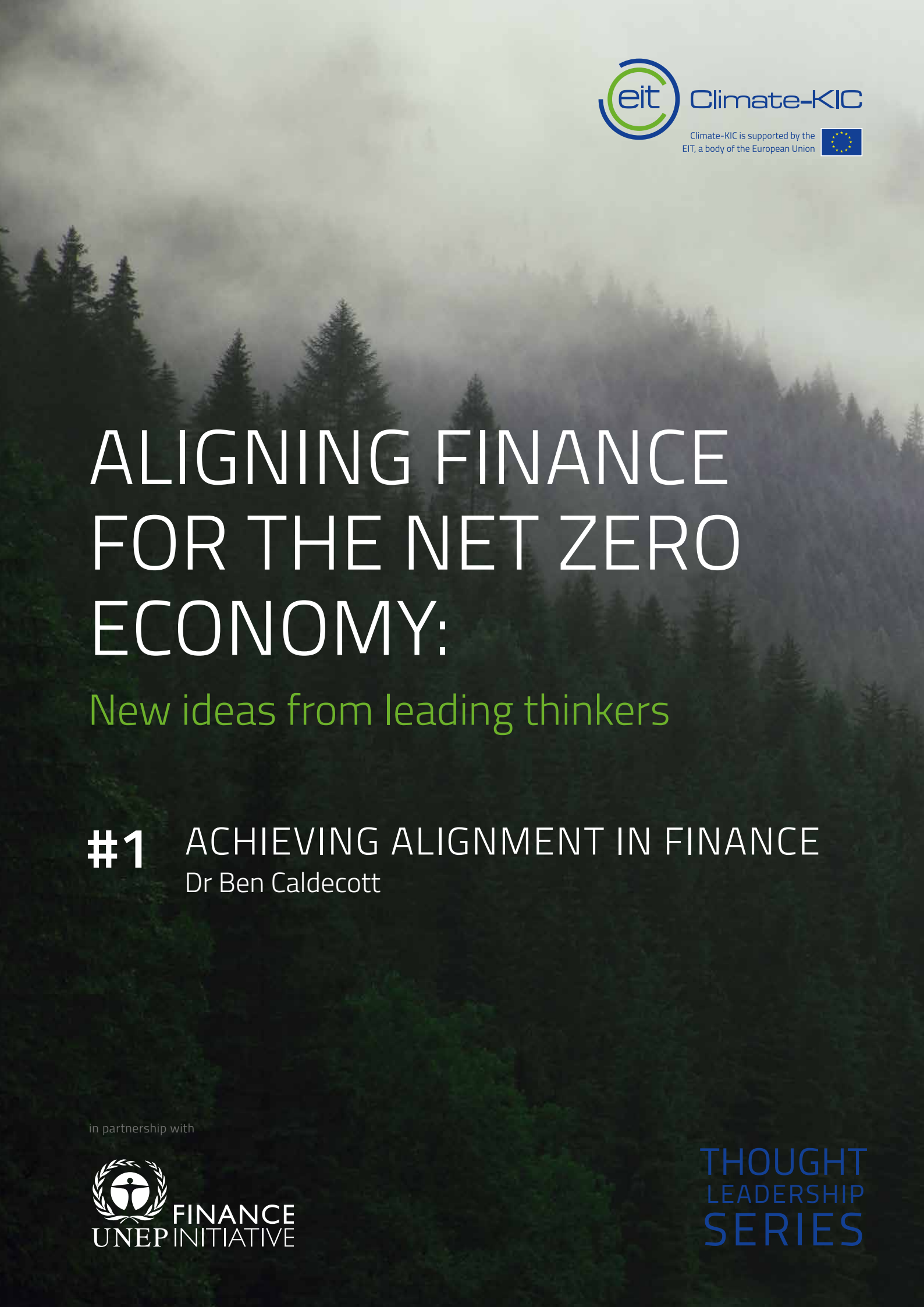

Climate-KIC

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ALIGNING FINANCE FOR THE NET ZERO ECONOMY:

New ideas from leading thinkers

#1 ACHIEVING ALIGNMENT IN FINANCE

Dr Ben Caldecott

in partnership with

UNEP FINANCE INITIATIVE

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Foreword

Eric Usher, Head of UNEP FI &
Dr. Kirsten Dunlop, CEO of Climate-KIC

Since the 2015 Paris Agreement, conditional pledges have fallen well short of the target of holding the global temperature increase to well below 1.5°C above pre-industrial levels. To reach the aim of decreasing global greenhouse gas emissions annually by 7.6% up to 2030[1], we need to increase collective ambition by more than fivefold over the next ten years.

The low-carbon transition will require the integration of climate action into the economic, social and environmental dimensions of development: a distinguishing feature of the 2015 UN Sustainable Development Goals (SDGs). Interlinkages within and across the goals have been created to build on lessons from the past that sustained systemic change cannot be achieved through single-sector goals and approaches. Investing in climate-resilient infrastructure and the transition to a zero-carbon future can drive job creation while increasing economic, social and environmental resilience. Investing in innovation will further reduce the costs of climate change and generate options for alternative business models and ways of living that contribute to economic stability and to a smooth transition.

Short-term thinking in investment cycles and in ideas of economic value are acting to prevent the 1.5°C transition we need, and this will require transformation and innovations in the financial system. Financial institutions play a leading role in allocating and pricing the investment necessary for business development and economic growth. Our financial systems cannot afford to view investments in economic recovery as separate from the sustainability agenda. Therefore, financial actors need to embrace new concepts of value, monetization and externalities, and to address underlying behaviours and mindsets, including short-termism, that govern choices and decisions. Above all, the financial system needs to redefine what it is in service of.

Reviews of the effectiveness of research and innovation activities funded by Europe's Horizon 2020 programme have led to calls for more systemic and cross-sectoral approaches, breakthrough thinking

1 United Nations Environment Programme (2019) Emissions Gap Report 2019. Nairobi, Kenya. Available at: **https://www.unenvironment.org/resources/emissions-gap-report-2019**

and solutions, deep demonstration projects and social inclusion through citizen engagement and participation. The final Report from the High Level Panel of the European Pathways to Decarbonisation initiative, released in November 2018, specifically calls for a focus on: "system-level innovation, promoting sector-coupling so that the individual elements of decarbonisation fit together in a coherent whole" and recommends the establishment of large mission-oriented programmes of a cross-cutting nature for the deployment of system-level transdisciplinary innovation.

In the meantime, the coronavirus pandemic has triggered a major global public health and economic shock. We can draw comparisons between pandemics and the climate emergency: as systemic, non-stationary, non-linear, risk-multiplying and regressive shocks. Many countries have been unprepared for a global shock of this scale and it is clear that we must collectively build a more coherent response to the potentially more disruptive climate emergency and build an anti-fragile capability for resilience and renewal.

The pandemic has also shown that business-as-usual cannot deliver the necessary emissions reductions. Despite international travel plummeting, factories scaling down production, and employees working from home, the annual drop in emissions has only been around 8% and unemployment has soared. Emergence from lockdown in China, for example, has shown that emissions quickly reach or even exceed pre-CoVID levels , while government stimulus packages have only partially delivered transition-oriented funding and, in some cases, thrown a lifeline to high emissions industries.

Leading banks and investors have recognised that there is no alternative to a low-emissions, sustainable economy. Convened by UNEP FI and partners, the Net-Zero Asset Owners Alliance and the Collective Commitment to Climate Action by banks worldwide, have brought together over 70 financial institutions, committed to working with governments and other stakeholders, to support the financial and economic transformation needed to help deliver the Paris Agreement by aligning financial portfolios with the corresponding emissions pathways – a step that was hitherto unheard of – and deliver what the IPCC report calls, "rapid, far-reaching and unprecedented changes in all aspects of society".

However, the climate emergency will require current thinking and paradigms to be challenged and questioned. This is why EIT Climate KIC, in partnership with UNEP Finance Initiative, is convening leading thinkers to present their ideas for sustainable financial and economic transformation. We hope that this inspires financial actors to work across the field to draw up a financial system that enables the low emission societies of the future.

Eric Usher
Head of UNEP FI

Dr. Kirsten Dunlop
CEO of Climate-KIC

Aligning Finance to the new carbon economy: new ideas from leading thinkers

Series Introduction

The IPCC Special Report released in late 2018, highlighted the urgency of minimising global temperature rise to 1.5°C and emphasised the need for systems transitions that can be enabled by investments in climate change mitigation and adaptation, policy and acceleration of technological innovation and behavioural changes (IPCC; 2018). Amongst the emissions pathways scenarios, it proposed, for the first time, a limited or no overshoot scenario – the P1 low energy demand (LED) scenario, where future energy demand could be met through low-emission energy sources and enhanced energy efficiency. This scenario presupposes that system changes are more rapid and pronounced over the next two decades.

Five years after the Paris Agreement, and with calls by the IPCC for urgent action in the coming decade to prevent climate change catastrophe, 2020 has been billed as a key year for climate action. The COVID-19 crisis that has accompanied this year marks a point of transformation for the economy and society: it has demonstrated how remarkable and rapid systems change can be. The global pandemic has given us a clear opportunity to pave the way for building back better and establishing new norms, as well as lessons that can inform how we might face the unabated climate crisis and future climate shocks.

A paradigm shift is needed if we are to move towards a limited or no-overshoot climate scenario. Stakeholders in financial markets, capital and investment represent important levers of change, as they have a key allocative role in society, and can enable investment into a net-zero low-energy future. Financial intermediaries can effectively support and enable societies to mobilise the investment required for the systems change needed to transition economy and society onto a net-zero pathway that is compatible with 1.5°C by 2100.

EIT Climate KIC has been working over the past decade to catalyse systemic transformative change through innovation and has supported the development and uptake of innovations that could help financial markets scale up investment in green technologies and transformative alignment. Action has to move beyond disclosure of climate-related financial risks towards proactive interventions, from engaging the world's emitters to set GHG reduction targets that are sufficiently ambitious, credible and science-based to investing in, financing and helping enable the breakthrough technologies and business models of the future. Moreover, a focus on the role of regulators, fiduciary duty and other fiscal incentives is imperative to understand how we might reset the rules to develop a more regenerative and resilient economy.

The United Nations Environment Finance Initiative (UNEP FI) is a partnership between UNEP and the global financial sector to mobilise private sector finance for sustainable development. UNEP FI have been leading two initiatives, which aim to move beyond a passive risk disclosure perspective to a more active engagement of private sector actors in committing to meet the objectives of the Paris Agreement and support the low-carbon transition. 38 banks have committed to align their portfolios with Article 2.1c of the Paris Agreement under the aegis of the Principles for Responsible Banking, while UNEP FI has partnered with PRI, WWF, and Mission 2020 to launch the Net Zero Asset Owner Initiative, bringing together 29 institutional investors as of September 2020 to commit to net zero emissions by 2050.

EIT Climate-KIC has therefore partnered together with UNEP FI to produce this thought leadership series that aims to inspire financial actors worldwide to move from risk to alignment, challenge current assumptions around climate alignment and develop ideas and concepts on how alignment can best be achieved. We hope to encourage stakeholders that a proactive climate response is not only about disclosing risks, but also about investing in green opportunities that can enable the low emissions societies of the future. This series convenes innovators and industry experts to provoke discussion, challenge the status quo and guide the transformation of business and finance towards a sustainable future.

THE PAPERS IN THIS SERIES WILL RESPOND TO A NUMBER OF KEY QUESTIONS :

- What economic system transformation is actually required to deliver the Paris Agreement?
- How do financial institutions achieve alignment with the Paris Agreement and how does it differ from transition risk transparency as captured in the TCFD?
- What is the future of financial institutions as a result of these changes?
- What are the various strategies and action tracks through which financial institutions can enhance and achieve full portfolio alignment?
- What are the pathways and choices needed for financial institutions and the financial system to drive an active transition to a net zero-carbon economy?V

ACHIEVING ALIGNMENT IN FINANCE

Dr Ben Caldecott

Dr Ben Caldecott is the founding Director of the Oxford Sustainable Finance Programme. He is an Associate Professor and Senior Research Fellow at the University of Oxford Smith School of Enterprise and the Environment, a Supernumerary Fellow at Oriel College, Oxford, and a Visiting Scholar at Stanford University. Ben is also the COP26 Strategy Advisor for Finance based out of the UK Cabinet Office.

He has conceived and initiated a number of initiatives related to sustainable finance. Ben founded and co-chairs the Global Research Alliance for Sustainable Finance and Investment (GRASFI), an alliance of global research universities promoting rigorous and impactful academic research on sustainable finance. He established and leads the Sustainable Finance Theme at The Alan Turing Institute and initiated the Spatial Finance Initiative, which aims to mainstream geospatial capabilities enabled by space technology and data science into financial decision-making globally. He co-founded the Commonwealth Climate and Law Initiative (CCLI), which is examining the legal basis for directors and trustees to consider, manage, and report on climate change-related risk, and the circumstances in which they may be liable for failing to do so.

Ben currently serves on the US Commodity Futures Trading Commission's Climate-Related Market Risk Subcommittee and the UK Department for International Trade's Export Guarantees Advisory Council. In his capacity as a Member of the UK Green Finance Taskforce, he chaired its Workstream on Task Force on Climate-related Disclosures (TCFD) Implementation.

This paper examines how financial institutions can move beyond climate risk management and towards much closer alignment with climate outcomes. Instead of incidentally contributing to alignment with climate outcomes through climate risk management initiatives, we need specific ways of dealing with and contributing to the challenge of alignment. These need to be articulated, developed, and scaled across the financial system rapidly. Without rebalancing the distribution of effort and spending more time explicitly on alignment with climate outcomes, we cannot ever hope to align finance and the financial system with climate change objectives. This report is one attempt to try and rebalance the conversation.

Contents

1.

Introduction

This report focuses on what alignment with the Paris Agreement could mean for financial institutions serving the real economy. What should alignment entail for financial institutions and financial practices? How can we accelerate alignment across finance? I attempt to set out some of the key issues and outline a direction of travel, as well as provide some recommendations for action.

Over the last decade the idea that climate-related risks, whether physical or transition, can strand assets in different sectors of the global economy has become much more widely accepted (Caldecott, 2018). The threat of climate-related risks stranding assets has spurred work by financial supervisors and central banks, who have announced new supervisory expectations and climate stress tests to help improve the solvency of individual financial institutions, as well as the resilience of the financial system as a whole (NGFS, 2019). The G20 Financial Stability Board's Task Force on Climate-related Financial Disclosures (TCFD) has created a framework to help companies and financial institutions consistently measure, manage, and report their climate-related risk exposures (TCFD, 2019). There have also been a plethora of new initiatives, products, and services intended to help financial institutions measure and manage climate-related risks.

But climate risk management (CRM) is often erroneously conflated with seeking or achieving alignment with climate outcomes (ACO). While there is some overlap between CRM and ACO they have different objectives and often different results.

CRM can make little or no contribution to ACO. For example, reducing a company's exposure to projected increases in Country A carbon prices could entail moving emitting production to Country B which has lower environmental standards, potentially increasing net carbon pollution overall. Or a company could hedge its exposure to projected increases in carbon prices through derivatives contracts such as swaps, which would not alter the underlying economic activities of the firm and thus have little or no impact on emissions. Or a retail investor could disinvest shares from a fossil fuel company listed on the FTSE 100, thereby reducing their exposure to climate-related transition risk, but this will make very little or no difference to whether the fossil fuel company becomes more likely to achieve ACO (Ansar et al., 2013). Depending on who buys the disinvested shares, it could in fact, make ACO less likely (Ibid.).

This is not to say that CRM cannot, intentionally or unintentionally, result in better climate outcomes. A way to reduce Company A's exposure to projected increases in carbon prices could be reducing the company's carbon emissions, thereby helping ACO. A universal owner, such as a large pension or sovereign wealth fund, by advocating for timely and effective climate action by governments could potentially contribute to lower climate-related transition risks across their holdings if governments heed their advice. CRM and ACO can work together in specific financial products, for example, a bank providing a sustainability-linked loan. Company A secures a lower cost of capital from the bank if it achieves ambitious, predetermined carbon reduction targets. A lower cost of capital is possible because Company A has calculably lower credit risk due to less energy use resulting in lower energy bills and lower potential future carbon price liabilities. The lender can share some of that reduction in credit risk with the borrower, creating a win-win where the borrower secures a lower cost of capital and the bank makes more money.

These synergies between ACO and CRM are clearly important and it makes sense to maximise them at every opportunity. But that is different from saying there is always a positive relationship between them both, or that CRM automatically and inevitably leads to ACO. It does not.

There is a risk associated with the accidental (or sometimes intentional) conflation of CRM with ACO. Firms and financial institutions signing up to the TCFD, for example, may think that by doing so they are making a difference to the climate, when this is not necessarily the case. Policymakers and civil society groups may have unintentionally made this mistake easier to make, by hyping-up one CRM framework, the TCFD, in way that is disproportionate to its potential climate impact.

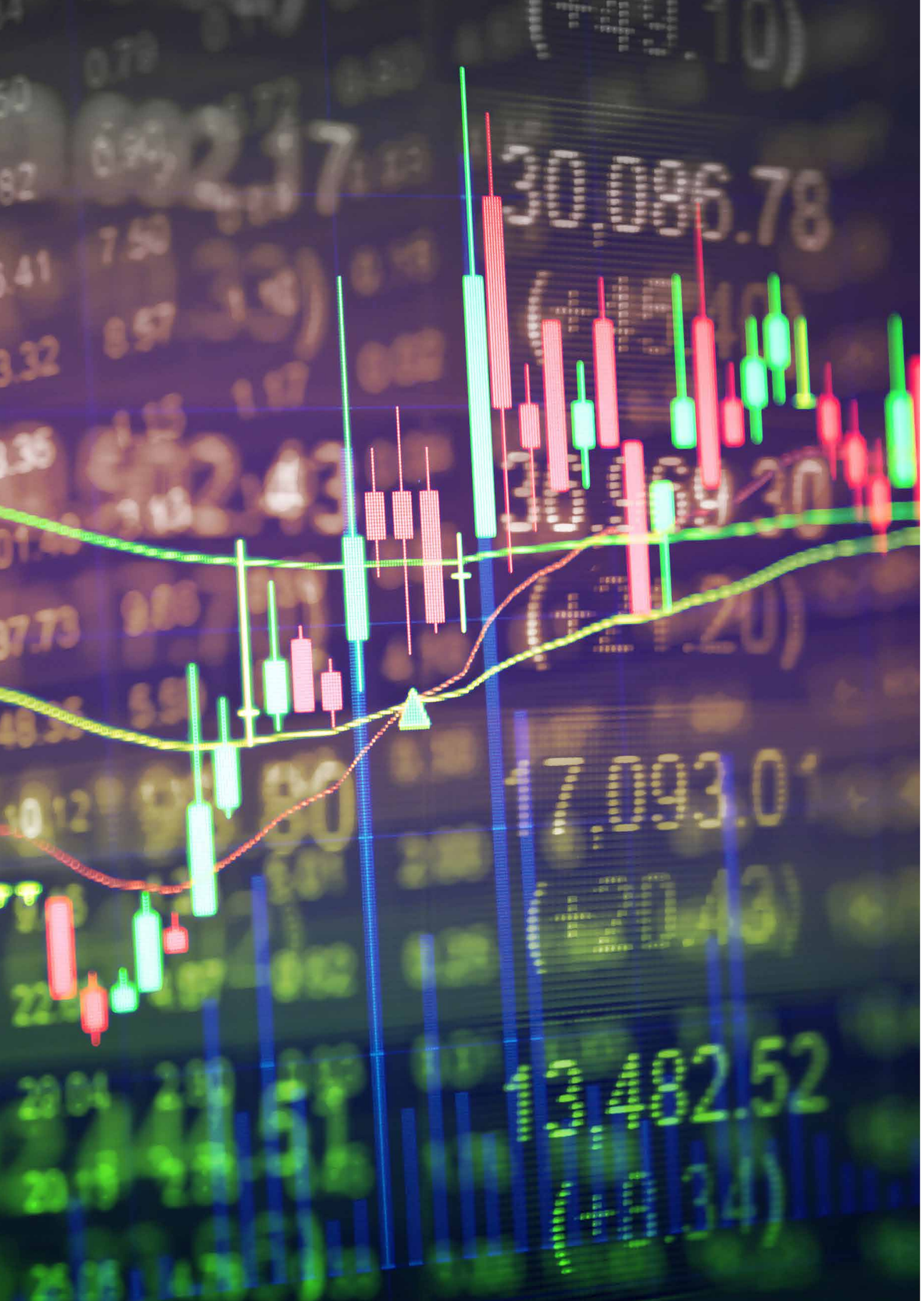
The TCFD is an important development, but even if every economic and financial actor signed up to the TCFD and implemented it perfectly, we would still not have global ACO. And, of course, the idea that we will secure comprehensive or effective TCFD implementation globally anytime soon is naïve. It will take many years to achieve anything like global coverage for some of the most basic climate-related information disclosures. In an area where time is of the essence – we must achieve net zero emissions by mid-century to deliver Paris, and physical climate-related risks are already having a material impact – this is deeply unsatisfactory.

Instead of incidentally contributing to ACO through CRM initiatives like the TCFD, we need specific ways of dealing with and contributing to the challenge of alignment. These need to be articulated, developed, and scaled across the financial system rapidly. Without rebalancing the distribution of effort and spending more time explicitly on ACO, we cannot ever hope to align finance and the financial system with climate change objectives. This report is one attempt to try and rebalance the conversation.

Keeping these differences and tensions in mind, the rest of this report is structured as follows. The next section looks at what ACO could mean, not just in terms of a final outcome or end state, but also as an ongoing process through which financial institutions can actively support the timely, efficient, and effective actions required to achieve net zero over several decades.

The third section briefly considers how policymakers and supervisors should think about ACO in public finance, as well as how they should supervise and regulate private finance to deliver ACO.

The fourth and final section concludes and summarises recommendations for how we can accelerate ACO.



2.

What we mean by alignment

The central aim of the Paris Agreement is to keep the global temperature rise this century to "well below 2°C above pre-industrial levels". For the purposes of this report, the climate mitigation aspect of the Paris Agreement and UNFCCC process is what I mean by ACO, rather than say climate adaptation or other aspects of the UN climate negotiations.

To stabilise the climate at any given warming threshold, whether it is well-below 2°C (widely interpreted as 1.5°C), 2°C, 2.5°C, 3°C, or 4°C, we need to achieve net zero carbon emissions in order to stabilise the stock of carbon in the atmosphere (IPCC, 2018).

This means reducing carbon emissions to zero in every sector we can, while also extracting and sequestering carbon from the atmosphere using biological, chemical, and industrial processes at incredibly large scales (McGlashan, Shah, Caldecott, & Workman, 2012). We need the capacity to capture and sequester carbon because some sectors, such as agriculture, will have residual emissions that are nearly impossible to stop. There are also sectors like aviation where we do not yet have viable zero carbon alternatives.

The longer we delay achieving net zero, the more likely we breach different warming thresholds. Whether assets, companies, or portfolios are compatible with a warming threshold is therefore not static. It changes based on how much of the carbon budget associated with a given warming threshold is left. And absolute carbon budgets, based on the latest available science and regularly updated via the Intergovernmental Panel on Climate Change (IPCC) process, will also change as our understanding of the climate system evolves. There have already been significant revisions to global carbon budgets from IPCC AR5 (2014) to SR15 (2018), with further significant revisions possible when IPCC AR6 is published.

ACO is often taken to mean that an asset or company has promised to reduce its absolute emissions at a rate commensurate with achieving net zero emissions by mid-century. If an asset or a company promises to do this, and reports on its progress, then it is deemed to be compatible with Paris and if it doesn't then it is incompatible.

For the financial institution investing or financing an asset or company, or providing other financial products and services, it is often assumed that increas-

ing exposures to compatible assets and companies increases their own compatibility with Paris, whereas reducing exposures reduces compatibility.

In this report I outline what I consider to be an improved approach for properly measuring the (in) compatibility or assets and companies, and the portfolios and loanbooks that are exposed to them. (In)compatibility is not just about today's emissions, but the sum of tomorrow's and it will depend on your behaviour, what others do, and when they do it, as well as changing science. Getting the measurement, tracking, and targeting of Paris (in) compatibility right, given these uncertainties, is an essential part of ACO.

But in addition to (in)compatibility, I also set out two further elements of ACO for financial institutions that go beyond simply being exposed to compatible assets or companies:

- **Making a real economy contribution –** alignment is not as simple as owning lots of green listed equities. How can financial products and services across different asset classes have an impact on the real economy and how should we channel them towards ACO?

- **Perseverance and consistency –** alignment is not a one-off but a way of working and will evolve over many years. What are the governance arrangements, behaviours, and principles we should painstakingly adopt and implement to support ACO?

2.2

PROPERLY MEASURING, TRACKING, AND TARGETING (IN)COMPATIBILITY

How should we assess the (in)compatibility of holdings and portfolios with carbon budgets associated with different warming thresholds?

The first thing we need to do is concentrate not only on today's emissions, but the sum of all future emissions. We do this by looking at the carbon lock-in associated with individual current and planned assets, which can then be aggregated for company and portfolio-level analysis. I set out this approach briefly below, provide references for further literature on this topic, and set out how carbon lock-in approaches can lay the foundation for an ambitious new approach for measuring and tracking (in)compatibility, which in turn forms part of a more holistic approach to ACO.

Existing approaches to targeting and tracking alignment, such as Science Based Targets (SBTs), share a common focus: tracking annual changes in carbon-related performance and seeing if these improvements are aligned with the pace of change required to deliver a given climate target. Carbon-related performance is most commonly assessed with a measure of annual carbon intensity (e.g. emissions per unit of output) and the pace of change is benchmarked, usually to an IEA scenario that delivers a 2°C objective.

This has a number of problems. In particular, it assumes that annual changes in company carbon efficiency, i.e. short-term directional signals, are a good proxy for assessing compatibility with carbon budgets. This is a highly questionable assumption. To begin with, it assumes that the universe of companies in a sector all act in unison. For example, if under an IEA 2°C scenario the power sector needs to reduce carbon intensity by X% per year by 2050, then if power Company A achieves X% it is determined to be compatible with 2°C. But what if power companies B, C, and D underperform and only achieve X-1%? What does this mean for the target of power Company A?

It is also implies that reductions happen smoothly and that each change is of equal difficulty. Whereas we know that early reductions may be much easier than later ones. Achieving a modest reduction in emissions might be very easy, whereas deeper emissions reductions will likely require more profound changes. Consequently, it rewards companies that have acted later, whereas early movers will face comparatively more challenging expectations.

2.2.1
Stock vs flow and achieving 'net zero'

The following example highlights some of the problems with approaches that focus on tracking real and promised changes in annual carbon emissions. Let's take an old coal-fired power station and replace it with a new gas-fired power station. The new gas-fired power station might emit 50-60% less carbon than the old coal-fired power station. But the new gas asset will operate for at least 20 years (and as long as 40+ years depending on your assumptions), whereas the old coal asset might operate for only 5-7 years and which point it is replaced by renewables plus storage.

Under this quite plausible scenario, this means that while annual carbon emissions have improved significantly, the new gas investment actually results in much more cumulative carbon emissions over its anticipated lifetime. This is true even if the gas asset is on average utilised much less than the coal one. In this case the new gas asset is less compatible with Paris and the associated carbon budget than the coal asset.

Whether either asset is compatible with a given carbon budget depends on how much of the global budget is left and how much of this is allocated to the sector (in the case power generation) in which the asset is located. It also depends on anticipated utilisation of the asset and the asset's carbon efficiency.

This example illustrates a number of factors that need to be considered: the size of the carbon budget and what remains for a given warming threshold; how much of this carbon budget is allocated to different sectors; and the anticipated cumulative carbon emissions or 'carbon lock-in' of assets in these sectors to see if there is 'space' for them within a carbon budget.

A better approach for assessing (in)compatibility with a warming threshold should therefore take account of carbon lock-in and the interactions between the stock of carbon in the atmosphere and the annual flows, acknowledging that to achieve any warming threshold requires net zero emissions globally and across all sectors.

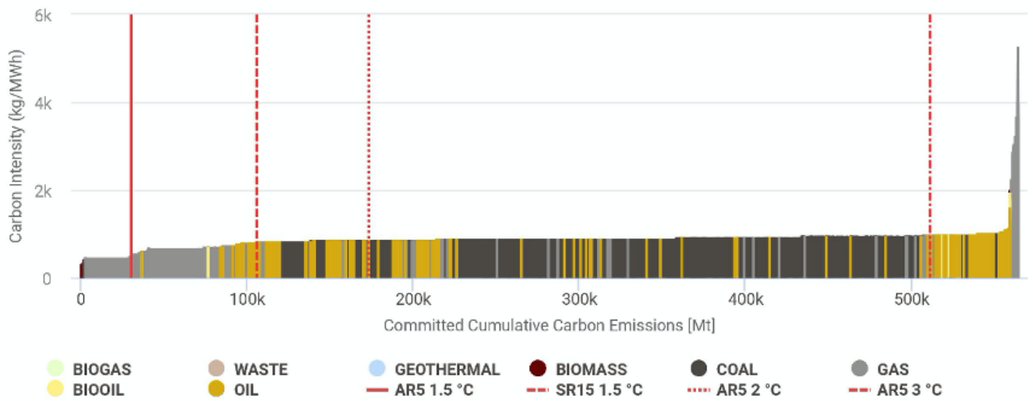
The global carbon budget can be allocated to sectors in different ways. But all things being equal, the longer we take to achieve net zero, the greater the number of assets, companies, and portfolios that will be incompatible with any given warming threshold.

2.2.2
Carbon Lock-in Curves

Carbon Lock-in Curves (CLICs) are one very promising approach for resolving these issues by objectively assessing the carbon budget implications of current and planned assets (Caldecott, Dericks, et al., 2018; Caldecott, McCarten, & Charalampos, 2018). CLICs create a way to order, optimise, and represent portfolios of assets based on their committed emissions or future 'carbon lock-in'. Cumulative committed emissions across assets are compared to carbon budgets to determine which assets are (in)compatible with a given budget.

CLICs are built on a methodological approach that combines the concept of 'Committed Cumulative Carbon Emissions' (CCCEs) or 'carbon lock-in' with the concept of marginal abatement cost (MAC) curves (Kesicki & Strachan, 2011). CCCEs are an estimate of the emissions that will result from an asset over the remainder of its expected lifetime (Davis and Socolow 2014; Pfeiffer et al. 2016; Pfeiffer et al. 2018). MAC curves provide a method of comparing specific abatement actions. MAC

A global CLIC with all current and planned power assets



SR15 1.50°C	AR5 1.50°C	AR5 20°C	AR5 30°C
42.9%	94.4%	30.3%	9.3%

% of GLOBAL assets incompatible with each warming threshold

FIGURE 1: A global CLIC with all current and planned power assets N.B. To improve rendering, assets with the same efficiency are aggregated and plotted as one. Therefore, each bar may represent the CCCEs of many individual assets. Power generating assets are ordered by asset efficiency (carbon intensity (kg/MWh). The vertical lines represent the global emissions budget allocated to the global power sector for each warming scenario.

curves calculate the cost of specific abatement actions relative to a business-as-usual baseline. These abatement actions are then ranked using an estimate of the unit cost of emissions abated, thus providing a way of comparing the relative merit of each action (Huang, Luo, & Chou, 2016).

Figure 1 plots a global CLIC for power and shows all current and planned thermal power stations in the world. The orange vertical lines represent the proportion of the carbon budget allocated to the global power sector for each warming threshold.

A CLIC plots the CCCE for each asset ordered by a particular ranking method (e.g. plant efficiency, marginal cost, plant age). The width of each column represents the CCCEs and the ordering variable is plotted on the y-axis. The carbon budgets are then plotted as a vertical line. Assets that are on the left of these vertical carbon budget lines are compatible with that carbon budget, given various assumptions, whereas assets that fall to the right of these budget lines are incompatible with the carbon budget for a given warming threshold.

Global carbon budgets are allocated to sectors Integrated Assessment Models (IAMs) on an industry fair-share basis. Box 1 contains more information.

Caldecott et al. (2018) developed CLICs for initial use in the power sector. The methodology is applicable to other sectors with emitting assets. All of the assumptions employed in CLICs are transparent and can be changed by users based on their beliefs and the sensitivity analysis they want to conduct.

CCCEs represent the total CO2 emissions that are estimated to be emitted over the remaining lifetime of an asset, without substituting inputs, upgrading assets, retrofitting assets or refurbishments. CCCEs occur from both direct and indirect emissions (Carlson et al., 2012) and arise from both existing assets and planned or under construction assets (Pfeiffer et al., 2018).

CLICs are constructed based on the estimated committed emissions for each thermal unit using calculations in line with prior work (Davis, Caldeira, & Matthews, 2010; Davis & Socolow, 2014; Pfeiffer et al., 2016). The calculations of committed emissions and construction of the CLICs are dependent on access to good asset-level data. The database of power generating units that has been used to build the global CLIC in Figure 1 consists of unique units merged from the Platts World Electric Power Plants Database (Q4, 2019), Global Energy Monitor's Global Coal Plant Tracker (Q2 2019) and the World Resources Institute's (WRI) Global Power Plant Database (Q2 2019). This merged database is a comprehensive dataset providing detailed information about power generating units globally. It consists of 84,433 emitting power units spread across 226 unique countries/regions, of these emitting power units 77,610 are operating, and 6,823 are either planned or under construction.

BOX 1:

What are IAMs and what is 'industry fair-share'?

Integrated Assessment Models (IAMs) are a complex method of modelling a system by assimilating information from multiple disciplines. IAMs are mathematical computer models that model the behaviour of a system using explicit assumptions. The key strengths of IAMs is the ability to interact many factors simultaneously and to understand the consequences of changing the underlying modelling assumptions.

Initial assessments of the impact of decarbonisation on the power sector were undertaken using IAMs, which modelled the interaction of global energy, climate, and economic systems. One of these IAMs is "Assessment of Climate Change Mitigation Pathways and Evaluation of the Robustness of Mitigation Cost Estimates" (AMPERE), which was a collaborative project across 22 institutions to assess mitigation pathways for medium and long-term climate targets.

'Industry fair-share' represents an economically efficient distribution of mitigation burdens across emitting sectors. Within AMPERE are nine energy-economy models that assess the effects of policy and technology on the feasibility and cost of the various warming scenarios. The percentage of the country-level carbon budget for the power sector was derived from all 2°C compliant AMPERE scenarios.

2.2.3
CLICs in practice

The carbon lock-in approach outlined above can be applied to any emitting asset, whether in the power sector or elsewhere, including but not limited to agriculture, automotive, aviation, cement, chemicals, healthcare, iron & steel, IT, mining, oil & gas, real estate, road & rail, and shipping.

The construction of global CLICs for different sectors requires: 1) a global carbon budget for a Paris aligned warming threshold (i.e. a "well-below 2°C" carbon budget), 2) a proportion of this global carbon budget allocated to each sector, 3) assumptions of asset-level utilisation and efficiency (to calculate asset-level CCCEs within each sector), and 4) an ordering method (e.g. by marginal cost, age, efficiency, or some combination) for assets to see which assets are at or below the carbon budget line for a given Paris aligned warming threshold.

Trusted third parties can provide key assumptions and standardised metrics for 1-4 above. Computing the analysis consistently across all sectors with emitting assets is not particularly challenging if these assumptions and standardised metrics are provided. The main impediment is the availability of consistent asset-level data (3), as well as related data on marginal costs (4) that could be used for certain ordering approaches.

These data challenges are far from insurmountable and have already been largely addressed in some sectors (such as power). For sectors that currently lack good asset-level data, much of this data will be held by companies for their own assets.

We can also secure this data in different ways. Asset-level data resides in many different locations. It exists in existing company disclosures to financial markets, regulators, and government agencies (in multiple jurisdictions and in different languages); in voluntary disclosures; in existing proprietary and non-proprietary databases; in public and private research institutions; and in academic research. The challenge is finding the relevant sources, integrating the data, cleaning the data, and then of course making the data available for analysis. In addition, there is significant and exciting potential for new data from 'big data' and remote sensing to complement these existing datasets. We have never been in a better position to observe assets and what is going on in listed and non-listed companies at low cost, even if companies do not want to disclose.

There are existing collaborative efforts, such as the GeoAsset Project[1], that aim to, "… make accurate, comparable, and comprehensive asset-level data tied to ownership publicly available across key sectors and geographies" (GeoAsset, 2020). In a way that is analogous to what the Human Genome Project achieved, GeoAsset aims to coordinate the production of universally trusted, transparent, and verifiable datasets of every asset in the global economy (Ibid.).

Efforts to provide key assumptions and standardised metrics, particularly for allocating global carbon budgets to sectors, and asset-level utilisation and efficiency numbers, can be enhanced by greater collective efforts.

These efforts are a pre-requisite for much more accurate and robust measurement of (in)compatibility. This may sound onerous but would build on existing activities. These approaches have significant benefits in terms of robustness and are not any more onerous, and potentially even much more efficient, than current efforts to secure backward-looking carbon disclosures that then need to be assured, or when not disclosed, estimated by third parties.

Carbon lock-in assessments across all emitting sectors are, in my opinion, the most robust way of assessing (in)compatibility with any given carbon budget and should become the norm. It can be integrated over time into existing approaches as more and better data becomes available.

2.2.4
Introducing confidence levels

As we saw in the previous section, we can assess whether an asset (or a group of assets at the company- or portfolio-level) are (in)compatible with a given carbon budget. This is a binary state: given certain assumptions your asset(s) are either compatible or incompatible with a given carbon budget associated with a warming threshold.

But the state of (in)compatibility could change under different circumstances (or given different assumptions). For example, if the size of sectoral carbon budgets reduces due to changes in our scientific understanding of the climate system, more assets will become incompatible. Or if assets are utilised less than previously thought due to falling demand and keeping all other factors constant, then more assets will be compatible. Or if more polluting assets prematurely close, then the remaining assets will have more budget between them, and more will be compatible.

We should set targets in a way that explicitly acknowledges these uncertainties (or sensitivities). For example, targets could be set as follows: in 2025 X% of my firm's assets will be compatible with Y carbon budget with Z confidence level. Z could represent +/- some range of carbon budget uncertainty or be some other measure of confidence.

The key thing is that whatever the confidence level it would quantify simply how resilient your asset(s) or portfolio(s) level of Paris compatibility is/are to changes to your asset(s) usage and efficiency, the sector(s) carbon budget, and the global carbon budget.

A portfolio that has X% of Paris compatibility, but a much lower confidence level would be less desirable than one with the same level of compatibility and a higher level of confidence. It also opens the prospect of third parties, including government and regulators, requiring certain levels of confidence in current and future levels of firm or financial institution Paris compatibility. It is not sufficient simply to say I will meet X target by X year, you have to be clear about how robust that target it, in terms of how likely it is for X% of your assets in a sector(s) is/are compatible with a given carbon budget.

This approach – carbon lock-in approaches for measuring (in)compatibility plus confidence levels for given targets – has a number of benefits:

- **HONESTY**

  This approach makes it clear that some types of asset or ways of utilising an asset can never be compatible with a given carbon budget. It is mathematically impossible, or it is only possible under heroic assumptions about what other assets in the same sector or other sectors do and the availability of negative emission technologies. Under current approaches that track annual emissions (see our gas vs coal example earlier), these truths are hidden. It also makes clear that a point could be reached where every asset and portfolio is incompatible (i.e. nothing is compatible) with a given carbon budget. It brings the need for collective action to deliver Paris home.

- **RATCHET**

  There is an in-built ratchet within the target. Meeting a 50% compatibility target for the power sector in 2025 with the same confidence level is harder than a 50% compatibility target in 2020. This is because all things being equal, there is less of a carbon budget to go around. This demonstrates and internalises the importance of early action.

- **COMPARABILITY**

  While levels of ambition, e.g. X% of my firm's assets will be compatible with a Paris aligned carbon budget by 2025, 2030, 2035 and so on, can vary by firm and portfolio, they are easy

to compare. If the same basic assumptions are used consistently and/or if the assumptions are disclosed, transparent comparisons are straightforward.

- **SCALABILITY**

  Targets can be set for all assets across multiple sectors or be set for assets in specific sectors and target stringency can also vary sector by sector. For example, "…in 2025 X% of my firm's assets across all sectors we have exposure to will be compatible with Y carbon budget with a confidence level of Z". Alternatively, "…in 2025 X% of my firm's assets in the [power][mining][shipping][…] sector[s] will be compatible with Y carbon budget with a confidence level of Z."

- **CAPEX**

  Capex decisions matter. Planned assets and their impact on future carbon lock-in are not ignored but are explicitly factored in. This forward-looking aspect to this approach is critical for appraising (in)compatibility.

- **ENDOGENEITY**

  The economic performance of your firm or your firm's peers within a sector, as well as technological or regulatory changes that can influence carbon budgets in sectors and globally are all internalised. These variables change the size of the remaining carbon budget and make it easier or harder for asset(s) or portfolio(s) to be compatible.

Seeing objectively at any given time what percentage of assets are (in)compatible with Paris and at what level of confidence, would be one powerful tool for encouraging and tracking alignment. If the asset-level data is available then there are no reasons, other than processing costs and reporting burdens, why these calculations cannot be updated and reported regularly, perhaps even monthly or quarterly.

2.3

MAKING A REAL ECONOMY CONTRIBUTION

In the previous section we set out a new way of measuring (in)compatibility and tracking it dynamically using asset-level carbon lock-in type approaches. We also introduced the importance of confidence levels for testing and targeting levels of Paris (in)compatibility. This will allow us to see which asset(s) and portfolio(s) are (in)compatible with Paris and how robustly.

Using these methods, we can compare individual assets, or investor portfolios and bank loan books comprising of exposures to assets. While this is a significant improvement on what we have today, it would not be sufficient.

Financial institutions contribute to alignment through the financial products and services they offer, as well as the investments they make or finance they provide. Another element of ACO for financial institutions is ensuring that they are actually making a positive contribution to the real economy transition.

2.3.1
How can finance make a difference to the real economy transition?

At least two conditions need to hold for any finance, investment, or financial product or service provided in any asset class (an "instrument") to make a difference to the real economy transition required for Paris.[2]

First, as we have already covered, the activity the instrument is encouraging should be (or be able to become) compatible with a global carbon budget for a Paris Agreement aligned warming threshold and/or the activity it is discouraging should be incompatible with this threshold. We examined my preferred method for this in the preceding section.

Second, the instrument must make a clear and measurable difference to the activity in the real economy in one or more of the following ways:

A. cost of capital – reduce, or increase, the cost of capital for Paris compatible or incompatible activities

B. liquidity – increase, or reduce, liquidity for Paris compatible or incompatible activities

C. provide or enable **CRM**

D. encourage or enable **company adoption of practices that support ACO**

E. support systemic change through **spill over effects** that support ACO

To be certain that the instrument is making a difference to ACO, we need to understand how an instrument can contribute to the real economy transition in one of these five ways.

A (cost of capital) and B (liquidity) are the most directly and obviously important. They directly affect the availability and cost of capital for Paris (in) compatible activities.

C (risk management) and D (adoption of sustainable practices) span a wide range of activities including climate-related financial disclosures, insurance, derivatives, investor engagement, and sustainability-linked loans.

E (spill over effects) is a catch all for possible changes to consumer awareness, how finance that is ACO might beget more such finance, and the role of finance as a system that influences other systems, like politics.

Let's put this simple framework into action across three different asset classes (bonds, credit, and public equities):

EXAMPLE 1

Climate bonds: there is little evidence to support the claim that standard recourse-to-the-issuer climate bonds (where the repayment obligations reside with the legal entity issuing the bonds not the projects or activities the bonds are being used to finance) contribute to A, B, and C, and that a lot hinges on the claims their proponents make for D and E. In contrast, non-recourse climate project or infrastructure bonds (where the repayment obligations reside with the infrastructure project via an SPV not the sponsor) could also provide C to investors.

EXAMPLE 2

Sustainability-linked loans: where targets for the debtor help to both improve climate outcomes and reduce credit risk with the subsequent cost of capital reduction being shared between creditor and debtor: I think they can certainly support A, C, and D, and there is an argument to be made in favour of B and E.

EXAMPLE 3

Climate themed listed equity funds: indices based on deep and highly liquid benchmarks like the S&P 500 won't contribute to A or B, might potentially contribute to C depending on the fund and the investor's other holdings, and could contribute to D if the fund has an effective investor engagement strategy. They may possibly contribute to E, but that depends on the fund and how influential it is.

If an instrument doesn't do at least A, B, C, or D and can't evidence that it is actually making a difference, then it is very hard to see how it would be making a contribution to ACO. Instruments just claiming E need to have a very clear theory of change and I am not sure any pass that threshold.

We could also add a strict **third condition,** that of additionality. Even if the instrument is making a positive contribution to ACO, would that impact have happened anyway given a counterfactual baseline. I am personally content with simply demonstrating that an instrument is actually having a positive contribution to ACO, but additionality is important, particularly for policymakers deciding what they might subsidise directly or indirectly and when.

There has been surprisingly little interest and urgency in clarifying these impact pathways (A to E), in part, I suspect, because of how little difference many instruments being promoted actually have on ACO.

If an instrument is claiming it will make a contribution to ACO, it should be clear how it will do it and there should be an accountable and transparent way of measuring the claimed contribution over time. Financial supervisors should be much stricter at authorising and monitoring such product and fund claims. The above framework can help them, and others, make this a reality.

2.3.2 Maximising real economy contributions

The ability of an instrument to have an impact is inherently defined by its asset class. For example, heavily traded public equities in large and liquid markets with many buyers and sellers will always have much less potential real economy impact than private equity or bank loans.

This is a function of the rights and responsibilities associated with instruments in different asset classes and the intrinsic ability of sources of capital to make a difference to firms. A private equity investor is likely to have more say on the strategy and decisions of a firm that a public equity investor and banks' terms of finance can be incredibly important for shaping firm choices.

Context is obviously very important, but the intrinsic ability of instruments in different asset classes to make a difference does vary and it varies significantly.

For the same type of instrument in the same asset class operating in the same sector and geography, some instances of instruments will be better than others at having impact. Some forms of public equity investing as executed by asset managers will be more impactful on the real economy transition than others, even if you keep fund size, benchmarks, and other relevant factors constant. In the case of a public equity fund, that could be because of better and more impactful investor engagement than a similar competitor fund.

The job of the financial institution attempting to secure ACO, is to get as close as possible in practice to the theoretical maximum potential impact an instrument in an asset class can have. If the maximum theoretical potential impact of an instrument in an asset class is performance-level X, then the financial institution should get as close to X as possible. How we define these maximum potentials by instrument and then track performance against them is key and is something that requires further investigation and research. It is beyond the scope of this report but is something I plan to return to in more detail separately.

Further, for financial institutions operating across instruments in different asset classes, their job for ACO should be to maximise the positive real economy impact across all the instruments they have and potentially even seek to optimise their portfolio of instruments, i.e. do more in instruments that have more impact and less in instruments that have less. This is particularly relevant to asset owners undertaking strategic asset allocation decisions or asset managers offering funds and products across asset classes.

This way of looking at how finance and investment contributes to the real economy is a rich area for further work and I think highlights some of the problems in current thinking, namely that having more exposure to compatible assets and companies means more alignment.

2.4 PERSEVERANCE AND CONSISTENCY

In the previous two sections we have covered complementary elements of a comprehensive approach to delivering ACO in finance. The first was robust targets for compatibility for assets and portfolios and the second was ensuring that instruments across asset classes make a genuine and measurable contribution to the real economy transition. This section sets out the third and final element: some of the governance, behaviours, and principles financial institutions need to stick to over time in order to deliver ACO.[3]

Financial institutions seeking ACO will have to systematically review different functions to identify how they can better support ACO and then develop plans to embed alignment through changes in governance, strategy, processes, training, and culture, as well as updating the tools used by staff to fulfil their functions. This will need to happen semi-regularly, at least every three to five years.

2.4.1 Target setting

Portfolio or loan book ACO will take time to achieve. Financial institutions will need to create board-approved targets and strategies to achieve alignment over time. This should set out the ultimate destination in terms of the percentage of assets that will be compatible with Paris aligned global warming thresholds for every 5-year period starting in 2020 up to 2050 for a given confidence level.

This should include details of the steps financial institutions will take to get there updated regularly, as well as clarity on when metrics for assessing progress will be published and who is responsible for implementing the strategy.

2.4.2
Capacity building

The Board, senior executive management, portfolio managers and other relevant functions should undertake courses and training, as well as continued professional development, to ensure they have access to the latest skills and knowledge to support ACO. The methods and solutions are rapidly evolving, and approaches will need to be regularly reviewed and refreshed.

Financial institutions should also develop education and training programmes and tools to ensure that employees are aware of relevant research and best practice as it evolves in the coming years.

2.4.3
Accountability

There should be complete internal and external clarity about the key individuals at a board-level and in senior executive management who are responsible and accountable for implementing, monitoring, and improving ACO over time. Financial institutions should disclose their climate strategy and levels of ACO publicly.

2.4.4
Consistency

Financial institutions should align their strategy with external communications and government affairs work that they do. As players in the market, they should participate in and shape local and international initiatives, including by publicly signing statements and targets to ratchet progress and increase ambition.

2.4.5
Active ownership

Investors should clearly outline their expectations of investee companies regarding ACO. This should include the expectation that company boards have their own plans, strategies, and targets for ACO, and that these are incorporated into strategic planning and reporting. Financial institutions should promote, and over time require, investee company alignment with the Paris Agreement.

Where appropriate, investors should undertake engagement to ensure ACO is integrated into corporate strategic planning and reporting by investee companies. They should either do this directly or through mandated proxies. Active climate-related ownership could begin by focusing on companies with significant incompatibility with Paris, but over time this should be extended across all sectors and geographies.

Asset owners should develop methodologies to measure and monitor how their asset managers are conducting engagement on ACO on their behalf, and include responsible stewardship in manager selection, monitoring, and reviews.

Asset owners should collaborate with other stakeholders to develop robust methodologies for measuring and monitoring the engagements undertaken on their behalf (internally or externally), to ensure that their interests are being represented and that these engagements secure ACO.

Engagement with companies lagging behind should make clear the improvements expected and the consequences of non-compliance, including (if appropriate) the option of disinvestment.

Asset owners should ensure that responsible ownership strategies and practices are built into their passive holdings. This is particularly important as passive funds, unlike active funds, by definition follow the index and have to buy the holdings contained in the index. Active ownership is, therefore, the most powerful tool passive funds have to effect change in investee companies.

2.4.6
Incentives

Financial institutions should put in place the necessary processes and incentives to implement the above. This includes integrating ACO into Asset-Liability Matching (including Strategic Asset Allocation), investment mandates, and outlining the expectation that portfolio managers (whether internal or external) should measure and manage ACO.

Financial institutions should also link internal and external manager incentives, including remuneration and renewal of mandates, to progress against ACO.

2.5
CONCLUSION

This section of the report has set out a framework consisting of three interlocking elements of ACO:

The first, **'properly measuring, tracking, and targeting (in)compatibility',** is essential. Carbon lock-in approaches for measuring (in)compatibility together with confidence levels for given targets is a new way of measuring Paris (in)compatibility at asset, company, and portfolio levels and tracking it dynamically. Combined with confidence levels for targeting and tracking, we can see which asset(s) and portfolio(s) are (in)compatible and how robustly they are (or are not).

The second, **'making a real economy contribution',** recognises the limitations of the first. Just because you hold a lot of Paris compatible assets, doesn't necessarily mean you have made a contribution to ACO. Finance can contribute to the real economy transition in five main ways: A (cost of capital), B (liquidity), C (risk management), D (adoption of sustainable practices), and E (spill over effects). ACO must also mean demonstrating and measuring contributions across and within each of these buckets much more precisely than hitherto. Financial institutions seeking ACO should proactively maximise the positive real economy impact for the instruments they have and potentially even seek to optimise their portfolio of instruments to maximise ACO.

The third and final element of ACO, **'perseverance and consistency',** sets out some of the governance, behaviours, and principles we need to stick to over time in order to deliver ACO. In addition to robust target setting and tracking, and ensuring finance really does accelerate the real economy transition, financial institutions will have to systematically review how they can better support ACO and then develop plans to embed alignment in everything they do. This is an ongoing and resource intensive process.

Together these three elements can help financial institutions, wherever they are, and the financial system as a whole, deliver ACO.

3.

What alignment means for policymakers and supervisors

This section explores how policymakers and supervisors should think about ACO in public finance, as well as how they should supervise private finance to deliver ACO, particularly in light of the Covid-19 post-crisis recovery.

There are growing calls for post Covid-19 recovery stimulus and bailouts to be ACO. For example, EU leaders have backed a Covid-19 recovery strategy that 'integrates energy transition' (Gewessler et al., 2020; Radowitz, 2020), Germany's finance minister has argued for a green stimulus (Parkin, Wilkes, & Carr, 2020), and World Bank economists are making the case for a green stimulus framework (Hallegatte & Hammer, 2020). They are joined by countless calls for similar actions by civil society groups.

Public and private finance will play a significant role in realising these ambitions, including through unprecedented government stimulus and bailouts that will provide both short- and long-term financing facilities to different sectors of the global economy.

3.1

PUBLIC FINANCE

Governments and government-backed entities will have an important role to play in helping to finance the transition to ACO. The sheer quantity of capital required is one reason. In the energy sector alone, meeting well-below 2°C could require US$1.5 trillion of additional investment per year from now until 2050 (McCollum et al., 2018), up from a total of around US$1.2 trillion of investment last year (Buchner et al., 2019). This story is replicated in other sectors and already constrained private sector balance sheets are probably unable to efficiently raise all the capital needed.

Further, at any given time in different parts of the global economy there will be challenges accessing capital cheaply and efficiently, even for profitable investments. Poor access to capital can be the result of temporary or structural problems, or a combination of both.

In developing countries this is mainly the result of underdeveloped capital markets and poorly capi-

talised domestic financial institutions. Developed economies, even those with the most sophisticated financial systems and deepest capital markets, like the US and the UK, also face problems, ranging from a lack of experience in underlying technologies through to temporary collapses in confidence.

Covid-19 makes all of these issues much harder to deal with and will almost certainly increase the need for a dramatic scaling up of public financing for everything, including the very capital-intensive longer-term transition required to tackle climate change.

Public financing covers a number of different areas, including:

- **Infrastructure finance –** the role of public financing in different stages of infrastructure projects, from development through to operation. Many countries have very well-established infrastructure banks, including KfW in Germany, Caisse des Dépôts in France, BNDES in Brazil, and the China Development Bank.
- **Business finance –** the role of public financing in supporting company growth and development, from start-ups and SMEs through to large multinational enterprises.
- **Personal finance –** enabling individuals to borrow for education/skills or home investments that provide public and private goods, e.g. energy efficiency.
- **Export credit –** government guarantees and loans provided by Export Credit Agencies (ECAs) to help companies export goods and services.
- **Insurance –** supporting insurance provision, particularly for risks that are uninsurable or prohibitively expensive to insure through private markets.
- **Development finance –** delivering combinations of the above through Multilateral Development Banks (MDBs) and Development Finance Institutions (DFIs) focused on developing and emerging economies.

Achieving ACO will not be possible without all of these aspects of public finance adopting the three interlocking elements of alignment set out in the previous section of this report. But additionally, their financing capacity will also need to increase to help deliver the quantum of capital required.

The pandemic recovery will increase the urgency of thinking through the role of public finance. How should public financing be provided through existing institutions, do they have the right mandates, and how much more financing capacity do they need to see us through the current crisis and beyond?

Answering these questions is well beyond the scope of this report. But policymakers should urgently review public financing and public financial institutions to ensure public finance is supportive of ACO, both in terms of the quality and quantity of financing available. Not doing so will mean we fail to secure ACO and will result in carbon lock-in and stranded assets on public sector balance sheets.

3.2

SUPERVISING PRIVATE FINANCE

While central banks and financial supervisors have shown significant and growing interest in climate-related risks, they have generally shown much less interest in ACO.

The focus of the Network of Central Banks and Supervisors for Greening the Financial System (NGFS) has primarily been on micro-prudential supervision, and to a lesser extent macro-prudential supervision, followed by monetary policy and financial conduct.

Perhaps the area that has most overlapped with ACO from a NGFS perspective has been growing concern about greenwashing and the mis-selling that could result. The UK FCA has recently warned that, "[greenwashing] could undermine confidence in the green finance sector, leading to unsatisfied demand, reduced participation and competition and insufficient investment in the transition" (FCA, 2019, p. 27).

As we have discussed, if a product is claiming it will make a contribution to ACO, it should be clear how it will do it and there should be an accountable and transparent way of measuring the claimed contribution over time. Financial supervisors should be much stricter at authorising and monitoring such product and fund claims. The proposals outlined in this report would help to address these greenwashing challenges.

While central banks and supervisors have been more interested in CRM than ACO, there are clearly potential levers they could pull to ensure financial institution and financial system ACO. Sidestepping the question of whether this is within their mandates and assuming they would be given proper instructions from politicians held to account by the public, what could these levers be?

Below is an attempt to outline some of them. I do not think now is the right time for central banks or financial supervisors to pull these levers, but there may be a time in the future when this is desirable or even necessary. In the meantime, central banks and supervisors, together with policymakers, should work on these and other related ideas to understand their pros, cons, and delivery challenges. A full assessment of these supervisory options for ACO is beyond the scope of this report.

- **Capital charges for ACO –** capital charges for finance provided to incompatible assets could be introduced. This would go beyond aligning capital charges with climate-related risk and would overlay ACO considerations onto the setting of risk weights.
- **ACO targets for supervised firms –** ACO targets for portfolio and loan books could be introduced. Supervisors could ask firms to disclose voluntary targets or they could set mandatory ones. If targets were introduced, they should set out the ultimate destination in terms of the percentage of assets that will be compatible with Paris aligned global warming thresholds for every 5-year period starting in 2020 up to 2050 for a given confidence level. For voluntary target setting, supervisors could require standardised levels of confidence, as well as common metrics and assumptions, to ensure comparability. Supervisors could consider requiring quarterly or even monthly reporting for all supervised firms.
- **Introduce carbon budgets to ALM and SAA** – risk budgeting is used to guide Asset-Liability Matching and Strategic Asset Allocation. Supervisors could require that carbon budgets be factored into these processes, which would allow institutions to determine the most efficient use of a given carbon budget allocated to their institution. This carbon budget would need to take account of carbon lock-in (see previous sections) and could be introduced voluntarily or compulsorily.
- **Senior Managers Regime ACO –** in a similar way to how the Senior Managers Regime is now used in the UK for climate-related risk management (see Bank of England, 2019), ACO could be added to this framework. This would create clear supervisory oversight and accountability of senior executive management.

3.3 CONCLUSION

Public finance should be a first mover in the adoption of financial practices for ACO. Public financial institutions also have a role to play in supporting private finance deliver the capital required to implement Paris, and the role of public balance sheets has significantly increased as a result of the 2020 pandemic. These issues and changes merit an urgent review of the role of public finance and public financial institutions in ACO.

Supervisors clearly have options for accelerating ACO, but these should not be entered into lightly and there are significant and very legitimate questions about the remits of central banks and financial supervisors in society. While these are debated, there is a no-regrets need to explore the options they have together with policymakers, including the pros, cons, and delivery challenges. In many instances the first-, second-, or even third-best options will not be action by central banks and supervisors, but action by policymakers or the private sector.

4.

Conclusion and Recommendations

I have focused on what alignment with the Paris Agreement should mean for financial institutions serving the real economy.

Instead of incidentally contributing to ACO through CRM initiatives, we need specific ways of dealing with and contributing to the challenge of alignment. This report is a non-exhaustive attempt to try and rebalance the conversation.

I have outlined three interlocking elements of ACO for financial institutions:

- Measuring, tracking, and targeting using carbon lock-in approaches for assessing (in)compatibility together with confidence levels for given targets;

- Contributing to alignment through instruments across asset classes actually making a difference to the real economy transition, with financial institutions proactively maximising their impact; and

- Adopting appropriate governance, behaviours, and principles and embedding alignment in overarching strategies and key functions.

Together these three elements combine to make ACO possible for financial institutions.

Further, adopting the following recommendations can help ensure financial institutions, wherever they are, and the financial system as a whole, deliver ACO.

- Carbon lock-in assessment across all emitting sectors is a robust way of assessing asset, company, or portfolio (in)compatibility and should become a norm.

- We should also set and track targets for (in)compatibility in a way that explicitly acknowledges uncertainties. Targets should have confidence levels associated with them and these would quantify how resilient your asset(s) or portfolio(s) are to Paris compatibility if there are changes to asset(s) usage and efficiency, the sector(s) carbon budget, and the global carbon budget.

- Financial institutions contribute to alignment through the financial products and services they offer, as well as the investments they make or finance they provide. ACO must also mean demonstrating and measuring these contribu-

tions to A (cost of capital), B (liquidity), C (risk management), D (adoption of sustainable practices), and E (spill over effects) much more precisely than hitherto has been the case.

- Financial institutions should maximise the contribution they make to the real economy transition by getting as close as possible in practice to the theoretical maximum potential impact their instruments in an asset class can have. Further, financial institutions seeking ACO should maximise the positive real economy impact across all the instruments they have and potentially even seek to optimise their portfolio of instruments to have the most impact on ACO.

- Financial institutions should have to systematically review how they can better support ACO and then develop plans to embed alignment in everything they do. This is an ongoing and resource intensive process.

- Financial institutions should create board-approved targets and strategies to achieve alignment over time. This should set out the ultimate destination in terms percentage of assets that will be compatible with Paris aligned global warming thresholds for every 5-year period starting in 2020 up to 2050 for a given confidence level.

- Boards, senior management teams, portfolio managers and other relevant functions should undertake courses and training, as well as continued professional development, to ensure they have access to the latest skills and knowledge to support ACO.

- There should be complete internal and external clarity about the key individuals at a board-level and in senior executive management who are responsible and accountable for implementing, monitoring, and improving ACO over time.

- Investors should clearly outline their expectations of investee companies regarding ACO. This should include the expectation that company boards have their own plans, strategies, and targets for ACO, and that these are incorporated into strategic planning and reporting. Financial institutions should promote, and over time require, investee company alignment with the Paris.

- Asset owners should ensure that responsible ownership strategies and practices are built into their passive holdings. This is particularly important as passive funds, unlike active funds, by definition follow the index and have to buy the holdings contained in the index. Active ownership is, therefore, the most powerful tool passive funds have to effect change in investee companies.

- Financial institutions should put in place the necessary processes and incentives to implement the above. Financial institutions should also link internal and external manager incentives, including remuneration and renewal of mandates, to progress against ACO.

- Achieving ACO will not be possible without every type of public finance adopting the three interlocking elements of alignment set out in this report. Policymakers should urgently review public financing and public financial institutions to ensure public finance is supportive of ACO, in both the quality and quantity of financing available.

- Central banks and financial supervisors should explore options for supervising for ACO and develop an understanding of their pros, cons, and delivery challenges. The options should include capital charges for ACO, ACO targets for supervised firms, introducing carbon budgets to ALM and SAA, and integrating ACO into Senior Managers Regimes.

ENDNOTES

1 **https://spatialfinanceinitiative.com/geoasset-project/**

2 This section builds upon and expands the argumentation made in Caldecott (2020)

3 For further details, particularly for how this relates to sovereign wealth funds, see Caldecott & Harnett (2019)

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LIST OF ABBREVIATIONS

ACO	Alignment with Climate Outcomes
ALM	Asset Liability Matching
AMPERE	Assessment of Climate Change Mitigation Pathways and Evaluation of the Robustness of Mitigation Cost Estimates
AR5	Fifth Assessment Report of the IPCC
AR6	Sixth Assessment Report of the IPCC
BNDES	Banco Nacional de Desenvolvimento Econômico e Social (National Bank for Economic and Social Development, Brazil)
CCCE	Committed Cumulative Carbon Emissions
CLIC	Carbon Lock-in Curves
CRM	Climate Risk Management
DFI	Development Finance Institution
ECA	Export Credit Agencies
EU	European Union
FCA	Financial Conduct Authority (United Kingdom)
IAM	Integrated Assessment Model
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
KfW	Kreditanstalt für Wiederaufbau
MAC	Marginal Abatement Curve
MDB	Multilateral Development Bank
NGFS	Network for Greening the Financial System
SAA	Strategic Asset Allocation
SPV	Special Purpose Vehicle
SR15	Special Report: Global Warming of 1.5°C of the IPCC
TCFD	Taskforce for Climate-related Financial Disclosures
UNFCCC	United Nations Framework Convention on Climate Change
WRI	World Resources Institute

About EIT Climate-KIC

EIT Climate-KIC is Europe's largest climate innovation initiative, leveraging the power of innovation in pursuit of a zero-carbon, climate-resilient, just, and inclusive society. Established in 2010 and headquartered in Amsterdam, EIT Climate-KIC orchestrates a community of more than 400 organisations including large corporations and SMEs, municipal and regional governments, universities and research institutes, as well as non-governmental organisations and uncommon actors. The organisation uses a portfolio approach for developing and deploying innovation to achieve systemic change in those human systems that matter for long-term prosperity, combining activities and innovation outputs from applied research, education, start-up incubation, and innovation ecosystem building. EIT Climate-KIC is supported by the European Institute of Innovation and Technology (EIT), a body of the European Union.

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