (OECMs) by 2030 to be included in the Post-2020 Global Biodiversity Framework under the Convention on Biological Diversity (CBD);



▲ **Figure 1. Overview of the key ocean-based mitigation and adaptation solutions that underpin ocean–climate ambition. (Light green boxes indicate contributing factors – or in the case of carbon capture and storage, potential contribution – that are out of the scope of this article.)**

- The ongoing negotiations under the United Nations Convention on the Law of the Sea (UNCLOS) towards a legally binding instrument on the conservation and sustainable use of marine areas and biological diversity beyond national jurisdiction (BBNJ); and
- The transformations commitments[3] of the High-Level Panel for Sustainable Ocean Economies (the Ocean Panel).

OCEAN–CLIMATE PRIORITIES

Effective advocacy that can actually drive progress on the ambition for ocean–climate action requires high-level agreement on shared priorities. This agreement in turn provides a clarity of message that can achieve cut-through for the ocean when competing with the multitude of other climate priorities. The priorities within the UNFCCC Ocean and Climate Dialogue, as well as those of other international alliances (e.g., the Ocean Panel, High-Ambition Coalition for Nature and People, Because the Ocean), provide an insight into the ambitions of the ocean–climate community. Once synthesised, they show the broad international ambition and priorities for driving action on ocean-based solutions for mitigation and adaptation (**Figure 1**).

It is important to recognise that, while there may be broad, high-level consensus on ambition for ocean–climate action, specific prioritisation, approaches and needs are often highly localised and nuanced according to national and regional contexts. It is vital that national and regional interests are advocated and recognised at an international level, but there is a risk, due to a lack of an agreed ocean–climate narrative across international processes, that high-level ocean–climate ambitions may not be effectively and consistently communicated by the ocean–climate community. The strength and weight in speaking with one voice is vital for catalysing high-level action and integration of ocean considerations into the wider climate landscape.

REALISING AMBITION INTERNATIONALLY

The level of engagement with the UNFCCC Ocean and Climate Dialogue and the number of international alliances advocating for ocean action highlights the growing, shared ambition to deliver coherent ocean-based solutions that can help tackle the twin crises of climate change and biodiversity loss together.

However, gaps in existing international legislation must be addressed to realise ocean–climate ambition and the potential of ocean-based solutions to contribute to climate-resilient pathways and the Paris Agreement goals. Although progress is being made to enhance consideration of the ocean across United Nations agendas, the existing legislative landscape is fragmented and complex. So are the routes by which nations and organisations access cross-cutting support (such as finance, capacity building and technology), that are required to achieve a fair, equitable and inclusive future for all. While systemic change can be slow, simplifying and centralising access to support and information, as well as streamlining obligations across agendas, would reduce the administrative burden on nations, particularly those with limited resources that are often the most vulnerable to climate-change impacts.

In the final COP26 decision, relevant work programmes and bodies under the UNFCCC have been invited to consider how to integrate and strengthen ocean-based actions in their existing mandates and work plans. The decision also introduces an annual ocean-climate dialogue to be held by the SBSTA, commencing in June 2022. This outcome, along with other initiatives such as the UN Ocean Decade, offer pivotal opportunities to capitalise on the current momentum to drive ocean-climate action. It is vital that the international ocean–climate community continues to leverage their collective political and diplomatic weight by coalescing around shared ocean–climate ambitions, as well as catalysing progress via international collaboration, national commitments and leadership.

An extended version of this article was previously published in October 2021: http://www.howellmarine.co.uk/publications.html.

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Kathryn Collins has a PhD in marine governance, decision-making and publicness, and a decade of experience within marine regulation, policy, planning and resource management. Kathryn's main research and professional interest is in ensuring equitable access to decision-making within marine space. She is a Principal Consultant at Howell Marine Consulting.

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Ross Baker – Senior Consultant
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Christopher Cooper – Geo-environmental Specialist
Findlay Cranston – Environmental Planning Consultant
Kirsty Crocket – Environmental Specialist
Oliver Dube – Lecturer
Samantha France – Senior Consultant
Victoria Gaskin – Principal Consultant Land Quality
Aliyssa Glen – Principal Environmental Consultant, Ground & Water
Pauline Graham – Associate Director/Consultant
Rory Griggs – Senior Project Manager
Rebecca Hodnett – Senior Geo-environmental Consultant
Sarah Hodson – Senior Climate Change Consultant
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David Johnson – Senior Environmental Scientist
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Kieran McCartan – DAERA Agri-environment Advisor
Olajide Olawoyin – Environmental Consultant
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Lara Griffin – Environmental Consultant
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Hong Ching Kwok – Assistant Consultant
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CASE STUDY

The Blue Climate Initiative

Jeanne Everett, Lorin Fries and **Neil Davies** give an overview of transformational opportunities for protecting and conserving our ocean.

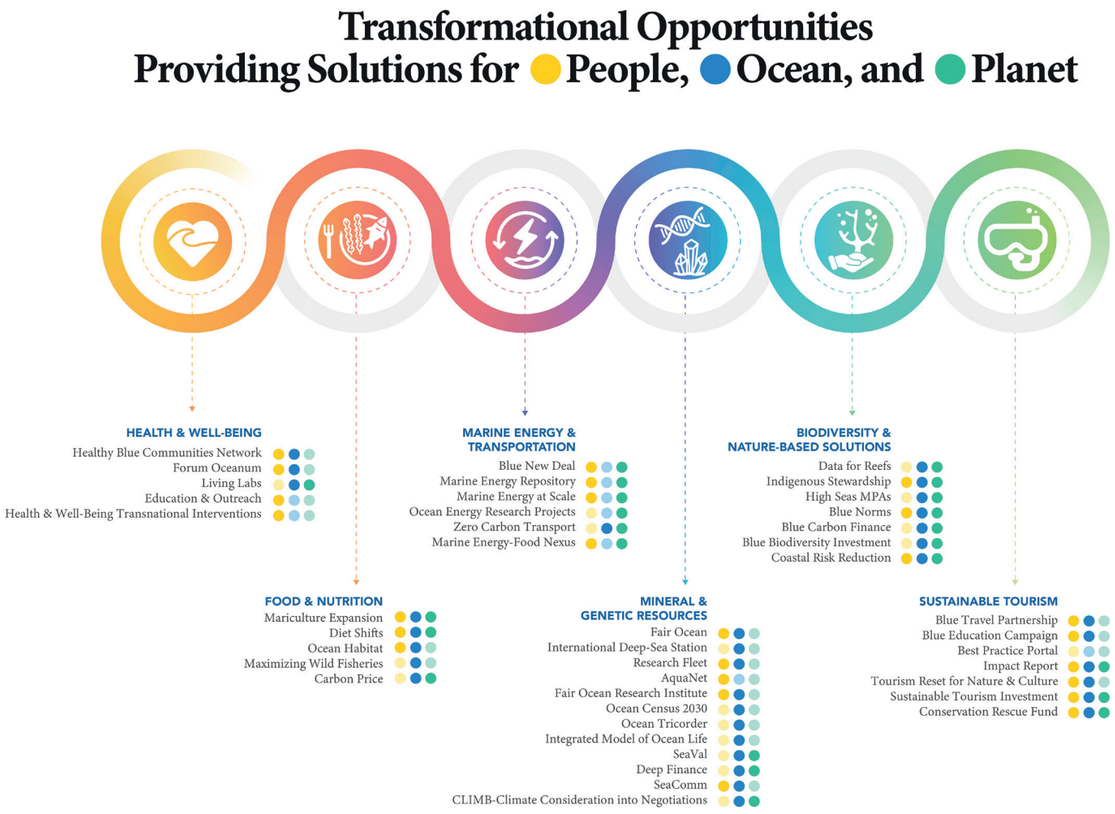
A thriving human population is inconceivable without a healthy ocean. The ocean underpins a stable climate and flourishing biodiversity; it is integral to Earth's life-support systems. The Blue Climate Initiative brings together individuals and organisations that are passionate about the ocean, committed to social justice, and striving to build a sustainable planet. The Blue Climate Initiative targets breakthrough solutions that combat climate change while protecting and conserving our ocean. The idea is to leverage the power of the ocean to address some of the greatest challenges of our time – improved human health, flourishing biodiversity, secure and nutritious food supplies, renewable energy, and sustainable ocean economies. The Blue Climate Initiative supports innovative action towards three interconnected goals that are critical to global health:

▲ **Tetiaroa atoll in French Polynesia – the birthplace of the Blue Climate Initiative. (© Tim McKenna)**

- To build resilient, thriving and equitable communities;
- To understand and protect our ocean; and
- To restore a healthy climate.

WORKING TOGETHER

As a first step, in 2020 the Blue Climate Initiative engaged more than 60 multidisciplinary scientists and academic experts to identify the most promising ocean-related transformational opportunities that tackle climate change while protecting the ocean and serving humanity's needs. Their insights were released in six papers focused on health and wellbeing,[1] food and nutrition,[2] marine energy and transport,[3] mineral and genetic resources,[4] biodiversity and nature-based solutions,[5] and sustainable tourism.[6]



▲ **Figure 1. Six sectoral working groups and the transformational opportunities they identified. Together, these actions would build resilient, thriving and equitable communities, help understand and protect the ocean, and restore a healthy climate. The darker dots indicate stronger associations with people, ocean and/or planet.**

A book summarising and analysing their findings was published at the same time: *Transformational Opportunities for People, Ocean, Planet*.[7]

While the experts were organised into working groups focused on specific areas, the challenges they tackle are systemic, unbounded by any single discipline or sector. Indeed, the working groups address an overlapping set of priorities. The mapping shown in **Figure 1** illustrates how the transformational opportunities can advance interconnected holistic goals, addressing human needs (e.g., food security, abundant energy, clean fresh water, new medicines, good jobs) and promoting the ocean and climate agenda.

OBJECTIVES FOR COLLECTIVE ACTION

In synthesising the transformational opportunities, seven strategic objectives emerge for collective attention and investment (see **Figure 2**):

- Strengthened policy that better protects the ocean against pollution, biodiversity loss and other threats, and that further enables ocean and climate action;
- Expanded blue innovation including new technologies, models and ideas that provide impactful solutions;
- Deepened inclusive scientific understanding of the ocean, including its role as a solution to climate change;
- Education and outreach, including to enable enhanced collaboration between innovators, community groups, scientists, investors and global experts around ocean-based climate solutions, through network platforms and data infrastructure;
- Increased financing for a blue economy, with emphasis on sustainability and equity;
- Changed behaviour among consumers and industry towards more ocean- and climate-conscious action and decision-making; and

▲ **Figure 2. Through a holistic approach and cross-sector collaboration, the Blue Climate Initiative pursues seven strategic objectives to advance collective attention and investment for people, ocean and planet. (Adapted from: Seddon, *et al.* [2021].[8])**

- Informed, engaged and empowered citizens and communities, building agency, capacity and leadership, especially among island and coastal populations.

A blue climate action agenda based on this work identifies a compelling set of priorities to address the climate crisis while feeding, healing, powering, sustaining and nurturing human society. The priorities come with associated challenges, benefits, feasibility and risks, which are also reviewed in the transformational opportunities papers. Together, these ideas are a rallying call for collective action to achieve holistic progress for people, ocean and planet. They align closely with the UN Sustainable Development Goals, as well as the UN's Decade of Ocean Science for Sustainable Development (2021–30).

A WINDOW OF OPPORTUNITY

The world is still emerging from the Covid-19 pandemic. While many of its impacts are grim, others offer a profound and unprecedented opportunity to redesign policy, business and social norms, compounded by the momentum built through COP26 – but only if we can act together. Despite the enormity of the challenges facing humanity in the coming decade, there are grounds for optimism. Rediscovering the need, capacity and appetite for collective action, political changes in key geographies are ushering in a new era of commitment and collaboration for social and environmental justice. The pandemic 'reset' is a window of opportunity to build back better.

The opportunities presented in this first phase of the Blue Climate Initiative draw on proven practices alongside creative new ideas to provide concrete actions that could help us build a better world. These actions weave an intelligent fabric supporting human health in equitable and prosperous societies. Examples include:

- Zero-carbon innovations integrating marine energy and food production, incentivised by a price on carbon;
- Digitally supported reef protection;
- Ambitious marine protected areas (MPAs);
- Elevating Indigenous and local knowledge; and
- Mechanisms for blue carbon financing.

Other examples seek to accelerate inclusive ocean exploration, such as through a deep-sea station and a global research fleet, pursuing projects such as a census of all the ocean's creatures.

A cross-cutting theme is the urgent need, and opportunity, to transform the dynamics around the ocean agenda – such as by designing blue financial instruments, influencing behaviours such as dietary choices, and expanding sustainable tourism through new portals, partnerships, plans and incentive mechanisms. Underpinning such progress is the imperative to collaborate in fundamentally more effective ways,

sharing knowledge and linking communities through democratic and empowering networks.

OCEAN INNOVATION PRIZE

As one of several ways to spur such action, the Blue Climate Initiative hosted a US$1 million Ocean Innovation Prize to identify and accelerate market-based ocean-related solutions to our climate crisis. In partnership with the United Nations and the Sustainable Oceans Alliance, the Blue Climate Initiative announced the 21 semifinalists at COP26. These semifinalists are advancing creative, innovative approaches. Coming from all corners of the globe, their projects include clean energy and desalination from sea waves and solar technologies; kelp forest restoration and seaweed innovations for bioplastics and livestock feed supplements that reduce methane emissions; and carbon dioxide removal through gasification of algae biomass, electrochemistry and alkalinity enhancement; and many more. The Blue Climate Initiative received 236 applications from more than 60 countries. The semifinalists were selected by a global group of 18 expert evaluators for their impact potential, innovation, commercial and scale potential, capacity and feasibility, alignment with the principles of the prize, and the value of support from the prize. Final prize winners will be announced in early 2022.

The ideas cited here are among the many transformational opportunities presented in the Blue Climate Initiative's book. They are meant to help inform and inspire those who will put them into action – from wherever they sit. We all have a role to play. The time for blue climate action is now. ES

Jeanne Everett serves as the Manager for the Blue Climate Initiative. She has a civil engineering degree and an MBA from top French universities, and studied international development at the Fletcher School of Law and Diplomacy. Born and raised in West Africa, she spent 17 years living and implementing community-based infrastructure, rural development and climate change projects in nine different countries across Asia.

Lorin Fries founded and leads FutureTable, a food systems strategic advisory firm. In this capacity she serves as the Blue Climate Initiative's Strategy Lead. Lorin formerly worked with the World Economic Forum, Harvard University, and Save the Children in Uganda. She has a master's in public policy from Harvard.

Neil Davies is Executive Director of the University of California, Berkeley's Gump South Pacific Research Station in Moorea, French Polynesia. Davies received his PhD in evolutionary genetics from University College London and has conducted fieldwork across the Caribbean, Latin America and Pacific Islands. He serves as board member and Science Director for Tetiaroa Society, the fiscal sponsor of the Blue Climate Initiative.

Acknowledgements: *we thank all those who contributed their expertise to the working groups, Lauric Thiault of Moana Ecologic for the graphics, and Stanley Rowland and Victoria Schoenwald for their comments and suggestions on drafts of this manuscript. Special thanks go to Richard H. Bailey (Chairman and CEO of Pacific Beachcomber S.C.) without whom the Blue Climate Initiative would not be possible.*

Funding sources: *this article was funded through a gift to the Blue Climate Initiative. The donor had no role in writing it or the decision to submit it for publication. The fiscal sponsor for the Blue Climate Initiative is Tetiaroa Society, a US 501(c)(3) non-profit organisation (tetiaroasociety.org).*

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Weather, climate and perceptions of risk

Mark Everard points out that a crisp and simple distinction between weather and climate may be more elusive than we have assumed.

The US Geological Survey has helpful definitions: 'Weather refers to short term atmospheric conditions while climate is the weather of a specific region averaged over a long period of time. Climate change refers to long-term changes'.[1] Another favourite, succinct definition is from science fiction author Robert Heinlein: 'The climate is what you expect; the weather is what you get'.[2] Distinctions are ones of space and time. Climate is 'bigger' and 'slower'; its local manifestation as weather is more immediate and volatile.

THE ELEPHANT IN (OR OUTSIDE) THE ROOM

While 'bigger/local' and 'slower/now' divisions distinguishing weather from climate are not absolute, their psychological resonance is more significant. Parents quickly discover what developmental scientists know: the promise of something better tomorrow if we hold back from grasping it today – ice cream, playtime, intimacy – is alien to infant psychology. With age, anticipating future and more distant rewards – from investments or in an afterlife, for example – is a learned response as our faculties and life experiences develop.

FEATURE

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The temporally shifting perception of distant risks is defined in various ways. Economists calculate net present value by applying compound discount rates, high valuation of short-term benefits progressively declining with perception of value over time. For various religious traditions, rewards of abstinence come more distantly in time and metaphysical space in heaven. On a more parochial level, the saying 'jam today or jam tomorrow' sums it up well.

Behavioural psychologists use the term 'availability heuristic'. Another metaphor is the 'far-off elephant': appearing small at distance and not bothering us, but as it looms closer its bulk gives us serious cause for concern. Temporal examples include rising anxiety experienced as an exam or publishing deadline, conference presentation, or dental appointment approaches, after having put off thinking about them while they seemed remote concepts.

CONCEPTIONS OF CLIMATE RISK

How we react to challenges at different spatial and temporal scales is highly germane to perceptions and reactions to those distinctions between climate – big, remote, slow to manifest like that far-off pachyderm – and weather. As I typed this article, a downpour had me rushing to close windows and our cat racing in through the catflap. Though humans possess more capacity to envisage and plan for the future than cats, perhaps the inter-species distinction is not so stark when it comes to reaction to weather as opposed to climate risks!

The politics of risk also suffer from short-term 'jam today or jam tomorrow' horizons, exacerbated by the pressure to deliver immediate results satisfying voters and funders over short election cycles and terms in office. Annual and other business cycles, with expectation of short-term returns to shareholders, stifle long views. A survey of risk attitude amongst public stakeholder groups about another long-term issue, management of nuclear waste, found people were not willing to accept a local high-level nuclear waste repository in their home region, significantly shaped by fear of radiation.[3] By contrast, politicians were less concerned. Other technologies tend to generate similar social, psychological and political disparities as key players perceive risks differently.[4]

Communication of scientific uncertainty can also result in differing perceptions. Unless uncertainty is communicated effectively, decision-makers may put too much or too little faith in it, or selectively accept it as supporting preferred positions. Interpretation of uncertainty is also framed by context, for example whether decision-makers are looking for a signal to trigger an evacuation before a hurricane; selecting options such as a best course of medical treatment; or exploring options such as how best to regulate nanotechnology.[5] In these situations, immediacy influences the interpretation of inherent scientific uncertainties. Global climate change fulfils three prerequisites of long-term policy challenges, defined as '…public policy issues that last at least one human generation, exhibit deep uncertainty exacerbated by the depth of time, and engender public goods aspects both at the stage of problem generation as well as at the response stage'.[6] However, climate-related uncertainties are now not so much 'if' as 'when', 'to whom' and 'how much' impacts will be felt.

ARM-WAVING VERSUS ACTION

Fine words may be spoken, but proportionate action to address climate risk lags dramatically. We know we must limit emissions. We must cease and reverse perverse decisions, such as the UK recently axing plans to insulate draughty homes and to commit to green rather than lowest-cost building, while driving through new road and airport expansion schemes, and caving in to pressure from industry to approve a new oilfield in the North Sea that will extract 150 million barrels of oil and emit more than 3 million tonnes of carbon over its lifetime.[7]

In May 2021, the International Energy Agency made it clear that no new fossil fuel developments should be approved by governments beyond 2021 if the world is to limit global warming to 1.5 °C.[8] Recent commitments have come from some, though far from all, G7 nations to accelerate the transition away from coal, but few have clear deadlines and action plans to abandon oil and gas. The UN Framework Convention on Climate Change's COP26 is ongoing as I write, and we wait optimistically for the emergence of strategic decisions, and more significantly firm commitments and investments, to back them up.

Major polluters must not be given tacit political wriggle room to delay action on the spurious argument that long-term damage to climate and biodiversity entails excessive costs in the here and now. Jam today rather than tomorrow, and whose jam are we talking about while the toast falls butter-side down for the countless millions inhabiting a parlous future?

A report by the UK government's Climate Change Committee constitutes a damning assessment of the UK's progress on tackling climate change to date, both in reducing emissions and adaptation,[9] highlighting a growing gulf between government pronouncements and actions: just 20 per cent of the emissions needing to be cut by 2035 are currently on course for delivery through credible policies. Globally, because of active support for contrary policies as well as inaction, governments are failing to meet their Nationally Determined Contributions (NDCs) under the Paris Agreement, with global carbon emissions set to rise by 16 per cent by 2030 rather than the

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50 per cent decrease necessary to keep global heating under the agreed limit of 1.5 °C.[10]

The financial sector needs serious reform globally, as banks and financial institutions enable climate destruction by heavily weighting lending and investments towards high-carbon industries. The UK's financial sector is responsible for funding more carbon emissions than the annual emissions of Germany.[11] The world's largest financial centres, such as London, New York and Tokyo, lack substantive regulation requiring institutions to ensure their lending is consistent with stated political goals of limiting global temperature rise to 1.5 °C.

We can thank campaigner Greta Thunberg for cutting through the obfuscation and excuses behind the mismatch of words and deeds in her September 2021 speech to the Youth4Climate summit in Milan: 'Build back better. Blah, blah, blah. Green economy. Blah blah blah. Net zero by 2050. Blah, blah, blah… This is all we hear from our so-called leaders. Words that sound great but so far have not led to action. Our hopes and ambitions drown in their empty promises'.[12]

MAKING IT REAL

But we can change.

One thing the dreadful Covid-19 pandemic has shown us is that a pressing existential crisis can bring global society together to find solutions. The innovation, testing and approval, and subsequent distribution and vaccination strategy involving not one but multiple vaccines within a year – processes otherwise generally taking at best a decade – constitute heroic, life-saving successes of which scientists across multiple disciplines can be proud. If there is now greater trust in science, perhaps we can be more bullish about communicating the science of climate change to stimulate committed action.

We have formerly made major strides eradicating smallpox, and significantly suppressing polio, tuberculosis, Ebola and other diseases. We have collaborated globally to tackle stratospheric ozone depletion, phasing out the worse catalysts of ozone breakdown under the 1987 Montreal Protocol. The Stockholm Convention brought nations together to control some of the most problematic persistent organic pollutants (POPs). More locally, we have driven behavioural transitions mandating wearing seat belts in cars, bans on indoor smoking in public places and phasing out asbestos, all of which have saved lives and advanced public health.

What all of these successes have in common is that they have framed longer-term threats in terms of their realities in the here and now: risk of death or debility, and/or potential legal liabilities and costs. Recognition of the rewards of survival and health, rather than the shaming and guilt often endemic in the climate debate, has galvanised action and choice in working with socially held and shared beliefs about achieving a greater good.[13] This is what we must achieve to marry the 'far-off elephant' with its proximal and short-term implications and the ultimate promises of action. As expressed by Everard *et al.*,[14] 'The scale of current emergency legislation and stimulus packages in response to the Covid-19 pandemic, and the pace at which they were introduced, demonstrate an institutional and societal capacity for substantial and timely response in the face of existential threats. The pressing issues of climate change and 'biodiversity crisis' are no less, and are arguably more, existential in nature, albeit perceived as approaching at a different pace'. These slower-paced existential threats are also indivisible from strategic solutions reversing the degradation of ecosystem services that currently exacerbates risks of zoonotic disease origination and transmission. We need to recognise the pressing threats of climate change and biodiversity loss with a similar level of focus as the Covid-19 pandemic if we are to succeed in driving urgent and proportionate responses to underpin a more secure future.

MAKING CLIMATE CHANGE REAL

The downscaling of climate change forecasts has created a lens to understand the implications in our own back yards, offering a more tangible focus for the average person and local authority than probabilistic models expressing global trends over the coming century.

Consequences for 'natural' disasters, the rising incidence of which suggest they may be rather more acts of people than acts of God, has focused the insurance industry for decades. If longer-term trends can be translated into near-term financial risks, and by implication higher premiums charged to you, me, and the businesses serving our needs that then pass those costs down the line to us, that is also certainly a more proximal and immediate signal around which we can mobilise.

Determining that any one storm, severe rainfall, flooding or other extreme event is attributable to climate change has formerly not been possible due to the chaotic nature of the climate system. However, pioneering work by Friederike Otto on weather attribution is beginning to identify clear contributions from the warming global climate over and above norms without additional climate forcing. With Dutch scientist Geert Jan van Oldenborgh, Otto founded the World Weather Attribution (WWA) initiative[15] in 2014 as a global network developing methods to rapidly assess extreme event attribution. WWA works by selecting strong candidate extreme weather events to analyse, and teasing out the additional contributions from anthropogenic emissions (if any) based on modelling the probability of these extremes occurring both with and without climate forcing. These


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estimates are then combined to generate a coherent attribution statement about the contributory role of climate change. Methods have been peer-reviewed and risk assessed,[16] and a robust and replicable protocol for probabilistic extreme event attribution analysis has also been published.[17]

Weather attribution, from its inception little more than 10 years ago, forms a critical bridge between the remote and immediate meanings of anthropogenic climate change, making the elephant's footsteps audible in the here and now. Importantly, it does so by the detailed calculation of relative contributions of normal variability and additional contributions, a far cry from polarised media verdicts that particular events viewed in isolation confirm or refute climate impacts. Paradoxically, apparently contradictory scientific analyses, respectively 'proving' that extreme events are evidence of climate change or conversely that they are not, may in fact both be right. (Otto presents as her initial inspiration the example of two such conflicting yet correct scientific analyses of the 2010 Russian heatwave.)

More nuanced analyses identify climate change as one of the causes of extreme events, but never the only one. Further analyses by the global WWA network of heat waves, deluges, dust storms, wildfires, rainfall-driven landslides and other extreme events have found that many have occurred at intensities that could not have been forecast without climate change playing a role. As reassuringly, some analyses found that climate change played no detectable role in other events. It is all a matter of how the warming climate changes the likelihood of these events, rather than about binary outcomes. Increasingly, we are learning that the link between greenhouse gas emissions and meteorological change, subsequently producing societal impacts, is a matter of probabilistic event attribution (PEA) associating events with past anthropogenic emissions.

Does PEA give us a 'smoking gun' of direct cause and effect? In an interview provocatively subtitled 'Can we sue oil giants for extreme weather?', Otto suggested that this new science could soon provide evidence in legal cases against fossil fuel companies.[18] In reality, we are some way short of definitively pinning any single extreme event on greenhouse gas emissions and also, as users in a petrochemically driven economy, we are all culpable. But we are getting closer to understanding the proportion of the contribution of these emissions.

ACCELERATING SUSTAINABLE PROGRESS

Inherent challenges behind climate change are common to many dimensions of sustainable development. Certainly, this applies to the biodiversity crisis. If we can discern in the here and now the ripples of a potentially disturbing future in terms of their incremental consequences for reduced pollination, predation by crop pests and food security, with rising costs as well as health risks from increased pesticide inputs as a myopic substitute for lost ecosystem services from insect decline, then we can feel the hot breath of that particular elephant.

We are good at triumphalist global agreements and national strategies but, as yet, we prevaricate over meaningful action and challenges to vested interests. 'Blah, blah blah' indeed! But let us fine-tune our tools to pick up signals from alternative futures, informing us not only about their contributions to emerging threats but also about how innovation of novel approaches and markets can better anticipate and avert adverse outcomes and so generate resilient profits within a safer future.

The elephant is talking to us right now, if we have the ears to listen. ES

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Mobilising private capital for nature-based solutions

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FEATURE

Raphaëlle Vallet, David Viner, Adrian Barnes, Robin Grenfell and **Hannah Whyte** set out what is needed to enable private financial institutions to invest in nature.

It is undeniable that healthy nature is essential for human existence – from providing food and water, physical and mental health, energy and cultural benefits. Yet the planet is in the midst of an extinction event that is going at least tens, if not hundreds, of times faster than any such event has averaged in the last 10 million years.[1] Since 1970, wildlife populations (including mammals, birds, fish and reptiles) have declined by around 60 per cent, and 1 million species (around 25 per cent of all species) could be lost within decades if the world pursues business-as-usual activities.[1] The biodiversity loss caused by human activities will be obvious in the fossil record for as long as Earth will exist.

While we cannot quantify the full implications of this, we do know that biodiversity loss and the subsequent loss of ecosystem services is already affecting the global economy. Land degradation has reduced the productivity of 23 per cent of the global terrestrial area and the destruction of marine and coastal habitats is increasing risks to the life and property of hundreds of millions of people.[1] More than half of global gross domestic product (GDP) is moderately to highly dependent on nature and ecosystem services.[2] Nature plays a much greater role in supporting human and economic activities than was understood just a few years ago.

This article describes five challenges to and opportunities for accelerating private funding for nature-based solutions (NBS), exploring how the market and policy-makers can learn lessons from the energy transition, and then apply them to nature.

ACCELERATING PRIVATE INVESTMENTS IN NBS

As with climate solutions more broadly, the world needs much greater levels of investment to restore its ecosystems – in order to limit temperature increases to 2 °C, reverse loss and stabilise biodiversity by 2050 compared to today's levels, and stop land degradation.[3] This is estimated by the UN to be more than four times what was invested in 2021 in NBS by 2050,[3] and up to 10 times by others.[4] This investment requirement is too great for the public sector alone to meet, so there is a crucial role for private finance to play. The UN estimates that around US$133 billion is invested in NBS annually. Currently only 14 per cent of that funding comes from private capital.

FEATURE

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CHALLENGE 1: DEFINITIONS

Nature-related risks and opportunities (which entail uncertainty) and correspondingly, adverse impacts and benefits (which are more predictable) – are not well defined or priced by the financial system.

The Bank of England's framework on climate risks and opportunities lays out specific ways in which climate change poses financial risks for banks and insurance companies;[5] this influential framework has since been widely adopted by the market. Similar work needs to be done to classify and define nature-related risks and opportunities.

Here we set out the types of risks and opportunities that could be included in a nature-focused classification system:[6]

- Risks/adverse impacts posed directly by economic activities to the natural environment (e.g. habitat destruction, overfishing, pollution);
- Risks/adverse impacts posed indirectly by economic activities to the climate in the form of greenhouse gas emissions, which in turn affect natural ecosystems (e.g. ocean acidification as a result of higher concentrations of CO_2 in the atmosphere causing coral bleaching[1]);
- Risks/adverse impacts posed by degraded ecosystems to social or economic activities (e.g. reduced genetic diversity and soil quality reducing resilience to drought or flood events[1]);
- Climate mitigation opportunities/benefits, i.e. potential to absorb carbon emissions with natural carbon sinks. The Intergovernmental Panel on Climate Change (IPCC) estimates that NBS could provide around 30 per cent of the CO_2 mitigation needed through to 2030 to avoid dangerous climate change.[6] Other estimates are even higher: as much as 37 per cent of the emission reductions needed by 2030[7] and the removal of 10–20 GtC annually based on certain scenarios;[8]
- Climate adaptation opportunities/benefits, i.e. potential to use NBS to improve the resilience of social or economic activities to physical climate change risks (e.g. sustainable urban drainage systems, estuarine flood protection using managed wetlands, drought-resilient farming using biodiverse agroforestry); and
- Opportunities/benefits to improve biodiversity and restore nature for its own sake, or to maintain or enhance the economic and social benefits derived from other ecosystem services (e.g. water treatment, pharmaceutical use, tourism/leisure).

Classifications matter because both the public and private sectors have different roles to play in each category, which will need to be articulated in specific ways by industry standards and regulators in order for them to become well understood in the finance sector, as has been done with climate risks over the past few years.

CHALLENGE 2: DATA AND METHODOLOGIES

Data is arguably the cornerstone of improving the management of nature-related risks and realising investment opportunities in financing NBS. One challenge will be to develop databases and frameworks that will allow finance professionals to manage these risks and capture these opportunities. We have outlined below some of the hurdles to be overcome:

- Modelling and costing of the risks posed to nature and/or economic activities, including:
  - How infrastructure projects may negatively impact local ecosystems and how these risks can be mitigated; and
  - How damage to nature systems may endanger economic activities, people's physical and mental health, cultural significance and future resilience to climate change.
- Modelling and costing the various benefits of NBS projects, including:
  - Specific climate mitigation benefits (e.g. carbon sequestration achievable by different types of soil and vegetation);
  - Health or other social benefits (e.g. any avoided costs of physical and mental healthcare thanks to the air quality benefits of urban green spaces);
  - Economic benefits (e.g. avoided losses due to nature-based flood reduction measures, or improved crop yields as a result of measures to enhance soil health);
  - Infrastructure access (e.g. access maintained for critical infrastructure such as schools and hospitals during extreme weather events); and

- Measuring the benefits of NBS compared to grey infrastructure alternatives (e.g. wider benefits of natural flood defences versus concrete flood barriers).

- More accurate modelling/forecasting of the levelised lifetime cost of NBS projects compared to grey infrastructure alternatives.

Most climate impacts can be encapsulated in a single metric – greenhouse gas emissions, expressed in carbon dioxide equivalent (CO_2e). When it comes to natural ecosystems, no single metric can capture all the impacts or benefits of NBS, including ways to price or measure market values. While nature-related data should be easily accessible and usable by financiers, the complexity of natural systems should not be overly simplified and may therefore entail a wide variety of metrics.

CHALLENGE 3: STANDARDS AND TARGETS

With better data can come target-setting and reporting. The climate finance sector has seen a flurry of climate targets, standards and frameworks emerge in the last few years. These allow the finance sector to understand how they can align their investment activities with the goals of the Paris Agreement and the recommendations of the IPCC, while enabling transparency, accountability and comparability between companies. This includes new processes for the finance sector, such as measuring baseline emissions, aligning emissions pathways with specific climate scenarios, and measuring absolute emissions or the emission intensity of assets.

Overall, the process that financial institutions must follow as they work towards aligning their financed activities with climate targets is four-fold, based on a 'pledge, plan, proceed and publish' framework established by the Race to Zero campaign, supported by the United Nations Framework Convention on Climate Change (UNFCCC).

These types of processes and frameworks could be replicated for aligning financed activities with sustainable nature-related management objectives. The Taskforce on Nature-related Financial Disclosures (TNFD) was set up to mirror the work of the Taskforce for Climate-related Financial Disclosures (TCFD), without creating new disclosure standards, but rather to establish robust risk management and disclosure frameworks.[9] Therefore more detailed standards and frameworks will be needed to build on the TNFD's groundwork.

One reason the market needs standards and frameworks is to build a common understanding of what success looks like. Climate targets use reference years (1850 as the baseline, 2030 and 2050 as targets) as well as carbon emissions and average temperature increases as metrics and key performance indicators (KPIs). Putting timelines and metrics together, the IPCC and others have developed climate scenarios that enable the market to understand how their activities might impact future climate change. However, the market still needs a globally agreed standard for what science-based targets and overall success looks like for nature.

CHALLENGE 4: EFFECTIVE POLICIES

In a similar way to climate investments, the investment required to meet global targets and objectives cannot be met with public finance alone. In the UK, it is estimated that more than 90 per cent of funding will come from the private sector in order to achieve net zero[10] and we can reasonably expect a similar split may be needed for NBS to achieve the scale of funding necessary. Currently around 86 per cent of all NBS finance comes from public sources.[3] Accelerating private investment in NBS requires supportive policy and regulatory environments.

Two important elements required to kick-start the market include:

- **Pipeline:** private investors typically look for single large projects or smaller but highly replicable projects in order to cover the high upfront costs of developing capability, developing new finance models, acquiring new data etc. Aside from large forestry projects with clear carbon-offset benefits, most NBS projects are small and highly bespoke, making them uncommercial. More work is needed to design projects that will meet financiers' standards without compromising on the quality and impacts of the projects.

- **Revenue streams:** as we saw in the section on data, because the benefits of NBS are not straightforward to account for, neither are the revenue streams. Some types of NBS can be financed with traditional finance instruments; and provided the finance sector can access a wide range of reliable data on the benefits of NBS, others may rely on new types of revenue streams and therefore require new financing models.

CHALLENGE 5: EMBRACING THE COMPLEXITY

Currently, the majority of private finance into NBS is driven by carbon offsets, as they constitute the most obvious revenue and risk-management opportunities. However, NBS should not be considered a substitute for the rapid phase-out of fossil fuels and decarbonisation of economic activities. While many studies have shown that NBS have an integral role to play in getting the world on a path to net zero, the mitigation effect of NBS can only happen *because* other mitigation work is also taking place. If other systems are not rapidly decarbonised and average temperatures continue to rise, many ecosystems (such as forests, peatlands and tundras) stop functioning as net carbon sinks.[11]

Much of the focus on NBS, driven by carbon benefits, has been on afforestation. This creates two potential issues: distraction from other much-needed work to preserve other types of ecosystems, and too great a focus on restoring degraded ecosystems though planting programmes, possibly at the cost of protecting the world's remaining intact ecosystems that are also at risk.

Lastly, some benefits of NBS may never be quantifiable in financial terms. While academics and economists are increasingly able to link biodiversity metrics with economic benefits such as productivity and yield, the long-term benefits of ecosystem health have more to do with their overall resilience to shocks such as the effects of climate change, invasive species or new pathogens.[12] This is why designing pathways to success for NBS projects should also include promoting healthy and resilient ecosystems for their own sake. ES

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FEATURE

Harnessing the full benefits of natural climate solutions

Evan Bowen-Jones describes the benefits of encouraging natural mechanisms of carbon capture and biodiversity restoration to flourish in the UK.

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The world is in the midst of an interlinked, anthropogenic climate and nature crisis that threatens to destabilise, within only a couple of generations, the conditions under which humanity has thrived (see **Figure 1**). Recognising that biodiversity loss and climate change are linked, tackling both issues simultaneously is an immediate priority. Natural climate solutions (NCS), defined as the 'conservation, restoration and/or improved land management actions that increase carbon storage and/or avoid greenhouse gas emissions in or from forests, wetlands, grasslands and agricultural lands',[1] provide the mechanism.

BIODIVERSITY LOSS FROM CLIMATE CHANGE

Climate change is one of the biggest threats to nature.[2] The main threat is habitat loss, which exacerbates climate change by putting more carbon dioxide in the air as habitat is lost or degrades. By restoring habitat at scale, the risk to nature and climate can be countered by locking up atmospheric carbon in plants and soils within natural ecosystems – this is carbon sequestration. If this is done with sufficient speed, it may be possible to avoid ecological tipping points and prevent runaway climate breakdown while improving society's resilience and potential to adapt to current climate change.

Some believe that ecosystem collapse is an even greater threat than climate change itself,[3] so we address climate change at the expense of nature at our peril. Yet nature is continually undervalued by the human society it supports,[4] despite reports such as the *Dasgupta Review*,[5] commissioned by the UK Treasury, which confirm the need to accelerate investment in tackling both crises at the same time.

THE POTENTIAL OF NCS

In 2020, a paper in *Nature* estimated that globally, 'restoring 15% of ... priority areas … could avoid 60% of expected extinctions while sequestering 299 billion tonnes of the total CO_2 increase in the atmosphere since the Industrial Revolution'.[6] It also highlighted the importance of considering multiple ecosystems simultaneously (forests, grasslands, shrublands, arid lands and wetlands) to maximise climate and biodiversity benefits.

Given how nature depleted the UK is, ranking 189th in the world,[7] there is a clear need for, and significant carbon opportunity around, ecological restoration. The UK does not have vast tracts of rainforest to protect or restore – the carbon-rich habitats are varied and cover smaller areas. So the UK will need to deliver a cumulative programme of what are, in the global context, small NCS projects to make a real international contribution via NCS.

With the right mechanisms in place, cumulative NCS offer the opportunity to generate climate finance, through mechanisms such as offsetting, to pay for large-scale habitat restoration across the UK for the first time in recent history. This restoration will create climate-resilient, biodiverse landscapes that improve the capacity for people to adapt to changing weather and weather events. However, to date, only limited NCS schemes have been bought to bear in the UK over limited geographies, driven by narrowly focused single-habitat initiatives and policies, including the restoration of peat, and – in particular – the planting of trees.

CARBON STORAGE

Unfortunately, tree planting often equates to a commercial forestry agenda and non-native species. This only provides long-term carbon lock-up (known as 'permanence') if harvested timber is turned into building materials rather than being burnt at the end of short-term use.

By contrast, unharvested native forests provide higher stability of carbon storage,[8] plus old, large trees continue to actively sequester carbon.[9] In addition, the natural regeneration of forests is cheaper and more efficient whenever it is feasible.[10] Plus, restoration of non-treed habitats without afforestation can sequester large amounts of carbon without invoking the risks inherent in planting the wrong tree in the wrong place.[11]

Current efforts to restore or re-wet non-treed habitats are limited to upland peat, leaving out large areas of lowland peat and other habitats with significant potential for carbon lock-up, i.e. moorlands and grasslands, saltmarsh, wetlands, wet grassland and complex scrub habitats, including wood pasture. All of these can actually lock up as much, or more, carbon than forested habitats but they are currently out of investible carbon scope and supportive climate policy.[12]

Taking these significant land areas into account via more comprehensive mechanisms offers substantial additional cumulative national carbon benefits to deliver multiple UK policy ambitions. And, in the current absence of large-scale, affordable and immediate carbon reduction and/or engineered carbon capture technology, we need to start delivering scaled-up NCS right away wherever we can, because it takes time for ecosystems to recover and lock up carbon.[13]

QUANTIFYING THE OPPORTUNITY

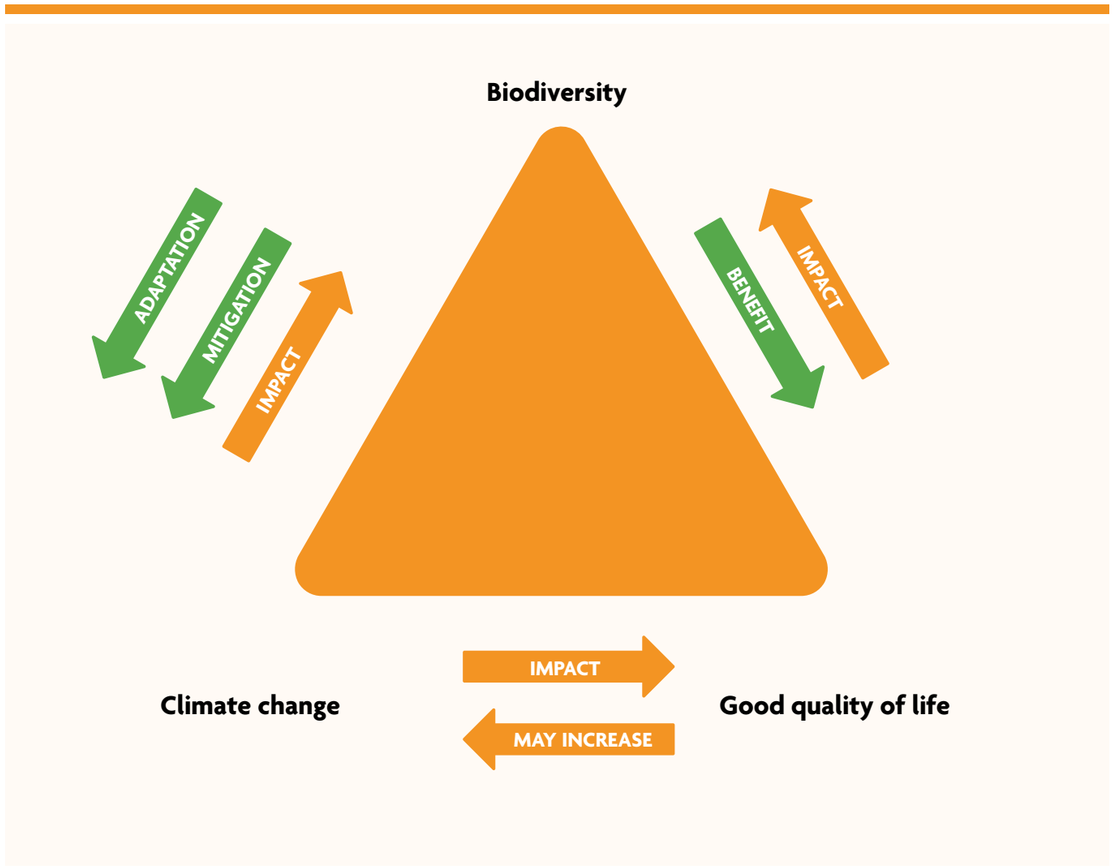
The question is: what scale of carbon sequestration benefit could be achieved by restoring a full range of carbon-rich native habitats across the UK? Wilder Carbon has modelled this while applying the principle of conservativeness to all 'assumptions, values, and procedures when uncertainty is high' to avoid overestimation – as per Greenhouse Gas Protocol good accounting practice. Even adopting this conservative approach, it found that if large-scale native habitat restoration is implemented within the decade and combined with actions already required by the existing national climate mitigation strategy (as set out in the Climate Change Committee's sixth carbon budget[14]), the UK can reach net zero faster, while boosting biodiversity and improving our chances of avoiding ecological tipping points. (The full report is due out within the month and will be available on the Wilder Carbon website).

THE LIMITATIONS OF NCS

Of course, nature restoration does not provide a stand-alone solution to climate change. We need to change the way we travel, how we produce food, and many other aspects of our lives. But, until technologies such as direct air capture become cheaper and more easily scalable, NCS are a major opportunity.

NCS should, however, be delivered in line with best practice, i.e. recognising that they:

- Are 'not a substitute for the rapid phase out of fossil fuels';
- Need 'to involve a wide range of ecosystems on land and in the sea, not just forests';
- Should be implemented with 'full engagement and consent of ... local communities'; and



▲ **Figure 1. Biodiversity dynamically influences quality of life and is influenced by climate change. Increased biodiversity provides positive climate conditions and improved quality of life. Equally, increased climate change negatively impacts both biodiversity and quality of life. (Source: Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services)**

- 'Should be explicitly designed to provide measurable benefits for biodiversity' in order to 'address the urgent challenges of climate change and biodiversity loss, sustaining nature and people together, now and into the future'.[15]

HIGH-INTEGRITY NCS

Many concerned businesses across the UK want to do something about their carbon emissions and to invest in NCS as an offset mechanism. However, NCS are new territory for many companies and there are significant reputational and financial risks in getting it wrong. Developing assurance mechanisms around quality of NCS projects is, therefore, important from a corporate standpoint.

Equally, however, many people regard 'traditional' offsets as having provided businesses with a licence to continue polluting[16] and this concern has now been reflected in government. This year the UK government launched the Voluntary Carbon Markets Integrity (VCMI) initiative, with COP26 president Alok Sharma stating that 'the era of carbon offsetting delaying meaningful climate action' is over.[17] At the same time he re-emphasised that voluntary carbon markets can quickly get 'funds to nature based solutions' providing it is done alongside companies cutting their emissions.

This voluntary market is key because private finance is going to be the way to scale up nature restoration to the point at which it can have a substantial positive climate impact. The level of funding required is not going to come directly from government given post-pandemic austerity and other macro-economic factors. Indeed, the 2021 Autumn Budget sets a target for government to raise £500 million in private finance to 'support

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FEATURE

nature's recovery' every year by 2027 in England, rising to more than £1 billion by 2030.[18] Meanwhile, the Green Finance Institute (GFI) estimates the funding gap for nature restoration in the UK to be £56 billion over the next decade.[13] The only realistic way to close the GFI-identified gap and raise the money in line with the Treasury's ambition is through mechanisms such as carbon offsetting, via NCS, linked to corporate emission-reduction strategies.

High-integrity NCS are, therefore, what ethical investors, the public and politicians all now require to assure one another that real positive climate impact and wider societal benefits can be delivered through nature restoration.

THE NEED FOR STANDARDS

An NCS scheme that only looks at how well a specific project, or a portfolio of projects, is delivered or that focuses purely on measuring carbon (in the way that existing single-habitat-focused carbon codes here in the UK, or many global voluntary standards, do) is missing the bigger picture. We need to match high-quality projects with buyers who are demonstrably reducing their carbon emissions, otherwise we are not properly harnessing the potential for NCS to contribute to keeping 1.5 °C alive. And we are not keeping the door open to even greater ambition that may yet be required since leading scientists now believe that the world needs to reach net-negative emissions to ensure a safe future.[19] These targets will only be achieved by making use of large-scale NCS to remove carbon from the atmosphere now, in addition to deploying emerging carbon capture technologies as they become available. The UK can start to lead the way by implementing national nature recovery in the name of climate while reaping the co-benefits of reversing biodiversity loss by putting the right frameworks in place.

It is in this context that the first version of the Wilder Carbon standards have been signed off by a panel of independent experts – who will now act as their guardians.[20] These standards are designed to facilitate the restoration of all carbon-rich terrestrial habitats in the UK in the best, most climate-resilient way possible (i.e. by maximising ecological complexity). Sales of Wilder Carbon credits will only be made to approved buyers who are demonstrably reducing their emissions in line with the science-based targets.[21]

This positions the Wilder Carbon initiative to act as the first functional high-integrity carbon finance scheme in the UK, establishing a benchmark for NCS projects that:

- Addresses the nature and climate crises at the same time;
- Provides a mechanism for restoring multiple native habitats using one assurance mechanism;
- Is applicable at multiple scales: from local authority landholdings to farms, rewilding projects and protected areas; and
- Leverages green finance in a truly defensible not-for-profit manner that results in real carbon reductions and removals.

We still have a lot of work to do, but high-integrity solutions like Wilder Carbon have to be the way forward if we are to capitalise on the massive opportunity that voluntary carbon financing of NCS offers here in the UK. ES

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Local authorities and climate action

Adam Williams examines the powers and influence of local government.

FEATURE

The Climate Change Act 2008 established a system of legally binding carbon budgets that limit the country's net greenhouse gas emissions in successive five-year periods. In April 2021, the government adopted the recommendation of the Climate Change Committee (CCC) and committed to set a statutory target for the sixth carbon budget to reduce the UK's emissions by 78 per cent from 1990 levels by 2035.[1] While UK emissions are, or are expected to be, below the caps set by the first three carbon budgets up to 2022, CCC analysis suggests that without further action, the UK will exceed its carbon budgets for 2023–27 and 2028–32.[2] The CCC has stated that the sixth carbon budget can only be achieved if government, regional agencies and local authorities work seamlessly together.

▲ **Figure 1. How local authorities control and influence emissions.[6]**

The National Audit Office, in its July 2021 report on local government and net zero,[3] found a wide range of actions to reduce emissions put forward by all tiers of local government. Examples include taking practical steps to decarbonise what is in an authority's direct control, embedding decarbonisation into the organisation from decision making to purchasing, and increasing partnership working between authorities, as the Devon Climate Emergency Partnership has done.[4]

THE ROLE OF LOCAL AUTHORITIES

The CCC has reported that around one-third of the UK's emissions are dependent on sectors that are directly shaped or influenced by local authority practice, policy or partnerships.[5] It has identified areas where it expects local authorities to have a key role in reducing greenhouse gas emissions and highlighted spheres of influence (see **Figure 1**); it has also suggested policy or actions for local authorities. So councils really do have a pivotal role in addressing the UK's net-zero targets.

Local authorities are only directly responsible for a very small portion of area emissions (1.4 per cent in South Hams, for example). However, the CCC estimates that local authorities have powers or influence over roughly a third of emissions in their local areas, and most authorities are aware of this. These powers and influence can cover areas such as planning, which will influence the energy efficiency and location of new development. New developments are considered anchor intuitions, so their buying power can have huge ramifications for social value in terms of supporting local economic, health and social wellbeing.

There is no one-size-fits-all approach for local authorities and achieving net zero. Depending on the type of authority, whether it is a unitary, district or county authority, the areas of control differ; district councils, for instance, do not have local highway responsibility, whereas county authorities do. The CCC produced some suggested actions that most local authorities should consider, covering surface transport, buildings, waste, land use, energy and industry. Some examples include:

- Communications and conversations with residents and businesses on their travel and transport needs to prepare the way for changes;
- Raise awareness and engage key staff across the whole council;
- Repurpose parking spaces for car clubs, cycle parking and electric vehicle charging;
- Promote electric vehicle uptake by installing electric vehicle charging points;
- Switching fleets to electric vehicles;
- Scale parking charges to promote the use of public transport;
- Make biodiversity net gain a priority alongside emission reduction in planning policy;
- Support farm building, infrastructure modernisation and low-carbon refurbishment through planning policy;
- Provide advice and information for residents and businesses on energy efficiency and low-carbon heating options;
- Identify areas suitable for heat networks, which are effective in providing low-carbon heat to dense areas; and
- Support local people and community energy organisations to install renewable generation for on-site local use, and link this to energy-efficiency behaviours.

Many of the actions relate to effective and targeted communication, as the CCC see a role for local authorities in influencing public behaviour to reduce emissions. The CCC has reported that nearly 60 per cent of the changes in its pathway to the sixth carbon budget rely on societal or behavioural changes,[3] and notes that local authorities' leadership role with the public puts them at the heart of developing and replicating local solutions. Local authorities have the means to do this, but resourcing continues to be a problem: promoting existing messages is simple enough, but more bespoke local materials and campaigns (such as running more engagement weeks and face-to-face events) could be created to help with messaging. Ashdens has produced a very similar toolkit[7] for local authorities to assist with the creation of action plans.

In terms of creating a decarbonisation pathway, information is available from the Tyndall Centre for Climate Change Research for instance.[8] However, with current local authority resources, it is not always possible to calculate the effects of each action's greenhouse gas emissions reduction to produce an emissions trajectory. To do this would require a full bottom-up calculation of the impact of individual policies, which would require in-depth detail and assumptions to be made about the uptake, impact and costs of each policy and action, which are often not readily available. Furthermore, many actions are enabling actions, rather than those that directly reduce emissions. For example, installing electric vehicle charging points does not reduce greenhouse gas emissions. Reductions start when people feel confident enough to make the switch to an electric vehicle.

FUNDING CHALLENGES

Currently, tackling the climate emergency is not a statutory function of local authority and most are carving out small amounts of budget to do this voluntarily alongside bidding for competitive government grants. Without sustained and reliable government support, councils could look to raise funds by other means in the interim. As it is now two years since climate emergency declarations began to be made by local authorities, some notable practice has started to emerge as authorities grapple with financing implications. Examples of fundraising highlighted by the CCC include:

- Nottingham City Council has a workplace parking levy, which is a charge on employers that provide more than 11 spaces of workplace parking. The money raised has helped to fund the extension to their tram system and a redevelopment of their train station; and

- Emissions-based parking charges can raise funds in similar manner, to be earmarked for sustainable transport funds.

WHAT'S NEXT?

In October 2021, the government published its Net Zero Strategy,[9] which contained some key highlights for local authorities. The Net Zero Strategy has its own local climate action section, which attempts to address some of the calls from the CCC and National Audit Office around the role of local authorities in achieving net zero. The government look to set clearer expectations of how central and local government interact in the delivery of net zero, but it has ruled out local statutory net-zero targets despite recognising that delivery on the sixth carbon budget relies on local authorities to some degree. The strategy rightly recognises that local government drives action directly, even referencing that 82 per cent of emissions are in their scope of influence. There is a lack of clarity around what this clearer expectation looks like in practice, but the recognition of the role of councils is a good first step.

The Net Zero Strategy also places increasing importance on emissions reporting, stating that public-sector organisations should be taking steps to achieve net zero now and should report their progress. Many authorities are already doing this, following the environmental reporting guidelines.[10] In spite of the government having not been clear on which Scopes are mandatory, some authorities choose to report on Scopes 1 and 2 only (Scope 1 refers to direct emissions and Scope 2 refers to indirect emissions, not including indirect emissions that occur in a value chain), while others report on Scopes 1, 2 and 3 (Scope 3 refers to all indirect emissions, including those that occur in the value chain, such as procurement, business travel and waste and water). However, the government has mentioned legislation to require the reporting of emissions for the public sector. This type of work will require specialist skills and the Net Zero Strategy acknowledges this in that they will require relevant skills and expertise, as well as funding, to act at an unprecedented scale.

WORKING IN PARTNERSHIP

Market-led solutions is a common theme throughout. The government seems keen to support local authorities to develop net-zero projects that can attract commercial investment, and it is likely that this will form part of future funding offers. One recent example of this was the Natural Environment Investment Readiness Fund, which sought projects with the ability to produce revenue from ecosystem services to attract and repay investment, as well as producing an investment model that could be scaled up and reproduced.

The Net Zero Strategy also encourages local authority and local community partnerships and relationships. The local authorities with good community energy groups in their areas were mentioned but nothing new was announced. Instead, existing support mechanisms were reiterated, which was disappointing, considering the challenges the energy system faces along with the knock-on effects on community resilience, something community energy can tackle directly.

Overall, the Net Zero Strategy is lacking the detail we were expecting for local authorities following the earlier reports from the National Audit Office and the CCC, but there are the bones of some level of direction and a clear recognition of the role of local climate action. It is an exciting time to be involved in helping to achieve net zero at a local level, with some really innovative actions being developed and delivered by many local authorities. ES

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OPINION

From pledges to plans: has COP26 delivered?

Ethny Childs and **Joseph Lewis** review some of the major themes of the conference and how likely it is that they will be actioned.

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Looking back on COP26, the complex and multi-faceted discussions distil down to simple truths: rising ambition is welcome but must accelerate until it amounts to transformative change, and commitments mean nothing until they are delivered on. As simple as those truths may be, they paint a path ahead that demands careful scrutiny, continuous attention to detail, and rigorous scientific insights.

Big UN summits are staging grounds for action, with the burden of delivery in the days between them. By reflecting on some of the biggest developments from COP26, it is possible to see the opportunity for meaningful gains to be made from these international commitments, as well as how they fit into the bigger picture of keeping global warming to 1.5 °C and what we still need in order to achieve that goal. Glasgow yielded developments in a number of key areas. This article focuses on three of these: deforestation, methane and Nationally Determined Contributions (NDCs).

OPINION

DEFORESTATION

Deforestation poses a severe risk to climate change, biodiversity and the wellbeing of Indigenous and local communities. The World Resources Institute estimates that, if it were a nation, tropical deforestation would rank as the third-largest emitter of CO_2 (after China and the USA). Eighty per cent of the world's land animals and plants live in forests and an estimated 250 million people globally depend on forests for their livelihoods. Halting the loss and degradation of forests and promoting their restoration have the potential to contribute more than one-third of the mitigation needed by 2030 to keep the goal of 1.5 °C alive.

This highlights the importance of tackling deforestation to address both the climate and biodiversity crises. For this to be done successfully it is essential that the United Nations Framework Convention on Climate Change (UNFCCC) and the Convention on Biological Diversity (CBD) work together to produce a credible plan for how this can be done, with a focus on multifunctional solutions that achieve co-benefits for planet, people and nature. A reduction in siloed working by scientists, government departments and international bodies is vital for this.

COP26 had an early win in the form of a landmark pledge to end and reverse deforestation by 2030, signed by more than 110 countries. This pledge signifies a considerable step forward as the signatory countries represent more than 85 per cent of the world's forests. Brazil, which has seen deforestation rates rise under Bolsonaro's presidency, was among the signatories along with Canada, China and Russia. The pledge is backed by the Global Forest Finance Pledge, with US$12 billion currently committed, along with US$7 billion of private investment, which will support partnerships in developing countries to tackle the root causes of deforestation.

A key component of achieving this pledge will be to tackle unsustainable food systems and land use. The production of beef, soya, palm oil, cocoa and wood products are the top five largest drivers of tropical deforestation, so it is essential that suppliers of these commodities work with consumer countries to transform the supply chain to support sustainable methods of production and afforestation. The Forests, Agriculture and Commodity Trade (FACT) Dialogue, hosted by the COP26 presidency, aims to support this transition by agreeing on principles for collaborative action – a shared roadmap on sustainable land use and international trade. Transformation of the global food system will also be dependent upon behaviour change and increased transparency to consumers so that they can make informed decisions.

Key to the success of the Deforestation Pledge is to champion Indigenous communities' voices and protect their rights through robust policies. This will help to maintain intact forests and recognise Indigenous communities' role as custodians of these environments. It will not be enough to maintain intact forests, however – we must also work to restore degraded forest habitats and support healthy forest ecosystems that can truly act as the 'lungs of the planet'.

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Although promising, whether this pledge delivers will be contingent upon substantive actions on the ground as well as supply-chain optimisation and supporting behaviour change. The pledge should be met with a healthy amount of scepticism: the signing of the previous New York Declaration on Forests, which aimed to halve deforestation by 2020, was in fact followed by an increase in deforestation rates. One caveat to this was that Brazil and Russia were not signatories to this declaration and represent a significant proportion of the world's forests.

Indonesia also appeared to pull out of the Glasgow Deforestation Pledge, just days after signing it, highlighting issues related to the interpretation of the declaration. To instil faith in the declaration it is imperative that signatories provide credible plans to support the pledge within their NDCs that are measurable and enforceable.

METHANE

Methane, a short-lived greenhouse gas that is significantly more potent than CO_2 in terms of warming effect, has long been neglected in previous climate plans. As 2030 races towards us, by which the Intergovernmental Panel on Climate Change (IPCC) states we need to have cut global emissions by about 45 per cent to stay within the Paris Agreement, methane has shot to centre stage as a way of buying more time in the race to zero. The Global Methane Pledge, led by the USA and the European Union (EU), saw more than 100 countries committing to cutting methane emissions by 30 per cent by 2030. This pledge represents an opportunity for a quick win in terms of slowing warming, while we work towards cutting carbon emissions. According to EU estimates, cutting methane emissions by 30 per cent could lead to a reduction of 0.2 °C of projected warming, and these effects would be felt quickly due to the short-lived nature of methane in the atmosphere.

One caveat to the Methane Pledge is that some of the world's largest emitters, including China, India and Russia, have not yet signed up. Moreover, alignment with the IPCC's emissions reduction pathways to keep to 1.5 °C actually requires a 34 per cent global cut in methane emissions, so the pledge is not yet consistent with the Paris Agreement. Nevertheless, if all countries signed up and delivered on the pledge, it would significantly contribute to mitigation efforts, reducing the emissions gap by 14 per cent. However, it is essential that decreases in methane emissions are met with even more ambition in terms of reduced CO_2 emissions and the Methane Pledge cannot be seen as an excuse to take the foot off the (electric) pedal in terms of cutting carbon emissions; we must accelerate decarbonisation across all sectors.

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The good news is that reducing methane emissions is linked to CO_2 reductions, with 60 per cent of methane emissions cuts coming from a reduction on fossil fuel use in emissions reduction pathways aligned with the Global Methane Pledge. This would result in a significant dent in CO_2 emissions, helping to close that emissions gap and bring us closer to achieving a world limited to 1.5 °C of warming. Moreover, there is cautious optimism that the pledge could be met, since reducing human-related methane emissions can be done using existing technology at low cost. By contrast, technology such as carbon, capture, usage and storage (CCUS), which is currently included in the sixth carbon budget to reduce CO_2 emissions, is still not at the level needed in terms of development and deployment.

The pledge does currently lack enforcement mechanisms, so it is essential that nations hold themselves, and others, to account and that industrialised nations lead the way and share best practice. Overall, the Global Methane Pledge is an important step in the right direction but must be done in tandem with wider emissions cuts; reducing methane must not detract finance or focus from cutting CO_2 emissions. Otherwise, we may end up reducing temperatures in the short term, only to commit ourselves to higher rises in the future due to the cumulative warming effect of CO_2 in the atmosphere.

NATIONALLY DETERMINED CONTRIBUTIONS

Although COP26 was a global event, intensely focused on multilateral agreements and international cooperation, at the heart of the UNFCCC are the NDCs: how much each country is willing to do and how quickly they will do it. Global cooperation is essential in the fight against climate change, but is meaningless unless countries are willing to take their own responsibilities seriously.

Despite a major drive to ratchet up the NDCs in the advent of the conference, they do not yet set us on track to limit global warming to 1.5 °C. On the question of how close they come, there is an element of complexity. Initial projections by the International Energy Agency suggested they may limit the rise in temperature to 1.8 °C, whereas a second projection released later in the conference by Climate Action Tracker produced the less positive prediction of 2.4 °C. The substantial difference between the projections come down to what the numbers really represent.

The 1.8 °C projection includes all the targets to reach net zero, including those for 2050 or later, and those without clear policies or plans to achieve the ambitions, or where targets have been inadequately designed to produce results. The 2.4 °C projection does not include those promises, and is based instead on implementation of the 2030 NDC targets alone. While neither number is a sufficient end point for our aspirations, the message from the projections is simple: if ambition becomes action, we can create change, but that relies on implementation, monitoring and action, which has been hitherto unseen. If we want to achieve a peak 1.5 °C rise, global leaders must follow through, even when things do not go according to plan.

With those caveats, there may still be reason for optimism. In a world of uncertainty, where delivery is pivotal, the way people with power think about the issues is paramount. The NDCs did not universally deliver clear, detailed plans for reaching net zero. They did deliver on ambition, and there has been a decisive change in the narrative around COP26 that may make that roadmap to action much more realistic than it would have been in the past. Crucially, the commitment to revisit the NDCs in a year's time at COP27, as opposed to allowing the usual five-year gap, presents a key opportunity to build ambition further.

The secret to success will be serious scientific reflection at the heart of implementation plans and firm scrutiny against delivery, particularly when things go wrong. If something unexpected happens and a country no longer feels that its plans will allow it to reach its targets, the temptation will be to keep the plan and discard the target. If we are going to succeed, we need to keep the target and discard the plans.

The next 12 months will require agility, global cooperation, and embedded science with a view to systemic risks, but the potential to achieve global ambitions is not yet outside our reach.

HONOURABLE MENTIONS

Adaptation: in the wake of numerous extreme weather events over the last few years, this COP saw a greater focus on adaptation and resilience, which has long been neglected in climate conversations. The UN Adaptation Fund, which finances adaptation projects that help vulnerable communities in developing countries, saw significant boosts, including €100 million from the EU and £15 million from the UK government. More is still needed in this area to support nations and communities bearing the brunt of current climate impacts.

Climate finance: the Glasgow Financial Alliance for Net Zero (GFANZ) used finance day to highlight the promise of US$130 trillion of finance towards addressing climate change, particularly in emerging and developing countries. At this stage, that money has not yet flowed into mitigation and adaptation projects but GFANZ represents a commitment to deploy asset funds with that total value in the days to come.

▲ **The authors (left: Ethny Childs; right: Joseph Lewis) and IES CEO Adam Donnan (centre) at COP26. (© Adam Donnan)**

Coal: fossil fuels are driving climate change, and there was early hope that coal could be phased out at COP26, which some countries increasing their commitments. Although fossil fuels were directly named in the text of the agreement, the commitments on coal were significantly weakened in the final days of COP26, undermining the push to put an end to coal power.

China–USA cooperation: two of the world's biggest polluters announced a joint declaration to work together on climate change. At the end of COP26, where both countries were criticised for not being ambitious enough, it may give some hope of more work to come, but credible action to accelerate the pace of climate action by both states, jointly and independently, will be essential for reaching net zero.

ACTING ON AMBITION

A consistent thread running through all climate discussions and negotiations has been the need to move beyond rhetoric to action. Renewed NDCs and the new pledges made in Glasgow are heartening, but must be underpinned with short-term, science-based, measurable targets that can be used to track progress and facilitate accountability. This is absolutely crucial if we are to have any hope of keeping warming to 1.5 °C (or even to less than 2 °C).

The transition must also be a just one, addressing climate change in a way that works for people, planet and nature. A key aspect of this will be to deliver on climate finance promises to support developing countries in both mitigation and adaptation. Finally, language and negotiations can no longer be soft on fossil fuels. Market forces are not enough to facilitate a green transition and must be supported by international cooperation and policy levers such as a carbon tax and the removal of all subsidies.

What has become clear is the need for multifunctional solutions that address the Rio Conventions simultaneously, while ensuring that solutions are delivered according to local needs and contexts. There is no panacea for addressing climate change, but through systems thinking and co-production, we can develop and deploy tailored, localised solutions with global impacts.

The IES's *Manifesto for Transformative Change*[1] outlines what we believe are the key recommendations needed to achieve climate ambitions and reap co-benefits for people and nature. Now is the time to take these recommendations from paper to planet, and act on our ambition for a transformed society that works for all life on Earth. ES

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Printer Lavenham Press Ltd

Published by Institution of Environmental Sciences
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