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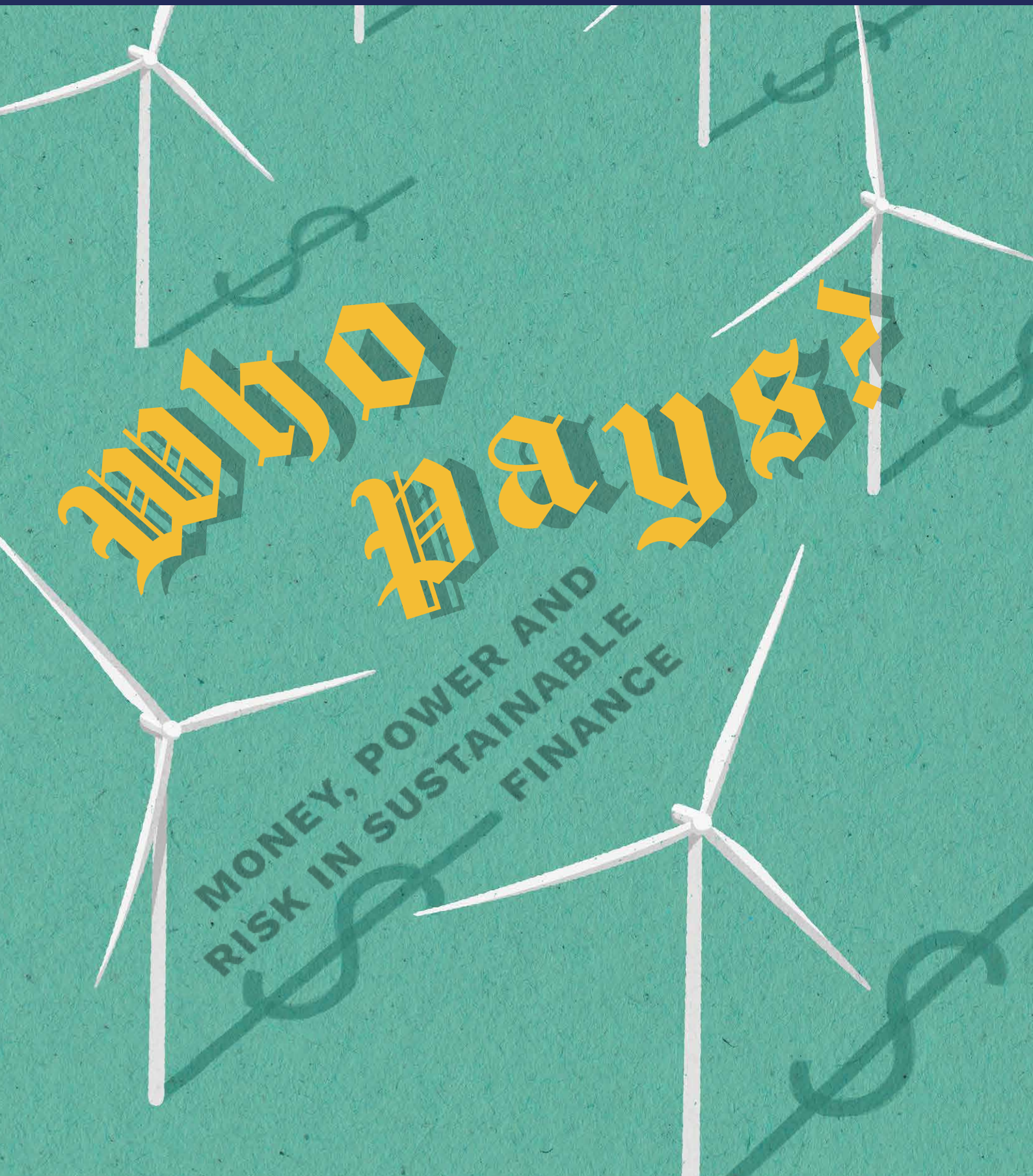

Who Pays?

MONEY, POWER AND RISK IN SUSTAINABLE FINANCE

EDITORIAL

Can our financial system become the agent of change our planet needs?

There are so many illustrations of the strife our planet is in that it should not need to be repeated. Yet, notwithstanding some heartening trends and good-news stories, it is hard to deny that current production and consumption pattens are putting ecosystems in peril with devasting consequences for communities around the world.

Finance is a culprit in this story, but it also offers us a realm of possible solutions.

The financial system has enabled externalisation and extractive behaviours by companies. Many dynamics of the financial system play a substantial role in channelling wealth to those who already have it and impose short-term perspectives on company management. This can encourage externalisation of environmental costs and conceptualisation of ecosystems as resources for profit rather than as nature's gifts, which sustain us and need protection.

This issue explores aspects of the finance industry and influences on it (e.g. policy, accounting, global agreements), highlighting how prevailing dynamics lock the finance system into current ways of operating and where drivers for change might exist.

Such realities can become opportunities for transformation. These might lie beyond the more obvious places such as reporting, accreditation, global agreements, taxonomies and direct investment, critical though these are. The role the financial sector plays in generating or addressing economic inequalities is also a lever for environmental action. This is seen in the findings of the landmark Earth4All project that:

'Inequality not only has profound effects on how we negotiate these difficulties. It also sets necessary conditions on what a sustainable society should look like, and, above all, on whether we are willing to make the changes required to get there.'[1]

Harnessing finance for positive impact here will require that those within the industry see their role not just as enabling wealth creation but as supporting fairer wealth distribution and direction of financial wealth to activities that are better aligned with the needs of people and planet.

There are at least four possible motivations for such approaches and actions, none of them mutually exclusive:

1. Compliance with government mandates;
2. The financial return that can be generated from investment in activities that have positive social or environmental impacts;
3. Reducing the risk that social and environmental breakdown present to the activities supported by the financial sector and the loss of revenue this could incur; and
4. The possibility that decisions in the financial system are driven by more than financial calculations, and instead also reflect goals such as contributing to social and environmental benefit.

These will resonate and be more (or less) compelling to different people in the financial industry depending on the nature of their work, their background and world view, and the governance of the institutions they work in. In time, however, if the financial system is to truly become an agent of transformation, it needs to be spurred more by the fourth motivation than compelled by the first three.

REFERENCES

1. Wilkinson, R. and Pickett, K. (2022) *From Inequality to Sustainability.* Earth4All Deep Dive Paper 1. https://www.clubofrome.org/wp-content/uploads/2022/05/Earth4All_Deep_Dive_Wilkinson_Pickett.pdf (Accessed: 11 March 2025).

Editorial: Katherine Trebeck is Writer-at-large and Co-director of the Compassion in Financial Services hub at the University of Edinburgh and Economic Change Lead at The Next Economy. She is a member of the Club of Rome, co-founded the Wellbeing Economy Alliance (WEAll) and WEAll Scotland, and instigated the Wellbeing Economy Governments partnership. The views contained here are personal and do not represent the views of those organisations.

Cover design: John Holcroft studied graphic design in the 1990s but decided to become an illustrator. He started out painting acrylics but turned digital in 2000, reinventing his style over the years. Past clients include the *Financial Times*, Nike, *The Economist* and Spotify.

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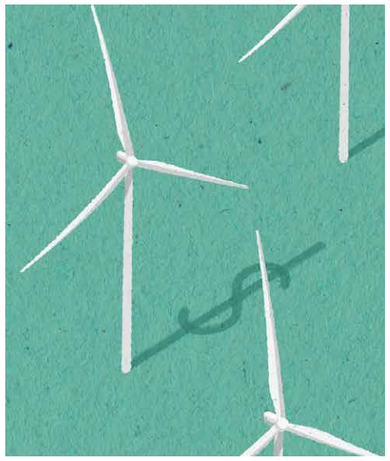

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INTRODUCTION

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Risk, return and resilience: the changing climate of finance

Iain Clacher sets the scene for a shifting paradigm in future-proofing investment.

Climate finance is something that is often talked about across government, industry and academia, as well as in public discourse. Often these discussions look at the amount of money needed to fund the transition to a low-carbon, climate-resilient, nature-positive world, and the fact that there is around US$170 *trillion* of assets under management across global insurance and asset management. When viewed like this, it is easy to state that there is more than enough money to invest in the climate transition and areas such as clean energy, which are key to achieving this. Sadly, it is not that simple; climate finance is much more complicated and there are a multitude of things that need to be considered.

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Money that sits within the global financial system has a purpose. Whether that is saving for a pension, a charity's endowment, or a foundation, that money is there to achieve a specific outcome. It is worth emphasising that those managing this money have a fiduciary duty to invest it to achieve this specified goal – for example, paying a pension. It is not therefore within the powers of these investors to simply invest in a project because it is good for the planet. They must make investments that enable them to achieve their goals. So, investments must be reasonably expected to achieve a given return for an acceptable level of risk in pursuit of this goal.

There has, however, been a significant shift in how investors view climate change. Climate change, and the risks it poses to investments, is now increasingly recognised across the financial system – from regulators to asset owners, asset managers and beyond – as an investment risk; not incorporating climate risk into investment decision-making processes will materially affect investment objectives. This is a crucial aspect in changing the investment system, as better understanding of investment risks changes investor behaviour. The other aspect that has changed investor views is the investment opportunities that the climate transition presents (e.g. clean and renewable energy).

There is a realigning of the investment system taking place right now; but questions do remain about the scale and pace of this change.

When reading this issue of environmental SCIENTIST, it is worth bearing in mind that only a subset of the challenges of climate finance are covered – including the complexity of regulatory architecture; the technological innovations that are needed at scale; the reporting requirements; the politics of climate finance; and the challenges of risk and uncertainty when thinking far into the future, which are critical when investment horizons can be 50, 60 years from now. These are not presented to paint a picture of a hopeless endeavour, where the barriers to change are so manifest that nothing can be done, but to show the progress made and the major advances in a range of areas – in other words, how the global finance system is starting to evolve and, ultimately, how it will realign.

There are various examples that illustrate the changes that are taking place. The first thing that needs to be made clear is what is the standard logic of investment; this holds true in both academic research in finance and in practice – namely, the interaction between risk and return. Simply put, investors expect compensation (returns) for bearing the risk of potentially losing money. In this world of risk and return, the higher the risk, the greater the expected returns should be.

For instance, in finance, 30-day US treasuries (i.e. government debt) are considered the equivalent of a risk-free investment. There is a logic to this: we do not expect the US government to default on its debts in general, but almost certainly not in the next 30 days. At the other end of the risk spectrum are early-stage investments in start-up businesses. This form of investment is called risk capital because it is incredibly high-risk and typically takes the form of equity investment, which means that investors can lose all their money. Given the failure rate of new businesses, which is circa 90 per cent, there is clearly a significant level of risk.

Investors expect significant returns to bear that risk. It is also why investors spread their money across a portfolio of investments: the losses in the 90 per cent are more than offset by the gains in the 10 per cent (although it is still possible to lose everything, as you need to find a 10 per cent company). Yet people have at one point been early-stage investors in companies like Microsoft, Nvidia and Amazon, and this happens across all industries. The financial returns from early-stage investment in these companies have been very significant. Looking back, it seems obvious that companies like Microsoft, Nvidia and Amazon would be some of the largest and most successful today, but at the time of making these early investments, it was not clear that they would be trillion-dollar companies.

This logic of risk and reward also extends to all other investments.

So how does climate risk fit into this world, where previously all the standard factors that were considered in investment focused on the commercials of it, the economic context and some uncertain view of the economic future?

Take the example of a distribution centre and warehouse, which is a major asset class and investment in and of itself. Typically, a warehouse would be built, and investors would be presented with projections of cash flows into the future, along with scenarios of the upsides and downsides of this investment and associated risks (e.g. lower demand or higher costs). In a world where we can incorporate climate risks into decision-making, we can change how investors view the same investment.

Using the distribution centre and warehouse example, we can apply spatial finance – the process of using Earth observation data from satellites and incorporating climate hazard and projection data into the investment decision. We can apply geolocation to place the distribution centre and warehouse asset on a map; then, using flood risk as an example, we can do several things.

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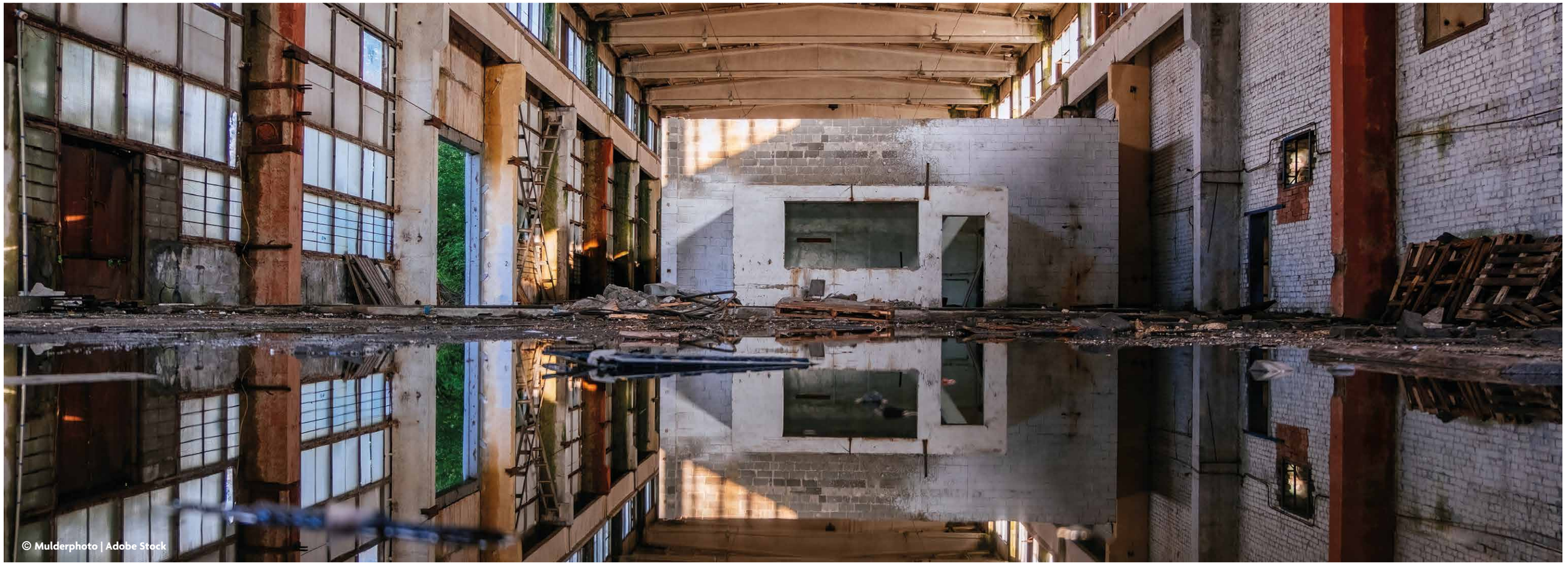

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The first is to look at the location to examine historical flood events and determine whether the asset is at risk of flooding; if it is, we can then consider the potential frequency and severity of floods. The second is to project forward and see to what extent we think the investment will be impacted by flooding in the future. If the asset has been exposed to high levels of flooding and the climate projections suggest that this is likely to either continue or worsen, this gives us our first decision point. For a distribution centre and warehouse that has already been built, a prospective investor can ask what has been done to mitigate this risk; if the answers are not satisfactory, they can choose not to invest.

However, if the distribution centre and warehouse is a new build, and an investor is being asked to finance it, this is where the historical analysis and projections can be applied. In analysing the investment case, the first thing to examine and potentially challenge is why it is being built in an area at risk of frequent or severe flooding both now and into the future. With this, investors can also interrogate how it will be built to be resilient to flooding and what mitigations are being incorporated into the build and the surrounding areas to manage this risk. If there was a strong rationale for building in that specific location and there were to be sufficient embedded resilience in the construction of the warehouse and distribution centre, then the investor may choose to go ahead and invest.

What is compelling about this approach is that it fits into the risk and return paradigm. By building with the impacts of climate change in mind (in this case flooding) then it will be more expensive, but it also lowers the risk of the investment as the impacts of flooding will have been reduced. As such, from an investment viewpoint, the incorporation of climate information into the decision-making process changes investment behaviour. Over time, it will change how and where things are built. Through this process, we get to an economy that is more resilient to the effects of climate change.

This example highlights the significant progress that has been made in linking climate and environmental science to social science and, crucially, to the world of finance. This is a vital step in driving the change needed in investor behaviour. While there are many aspects of climate and environmental science that use similar terminology to the world of finance (e.g. risk), what is very clear is there are different conceptions of what things, such as risk, mean in these different domains. However, these sectors are arriving at a common understanding on what each discipline means across a whole range of areas.

The final aspect is a note of hope and progress. It is very easy to point out the challenges and problems and barriers to change. However, through collaboration and a common purpose and understanding, environmental scientists, social scientists, political scientists and engineers are all now actively working on these challenges, and they are doing so with finance practitioners. In this way, the best science is being accelerated into the real world and, with that, the necessary change can be achieved to finance the transition to a low-carbon, climate-resilient, nature-positive world, while still meeting the investment system's financial goals. Both must be achieved; and with this more dynamic approach to science and research, then positive, real-world impact and change is possible on a global scale. ES

Professor Iain Clacher is Professor of Pensions and Finance, Founder Director of the University of Leeds Centre for Financial Technology and Innovation and leading researcher at the UK Centre for Greening Finance and Investment. He is recognised internationally as an expert on pensions and retirement savings, most notably on retirement decision-making, pension fund investment, infrastructure investing, sustainable pension systems, trustee governance, and fund management costs and fees. He is widely published in international journals, a key contributor to pension policy and practice, and is an expert adviser to a range of businesses, policy-makers and organisations, and has advised the CERN Pension Fund, City of London Corporation, Work Foundation, Pensions and Lifetime Savings Association, and Office for National Statistics. He was a board member of the Financial Conduct Authority's Institutional Disclosure Working Group and has been an expert witness to the Work and Pensions Select Committee's investigations into liability driven investment in 2022 and into defined benefit pensions in 2023.

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FEATURE

Transforming finance for a resilient future

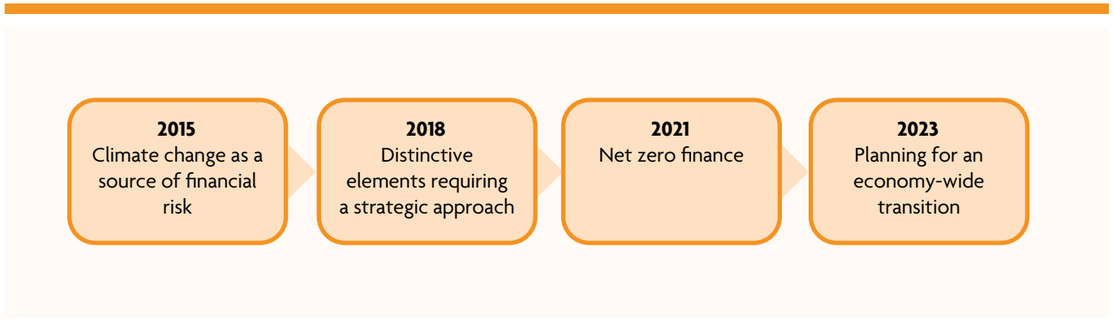
Matt Scott discusses the transition in thinking that has taken place to green the financial system and the need to now turn thinking into practice.

As is becoming increasingly evident from extreme weather events across the world, there is an urgent need to shift towards a more sustainable and resilient global economy. If we are to do this at the speed and scale required, the financial sector will need to play a critical role not only responding to but also contributing towards the transition to a net zero, climate-resilient and ultimately nature-positive economy. To realise this, we need a financial system that is underpinned by rigorous, science-based approaches to integrating climate, nature and environmental factors into investment decisions.

Fortunately, a substantial 'transition in thinking' is taking place at the intersection of environmental science and finance. And as this transition in thinking becomes a 'transition in practice', there are plenty of opportunities for environmental scientists to get involved.

TRANSITION RISK TO TRANSITION PLANNING

There have been many important developments over the last decade, as climate and, increasingly, nature-related risks have moved from niche to mainstream in the finance sector. There are four key inflexion points that have been particularly influential in shaping the policy and regulatory landscape that has emerged (see **Figure 1**). While these have a UK focus, many of the approaches developed in the UK have played (and continue to play) an important role in shaping the global landscape – for example, by contributing to the work of international networks, regulators and standard setters such as the Network of Central Bank and Supervisors for Greening the Financial System (NGFS), the Financial Stability Board (FSB) and the International Sustainability Standards Board (ISSB).



▲ **Figure 1. Progress in financial sector approaches to the climate and nature transition.**

2015: CLIMATE CHANGE AS A FINANCIAL RISK

In September 2015, Mark Carney, then-Governor of the Bank of England, made a seminal speech that firmly established climate change as a financial issue.[1] The speech set out three channels of climate-related financial risks: physical, transition and liability (see **Figure 2**). These risks had emerged from the Bank of England's Prudential Regulation Authority (PRA)'s review of the impact of climate change on the UK insurance sector.[2] The PRA is responsible for the supervision of around 1,500 financial institutions, including banks and insurance companies.

By evidencing the financial impact of a changing climate, and society's response to it, the Bank of England's research provided arguments for enhancing the financial disclosure of climate-related risks, in turn supporting the launch of the FSB's Taskforce for Climate-related Financial Disclosures in December 2015.[3] Climate disclosure has since become a mandatory requirement in multiple jurisdictions, legitimising climate change as a core strategic and financial issue in boardrooms around the world.

2018: A STRATEGIC APPROACH

The 2018 publication of the PRA's review of the impact of climate change on the UK banking sector – aptly entitled *Transition in Thinking*[4] – marked another important inflexion point: a recognition that financial risks from climate change have distinctive elements, which together present unique challenges to the financial sector and require a strategic approach. In the words of the PRA's latest climate change adaptation report:

- **'The risks are systemic.** They will affect every customer, every company, in all sectors of the economy and across all geographies. Their impact will likely be correlated, non-linear, irreversible and subject to tipping points. They will therefore occur on a much greater scale than the other risks that firms are used to modelling and managing.

- **'The risks are simultaneously uncertain and yet foreseeable.** The exact combination of physical and transition risks that will emerge is uncertain, but it is clear that we will either continue on our current emissions pathway and face greater physical risks or we change our pathway by reducing emissions and face greater transition risks.

- **'The size and balance of the future risks we face will be determined by actions we take now.** Once physical risks begin to manifest in a systemic way it will already be too late to reverse many effects through emissions reductions. Similarly, the longer that a meaningful adjustment to our emissions path is delayed, the more disruptive a transition we will see.'[5]

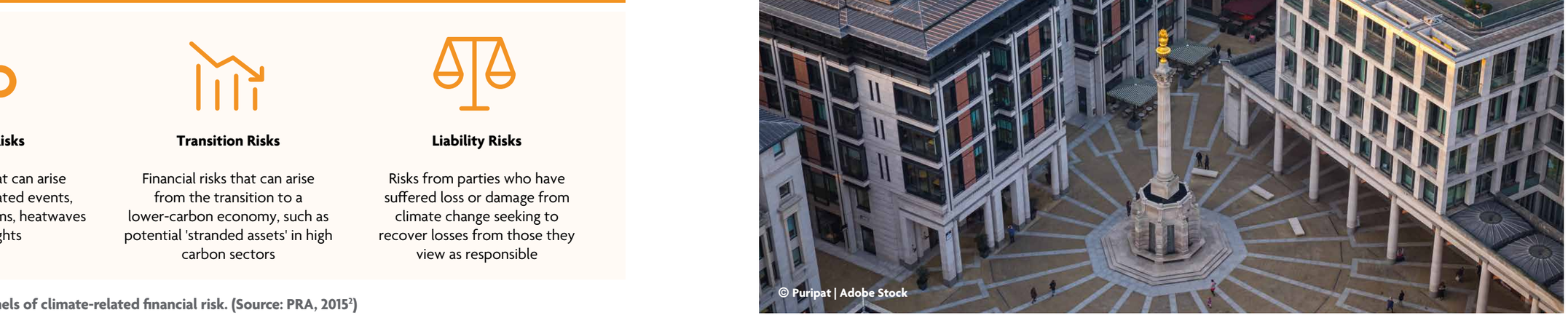
This refined understanding supported a new wave of progress, both in the UK and internationally:

- The launch of the Bank of England's climate exploratory scenarios (often referred to as climate stress tests) to test the UK financial sector's resilience to climate change, including scenarios out to 2050.[6]

- The publication of supervisory expectations in the UK requiring firms to take a strategic approach – one where firms consider the risks that can arise today as well as the actions they can take now to minimise future risks – and, in so doing, support an orderly low carbon transition.[7]

- Establishing the UK's Climate Financial Risk Forum (a joint regulator and industry forum) to build capacity and share best practice at the intersection of climate science and finance.[8]

- The expansion of the NGFS, initially a Central Bank and Supervisors 'community of the willing' that now includes over 100 members across five continents.[9]



▲ **Figure 2. The three channels of climate-related financial risk. (Source: PRA, 2015[2])**

2021: NET ZERO FINANCE

Consistent with the systemic nature of climate risks outlined above, the next key inflexion point on our climate journey is the emergence of net zero finance – most notably marked by the launch of the Glasgow Finance Alliance for Net Zero (GFANZ) at COP26 [Conference of the Parties], which was hosted in Glasgow, Scotland, in November 2021.[10]

The launch of GFANZ and momentum behind the Race to Zero initiative motivated many financial institutions to make a net zero commitment. These commitments were typically crystallised in the form of a long-term goal, such as reaching net zero by 2050 or earlier, and a set of interim milestones; for example, setting a target of a 50 per cent reduction in portfolio carbon emissions by 2030. This would be consistent with the global emissions reduction goals implied in the 2015 Paris Agreement, which was signed by over 195 countries at COP21.

The momentum behind net zero finance has been welcome. At the same time, the focus on achieving emissions targets at the portfolio level has given rise to some conceptual challenges and potential unintended consequences:

- **A conflation between financial risk and climate impact.** The carbon emissions associated with an investment portfolio – often referred to as financed emissions – are a good proxy for the impact of an individual portfolio on the climate. However, financed emissions are not necessarily a good measure of the impact of climate change on a portfolio – that is, the financial impact of physical, transition and liability risks. For example, some high-carbon companies, such

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as those mining critical minerals, can be well positioned for the transition. Conversely, some companies that report low carbon emissions, such as service providers to the fossil fuel sector, have business models that can be adversely impacted.[11] Also, the emissions profile of a company has little correlation with its exposure to the physical risks from climate change – for example, the financial impact from storms, floods or wildfires.

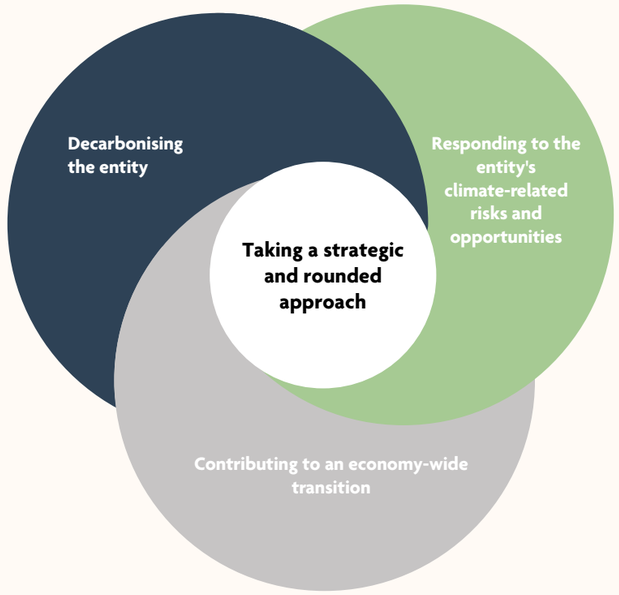
- **The potential for 'paper decarbonisation' and the need to take a system-wide view.** Ultimately, it will be global emissions arising from activity in the real economy, not those accounted for in individual investment portfolios, that will determine the size and magnitude of the future risks faced by the financial sector. It is therefore the real-economy impact of a financial institution's actions that is important in minimising future risks and protecting and enhancing long-term value. For example, the phase-out rather than divestment of high-carbon assets may be a more effective strategy in reducing global emissions, even if it leads to an increase in financed (or portfolio) emissions in the short term. Similarly, investing in climate solutions in hard-to-abate sectors or emerging markets can lead to a relatively carbon-intensive portfolio while playing a critical role in accelerating a global net zero transition. Too narrow a focus on achieving portfolio emissions reduction targets can therefore lead to 'paper decarbonisation' – a decrease in financed emissions that has very little, and a potentially adverse, impact on the global transition.

- **The need to move beyond decarbonisation.** While climate mitigation is clearly important, it is not the complete picture. As global temperatures increase, financing activity to adapt to climate change will be essential for a more resilient future. Broader environmental as well as social factors, such as biodiversity loss, water scarcity and the need for a just transition, also need to be considered.

These challenges have given rise to the next development: a strategic planning framework for an economy-wide transition to a net zero and climate-resilient future. And one that takes into account nature and any potential adverse impacts on society too.

2023: AN ECONOMY-WIDE TRANSITION

COP26 also set the stage for the UK Government to announce the launch of the Transition Plan Taskforce (TPT), a cross-sector initiative to set out best-practice recommendations for private sector transition plans.[12] Between April 2022 and October 2024, the TPT engaged with over 600 organisations globally and produced a comprehensive set of materials and guidance on transition planning, including publishing a sector-neutral disclosure framework in October 2023.



▲ **Figure 3. The Transition Plan Taskforce's strategic and rounded approach. (Source: Adapted from TPT, 2023[13])**

Core to the TPT's materials and recommendations is the concept of a strategic and rounded approach – one which invites companies in the private sector to disclose how they are both responding to and contributing towards an economy-wide transition through three interrelated channels (see **Figure 3**).

In many ways, the TPT's framework represents the culmination of a decade-long transition in thinking at the intersection of our natural environment and financial system. Building on the need for a strategic approach, first set out by the Bank of England in 2018, the TPT's work presents a clear and coherent framework for private sector companies to plan for the sustainability transition, and, in so doing, minimise future risks and protect and enhance long-term value.

FROM THINKING INTO PRACTICE

With the TPT's guidance now being taken forward by the ISSB, and the recently launched International Transition Plan Network supporting the development of global norms for private sector transition plans, attention is increasingly turning to building capacity and supporting implemention – that is, turning the transition in thinking into a transition in practice.[14]

Strengthening connections between the environmental science community and financial sector practitioners will be central to ensuring this transition takes place at the speed and scale required. That is one of the reasons why the UK Centre for Greening Finance and Investment is deepening collaboration between environmental science and finance and better connecting research with financial policy and practice – for example, through its work with the UK's Climate Financial Risk Forum.

We are at a critical juncture. Failing to plan for a sustainability transition will be planning to fail. The transition in thinking now needs to become a transition in practice. As highlighted earlier, the size and balance of the future risks we face will be determined by actions we take now, including those taken by members of the IES community. Ultimately, it is for each of us to help steward the path to a sustainable and resilient future. ES

Matt Scott is Executive Director of the UK Centre for Greening Finance and Investment, a national centre based at the University of Oxford. Matt previously led the Bank of England's Climate Hub, the UK's first Green Finance Strategy and co-chaired the TPT's Disclosure Working Group. He has a background in environmental science and graduated from Stanford Business School as a Fulbright Scholar.

REFERENCES

1. Carney, M. (2015) *Breaking the Tragedy of the Horizon – Climate Change and Financial Stability.* Speech by Mark Carney, Governor of the Bank of England, at Lloyd's of London, 29 September. https://www.bankofengland.co.uk/-/media/boe/files/speech/2015/breaking-the-tragedy-of-the-horizon-climate-change-and-financial-stability.pdf (Accessed: 8 March 2025).
2. Bank of England Prudential Regulation Authority (2015) *The Impact of Climate Change on the UK Insurance Sector.* https://www.bankofengland.co.uk/-/media/boe/files/prudential-regulation/publication/impact-of-climate-change-on-the-uk-insurance-sector.pdf (Accessed: 17 March 2025).
3. Task Force on Climate-related Financial Disclosures (no date) Home page. https://www.fsb-tcfd.org/ (Accessed: 17 March 2025).
4. Bank of England Prudential Regulation Authority (2018) *Transition in Thinking: The Impact of Climate Change on the UK Banking Sector.* https://www.bankofengland.co.uk/-/media/boe/files/prudential-regulation/report/transition-in-thinking-the-impact-of-climate-change-on-the-uk-banking-sector.pdf (Accessed: 8 March 2025).
5. Bank of England Prudential Regulation Authority (2025) *PRA Climate Change Adaptation Report 2025.* https://www.bankofengland.co.uk/prudential-regulation/publication/2025/january/pra-climate-change-adaptation-report-2025 (Accessed: 8 March 2025).
6. Bank of England (2022) *Results of the 2021 Climate Biennial Exploratory Scenario (CBES).* https://www.bankofengland.co.uk/stress-testing/2022/results-of-the-2021-climate-biennial-exploratory-scenario (Accessed: 8 March 2025).
7. Bank of England Prudential Regulation Authority (2019) *Enhancing Banks' and Insurers' Approaches to Managing the Financial Risks from Climate Change.* Supervisory Statement SS3/19. https://www.bankofengland.co.uk/-/media/boe/files/prudential-regulation/supervisory-statement/2019/ss319.pdf (Accessed: 8 March 2025).
8. Bank of England (no date) *Climate Financial Risk Forum.* https://www.bankofengland.co.uk/climate-change/climate-financial-risk-forum (Accessed: 8 March 2025).
9. Network of Central Banks and Supervisors for Greening the Financial System (no date) Home page. https://www.ngfs.net/en (Accessed: 8 March 2025).
10. Glasgow Financial Alliance for Net Zero (no date) *About us.* https://www.gfanzero.com/about/ (Accessed: 8 March 2025).
11. WTW and Institute of International Finance (2023) *Emissions Impossible: Quantifying Financial Risks Associated with the Net Zero Transition.* White paper. https://www.wtwco.com/en-gb/insights/2023/05/emissions-impossible-quantifying-financial-risks-associated-with-the-net-zero-transition (Accessed: 8 March 2025).
12. International Transition Plan Network (no date) *TPT legacy.* https://itpn.global/tpt-legacy/ (Accessed: 8 March 2025).
13. Transition Plan Taskforce (2023) *Disclosure Framework.* https://www.ifrs.org/content/dam/ifrs/knowledge-hub/resources/tpt/disclosure-framework-oct-2023.pdf (Accessed: 8 March 2025).
14. International Transition Plan Network (no date) Home page. https://itpn.global/ (Accessed: 8 March 2025).

OPINION

Barriers and risks to financing the energy transition

Gireesh Shrimali outlines the process towards net zero and some of the success stories in conversation with **Bea Gilbert**.

BEA GILBERT (BG): Could you give us a short explanation of the current state of finance for the energy transition?

GIREESH SHRIMALI (GS): There have been multiple studies that have been done and they're all trying to see what kind of investments we need per year until 2050, with the goal being the 1.5C target agreed in Paris in 2015. Obviously, there is a range of estimates, given different approaches, but there is a reasonable consensus that around US$5 trillion of investment is needed until 2050. And that's per year of investment. Following that is analysis on how much investment is actually happening. It turns out that, despite our best efforts, we are falling short; a ballpark number is that we're about an order of magnitude short. We have to really step up the game.

BG: What are some key challenges, risks and barriers to effective financing of the energy transition in our move away from fossil fuels towards net zero targets?

GS: Typically, there's significant work being done by academics, but also very focused work that's been done by think-tanks, NGOs [non-governmental organisations] etc. One broad consensus is that we need to decarbonise all the different sectors that are energy dependent. So, we have to decarbonise electricity, we have to decarbonise transportation, we have to decarbonise industry. And within that decarbonisation, there are key technologies that need to be scaled. These technologies have already been identified: renewables, which are solar and wind; battery storage; green hydrogen; carbon capture and sequestration; and potentially some carbon removal. Obviously, there are other things we could talk about beyond these.

Challenges exist on two sides. One is around the development of technology, or the supply side: developing a new technology, bringing it to market and making sure that it's ready to scale. There's a whole sequence around research and development, prototypes, and the pre-commercialisation and commercialisation stages. It's proven to be challenging for energy-related technologies, in that they require a lot of money, in particular since they take a long time to mature. Because of this, you need a significant amount of patient (i.e. long-term) capital.

There's this well-known phenomenon called the valley of death – a scenario where while technologies are ramping up they need more money and there's not enough available, so there's a gap. In reality, money is needed not only across the whole innovation cycle but also for at-scale deployment. For at-scale deployment, there are representative risks that a project faces – usually around project finance, because a lot of these energy projects happen on a project-by-project level.[1]

Under deployment, we must consider various risks. Technology risk, for one, because if it's a new technique or technology, even if it's close to commercialisation, people are less willing to invest. They're not sure whether the technology is going to do what it's supposed to do – for example, with green hydrogen. There is also a market risk: the markets for these technologies don't yet exist, so it is not easy for the technologies to scale up. There are a lot of risks around construction when trying to build these projects to scale, and there are issues around getting the land and permits as well. Lastly, there are issues around the buyer side of the equation: somebody has to be willing to buy the outputs (or products) of green technology projects.

For developing economies, a further risk is just getting money into and out of the country, especially if it is to come from foreign sources, because there are political, currency depreciation and all sorts of other issues to contend with. All these add up and become barriers to investment.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BG: Who really decides whether this happens? Is it banks? Is it politicians? Which authority is ultimately the most in control?

GS: From my perspective there are two primary stakeholders that hold the power: policy-makers and regulators. I differentiate between them because in my world policy-makers refers to a perspective of what I call the real economy – getting investments into actual projects like a solar or a green hydrogen plant or putting electric vehicles on the road. Actual projects happening on the ground that connect to actual production of some of the green technologies. So policy-makers are very important: they have a role to play by giving a signal to the market when they say there's going to be demand for these technologies. It's called developing demand, and typically it's done by setting a long-term target, such as achieving 500 gigawatts (GW) of renewable power capacity by 2030. That is a long-term signal to the market.

But there also have to be short-term, yearly signals of what is going to be done, which investors tend to respond to. Policy-makers need to develop demand and the creation of new business. New technologies are not cost competitive with existing fossil-based solutions, so there need to be subsidies to make sure that these new technologies will be purchased. Over time, the cost goes down and eventually subsidies aren't required.

Regulators complement policy-makers and provide signals to the financial sector. They can help make it a level playing field for green technologies by providing information on climate-related risks and strategies.

That said, I think we need to be very clear that we include the public in the discussion, because at the end of the day, who is making policies? Who is selecting or electing the policy-makers? There's a public and policy-maker feedback loop. Ideally, the net zero transition agenda would cross party lines in any country.

That's my sense of the primary stakeholders.

Businesses and financial institutions are somewhat secondary, in the sense that they respond to the policy and regulatory signals. If the right policy environment exists, they will invest. Typically, businesses and investors look for the right balance of risk and return. That's why I put them as secondary, but it doesn't mean that they're any less important. Sometimes, businesses and financiers could also take an active role in making sure the right environment is there, so that the right amount of investment can happen.

BG: Are there any other hurdles for the transition of developing economies? And solutions?

GS: I said initially we need US$5 trillion a year. Where is that coming from? Do we even have that capacity? The answer to that is yes, we do. The markets and investments in the world are in the order of US$100 trillion, so the money is available.[1]


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OPINION

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For developing countries, however, two risks stand out. One is the issue of country risk – international climate finance for foreign investors to invest in developing countries, which has been part of the climate negotiations. Investment needs to be in the form of both public capital, which comes in terms of grants and subsidised or concessional finance, and private capital. The latter carries more political risk, with questions about whether investors will get their money back out – in other words, if the project will pay off and whether money can be taken out of the country.

Tied to this is the issue of currency risk. Most investors in developed countries are looking for returns in their own currency: dollar investors from the USA want their returns in dollars. The problem is that a lot of these projects are making money in the local currency. For example, in India the return is in rupees, which then need to be converted to dollars or pounds before being returned to investors. But what if the currency depreciates? Are you able to get the desired dollar return? There are solutions: currency hedging facilities could be created at various scales, and when done across multiple countries, investors can hedge their risks better.

The other issue is 'offtake' risk, particularly in developing countries. Let's say green steel – steel produced using electricity from renewable sources – is being bought, but the credit quality of the buyer – the offtaker – is low. That is problematic because when the projects are being funded and banks are looking at the cash flow streams to decide whether to invest, they know that the investment can only pay back if the eventual purchaser of the product is actually paying for it. This is a significant issue in developing countries. Various solutions have been discussed – for example, a partial credit guarantee or payment security mechanisms. Each addresses different parts of the risk. The partial credit guarantee tackles the whole issue of credit. The payment security mechanism deals with the issue of delayed payments, because sometimes state or publicly owned offtakers are able to pay but delay doing so because they don't have timely access to capital.

BG: Can you tell us about a successful case of financing the transition?

GS: I've done a lot of work in India, so I can talk about that, but success stories have their own challenges. Electricity, or the power sector, is where most of the emissions come from, which is also at the forefront of this transition. There have been success stories, where countries and jurisdictions have successfully transitioned, or are transitioning. Many European countries are success stories. If you look at Scandinavian countries, they've gone to very high percentage of renewable power. California, in the USA, where I lived for a while, can be taken as a case study.

But I'll return to India, because much of this transition needs to happen in developing countries, and that's also where a lot of challenges are. India has done well. On renewable energy, it has very ambitious targets of 500 GW of renewables capacity by 2030, which is in five years' time, and it is currently at about half of that. So, it still has to scale pretty ambitiously, but from a slow start about 15 years ago, it has ramped up.

As I said, you have to set ambitious targets but also make sure that the corresponding yearly procurement happens; demand creation has to be long-term so that investors see a long-term view. There are also projects happening on a yearly basis. Policy-makers also use this technique called reverse auctions, where the price at which power will be provided keeps being lowered, and the winning bid is the one willing to provide the power at the lowest cost. It reduces the cost burden to governments that might be associated with green technologies in the first place. India set up an agency for this process, the Solar Energy Corporation of India, which has been used as an example around the world.

One other thing that I had talked about was getting land and permits, and there is also getting access to the grid. A lot of these issues were solved in India by creating solar parks – large areas of procured land with permits for developers and connections to the grid. India has been able to achieve 250 GW (half its renewables target) using a variety of options, which address each of the risks that I mentioned. But there is still a long way to go. ES

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Dr Gireesh Shrimali is the Head of Transition Finance Research at Oxford University. Previously, he was a Research Fellow at Stanford University and a Director at Climate Policy Initiative. He has taught at Johns Hopkins University as well as the Indian School of Business. His research is on the catalytic role of finance in getting to the 1.5C climate target. He also focuses on environmental, social and governance issues, such as climate risk and net zero transitions. He holds a PhD from Stanford University, an MS from the University of Minnesota, and a BTech from the Indian Institute of Technology. Before his academic career, he worked in industry for nine years.

REFERENCES

1. Shrimali, G. and Prakash Jena, L. (2024) *Enabling finance for net-zero energy transitions*. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4659874 (Accessed: 14 March 2025).

OPINION

Climate finance and geopolitics: COP29 and beyond

Richard Beardsworth uncovers the complexities of financing climate change under the present international circumstances.

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THE CLIMATE FINANCE COP

The Conferences of the Parties (COPs) within the United Nations Framework Convention on Climate Change (UNFCCC) have increasingly closed in on climate finance as the key to delivering climate ambition and action. As the UNFCCC's Executive Secretary, Simon Stiell, recently stated:

'Put simply, we cannot achieve our climate goals without [climate finance]. Whether we are talking about transitioning to renewable energy, improving energy efficiency, building resilience, or protecting vulnerable communities from the impacts of climate change, all these challenges require investment.'[1]

OPINION

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November 2024's COP29 in Baku, Azerbaijan, was designated the climate finance COP for a specific reason. COP15 held in Copenhagen, Denmark, in 2009 had set up a climate finance goal to see capital flows from developed to developing countries reach US$100 billion by 2020. That goal was not reached until 2022 but expires this year. The major concern of COP29 was to reassess and extend it to 2035 as a 'new collective quantified goal' (NCQG). There are several interconnected reasons why climate finance, in general, and the NCQG, in particular, are so significant.

Firstly, international climate finance propels global climate ambition around mitigation targets. At present, the world is on a trajectory of an average global temperature increase of 2.7–3.1C by the end of this century. The world can only achieve something close to 1.5C if *all* countries' contributions to reduce greenhouse gas (GHG) emissions that are conditional on external help from developed countries are implemented – known as conditional Nationally Determined Contributions.

It is worthwhile recalling that 70 per cent of present GHG emissions are emitted by upper-middle-income countries like China, Brazil, Indonesia and Mexico and lower-middle-income countries like Egypt, India and Iran. Except for China, they all require, to varying degrees, external investment to both meet and increase their targets.[2] The international cooperation between developed and developing countries that is necessary to achieve climate goals is therefore predicated on cross-border climate finance.

Secondly, climate finance is required to decouple economic development from GHG emissions within developing countries and help steer them towards becoming low-carbon economies. Without that investment, several things follow – depending on the geography, population density and energy profile of the country. Certain countries, particularly in Africa and Southeast Asia, will remain attached to fossil fuels and will find it difficult to transition to clean energy. People in countries most vulnerable to climate impacts (island states, the Afrotropical realm, South Asia) will have to increasingly adapt to heatwaves, floods, droughts and other climate hazards or migrate to less vulnerable parts of their continents. By addressing sustainable economic development, adaptation and resilience, international climate finance helps to provide a necessary foundation upon which countries can become self-sustaining in a world simultaneously undergoing an energy transition away from fossil fuels and dealing with increasing climate impacts due (in large part) to fossil fuels.

Thirdly, climate finance is about justice.[3] The countries most affected by climate change are those that have contributed to it the least; inversely, the countries with the greatest capacity to adapt to climate change are in their majority those that have contributed to it the most. For example, countries on the African continent contribute around 5 per cent of total GHG emissions, yet almost half the continent is caught in a vicious circle of climate vulnerability, debt distress and the high cost of capital. African countries are requesting US$1.3 trillion in climate investment for adaptation and energy transition purposes; financial flows to African countries were US$43.7 billion in 2022 (0.05 per cent of what was requested).[4] Africa received less than 3 per cent of global energy investment in 2023 despite harbouring approximately 60 per cent of global solar power.[5] Climate finance, therefore, provides one of the most critical tools with which climate change moral injustices can begin to be addressed.

Taken together, these three points on the flow of climate finance constitute the conditions for organising a global transition out of increasing vulnerability to climate change. Climate finance matters for *all* countries.

As an extension to the COP15 US$100 billion climate finance goal, the NCQG relates to the part of climate finance that is exclusively provided from outside the countries concerned. In the international meetings leading up to COP29, three questions dogged proceedings:

1. How much?
2. Who should pay?
3. What form should the finance take?

Throughout 2024 and during the COP29 meeting, there was intense disagreement among groups of developed and developing countries on each of these questions. By the end of the conference two numbers were agreed. Firstly, developed countries would put up US$300 billion per year by 2035. This money will be provided by bilateral arrangements between donor and recipient countries, arrangements through multilateral development banks (MDBs) and private finance leveraged through the public funds of developed countries. Secondly, a further US$1.3 trillion, which constitutes the investment goal, would be secured to help low- and middle-income countries transition to renewable energy and low-carbon economies. Negotiations at COP29 indicated several avenues to find this money: MDBs leveraging their own capital with the private sector; raising international taxes on aviation and maritime transport; debt-for-finance swaps; and the use of carbon markets. It was understood that at least half must come from the private sector.


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In the context of these large numbers, it is worth noting a couple of things. According to standard economic modelling it is estimated that by 2035, that US$1.3 trillion will be equal to 1 per cent of global gross domestic product (estimated to be US$150 trillion). Seen in this light, this sum is not large. Furthermore, if something close to a 1.5C global average temperature increase is not achieved, the cost to the global economy is estimated to be at least five times greater than the climate finance needed by 2050 to achieve it (circa US$200 trillion).

Based on these calculations, and whatever their exact worth, it is clearly in the interest of *all* countries – developed, emerging, developing, least developed – to find ways to implement the NCQG. Again, cross-border climate finance constitutes the pillar on which climate change can be addressed collectively and the divide between global north and south – a divide that has unhelpfully dogged climate negotiations since 1992 – can be transcended. It nevertheless requires, as both Ani Dasgupta and Avinash Persaud have argued, the coming together of all these funding sources.[3,6] This requires, in turn, important changes to existing international financial norms and to the international financial architecture embodying them: for example, debt cancellation, reorganisation of the rate of interest on loans to low-income countries, and facilitation of the International Monetary Fund's special drawing rights for climate purposes.[7]

None of these reforms are easy. To transform the present US$110 trillion global economy in a matter of decades is, to say the least, difficult. It is even more difficult in the present geopolitical and political circumstances, which are moving quickly against the interrelated norms of global collective action, international cooperation and multilateral institutionalism.

THE GEOPOLITICAL COP

While COP29 was a climate finance COP, it was also a geopolitical COP. Since the establishment of the UNFCCC in 1992, its intergovernmental meetings have always been geopolitical: intercountry dialogue is by nature structured by geopolitics. COP29 was geopolitical in a specific sense, however. Never within the period of the UNFCCC have geopolitical considerations so overtly framed negotiations.

The choice of hydrocarbon-rich Azerbaijan as the site for COP29 was due to Russian resistance to a western European state hosting it. Squeezed between the larger COPs in the United Arab Emirates (COP28) and Brazil (COP30), and with a heavily compromised presidency leading it, COP29 was expected to fail. Throughout the conference, Saudi Arabia sought to unpick the gains of COP28: the energy pledges of a transition from fossil fuels, and the tripling of renewable energy and doubling of energy efficiency by 2030. The election of Donald Trump to the US presidency six days before COP29's opening cast a long shadow over the leadership

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role of the US delegation and constrained financial commitments from developed countries.

More broadly, the economic, social and political challenges ensuing from Russia's invasion of Ukraine and the consequent energy and cost of living crises (most immediately experienced in the richer developed countries but with significant repercussions in developing ones as well) meant that financial negotiations between developed and developing countries took place in the context of fiscal constraint and sovereign debt crisis. Finally, domestic pushback against climate policies in an increasing number of major developed countries – or, at least, the political weaponisation of climate change to obstruct policy and the transition to a low-carbon economy – weighed heavily on the international dimension to the negotiations. In the context of these (geo)political considerations, the US$300 billion pledge and the accompanying US$1.3 trillion target could be considered not as failures but as diplomatic successes.

Whatever one's final judgement on the financial outcomes of COP29, the overtly geopolitical nature of the meeting indicated something else: the new Trump administration and withdrawal of the US from the Paris Agreement signified an acceleration to a new world order. The first five weeks of the Trump administration have confirmed this. The post-Second World War rules-based order, within which the UNFCCC and its COPs were established, has been in decay for several years, as the recent spike in international conflicts and mass atrocities alone illustrate.

The return of Trump to the US presidency brings this decay to a sharp conclusion, opening the door to a new geopolitical era. This era will be initially defined by increasing tensions between a world of international powers and their spheres of influence on the one hand, and multilateral initiatives, international institutions and international cooperation on the other. The precise shape of the world resulting from these tensions is contingent on many factors. What is nevertheless already clear is that the absence of the USA from the Paris Agreement leaves a hole to be filled: that of global climate leadership. The nature of that leadership will determine the future of climate multilateralism. It is in this context that the pace and scale of climate action – together with the climate finance and international financial architecture underpinning them – will be decided. The overt geopolitical framing of COP29 anticipated, in this sense, the diplomatic mechanics of a new era. Several questions follow.

FUTURE UNCERTAINTIES

The absence of the USA from the climate negotiations for the next four years gives China and the EU an opportunity to take the lead. The EU stepped up in 2017 during the first Trump presidency to uphold climate multilateralism. Europe has, however, changed since: the EU is made domestically fragile by nationalist populism


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and geopolitically insecure by an aggressive Russia on its eastern border. At the global level, China can only lead technologically; even its political leadership of the developing world in climate multilateralism remains too self-interested. Consequently, it is difficult to see how it could become a global climate leader except by changing the global rules to its advantage (always a possibility).

This leaves upper-middle-income countries like Brazil, Mexico and South Africa, together with the UK and EU Member States like Spain, to explore alliances at a lower level – alliances among themselves and with island states and low-income countries – that could nudge the 'international powers' of the USA, China and Russia towards acts of international cooperation on climate. Whatever this configuration, the critical question is: in the absence of the USA, which countries and which alliances of countries can lead on climate ambition and on the international finance that we have seen needs to underpin it?

In geopolitical terms, energy is power.[8] The British empire was built on the coal-powered steam engine. US hegemony in the last century was only possible through strategic alliances with Arab states and their oil exports. The so-called transition from fossil fuels to renewable energy is laced with questions of international power politics, which is one reason why it is unfolding slower than expected. Does the financial investment required to help steer developing countries onto a low-carbon energy pathway collide with the geopolitical world we are entering? Or can countries find alliances between themselves that are powerful enough to reform the international financial architecture in a way that facilitates capital flows to more vulnerable countries? In the absence of global US leadership, in a new era of competing international powers, how will the global north–south divide that still determines how we negotiate the flows of financial investment be reorganised? Is this impending reorganisation a good thing? The answers to these questions will determine to what extent geopolitics will shape international finance capital.

One often hears the argument today that, whatever the international or domestic political situation concerning climate *in*action, economic decisions will carry through the energy transition and, with it, climate ambition. It is, for some, a last thread of hope. The strength of the argument lies in the fact that renewable energy (specifically wind and solar) is now cheaper than fossil fuels. However, financial investment decisions are made not on price but on the returns on investment (of which price is one factor).[9] Renewables are not a high-profit business, which is why the oil and gas majors are again cutting back on investment in renewables in the name of profitability.

The economic transition from fossil fuels to renewable energy is not automatic; it must be politically framed if the momentum behind renewables is to accelerate. Such a regulatory environment would require, among other measures, the end of fossil fuel licensing and exploration, as well as the limitation of fossil fuel production and consumption. This kind of regulatory environment is already undermined by domestic political considerations; it will also collide with an era of international powers in which norms, rules and targets lose some of their traction. And yet, are the returns on financial investment in low-carbon economic development not ultimately dependent on such an environment?

All these questions pitch an emerging geopolitical constellation of international powers and spheres of influence against global collective norms and international cooperation on climate. Although it is unclear what will evolve out of this collision (new climate leaders, new climate alliances, a confrontation with oil-rich countries or the collapse of the UNFCCC), climate realities will increasingly shape the terms of this collision. From this dangerous mix, the future of climate finance and the transition of *all* countries to low-carbon economies and societies will be decided. ES

Richard Beardsworth is Professor of International Politics and Head of the School of Politics and International Studies at the University of Leeds. He co-chairs the university's UNFCCC Task Force and is a commissioner on the Yorkshire and Humber Climate Commission. His research focuses on the international politics of climate change.

REFERENCES

1. Stiell, S. (2023) *Why climate finance matters: remarks by UN Climate Change Executive Secretary Simon Stiell.* Sustainable Investment Forum, 9 May. https://unfccc.int/news/why-climate-finance-matters-remarks-by-un-climate-change-executive-secretary-simon-stiell (Accessed: 5 March 2025).
2. Naran, B., Buchner, B., Price, M. *et al.* (2024) *Global landscape of climate finance 2024.* https://www.climatepolicyinitiative.org/publication/global-landscape-of-climate-finance-2024 (Accessed: 5 March 2025).
3. Dasgupta, A. (2025) *Climate finance is a top story to watch in 2025.* https://www.wri.org/insights/climate-finance-progress-2025 (Accessed: 5 March 2025).
4. Meattle, C., Balm, A., Diaz, J.E. *et al.* (2024) *Landscape of climate finance in Africa 2024.* https://www.climatepolicyinitiative.org/publication/landscape-of-climate-finance-in-africa-2024 (Accessed: 5 March 2025).
5. World Resources Institute (no date) *Stories to watch 2025: delivering climate finance to the people who need it most.* https://www.wri.org/stories-to-watch (Accessed: 5 March 2025).
6. Persaud, A. (2022) Breaking the deadlock on climate: the Bridgetown Initiative. *Groupe d'études géopolitiques*, issue 3. https://geopolitique.eu/en/articles/breaking-the-deadlock-on-climate-the-bridgetown-initiative (Accessed: 5 March 2025).
7. The Bridgetown Initiative (no date) *Bridgetown Initiative on the Reform of the International Development and Climate Finance Architecture.* https://www.bridgetown-initiative.org/download/1492/?tmstv (Accessed: 5 March 2025).
8. Yergin, D. (2021) *The New Map: Energy, Climate and the Clash of Nations.* New York: Penguin Press.
9. Christophers, B. (2022) Fossilised capital: price and profit in the energy transition. *New Political Economy*, 27 (1), pp. 146–159. https://doi.org/10.1080/13563467.2021.1926957 (Accessed: 5 March 2025).

Spatial finance: (re)connecting the financial system with the real economy and the environment

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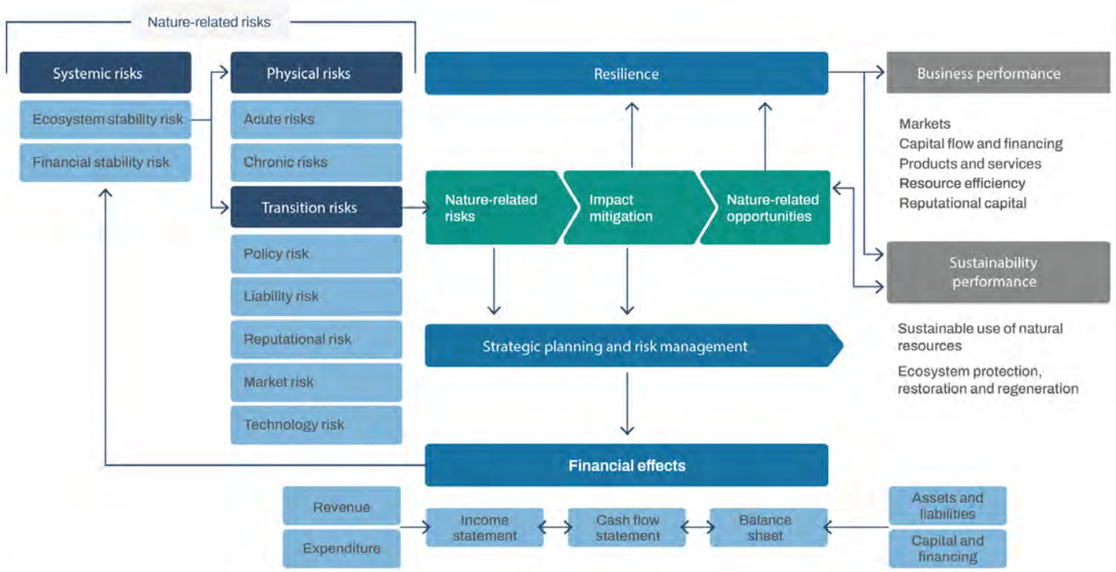
ANALYSIS

Christophe Christiaen sets out how environmental data can empower finance to contribute to a greener, more resilient world.

The transition towards a net zero, resilient and nature-positive economy is by far the most significant challenge of a generation. This means reducing emissions, protecting ecosystems and designing resilient infrastructure to better withstand environmental shocks. To tackle these issues effectively, local environmental intelligence must be connected with how financial decisions are made. Without precise knowledge of the location of industrial facilities or critical habitats, financial assessments remain incomplete and capital cannot be directed to where it matters most.

The financial system can play a key role in mobilising and directing capital towards innovative solutions and sustainable projects that can accelerate this transition. It is important to explore how this can happen and the role environmental science and data can and should play to support the green finance agenda, focusing on the emerging field of spatial finance.



▲ Figure 1. Links between nature-related risks and opportunities, business performance and financial effects for an organisation. (Source: Taskforce for Nature-related Financial Disclosures[1])

GREEN FINANCE

The UK Government's first Green Finance Strategy provides a helpful framework by distinguishing 'financing green' from 'greening finance'.[2] In summary:

- **Financing green** refers to mobilising finance towards projects, companies and activities with explicit environmental or climate benefits. This covers green bonds that raise capital for projects with specific environmental benefits, or voluntary carbon markets that fund emissions reduction projects through the sale of carbon credits.

- **Greening finance** refers to the integration of current and future financial risks and opportunities from environmental factors into mainstream financial decision-making. This covers the incorporation of climate risk within credit risk models for banks to determine loan interest rates, or the increase of investment allocations by asset managers into shares of companies with technologies that are likely to be in high demand for the energy transition.

They are two sides of the same (green) coin and both approaches are crucial. While new financial instruments and markets are needed to finance green, there is enormous potential for impact in greening finance by shifting mainstream capital. For instance, while voluntary carbon markets reached a cumulative value of €10 billion globally in 2023, the total value of financial assets held by financial corporations in the EU alone amounted to €86.2 trillion in 2023.[3,4] Therefore, even a small shift of this mainstream capital, when informed by robust environmental data, can drive significant real-world change.

IMPACT TRANSMISSION MECHANISMS

For this impact to be realised it is vital to ensure greening finance activities genuinely lead to environmental changes in both the real economy and the physical environment. Too often, green finance strategies involve reducing an individual institution's exposure to environmental risks without environmental benefits in the real world – for instance, a 'responsible' investor selling off shares in high-risk companies to another investor. While the sale leads to a reduction in risk or impacts on paper for the responsible investor, companies continue to operate as before, without genuine incentives for change.

Achieving environmental outcomes in the real economy through financial systems can be done in three ways:[5]

ANALYSIS

1. **Reducing (increasing) the cost of capital for a company's (un)sustainable activities.** Cost of capital is the price a business pays to access capital, such as the interest rate on a loan or the return shareholders expect for investing in the company. Therefore, if a company's environmentally responsible practices are rewarded with lower costs through lower interest rates, the company gains a competitive advantage.

2. **Increasing (reducing) a company's access to liquidity.** Liquidity refers to how easily and quickly a company can access capital. Restricting liquidity for high-risk, environmentally harmful projects can slow or halt them, whereas making liquidity more readily available to cleaner industries can accelerate their growth.

3. **Encouraging or enabling sustainable corporate practices.** Engagement here means active dialogue between investors (or lenders) and company management, alongside voting on proposals at shareholder meetings. Through ongoing conversations, financial institutions can push for concrete changes, like the adoption of renewable energy, better waste management or stronger governance for biodiversity protection within companies.

However, financial institutions can only use these levers effectively if they have reliable information about environmental risks, impacts and opportunities. That information, which should be underpinned by the latest science, must be interpreted correctly, accommodating any uncertainty and the underlying assumptions within the data.[7] While there is a wealth of climate and environmental datasets available that could be relevant for the financial system and which are often generated by public or non-profit organisations, they can only inform financial decision-making and drive real economy change when linked to specific companies. This is where spatial finance comes into play.

BOX 1. RISKS AND OPPORTUNITIES

Environment-related financial risks (and opportunities) typically fall into two categories:[1,6]

- **Transition risks (and opportunities)** occur when we move to a lower carbon or nature-positive economy, often driven by (rapid) changes in policies, markets or technologies. For example, a coal-fired power station closing before the end of its operational lifetime because a high carbon price makes it uncompetitive; or industrial farming operations unable to renew environmental licences as new policies restrict nitrogen pollution.
- **Physical risks (and opportunities)** stem from changes in climate, weather patterns or environmental degradation. For example, manufacturing activities halting due to droughts that disrupt water supplies or logistics; or higher prices for agricultural commodities caused by the collapse of pollinators, which reduces crop yields.

SPATIAL FINANCE FOR ACTIONABLE INSIGHTS

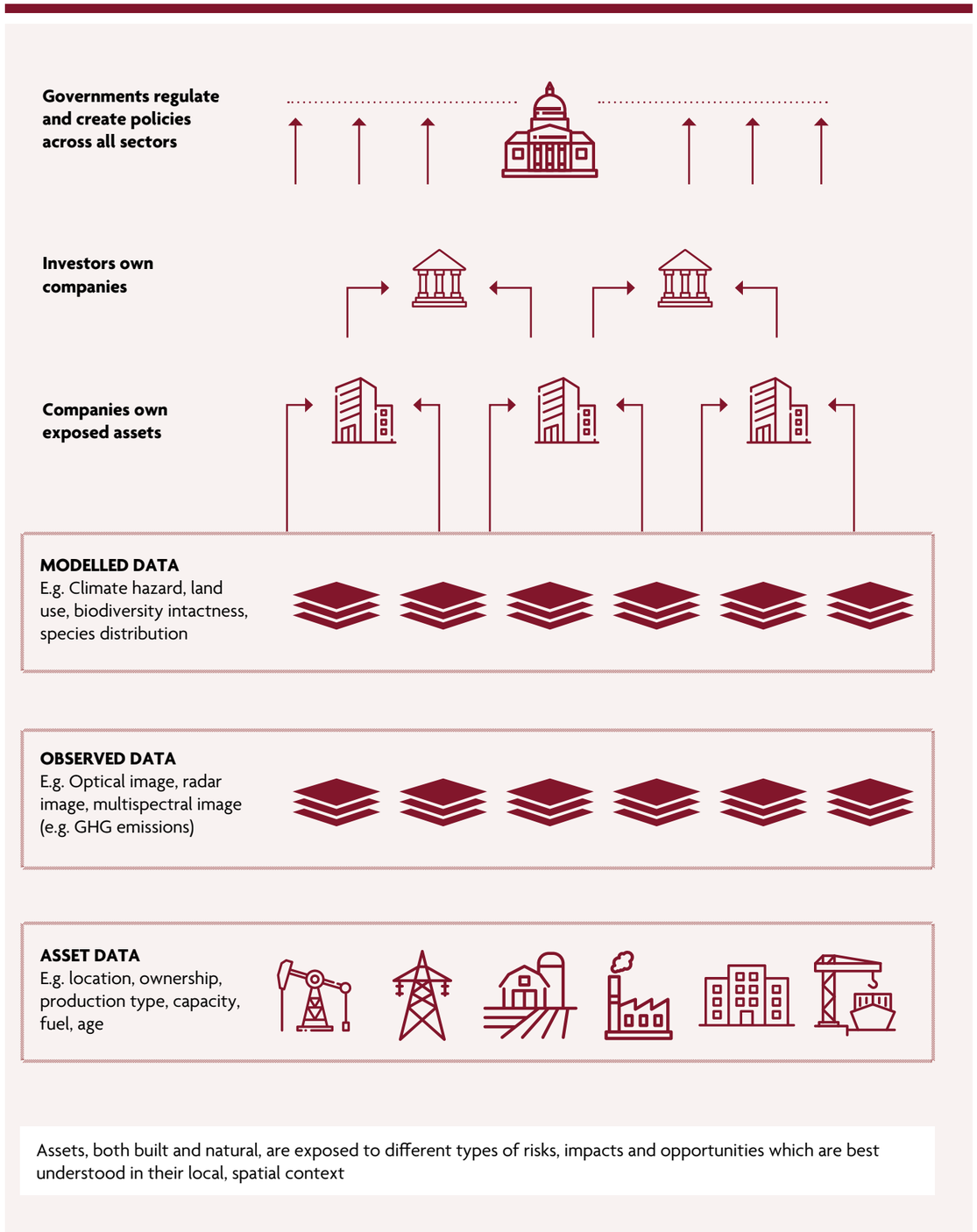
The concept of spatial finance emphasises the need for geospatial data and analysis to be incorporated into financial decision-making.[8] If financial institutions are to fully integrate and price environmental risks, opportunities and impacts, they must understand how these factors vary at the local operational level for their clients or investees (see **Figure 2**). Although this may seem straightforward to environmental scientists, it does not align with the typical operations of financial institutions. Investment, credit or other decisions are usually based on financial and non-financial information at the company level.

When it comes to environmental data, high-level aggregate information rarely sheds light on how environmental risks actually manifest on the ground; nor does it indicate its true significance for a company's operations in local contexts. Recent reporting frameworks, such as the Taskforce for Nature-related Financial Disclosures, are beginning to encourage a more granular, location-based assessment of environmental risk.[9] While these are currently voluntary and do not mandate location-specific reporting, they demonstrate a growing recognition that 'where' matters as much as 'how much'.

Meanwhile, researchers, non-profits and commercial data providers are increasing the availability of spatially explicit datasets, tools and methods for companies to quantify environment-related risk and impact. Researchers have developed methodologies for modelling physical climate risk, nature-related risks and the environmental impacts of individual physical assets.[10-15] Non-profits have developed tools to assess deforestation, water and biodiversity risks at the asset-level in a spatially explicit way.[16-18] Commercial organisations, including both start-ups and incumbent financial data providers, are launching or expanding environmental risk analytics based on geospatial and asset datasets.[19,20]

At the Oxford Sustainable Finance Group, work has focused on identifying and developing open global asset databases for high-impact industries.[21,22] The datasets include precise geolocation, ownership, production and other operational details for individual assets. Linking location to ownership is crucial for financial institutions, enabling the connection of insights derived from geospatial environmental datasets with specific assets and the respective owners or operators.

Financial institutions worldwide have begun using these spatial and environmental datasets and tools for a wide range of uses, such as screening investments for reputational risks associated with companies or projects engaged in potentially damaging activities; assessing future financial impacts of climate hazards on cash flows from long-term infrastructure investments; prioritising companies for engagement around environmental concerns; incorporating environment-related financial risk concerns in credit risk or credit-rating methodologies; assessing portfolio-wide impacts and setting net zero or nature-positive targets; and reporting on environmental risk exposure and management as part of annual reporting cycles. Additionally, on the financing green side, innovations in monitoring, reporting and verification in environmental markets, design and monitoring of sustainability-linked financial instruments are coming to fruition.



▲ Figure 2. Asset-level analysis allows for a bottom-up assessment of environmental risks, impacts and opportunities for companies or portfolios. (Source: Christiaen, 2023[23])

LIMITATIONS

While environmental data are making their way into (green) finance, there is still a long way to go before they are steering capital in the right direction. Scientists are raising concerns about the proliferation of environmental analytics to model business risks and the consequences of potential misuse.[7,24] Particularly in climate science, where 'many of the emerging demands for financially meaningful information cannot be met by current climate models that were designed for other purposes'.[21] It is vital that decision-makers understand what models can and cannot do. This requires both commercial vendors to be transparent about their methodology and users to be sufficiently informed to correctly interpret results.

Therefore, genuine integration of robust environmental science into mainstream finance is still in its infancy. A substantial shift in the cost of capital or access to liquidity that would truly reward sustainable companies and penalise polluters has not yet been seen. Engagement with companies is still often based on self-reported data or minimal disclosures, and spatial finance tools, while expanding quickly, remain underused by most financial practitioners.

THE WAY FORWARD

Bridging this gap requires action on both the supply and demand sides of the equation. On the supply side, environmental scientists and data providers must ensure their models are tailored to practical finance use cases, transparent in methodology and clearly understandable in their presentation of results. On the demand side, financial practitioners must learn how to handle spatial data and understand the uncertainties inherent in environmental models – so they can confidently integrate this information alongside other financial considerations in day-to-day decision-making. At the same time, more datasets and research that link and

attribute environmental insights to individual assets and companies are needed. This is a prerequisite for connecting finance with the real economy and for connecting environmental science with finance at large.

Incorporating environmental science into mainstream finance is about more than simply managing risk on paper: it is about genuinely linking the natural environment with the financial capital that shapes our economies. Spatial finance and asset-level data provide a means to achieve this. By integrating high-quality, location-based environmental data into the decisions of lenders, investors and businesses, we can begin to redirect the flow of finance towards interventions that cut emissions, restore nature and enhance resilience in a changing climate. This transformation will not happen overnight but will require ongoing dialogue, collaboration and knowledge sharing from both sides. So that we can ultimately move towards a financial system that invests in resilience, reduces risks for society and incentivises sustainability in the real world. ES

Christophe Christiaen is the Head of Spatial Finance at the Oxford Sustainable Finance Group and Head of Innovation and Impact at the UK Centre for Greening Finance and Investment. Previously, Christophe worked in the Responsible Investment Team at Nest pensions and held roles at Satellite Applications Catapult, the European Space Agency and Henkel.

REFERENCES

1. Taskforce on Nature-Related Financial Disclosures (2023) *Recommendations of the Taskforce on Nature-related Financial Disclosures.* https://tnfd.global/wp-content/uploads/2023/08/Recommendations-of-the-Taskforce-on-Nature-related-Financial-Disclosures.pdf (Accessed: 6 March 2025).
2. Department for Energy Security & Net Zero, HM Treasury, Department for Environment, Food & Rural Affairs, and Department for Business, Energy & Industrial Strategy (2023) *Transforming finance for a greener future: 2019 Green Finance Strategy.* www.gov.uk/government/publications/green-finance-strategy/transforming-finance-for-a-greener-future-2019-green-finance-strategy (Accessed: 3 March 2025).
3. Eurostat (2024) *Financial corporations – statistics on financial assets and liabilities.* https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Financial_corporations_-_statistics_on_financial_assets_and_liabilities (Accessed: 3 March 2025).
4. Donofrio, S. and Procton, A. (2023) *Paying for Quality: State of the Voluntary Carbon Markets 2023.* Ecosystem Marketplace Insights Report. https://3298623.fs1.hubspotusercontent-na1.net/hubfs/3298623/SOVCM%202023/2023-EcoMarketplace_SOVCM-Nov28_FINALrev-Mar2024.pdf (Accessed: 3 March 2025).
5. Caldecott, B., Clark, A., Harnett, E. and Liu, F. (2024) How sustainable finance creates impact: transmission mechanisms to the real economy. *Review of World Economics*. https://link.springer.com/content/pdf/10.1007/s10290-024-00541-9.pdf (Accessed: 6 March 2025).
6. Taskforce on Climate-Related Financial Disclosures (2017) *Recommendations of the Task Force on Climate-related Financial Disclosures.* Final Report. https://assets.bbhub.io/company/sites/60/2021/10/FINAL-2017-TCFD-Report.pdf (Accessed: 6 March 2025).
7. Condon, M. (2023) Climate services: the business of physical risk. *Arizona State Law Journal*, 147. https://arizonastatelawjournal.org/2023/08/01/climate-services-the-business-of-physical-risk/ (Accessed: 3 March 2025).
8. Caldecott, B., McCarten, M., Christiaen, C. and Hickey, C. (2022) Spatial finance: practical and theoretical contributions to financial analysis. *Journal of Sustainable Finance & Investment*, pp. 1–17. https://doi.org/10.1080/20430795.2022.2153007 (Accessed: 6 March 2025).
9. Taskforce on Nature-related Financial Disclosures (2023) *Guidance on the Identification and Assessment of Nature-related Issues: The LEAP Approach.* https://tnfd.global/wp-content/uploads/2023/08/Guidance_on_the_identification_and_assessment_of_nature-related_Issues_The_TNFD_LEAP_approach_V1.1_October2023.pdf (Accessed: 6 March 2025).
10. Crona, B., Parlato, G., Lade, S. *et al.* (2023) Going beyond carbon: an 'Earth system impact' score to better capture corporate and investment impacts on the earth system. *Journal of Cleaner Production*, 429 (article: 139523). https://doi.org/10.1016/j.jclepro.2023.139523 (Accessed: 6 March 2025).
11. Mandle, L., Shea, A., Soth, E. *et al.* (2024) An open-source approach for measuring corporate impacts on ecosystem services and biodiversity. *Communications Earth & Environment*, 5 (625). https://doi.org/10.1038/s43247-024-01797-7 (Accessed: 6 March 2025).
12. Kerkhofs, R., Bernhofen, M., Baer, M. *et al.* (2025) An asset-level analysis of financial tail risks under extreme climate events. *SSRN*. http://dx.doi.org/10.2139/ssrn.5095534 (Accessed: 6 March 2025).
13. Bressan, G., Đuranović, A., Monasterolo, I. and Battiston, S. (2024) Asset-level assessment of climate physical risk matters for adaptation finance. *Nature Communications*, 15 (5371). https://doi.org/10.1038/s41467-024-48820-1 (Accessed: 6 March 2025).
14. Fatica, S., Grammatikopoulou, I., Hirschbühl, D. *et al.* (2024) European SMEs' exposure to ecosystems and natural hazards: a first exploration. *Sustainability*, 16 (11). https://doi.org/10.3390/su16114841 (Accessed: 6 March 2025).
15. Rossi, C., Byrne, J.G.D. and Christiaen, C. (2023) Breaking the ESG rating divergence: an open geospatial framework for environmental scores. *Journal of Environmental Management*, 349 (article: 119477). https://doi.org/10.1016/j.jenvman.2023.119477 (Accessed: 6 March 2025).
16. World Resources Institute (no date) *Aqueduct water risk atlas*. https://www.wri.org/applications/aqueduct/water-risk-atlas/ (Accessed: 3 March 2025).
17. World Resources Institute (2025) *Global forest watch.* https://www.wri.org/initiatives/global-forest-watch (Accessed: 3 March 2025).
18. World Wide Fund for Nature (2025) *WWF Risk Filter suite.* https://riskfilter.org/ (Accessed: 3 March 2025).
19. UN Environment Programme Finance Initiative (2024) *The climate risk dashboard.* https://www.unepfi.org/sdm_downloads/climate-risk-dashboard-data/ (Accessed: 3 March 2025).
20. Christiaen, C. and Padhiar, J. (2024) *Green Fintech 2.0: Next Generation Climate and Environmental Analytics to Accelerate Green Finance.* UK Centre for Greening Finance and Investment. https://www.cgfi.ac.uk/wp-content/uploads/2024/07/CGFI-Green-Fintech-2.0-report.pdf (Accessed: 3 March 2025).
21. Christiaen, C., Jackman, A. and Lockwood, P. (2024) *Location, Location, Location: Asset Location Data Sources for Nature-Related Financial Risk Analysis.* Oxford Sustainable Finance Group. https://www.cgfi.ac.uk/wp-content/uploads/2024/10/SFI_Report_Asset-location-data-sources-for-nature-related-financial-risk-analysis.pdf (Accessed: 3 March 2025).
22. Spatial Finance Initiative (2024) *GeoAsset databases*. https://www.cgfi.ac.uk/spatial-finance-initiative/geoasset-project/geoasset-databases/ (Accessed: 3 March 2025).
23. Christiaen, C. (2023) *State and Trends of Spatial Finance 2023. Fundamental Building Blocks for Transparency and Accountability in Green Finance.* Spatial Finance Initiative. https://www.cgfi.ac.uk/2023/03/state-and-trends-of-spatial-finance-2023/ (Accessed: 11 March 2025).
24. Fiedler, T., Pitman, A.J., Mackenzie, K. *et al.* (2021) Business risk and the emergence of climate analytics. *Nature Climate Change*, 11, pp. 87–94. https://doi.org/10.1038/s41558-020-00984-6 (Accessed: 6 March 2025).

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Chi-Wing Chan – Deputy General Manager

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Hannah Davies – Senior Consultant
Luke Day – Senior Consultant
Ahmed Medhat Mohamed Ahmed Eldessouky – Acting Environmental Project Manager
Fortunata Immaculata Famah – Environmental Consultant
Alexander Fell – Geo-environmental Engineer
Harshad Fendarkar – Project Manager
Sam Flay – Environmental Advisor
Mohamed Fouad – Postgraduate Student
Daniel Francis – Senior Air Quality Scientist
Michael Freely – CMO & Director
Evanthia Giagloglou – Researcher
Michelle Gibson – Principal Environmental Consultant
Amanda Honeysett – Senior Environmental Analyst
Samara Hyde – Senior Geo-environmental Consultant
Amaechi Innocent – Graduate
Mark Jacob – Science Lead - Environmental Improvement Plan
Ella Jeffrey – Contaminated Land Consultant
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David Jones – CEO
Nicola Kent – Senior Consultant Climate Resilience & Digital
Ashley Lawrence – Environmental Advisor EDF NNB
Shane Lishman – HSE Manager
Craig Lloyd – Environmental Specialist
Tahir Mahmood – Environmental Manager
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Abdulrahman Nassar – Environmental Specialist
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Ketan Patel – Associate Technical Director - Environment
Harry Porter – Senior Consultant (Air Quality)
Amanda Porter – Senior Scientific Officer
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Umair Rasheed – Environmental Expert / General Manager
Tom Richardson – Environmental Projects Officer
Alice Roberts – Technical Bid Manager
Sowmya Shah – Environmental Consultant
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Change the language, change the conversation

Liz Callegari outlines how to talk about investment when it comes to action on climate, nature and development.

FEATURE

Wherever you sit on the political spectrum, it is hard to ignore the fact that we are in the grip of a series of global crises. We live in a world of soaring energy prices, where the residents of Los Angeles had to flee their homes to escape wildfires and people in Somerset had to be evacuated because of flooding caused by Storm Éowyn. Meanwhile, 82 per cent of Britons report that prices are rising faster than their income and many are struggling to put food on the table.[1] People around the world continue to flee their homes due to war, economic instability and climate change, creating a practical and moral crisis about illegal immigration across the world. Most people have been affected in some way by our politically, financially and environmentally unstable world.

▲ **Figure 1. The top global issues for the public. (Source: MoneyTalks, 2024[4])**

Yet while there is no shortage of solutions to these problems, solutions need funding; funding often comes from governments; and governments need to be persuaded to act. Creating the space for decision-makers to take action needs either a mandate from voters or a sense that public opinion is on-side. This is where things get complicated. Despite recognising these problems, our views as to why they exist in the first place have become so polarised that our ability to fix them is being dangerously compromised.

Nowhere has this been more starkly illustrated than in the recent decision by the Trump administration to dismantle USAID. The ensuing response has veered from impassioned pleas about the threat to life of marginalised communities in other countries to debates about the values of soft power and international relationships. Finding a way to engage people on funding critical issues like fighting hunger, preventing disease and adapting to climate in lower-income, cash-strapped and debt-burdened countries has never been more difficult or more important.

THE MONEY TALKS PROJECT

The way we talk about these issues is not helping the situation, and it is time to change that. Since 2022, the Money Talks project has sought to drive more effective communications on the need to increase and improve investment in climate, nature and development.[2] The project provides research, insight, assets and a platform for organisations to come together to share information.

Working with Stack Data, three sets of global polls have now been run to determine who is interested in these issues, what is turning off those who are not engaged and, most importantly, how to communicate to increase people's support.[3] In 2022, a survey of 20,000 people was undertaken across the G7 countries, which was expanded in 2023 to a further 30,000 people across 15 countries (the G7 plus Australia and seven lower-income countries: Argentina, Brazil, India, Indonesia, Kenya, Nigeria and South Africa). In 2024, a deep dive into taxation was completed and the Money Talks: Debt project is planned for 2025.

This research has shown that the people most likely to be engaged across the G7 are those who are highly informed on global issues and politically engaged. More importantly, within the G7 this segment only makes up about 16 per cent of the population – not enough to create the critical mass needed to support global economic reform.[2] We need to find a way to motivate the masses in the middle. This is where framing comes in.

Framing creates shortcuts to understanding. In the same way a graph gives data shape and context, a frame gives people a sense of scale and comparison. Frames can influence how someone interprets a problem, inform how they respond to it and help create a long-term

▲ **Figure 2. People's national priorities. (Source: Money Talks, 2024[4])**

position for an audience. Branding is built on framing principles, so in essence framing is a brand strategy, but for an issue rather than a product. And the conversation about global finance needs a rebrand.

FROM GLOBAL TO LOCAL

One of the biggest challenges we have is getting people to understand that local issues need global solutions. This is far from an alien concept to mainstream audiences. The research has shown that climate change is seen as a top global issue that the world should be focusing on, followed by food insecurity and hunger (see **Figure 1**). However, on a national level, priorities shift, with cost of living, immigration, the economy, unemployment and corruption coming to the fore (see **Figure 2**).

Facts alone will not change the world. If statistics about rising temperatures and debt levels were enough to spur people into action on climate and poverty, we would have sorted ourselves out a long time ago. Facts and numbers need context, and that context must be relatable and comprehensible, because few will keep listening if we dive straight in with highly technical or scientific language. A 'just transition to a net zero world' or 'biodiversity net gain' mean nothing to most people and, frankly, sound unappealing, boring and far removed from daily reality. Many cannot relate with talk of 'decarbonising energy infrastructure' or 'unsustainable economic systems' and it does not engage people.

The research focus groups also brought home that people feel angry about the lofty and sometimes convoluted language used around climate change and financial systems. Restructuring the financial system is not something that just trips off the tongue, but these things affect us all and the way we talk about them needs to be more accessible. However, what does offer hope is that when given time and space to have the conversation, people absolutely make the connection between their local reality and the need for global solutions.

Frames can create common ground around our biggest issues, so we can work together to create better solutions. Over two days of filming *Coffee, Bread and the Economy* in London, the filmmakers spoke to more than 30 people from 12 different countries. Only one disagreed that the world should take an international approach to solving climate change and development problems, including the need for high-income countries to invest in developing ones. The film captures what people think and how framing this issue with a more understandable approach (in this case from the perspective of the food we eat) connects people in a less-divisive way.[5]

SIX EFFECTIVE COMMUNICATION TACTICS

How we talk about investing in action really matters – and the research shows that the frames that were developed can increase support, in some cases by up to 20 per cent. Such a leap should be recognised as a vital opportunity to drive progress and change, and reach

beyond the bubble of policy, research and campaign communities working in this space.

We have consistently seen the importance of unlocking vocabulary to help climate change, nature and development finance become everyday concepts that people can talk about more easily.

TACTIC 1: WHAT DO THEY CARE ABOUT?

We know we face a climate emergency. But money matters. Given economic anxieties, messaging should connect climate and development finance initiatives with people's daily realities and the positive impact on living costs (especially food and energy), the national economy and – especially in emerging economies – jobs.

Connecting to what people really care about and provoking an emotional response is vital for science communicators, especially when it comes to connecting with a non-scientific audience. This does not mean we cannot use data or demonstrate our analysis – just that we should not necessarily start with this. Opening with a big statistic or grand academic concept can overwhelm an audience.

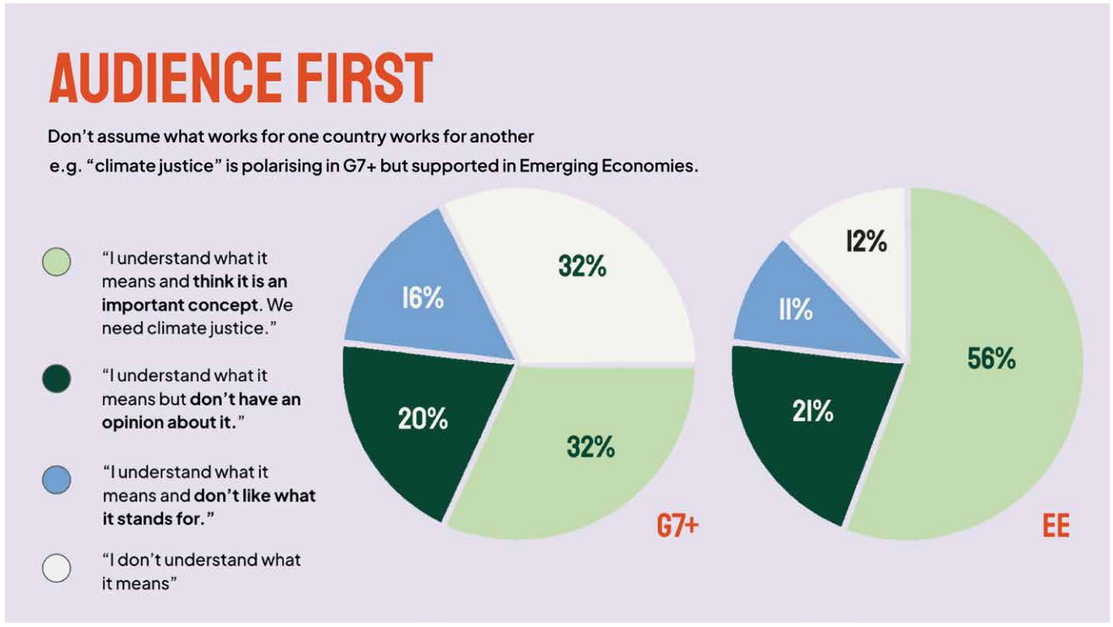
Instead, we need to find a meaningful connection to people's lives. Storytelling is a powerful tactic. For example, rather than starting with data about renewable energy capacity, we can spark intrigue and optimism by telling the story of new jobs and opportunities in a growing industry: Did you know that Texas (yes, Texas!) has the greatest number of clean-energy jobs in the USA? Once an audience's interests and emotions are piqued, there will be a more meaningful connection to the research findings – and the audience is more likely to stick around and listen.

TACTIC 2: GO BEYOND THE MORAL ARGUMENT

The research showed that spelling out investment in simple and immediate terms – such as in terms of jobs, livelihoods, clean water, prevention of disease and economic stability – has a greater impact. We need to paint a picture in a relatable way of what funding will actually deliver.

However, we need to go further and spell out how investing in action connects to tangible benefits to the investor country and to voters. To bolster support, we need to go beyond the moral argument by showing the domestic benefits. For example, will investing result in more stable food supplies and prices? In clean and secure energy sources? In business opportunities? Or in preventing flooding or pandemics? Is there a return on investment?

Take a look at the reporting around USAID. At time of writing, the US government appeared to be reinstating funding for Costa Rica. Marco Rubio was quoted as saying that in Costa Rica aid is used 'to solve a problem, to help us, and to do so in a way that actually helps the United States, by stopping drugs, stopping criminals, and identifying terrorists. This is foreign assistance that promotes our national interest'.[6] At the same time, there is no shortage of commentators pointing out the historic benefits of USAID when it comes to soft power and the potential for China to benefit at the USA's expense from the recent changes.[7]



▲ **Figure 3. Matching the audience with the messaging. (Source: Money Talks, 2023[5])**

▲ **Figure 4. Average of seven countries (UK, USA, France, Germany, Brazil, Kenya, South Africa). (Source: Money Talks, 2024[4])**

TACTIC 3: REMEMBER NATIONAL DIFFERENCES

It is vital to be aware of different national contexts. For example, if you are based in a country like Kenya and you are trying to persuade G7 decision-makers to act, messaging that works for your national campaigns may be perceived differently elsewhere. We cannot assume that what works for one country will work for another.

The research included testing the concept of climate justice, and it was found that it was often poorly understood – and even polarising – in G7 countries yet strongly supported in emerging economies. Relatedly, focusing on responsibility as a wealthier country may not land well, especially for people whose experiences of living in that country do not match this description and who are likely to want to fix problems at home first.

Here in the UK, we know from other research projects that most Britons support the principle of giving aid to the poorest countries around the world.[8] The moral argument exists and should be used, but it is no longer enough.

TACTIC 4: SOME POLICIES ARE POPULAR!

Policies such as the polluter pays and taxing the super-rich have strong support across countries and political leanings. Globally, 73 per cent of study respondents supported policies that would tax industries profiting from fossil fuels to help developing countries to reduce their carbon emissions. The more polluted the country, the greater the agreement.

In general, people believe their governments should spend more on tackling the cost of living and on nature restoration, more than on climate change in many countries and substantially more than on aid to poorer countries. Positioning government investment in climate change and development as a way of responding to the cost of living crisis or protecting and restoring nature can increase support. This particularly increases support among those who see climate change and development as less of a priority.

TACTIC 5: BEWARE OF BIG NUMBERS

We often see the non-governmental organisation community talking about global funding using enormous monetary figures as targets or demands. Talking about money in terms of trillions and billions can be confusing and alienating. Instead, creating a meaningful comparison can give audiences more context. For example, by expressing numbers in terms of percentage of gross domestic product (GDP) or comparing them to spending on other issues.

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Interestingly, the research found that simply by communicating cost as a percentage of global GDP, support for international investment increased by an average of 7 per cent (and in some countries by up to 20 per cent). However, with more context an even more compelling story can be created. For example, the UK Government just announced a cut of 0.2% of GNI (Gross National Income) to overseas development – that's equivalent to around £6 billion. We can help audiences get a handle on what this means by contrasting it, for example, with the reports that £4 billion was spent by the last government during the Covid-19 pandemic on unusable medical equipment (such as masks and gowns) or by highlighting how many lives could be saved with this money.

TACTIC 6: MESSENGERS MATTER

Finding the right messenger matters. This is crucial to remember, especially if trying to motivate the mainstream middle: activist and partisan voices may not be appropriate, particularly for more right-leaning and conservative audiences. Trust and support grow when we choose the right messenger. Investing in a variety of messengers that appeal to different constituencies is also important – for example, lifestyle, business, faith or military voices could all have a role – but to start, messengers should be trusted by the people they are talking to. Take the recent media flurry around Timothée Chalamet arriving at his latest film premiere on a Lime bike to beat traffic; would that have had the same impact if Greta Thunberg had been riding the bike?

Ultimately it comes down to this: we are at a crucial moment when we can move the world to net zero with a just transition, but we cannot use such buzz words to describe the process because they simply do not resonate with people in the real world. If we want to create a conversation that everyone can be part of, we cannot use elitist or complicated language. We must be pragmatic, grounding our messages in people's realities, concerns and priorities. ES

Further reading Learn more about how our insights can help you start a better conversation with your audience to drive impact. Explore the research and our interactive data dashboards at www.moneytalksresearch.org.

Liz Callegari is Co-founder of Black Sands Communications, a consultancy that works on brand, communications and campaign strategy for purpose-led organisations. Black Sands also runs the Money Talks project, dedicated to improving how we communicate on the need to invest in climate, nature and development.

✉ liz@blacksands.co.uk

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REFERENCES

1. Dylan Difford (2024) *How are Britons coping with the cost of living at the end of 2024?* https://yougov.co.uk/economy/articles/51038-how-are-britons-coping-with-the-cost-of-living-at-the-end-of-2024 (Accessed: 7 February 2025).
2. Money Talks (no date) Home page. https://www.moneytalksresearch.org/ (Accessed: 7 February 2025).
3. Stack Data Strategy (no date) Home page. https://www.stackdatastrategy.com/ (Accessed: 10 February 2025).
4. Money Talks (2024) *Money Talks Tax (2024).* https://docs.google.com/presentation/d/1wBEZpNWXP7qM2QzszTQWp8b_-sByjG6jVbsWstM6e-c/edit#slide=id.p (Accessed: 28 February 2025).
5. The Global Goals (2024) *Why global investment #MakesTotalSense.* YouTube video [1:36]. https://youtu.be/5dKr7bwQ1To?feature=shared (Accessed: 10 February 2024).
6. Tico Times (2025) *U.S. freezes USAID funds: will Costa Rica receive assistance?* 5 February. https://ticotimes.net/2025/02/05/u-s-freezes-usaid-funds-will-costa-rica-receive-assistance (Accessed: 28 February 2025).
7. Hale, E. (2025) *Trump's assault on USAID leaves China soft power opening in Southeast Asia.* https://www.aljazeera.com/news/2025/2/13/for-china-usaids-demise-could-be-a-soft-power-win-in-southeast-asia (Accessed: 28 February 2025).
8. Green and Global (no date) Home page. https://www.greenandglobal.org/#read-more (Accessed: 28 February 2025).
9. Money Talks (2023) *Money Talks 2023 key insights.* https://docs.google.com/presentation/d/1nvEwGI1aHtcOdN1m1WjlekEbMmjPC6xpGaVhbirmuS4/edit#slide=id.g1e971663418_3_1361 (Accessed: 28 February 2025).

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ANALYSIS

Beyond finance: applying the Taskforce for Nature-related Financial Disclosures framework

Kripa Dwarakanath looks at the framework's environmental benefits and how environmental practitioners can get more involved.

There is increasing interest from Fortune 500 companies and businesses on the topic of nature, particularly around water, chemicals and plastics pollution, biodiversity, and forests, evidenced by the increase in the number of companies that set nature-related targets in 2024 compared to 2022.[1] Increased participation at the last United Nations Biodiversity Conference of the Parties (COP16) held in Colombia in 2024 is also reported, which confirms that nature is now an important consideration for businesses.[2]

There could be several drivers to this, but two stand out:

1. The Taskforce on Nature-related Financial Disclosures (TNFD), a market-led initiative to improve corporate sustainability reporting requirements around the pillars of governance, strategy, risk and impact management, and metrics and targets.

2. The EU's Corporate Sustainability Reporting Directive (CSRD), which through the double materiality assessment requirement obliges qualifying businesses to report on their impact on the environment (including nature) and communities. (While CSRD requires businesses to consider impacts across environmental, social and governance topics, the focus here is on nature.)

ANALYSIS

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Built on risk evaluation methods, the requirements driven by both the TNFD and CSRD help businesses to systematically consider their relationship and dependency on nature and how they could affect business continuity and growth (i.e. financial risks). These frameworks encourage businesses to go further and to test the potential impact of their activities on nature (and any interconnected natural resources) based on knowledge and evidence from relevant stakeholders and scientists – a key step where science meets finance.

FRAMEWORK OVERVIEW AND APPLICATION

The TNFD was formally launched in 2021, with the final framework released in September 2023, aimed at supporting businesses to transparently report on their relationship with nature and to guide and shift financial flows from nature-negative into nature-positive investments.[3] The disclosure is currently voluntary and, by October 2024, 129 financial institutions had registered as adopters, representing US$7.7 trillion in assets under management. The UK Government's next step is to review how to integrate TNFD into legislation and practice.[4]

While more than 500 organisations have formally signed up as adopters, some businesses use the framework without being formal signatories. They use it as a guide to develop their understanding of nature-related risks to their businesses and to develop strategies to mitigate impacts, with the aim of developing a nature-positive business model. The TNFD outlines a methodological approach to enable businesses and financial institutions to consider and integrate nature into their activities, referred to as the LEAP process: locate, evaluate, assess and prioritise. The LEAP approach is a standardised first step for organisations to understand and assess their nature-related impacts, dependencies, risks and opportunities.[5]

Based on this understanding, organisations across all sectors will further develop their actions guided by four TNFD pillars, with recommendations included for each:

- **Governance.** Disclosing information on organisational governance arrangements in managing nature-related dependencies, impacts and risks, including roles and responsibilities.
- **Strategy.** Providing details on how information on nature-related impacts and risks has been considered in business strategies and operations and in finance planning.
- **Management of risk and impact.** Disclosing how risks and impacts were identified and assessed – for example, through scenario analysis – and how they are managed.
- **Metrics and targets.** Outlining arrangements for a structured method to measure and monitor the management of identified risks and impacts on a continual basis.

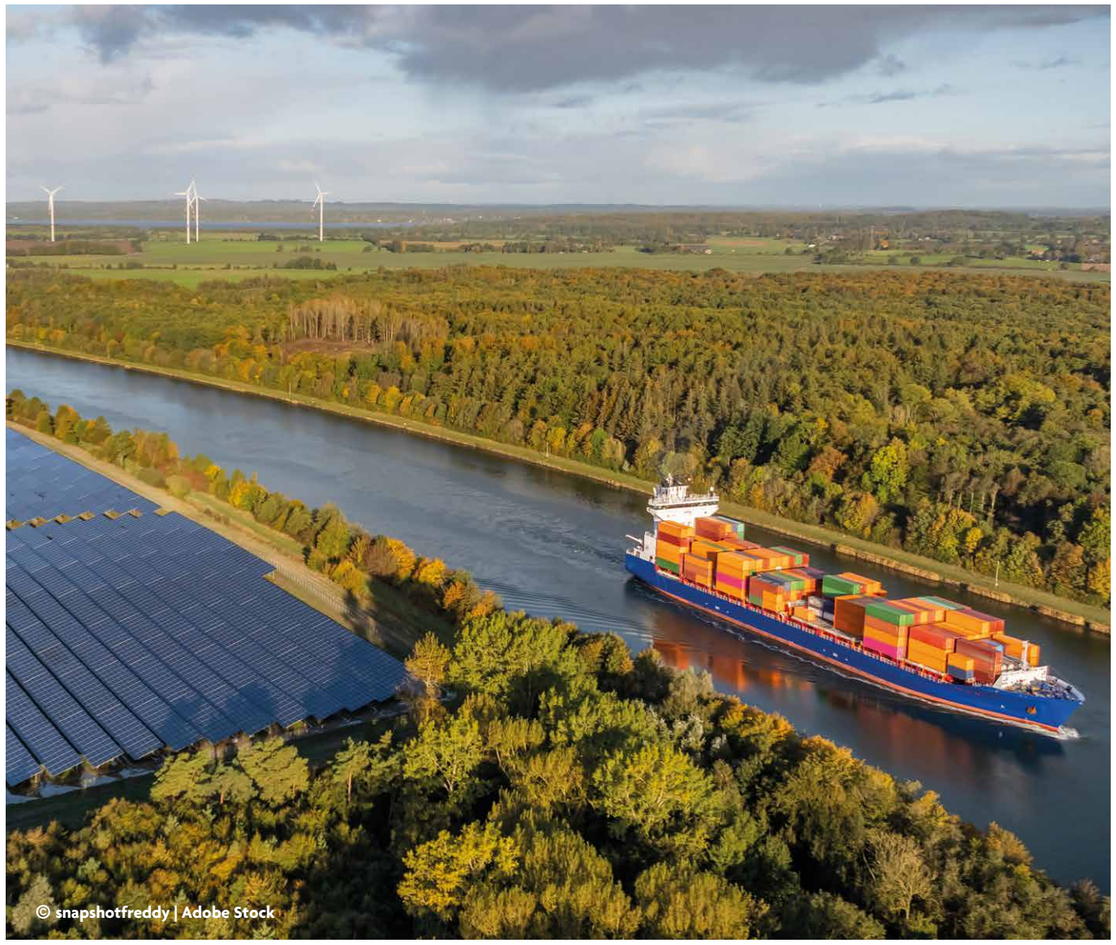
In practice, there are several parallels to the LEAP approach. These include the integration of risk and impact findings into developing plans and strategies and supporting them through monitoring frameworks. It also includes taking a strategic environmental frameworks development approach – more typically developed for plans and programmes – and starting with establishing a baseline and identifying material topics relevant to the context.

DEVELOPING A PRINCIPLES-BASED STRATEGY

Water is a key component of nature and life on earth, and in that context the development of a water management strategy is closely linked to the development of a nature strategy. However, it is acknowledged that a similar approach to biodiversity is required for a fully comprehensive nature strategy. Using a water-based case study, we illustrate the application of TNFD principles and the framework as a useful tool to identify water-related risks and impacts, and to develop strategies to manage these risks to the business.

An international organisation providing shipping and ports-related logistics services and operating across more than 700 sites wanted to adopt water stewardship principles across its operations and further its sustainability performance. Taking a bottom-up approach, and assisted by GHD, the company wanted to produce a deliverable global water management strategy.

Gathering an understanding of how nature and business interact in their operations is the first step in developing nature strategies for businesses.



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To establish this interdependency, an analysis of the state of water resources around the company's operating sites was conducted. For example, for sites in areas subject to water stress, we gathered information on water quality by analysing open-source data. Applying the LEAP framework, the following actions were taken.

Locate: Using available open-source data on water risk factors (e.g. water basin physical risks and water quality) from the World Resources Institute, World Wide Fund for Nature and UN Global Compact Water Action Hub, geographical information systems tools and other known site-based data were applied to identify which operating sites coincided with water risk areas.[6,7]

Evaluate and assess. Next, the impacts and dependencies the sites and operational activities are likely to have on water resources were evaluated. This was done through a review of internal data from selected operating sites, supplemented by a bespoke, sample-based survey of sites. The survey findings provided useful information on the various activities water was used for on-site and how they differed across business operations. It provided further insights into direct and indirect control that operations can have in water procurement to design potential intervention methods such as water metering or engagement with water tanker suppliers. The findings also identified the different water treatment practices prior to discharge. The survey also demonstrated the gap in data capture and reporting, which led to the establishment of the strategy's top task: the need to strengthen data collection to better understand the organisation's relationship with water. Survey findings, combined with the findings from the previous locate step assisted in identifying priority sites and top actions (such as installing water meters to improve measurement and monitoring).

Prepare. The survey also gave useful insights into the variability of dependency the different organisational divisions had on water. This assisted in site prioritisation and in supporting the decision to take a phased approach in rolling out water management practices across all sites. This included a clear direction for the organisation, starting with the priority sites, with a view to reaching full global coverage and becoming net water-positive.

A roadmap to deliver the water management strategy, along with a set of measurable targets and actions, was included and shared with key internal stakeholders. Although the strategy and roadmap are expected to be launched in spring 2025, the company has already begun to implement the strategy by launching activities to strengthen internal capabilities for assessing the interdependency between site activities and water in a way that will drive measurable actions. These will be reported and monitored for continuous improvement.

APPLYING CORE ENVIRONMENTAL KNOWLEDGE

Most of the steps in the LEAP process require specialist knowledge of environmental assets, impact prediction methodologies and credible data sources – including the interface with nature and nature-sensitive areas; the identification of environmental assets, ecosystem services and impacts knowledge; the identification of dependencies and impacts; and dependency and impact measurement. For example, understanding where to look for open-source data and how these data were derived was helpful in using a complex set of information to locate and assess nature-related risks to the business.

As important as it is for financial institutions and other organisations to get involved and drive framework adoption, it is equally vital for environmental practitioners to participate – to apply their knowledge of the complexities between natural resources and processes and to influence and shape the practice. Practitioners who are well-versed in developing systems-approach frameworks and sustainability and habitat assessments at a strategic level would benefit from upskilling to collaborate with financial institutions and, as far as possible, simplify the risk assessment process. Environmental practitioners play a crucial role in enabling financial flows to shift to nature protection and to the enhancement of natural resources. ES

Kripa Dwarakanath CEnv has 21 years of experience in sustainability consulting and advisory roles and leads GHD's Europe and Middle East Sustainability and Resilience service line in the UK. Her team works with businesses and public sector infrastructure organisations providing sustainability advisory services, including around nature-based solutions, decarbonisation and climate mitigation and adaptation.

REFERENCES

1. Kronschnabl, A., Katz, J., Patel, M. *et al.* (2015) *Ten tests for nature strategy.* https://www.mckinsey.com/capabilities/sustainability/our-insights/ten-tests-for-nature-strategy. (Accessed: 18 March 2025).
2. Business for Nature (2024) *UN Biodiversity COP16: a step forward, but not far enough.* https://www.businessfornature.org/news/un-biodiversity-cop16-a-step-forward-but-not-far-enough (Accessed: 24 March 2025).
3. Taskforce on Nature-related Financial Disclosures (2023) *Recommendations of the Taskforce on Nature-related Financial Disclosures.* https://tnfd.global/wp-content/uploads/2023/08/Recommendations-of-the-Taskforce-on-Nature-related-Financial-Disclosures.pdf?v=1734112245 (Accessed: 18 March 2025).
4. Department for Energy Security and Net Zero, HM Treasury, Department for Environment, Food & Rural Affairs, and Department for Business, Energy & Industrial Strategy (2023) *Green finance strategy.* https://www.gov.uk/government/publications/green-finance-strategy (Accessed: 18 March 2025).
5. Taskforce on Nature-related Financial Disclosures (2023) *Guidance on the Identification and Assessment of Nature-related Issues: The LEAP Approach.* Version 1.1. https://tnfd.global/wp-content/uploads/2023/08/Guidance_on_the_identification_and_assessment_of_nature-related_Issues_The_TNFD_LEAP_approach_V1.1_October2023.pdf (Accessed: 26 March 2025).
6. World Wide Fund for Nature (no date) *Water Risk Filter.* https://riskfilter.org/water/home (Accessed: 17 March 2025).
7. UN Global Compact Water Action Hub (no date) *100 priority basins.* https://wateractionhub.org/100basins/ (Accessed: 17 March 2025).

Climate models in finance: the good, the bad and the ugly

Anubhav Choudhary and **Jason Lowe** review the benefits and pitfalls of using climate risk predictions.

TECHNICAL

CLIMATE RISKS ON THE FINANCE SECTOR

From extreme heat and wildfires to rising sea levels and hurricanes, climate-related risks are no longer distant threats. They are already shaping financial markets and are expected to change further in the future, affecting asset values, mortgage markets, pension funds and insurance systems.[1,2] Global warming beyond 1.5C or 2.0C is likely to amplify macroeconomic instability, intensifying financial shocks from extreme heat, flooding and agricultural losses.[3,4,5]

The financial sector faces several categories of risk, with the greatest focus until now having been on transition risk. This addressed the effects of climate policies on firms, including aspects such as carbon prices, stranded assets, and additional reporting and

compliance requirements. More recently, there has been a shift to also consider physical climate risks, including from changes in extreme weather.

Observations of weather variables provide one source of data for assessing past and present climate hazards and physical risks. However, because of the short observational record and the non-stationary nature of the climate recently, they are limited in what they can tell us about the likelihood of rare events in the present day. Additionally, there is a need to quantify risks in the coming years and decades, beyond the end of the observational record. Therefore, climate system models are increasingly being used as part of financial risk assessment and management, although often without a full understanding of their strengths, weaknesses or limitations.[6,7,8,9]

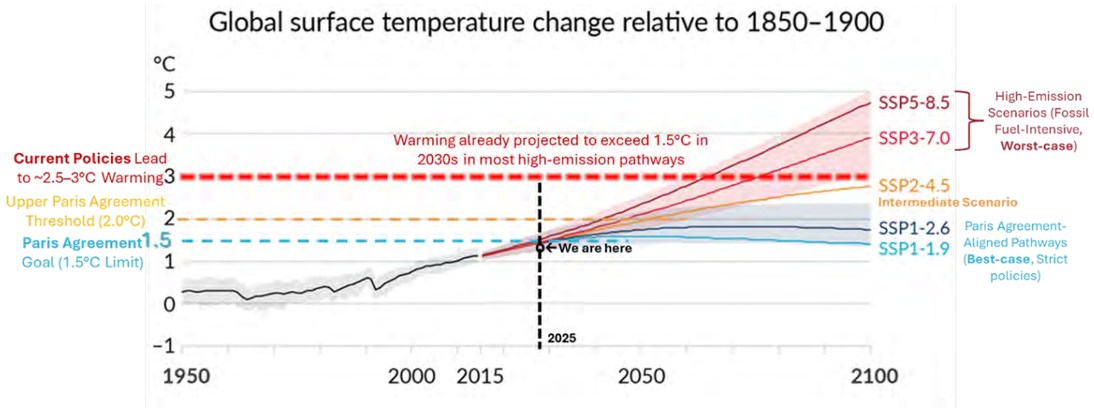
Physical climate models simulate future conditions by solving the equations that govern the movement of the atmosphere and ocean, as well as by representing features such as clouds and sea ice and their interactions with the land surface. While the physical principles are well known, often their representation within the models is simplified, and the equations are solved on a coarse spatial grid. The models are driven forward in time using scenarios of greenhouse gas emissions. (For some models these emissions scenarios need to be converted into estimates of the change in atmospheric concentration of gases such as carbon dioxide and methane.) A key challenge is how climate analysts translate these simulations into decision-relevant information for the real world.

THE GOOD: CLIMATE MODEL OPPORTUNITIES

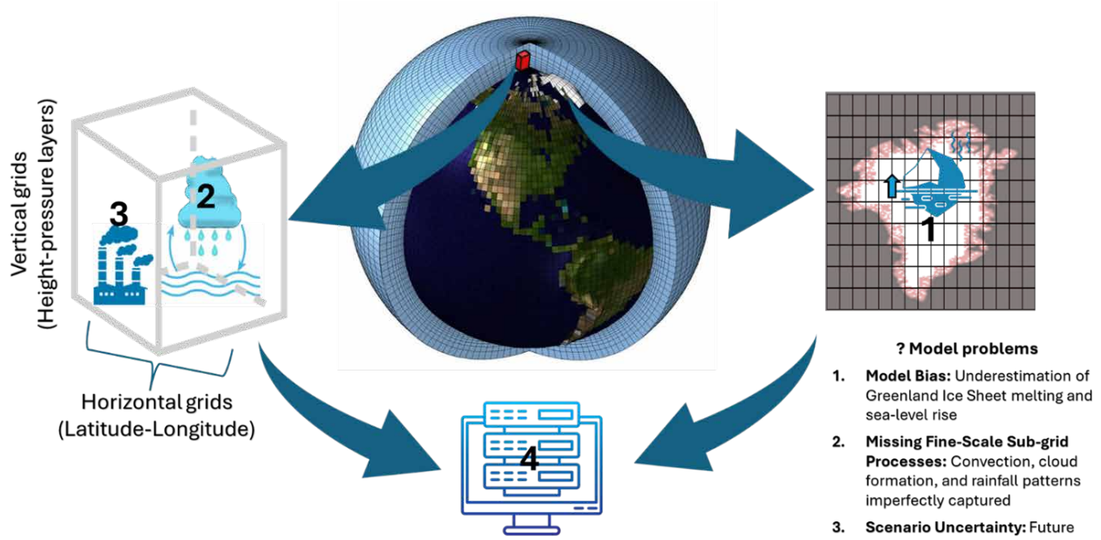
Firstly, climate models allow examination of a range of alternative versions of present-day weather conditions. This overcomes the limitations of the short observational record to explore other weather events that could plausibly occur in the present, allowing financial institutions to explore longer return periods with more confidence than by simple statistical extrapolations from the observations.

Secondly, climate models enable financial institutions to explore a wide range of alternative plausible future emissions pathways. For instance, the Shared Socioeconomic Pathways cover a range of different views of future world development and have been combined with different estimates of future greenhouse gas emissions.[10,11] Climate models have then been used to simulate the global climate response for these scenarios, with a key finding being that for current policies we are likely on a trajectory of 2.5–3.0C of global warming, far exceeding Paris Agreement and well above 2.0C and the 1.5C guardrails (see **Figure 1**). By running several different climate models for the same emissions pathway, it is also possible to explore the model response uncertainty, helping financial institutions to assess a spectrum of possible futures rather than relying on deterministic forecasts.[12]

Global climate models (GCMs) offer broad insights into large-scale changes in weather and climate but lack the granularity for asset-level risk assessments. Regional climate models (RCMs) take the output from the global models and simulate changes over smaller regions but with more spatial detail (sometimes down to scales of 2 km with the latest regional models), improving local risk analysis and aiding decision-making in real estate, insurance and infrastructure investments.[13] For instance, risks associated with coastal-area mortgages depend on precise sea-level rise projections, as slight



▲ **Figure 1. Projected global temperature change under different Shared Socioeconomic Pathways scenarios relative to the 1850–1900 period. The 1.5C and 2.0C lines highlight Paris Agreement targets. (Source: Adapted from Masson-Delmotte *et al.*, 2021[17])**



▲ **Figure 2. Schematic representation of key limitations in climate models for financial risk assessment. The figure highlights: (1) model biases in representing large-scale ice sheet dynamics (e.g. Greenland ice sheet underestimation); (2) unresolved fine-scale atmospheric and hydrological processes (e.g. convection, cloud formation and rainfall distribution); (3) scenario uncertainty due to future emissions pathways and socio-economic assumptions; and (4) computational constraints limiting model resolution and number of model runs. These factors contribute to challenges in translating climate projections into actionable financial risk assessments.**

variations in storm surge intensity can escalate property devaluation risks.[14,15] Similarly, heat stress models influence labour productivity and insurance pricing in climate-exposed industries.[16]

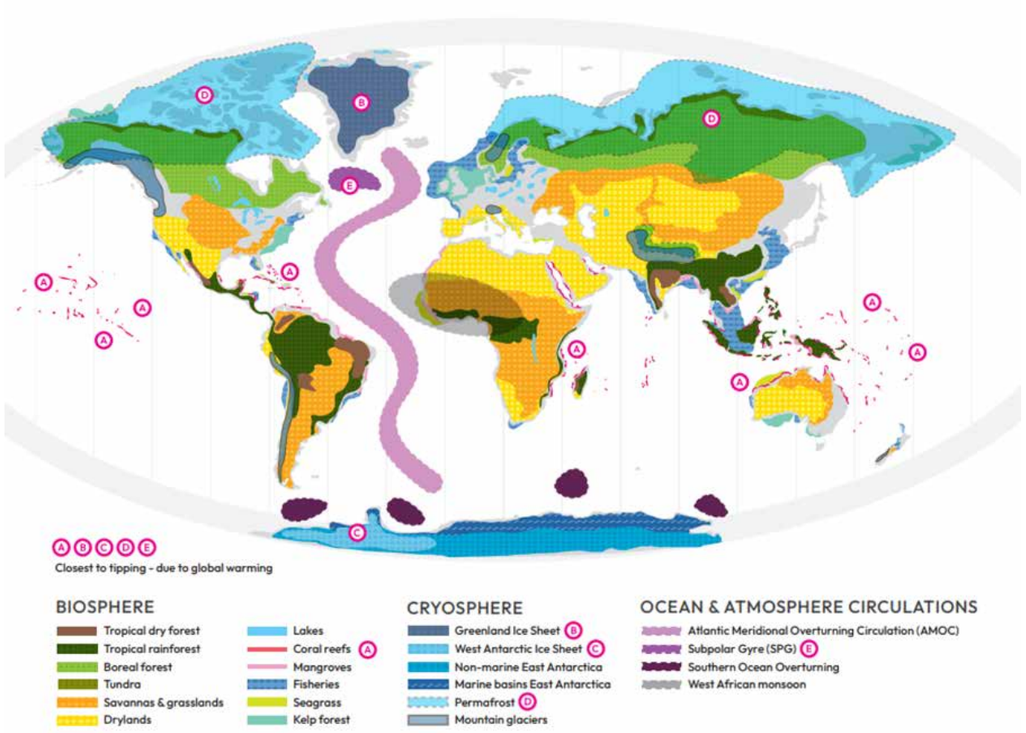
Therefore, climate models appear to provide information that finance is demanding for physical risk assessment years and decades into the future.

THE BAD: LIMITATIONS AND BIASES

Both GCMs and RCMs struggle with simulating small-scale atmospheric processes, such as cloud microphysics, localised precipitation and convective storms, although the problems may be reduced in the most spatially detailed models (see **Figure 2**).[18,19] These limitations introduce uncertainties in extreme weather projections, leading to inconsistencies across spatial and temporal scales.

Another key challenge in climate modelling is accurately capturing large-scale climate patterns, such as the North Atlantic Oscillation (NAO). The NAO significantly influences winter climate variability in Europe and North America, affecting storm tracks, precipitation and energy demand.[20] However, climate models often underestimate NAO variability and misrepresent long-term trends, leading to uncertainty in extreme winter weather projections. These biases affect financial risk assessments by distorting forecasts for insurance claims, infrastructure resilience and sovereign credit ratings.[21] Misrepresentation of NAO phase shifts can also lead to errors in drought and flood risk assessments, impacting agricultural investments. While high-resolution models have improved NAO simulations, challenges remain in capturing its response to anthropogenic climate forcing, complicating financial risk pricing.

Despite their higher resolution, RCMs struggle to simulate extreme precipitation, particularly convective storms and tropical-cyclone-related rainfall.[19] Many models underestimate short-duration, localised and intense rainfall, leading to flawed flood risk projections and mispriced insurance assets. Biases in orographic precipitation further impact hydropower planning, affecting energy security. While very high-resolution convection-permitting models show improvements, computational constraints limit their widespread use.[18]



▲ **Figure 3. Regions of the Earth's system identified as potential tipping points, with implications for financial risks such as stranded assets, supply chain disruptions and systemic economic shocks. (Source: Lenton *et al.*, 2023[25])**

Thus, the challenge for financial analysts is to understand the model biases and then estimate which aspects of the model simulations can reliably relate to the real world. Even where this can be done, a further problem is the mismatch between large-scale models and asset-level financial risk assessments, especially with GCMs but also to some extent with the latest RCMs.[3]

THE UGLY: TAIL RISKS AND TIPPING POINTS

While the impacts caused by the likely ranges of the future climate scenarios present many challenges to society in general and the finance sector in particular, a growing concern is the risk of high-impact low-likelihood events—also referred to as tail risks – which are rare but potentially severe occurrences.[22] These events have the potential to cause catastrophic impacts over a very wide area, affecting every aspect of society and business. Sometimes, these tail risk events might happen due to a rare combination of random events leading to exceptional weather conditions, such as extreme temperatures or flooding. However, a major area of focus is on Earth system tipping points (see **Figure 3**).

For financial firms, these high-impact scenarios present a major challenge.[13] Underestimating upper-tail risks will lead to mispricing in risk transfer markets, sovereign bonds, and infrastructure investments.[3,23] However, overestimating these risks or focusing too much on tail risks at the expense of considering the wider spread of impacts can also have consequences, leading to inefficient capital allocation and mispriced risks.[24]

Unfortunately, the ability of climate models to credibly simulate many Earth system tipping points is limited, with inadequate treatment of the real-world Earth system processes. For example, simulating the potential accelerated sea-level rise that would come from more rapid loss of ice from the Antarctic ice sheet requires models to be able to reliably simulate the transfer of heat at multiple depths to the ocean margin around the ice sheet, mixing processes under the floating ice shelves, ice sheet processes including fast ice streams, and marine ice cliff instability.[26] Some of these processes are not fully understood, requiring further fundamental research, and some are missing or represented in unrealistically simple ways in most mainstream climate models.[27] Furthermore, until recently, experimental designs for using climate models have not been designed to focus on quantifying the likelihood of tipping points.[4]

The inadequate simulation of tail risk events is not the only major problem when considering worst-case scenarios. There is still inadequate study of many compound events (two or more types of hazards occurring together), sequences of events and hazard cascades (where one type of hazard makes another more likely to occur – such as high temperatures making wildfires more likely). While the Network for Greening the Financial System has advanced climate stress testing, many financial models still fail to account for compounding physical risks and policy shifts, leaving markets vulnerable to sudden asset repricing.[9,13,28,29]

Extreme climate outcomes and tail risks, therefore, present a particular challenge to both climate modelling and decision-making within the finance sector.

WHY THIS MATTERS FOR FINANCIAL RISK

Failure to fully and accurately integrate climate risk into financial models exacerbates mispricing, amplifies systemic vulnerabilities and heightens market instability. Furthermore, strengthening disclosure frameworks and regulatory harmonisation is crucial to enhancing financial system resilience.

For instance, the underpricing of physical climate risks leads to insurer insolvency risks, while overpricing raises premiums, limiting affordability.[9] Pension funds, which hold long-term assets, face rising exposure to physical risks in real estate, infrastructure and sovereign bonds if they fail to integrate forward-looking climate projections.[13] Some institutions starting to consider climate change appear to overemphasise tail risks while underestimating the more likely range of outcomes, potentially misallocating capital and exposing financial markets to climate shocks.[3,29]

What can be done to improve the situation? Firstly, there is a range of technical and scientific improvements that can be made over the coming years, and these need to be prioritised. Key developments will likely include advancements in supercomputing, artificial intelligence (AI) and machine learning, some of which are already finding applications in climate risk analysis. AI-driven downscaling refines GCMs into localised financial insights, which are crucial for mortgage markets and insurance pricing.[30] Additionally, improved experimental designs are needed for running large multi-model climate experiments.

Secondly, there is a need for institutional improvements. Financial institutions require standardised climate risk assessment frameworks to enhance market credibility. Regulators must strengthen stress-testing methodologies (including better treatment of extreme weather events), model uncertainties, and compound risk in scenario designs (including supply chain disruptions and extreme precipitation).[13] Interdisciplinary collaboration

is also vital: climate and social scientists, financial institutions and policy-makers must work together to align methodologies to translate complex climate projections into actionable financial insights.

Institutions like the UK Centre for Greening Finance and Investment are playing a key role in bridging this gap by fostering academia–industry collaborations and accelerating adoption of advanced climate analytics into financial decision-making.[31] ES

Dr Anubhav Choudhary is a Research Fellow in Climate Finance Analytics at the University of Leeds. As part of UK Centre for Greening Finance and Investment, he works on quantifying physical climate risks and their financial impacts with a focus on pension funds.
✉ **a.choudhary@leeds.ac.uk**

Professor Jason Lowe OBE is Chair in Interdisciplinary Climate Research at the University of Leeds and Principal Fellow and Head of Climate Services at the Met Office. His experience includes leading major national and international policy-relevant climate modelling projects.
✉ **jason.lowe@metoffice.gov.uk**

REFERENCES

1. Pörtner, H.O., Roberts, D.C., Adams, H. *et al.* (2022) 'Technical Summary', in H.-O. Pörtner, D.C. Roberts, M. Tignor *et al.* (eds) *Climate change: impacts, adaptation and vulnerability.* Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. https://www.ipcc.ch/report/ar6/wg2/downloads/report/IPCC_AR6_WGII_TechnicalSummary.pdf (Accessed: 7 March 2025).
2. Reisinger, A., Howden, M., Vera, C. *et al.* (2020) *The Concept of Risk in the IPCC Sixth Assessment Report: A Summary of Cross-working Group Discussions.* Guidance for IPPC authors. Geneva: Switzerland. Intergovernmental Panel on Climate Change, p. 130. https://www.ipcc.ch/site/assets/uploads/2021/02/Risk-guidance-FINAL_15Feb2021.pdf (Accessed: 7 March 2025).
3. Pitman, A.J., Fiedler, T., Ranger, N. *et al.* (2022) Acute climate risks in the financial system: examining the utility of climate model projections. *Environmental Research: Climate, 1* (article: 025002). https://iopscience.iop.org/article/10.1088/2752-5295/ac856f/pdf (Accessed: 7 March 2025).
4. Armstrong McKay, D.I., Staal, A., Abrams, J.F. *et al.* (2022) Exceeding 1.5°C global warming could trigger multiple climate tipping points. *Science*, 377 (6611). https://www.science.org/doi/abs/10.1126/science.abn7950 (Accessed: 7 March 2025).
5. Kahn, M.E., Mohaddes, K., Ng, R.N. *et al.* (2021) Long-term macroeconomic effects of climate change: a cross-country analysis. *Energy Economics*, 104 (article: 105624). https://doi.org/10.1016/j.eneco.2021.105624 (Accessed: 10 March 2025).
6. Dietz, S., Bowen, A., Dixon, C. and Gradwell, P. (2016) Climate value at risk of global financial assets. *Nature Climate Change*, 6, pp. 676–679. https://www.nature.com/articles/nclimate2972.pdf (Accessed: 7 March 2025).
7. Dafermos, Y., Nikolaidi, M. and Galanis, G. (2018) Climate change, financial stability and monetary policy. *Ecological Economics*, 152, pp. 219–234. https://doi.org/10.1016/j.ecolecon.2018.05.011 (Accessed: 7 March 2025).
8. Burke, M., Hsiang, S.M. and Miguel, E. (2015) Global non-linear effect of temperature on economic production. *Nature*, 527, pp. 235–239. doi: 10.1038/nature15725.
9. Fiedler, T., Pitman, A.J., Mackenzie, K. *et al.* (2021) Business risk and the emergence of climate analytics. *Nature Climate Change*, 11, pp. 87–94. doi: 10.1038/s41558-020-00984-6.
10. Masson-Delmotte, V., Zhai, P., Pörtner, H.-O. *et al.* (eds) (2019) *Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty.* https://www.ipcc.ch/site/assets/uploads/sites/2/2019/06/SR15_Full_Report_High_Res.pdf (Accessed: 7 March 2025).
11. O'Neill, B.C., Tebaldi, C., van Vuuren, D.P. *et al.* (2016) The Scenario Model Intercomparison Project (ScenarioMIP) for CMIP6. *Geoscientific Model Development*, 9, pp. 3461–3482. https://doi.org/10.5194/gmd-9-3461-2016 (Accessed: 10 March 2025).
12. Hallegatte, S., Shah, A., Lempert, R. *et al.* (2012) *Investment Decision-making under Deep Uncertainty. Application to Climate Change.* Policy research working paper 6193. https://openknowledge.worldbank.org/server/api/core/bitstreams/24b2bb36-2aaa-597f-8ed1-de11183d7063/content (Accessed: 10 March 2025).
13. Ranger, N.A., Mahul, O. and Monasterolo, I. (2022) *Assessing Financial Risks from Physical Climate Shocks.* Washington, DC: World Bank. https://openknowledge.worldbank.org/server/api/core/bitstreams/9c82ed4b-6554-5475-b7ae-8a0ef15e685b/content (Accessed: 7 March 2025).
14. Calabrese, R., Dombrowski, T., Mandel, A. *et al.* (2024) Impacts of extreme weather events on mortgage risks and their evolution under climate change: a case study on Florida. *European Journal of Operational Research*, 314 (1), pp. 377–392. https://doi.org/10.1016/j.ejor.2023.11.022 (Accessed: 10 March 2025).
15. Mandel, A., Tiggeloven, T., Lincke, D. *et al.* (2021) Risks on global financial stability induced by climate change: the case of flood risks. *Climatic Change*, 166 (article: 4). https://link.springer.com/article/10.1007/s10584-021-03092-2 (Accessed: 10 March 2025).
16. Borg, M.A., Xiang, J., Anikeeva, O. *et al.* (2021) Occupational heat stress and economic burden: a review of global evidence. *Environmental Research*, 195 (article: 110781). doi: 10.1016/j.envres.2021.110781.
17. Masson-Delmotte, V., Zhai, P., Pirani, A. *et al.* (eds) (2021) *Climate Change 2021: The Physical Science Basis.* Summary for policymakers. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_Citation.pdf (Accessed: 10 March 2025).
18. Kendon, E.J., Prein, A.F., Senior, C.A. and Stirling, A. (2021) Challenges and outlook for convection-permitting climate modelling. *Philosophical Transactions of the Royal Society A*, 379 (2195). https://doi.org/10.1098/rsta.2019.0547 (Accessed: 10 March 2025).
19. Kendon, E.J., Roberts, N.M., Senior, C.A. and Roberts, M.J. (2012) Realism of rainfall in a very high-resolution regional climate model. *Journal of Climate*, 25 (17), pp. 5791–5806. https://doi.org/10.1175/JCLI-D-11-00562.1 (Accessed: 10 March 2025).
20. Hurrell, J.W., Kushnir, Y., Ottersen, G. and Visbeck, M. (2003) 'An Overview of the North Atlantic Oscillation', in J.W. Hurrell, Y. Kushnir, G. Ottersen and M. Visbeck (eds) *The North Atlantic Oscillation: climatic significance and environmental impact.* Geophysical Monograph Series, 134. Washington, DC: American Geophysical Union, pp. 1–35. https://doi.org/10.1029/134GM01 (Accessed: 10 March 2025).
21. Zanardo, S., Nicotina, L., Hilberts, A.G.J. and Jewson, S.P. (2019) Modulation of economic losses from European floods by the North Atlantic Oscillation. *Geophysical Research Letters*, 46 (5), pp. 2563–2572. https://doi.org/10.1029/2019GL081956 (Accessed: 10 March 2025).
22. Wood, R.A., Crucifix, M., Lenton, T.M. *et al.* (2023) A climate science toolkit for high impact-low likelihood climate risks. *Earth's Future*, 11 (4). https://doi.org/10.1029/2022EF003369 (Accessed: 10 March 2025).
23. Kunreuther, H., Michel-Kerjan, E. and Ranger, N. (2013) Insuring future climate catastrophes. *Climatic Change*, 118, pp. 339–354. doi: 10.1007/s10584-012-0625-z.
24. Cormack, C. and Shrimali, G. (2023) *The Challenge of Climate Risk Modelling in Financial Institutions – Overview, Critique and Guidance.* Discussion paper. https://www.cgfi.ac.uk/wp-content/uploads/2023/12/Cormack_Shrimali_2023_CGFI.pdf (Accessed: 10 March 2025).
25. Lenton, T.M., Armstrong McKay, D.I., Loriani, S. *et al.* (eds) (2023) *Global Tipping Points.* https://report-2023.global-tipping-points.org/download/4608/ (Accessed: 10 March 2025).
26. DeConto, R.M. and Pollard, D. (2016) Contribution of Antarctica to past and future sea-level rise. *Nature*, 531 (7596), pp. 591–597. https://www.nature.com/articles/nature17145 (Accessed: 10 March 2025).
27. Bamber, J.L., Oppenheimer, M., Kopp, R.E. *et al.* (2019) Ice sheet contributions to future sea-level rise from structured expert judgment. *Proceedings of the National Academy of Sciences*, 116 (23), pp. 11195–11200. https://doi.org/10.1073/pnas.1817205116 (Accessed: 10 March 2025).
28. Kruczkiewicz, A., Klopp, J., Fisher, J. *et al.* (2021) Compound risks and complex emergencies require new approaches to preparedness. *Proceedings of the National Academy of Sciences*, 118 (19), e2106795118. https://doi.org/10.1073/pnas.2106795118 (Accessed: 10 March 2025).
29. Network for Greening the Financial System (2020) *Guide to Climate Scenario Analysis for Central Banks and Supervisors.* Technical document. https://www.ngfs.net/sites/default/files/medias/documents/ngfs_guide_scenario_analysis_final.pdf (Accessed: 7 March 2025).
30. Kyriakopoulou, D. (2023) *What opportunities and risks does AI present for climate action?* https://www.lse.ac.uk/granthaminstitute/explainers/what-opportunities-and-risks-does-ai-present-for-climate-action/ (Accessed: 7 March 2025).
31. Grant, T. (2025) *UK CGFI Leeds Innovation Hub celebrates climate research impact in the finance industry – one year on and beyond.* https://www.cgfi.ac.uk/2025/02/uk-cgfi-leeds-innovation-hub-celebrates-climate-research-impact-in-the-finance-industry-one-year-on-and-beyond/ (Accessed: 7 March 2025).

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