THE UNIVERSITY *of* EDINBURGH

Advancing **action**

The University of Edinburgh's research and reflections for **COP 30** and the future

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Foreword

Professor Sir Peter Mathieson

Principal and Vice-Chancellor of the University of Edinburgh

In 2021, thought-leaders from around the world gathered in Scotland for COP 26. Some of the conversations were hosted at the University of Edinburgh. It was a privilege to witness world leaders, climate scientists and activists as they sought to find agreement on how we collectively tackle climate change, one of the most pressing and existential challenges of our time.

The field has progressed further in many ways in the four years since then. Powerful technologies have emerged, such as artificial intelligence (AI), which could be either a friend or foe in the battle. Fresh political headwinds have sprung up, potentially dampening the world's appetite to act as one. With so many countries in debt and battered by inflation, how do we pay for it all?

All the while, unmoved by our deliberations, the climate has continued to change – with disastrous results for ecosystems, economies and humanity.

At Edinburgh we haven't been idle in this time. As this collection of opinion pieces shows, our experts are facing up to the climate crisis in all of its forms.

Read on to find out how we are decarbonising fossil fuel-guzzling industrial processes by harnessing the power of microbes and how messy patches of weeds in neatly planted fields of crops can help eliminate livelihood-destroying pests.

You will also hear about projects using AI to track how the climate emergency is affecting health care systems, how partnerships with indigenous communities are deepening understanding of the polar oceans, and how a collaboration in the Horn of Africa is protecting vulnerable livestock farmers from the worst extremes of drought.

There is a thread that runs through all of these pieces. Tackling climate change and mitigating its effects cannot be done alone. Forging a path through the uncertainty of climate change needs global cooperation. That is the promise, the potential of COP.

That is what we are already living out at the University of Edinburgh, through world-class and globally connected research groupings, which you can find out more about on page 44.

Our experts are often called upon by intergovernmental bodies such as the United Nations to offer advice or co-author reports. We are proud of our contributions, but we can – and want to – do more.

We are committed to devoting ever more effort to pushing back against the pernicious effects of climate change. In this fight we all have much to gain. Let's do it together.

Introduction

Professor Margaret Graham

Personal Chair in Environmental Geochemistry, Director of the Edinburgh Earth Initiative

We face a plethora of uncomfortable realities: transdisciplinary action offers us a path to a more positive future.

Concentrations of carbon dioxide are almost certainly higher than they have been in the last two million years; glacial retreat is unmatched for more than 2,000 years; sea level rise is faster than in any century in the past 3,000 years; the past decade has been warmer than any other in the past 125,000 years; oceans are warming at a greater rate than any time in at least the last 1,000 years and ocean acidification is occurring at a greater rate than it has done at any time in at least the past 26,000 years. There is strong evidence of local species losses, and links in this publication will take you to recent reports that reveal how parts of our global forests have already switched from carbon sinks to sources, directly as a consequence of weather extremes.

At the same time, extreme weather conditions increase energy expenditure on heating and cooling, which exacerbates CO_2 emissions where fossil fuels are used to meet this demand. In both 2023 and 2024, record temperatures were set then broken and total energy-related CO_2 emissions reached record high levels of 37.8 gigatonnes CO_2 in 2024. Indeed, with the exception of Australia and Antarctica, 2024 remains the warmest on record across all continents and was the first calendar year when mean temperatures exceeded pre-industrial levels by 1.5 degrees Celcius. While a single year above this threshold does not break the long-term goals set by the United Nations' Framework Convention on Climate Change (UNFCCC) Paris Agreement, we may be teetering on the edge of climate 'tipping points' and the severity of our predicament should not be understated. Confronting the current climate and environment crisis is a daunting task but one that requires urgent and co-ordinated action across all sectors of society.

The UNFCCC Action Agenda, which has six thematic pillars (Transitioning Energy, Industry and Transport; Stewarding Forests, Oceans, and Biodiversity; Transforming Agriculture and Food Systems; Building Resilience for Cities, Infrastructure, and Water; Fostering Human and Social Development; and Unleashing Enablers and Accelerators), was established as a framework for mobilising voluntary climate action from civil society, the private sector, investors, cities, regions, and national governments. Its continued purpose is accelerated action to meet the core aim of the Paris Agreement: limiting global warming to 1.5 degrees Celcius above pre-industrial levels by combating carbon emissions, strengthening climate adaptation,

and supporting the transition to sustainable and resilient economies. Crucially, by engaging actors who do not participate directly in negotiations, the Action Agenda focuses on how commitments made at the international level can be realised 'on the ground'.

The President-Designate, Ambassador André Aranha Corrêa do Lago, has emphasised the centrality of the Action Agenda for COP 30, drawing on the Synthesis Report of the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) and the findings of the most recent Global Stocktake. The COP Presidency has highlighted the need for 'cross-cutting climate action that generates cascading co-benefits across sectors while avoiding isolated or fragmented approaches that limit systemic impact'.

This publication uses the lens of the six thematic pillars of the Action Agenda to highlight the range of actors and policy considerations involved in achieving a truly systemic and coordinated response. It explores the scientific, economic, social, and political factors behind the *uncomfortable realities* of the climate and environment crisis. Critically, however, it also presents a cross-sectoral set of actions that offer a path towards a more positive and sustainable future.

- It demonstrates how engineering biology and circular carbon approaches can drive a more sustainable industrial economy, and outlines how effective CO_2 storage can help limit global warming.
- It underscores the importance of international collaboration and coherent cross-sectoral policy at local and regional levels to ensure efficient energy use and production.
- It highlights the role of 'wise regulation', while challenging the narrative that economic growth is the solution to environmental destruction.

This publication emphasises the ocean's critical role in mitigation and adaptation, the need to protect and invest in rainforests, and the imperative to develop equitable and sustainable future food systems. It showcases how our work supports climate-ready, resilient infrastructure in cities, alongside ensuring water security — both essential to safeguarding the wellbeing of the planet's human population. It reminds us that a just transition, grounded in equality and human development, is essential for systemic change. It calls for a reimagining of what development means as we move toward a post-fossil fuel world, and highlights the importance of transforming healthcare systems to address current realities, mitigate further environmental damage, and secure future wellbeing. It suggests how climate and sustainable finance can be mobilised at the scale required, and illustrates how education and lifelong learning are central to building a regenerative, long-term future. Finally, it demonstrates how effective collaboration between universities and industry can drive action at the scale needed.

The contributions herein reflect the depth and breadth of our transdisciplinary research and innovation expertise across the University of Edinburgh. Through this publication, the University aims to inform the ambitions of COP 30 to advance meaningful global action. We invite collaboration; find out more about these and other projects by contacting us. See page 44 for contact details.

Beyond clean electrons to clean molecules: Pillar 1 transitioning energy, industry, and transport

Stephen Wallace
Professor of Chemical Biotechnology

The true test of COP 30 will be whether we can move beyond clean electrons to use engineering biology and circular carbon to build a fossil-free industrial economy.

As the world approaches COP 30 in Belém, the conversation on the energy transition remains dominated by electrons: tripling renewables, doubling energy efficiency, and ensuring universal energy access. These are vital targets, but energy is only one leg of the transition. Industry and transport – the sectors that transform energy into materials, medicines, fuels, and mobility – must also change fundamentally. If we succeed in decarbonising power but continue to manufacture the building blocks of modern life from fossil carbon, we will have shifted emissions rather than eliminated them.

The COP 30 Action Agenda rightly includes industry and transport alongside energy in its first pillar. The challenge is not only how we power factories and vehicles, but what we make within them, and the origins of the carbon we use. Here lies both risk and opportunity: the risk of locking in fossil-derived materials for another generation, and the opportunity to reimagine supply chains around renewable, circular, and waste-based carbon.

From 'less bad' chemistry to fossil-free synthesis

For years, green chemistry has worked to make petrochemical processes less harmful: fewer solvents, lower energy, less waste. That progress is important, but it doesn't solve the root problem – the carbon itself. To deliver a just and lasting transition, we must redesign synthesis around carbon sources that are renewable, circular, and waste derived.

This is not theoretical. My team and others are already showing what's possible. Using engineered microbes programmed with the tools of engineering biology, we have synthesised paracetamol, a globally essential medicine, directly from plastic waste. With similar approaches, we have converted plastic waste into vanillin, the world's most widely used flavour molecule. We can make adipic acid, a key precursor for nylon and performance polymers, from both plastic and lignin waste. We have even produced sustainable fragrance molecules – the kind used in perfumes – from the fatberg sewer waste clogging our cities, offering a striking demonstration of waste-to-value innovation.

These examples show that we can convert some of society's most intractable waste problems into valuable molecules, using biology, chemistry, or bio-hybrid routes. The possibilities are vast – and with the right design, these processes can even be carbon-negative, pulling more carbon out of waste than they emit.

Waste as feedstock, not liability

Plastic waste is emblematic. Mechanical recycling cannot keep pace with today's contaminated, heterogeneous plastic streams. Engineering biology and bio-upcycling offer another path. By programming microbes and enzymes to selectively break down polymers, we can recover high-value monomers or functional fragments and reroute them into medicines, flavour and fragrance molecules, performance chemicals, and materials. The same principle applies to lignin, a complex residue from forestry and paper production – widely regarded as one of the most untapped sources of carbon on Earth – which can be upgraded into platform chemicals like adipic acid.

Rather than treating waste as an externality to be buried or burned, we should treat it as a carbon reservoir, ripe for reinvention.

C-Loop Manufacturing: a circular carbon model

Realising this vision requires infrastructure that matches the scale of the challenge. One concept we are advancing is the Carbon Loop Sustainable Manufacturing Hub (C-Loop): a modular UK-wide facility where waste carbon streams – plastics, lignin, CO_2, organic residues – are processed into valuable products. In collaboration with six UK universities and more than 40 industrial partners, C-Loop brings together engineered microbes, advanced chemocatalysis, and hybrid processes in plug-and-play units, supported by waste analysis, sustainability assessments, strain engineering, and bioprocess scale-up. The Hub can flex to different feedstocks and integrate with renewable electricity.

By co-locating hubs at ports, industrial parks, or logistics centres – where waste, energy, and demand converge – we can shorten supply chains, reduce costs, and ensure waste carbon becomes a reliable feedstock for essential molecules.

Industry and transport: active partners in the transition

Industry and transport are often cast as 'hard-to-abate' sectors. With circular carbon manufacturing powered by engineered biology, they can become enablers of the wider transition. Drop-in fuels derived from waste will remain essential for aviation, shipping, and heavy-duty transport, complementing electrification. Flexible industrial plants can act as anchor loads for renewable grids, adjusting operations to stabilise supply and demand.

When designed around carbon circularity, these sectors no longer lag – they help drive transition forward.

What we must do now

To unlock this potential, at pace, we must act this decade:

- Procurement for provenance. Public and private buyers should specify circular or biogenic carbon content in chemicals and materials, creating the demand signals that de-risk first-of-a-kind plants.
- Route-agnostic regulation. Approval should focus on product quality and safety, not the production route – whether petrochemical, microbial, or hybrid.
- Geographic co-location. Place facilities where waste streams and renewable energy converge, compressing costs and logistics.
- Funding the 'boring' bits. Investment must extend beyond discovery into scale-up infrastructure, fermenters, separation units, and quality systems.
- Training a cross-skilled workforce. Operators must be comfortable running both bioreactors and chemical reactors, interpreting process analytics, and managing hybrid systems.

Conclusion

COP 30's Action Agenda asks whether we can transition energy, industry, and transport in a way that is just, equitable, and rapid enough to meet the Paris Agreement's goals. Yes – but only if we expand our focus from clean electrons to clean molecules. The pharmaceuticals we take, the plastics we use, the fuels that still move goods and people, can all be made from waste carbon and renewable inputs, rather than fossil feedstocks.

This is not speculative. The science is proven, the technologies are emerging, and the infrastructure is within reach. What is needed now is systemic support – policy, procurement, and investment – that treats sustainable industrial synthesis not as a niche, but as a central pillar of transition.

The real measure of success at COP 30 will not be whether we can generate enough renewable power. It will be whether we can build a fossil-free industrial economy – one that makes the molecules of modern life from the carbon we already have.

Collaboration across government, business and civil society: clean energy and energy productivity

Janette Webb

Professor of Sociology of Organisations at the School of Social and Political Science

COP 30 essential action on clean energy, energy saving and ending fossil fuel exploitation

The C0P 30 Action Agenda aims to mobilise businesses, civil society and local and regional governments. Our social science research on energy and climate change shows the imperatives of such cross-sector collaboration and coordination for clean energy development and use. In the context of global conflicts and weak or intermittent collaboration at previous COPs, local and regional government capacities for collaboration are particularly important.

Limited international collaboration thus far, and climate change denial, leaves us facing up to 3.1 degrees Celsius global heating by 2100. Biodiversity loss is accelerating, with extinction rates between 100 and 1,000 times higher than background rates over the past tens of millions of years. Fossil fuel exploitation is a major contributor. In 2024, energy-related CO_2 emissions continued to increase, contributing to record atmospheric concentrations 50 per cent above pre-industrial levels.

Renewables

To avert climate disaster, we need to replace fossil fuels with energy from renewable sources, rather than, as at present, adding renewable energy to the mix. Despite significant fossil fuel subsidies, renewables are now the most economic and affordable route to provision, with co-benefits for health, welfare and jobs, as well as reducing dependence on fossil fuel imports. We also need to avoid the wicked problems of earlier industrialisation by ameliorating social and environmental impacts of new resource exploitation, such as mining for lithium and critical minerals. Renewable technologies themselves produce greenhouse gas (GHG) emissions, and failure to plan for, and mitigate, whole life cycle emissions results in further environmental destruction. We need instead to prioritise circular economy principles of reuse, repurposing and recycling.

Action by local and regional government with civil society

In more affluent, high-energy consuming economies, clean energy policy typically focuses on technology, but meeting net-zero targets will also depend on changing energy use and increasing energy productivity. The UK's Clean Power 2030 plan exemplifies the common emphasis on large scale supply-side technologies; energy efficiency and user flexibility are referenced but not given equal weight. Our research shows, however, that 'reshaping demand' – using less and wasting nothing – is an extremely valuable and effective route to reducing GHG emissions, with socioeconomic, health and security benefits. Related research shows that, as part of a comprehensive climate plan, the UK can reduce energy use by around 50 per cent while improving quality of life, health and energy affordability.

Local and regional governments are critical intermediaries, working with central governments and international networks to engage the public and businesses in such changes. They are one of the few organisations with unavoidably long-term commitments to a locality and have unique local knowledge. They are critical to climate protection, given their planning, public procurement and economic development responsibilities. However, they need resources to act. Our research showed, for example, that every one million euros in EU local energy assistance funding to British local authorities, invested in people, skills and expertise, resulted in 37 million euros investment in local low carbon energy and energy productivity. Modest public investment had major benefits, offering a highly effective route to material progress for clean energy and sustainable prosperity.

Heating homes

A critical sphere of local and regional coordinated action is retrofit of building stock to support high energy performance, clean energy for heating and better places to live and work. Heat in buildings is a challenging policy area; it involves every member of society as owners, occupants and users of domestic, commercial and public buildings. It is therefore consequential for how we live and work, and what we consume, simultaneously providing a critical route to public engagement. Effective policies need to encompass incentives; supply of skilled labour and materials; consumer protections; future regulation on property owners and performance review to ensure high standards. Such programmes can be organised effectively at locality scale, by empowering municipal government and civil society organisations to work with business and central governments.

In addition, our UK Energy Research Centre (UKERC) work shows that locally integrated systems, comprising decentralised renewables, storage and district heating networks using waste or residual heat, can reduce costs of whole system transformation. Energy-intensive data centre businesses can, for example, help optimise use of decentralised energy and storage systems and provide waste heat as a resource for district heating to decarbonise nearby buildings. Making best use of decentralised assets to balance supply and demand regionally reduces the need for costly investment in large scale stand-by fossil fuel power generation and long-distance transmission infrastructure. Local and regional governments are again critical convenors of necessary cross sector collaboration. Integrated local and regional systems can also enable more local engagement in energy provisions, reflected in some countries in municipal buy-back of energy infrastructure and services, reclaiming responsibility for energy as public good and accelerating clean energy development.

In conclusion

Despite the poor state of international collaboration, parties to COP 30 can improve resources for collaboration at critical regional and local scales, where cost effective and socially responsible progress on energy productivity and zero waste is happening. To accelerate such progress means:

- Ensuring a local and regional policy mandate for net zero localities;
- Institutionalising local and regional net zero planning and action through devolved powers and resources;
- Investing in local and regional authority energy and carbon management expertise;
- Ensuring that all public expenditure is evaluated against net zero principles, so that local and regional procurement can be directly aligned;
- Using regeneration funding to drive investment in net zero localities, including decent jobs, supply chain innovations, sustainable housing and social justice.

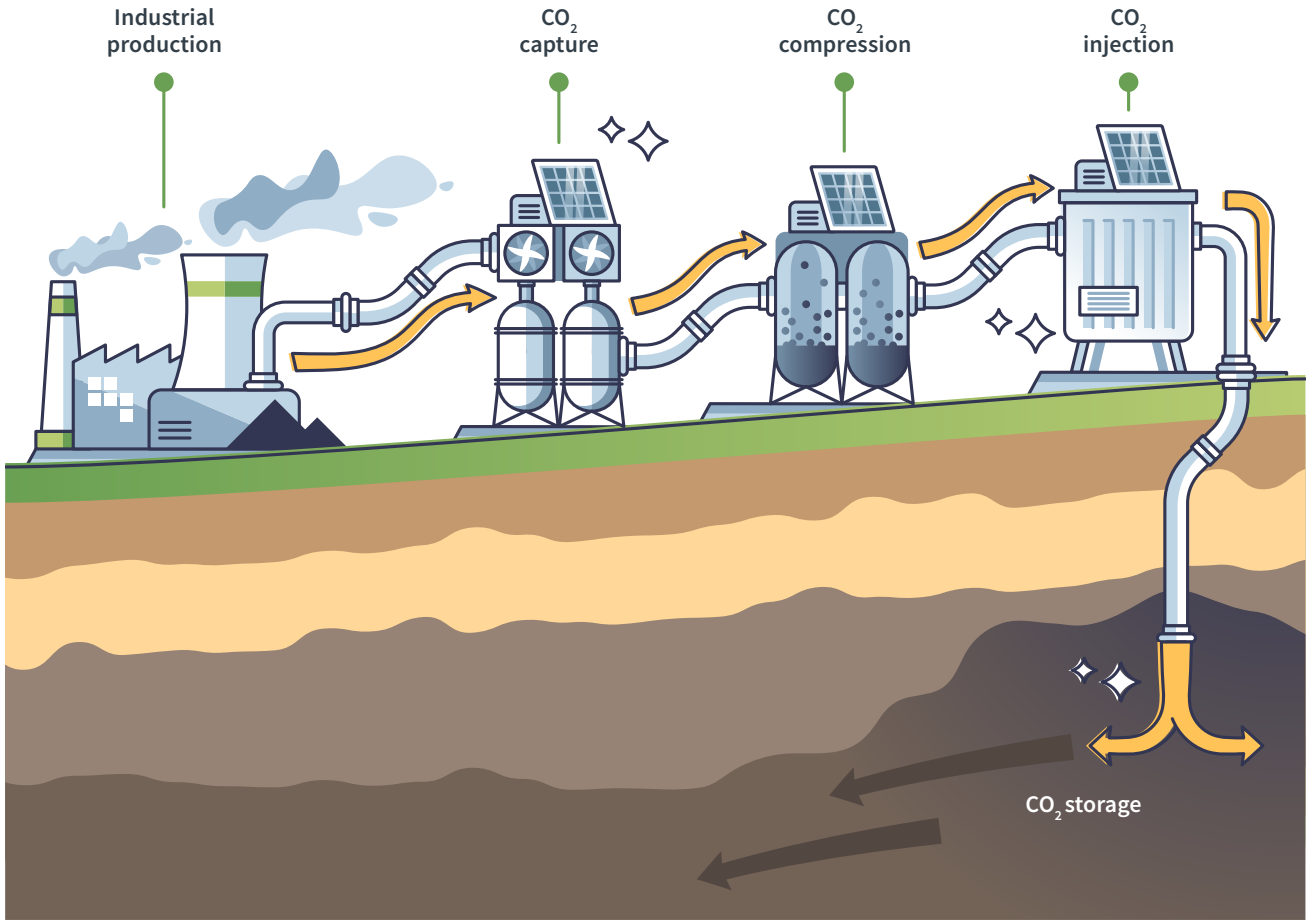
Despite conflicts, COP 30 must demonstrate this kind of capacity for collaboration in climate protection. The hottest year on record was 2024, with average global temperatures 1.6 degrees Celsius above pre-industrial levels. We need rapid GHG reductions in the next five years, although writing this represents the triumph of hope over experience.

Gas underground, where does it go?

Professor Andrew Curtis

Chair of Mathematical Geoscience, School of GeoSciences

There are no commonly accepted climate scenarios that could achieve the Paris Agreement target of limiting warming to 1.5 degrees Celsius above preindustrial levels, without widespread adoption of sequestration of CO_2. Large volumes of CO_2 must either be captured at the point of emission before it reaches the atmosphere or harvested from the atmosphere. The only possible engineered storage location for CO_2 at the required scale is in the inter-granular pore space of rocks in the Earth's subsurface. Additional pathways to transition to carbon emission-free transport at the point of motion involve the widespread use of hydrogen fuel as an alternative to electricity or fossil fuels. Hydrogen can be separated from oxygen in water using renewable electric power, which is particularly attractive using intermittent energy generation farms that are not connected to electricity grids, yet may produce huge volumes at peak times. Storing this hydrogen at an appropriate scale before it can be collected or used also requires injection into storage reservoirs in the Earth's subsurface. The ability to store gases in liquid form on the Earth's subsurface is therefore a critical component of the infrastructure that is necessary for the first pillar of the COP 30 Action Agenda to meet existing emissions targets — in particular to meet Objective 2 ('Accelerating zero and low emission technologies in hard-to-abate sectors'); Objective 3 ('Ensuring universal access to energy'); and Objective 4 ('Transitioning away from fossil fuels in a just, orderly and equitable manner').



Subsurface storage

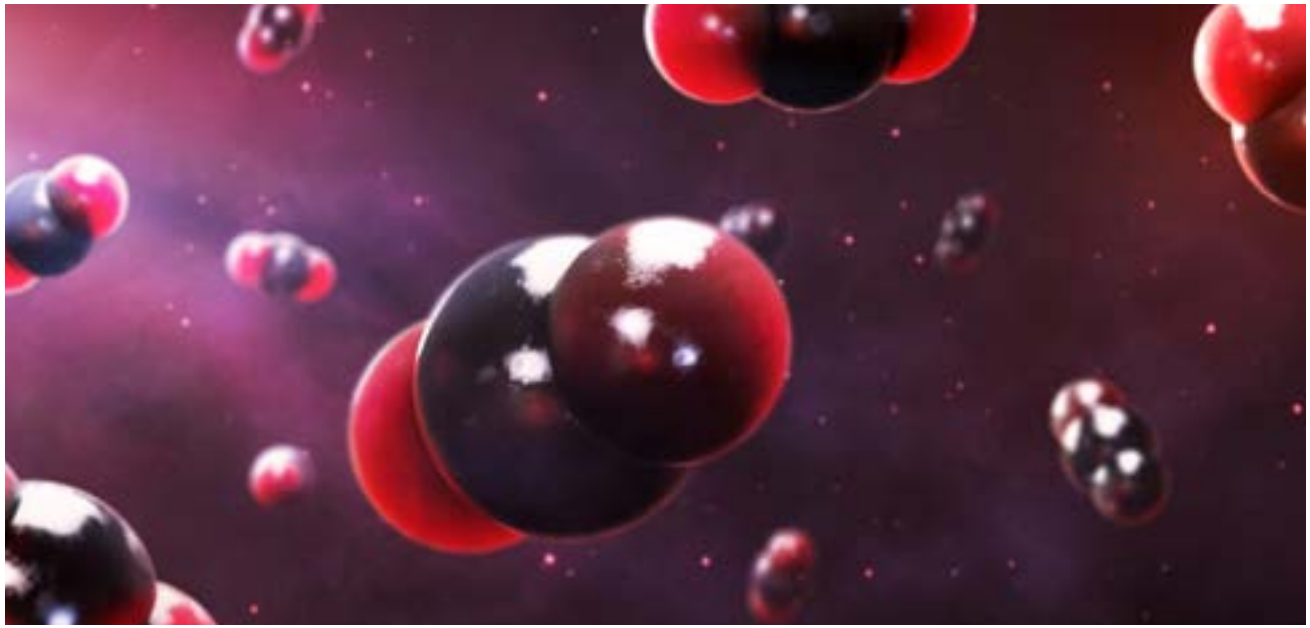
There has been much experience in subsurface fluid storage, because various countries use subsurface reservoirs to store national stocks of methane. Huge sums have been invested into developing expertise in exploring

and developing subsurface reservoirs for hydrocarbon production over the past 70 years, much of which is relevant for methane storage and retrieval. While CO_2 and hydrogen have different chemical properties to methane, and Hydrogen has quite different flow mobility through rock pore space, this experience, and many technologies from the hydrocarbon sector, remains transferable to their large-scale storage.

Even after such significant investment, several problems connected to monitoring and verification hinder the adoption of subsurface fluid storage at a very large scale. Typically, regulators require that modelled scenarios and forecasts for the future location and movement of the injected fluids through the subsurface are registered prior to establishing a storage site. These forecasts are then checked during the actual injection using geophysical methods to interrogate the subsurface. Any significant deviation from the storage plan leads to some kind of decision that may alter monitoring plans, injection rates and volumes, or progress to other remedial actions.

Issues

The most general problems are twofold. First, CO_2 is commonly regarded as a waste product with little current value, and storage itself is not likely to generate value (other than by facilitating other activities that would otherwise result in emissions to the atmosphere). Monitoring and verification must therefore be conducted at low cost, over large geographical areas – a niche of monitoring technology that was not developed by the more profitable hydrocarbons industry which could afford more expensive methods. Second, since subsurface imaging and monitoring is fraught with technical difficulties, scenarios can only be verified to a certain level of confidence. Yet this



level of confidence is extremely difficult to calculate. This renders verification itself an uncertain endeavour.

It is therefore necessary to ensure that sufficient value is attributed to stored CO_2, derived from the value generated by other activities which would otherwise be curtailed due to their atmospheric emissions. It is important to devote attention to the development of accepted methodologies that provide robust and reliable, cost-effective verification over large spatial scales. And it is critical that projects that are planned, and those for which initial subsurface tests have already been conducted, move to larger scale development without unnecessary delay; and then to ensure that the experience gained in storage, monitoring and verification is disbursed globally to ensure the security of storage sites worldwide, and that such CO_2 never reaches the atmosphere.

The University of Edinburgh designs cost-effective monitoring systems to ensure gases are stored securely in subsurface reservoirs. University of Edinburgh academics develop the science of uncertainty assessment and risk analysis for making decisions about whether and how to develop particular subsurface stores, and to assess conformance with pre-injection expectations. The potential volumes of offshore storage reservoirs have been assessed across the North Sea and elsewhere around the UK. Research into Hydrogen storage and natural Hydrogen reservoirs progresses towards secure and cost-effective Hydrogen supplies and storage. And through Scottish Carbon Capture and Storage, University academics provide research and advice to businesses, industry, the public, regulators and policymakers worldwide, to advance CO_2 storage projects everywhere.

Economic growth is not the solution to environmental destruction — Pillar 2 Stewarding Forests, Oceans and Biodiversity

Dr Hannah Wauchope
Lecturer in Ecology & Conservation

Hannah Wauchope

COP 30 must face the reality that economic growth is driving environmental destruction, and relying on it to fund environmental protection and decarbonisation is a paradox that will ultimately result in more harm.

COP 30's Action Agenda places the stewardship of forests, oceans and biodiversity as a core thematic pillar, to support ecosystem services and foster climate solutions. Yet despite successive climate and biodiversity COPs, emissions are rising, deforestation and green space destruction continue, emissions rise, and we are breaching more planetary boundaries. Clearly, we need stronger solutions to solve the joint climate/biodiversity crises.

The first solution proposed in the 'Stewarding Forests…' pillar is a call for 'investments to halt and reverse deforestation and forest degradation'. Often, these investments will be sourced from private finance. This reveals a paradox in the solution we are relying on: economic growth.

Paradox

It is often taken as a given that growth is the only means of human progress, with sustained economic growth being an explicit UN Sustainable Development Goal. Consistent critiques have pointed out the impossibility of endless growth on a finite planet, yet for more than 50 years, global economies have shown a near single-minded pursuit of it.

In recent decades, there has been an increasing focus on the idea that environmental protection can walk hand in hand with economic growth, and it is the means of funding two core strategies being proposed for achieving forest stewardship at COP 30, as described below.

However, there is no evidence that green growth is possible. Higher GDP equates to higher resource

consumption and more intensive land use, and studies show that if the global north has been able to reduce (though not eliminate) local environmental harms associated with economic growth, this is only because those harms have been externalised to the global south. Meanwhile, improved technological efficiency does not reduce resource consumption; it often increases it, a phenomenon known as Jevons paradox. Clean energy technologies still cause environmental harm, whether land for solar panels or mining for metals.

What all this means is that plans for environmental protection, and by proxy decarbonisation, that rely on economic growth are a paradox. For example, the Tropical Forests Forever Facility (TFFF), being launched at COP 30, is an innovative scheme to fund the protection of tropical forests through dividends from investment that, within current systems, could help some countries to reduce deforestation. Even though TFFF precludes direct investment in fossil fuel or deforestation related industries, returns from other investments will indirectly and inevitably rely on resource extraction.

Similarly, carbon credits, for which Brazil is proposing to establish a global market at COP 30, are often focused on preventing deforestation. They allow land holders to be paid for protecting their forests, yet these payments nearly always come from companies and economies looking to offset their emissions from growth. What's more, our research has shown that nature crediting schemes also inevitably involve abstractions of the true values of nature, meaning they can cause more harm than good, and studies from others at Edinburgh have shown how the accounting used to determine offsets often means their benefits are exaggerated.

Preserve and reduce

In both above examples, clients are paying for protection using profits from damage. But to achieve climate and biodiversity targets we need to preserve what remains of the natural world and reduce harms, not one or the other. We do not need endless growth for wellbeing: though some degree of growth has and will continue to bring poorer nations out of poverty, in wealthier countries such as the UK the link has been broken. Growth increasingly serves to accumulate wealth and affluence in the hands of a few.

Instead, we must turn to new economic models that are compatible with a good life for all and a sustainable planet. This means increasing regulation to safeguard areas of the planet, permanently, from potential harm from destructive resource extraction, and transitioning to economies that make circular use of the resources we already have from the rest. To break out of the current system will require international cooperation and strong and decisive leadership, by leaders able to speak clearly for the rights and needs of the majority of living beings on the planet. Researchers at Edinburgh are working on solutions to foster these goals, for example our work arguing for stronger regulation of protected areas, or others discussing how to achieve international regulation of shared resources, ways to recover critical metals from recycling, or ensuring that energy transitions are just and fair.

Growth cannot save us

It is time for UN Parties to take a clear-eyed look at the system that is trapping us. We cannot shy away from the paradox that lies at the heart of many proposed solutions: that of relying on the very thing that is causing environmental degradation to try and fix it. Growth cannot save us. Wise regulation can.

Acknowledgements

Hannah is grateful for conversations with Sophus zu Ermgassen on this topic, as well as Harrison Carter on matters of Biodiversity Finance.

Oceans: a critical ally in mitigating and adapting to climate change

Sarah DelBen

Dr Sian Henley

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Sian Henley

COP 30's Action Agenda Pillar 2, Stewarding Forests, Oceans and Biodiversity, includes:

- Efforts to conserve, protect and restore nature and ecosystems with solutions for climate, biodiversity and desertification.
- Efforts to preserve and restore oceans and coastal ecosystems.

The global ocean covers more than 70 per cent of the surface of planet Earth. It plays a critically important role in stabilising global climate, by absorbing 25 to 30 per cent of the carbon dioxide (CO_2) emissions and more than 90 per cent of the excess heat caused by human activity. The polar oceans – in the Arctic and Antarctica – are disproportionately important in these climate-stabilising processes. For example, the Southern Ocean around Antarctica takes up 40 to 50 per cent of total ocean CO_2 uptake and around 75 per cent of the total ocean heat uptake. However, the ocean worldwide is in peril because of human-driven climate change, causing ocean warming, acidification and oxygen loss. Alongside this, pollution and overfishing reduce the resilience of ocean systems and undermine their ability to cope with the impacts of climate change. Once thought pristine, the polar oceans are not immune from these global threats and, in fact, are particularly at risk from the impacts of ocean warming, acidification and rapid declines of sea ice, which has regulated these ocean systems for thousands of years.

Researchers in the School of GeoSciences' Global Change Research Institute are actively involved in scientific investigations that aim to improve our understanding of the importance of these ocean systems, the threats that they are facing, and the best ways to safeguard them now and in the future. I have led, and am currently involved in, several projects aiming to better understand, and more effectively protect, the Southern Ocean (Henley et al., 2020; Henley and Tudhope, 2025; MEASO Summary for Policy Makers, 2023).

Interconnected approach

The rapid changes underway and the severe impacts of change have implications far beyond the Arctic and Antarctic regions, which influence global ocean health and productivity, underpin globally significant fisheries, and regulate climate on regional-to-global scales. This places the Arctic and Southern Oceans and their connectivity with ocean regions around the world as high priorities under Action Agenda Theme 2. In particular under this theme, efforts to conserve, protect and restore nature and ecosystems with solutions for climate, biodiversity and desertification, and efforts to preserve and restore oceans and coastal ecosystems, must take a comprehensive and interconnected approach, including the polar oceans alongside all other regions of the global ocean.

Indigenous peoples

As part of the Global Mutirão mobilisation envisioned at the heart of Brazil's COP 30 presidency, there is strong emphasis on calling on science and ancestral wisdom to prepare now for an unpredictable future. This combination of science and traditional knowledge will be fundamental in meeting oceans-focused objectives, including centring those most vulnerable to climate-driven ocean change around the world. Special emphasis must be placed on Indigenous and local communities as rights holders of land, coastal and ocean territories, through the UNFCCC Local Communities and Indigenous Peoples Platform and other relevant mechanisms, in line with the UN Declaration on the Rights of Indigenous Peoples (UNDRIP, 2007). The importance of the ocean in helping humanity to mitigate and adapt to climate change is recognised within the UNFCCC via the Ocean and Climate Change Dialogue, mandated by COP25 (2019) and conducted in December 2020 and annually since 2022. The need to address

Sian Henley

the global climate and biodiversity crises together in a coherent and well-connected manner is also increasingly recognised and led to the first joint workshop and report of the Intergovernmental Panel on Climate Change (IPCC) and the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) in June 2021. These efforts see active participation from Prof Sandy Tudhope, Dr Meriwether Wilson and several members of their Edinburgh Ocean Leaders programme.

Equilibrium

The role of the global ocean, and the polar oceans in particular, in mitigating climate change and supporting globally important biodiversity relies on healthy ecosystems and natural processes being in equilibrium; yet this is threatened by the very climate change it is key to protecting against. Restoring and maintaining this equilibrium and safeguarding these ecosystems requires urgent and deep cuts in greenhouse gas emissions, in line with the Paris Agreement target of limiting warming to 1.5 degrees Celcius above preindustrial levels, as well as effective marine environmental protection.

The COP 30 Action Agenda has the potential to deliver the step change in climate and ocean action that is required, as long as Parties, civil society and other actors operate in good faith to prioritise the long-term sustainability of ocean, coastal and land systems, and the human societies that rely on them, rather than short-term profits and financial gain.

The recent ratification and forthcoming entry into force of the UN BBNJ Agreement or 'High Seas Treaty' – in which Dr Harriet Harden-Davies and several members of her Ocean Voices programme are involved – is proving that multilateralism still works, even in the face of mounting environmental and geopolitical challenges, to safeguard the global ocean beyond national jurisdiction. COP 30 has a huge opportunity to show that the same can be achieved for addressing climate change. The Paris Agreement targets are still within reach through decisive global action and reaching them is fundamental to protecting the oceans in the polar regions and worldwide, as well as human societies that rely on them directly and indirectly.

Rainforests reloaded: opportunity and urgency at COP 30

Professor Patrick Meir

Chair of Ecosystem Science, Director of the Centre for Sustainable Forests and Landscapes

Dr Paulo Bittencourt

Forests hold huge value to humanity. They provide livelihoods to communities close and far, they harbour a large slice of global biodiversity, they protect water and soil. They ameliorate climate change and its extremes, and they underpin our shared bio-cultural diversity.

One focus on forests at COP 30 will be narrowed to the critical issue of climate. However, any successful discussions on the future of forests must go beyond climate alone. They must embed the integrated value of forests to society, with new agreements delivering justice as well as environmentally and economically positive outcomes.

This year's COP will be held 'in the rainforest' – in the equatorial city of Belém, State of Pará, Brazil, near the mouth of the Amazon River. The iconic location will force the discussion on forests further up the priority list than ever before. Here and in this region, the competing demands from people on forests and on the land they occupy, reaches a maximum focus. The solutions are not easy; they involve a complex balancing act with changing rules and resources.

The value of forests

Social and financial sustainability are critical to success, but no plans will work without being strongly informed by science, to enable us to monitor, quantify and understand future change. These issues are not discrete to Amazonia or even the tropics, though tropical forests play a disproportionately large role in helping to keep our climate stable. The recent rise in awareness of the value of forests and the growing risks to them has been global. The University's Centre for Sustainable Forests and Landscapes provides expertise and builds leadership across this complex field, with a focus on the wet and dry tropics as well as in cooler climate zones.

One of the biggest environmental questions of our time focuses on the future of Amazonian forests and our climate. Forests absorb carbon out of the atmosphere, acting as a brake on climate change. In the absence of climate extremes and deforestation, Amazonia is thus able to act as a globally large 'carbon sink'. In addition, water evaporates from Amazonian rainforests as they grow and is partly

recycled as rain that then supports forests, agriculture or hydropower further afield. Amazonia and tropical forest regions globally have a key role to play in helping to maintain environmental and economic stability, but they of course are under pressure from increasing extremes in climate and land use change.

Climate cost

Edinburgh scientists, collaborating closely with colleagues in Brazil and elsewhere, have helped lead in this area for over three decades. Recent work has demonstrated that even intact tropical rainforests can experience high rates of tree death during extreme or persistent drought, although thankfully the surviving forest shows some resilience over the longer term. High tree death rates exact a climate cost by releasing more carbon to the atmosphere as the dead trees decompose. The effect can be large – increased carbon losses from intact Amazonian rainforests in recent years have weakened the strength of its huge natural carbon sink. Indeed, elsewhere we have shown recently that Australian tropical rainforests switched from being carbon sinks to being net biomass carbon sources as early as the year 2000. In both regions, increased tree death rates within intact rainforest are a key factor, with intensifying increases in heat and drought extremes being important drivers.

Accelerating climate change and land use

What does this mean for how we manage tropical forests as a critical part of our Earth system, our home? Even if we just focus on carbon, we know that tropical forests remain as globally important carbon stores, irrespective of the size of their current carbon sink. Removing these forests would therefore cause significant carbon emissions to the atmosphere, accelerating climate change and costing us all, even before we consider other effects on biodiversity

and society. Extreme climate events are often associated with the combined impact of climate change and land use, and have rightly focused global attention on halting deforestation. However, our recent collaborative work has also shown that even protected Amazon forest regions that are remote from the forest edge are experiencing rapid increases in climate extremes, underlining the pervasive impact of accelerating climate change.

New approaches

The avoidance of tropical forest loss and maximising its recovery are obvious key aims for COP30 to work towards, with similarly clear social, economic and environmental benefits. Yet, if both the forest frontier and the interior are at high risk, this emphasises even more strongly the need for reductions in global greenhouse gas emissions.

Important new approaches to funding and enabling adaptation and conservation interventions in tropical forests, including the Fund for responding to Loss and Damage and the Tropical Forest Forever Facility, should attract substantial international investment at this COP. But the central need for rapid global emissions reductions must also remain in focus if we are to avoid both further advances into the tropical forest frontier and intensification of the effects on forests of climate extremes.

Watch

A Future Forest? A 25-year Brazil/UK experiment to understand the impact of drought on Amazonian rainforests:

- https://www.youtube.com/watch?v=-pXt_2RnGrM (English)
- https://www.youtube.com/watch?v=LBcVn_im7ok (Portuguese)

A healthy diet is attainable for everyone, within planetary boundaries, but some of us need to eat less meat

Professor Lindsay Jaacks
Personal Chair of Global Health and Nutrition

One of three objectives for the COP 30 Action Agenda's thematic pillar, Transforming Agriculture and Food Systems, is 'equitable access to adequate food and nutrition for all'.

There is no doubt that existing actions on this front are insufficient. According to the 2025 edition of *The State of Food Security and Nutrition in the World*, hunger continues to rise in most subregions of Africa and in Western Asia. It is estimated that between 638 and 720 million people faced hunger in 2024. This number is projected to decrease by 2030, but will remain high at 512 million people, nearly 60 per cent of whom will be in Africa. It's increasingly clear that we won't meet Sustainable Development Goal 2, Zero Hunger.

Moreover, while the COP 30 objective focuses on 'adequate' food, the definition of a 'healthy diet' by the Food and Agriculture Organization (FAO) of the United Nations and the World Health Organization covers three additional principles: balance, diversity and moderation.

Cost and affordability

Global nutrition has moved on from measuring just hunger to measuring the cost and affordability of a healthy diet. This is important because our research, in partnership with the University of Göttingen, shows that even rural subsistence-oriented and extremely poor households – those most affected by food insecurity and malnutrition – purchase most of their food. Yet according to the FAO, 2.6 billion people could not afford a healthy diet in 2024. It's time to act, monitor, evaluate, fail fast and scale out fast.

Changes in both what we eat and how we produce it are needed if we are to achieve 'equitable access to adequate food and nutrition for all' and stay within planetary boundaries. Changes will look different between, and within, countries but one thing is consistent: when it comes to climate change, we need to focus on meat.

Between 12 and 19 per cent of total global anthropogenic greenhouse gas emissions come from livestock. Expanding livestock production is also a leading contributor to deforestation and biodiversity loss.

In countries such as the UK, we need to reduce our production and consumption of meat, particularly ruminant meat. The UK Climate Change Committee has recommended a 20 per cent reduction in meat and dairy by 2035, rising to a 35 per cent reduction in meat by 2050. A steeper reduction in red meat consumption is recommended (40 per cent by 2050) to reflect the higher carbon intensity of beef and lamb. To maximise the benefits of such reductions on health, the Committee recommends that meat products foregone are replaced with healthy plant-based foods.

Co-benefits

Our research has shown that if the Climate Change Committee recommendations were to be adopted in Scotland, more adults would achieve the Scottish Dietary Goals, and greenhouse gas emissions associated with our diets would significantly decrease, getting us closer to net zero. We also found that these changes wouldn't result in a significant change in the cost of diets. Similar reductions in other countries where meat consumption is above healthy and sustainable levels, such as the United States, China and Brazil, could have similar co-benefits.

In other countries, such as Ethiopia, our researchers have found that meat consumption is generally low due to a variety of factors including affordability. Actions to promote consumption of meat and other animal-source foods in this context may therefore be beneficial for nutrition and health.

Such efforts should be conducted alongside efforts to improve the efficiency and sustainability of animal-source food production in these contexts. The Centre for Tropical Livestock Genetics and Health and other research in the Royal (Dick) School of Veterinary Studies here at the University aims to do just that.

Occasionally, some stakeholders in the Global North claim that because their production is efficient, it should continue at current levels or even increase to support global nutrition. This is a false promise. Research has shown that high- and upper-middle-income countries primarily trade animal-source food products among themselves. Lower-middle- and low-income countries receive less than six per cent of the total trade value of animal-source foods.

Meat and equity

Business as usual in the Global North risks worsening global inequalities. It is livestock producers in low-resource contexts who face some of the largest impacts of climate change yet have the fewest options to adapt. Our work through the Jameel Observatory for Food Security Early Action explores anticipatory action in the Horn of Africa as a way of protecting livestock herders from the worst effects of drought.

The way that we currently produce and consume food is not achieving a healthy diet for everyone today, and it is jeopardising our ability to eat a healthy diet in the near future. Meat and equity need to be top of the agenda for food systems transformation at COP 30.

More mess please! How a little more clutter can protect our crops under climate change

Dr Alfy Gathorne-Hardy
Senior Lecturer in Sustainable Resource Use for Food Security

I grew up on an intensive arable farm in England, and it mattered to me, and all of us, that the farm looked neat and tidy. We'd start work at 7.30am, but always meet 15 minutes earlier to plan the day – and to critique the neighbouring farms: where one neighbour hadn't drilled (sown) their wheat in straight lines, or where another had too many weeds in their sugar beet. A neat field was something to be proud of: a neat field was a good field.

But we were wrong. Now, it is the perfect uniform fields I critique. Clean crops provide a field day for agricultural pests, and the impact of pests – if we maintain current farming practices – are likely to get worse with climate change. This risks the use of more insecticides; wasting money and damaging biodiversity. We're addressing this at the University, but not through finding ways to directly kill pests, but instead exploring how we can change farming techniques so that pests won't be a problem in future warmer climates.

Pictures courtesy of Barbara Smith (a) and Nurainie Wan Ismail (b and c).

Are insects a problem?

Most insect species are benign to farmers: of the million plus insect species, only one to two per cent are pests. But those few species can cause havoc, wrecking farmer finances and threatening food security. Key to pest insects' success is their rapid population growth. For example, aphids (the plant's mosquito – causing little direct damage but with a devastating ability to spread disease) reproduce through telescoping their generations: daughters are born pregnant with their own daughters so some species are doubling their population in three days. One aphid, weighing a thousandth of a gram, can reproduce to a population with a biomass greater than all humanity within six months.

a. *A bumblebee feeding on extra floral nectar – nectar produced by the bean to feed natural enemies but used by pollinators too.*
b. *'Mummified' aphids: the whole aphid eaten from the inside by a parasitoid wasp – highly effective pest control. Parasitoids also depend on extra floral nectar.*
c. *A parasitoid feeding on extra floral nectar.*

Will climate change make insect pests worse?

Climate change may exacerbate current problems. Insect damage arises through weight of numbers, and as ectotherms (cold-blooded organisms), insects respond rapidly as temperatures warm (excellent review here).

Therefore, we can expect faster growth, more generations per year and extended ranges in a warmer world – climate change is likely to be 'good' for pests under current farming models.

Why not stick with what's worked for 70 years?

For seven decades yields have risen through new varieties, irrigation, fertilisers and pesticides – but the system is no longer fit for purpose. Regulators are restricting the most hazardous pesticides due to their impact on biodiversity and human health (to the chagrin of some), and pests evolve resistance at alarming speed. For example, the diamondback moth – a global pest of brassicas – evolved resistance to DDT in less than a decade, and is now resistant to almost all types of insecticide. Climate change will accelerate resistance, as faster life cycles enable faster evolution of resistance, decreasing pesticide efficiency.

If ecologists designed agriculture, they wouldn't start from here

Currently, most of our calories come from monocultures, whole fields of a single crop. Ecologically this is bonkers, as if designed to favour pests: for pests, monocultures offer endless food.

In natural ecosystems, pest populations are kept in check as insects struggle to find food in complex environments, and through predation by natural enemies. In agricultural monocultural ecosystems, pest populations are kept in check through applying insecticides – at the expense of human health and biodiversity.

Why more mess means fewer pests

Many natural enemies need nectar as fuel to help them find their prey – our pests. But clean fields of wheat, rice or maize contain no nectar. Our PhD student Nurainie Wan Ismail is working with parasitoids, tiny flying insects. These lay eggs inside the pest and eat them inside-out: horrible but highly effective pest control. But these excellent pest controllers can only find their prey when they've got fuel from nectar. With Nurainie we've found that adding another crop – such as field beans – substantially increases how long parasitoids can live, and how many pests they can kill. And it's not just natural enemies that benefit from the more complex fields. Our research highlights the potential of complex cropping systems to increase biodiversity and yields too – and this becomes especially important as the climate changes.

Why are so many farms still clean?

Uncontrolled weeds have always been, and remain, a major problem for farms, and so farmers react negatively when we suggest that their fields should be messier – even though we're suggesting a managed mess, which will improve yields. Also, many people still don't know about parasitoids – look at (c) on previous page – while vital, they're easy to miss! But most importantly, for decades this research has been swamped by that of pesticide companies, as it's impossible to patent intercropping.

However, over recent years we're finding that farmers are rapidly adopting alternative techniques, especially since the neonicotinoids ban, and so we're excited that our research will soon be used in the field – improving human and environmental health in the face of climate change.

Delivering biodiversity-positive climate action

Professor Peter Alexander
Personal Chair of
Global Food Systems

The climate and biodiversity crises are tightly linked, as recognised in COP 30's Action Agenda. Land-based climate measures such as reforestation and bioenergy, including Bioenergy with Carbon Capture and Storage (BECCS) will require large areas of land to meet climate targets. That extra demand increases competition for land and can damage habitats through land-use change, displacing agriculture and timber production, and causing knock-on deforestation. These changes can raise food prices and drive further biodiversity loss. To deliver climate- and biodiversity-positive action, we need to consider wider outcomes than greenhouse gasses alone and recognise the different ways people value nature, so choices are fair and workable.

Assessing these outcomes together, and the different values people hold, clarifies the trade-offs and points to practical steps: shifting towards more plant-based diets where consumption is high, protecting key ecosystems, and restoring degraded land. To support a just and workable transition, further research is needed on values-based, target-seeking scenarios and modelling that captures human–nature feedbacks, variability and shocks, and how policy, markets and trade respond across scales. Coupled socio-ecological models that link demand, land use, biodiversity and institutions can be used to stress-test options and identify robust choices. Work at the University of Edinburgh addresses these gaps by advancing such modelling and values-based scenario tools.

Giant soy fields around Sinop, Mato Grosso, Brazil

Why looking beyond carbon matters

Land based mitigation options play a major role in Paris consistent pathways, but the scale of land required is considerable. Many such pathways expand bioenergy crops and new forests by hundreds of millions of hectares by the mid- to late century. National net-zero pledges have about one billion hectares for land based Carbon Dioxide Removal (CDR); comparable to today's global cropland of ~1.56 billion hectares. This implies roughly 35–40 million hectares converted or restored each year to 2050, including around 13 million hectares per year for reforestation (Dooley et al., 2024). Within two degrees Celcius or lower pathways, the median expansion rate of bioenergy crops for BECCS is about 8.8 million hectares per year (Perkins et al., 2023).

Over recent decades the fastest observed cropland expansion has been soy, which increased by around 1.7–1.8 million hectares per year between 1961 and 2021. The implied BECCS rate is therefore more than three times that pace, making the required land use change unprecedented in speed and scale (Perkins et al., 2023). For total land-based mitigation, it would be higher still. At such rates the pressure on habitats, freshwater and food systems would be severe, with significant risks of displaced land-use change, loss of culturally important landscapes and rising food prices. In our study, we also showed that environmental, sociocultural and institutional constraints mean the deliverable potential of land based CDR is much lower than technical or economic estimates suggest (Perkins et al., 2023). As a result, it is essential to plan for more than carbon and to judge options against biodiversity, freshwater, food and social outcomes, in line with COP 30's Action Agenda (Pillars 2, 3 and 6).

Desirable futures and plurality of values

The trade offs, for example between climate mitigation, biodiversity, and food, cannot be reduced to a single metric, so policy and planning should reflect multiple perspectives and values, and target seeking (normative) scenarios are needed to define desirable futures that account for these different perspectives. The Shared Socioeconomic Pathways (SSPs) and Representative Concentration Pathways (RCPs) are the main scenario tools used in climate analysis and by the IPCC. SSPs describe alternative socioeconomic futures, while RCPs describe greenhouse gas concentration and warming levels. Used together, they explore plausible futures and focus on climate outcomes; they do not aim to specify what a desirable future for nature looks like, and give limited insight into biodiversity, freshwater or cultural landscapes.

The Nature Futures Framework (NFF) was developed by IPBES to address these gaps. It provides a nature-centred, values-based set of desirable futures, organised around three perspectives: nature for nature (protecting species and intact habitats); nature for society (the benefits people rely on, such as food, water and climate regulation); and nature as culture (people's ties to nature through identity, place and stewardship). Used alongside SSP/RCP, the NFF helps make co-benefits and trade-offs explicit beyond carbon and translates targets into credible pathways.

Assessing SSP–RCP pathways with Nature Futures indicators

We used NFF-aligned indicators across the three value perspectives to assess outcomes from SSP–RCP futures with the LandSyMM global land system model. Each indicator was scored by benchmarking model outputs against target ranges for desirable futures. Even under the SSP1 Sustainability scenario (Taking the Green Road), scores for 'nature for nature' decline relative to a 2010 baseline, while some society and culture indicators improve. Across scenarios we see a bias towards material provisioning (for example, food production), persistent shortfalls in water regulation and pollution, and land intensive options that create trade-offs across food, water and habitats (Alexander et al., 2024).

Values based narratives for biodiversity positive implementation

In other work, we developed values-based narratives for how the Kunming–Montreal Global Biodiversity Framework (KM-GBF) could be implemented under each NFF perspective (Burns et al., 2025). We outline three legitimate pathways aligned with the NFF perspectives:

- nature for nature (prioritising strong protection and restoration with limited use of offsets and a stronger role for global coordination);
- nature for society (optimising ecosystem services through multi-level governance and market instruments bounded by ecological limits); and
- nature as culture (centred on community stewardship, cultural landscapes and local governance).

We also describe indicative trends in other indirect drivers under each pathway (for example, more localised systems and lower material consumption in nature as culture; higher technology uptake in nature for society) and illustrate blended approaches with case studies.

Find out more

The Land use and Food systems Lab

Climate ready resilient infrastructure for cities: Is your country ready to deliver for COP 30?

Professor Sean Smith
Director of the Centre for Future Infrastructure

Why countries need to enhance resilience for cities, infrastructure and water

Many countries and their cities across the globe are increasingly experiencing the impacts of climate change and especially in relation to impacting the operational capacity of their existing infrastructure. The increasing precipitation intensity and slow-moving heavy rainstorms have resulted in all areas, from urban to rural, and mountain villages to low-level croplands, experiencing unprecedented floods. Specifically for cities, towns and villages the man-made roads and streetscapes have now become the new flood flow canals, channelling rainwaters to become road rapid rivers. Underpinned by global warming resulting in higher moisture content and leading to increased storm intensities the existing infrastructure, while designed for a '1 in 100 years' event, is now often unable to cope with such significant rainfall in very short time periods.

Bookends

But also too is the inverse, where such intense rainfall events are the 'bookends' spanning long dry periods resulting in droughts and very low water levels, impacting not only food supplies and farm animal health, but also the green power generation infrastructure such as hydro-electric dams. The lack of water is directly impacting the green power infrastructure so many countries aim to rely on for the energy transition away from fossil fuels.

Increasingly countries, which would not have considered 40–50 years ago when such hydro-power infrastructure was built, the potential for such low-level rainfall in key areas around the globe which historically 'saturated' with key rain periods in the year. Such intense rainfalls, pressures on the continuity of clean potable water supply and hydro power shutdowns due to inadequate water supply have led to more uncertainty in planning and operations of cities and their infrastructure.

The rising heat levels in many cities is spiralling to intensify the urban heat island effects. With additional moisture levels and higher humidity this creates increasing demand for city cooling and ventilation systems, resulting in increasing energy demands. Such higher temperatures for railway tracks, electrical grids and other related infrastructure are often exceeding the original operational design limits.

Cascade effects: Cities and regional supporting infrastructure

Infrastructure is the very underpinning of economies, transport, manufacturing, IT systems, future AI data centres, food production, food storage and goods transportation. It is the critical component to basic societal habitat needs of water systems, heating, cooling and health and hospital functions. But in this new world of uncertain meteorological events, there is now an increasing awareness of the golden thread that power, water, telecoms and transport infrastructure share through the knock-on or cascade effects resulting in multiple interconnected impacts, costs, delays and geographic reach.

Examples include the loss of power to water systems, specifically pumped water supplies, impacting urban water supplies, housing, education and health building occupants. High wind speeds in storms not only impact the grid 'wire' and substation infrastructure but also the telecommunications operations (damage to masts) and major transport rail corridors between cities.

The significance of these cascade effects has increased resulting in higher costs, longer delays and a greater complexity to then repair, restore and return to full operational capacity across diverse infrastructures.

Future resilient cities and infrastructure – a world first!

In Scotland, to address the complexity of challenges such as storms, wildfires, droughts and higher intensity rainfall and their impacts on cities and regional hinterland infrastructure a new forum has been established – Climate Ready Infrastructure Scotland (CRIS). This provides a world-first unique integrated forum of all the of the major infrastructure operators (non-party stakeholders) for power, transport, water, telecommunications and major asset owners involving forestry, land, (large critical building operators such as for health) and the UK MET office. By sharing their common challenges, solutions and resilience plans the forum in partnership with Scottish universities, such as the Centre for Future Infrastructure at the University of Edinburgh, aim to collaborate on key data, modelling and forecasting. It will also trial and test resilience scenarios and learn from previous climate change impacts on infrastructure supporting accelerator knowledge exchange and future resilience planning.

Eowyn

An example was the recent storm Eowyn in early 2025, which the MET Office and governments issued as a red alert level storm. Large scale infrastructure operators outlined post-event their planning and resilience leading up to the storm, the impacts, approach timelines and resulting impacts. The categorisation of a red alert level storm 48 hours before the storm's arrival allowed the major infrastructure operators to instigate shutdowns of key inter-city transport routes in advance, and have staff for power and water infrastructure already stationed in key geographies in advance. This assisted a faster recovery and deployment of resources and importantly reduced the potential for danger to life, casualties and community impacts.

The storm primarily affected the west, central and north parts of Scotland resulting in a 40 per cent impact on the rail network due to more than 600 fallen trees, major power outages affecting pumped water systems and power networks and significant loss of mobile telecommunications for 24 hours. Storm Eowyn illustrated not only the fragility of existing infrastructure but also the significance of cascade effects across diverse critical infrastructures.

As climate change increases to impact on existing infrastructure and the significance of shared resilience platforms, knowledge exchange and collaborative planning it is highly likely that more countries will establish their own version of CRIS.

Find out more

- The Centre for Net Zero High Density Buildings
- Future Infrastructure, Climate Change and Sustainability MSc
- The Centre for Future Infrastructure

Building resilience through co-production

Professor Soledad Garcia Ferrari

Personal Chair of Global Urbanism and Resilience

COP 30 is taking place in Belém, a strategic location at the heart of the Amazon rainforest at a crucial time for climate action. How can COP 30 be a turning point in the climate agenda?

The Brazilian state of Pará reminds us that climate is not independent from loss of biodiversity and deforestation and that solutions cannot be focused only on physical sciences. Moreover, COP 30 might provide a platform for acknowledging that while a focus on resilience allows for a socio-ecosystem to maintain its functional integrity in the face of a shock, it also allows existing unjust and unsustainable practices to continue without questioning underlying sociopolitical assumptions. This was discussed at our recent policy briefing published by the International Research in Disaster Risk, which is co-sponsored by the International Science Council. Furthermore, incremental changes in governance systems can be identified when climate transition actions are implemented considering the wider socio-ecosystem. However, a dramatic change is needed, where transformative adaptation should address the root causes of vulnerability and poverty. Understanding the relationships between people and the environment requires questioning the current system that favours capitalism and profit over human wellbeing and social equity.

Wilmar Castro (2025)

El Pacífico neighbourhood forest nursery project: community training at 'Cantos de Agua' natural reservoir, Colombia

Exploring co-production practices

Climate change measures tend to be implemented from the top down, that is, directed by national or regional institutions toward communities, and frequently with a technocratic approach that seeks to solve risks through the construction of infrastructure or the use of technology. These top-down approaches tend to ignore knowledge and actions that already exist at the local level, and that could be supported, for example, by technical or academic expertise. Tackling climate change impact and potential actions, beyond consultation and participation,

requires deliberation and social learning, which are essential to achieve transformative adaptation through learning by doing and constant experimentation. In this context, our research in growing Latin American cities, hosted by Edinburgh's Centre for Latin American Studies, has explored co-production practices that enable communities to collaborate around their needs, challenge power imbalances and negotiate with authorities when implementing mitigation and adaptation actions.

Community-led action

Our impactful action research collaboration in Medellin, Colombia, an Andean city of 4.17 million inhabitants including its metropolitan area, and high exposure to landslide risks on its urban edge, demonstrated vulnerable communities' knowledge and capacity for monitoring and mitigating landslides. Moreover, community-level pilot interventions in the vulnerable and informal rural-urban border of the city have integrated disaster risk management and climate change adaptation through community-led actions around water management, nature-based solutions and forest restauration. These interventions are bringing together government and community to develop knowledge co-creation and inclusive decision-making processes informing policy-making and implementation. Our research has explored how co-production can restructure relations between civil society and the state, redressing power imbalances and antagonisms through bringing together different types of knowledge on a level platform. This approach to tackling climate challenges has led the implementation of appropriate, context-specific, negotiated, and agreed-upon mitigation and adaptation solutions through collective decision-making, multi-scalar negotiations, and power-sharing structures.

Andrés Peña (2025)

El Faro neighbourhood ecologic restoration project: community training by 'Madretierra Permacultura', Medellin, Colombia

Generating successful interventions

Building resilience in the long term requires leveraging non-financial resources at the local level through articulating community knowledge and capacity with those of local government, not-for-profit organisations and academia. This is particularly important in urban areas exposed to the highest impact from disasters due to economic inequality and informality. Exploring the socio-ecological system within these urban areas, co-produced integrated climate and risk management actions have focused on generating radical changes, creating opportunities for adaptive transformation, increased community agency, and reduced socioeconomic inequalities and poverty. Although this approach has generated successful interventions towards risk reduction and climate change adaptation, challenges remain around power imbalances and the longevity of interventions if these are not embedded within planning, climate and risk management frameworks.

Exploring avenues for tackling these imbalances and understanding how available data and associated actions related with increasing weather-related risks can contribute more effective early warning systems in urban areas is the aim of the World Weather Research Programme Urban-PREDICT project. Integrating physical and social science, this project combines advanced weather prediction models with community and place-specific insights, including decision-making structures across a range of selected case study cities, to reduce vulnerabilities and enhance climate resilience in urban populations.

Our research demonstrates that strengthening technical and political community capacity and creating spaces for a dialogue of knowledges engaging local communities, academia and governments not only improve communities' ability to influence policy but also contributes to the construction of alternative urban planning approaches which may help address the impact of climate change faced by cities.

Can COP 30's Action Agenda create systemic climate action change?

Professor Lindsay Beevers
Established Chair in Environmental Engineering

Achieving water resilient cities is a significant and urgent challenge given the dual drivers of global climate change and urbanisation. Between July 2023 and April 2025 global temperatures were continuously recorded 1.5°C above pre-industrial levels (with the brief exception of July 2024). It is now clear that we must prepare for a 3°C warmed world by 2050, which has significant impacts on extreme weather. Climate change impacts are felt acutely through water; significantly changing the hydrological cycle and resulting in more severe floods and droughts. Alongside this growing threat is rapid urbanisation, with the UN projecting that 68 per cent of the global population will live in a city by 2050; an increase from 55 per cent in current times and indicating an intensification of the role cities will play in the future of the planet.

Water security

Currently, urban areas represent only two per cent of the Earth's land surface but are responsible for 75 per cent of the material resource use globally. This concentration of people and activities require water resources to survive but at the same time makes cities particularly vulnerable when they are exposed to natural hazards (such as floods, hurricanes, cyclones, or drought) and poses a distinct challenge for future water security.

Water security for communities requires sustainable access to adequate quantities of acceptable quality water and protection against water-borne pollution and water-related disaster which should be delivered through an appropriate mix of water supply, management and adaptation approaches that support future resilience.

Concurrent issues

It is clear that, globally, we are failing to deliver water security for cities arising from several concurrent issues. Climate change is changing the quantity and timing of water distribution. Increased temperatures result in drier summers causing prolonged drought periods, interrupting supplies and increasing the volume of water vapour held in the air, resulting in more extreme precipitation patterns and subsequent flooding. Our recent work has developed

methods to attribute climate change influence on river flows and explore trends in climate change to UK water resources as well as implications for future water resources at the UK and global scale. Such findings highlight the urgency of this challenge for future adaption. Sea levels are expected to rise due to climate change, increasing the exposure and vulnerability of infrastructure near the coasts as well as intensifying seawater intrusion to aquifers compromising water quality for supplies. In addition to this, aging water infrastructure, such as the Victorian sewage systems of the UK, which was designed for lower flows and fewer people is being overwhelmed more frequently, resulting in urban flooding, and increased pollution of waterways. At the same time, conventional drinking water treatment systems are struggling to deal with emerging pollutants such as microplastics, which place our supplies and waterways at risk and require novel methods to clean our water.

Solutions

Opportunities to address these challenges exist; from novel technology to nature-based solutions. Adaptation to climate change requires technical and engineering strategies to manage water throughout river catchments. Nature-based solutions, such as water interception and retention by forests, wetlands and working with land managers, for example, to improve soil, provide a real potential to re-conceptualise existing engineering practices and technologies to address current water security challenges, and increase the resilience of UK communities to climate change. Novel technologies which use nature-inspired materials (adsorbents, membrane filters) are promising for removing emerging pollutants from water. While recent research is exploring the potential for decentralised water systems for rural communities, which seek to employ biofilters which require minimal energy input to deliver drinking water to off-grid households. These promising techniques offer hope in the face of the growing challenge; however, they must be scaled up and delivered at pace if we are to achieve water resilience for future cities.

Interconnected systems

As we look to COP 30, with explicit reference to water management within its action agenda, countries can use this as an implementation engine for scaling sustainable solutions. However, there is still a way to go. The action agenda breaks up challenges into themes. These themes reinforce the silos which exist in society, and which prevent systemic change at the larger scale.

If we are to scale up on promising novel technology and sustainable solutions which can revolutionise water management to deliver true water security, we must recognise the interconnectedness of systems. At the University we have developed a novel technique which can explicitly represent interconnected urban systems and allow cascading impacts to be tracked through linked systems quantitatively to support holistic understanding.

Without systemic change across all systems, starting with financial systems, we are unlikely to achieve the pace of adaptation which is required to deliver true water security. By transforming our financial systems, and directing sources of finance towards green, sustainable and scalable adaptation measures we can deliver water security within cities and beyond.

Will COP 30 foster human and social development?

Elizabeth Bomberg
Professor of Environmental Politics

The UN climate summit in Belém, Brazil (COP 30), prioritises action. Instead of striving for new targets or pledges, the focus will be on implementation of commitments already made. The COP Presidency has identified six 'action agendas' which should enable states to meet goals set at the Paris climate summit 10 years ago. One of the broadest agendas is Pillar 5: Fostering Human and Social Development. How likely is it that this agenda's aims will be realised?

Unlike the agendas around specific carbon emission reductions or finance commitments, this axis is more far-reaching and ambitious. In broadest terms it aims to ensure human and social development is integrated into climate action. More specifically, this axis calls for: 'reducing the impacts of poverty and hunger, promoting resilient communities, and ensuring fair transitions'. A core aim here – introduced but not developed in earlier COPs – is to create an equitable, 'just' transition to a climate-safe world.

Synergies

That ambition is necessary. As climate justice scholars here at Edinburgh have demonstrated, a more holistic agenda – one that takes seriously equity and just transitions – is absolutely core to creating the systemic change required for meaningful global action. At first glance the theme's aim appears uncontentious: who could object to action designed to foster human and social development? But this axis is also the most vulnerable to political neglect and may thus prove the most difficult to achieve.

This axis focuses on synergies between climate action and sustainable development. The assumption behind this link reaches back to the original 1992 Earth Summit also held in Brazil. There, signatories agreed that environmental destruction and climate change are inextricably linked to poverty and inequality. Put another way: climate change cannot be tackled without addressing human and social development.

Collective action

The Brazilian Presidency takes this aim seriously and has prioritised it in the organisation, participation and agenda

of this COP summit. Indigenous communities are likely to be far more present than in previous COPs. Knowledge from those communities has shaped the COP Presidency's distinct approach to action, including its central calls for a Global Mutirão – collective mobilisation and effort across society. Moving beyond a reliance on state leaders and formal parties, the Presidency calls on a range of civil society, businesses and other sub-state actors to mobilise delivery of country-level targets. This emphasis is clever because it relies less on states reaching international consensus on major action – an aim this COP is unlikely to achieve.

However, reliance on non-state actors is not a panacea. Business engagement is key, but not all businesses want the same thing. Belém will need to reverse the trend whereby fossil fuel firms are better represented than civil society or developing nations themselves. The Belém approach may also put an undue burden on civil society. As my political analysis outlines, public engagement in climate has diminished in recent years. The reasons are many – including the distraction of wars and shifting economic priorities. Civil society will also face a more immediate obstacle in Belém – an acute shortage of affordable accommodation. That lack of presence and participation matters – without it leaders will find it easier to offer 'wellbeing platitudes' rather than specific action.

Transition

A further challenge lies in the very core of the axis – reconciling climate action and justice. When taken seriously the emphasis on just transition is a crucial way to ensure climate action is not seen as a counter to cost of living protection, wellbeing, or human thriving. The boosting of a green economy and a reduction in pollution should result in safer, cleaner, more secure jobs, lower energy costs and healthier environments. The contrast with a fossil-fuelled polluting future is massive. However, as research from our network of energy and sustainability scholars confirms, just transitions are never quick. The realisation of synergies between equity, health and climate action requires a longer-term perspective. It is often abandoned when elected governments face the powerful discourse of fossil fuel firms (and allied politicians) insisting climate action threatens human progress and 'ordinary folk'.

No one summit can solve this larger narrative battle. But an important step is ensuring justice, health, wellbeing (the real bonuses of climate action!) are on the agenda and not just flogged off by empty words. The Just Transition Working Group highlighted in the 2025 Bonn preparatory summit is one example, even if its remit remains vague and open to interpretation. Research by Edinburgh scholars demonstrates the Just Transition Commission in Scotland could provide lessons on how to turn words into action. It suggests calls for something like a Belém Action Mechanism to 'accelerate, consolidate, and achieve a holistic just transition within and between countries' could be a small but significant action.

Conclusion

In sum, it is quite possible the prioritisation of development and just transition will not get the attention it deserves at Belém. Even so, small actions will help. It is critical to maintain the focus on this important axis. Addressing climate change is about carbon reduction and finance metrics – but not only. Justice, wellbeing, and human development remain key.

Green illusions and the extractive state: The moral dynamics of Africa's post-oil futures

Dr Nelson Oppong
Senior Lecturer at the Centre of African Studies

At the 26th UN Climate Conference in Glasgow, Ghana's former President Nana Addo Dankwa Akufo-Addo declared: "The Almighty has blessed our lands with abundant natural resources, and it would be wholly unfair for the world to demand that Africa abandons the exploitation of these same resources needed to finance her development…"

This poetic and politically charged statement encapsulates the moral dilemma at the heart of Africa's climate discourse. It is a familiar refrain – one that invokes divine providence and historical injustice to justify continued fossil fuel extraction. Yet, mere days after this speech, the Ghanaian government inaugurated a National Energy Transition Committee to chart a path toward net-zero carbon emissions. This apparent contradiction is not incidental; it is emblematic of a broader paradox shaping Africa's post-oil futures.

The double game of energy transition

Ghana, like many resource-rich African states, is engaged in a double game. On one hand, it has pledged allegiance to global climate goals, committing to a net-zero future by 2060. On the other, it is actively expanding its oil and gas infrastructure, including a Petroleum Hub initiative aimed at attracting petrochemical investments. This duality is not merely strategic; it is deeply political.

Between 2016 and 2021, Africa attracted over 50 billion US dollars in new oil and gas investments, even as governments adopted net-zero targets. While critics often dismiss this as climate denialism or greenwashing, it reflects the structural contradictions confronting oil-rich African states: the imperative to finance development through proven commodities, juxtaposed with mounting pressure to conform to global climate orthodoxy.

Beyond green dogma

Supported by the Carnegie Fund for the Universities of Scotland, my research – 'Energy Compacts and the Burning Question of Africa's Post-Oil Future' – explored these tensions within Ghana's energy landscape. Over two years, we conducted interviews with more than 70 stakeholders and analysed a wide array of policy documents. A clear consensus emerged: climate change is real, and its impacts are devastating. Yet, there is a growing demand for realism – an insistence that energy security and economic justice must be central to any transition.

Ghana's energy sector is beset by structural challenges:

- Over three billion US dollars in debt to Independent Power Producers (IPPs), leading to plant shutdowns.
- Approximately 40 per cent technical and commercial losses within the Electricity Company of Ghana (ECG).
- Renewable energy penetration remains at a mere two per cent, despite abundant solar and wind potential.
- Regulatory bottlenecks and fragmented institutional coordination persist.

The government estimates that achieving net-zero by 2060 will require 550 billion US dollars in capital investment. Yet current public and private commitments fall woefully short. Without bold reforms and robust governance, the energy transition risks becoming another illusion.

Emmanuel Turkson

Climate justice or climate compliance?

The global climate regime often demands compliance without compensation. African countries are urged to phase out fossil fuels, but where is the support for alternative pathways? Where is the investment in green infrastructure, technology transfer, and capacity building?

This is not merely a technical debate; it is a moral and existential one. Ghana discovered oil barely a decade ago. During two rounds of workshops with policy actors and researchers in the energy sector, a recurring question emerged: Why should the country abandon a resource with proven developmental value, especially when wealthy nations continue to exploit theirs?

Extant scholarship offers critical insights into how states are embedded in energy-configured regimes. Concepts such as 'fossil capitalism', Achille Mbembe's 'gestural symbols' and Jean-François Bayart's 'politics of extraversion' illuminate how African states often mimic global norms to secure legitimacy and resources, even when those norms conflict with domestic realities.

Reimagining the future

We must move beyond simplistic binaries – fossil or clean energy – and interrogate the deeper materialities and imaginaries that shape climate action. This includes:

- **Justice and differential impact:** How do colonial legacies shape Africa's vulnerability?
- **Livelihoods and local economies:** What are the real costs of mitigation for communities?
- **Political aesthetics:** How is climate action expressed in governance and public discourse?

Ghana's energy transition is not just about carbon, it is about sovereignty, development, and the future of the state. It demands a reimagining of what development means in a post-oil world. The path forward must be just, inclusive, and transformative – not merely dictated by external agendas but shaped by local realities and aspirations.

Making change work – how designing for resilience in our health systems creates new possibilities for tackling the climate crises

Professor Liz Grant
Director of the Global Health Academy

Dr Rowan Jackson
Lecturer in Planetary Health and Food Systems

While the whole of the COP 30 Action Agenda speaks to a fractured world where the causes, drivers and impacts of climate change are recognised as parts of a much bigger jigsaw of crises, theme five: Fostering Human and Social Development, calls out the often-neglected component, that of the power of people in different sectors, across public, civic and private organisations, to collectively develop and design tangible co-benefits that work at system, societal and community level. Relationship building and the strengthening of the societal systems in which we live and work, is at the heart of this theme.

Our combined climate, environment and health data tells us with absolute certainty that the future will be very different from the past. The first objective of the theme 'promoting resilient health systems', asks us to consider whose futures will become rapidly diminished if we take no action, and what we can do to design and develop systems and services that strengthen social cohesion and wellbeing, while simultaneously reducing inequalities.

How every nation cares for the health of its people has been the signature of that nation. Now, how nations grasp the opportunities of the Belém Health Action Plan for the Adaptation of the Health Sector to Climate Change, to build equitable solutions inclusive of all, and especially those most vulnerable, will be the signal of turning from fear, to fostering win-win solutions for climate and health.

Approach

Our overarching three-fold approach to building health resilience at the University of Edinburgh speaks directly to the action lines of the Belem Health Action Plan, namely: Surveillance and Monitoring; Evidence-Based Policy Strategy; and Capacity Building and Innovation and Production.

Curating real-time local evidence on the changing nature of the types, the prevalence, and the complications of diseases and their consequences, is essential. Though the determinants of healthiness sit for the most part outside health systems, a strong health system is essential for protecting health, preventing disease and enabling flourishing.

Almost all health systems were configured to function within what was assumed to be a stable, predictable climate and to respond to a disease portfolio characterised by commonly presenting diseases and illnesses. Health systems manage the diseases of the present, not the diseases of the future.

Changing health

We know our changing climate is changing health directly, through the immediate effects of adverse weather events such as storms, droughts, floods, cyclones, fires and heatwaves, causing illness, injury and death. We know it is also changing health indirectly, through rising vector-borne, food- and water-borne disease, malnutrition, and increasing mental illness; pollutants in the air from the drivers of climate change are causing more respiratory illness, strokes, cancers and heart disease; and through eco- and socio-mediated effects of these adverse events seen in rising poverty, and inequitable access to livelihood support, alongside increasing conflict, displacement and migration.

Edinburgh Infectious Diseases, the UK's largest network of scientists, is producing global evidence banks on all these impacts, challenging us to recognise how their interactions are creating new wicked challenges such as AMR.

Working with Universiti Malaya and seven South Asian partners, the RESPIRE consortium are not only collecting data on the lived experiences of climate impacts, including the effect of harvesting fires on air pollution, increases in paper mulberry pollen, and the consequences of flooding on respiratory disease, but are co-designing regional solutions.

Health System Resilience requires readiness. Our work, The role of open standards in catalysing knowledge transfer to deliver climate adaptive care | npj Digital Medicine, shows the value of collecting live patient data over time and overlaying this with climate and environmental data to establish patterns and prepare services to respond effectively. Applying AI capabilities to digital health ecosystems to collect and interpret sensitive climate-related changes offers opportunities for health systems to design timely locale-specific care in response to increasing adverse weather events.

Intersectoral policies and intersectoral education

The challenge of the climate and health community has been our tendency to speak with one voice to ourselves. The health-environment nexus asks the questions of how we work together not simply to build individual lines of capacity, but to create win-win opportunities where investments deliver co-benefits. The Policy Guide co-developed with the International Institute for Social Development provides a toolkit of shared language across the UN global policy agenda.

The Scottish National Health Service, recognising the complexities and interconnectedness of health system shocks, has set in place pre-emptive interventions and adaptive protocols relevant not only to health services but to every industry, agency and public service. Our contributions into Scotland's Chief Medical Officer (CMO) Annual Reports Realistic Medicine – Doing the right thing changes the dynamics of who hears and who can take responsibility for health. Systems can only become resilient if everyone understands that the climate crisis is a health crisis. Financiers, industry leaders, journalists, energy experts, urban designers, along with health practitioners have joined our MSc Planetary Health to understand how to anticipate risk and read shocks, and how to embed compassionate methodologies which care for people and planet, and drive an economy in service of both, rather than one which is driving risk.

Health system resilience also comes from recognising that the climate emergency is a socioeconomic emergency, where social inequalities will exacerbate health inequalities. Livvy Swann, a paediatrician and data scientist, is breaking new ground in understanding how climate-related damp housing impacts on young children's lungs, leading to respiratory infections: Homes, Heat and Healthy Kids Study | Usher Institute | Usher Institute.

Investing in innovations, technologies, architecture, infrastructure and nature-based solutions to reduce the carbon emissions of the health system and service as a whole

The *British Medical Journal* notes that: "If the healthcare sector was a country, it would be the fifth largest emitter on the planet". An estimated five per cent of the UK's greenhouse gas emissions come from the health service. The NHS is the UK's largest public sector energy user, with the bulk of energy used in secondary and tertiary-care facilities. This, coupled with transport to and from health services, and medicines, together constitute the majority of emissions. Reducing hospital usage is central to a resilient health system. Innovations in AI offer part of the solutions. The Advanced Care Research Centre has combined knowledge from medicine, engineering, informatics and social sciences to design programmes supporting older people to live for longer and live more sustainably, outside of hospitals and high-dependency units.

Health systems are in transition; our response is to work with the opportunities that being in a transitional state offers, and to shape the transitional pathway towards improved wellbeing and the conditions for flourishing and thriving.

Find out more

Planetary Health MSc

Mobilising climate and sustainable finance for adaptation and resilience

Professor Luca Taschini

Chair in Climate Change Finance and Director for the Centre for Business, Climate Change and Sustainability

The next decade will test whether finance can be an instrument of resilience rather than reaction. While capital markets have learned to value decarbonisation, they remain ill-equipped to price adaptation. Global climate finance exceeded 1.9 trillion US dollars in 2024, yet less than four per cent supported adaptation and resilience. The rest continues to chase mitigation – technologies that reduce or remove emissions – because they offer measurable, monetisable returns and (to some extent) clear policy signals. Finance for adaptation, by contrast, remains fragmented, under-incentivised, and poorly integrated into investment decision-making.

This imbalance is no longer tenable. The physical impacts of climate change have caused an estimated 3.6 trillion US dollars in economic losses since 2000, and these costs are rising faster than mitigation investments can curb them. Adaptation finance must therefore be seen not as residual spending but as preventive investment, essential insurance for the global economy.

At the University of Edinburgh, research at the Business School and through the Centre for Business, Climate Change and Sustainability (B-CCaS) explores how financial architectures can be redesigned to support climate resilience.

Mainstreaming climate in investment and insurance

Mainstreaming climate risk across financial systems means embedding resilience metrics into every major investment and insurance decision. Progress has been uneven. Carbon metrics such as tonnes of CO_2 avoided have become the lingua franca of climate finance, but they do not capture resilience value: the avoided losses and stability gained from adaptation. This 'carbon tunnel vision' narrows capital allocation and systematically undervalues projects that protect lives and assets rather than reduce emissions.

To correct this, regulators and market actors must adopt resilience-based disclosures alongside mitigation targets. Expanding frameworks such as the Task Force on Climate-Related Financial Disclosures (TCFD) to include physical-risk preparedness can create demand for adaptation solutions within corporate supply chains and infrastructure portfolios. Similarly, insurers – among the world's most climate-exposed financial institutions – can play a pivotal role by linking premiums, credit ratings, and lending conditions to resilience performance. Typically, when insurance markets reward prevention, capital flows follow.

Universities and research centres can accelerate this mainstreaming process by developing transparent methodologies for measuring resilience. The absence of standardised adaptation metrics is not merely technical, it is financial. Without a common language of resilience, investors cannot benchmark opportunities or price risk accurately. Collaborative efforts between academia, financial institutions, and data providers can fill this void by quantifying avoided losses, social co-benefits, and long-term productivity gains from resilient systems.

These issues were central to recent work presented by B-CCaS member Karishma Ansaram at the Adaptation Futures Conference in New Zealand early in 2025, where she discussed the capacity-building needs of climate-finance institutions. Her ongoing research on data reporting and metrics for Green Climate Fund (GCF) projects is helping to shape how financial intermediaries track resilience outcomes and improve transparency.

Finance for adaptation: De-risking and crowd-in capital

Closing the adaptation finance gap will require both public leadership and private innovation. Public funds remain the backbone of adaptation finance, but they are insufficient to meet global needs – estimated between 500 billion and 1.3 trillion US dollars per year by 2030. To leverage private capital, financial architecture must evolve from reactive grant-making to proactive risk-sharing.

Blended-finance models can be powerful enablers. Government or multilateral investors can provide first-loss capital or guarantees that absorb early-stage risk, thereby crowding in commercial investors. In the venture-capital ecosystem, catalytic public investors such as Canada's Business Development Bank, profiled in recent research, can use their longer-term horizons to nurture adaptation technologies that traditional funds often overlook. These include innovations in water management, fire-resilient materials, and predictive climate analytics – sectors that protect economies from physical risk while generating investable returns.

These themes are echoed in recent dialogues we have led through the Scotland Beyond Net Zero Climate Finance Roadshows and the Centre of African Studies conference on post-carbon Africa, which brought together financial institutions and policymakers to identify derisking instruments and equitable pathways for mobilising private investment in adaptation.

Policy coherence is equally important. The success of clean-energy finance over the past decade owes much to consistent policy signals – tax credits, renewable-energy standards, and carbon-pricing mechanisms – that reduced uncertainty and created markets. Adaptation requires an equivalent set of 'resilience incentives.' Governments can integrate adaptation criteria into public procurement, infrastructure planning, and disclosure regulations. Doing so creates predictable demand for adaptation technologies, which, in turn, supports venture investment and innovation.

Building an enabling ecosystem

Finance for adaptation will not scale through capital markets alone. It depends on an enabling ecosystem that includes governance reform, digital infrastructure, and capacity building. Transparent data platforms and interoperable taxonomies can reduce information asymmetries that deter investors. Artificial intelligence and remote-sensing technologies can improve the measurement of physical climate risk, while open-source digital tools can democratise access to resilience analytics for small and medium-sized enterprises.

This innovation mindset is already visible at the University of Edinburgh, where a team from the MSc Climate Change Finance and Investment programme recently won the 2025 Climate Investment Challenge for designing a resilience credit market to mobilise private and public finance for adaptation in the Philippines. The project demonstrates how academic initiatives can translate climate-finance theory into practical market instruments that advance resilience goals.

At the same time, adaptation must be reframed as a driver of competitiveness, not a cost of compliance. Entrepreneurs developing resilience technologies should be treated as climate innovators, and venture investors should recognise the latent market potential of protecting assets worth trillions. Educational and research institutions have a critical role in nurturing this reframing – through interdisciplinary curricula, evidence-based policy design, and partnerships that translate science into financeable solutions. For example, the University of Edinburgh's Mastercard Foundation Scholars Program is equipping justice-oriented climate leaders across Africa with postgraduate training, entrepreneurial pathways and digital skills for resilience and sustainable transitions.

From mitigation to mutuality

The evolution of climate finance from mitigation-centric to resilience-inclusive is not only an economic adjustment but also a moral and systemic one. Adaptation finance aligns investment with the realities faced by communities, businesses, and ecosystems already living with climate disruption. It calls for a shift from carbon accounting to mutual risk management – a recognition that resilience is the new return.

As COP 30 approaches, the challenge for the international community is to unleash these financial enablers at scale. Mobilising private capital for adaptation will demand policy stability, innovative risk-sharing instruments, and a credible measurement framework. But most of all, it requires a change in mindset: to see adaptation not as a sunk cost but as an asset class that safeguards the foundations of prosperity.

The vital role of education and learning in enabling change

Dr Beth Christie

Senior Lecturer, Moray House School of Education and Sport, and Director, Scotland's UN University-Recognised Regional Centre of Expertise on Education for sustainable development

Andrew Perry

Education is one of the most powerful tools we have for building a just, equitable and sustainable world. It should hold a vital, cross-cutting role within COP 30's Action Agenda, to enable capacity building, and drive progress across multiple areas — from transitioning energy and industry, to strengthening resilience, transforming agriculture and food systems, and supporting finance and technology. Yet, it is currently confined to Pillar 5 as a single, isolated objective focused on: 'education, capacity building, and job creation to address climate change,' which significantly limits its overall impact.

While COP 30 focuses primarily on climate, education and learning are more effectively understood and implemented within a broader, interconnected framework of sustainability education. This approach is lifelong, extending beyond formal institutions into families, communities, workplaces, and public life, shaping the values, skills and actions needed to address the multiple unfolding crises — including those related to climate and nature.

Sustainability education

A strong example of this is Scotland's UN University-recognised Regional Centre of Expertise on Education for Sustainable Development, hosted by the University of Edinburgh. Through a pan-thematic and cross-sectoral, partnership-driven ethos, it supports and embeds Scotland's approach to sustainability education — Learning for Sustainability — which situates climate education within a wider economic, environmental and social curricular approach. This holistic policy approach, which is **the entitlement of every learner in Scotland**, spans all educational settings — from formal 3–18 education, through to colleges, further and higher education, as well as community and informal learning. It is embedded across governance and organisational structures, cohering all aspects of Scotland's educational architecture – curriculum, professional standards and inspection processes, aiming to ensure all learning settings (grounds, buildings and infrastructure) will be sustainable by 2030.

Understood this way, education plays multiple, interconnected and fundamentally important roles.

At an individual level, it enables people to recognise and confront their own complicity, while guiding them toward

meaningful and compassionate action that embraces uncertainty and acknowledges the provisional nature of their contributions. As an example, at the University of Edinburgh, all staff and students are encouraged to take up industry-recognised courses in biodiversity and carbon literacy. Feedback from these sessions suggest that it has just this effect at an individual level.

At a systemic level, it acknowledges that education systems and structures themselves must be reoriented towards sustainability education and supported to become climate resilient. Globally, all educational settings should be equipped to withstand climate shocks while continuing to provide safe, inclusive and transformative spaces for learners.

Issues

The COP 30 Action Agenda can support the systemic change needed to amplify climate and sustainability education, but only if it positions education in a more holistic and transversal way that recognises three inter-related issues:

- A need to move beyond short-termism towards systemic change: Sustainability education (including climate education) must be integrated into national standards, initial teacher education, ongoing professional learning for educators, and assessment systems as well as, for example, campus infrastructure including procurement, buildings and grounds. Equally, the culture, ethos and governance of educational settings should also be supported through a reorientation process, ensuring that a whole-school or whole-institution approach is adopted that works with the wider community, its peoples, its knowledges and its cultures to enact change. In this way, education and learning for sustainable futures is a shared process — co-creating with and for all communities; human and more-than-human alike.
- **The need for sustained, long-term, financial investment:** Including education in Nationally Determined Contributions (NDCs) can help secure climate finance for education, supporting systemic national implementation. Initiatives like the Climate Education NDCs Tracker already monitor the inclusion of climate education in national commitments by evaluating curricular integration, teacher education, community engagement, and youth leadership. This sustained investment is key to achieving transformative impact.
- **A more holistic understanding of education's transformative potential:** Sustainability education is fundamentally a social justice issue, rooted in histories of inequality, extractivism, and exploitation of people and the environment. Futures thinking and action toward a flourishing, sustainable planet must therefore be grounded in equity, compassion and inclusivity. This requires making explicit the connections to racial justice, gender equality, labour rights, and geopolitical realities such as war, genocide and displacement, as well as addressing the powerful role of misinformation and disinformation.

Valuing reciprocity, relationality, diverse ways of knowing, indigenous knowledge systems, and both intra- and inter-generational perspectives is essential. Ethical, social and political dimensions must be brought to the forefront, surfacing unequal impacts and debating questions of fairness, power, and rights — human, natural and planetary. Critical questions must be asked: Who benefits? Who suffers? Whose knowledge counts? When does that knowledge count?

Conclusion

At the 1992 Earth Summit in Rio de Janeiro the United Nations Framework Convention on Climate Change, in its landmark report 'Agenda 21', highlighted the importance of education, training and public awareness in a sustainable future. Since then, the journey of education and learning within the COP process has shown both progress and unrealised potential. Thirty-three years on, COP 30 (again in Brazil) looks set to be no exception. Climate action cannot rely on multilateral agreements, policies and technologies alone. While these tools are essential, they ultimately depend on informed and empowered people and communities.

Education offers an integral enabling and capacity-building foundation for this work. Without it, a just, equitable and sustainable future cannot be achieved.

Massive Open Online Courses (MOOCS)

The University of Edinburgh, Scotland's UN University-Recognised Regional Centre of Expertise on Education for Sustainable Development (Learning for Sustainability Scotland), and the British Council are offering two free online learning opportunities:

- Learning for Sustainable Futures: Live at COP30
  A two-week course
- Learning for Sustainable Futures
  A five-week course

GeoSciences resilience – connections from nature, resources, and society

Stuart Haszeldine
Professor of Carbon Capture and Storage

Geosciences at Edinburgh connects with COP 30 themes across all levels of University staff – drawing on a strong balance between established academics, doctoral and postdoctoral early career researchers, and undergraduate students across the full array of disciplines the University has to offer. The research influences come from developing basic understandings of the natural earth ecosystems – from oceans to forests, and icefields to atmosphere.

Towards net zero

Here climate monitoring and modelling developed in Edinburgh is being applied to inform government policies for resilience in the UK and internationally. Scotland has a national aspiration to reach net zero in 2045. The University is also among world leaders in planning for, and investing financially, to go beyond a sustainable pathway to become a regenerative organisation by 2040, which will actively repair environmental systems.

For University members working and researching in GeoSciences this means a huge range of expertise and knowledge is continually created. A core of this is the emphasis on the central role of a university to invent and develop mitigation and solutions to global challenges of sustainability and survival. One of the three pillars of Edinburgh research is tackling the environment and climate crisis.

Paul Dodds

Edinburgh research has provided national and international classifications of biochar types, which informs government policy on deployment and price support

Examples of problem-focused groups cross traditional disciplines and can continually create teaching and research teams. Examples of this expertise focus are on the explicit provision of support teams to ensure that research is funded by winning grants, is reliably undertaken and published to the highest of standards in peer journals,

digital and social media – and followed through with impact to capture commercial opportunities. Examples of research across boundaries are some of the groups created out of GeoSciences to address global themes.

Fostering change

Forests and landscapes provide understanding of past landscapes and predict nature planning into the future as long-lived ecosystems are forced to change rapidly. The Edinburgh Ocean Leaders programme supports a new generation of 48 individual changemakers globally networked across 30 countries. Edinburgh Earth Initiative creates a network across the University of 16 Earth Fellows who take time out from their research or studies to deliver strategic projects which improve connectivity and networking across the University. Specifically based out of GeoSciences, the Climate Exchange develops short research and review projects in collaboration with Scottish Government to inform policy choices on legislation such as the Climate Bill.

Scottish Carbon Capture and Storage undertakes original international research, reviews and education on topics of carbon capture and storage relating to management and storage of fossil carbon. The UK Biochar Research Centre has developed analytical methods to inform government standards, methods and classification of biochar use as a mid-lifespan carbon storage option. Climate Partnerships is creating a digital display platform shared between all Scottish local government regional councils to display the progress and co-benefits being achieved from local-level investments for climate action in urban, rural and remote communities. And the Sustainable Scotland Network maintains and compiles an annual overview of climate actions and policy performance in each local government area of Scotland.

Innovative teaching and research

The School of GeoSciences hosts 10 taught MSc programmes – many with a strong element of climate, energy, social sciences and transition. That means Edinburgh trains about 500 professionals each year to become informed and adaptable changemakers through their future careers. Also, here is one of the world's best equipped laboratories for analysis of minerals at micro scale, of relevance to understanding the genesis of critical mineral deposits, geochemical interactions storing carbon dioxide, hydrogen or compressed air in clean energy systems. There are groups reconstructing the geological record of past climate change, and in the energy system – solving mechanisms of earthquakes generated by fluid injection – storing compressed air or pumped water storage in a renewable energy system. In addition, we're developing innovations using water-filled former deep coal mines storing heat from computer servers, data centres, or AI national or global nodes, for use in heating workplaces, swimming pools or shopping precincts. We're also using knowledge of melting cryosphere ice sheets and glaciers to understand changes in ocean currents, sea level and global reflectivity.

Cross discipline linkages are important. Work on future energy systems can link engineered innovation of new capture systems to geological sites of CO_2 storage. Understanding of marine wave dynamics helps to design survival of offshore wind power systems. And linking understanding of construction of low energy buildings to engineered heat stores, to behaviour of building users can greatly reduce the energy consumption of future infrastructure.

A climate resilient future

In all these adventures into creating the future, Edinburgh can help to solve problems and improve present established systems. These can rapidly assemble world-class teams of expertise – to investigate and solve or mitigate problems in all areas of UN priorities, and those of the COP 30. The number of staff, the identification of climate and resilience as a University priority from the top down, and the support to achieve dissemination and impact of results – all position Edinburgh as one of the world's leading universities for climate analysis, research, intervention and design of policy application. Instead of travelling to world-class conferences, every day at Edinburgh is more like the conference comes to Edinburgh. The Edinburgh experience provides students, ECR and academic researchers with a flexible and versatile suite of experiences, information and skills which is making the climate resilient future world we are rapidly developing.

Mobilising transformative climate action through innovation

Charlotte Lee-Woolf

Business Development Manager for Social Responsibility & Sustainability, Edinburgh Innovations

Callum Bennetts

Many of the factors that support collective climate action can also maximise potential for positive impact from innovation. This article reflects on the role of innovation in enabling climate action and some of the qualities that can enhance its contribution to the COP 30 Action Agenda – a call for collective action to translate commitments into meaningful action on the ground.

What is innovation and why does it matter?

The COP 30 Action Agenda aims to accelerate the adoption and scaling of climate solutions.

Innovation – the process of adoption and use of new knowledge and ideas – facilitates this agenda by providing mechanisms and incentives to develop and deploy solutions in the transition to a low-carbon economy. In doing so, innovation can build resilience of individuals, organisations, cities and nations to climate change, and increase capacity for climate action in different areas of society, as part of a just transition.

Innovation encompasses many different activities, stakeholders and pathways to impact. At Edinburgh Innovations – the University's commercialisation service – we transform academic knowledge and ideas into new technologies, products and services for societal impact. Working across priority themes and sectors, such as biodiversity, circular economy, and clean energy, we support our academics and industry partners to drive innovation in a variety of ways. This includes licensing, company formation, business acceleration and investments.

One University spinout, SeaWarm, is a great illustration of the positive commercial outcomes and societal benefits that can flow from such activities. With investment secured to roll out its renewable heating system across Scotland's communities, SeaWarm's modular, low-cost, heat exchanger technology harnesses natural warmth from water to deliver affordable, sustainable heating and cooling. By replacing oil and gas systems, the company could cut CO_2 emissions by up to 90 per cent, while also reducing energy bills for households and businesses. While Scotland's coastal communities are an immediate focus for SeaWarm, it aims to expand into national and international markets as it seeks to play its part in the global clean energy transition.

Ingredients for transformative action

If innovation is a key enabler of climate action, what aspects increase the potential pace and scale of change that is demanded by the environmental polycrisis? We consider three inter-related elements of cross-boundary collaboration, synergistic working and systems thinking.

Firstly, there is the need to recognise and promote the collaborative nature of innovation processes. They require many actors with different skills and experiences, who work together across functional boundaries, to create the right conditions for new solutions to be validated and grow.

With so many stakeholders represented at COP 30, the event itself is an opportunity to spark new connections leading to action that is founded upon cross-boundary collaboration. There is a risk, however, that competing views and negative perceptions between actors undermines efforts to build productive collaborations.

Universities and others can help avoid vital ground being lost, by championing successful models of cross-boundary collaboration – such as the University's Edinburgh Futures Institute – as a means of bringing different perspectives together to challenge convention and drive innovation for a better future.

Building on this, synergistic working can accelerate innovation by leveraging skills, experiences and perspectives of partners and collaborators.

Founded on a mutual desire to deliver positive impact through research, education and business innovation, the University's partnership with NatWest Group is a good example of synergy within an academic-industry partnership. The longstanding partnership with NatWest includes, among other initiatives, an award-winning Climate Education Programme that has equipped thousands of bank employees with the knowledge and skills needed to manage climate risk and support clients to engage with the net zero transition.

Lastly, as this year's COP President highlights in relation to COP 30, systems-thinking is key to realising transformative change through innovation. It is necessary because of the complex, interconnected nature of ecosystems in which new solutions are implemented and scaled. Systems-thinking provides insights that help to overcome blockages, unlock co-benefits, and avoid blinkered approaches that fail to capture the full value that innovation creates in complex systems.

The University's new Centre for Net Zero High Density Buildings is a case in point. An initiative that aims to significantly reduce carbon emissions from densely packed buildings in UK cities and towns, the Centre draws industry, education, public sector and the community together. This dynamic partnership will improve the energy efficiency of 'hard to treat' buildings, while delivering co-benefits for households on lower incomes, and opportunities to bring new sustainable construction products to market.

What else?

If COP 30 is about giving rise to additional support and opportunities for the adoption and scaling of climate solutions – what more can be done to achieve a step-change?

In 2023/24, Edinburgh Innovations supported £19.4 million of industrial and translational research awards; £32.4 million of investment into associated companies; and the creation of 18 startups and spinouts, that focused on addressing climate change and other environmental challenges.

These metrics indicate the scale of impact we have, and we intend to go further and faster by doubling innovation outputs by 2030 and continuing to find new ways to unlock the power of academic research through commercialisation.

This includes the new Regen Innovation Catalyst Proof of Concept Fund we are piloting as a means of further supporting innovators and entrepreneurs to progress the commercial readiness of promising climate technologies and other solutions.

We are also continuing to develop the knowledge, skills and behaviours of academic staff engaged in innovation, through an Innovation Competency Framework, to enhance positive outcomes from innovation.

Finally, the University is encouraging its researchers to think holistically about climate action, by supporting them to address priorities in the UK Concordat for Environmental Sustainability of Research and Innovation Practice, which include harnessing the power of collaboration and partnerships to extend the scale and reach of climate action from research and innovation.

We are committed to accelerating climate action through the commercialisation of innovative knowledge and ideas, alongside policy engagement and other pathways to impact. In tandem, we must always be open to innovation ourselves so we can make more of those ideas work better for a sustainable future.

Advancing action at the University of Edinburgh

Clean Energy Systems

Energy@Edinburgh
A cross-disciplinary research hub of 200 academics and researchers from across the University. It provides leading expertise and critical insight into a range of energy issues. The hub works across seven different research themes, including offshore renewable energy; energy, society and just transitions; energy and climate change; and energy storage and carbon capture.
E: energy@ed.ac.uk
W: energy.ed.ac.uk

Institute for Energy Systems (IES)
One of the seven research institutes that sit within the School of Engineering. With expertise across nine research themes, the institute delivers world-leading research in low carbon energy systems, technology, and policy.
E: RIS.Eng@ed.ac.uk
W: https://eng.ed.ac.uk/research/institutes/ies

Energy and Society Research Group
A network of social scientists from the University, whose research aims to address the challenges arising from energy transitions around the world. The group ensures public engagement with their work by partnering with public, private, and third-sector organisations, bringing social science insights into debates around the energy transition.
E: Faye.Wade@ed.ac.uk
W: energy-society.ed.ac.uk

Residential Heat Batteries (collaboration with Sunamp Ltd)
Researchers from the School of Chemistry work in partnership with Sunamp Ltd to address long-standing stability issues with the phase-changing materials required for heat batteries. This has allowed the development of patented formulations to store and release heat on demand, enabling Sunamp to bring the world's first commercially viable residential heat batteries to market.
E: Teresa.Raventos@ei.ed.ac.uk
W: https://edinburgh-innovations.ed.ac.uk/case-studies/sunamp-next-generation-thermal-energy-storage

The Edinburgh Geobattery Project
The University is the lead research partner on this project, led by Edinburgh-based geothermal company TownRock Energy. It will trial whether waste heat from the University's Advanced Computing Facility could be used to heat at least 5,000 homes via heat pump technology.
E: christopher.mcdermott@ed.ac.uk
W: https://www.ed.ac.uk/news/2024/supercomputer-heat-and-old-mines-could-warm-homes

FloWave Ocean Energy Research Facility
FloWave is a wave and current simulation tank for use in the testing and development of novel ocean energy technologies. As the first circular combined wave and current facility in the world, FloWave is the best simulation of real-world coastal waters available. It offers both commercial and academic clients the chance to accelerate the testing of their technology and is therefore a huge asset to ocean energy research in the age of rapid renewable energy development.
W: www.flowavett.co.uk

Circular Economy

Carbon-Loop Sustainable Biomanufacturing Hub
C-Loop is a sustainable manufacturing hub that uses microorganisms to transform carbon-based waste products into next generation materials such as pharmaceuticals. More than 40 industry partners from seven different sectors are involved in the hub, which will help integrate products manufactured using fossil fuels into a circular economy.
E: Stephen.Wallace@ed.ac.uk
W: https://science-engineering.ed.ac.uk/new-hub-uses-microbes-to-turn-trash-into-treasure

The Horsfall Group
The Horsfall Group is interested in multidisciplinary challenges involving Biotechnology and Synthetic Biology. It is especially interested in how these areas might make manufacturing more resource efficient and help move us towards a more sustainable, circular economy. The Group is affiliated to the Institute of Quantitative Biology, Biochemistry and Biotechnology; the Centre for Engineering Biology; and the Centre for Science at Extreme Conditions, at the University of Edinburgh:
W: www.biology.ed.ac.uk/horsfall/research

Data for Sustainability

Centre for Statistics
This Centre aims to foster collaboration between statisticians and researchers working across other disciplines, to better enable to use of modern statistical tools in research. It is made up of more than 100 researchers from across Edinburgh.
E: DirectorCfS@ed.ac.uk
W: https://centreforstatistics.maths.ed.ac.uk/

Jameel Observatory
An international partnership led by the University, that involves the International Livestock Research Institute, Save the Children, the Abdul Latif Jameel Poverty Action Lab (J-PAL) and Community Jameel. It uses data and evidence to prepare for and respond to environmental shocks. In addition to natural disasters, health, agriculture and food systems, the Observatory also considers the impacts of climate change that may threaten human and environmental wellbeing in their work.
E: info@jameelobservatory.org
W: https://jameelobservatory.org/

Data for Children Collaborative with UNICEF
A specialist unit within the University's Edinburgh Futures Institute that works with a range of partners, including UNICEF and the Scottish Government, to leverage data to address the problems faced by children. Work includes the development of the Children's Climate Risk index, delivered in partnership with the universities of Southampton, Stirling, and the Highlands and Islands, and the ONS-FCDO Data Science Hub.
E: https://www.dataforchildrencollaborative.com/dcc-contact-us
W: https://www.dataforchildrencollaborative.com/

The Bayes Centre, Edinburgh Space Hub
The Edinburgh Space Hub brings together experts from academia and industry to drive advancements in space technology. Based at the University of Edinburgh's Bayes Centre, a key hub of the Data-Driven Innovation initiative, the Space Hub focuses on areas such as robotics, AI for space, climate change, sustainability, and space law.
W: www.bayes-centre.ed.ac.uk/spacehub

The Scottish Climate Intelligence Service (SCIS)
The SCIS platform provides the data and knowledge to help local authorities decide on the actions needed to achieve net zero emissions, based on area-wide emissions.
W: https://www.climateintelligenceservice.scot

Sustainable Cities

Centre for Future Infrastructure
A world-class centre of excellence on infrastructure systems, which aims to deliver solutions for the complex challenges arising from climate change, sustainability, resilience and global population growth. Brings together research from several disciplines, including architecture, informatics, business, and social and political studies, to build and maintain resilient and sustainable infrastructure systems. CFI also encourages engagement from partners across all sectors of the economy to develop infrastructure solutions.
E: Sean.Smith@ed.ac.uk
W: https://efi.ed.ac.uk/ecosystem/centre-for-future-infrastructure/

Institute for Infrastructure and Environment
Based in the School of Engineering, this Institute aims to promote human wellbeing in the face of future challenges to both urban and natural environments. The environmental engineering research theme aims to develop sustainable processes to improve the natural and built environment. Increasing the biomethane potential of food waste, is one example of current relevant research.
E: RIS.Eng@ed.ac.uk
W: https://eng.ed.ac.uk/research/institutes/iie

Future Cities
This research theme brings together researchers from across the College of Arts, Humanities and Social Sciences to support the development of smart, sustainable and inclusive cities at both a local and international scale. It combines architecture and design with concepts of wellbeing and inclusion, sustainability and energy use, and the use of urban analytics and modelling.
E: CAHSSReception.Team@ed.ac.uk
W: https://cahss.ed.ac.uk/

Future Food Systems

The Global Academy of Agriculture and Food Systems
A leading interdisciplinary hub of researchers that develops knowledge on the intersection and independence of the systems that underpin the health and wellbeing of people and the planet, including food, farming and land use systems. It aims to understand the drivers of Food System and Planetary Health Challenges and accelerate the development of mutually beneficial solutions to address these.
E: globalagriculture@ed.ac.uk
W: https://vet.ed.ac.uk/global-agriculture-food-systems

Food Researchers in Edinburgh (FRIED)
A research group based in the School of Social and Political Science that brings together academics, students and others at the University interested in food-related research. Considering food from several angles, FRIED works across food production, governance and trade, inequalities in food access, long-term use and abuse of resources, and food in relation to health and wellbeing.
E: I.Fletcher@ed.ac.uk
W: https://www.sps.ed.ac.uk/research/research-project/food-researchers-edinburgh-fried

Centre for Tropical Livestock Genetics and Health
The University is associated with this centre, which aims to improve livestock-based livelihoods in the tropics. Work includes the use of genomic tools to improve livestock productivity in these regions and increase climate resilience.
E: info@ctlgh.org
W: https://www.ctlgh.org/

Centre for Business, Climate Change and Sustainability
A hub for interdisciplinary research related to climate change and sustainability in business contexts. Research falls into five broad themes including carbon accounting; climate risks and financial markets; and international climate finance.
E: b-ccas@business-school.ed.ac.uk
W: https://www.bccas.business-school.ed.ac.uk/

One Health

Edinburgh Infectious Diseases
A network that connects more than 900 researchers and clinicians in 200 research groups working across infectious disease research in the City of Edinburgh. Run from the University, the network includes other Edinburgh organisations including Heriot-Watt, Edinburgh Napier, and Queen Margaret universities, NHS Lothian, and the Moredun Research Institute. The network is divided into six research themes: immunology and vaccines; molecular pathogenesis; disease dynamics; genetic basis of resistance; clinical and translational research; and social and healthcare dynamics.
E: eid@ed.ac.uk
W: https://edinburgh-infectious-diseases.ed.ac.uk/

Global Health Policy Unit
Based within the School of Social and Political Science, this unit takes an interdisciplinary and policy-focused approach to population health and the factors that affect health at the regional, national and international scale. Research is focused around four themes: universal health coverage; commercial determinants of health; global governance of health; and knowledge, evidence and policy
E: marzia.ballardin@ed.ac.uk
W: https://ghpu.sps.ed.ac.uk/

Centre for Research on Environment, Society and Health (CRESH)
A virtual centre that joins researchers from the universities of Edinburgh and Glasgow. CRESH aims to contribute to improved population and environmental health by connecting the two in policy-related research. Research is divided into six research themes: environmental deprivation; environment and health behaviours; green spaces and health; inequalities; air pollution; and methodology.
E: Info@cresh.org.uk
W: https://cresh.org.uk/

Cross-sector partnerships: industry, government and network collaboration

Edinburgh Earth Initiative
The Edinburgh Earth Initiative is a strategic support unit that accelerates the University's interdisciplinary research, partnerships and innovation activities, addressing the climate and environmental crises.
E: earth@ed.ac.uk
W: https://earth.ed.ac.uk

The Edinburgh Climate Change Institute (ECCI)
ECCI is a centre of excellence within the School of GeoSciences at the University of Edinburgh. The centre is an inclusive hub for researchers, policy makers, businesses, students and educators. The ECCI community includes agencies who work to tackle climate change and experienced climate practitioners working on externally funded challenge-driven projects.

Scotland Beyond Net Zero
Scotland Beyond Net Zero is a collaboration of climate and sustainability experts from across Scotland's universities who are mobilising research, data and innovation to accelerate Scotland's transition to Beyond Net Zero.
W: www.scotland-beyond-net-zero.ac.uk

Failure Modes of Engineering (FeME)
FeME focuses on engineering solutions for climate change and biodiversity loss, and their impact on women, children and underrepresented communities. (FeME) is a network plus project funded by EPSRC, and a collaboration between the Universities of Edinburgh, Glasgow and Heriot-Watt.
W: www.feme.ac.uk

Babcock – Fastblade facility
This facility opened in 2022, as the world's first rapid testing facility for tidal turbine blades. It will speed up the development of marine energy technologies while helping to reduce cost and maintain Scotland's position at the forefront of tidal energy development.

NatWest Group –
Launch of Centre for Purpose-Driven Banking
This centre opened in 2023 to draw on academic expertise in data science, AI, climate, and business, to co-develop solutions to societal challenges that can be addressed in the banking sector.

TownRock Energy – The Edinburgh Geobattery project
Announced in 2023/24, this is a pilot study that is investigating whether energy required to power the University's Advanced Computing Facility could be harnessed and recycled to heat thousands of homes in Scotland's capital.

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