



MAINSTREAMING THE TRANSITION TO A **NET-ZERO ECONOMY**



DISCLAIMER

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FOREWORD

The Group of Thirty (G30) seeks to deepen understanding of international economic and financial issues, and to explore the international repercussions of decisions taken in the public and private sectors. This report, *Mainstreaming the Transition to a Net-Zero Economy*, continues the G30's long tradition of evidence-based, actionable studies.

Decisions taken by governments, market regulators, financial institutions, and investors, now and over the medium term alone, will have major implications for how livable and sustainable the world will be. The report makes clear that these decisions are

essential to both the world's environmental and ecological viability as well as economic sustainability. The report makes a series of recommendations which, if implemented, will accelerate the transition to a net zero economy, and boost long-term economic and financial returns.

On behalf of the G30, we extend our thanks to the co-chairs, Mark Carney and Janet Yellen, for their able leadership of the Working Group on Climate Change and Finance, and to the Project Director, Caspar Siegert. We also thank the G30 members who participated in the study as Steering Committee and Working Group members.



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We also must thank the many leaders in the financial community who supported the study and agreed to be interviewed, illuminating how their institutions

and firms are embedding net-zero goals within their businesses, practices, and cultures.

We extend our thanks to Project Director Caspar Siegert for his careful drafting and support. We also thank our team of experts, including Debarshi Basu, Jennifer Bell, Carole Crozat, and Sini Matikainen.

The coordination of this project and many aspects of project management, Working Group logistics, and report production were centered at the G30 offices in Washington, D.C. This project could not have been completed without the efforts of our editor, Diane Stamm, and the work of Executive Director, Stuart Mackintosh, and his team, including Desiree Maruca, Emma Prall, and Peter Bruno. We are grateful to them all.



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ABBREVIATIONS

BCBS	Basel Committee on Banking Supervision
°C	degrees Celsius
CCC	Committee on Climate Change
CCS	Carbon Capture and Storage
CEO	chief executive officer
CH₄	methane
CO₂	carbon dioxide
ESG	Environmental, Social and Governance
EU	European Union
F-gases	fluorinated gases
FSAP	Financial Sector Assessment Programs
G30	Group of Thirty
GDP	gross domestic product
GHG	greenhouse gas
GtCO₂eq	gigatonnes carbon dioxide equivalent
IAIS	International Association of Insurance Supervisors
ICBC	Industrial and Commercial Bank of China Limited
IFRS Foundation	International Financial Reporting Standards Foundation
IOSCO	International Organization of Securities Commissions
IPCC	Intergovernmental Panel on Climate Change
N₂O	nitrous oxide
NGFS	Network of Central Banks and Supervisors for Greening the Financial System
R&D	research and development
TCFD	Task Force on Climate-related Financial Disclosures
tCO₂eq	tonnes of carbon dioxide equivalent

EXECUTIVE SUMMARY

The evidence that climate change is posing unprecedented risks to our livelihoods is overwhelming. Atmospheric concentrations of carbon dioxide (CO₂) have reached the highest levels in 800,000 years. Over the last three decades, the number of registered severe weather events has tripled. The cost of weather-related insurance losses has increased eightfold over the past decade, to an average of US\$60 billion; and average uninsured losses from weather events have increased sevenfold.

Still, these effects pale in significance compared to what might come. If the world continues on its current path, temperatures will rise by over 3 degrees Celsius (°C) above preindustrial levels by 2100, leading to severe and irreversible physical damage. This includes higher sea levels, food insecurity, more frequent natural disasters, and significant increases in the number of dangerous heat days. Overall, world gross domestic product (GDP) could be up to 25 percent lower by 2100 due to these impacts.

Leaving the path toward a climate catastrophe requires us to embrace green technologies across all sectors of the economy. We will need to reduce carbon emissions to net zero to limit the increase in global temperatures to well below 2°C above preindustrial levels and avoid the most catastrophic consequences of climate change.

The window for an orderly transition to a net-zero economy is finite and closing, so we need to act now.

Rises in global average temperatures have already reached 1°C, and could exceed 1.5°C as early as 2030. At current rates, we will have exhausted the remaining “carbon budget” that is consistent with limiting global warming to 2°C within the next 25 years. To avert a climate catastrophe, we need to act now and put the world economy on a trajectory toward a net-zero carbon economy by 2050.

Transitioning to a net-zero economy not only addresses an existential threat—it also opens up significant opportunities. In the near term, significant green stimulus packages can help revive economies following the devastating consequences of Covid-19. Businesses that embrace the transition to net zero also stand to seize significant long-run returns. The United Nation’s Principles for Responsible Investing estimate that utilities that are fully embracing the net-zero economy could see their market values increase by over 40 percent as investors shift away from lagging to leading firms. New generations of electric vehicles demonstrate that green alternatives can not only be more environmentally friendly, but also commercially viable.

This report sets out the steps that governments have to take to provide the incentives for a transition to net zero. It also describes how the financial sector can accelerate and amplify the effectiveness of public policy by providing capital for sustainable technologies, and by supporting companies in transitioning from high carbon to green, and from green to greener (Box ES.1).

BOX ES.1: THE PUBLIC AND PRIVATE SECTORS' ROLE IN SHAPING THE TRANSITION TO A NET-ZERO ECONOMY

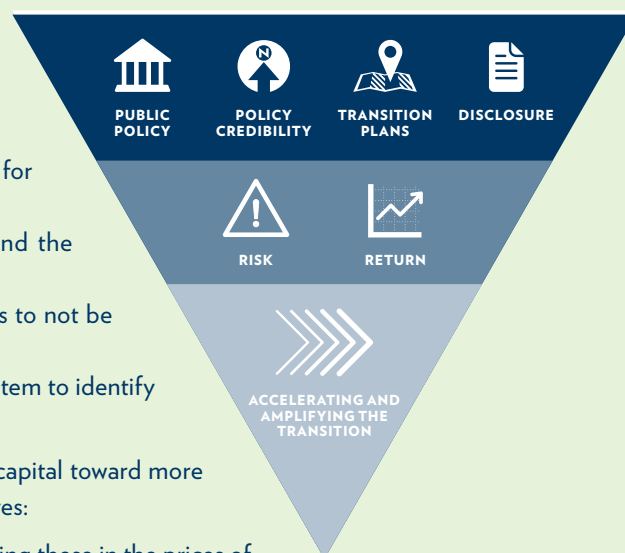
Credible public policies, transition plans, and disclosure of climate-related risks and opportunities provide the groundwork for transitioning to a net-zero economy:

- Public policies will have to shape the incentives for the transition to net zero.
- Policy credibility will reduce uncertainty around the future path of policy.
- Companies will need to draw up transition plans to not be left behind on the way to net zero.
- Disclosure of these plans allows the financial system to identify climate leaders and laggards.

The financial system must build on this to redirect capital toward more sustainable technologies and companies. This involves:

- Managing risks around the transition and reflecting these in the prices of less well-positioned assets.
- Helping companies and investors identify opportunities to generate sustainable returns.

This process will help accelerate and amplify the effectiveness of public policy.



Public policy has to shape the incentives for the transition

Public policy has to provide the foundation for a transition to net zero. Our climate is a public good. Private companies and financial institutions will not fully take the impact of their actions on our climate into account unless public policy forces them to do so. Leading businesses can accelerate change by anticipating future climate policies and adapting to them today. Ultimately, however, there is no substitute for effective, predictable, and credible public policies.

A number of countries have started publishing strategies for how to achieve the goal of net zero. Setting out these strategies can ensure that as the private and public sector deploy unprecedented amounts of capital to rebuild the world economy after Covid-19, they do so in a way that is consistent with the transition to net zero.

But more countries need to follow, and they need to act. As a first step, governments will need to phase out US\$480 billion of fossil fuel subsidies. This has to be accompanied by a suite of policy tools to ensure that every household and business internalizes the damage caused by their emissions.

Meaningful carbon prices are a cornerstone of any effective policy package. By charging an explicit price for the right to emit greenhouse gases, policymakers ensure that green businesses are not put at an unfair advantage relative to their polluting competitors. In addition, carbon prices can induce existing high-carbon businesses to adjust to net zero in whatever way is most efficient. Carbon prices should increase in a gradual and predictable way to support an orderly adjustment to a net-zero carbon economy, and they should be designed equitably—for example, by using some of the proceeds to support low-income households.

But the scale of the challenge means that carbon prices alone are not enough. In addition, policymakers will need to align public spending with the goals of the Paris Agreement. This includes investments in low-carbon infrastructure, loans and grants to support green research and development (R&D), and support for developing countries. Significant green stimulus programs can pay double dividends by supporting the economic recovery from the current pandemic in the short run, while also helping avert the catastrophic consequences of climate change in the long run. In addition, targeted environmental regulations can catalyze change in industries that are subject to significant collective action problems and that may be less responsive to carbon pricing.

Countries that move ahead of others are well-positioned to benefit from the opportunities that the transition to net zero brings. Our climate is a global public good, so all countries will need to pursue similar, ambitious net-zero targets. But we cannot wait for this. Countries that move ahead of others are likely to benefit economically, and they can avoid any temporary first-mover disadvantages by using “carbon border adjustments.” Any carbon border adjustments should be subject to a materiality threshold and should be limited to the most carbon-intensive products to reduce complexity. They will also need to be designed in a way that is fully consistent with World Trade Organization rules.

Developing countries are not only most impacted by climate change but also are least able to afford the consequences and they need support to meet the challenge of net zero. Developing countries need support in transitioning to a net-zero economy. Green technologies are capital intensive, and the cost of capital in developing countries is significantly higher, due, in part, to political and regulatory uncertainty as well as less liquid financial markets. Multilateral and National Development Banks and Development Finance Institutions have important roles in reducing the cost of capital, including by sharing some of the risk of sustainable projects and increasing the liquidity of local financial markets. Private investment must and will also play an important role in the transition in developing countries.

This report makes the following recommendations.

RECOMMENDATION 1

Governments must establish comprehensive strategies for putting their economies on a trajectory to reaching net zero by 2050. The specific steps that countries take will differ, but an effective policy framework will satisfy a number of common principles:

- a. Carbon prices that increase in a gradual and predictable way are one key element of any policy package.** Countries, however, will also need to provide public funding for low-carbon infrastructure and green R&D, and put in place targeted environmental regulation.
- b. The benefits that the transition to net zero brings have to be shared equitably.** One way of doing so is to use some of the proceeds of carbon pricing to support low-income households.
- c. To support an efficient global response to climate change, the level of ambition of national strategies will need to converge over time.** In the meantime, “carbon border adjustments” allow leading countries to pursue more ambitious targets, while avoiding carbon leakage. These adjustments should be designed in a way that is fully consistent with World Trade Organization rules.
- d. Multilateral and National Development Banks, Development Finance Institutions, and the International Monetary Fund should work on ways of reducing the cost of capital for sustainable projects in developing countries.** This includes sharing some of the project risk and collaborating with local governments to develop a pipeline of sustainable projects that helps increase the liquidity of these markets.

Public policy has to be credible: lessons from central banking

The increasing momentum behind climate movements around the globe should not be ignored. It demonstrates that in many countries there is already overwhelming support for ambitious policies to address global warming. An increasing number of politicians have

recognized this and campaign on ambitious targets to reduce emissions. By setting out clear strategies, politicians can provide forward guidance on the policies they plan to put in place. Such predictability of climate policy helps companies start adjusting to the reality of a net-zero world today, and ensures that this adjustment is orderly.

Too often, however, governments' climate strategies lack credibility. The benefits of climate policies will not be fully visible until long after the next elections, but any short-term cost will be felt immediately. Once elected, politicians are hence tempted to skimp on environmental efforts to fuel short-term growth. This can make it difficult for businesses to predict the future direction of climate policy. This credibility problem is similar to the challenge that monetary policymakers used to face.

A lack of predictability and credibility means missing out on the material benefits of an early, unambiguous commitment to act. If policymakers make clear that a decisive shift in climate policy is inevitable, finance will react. The financial system will pull forward future policies and ensure that the economy starts adjusting to them today. Every year that we win on the path to net zero can have significant benefits—leading to a one-off increase in the level of world GDP by 5 percent of 2019 world GDP in net present value terms. A credible commitment to act also avoids the risk of adding trillions to the stock of stranded assets, and means that policymakers will need to intervene less forcefully in the future.

First, climate policies need broad political support to be credible. The experience with inflation targeting demonstrates that to address a problem, it needs to be acknowledged by politicians across the political spectrum. Backtracking on ambitious climate agendas is more difficult if politicians share the same goals and expect to be held to account by both ends of the political spectrum. Such a broad-based consensus needs to be supported by clear communication and advocacy.

Second, countries should cement credibility by building a climate policy track record. Governments need to formulate intermediary goals that are consistent with their long-term strategies and demonstrate that they are taking steps to achieve these intermediary goals, for example, by setting appropriate carbon prices.

Third, governments can accelerate the process by delegating decisions to independent “Carbon Councils.” Determining the goals of climate policy, such as the commitment to reach net zero by 2050, requires democratic accountability and can only be done by elected governments. Governments can, however, delegate the calibration of the instruments that are necessary to achieve this target to “Carbon Councils.” Delegating these responsibilities helps insulate decisions with significant long-term implications from short-term political pressures.

RECOMMENDATION 2

Businesses need clarity on future climate policy. Governments need to take a number of complementary steps to ensure that climate policy is both predictable and credible.

- a. For policy to be predictable, the goals of climate policy need to be communicated effectively.** Clear communication and advocacy can help businesses plan and can also increase public support for green policies.
- b. Policy strategies have to command broad political support to be fully credible.** Climate policy is too important to be used to score political points. Instead, responsible politicians will work with opposition parties to try to establish common goals.
- c. Countries should cement credibility by building a climate policy track record.** To do so, governments have to formulate intermediary goals and demonstrate that the steps they are taking achieve these intermediary goals.
- d. Governments can build credibility more quickly by delegating key decisions to independent Carbon Councils.** The success of central bank independence shows that such delegation is a powerful way of boosting policy credibility.

A whole economy transition requires transition plans and climate governance

The economic fallout from the Covid-19 pandemic requires companies to reset their strategies. As companies recover from the devastating impact of Covid-19, they need to rebuild their business models in a way that is future-proof. Developing credible “transition plans” that are consistent with the imperative of a net-zero carbon economy can help turn an existential risk into the opportunity to protect long-term return prospects.

Company boards must review and approve companies’ transition plans. Boards should ensure the plans are part of regular discussion and deliberations; the firm’s climate change strategy must form an integral part of the organization’s overall strategy.

A designated board committee, or the entire board, should be tasked with overseeing the execution of the company’s climate transition plan. This ensures that the firm’s transition plan is continuously reviewed and updated.

The CEO and senior management team are responsible for developing the transition plan and leading its implementation. On a day-to-day basis, the CEO and senior management must be responsible for implementing the transition plan, including by ensuring that all parts of the business internalize the strategy.

Leaders should clearly and consistently communicate the company’s climate transition plan to employees throughout the company. Setting the “tone at the top” matters, but the same messages should also come from middle management. Business units and employees throughout the firm should be educated on and trained on how to apply the climate strategy adopted by the firm to their businesses.

Firms should link climate transition goals to executives’ compensation. Incentives matter to outcomes. Shifting incentives to include climate goals will change how a firm’s employees view the importance of these goals.

RECOMMENDATION 3

As companies recover from the devastating impact of Covid-19, they need to rebuild their business models in a way that is future-proof and consistent with the imperative of a net-zero carbon economy. Doing so can help turn an existential risk into various forms of opportunity for dynamic firms and sectors.

- a. To succeed in the transition, companies need clear transition plans.** At a minimum, companies will have to set out targets for their Scope 1, 2, and 3 emissions, and set credible milestones.¹
- b. Boards must review and approve companies’ transition plans.** A designated board committee or the entire board should be tasked with overseeing and monitoring the company’s climate transition plan.
- c. The CEO and senior management team are responsible for developing the transition plan and leading its implementation.**
- d. Firms should regularly publish and broadly communicate progress toward their transition plan.**
- e. Firms should ensure that performance measurement and compensation systems explicitly take account of the organization’s climate change transition objectives.**

Transition plans need to be accompanied by greater disclosure to help investors identify leaders and laggards

Climate transition plans need to be accompanied by disclosure of high-quality, decision-useful information. Such disclosures allow the financial system to systematically allocate capital toward more sustainable technologies and companies.

1 The GHG Protocol Corporate Standard classifies a company’s GHG emissions into three ‘scopes.’ Scope 1 emissions are direct emissions from owned or controlled sources. Scope 2 emissions are indirect emissions from the generation of purchased energy. Scope 3 emissions are all indirect emissions (not included in scope 2) that occur in the value chain of the reporting company, including both upstream and downstream emissions. (Greenhouse Gas Protocol; https://ghgprotocol.org/sites/default/files/standards_supporting/FAQ.pdf).

Over the past five years, disclosure of climate-related risks and opportunities has significantly increased. This has been achieved through widespread dissemination of the framework by the Task Force on Climate-related Financial Disclosures (TCFD), but more remains to be done.

First, more companies need to sign up to the TCFD recommendations. Disclosures remain far from the scale the markets need to mainstream green finance and systematically channel investment to sustainable and resilient business models. Asset managers and creditors should demand TCFD-consistent disclosure from all companies they invest in and lend to. Stock exchanges have to develop guidance for TCFD-compliant disclosures, and central banks need to lead by example and publish fully TCFD-compliant disclosures. There are limits, however, to what decentralized private sector action can achieve. Authorities around the world also need to set out a timetable for making TCFD-compliant disclosure mandatory by 2023.

Second, disclosures need to become more decision-useful. Enhanced disclosure of common, quantitative metrics will help investors more systematically identify climate leaders and laggards. These metrics are likely to include information on the financial impact of a range of transition and physical risk scenarios, as well as information on current Scope 1, 2, and 3 emissions and forward-looking targets. Given the complexity in estimating Scope 3 emissions, companies should set out the methodologies they use. The private sector should help identify a consistent and harmonized set of metrics. However, ultimately the process toward greater standardization will need to be driven by international standard-setters.

RECOMMENDATION 4

Companies across the whole economy need to disclose their transition plans and explain how they will realign their businesses with the transition to a net-zero economy. In disclosing these plans, companies should build on existing standards by the Task Force on Climate-related Financial Disclosures (TCFD). To increase the quantity and quality of these disclosures:

- a. **All asset managers and creditors should demand TCFD-consistent disclosure from the companies they invest in and lend to.**
- b. **Stock exchanges need to develop common guidance on climate disclosure that is consistent with the TCFD recommendations.** Stock exchanges should work toward making annual climate disclosures that reflect this guidance a continued listing requirement.
- c. **Central banks need to lead by example and publish fully TCFD-compliant disclosures.**
- d. **Governments need to set out clear timelines for making TCFD-compliant disclosure mandatory by 2023.** This will accelerate disclosure by climate laggards, and further embed TCFD as a common international standard.
- e. **Users of TCFD disclosures should help identify best practices for clear, comparable, and consistent disclosures.** International standard-setters should help turn these best practices into global standards.

The financial system can accelerate and amplify the effectiveness of public policies...

The financial system needs to play a decisive role in accelerating and amplifying the effectiveness of public policies. By factoring a forward-looking assessment of future climate policies into today's insurance premia, lending decisions, and asset prices, the financial system pulls forward the adjustment to a net-zero economy. By assessing the impact of policies in a systematic way, it can ensure that climate policies inform the allocation of capital across all sectors of the economy.

Finance is already starting to factor climate-related risks into today's decisions. Insurance companies are at the forefront of considering climate-related risks in their risk models. Many of the largest banks have decided to stop lending to high-carbon industries such as thermal coal, and financial markets are starting to price in the risks associated with transitioning to a net-zero economy.

...but to do so, financial institutions need to more systematically assess climate risks

Financial institutions need to do more to systematically assess the impact of various climate scenarios across all their exposures. Specific operational challenges include the fact that financial institutions' risk models typically consider short time horizons and rely on past data to estimate the severity and frequency of potential tail risks. Given its unprecedented nature, there is no such history to draw on in the context of climate change.

To effectively manage these risks, financial institutions need to take a strategic, forward-looking approach. Static information such as the carbon emissions of companies that financial institutions are lending to, insuring, or investing in is a natural starting point, but it may tell you little about the risks that a company is facing going forward. Financial institutions need to also consider companies' transition plans, and ask companies to assess how they would react to changes in the climatic and regulatory environment. This will support financial institutions in conducting robust scenario analysis and assessing risk to their own balance sheets.

Central banks and supervisors need to assess the resilience of the financial system as a whole to climate risks by incorporating them into their stress testing frameworks. Financial institutions' own scenario analysis is an important step toward measuring and managing the specific climate-related risks that they face, but it is not sufficient. Central banks and supervisors will need to extend and adapt existing stress testing frameworks to capture the full extent of the climate risks. This will ensure comparability of test results, and will allow authorities to assess system-wide feedback loops.

International organizations and standard-setters should support this by incorporating climate risk management into their work programs and frameworks. By using the Network of Central Banks and Supervisors for Greening the Financial System (NGFS) Reference Scenarios, these organizations can also promote harmonization of climate stress tests globally.

Together, these steps will help accelerate and amplify the transition to net zero. Understanding

transition risks is the first step toward pricing them. Companies that manage transition risks well will enjoy access to cheaper and more plentiful capital, while laggards will see their access to finance dry up. This can provide strong incentives for companies to take the transition to net zero seriously and to start taking action now.

RECOMMENDATION 5

To manage risks to their business, financial institutions will need to assess and aggregate the impact of climate-related risks on their counterparties. They also need to move beyond the static to the strategic and consider how they may be able to react to various climate scenarios. To support this by the end of 2022:

- a. Financial institutions should run their own scenario analysis.** This will help explore idiosyncratic climate-related risks that they may be exposed to. Using the scenarios designed by the Network of Central Banks and Supervisors for Greening the Financial System (NGFS) as a starting point will help maintain consistency across firms.
- b. Financial institutions should also encourage companies that they lend to, insure, or invest in to conduct similar scenario analysis, and they will need to work with the public sector to identify and address any data gaps.**
- c. Central banks and supervisors need to start running regular climate stress tests that are comparable across firms and allow authorities to assess system-wide feedback loops.** These tests should consider risks to current balance sheets, as well as the way in which financial institutions may be able to adjust their business model in response to various climate-related scenarios. Central banks and supervisors should seek to establish common practices in conducting these tests, including by using the NGFS Reference Scenarios as a starting point.

...and finance needs to more systematically identify and seize the commercial opportunities that the transition to net zero brings

Banks are well placed to help their customers seize the benefits of realigning their businesses with the net-zero economy. In many cases, transitioning to a low-carbon business model requires substantial investments. Leading financial institutions are already supporting their clients in transition from high carbon to green, and from green to greener—by providing both capital and advice. This helps accelerate a whole economy transition and provides leading banks with new and profitable commercial opportunities.

Better understanding climate-related risks can also open new insurance markets. (Re)insurance companies have a wealth of experience in modelling climate-related risks. By sharing risk models, data, and new technologies to improve the understanding and quantification of natural disaster risks in developing countries, they can develop new insurance products and address the US\$160 billion insurance protection gap that currently exists in developing countries. This will help grow the market for climate insurance, bringing significant benefits for insurers and policyholders alike.

Similarly, investors can generate significant risk-adjusted returns by assessing climate-related factors. As climate regulations become more widespread and climate events multiply, the integration of climate-related risks and opportunities in investment considerations has significantly gained ground. There is already evidence that by investing in “greener” companies, investors stand to reap significant financial rewards.

But to mainstream sustainable finance, the financial system needs to identify the full spectrum of companies that can support the transition to net zero. The number of deep green investment opportunities is limited. To drive real change and accommodate the growing demand for green investment opportunities, the financial system needs to support all companies that can help produce goods and services in more carbon-efficient ways.

Developing a set of common metrics that capture these “fifty shades of green” will help embed climate-related

considerations in every single investment decision. Such metrics should measure how companies and portfolios are performing relative to their peers and to what is necessary to limit warming to less than 2°C. They also need to capture both current and forward-looking measures of climate impact. Corporate disclosures are the building block for these metrics, but the financial system needs to put this information into context.

While additional metrics will be useful to deepen the markets for sustainable finance, this is not a reason for investors to drag their feet. The time for investors to consider climate-related opportunities is now. By moving early, investors can seize the opportunities that the transition brings before they are fully priced in. This will accelerate and amplify the effectiveness of public policy, and will help avert the catastrophic impacts of unmitigated climate change.

RECOMMENDATION 6

The financial system can play a key role in unlocking the commercial opportunities that the transition to net zero brings. This will accelerate and amplify the effects of policy. To do so:

- a. **Financial institutions should support their clients in transitioning to net zero, by offering both capital and advice on how to realign their businesses with the net-zero economy.**
- b. **(Re)insurance companies need to share risk models, data, and new technologies to improve the understanding and quantification of natural disaster risks in developing countries and open up new insurance markets.**
- c. **Banks, insurers, and asset managers should work with the TCFD to develop forward-looking metrics capturing the full “fifty shades of green” across portfolios and individual companies.**

INTRODUCTION

The evidence that climate change is posing unprecedented risks to our livelihoods is overwhelming. Atmospheric concentrations of carbon dioxide (CO₂) have reached the highest levels in 800,000 years (Exhibit I.1). Over the last three decades, the number of registered severe weather events that have led to losses has tripled.² The cost of weather-related insurance losses has increased eightfold over the past decade, to

an average of US\$60 billion; and average uninsured losses from weather events, which can often eclipse insured losses, have increased sevenfold.³

Existing challenges pale in significance compared to what might come. If the world continues on its current path, we will see temperatures rise by over 3 degrees Celsius (°C) above preindustrial levels by 2100, leading to severe and irreversible physical damage.

EXHIBIT I.1: Atmospheric CO₂ concentrations have reached the highest levels in 800,000 years



Source: US National Oceanic and Atmospheric Administration (US NOAA) (2018).

Note: Global average atmospheric concentrations of CO₂ measured in parts per million.

² From Bank of England analysis using Swiss Re and Munich Re loss databases.

³ Using nominal losses, based on 10-year moving average and Swiss Re Institute Data as at year end 2019 in 2019 US dollar terms.

These include higher sea levels, food insecurity, more frequent natural disasters, and significant increases in the number of dangerous heat days. Overall, world GDP may be up to 25 percent lower by 2100 due to these impacts.⁴

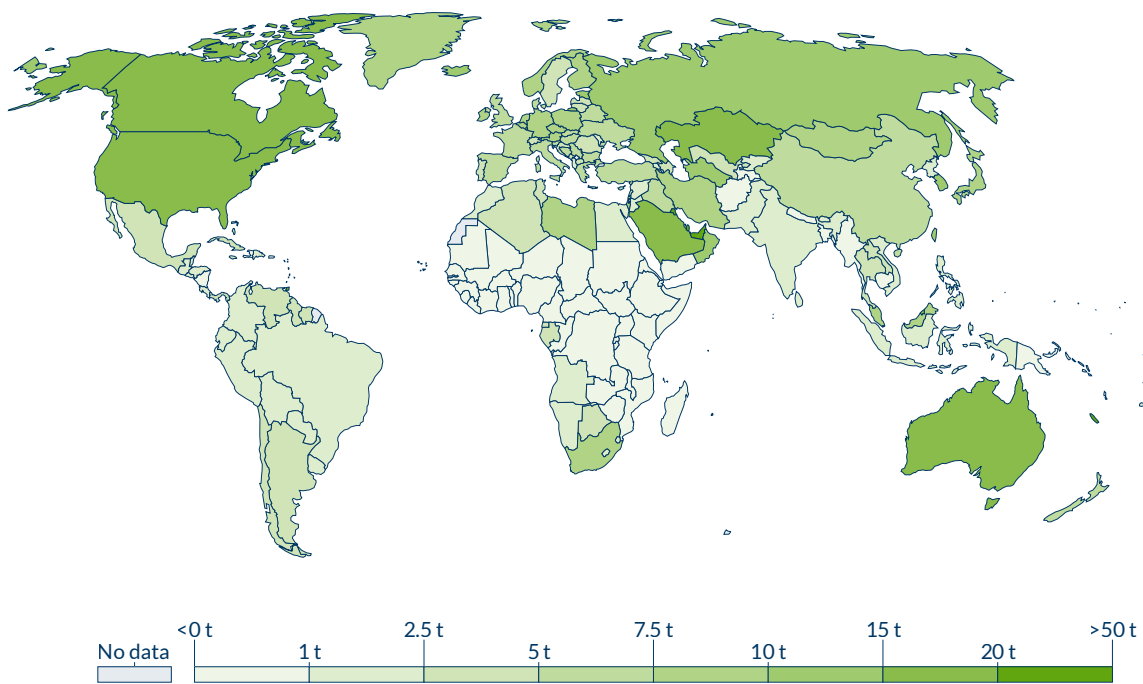
Limiting the increase in global temperatures to below 2°C will significantly reduce this damage. The impact of temperatures on our ecosystems is highly nonlinear. As a result, we may be able to reduce the impact of climate change by up to 80 percent by limiting the increase in global temperatures to below 2°C.⁵ As part of the Paris Agreement in 2015, governments hence agreed to limit the increase in temperatures to well below 2°C, and to pursue efforts to limit the temperature increase even further to 1.5°C.

The window for an orderly transition to a net-zero economy is finite and closing. The Intergovernmental

Panel on Climate Change (IPCC) has warned that rises in global average temperatures since preindustrial times have already reached 1°C and could exceed 1.5°C as early as 2030. At current rates, we will have exhausted the remaining “carbon budget” that is consistent with limiting global warming to 2°C within the next 25 years.⁶ The picture looks even worse if we account for any growth in emissions by low- and middle-income countries (Exhibit I.2).

Hence, governments need to accelerate efforts to address climate change and transition to a net-zero carbon economy by 2050. Our climate is a global public good. Households and businesses will not fully internalize the impact that their individual actions have on the rest of us, and while many green technologies are starting to compete successfully with their high-carbon alternatives, all too often relying on high

EXHIBIT I.2: Average CO₂ emissions per capita in 2018 (in tonnes per year)



Source: Our World In Data (<https://ourworldindata.org/>), based on Carbon Dioxide Information Analysis Center (CDIAC), Global Carbon Project, Gapminder, and the United Nations.

4 NGFS 2020.

5 NGFS 2020.

6 <https://carbontracker.org/carbon-budgets-where-are-we-now/>

carbon legacy technologies is still in companies' commercial interest. As a result, governments will need to provide the incentives for businesses to take into account the consequences of their actions.

The transition to a net-zero carbon economy requires enormous efforts, but the vast majority of technologies to do so are already available, and their cost is falling every day. We need to accelerate investments in these technologies rather than hoping to make progress by reducing growth. Shutting down the world economy for several months to slow the spread of Covid-19 is expected to reduce annual emissions by less than 8 percent, and did not stop the world from continuing to deplete its remaining carbon budget.

The transition to a net-zero economy not only addresses an existential threat, but also opens up significant opportunities. In the near term, significant green stimulus packages can help revive the economy following the devastating consequences of Covid-19. Businesses that embrace the transition to net zero also stand to seize significant long-run returns. The United Nation's Principles for Responsible Investing estimate that utility companies that are fully embracing the net-zero economy could see their market values increase by over 40 percent over the next years. New generations of electric vehicles demonstrate that green alternatives can not only be more environmentally friendly, but also commercially viable.

The Covid-19 pandemic has demonstrated the importance of taking action well before the full disastrous consequences of global warming are felt. During

the pandemic, countries had to impose painful restrictions early on to avoid catastrophic outcomes weeks later. In the context of climate change, leaders need to be even more farsighted and take actions decades before the disastrous consequences of inaction would become apparent. The Covid-19 pandemic has also demonstrated that an effective response relies on strong leadership by the public sector, accompanied by determined private sector action.

This report makes recommendations on how the financial sector can accelerate and amplify the effectiveness of public policy by redirecting capital toward more sustainable technologies and companies. Businesses and investors who move early to consider climate-related risks and opportunities can not only support the transition to net zero, but also stand to reap significant financial rewards. The report also sets out recommendations to the public sector. These recommendations focus on the foundations that policymakers need to put in place to allow the financial sector to be a force for good. While the financial system can accelerate and amplify the effectiveness of public policies, it cannot replace them.

Advising on issues at the intersection of public policy and finance is the key strength of the Group of Thirty. The Group of Thirty consists of economic and financial leaders from the public sector, academia, and the private sector. Its members have worked on numerous global public goods—including by developing international prudential standards, setting up cross-border central bank swap lines, or ensuring robust, fair, and transparent foreign exchange markets.

CHAPTER 1.

PUBLIC POLICIES

Our climate is a public good. Hence, we need to put in place effective public policies that incentivize the private sector to tackle climate change. These policies include carbon prices, public investment in green infrastructure and R&D, and targeted environmental regulation. Such policies are the foundation that the financial sector can build on, to accelerate and amplify the effectiveness of public climate policy.

Effective public policy provides the foundation for addressing climate change. Private companies and financial institutions will not fully take the impact of their actions on our climate into account unless public policy forces them to do so. Leading businesses can accelerate change by anticipating future climate policies and adapting to them today. Ultimately, however, there is no substitute for effective, predictable, and credible public policies.

Governments need to develop comprehensive strategies for putting their economies on a trajectory to reaching net zero by 2050. Over 120 countries, ranging from Afghanistan to Zambia are actively discussing the goal of reaching net zero by 2050. Countries that have set or are intending to set this goal already account for over half of the world's GDP.⁷

Countries have started publishing strategies for how they plan to achieve this goal. These set out the energy mix that countries aspire to, reductions in energy intensity that they plan to achieve, and the role of emerging technologies such as Carbon Capture and Storage (CCS). Setting out these strategies can ensure that as the private and public sector deploy unprecedented amounts of capital to rebuild the world

economy after Covid-19, they do so in a way that is consistent with the transition to net zero.

But a high-level strategy on its own is not enough. Governments need to start taking tangible steps that are consistent with their longer-term strategies to reduce emissions across all sectors of the economy (Exhibit 1.1). In aggregate, governments' international commitments fall significantly short of what is necessary to reach net zero by 2050, and the policies that they have implemented are not even sufficient to meet these commitments.⁸ Governments need to act now, while we have not yet fully depleted our remaining carbon budget.

As a first step, governments will need to phase out the US\$480 billion of fossil fuel subsidies that they provided in 2019 alone. The overwhelming majority of these subsidies are provided by developing countries. They actively encourage households and businesses to waste our remaining carbon budget, and substantially reduce countries' fiscal room for maneuver. They compare to just US\$25 billion of public money that was spent globally on clean energy R&D over the same period.⁹

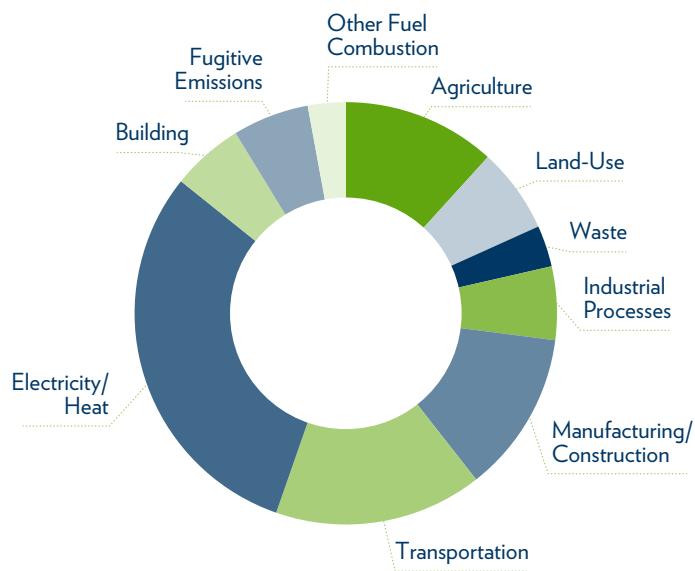
But reducing subsidies will not be enough to align our economies with net zero. Given the scale of the

⁷ <https://eciu.net/analysis/briefings/net-zero/net-zero-the-scorecard>.

⁸ Climate Action Tracker.

⁹ OECD 2020; IEA 2020.

EXHIBIT 1.1: Share of global CO₂ emissions in 2016 by sector



Source: CAIT Climate Data Explorer, World Resources Institute.

challenges, countries have to deploy a suite of policy tools to ensure that households and businesses internalize the damage caused by their emissions. The appropriate mix of policy tools will vary across countries, reflecting structural differences, societal preferences, and legal regimes. Any such policy package can be summed up by the “shadow carbon price” that it implies.¹⁰ Below we discuss four policy tools that will need to form the backbone of any policy package.

Meaningful carbon prices will need to form the foundation for a transition to net zero...

Explicit carbon prices help innovative, green companies compete successfully in the market. Carbon prices require businesses to compensate society for the amount of greenhouse gases (GHGs) they emit. By charging an explicit price for the right to emit GHGs, policymakers ensure that green businesses are not put

at an unfair advantage relative to their polluting competitors, and they use the market mechanism to induce existing, high-carbon businesses to adjust to net zero in whatever way is most efficient, given their individual circumstances.

A carbon price helps the private sector factor environmental considerations into all their decisions. An explicit price lends itself to inclusion in standard financial models that are used to assess new investment opportunities. As such, it is more likely to be reflected in every single long-term decision that a business makes than other, more bespoke policies and regulations.

Carbon prices should increase in a gradual and predictable way to support an orderly adjustment to a net-zero carbon economy. A gradual phase-in of carbon prices allows companies to adjust

their business model to increasingly stringent environmental standards, and mitigates any financial stability risks that could otherwise arise from the transition to net zero. However, policymakers need to act now to allow for a gradual phase-in while still meeting the goal of net-zero emissions by 2050.

While an increasing number of countries have already started pricing GHG emissions, prices will need to increase significantly to limit the rise in temperatures to less than 2°C. About half of the emissions covered by carbon pricing initiatives are still priced below US\$10 per tonnes of carbon dioxide equivalent (tCO₂e). This compares to a carbon price of US\$40 to US\$80 necessary to limit warming to less than 2°C.¹¹ Even the prices of some of the largest and most ambitious carbon pricing systems are currently only around US\$30 (see Exhibit 1.2).¹²

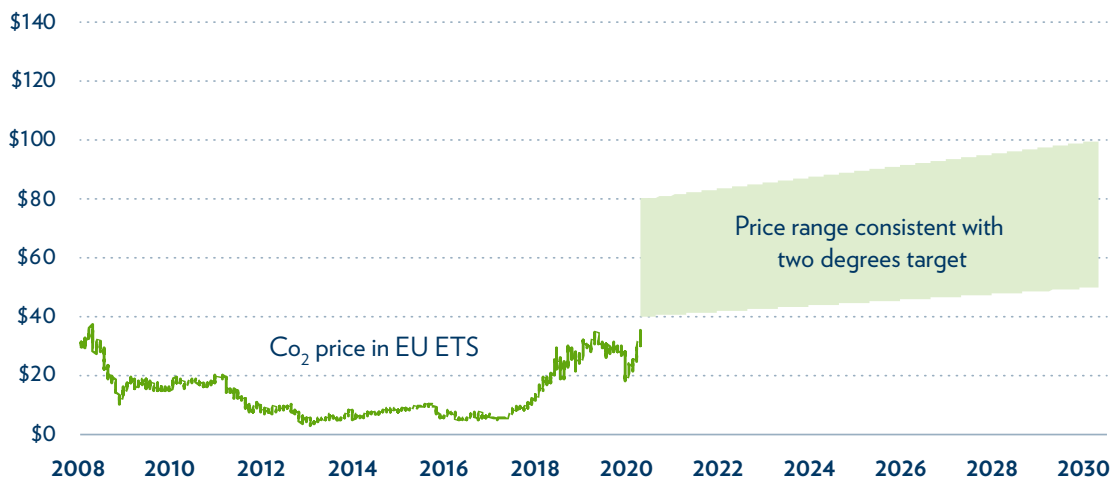
Many leading companies realize that current carbon prices are unsustainably low and use higher

10 The Integrated Assessment Models that are used to assess climate policy use “shadow carbon prices” as a proxy for the intensity of various government policies. The Network of Central Banks and Supervisors for Greening the Financial System (NGFS) estimates that by 2050, this shadow carbon price would need to reach US\$300 for us to have a 66 percent chance of limiting global warming to below 2°C.

11 The High-Level Commission on Carbon Prices, led by Joseph Stiglitz and Lord Nicholas Stern, concluded that a carbon price of US\$40 to US\$80 in 2020 is consistent with the objective of the Paris Agreement of keeping temperature rise below 2°. This price would need to rise to US\$50 to US\$100 by 2030.

12 Prices and exchange rates as of 31 July 2020.

EXHIBIT 1.2: Carbon prices in the European Union versus range estimated to be compatible with 2° target (in US\$ per tCO₂e)



Source: Intercontinental Exchange (ICE); High-Level Commission on Carbon Prices.
 Note: ETS = Emissions Trading System.

“internal” carbon prices to evaluate new projects. This reflects the long economic lifespan of many new investment projects, and a conviction that government-imposed carbon prices will rise significantly in the foreseeable future. While such carbon prices are far from universal, around 700 large global companies report using internal carbon prices, with average prices of around US\$40.¹³

Governments must not only increase the level of carbon prices, but they also need to ensure that these prices cover all GHG emissions—including nitrous oxide (N₂O), methane (CH₄), or fluorinated gases (F-gases), which have a significantly higher global warming potential than CO₂. Together, these gases account for around a quarter of GHG emissions.¹⁴ Countries need to do more to ensure that these prices are applied consistently to all sectors of the economy. For example, the European Union’s (EU’s) carbon pricing system currently covers only 45 percent of emissions and excludes sectors such as agriculture that are responsible for over 20 percent of GHG emissions globally.¹⁵

Carbon pricing should be designed equitably. Unless designed appropriately, the effects of carbon pricing can hit lower-income households hardest (Exhibit 1.3). This is because in many countries, low-income households spend a larger share of their income on energy or other carbon-intensive products. Governments should address this issue by using some of the revenues from carbon prices to support low-income households during the transition. By doing so, they can decouple the allocative effects of carbon prices from those distributive consequences. In the United States, 68 percent of registered voters now support a “revenue-neutral” carbon pricing scheme that would disburse any proceeds from a carbon price to households.¹⁶

One way of designing carbon pricing schemes in an equitable way is to share some of the proceeds of carbon prices via “carbon dividends”—lump-sum transfers to every household in the country. An analysis by the US Treasury suggests that in the United States, distributing all the revenues from carbon prices

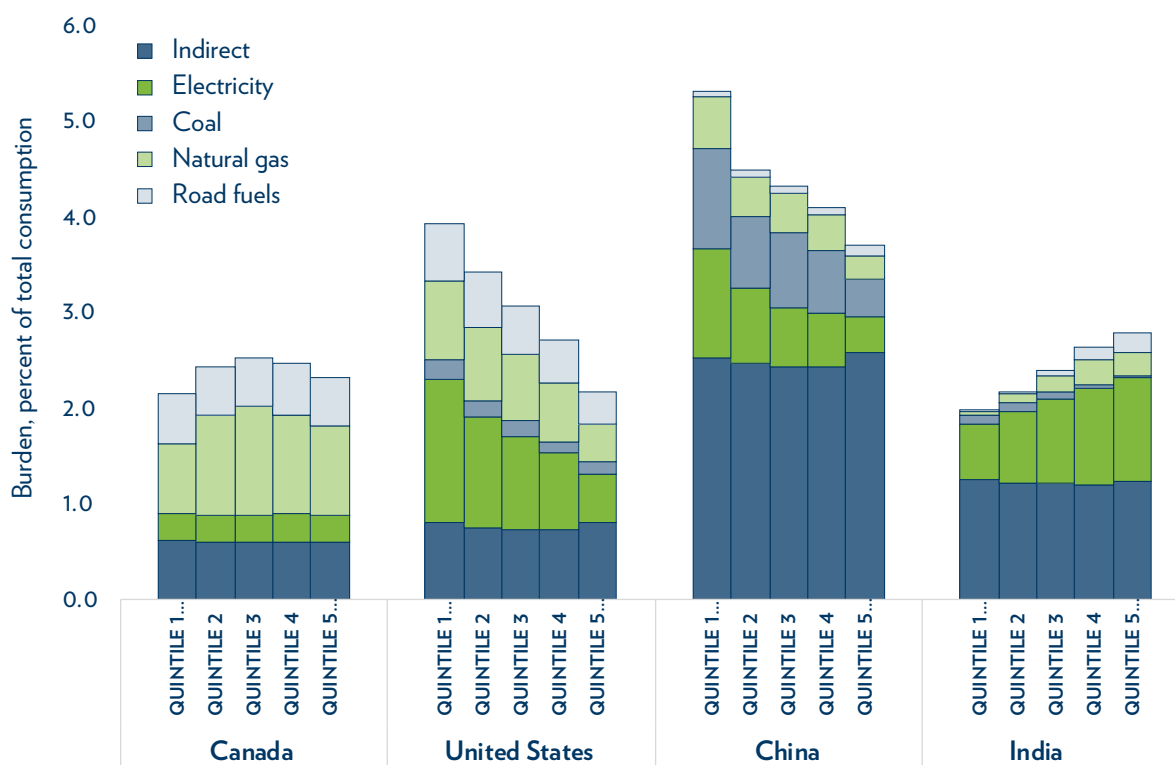
13 CDP 2019.

14 IPCC 2014.

15 https://ec.europa.eu/clima/policies/ets_en; <http://cait.wri.org>.

16 Leiserowitz et al. 2020.

EXHIBIT 1.3: Impact of US\$50 carbon price on household consumption (2030)



Source: IMF 2019.

Note: “Indirect” refers to the increased price of consumer goods from higher energy costs. Burdens are estimated prior to the use of carbon tax revenue; a full pass-through of taxes to consumer prices is assumed.

to households via such carbon dividends would lead to a net increase in after-tax income for the bottom seven income deciles.¹⁷ Some of the proceeds of carbon prices could also be used to fund low-carbon infrastructure and green R&D. Depending on the specific projects, this can accelerate the transition to net zero while also helping deliver inclusive growth.

Alternatively, countries could use some of the proceeds of carbon prices to repair sovereign balance sheets following the Covid-19 pandemic. The economic impact of the pandemic has left many countries’ public finances strained. Revenues from carbon prices could help address this: a price of US\$80 on carbon emissions could raise up to 3 percent of GDP per year. However, given the need to compensate low-income households

for the distributive effects of carbon prices, only some of these revenues are available for cutting public debt.

...but carbon prices will need to be accompanied by public investment...

In addition to carbon prices, policymakers will need to align public spending with the goals of the Paris Agreement. This includes investments in low-carbon infrastructure, and loans and grants to support green R&D. Large parts of the low-carbon infrastructure that is necessary to achieve carbon neutrality will be owned and operated by the public sector. For example, state-owned enterprises currently own around 40 percent of the power generation capacity in advanced

¹⁷ Horowitz et al. 2017.

economies.¹⁸ In addition, public R&D will help bring down the cost of green technologies. While most of the technologies necessary to transition to a net zero-carbon economy are already available, additional research will help make them more effective and affordable.

Providing public funding for green infrastructure and R&D should be a key element of post-Covid recovery packages. Fiscal multipliers during severe economic slowdowns like the one we are currently experiencing can be as high as 2.5.¹⁹ This means that investing in green infrastructure and R&D can not only support the transition to net zero, but can also provide significant near-term benefits. In light of these benefits, 231 central bank officials, finance ministry officials, and other economic experts rated green R&D as one of the most attractive policies to support the economic recovery following the Covid-19 pandemic.²⁰

Public R&D is important in areas where knowledge spillovers generate significant additional benefits that cannot be commercialized by the innovator himself. Such spillovers are largest in emerging technology fields with steep learning curves, which includes many clean technologies. Public R&D in these areas can generate significant macroeconomic returns, even before considering any positive environmental externalities of these technologies. Hence, support for R&D should be seen as complementary to other green policies, such as carbon pricing, which are designed to make businesses take these externalities into account.

One example of a field that exhibits such spillovers is energy storage technologies, such as batteries or hydrogen fuel cells. Energy storage technologies are key in ensuring a consistent supply of energy when the sun isn't shining and the wind isn't blowing. There is ample evidence that companies conducting research in these areas do not capture all the benefits of innovation themselves. For example, storage technologies developed for electric vehicles tend to spill over into grid-scale batteries, and patent data demonstrate that the knowledge spillovers from storage technologies frequently extend beyond the field of power generation.²¹

As a result, private companies may not invest as much in R&D as would be desirable from a macroeconomic perspective. Policymakers can address this issue by providing loans and grants for green R&D that take into account the benefits of innovations in other, perhaps unexpected, areas.

Public R&D should also support the development of solutions whose payoff may be too distant or too uncertain for research to be commercially viable. Sovereigns have longer time horizons than the private sector and are better placed to diversify risks, making them a natural provider of capital for such projects.

One example for such technologies is new Carbon Capture and Storage (CCS) technologies. Decarbonizing industrial processes such as cement or steel production is much more challenging than decarbonizing the electricity supply. This is because emissions occur as a by-product of the chemical processes involved in producing these materials. CCS can play an important role in capturing emissions and reducing the carbon footprint of these production processes. However, CCS technologies are still in their infancy and are characterized by both technical and economic challenges.²² As a result, leading countries have started to provide meaningful public funding for the development of CCS technologies and projects. Other examples of technologies that require public support are nuclear fusion and low-carbon aviation.

...and should further be complemented by targeted environmental regulation

Environmental regulation can play an important role in catalyzing change in industries that are subject to significant collective action problems and inertia. In such industries, companies may simply pass the cost of carbon prices on to consumers rather than reducing the carbon footprint of their operations or products. Hence, environmental regulation can be an important way of achieving more sustainable outcomes.

18 OECD 2018.

19 Blanchard and Leigh 2013.

20 Hepburn et al. 2020.

21 See, for example, Noailly and Shestalova 2017.

22 Hepburn et al. 2019.

Positive experiences with fuel efficiency standards suggest that well-designed regulation may be an efficient way of accelerating change. For example, in 2007, the European Commission announced regulations that required car manufacturers to reduce the average CO₂ emissions of new cars to less than 130 grams per kilometer by 2015. This led to a steep fall in emissions of new cars between 2007 and 2015. Over the same period, average prices of new cars in the EU fell relative to the general price level. While there were some confounding factors, this experience still suggests that such regulations can be effective without being expensive.²³

While we should strive for global coordination...

Our climate is a global public good, so many of these steps would ideally be taken in a globally coordinated way. A uniform, global carbon price, for example, would use the market mechanism to ensure that emissions are reduced wherever it is cheapest to do so. Mitigation projects that are economical in light of this carbon price would be implemented, regardless of where they are located. Even if countries do not agree on a global carbon price, they should still take steps to converge toward a common, higher level of ambition. This will help address the significant gap between the Nationally Determined Contributions that countries have committed to under the Paris Agreement and what is necessary to limit global warming to less than 2°C.

Private finance can help accelerate this convergence. Prudent financial institutions are beginning to disinvest and alter their investment strategies to account for a rising carbon price and net-zero goals. Such approaches are seen in proposals under the *Institutional Investors Group for Climate Change's* (IIGCC's) Net Zero Investment Framework for institutional investors to divest from high-carbon assets where this is

appropriate in light of risk management considerations. It would also draw on experiences with the Equator Principles—a risk management framework for assessing and managing environmental and social risks associated with project finance and corporate loans.

...countries should not delay domestic action waiting for global coordination

In the meantime, countries that move ahead of others are well-positioned to benefit from the economic opportunities that the transition to net zero brings. Most countries can come close to reducing emissions to a level that is consistent with the 2°C target by relying on proven technologies. In many cases, the macroeconomic benefits of higher investments and lower fossil fuel imports may outweigh the macroeconomic costs, even if countries move ahead unilaterally.²⁴ In addition, first-movers will build up expertise and technology that will pay off in the long run.

If necessary, countries can take measures to avoid putting their most carbon-intensive industries at a temporary competitive disadvantage. Differences in carbon prices across countries can lead to “carbon leakage”—the relocation of carbon-intensive industries to countries with lower carbon prices. Countries can address this risk via “carbon border adjustments.” Such adjustments ensure a level playing field internationally by imposing taxes on carbon-intensive imports from less ambitious countries, and by providing corresponding rebates for exports. It is important that carbon border adjustments are designed in a way that is fully consistent with World Trade Organization rules.²⁵

Any carbon border adjustments should be subject to a materiality threshold, and should be limited to the most carbon-intensive products. Small differences in carbon prices are unlikely to introduce significant distortions, and do not require the use of such adjustments.²⁶

23 In particular, average CO₂ emissions started increasing again in 2016. Some of this may be explained by a scandal around polluting diesel engines (“dieselgate”). This scandal broke in 2015 and led to a significant decline in the popularity of diesel engines and a shift toward more CO₂-intensive petrol engines.

24 Boston Consulting Group (BCG) and the BCG Henderson Institute 2018.

25 Appropriately designed carbon border adjustments have good prospects of being found compatible with World Trade Organization rules, as they ensure a level playing field and have pro-competitive effects (see, for example, Mehling et al. 2019).

26 Evidence on the effect of energy prices suggests that material “carbon leakage” is unlikely to emerge unless differences in carbon prices exceed US\$50. Moreover, the lion's share of global trade embodied emissions is concentrated in a small number of products (see, for example, Sato 2014).

Limiting the scope of a carbon border adjustment to the most carbon-intensive and easily tradable products such as metals and certain chemicals can significantly reduce the complexity of such a mechanism. This addresses one of the most common concerns around carbon border adjustments—that it can be difficult to assess the carbon content of complex products.

Carbon border adjustments can also encourage lagging countries to join more ambitious countries into “carbon clubs.” Under a carbon border adjustment, the carbon prices are levied by the country of destination, rather than the country of origin. This means that the country of origin is leaving money on the table, and provides strong incentives for that country to increase domestic carbon prices and join a “carbon club” within which border adjustments are waived.

Irrespective of any international coordination, we need to support low- and middle-income countries in the transition

Developing countries need support in transitioning to a net-zero economy. Green technologies are capital intensive, and the cost of capital in developing countries is higher, including due to political and regulatory uncertainty and to less developed and less liquid financial markets. Multilateral and National Development Banks and Development Finance Institutions have important roles in reducing the cost of capital—including by sharing some of the risk and increasing the liquidity of local financial markets. Development banks will need to provide seed capital, but should carefully select projects so that they are not crowding out private capital. Successful “blended finance” crowds in private capital, bringing down the cost of capital, and turning billions of public funding into trillions of private funding (see Box 1.1).

Blended finance is not a substitute for other forms of technical or economic support. Over the last 200 years, developed countries have benefited considerably from not having to pay for their emissions. During that time, Europe and North America have jointly produced more than 60 percent of the stock of global CO₂ emissions. As we move toward a world in which

emissions carry a price, developed countries should support countries that have not enjoyed this historical privilege, including by providing economic support. Doing so is a key element of a “just transition.”

RECOMMENDATION 1

Governments must establish comprehensive strategies for putting their economies on a trajectory to reaching net zero by 2050. The specific steps that countries take will differ, but an effective policy framework will satisfy a number of common principles:

- a. Carbon prices that increase in a gradual and predictable way are one key element of any policy package.** Countries, however, will also need to provide public funding for low-carbon infrastructure and green R&D, and put in place targeted environmental regulation.
- b. The benefits that the transition to net zero brings have to be shared equitably.** One way of doing so is to use some of the proceeds of carbon pricing to support low-income households.
- c. To support an efficient global response to climate change, the level of ambition of national strategies will need to converge over time.** In the meantime, “carbon border adjustments” allow leading countries to pursue more ambitious targets, while avoiding carbon leakage. These adjustments should be designed in a way that is fully consistent with World Trade Organization rules.
- d. Multilateral and National Development Banks, Development Finance Institutions, and the International Monetary Fund should work on ways of reducing the cost of capital for sustainable projects in developing countries.** This includes sharing some of the project risk, and collaborating with local governments to develop a pipeline of sustainable projects that helps increase the liquidity of these markets.

BOX 1.1: PROVIDING CAPITAL TO HELP DEVELOPING COUNTRIES TRANSITION TO NET ZERO

Developing countries need support in transitioning to a net-zero economy. Green technologies are capital intensive, and the cost of capital in developing countries is higher, including due to political and regulatory uncertainty, as well as less developed and less liquid financial markets.

Developed countries committed to a goal of jointly mobilizing US\$100 billion a year in climate finance by 2020 to address the needs of developing countries for climate mitigation and adaptation. This commitment came out of the Copenhagen Accord in 2009, was formalized in the Cancun Agreements in 2010, and was reaffirmed in the Paris Agreement in 2015. This funding is noted to come from a wide variety of sources, public and private, bilateral and multilateral, including alternative sources of finance. In Paris, it was decided that this collective mobilization goal would be continued through 2025 and that by that point there would be a new collective quantified goal under the Paris Agreement from a floor of US\$100 billion a year, taking into account the needs and priorities of developing countries.

Reaching these goals will require a blend of private and public finance. Multilateral and National Development Banks and Development Finance Institutions have important roles de-risking projects, including by reducing regulatory and political risks and providing guarantees to assume some of the remaining economic risk. Development banks can also help increase the liquidity of local markets, including by working with local governments to develop a pipeline of sustainable projects, providing technical assistance to create investment frameworks, and increasing transparency. Development banks will need to provide seed capital, but should carefully select projects so that they are not crowding out private capital.

Development banks should also commit to fully integrating climate risks into their operations and lending, and communicating comparable, robust, and bank-wide Paris alignment implementation plans. They should

commit to working collectively to help implement ambitious climate targets in relevant countries through the Nationally Determined Contribution enhancement and implementation cycle. The IMF has already signalled a strong commitment to addressing climate change and assisting countries in reducing emissions and increasing climate resilience.^a

Large real economy companies around the world can also help mobilize finance for developing countries. Many companies in “hard to abate” sectors will need to offset emissions to achieve net zero, creating demand for credible offsets. Since activities and projects in developing economies will likely provide the most cost-effective offsets, this is an efficient way to direct private finance toward emissions mitigation and sequestration activities in these countries. The Taskforce on Scaling Voluntary Carbon Markets, sponsored by the Institute for International Finance and chaired by Standard Chartered CEO Bill Winters, will provide a blueprint for the infrastructure needed to scale these markets up.

Implementation of the TCFD recommendations on climate-related disclosures in developing markets will help provide the information needed for investors to better direct financial flows to companies aligned with the transition to a low-carbon economy. Large TCFD supporters in developing markets include South Africa’s Investec and its Financial Services Board, Ghana’s National Insurance Commission, Brazil’s Itaú Banco and Petrobras, India’s Adani Power and Tata Steel, and China’s Industrial and Commercial Bank of China Limited (ICBC).

Comprehensive reporting by companies in advanced economies of their scope 1, 2 and 3 emissions will encourage them to minimize climate risks and maximize opportunities across their supply chains. With companies addressing sustainability across the breadth of their operations—including those of their suppliers, distributors and retailers—substantial green investment in developing countries will be encouraged, since this is where many scope 3 emissions are generated or outsourced.

Source: a. See Georgieva 2019; 2020.

CHAPTER 2.

THE IMPORTANCE OF PREDICTABILITY AND CREDIBILITY—LESSONS FROM CENTRAL BANKING

Ambitious climate goals often lack predictability and credibility. Addressing the credibility problem can ensure that future policies are factored into every decision taken today. This can accelerate the transition, and every year that we win on the path to net zero can generate benefits worth 5 percent of global GDP. The introduction of credible inflation targets provides key lessons for how credibility can be established and can benefit everybody.

The increasing momentum behind climate movements around the globe is difficult to ignore. In many countries there is already overwhelming support for ambitious policies to address global warming. This momentum will continue to build as the effects of climate change become more visible and are communicated more clearly. An increasing number of politicians have recognized this and campaign on ambitious targets to reduce emissions.

By setting out clear strategies, politicians can provide forward guidance on the policies they plan to put in place. Such predictability of climate policy helps companies start adjusting to the reality of a net-zero world today, and ensures that this adjustment is orderly. But there are limits to what non-binding guidance can achieve. Too often, governments' climate strategies lack credibility. The benefits of climate policies will not be fully visible until long after the next elections, but any short-term cost of climate policy will be felt immediately. Once elected, politicians are hence tempted to skimp on environmental efforts to fuel easily observable short-term growth. As a result,

current policies fall short of the goals that countries have signed up to as part of their own Paris Agreement pledges. In aggregate, this gap is projected to amount to 3 gigatonnes carbon dioxide equivalent (GtCO₂eq) in 2030 (see Exhibit 2.1). The gap to what is necessary to meet the overall ambition of the Paris Agreement and limit the increase in global temperatures to below 2°C is projected to be even larger, at over 20 GtCO₂eq.²⁷

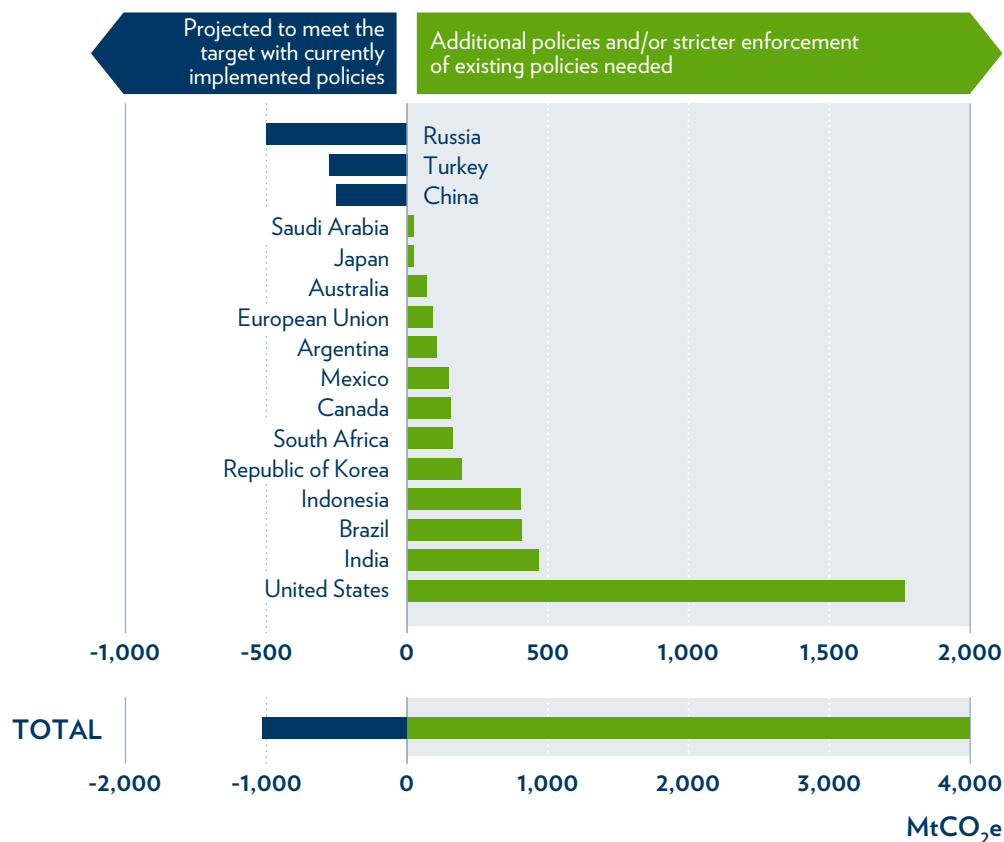
Unless politicians address this time inconsistency problem, companies will not take ambitious climate strategies sufficiently seriously. Climate policy will not be fully predictable unless politicians' promises are seen as credible.

Monetary policy offers lessons on how to successfully increase the credibility of long-term targets.

The credibility problem of climate policy is similar to the challenge that monetary policymakers used to face. Although the value of low and stable inflation

²⁷ Climate Action Tracker (<https://climateactiontracker.org/>)

EXHIBIT 2.1: Gap between current policies and governments' existing pledges



Source: UNEP 2019b.

Note: based on comparing projected 2030 emissions under countries' current policies to conditional Nationally Determined Contributions under the Paris Agreement.

was widely recognized throughout the 1970s and 1980s, delivering it proved challenging. This was because the instrument that affects inflation most powerfully—monetary policy—also affects output and employment, at least in the short run. Politicians promised tight monetary policy to rein in inflation expectations, but once they had convinced the public that inflation would be low, politicians were tempted to renege on their promises and use accommodative monetary policy to boost short-term growth. Expectations of high inflation became self-fulfilling and we ended up with significant inflation without benefiting from any higher employment (see Annex).

Ultimately, governments addressed this problem by tasking independent central banks with targeting low and stable inflation. Governments around the world

adopted explicit inflation targets, which allowed voters to hold them to account more easily for any failure to deliver on promises of stable inflation. In addition, they restricted their own role to formulating the long-term goals of monetary policy, and delegated the use of the instruments necessary to meet these goals (for example, the setting of interest rates) to independent central banks that are less exposed to the temptations of boosting short-term growth. Doing so allowed governments to credibly promise better outcomes for everybody, boosting their chances of re-election.

The fact that credible inflation targets successfully stabilized inflation is now universally accepted. For example, IMF (2005) shows that adapting explicit inflation targets significantly reduced average inflation rates, and Beechy (2008) shows that while UK

inflation risk premia drifted down since the adoption of a formal inflation target, it was only when the Bank of England was given independent control of monetary policy tools that they dropped sharply.

Credible inflation targets also helped shape the trade-offs between unemployment and inflation. Employers and employees negotiate wages with reference to both near-term and longer-term inflation expectations. As longer-term inflation expectations became well-anchored and less sensitive to short-term variations in economic activity, inflation itself became less sensitive to economic activity.²⁸ This effect can explain some of the changes in the shape of the Phillips curve over the past decades (Exhibit 2.2). The “flattening of the Phillips curve” can significantly improve the trade-offs that policymakers face in the future. In particular, it allows policymakers to run a tighter labor market, yielding significant benefits to workers without causing significant inflation.²⁹ Well-anchored inflation

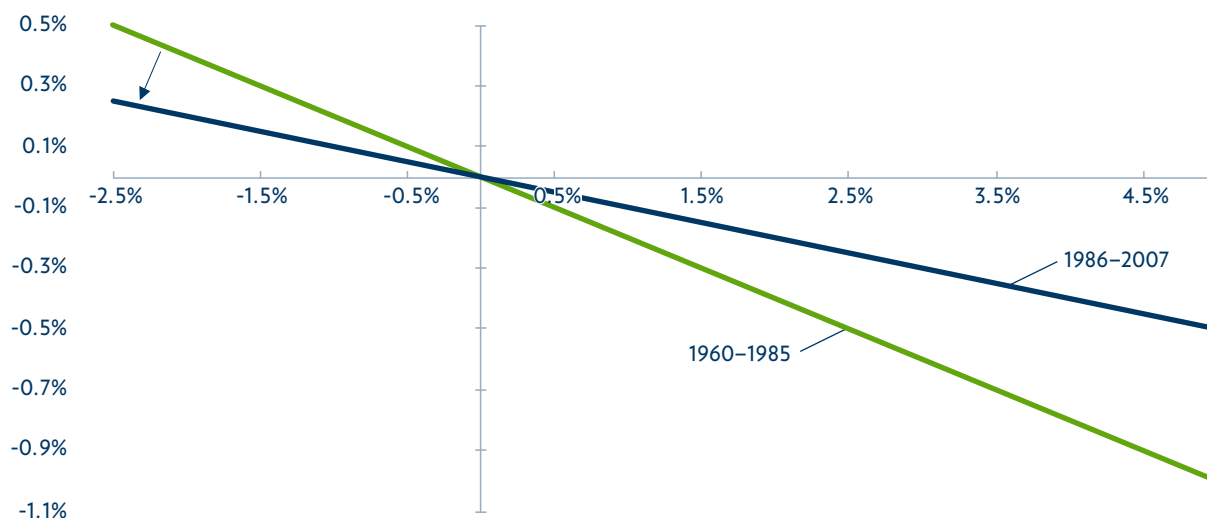
expectations can also reduce the risk of any deflationary spirals in times of persistently low inflation.

Credibility of climate policy can have material benefits

Credible climate policy is just as important as credible monetary policy. Even if politicians do end up taking the actions that are necessary to avoid a climate catastrophe, a lack of ex-ante credibility means missing out on the benefits of an early, unambiguous commitment to act. There are three ways in which credibility can support an efficient transition to net zero.

First, a credible policy framework ensures that financial markets anticipate future policies and the economy starts adjusting to them today. Starting to cut emissions to net zero one year earlier can significantly reduce the ultimate end-point carbon concentrations.³⁰ The precise economic benefits of reductions in end-point

EXHIBIT 2.2: Increases in the credibility of inflation targets may have contributed to the flattening of the Phillips curve



Source: Illustration based on Ng, Wessel and Sheiner (2018), using US data.

28 Bernanke 2007.

29 Yellen 2019.

30 An alternative assumption is that an early adjustment will lead to less mitigation in later years, resulting in the same end-point carbon concentrations. The IPCC’s Fifth Assessment Report demonstrates that in this scenario, pulling the adjustment forward can still have material benefits. This is because emission reductions in early years reduce the need to drastically reduce emissions in the future by relying on expensive technologies such as carbon capture and storage.

carbon concentrations are highly uncertain and depend on a number of assumptions.³¹ However, plausible estimates of the “social costs of carbon” suggest that the benefit of embarking on the trajectory toward net zero just one year earlier can be enormous. Doing so would reduce end-point carbon levels by over 35 GtCO₂eq and have significant benefits—leading to a one-off increase in the level of world GDP by 5 percent of 2019 world GDP in net present value terms.³²

Second, credible policy frameworks reduce the risk of adding to the existing stock of “stranded assets.” Credible policy frameworks reduce the risk that businesses form wrong expectations about future policies and continue to invest in obsolete technologies. Similar to the US\$900 billion of oil reserves that we may not be able to burn, these may turn out to be economically worthless.³³ The International Energy Agency (IEA) estimates that unless we see a clear change in policy, investments in fossil fuels—from exploration to power generation—will total over US\$25 trillion between now and 2040.³⁴ This is equivalent to over 25 percent of 2019 world GDP. Even if only a small fraction of these investments would need to be written off, this would still eclipse the value of stranded oil and gas reserves.

Third, if policy is viewed as credible, policymakers need to intervene less forcefully to achieve a given climate target. If ambitious climate targets are seen as credible, businesses will stop investing in high-carbon technologies and in the future, there will be fewer fully depreciated carbon-intensive plants competing against green alternatives. As a result, carbon prices will need to be raised less aggressively to price high-carbon legacy technologies out of the market and achieve a given reduction in GHG emissions (Exhibit 2.3). This can reduce any unintended consequences of high carbon prices, including the risk of carbon leakage.

The fact that credibility allows policymakers to achieve a given target more easily is not limited to climate policy. King (2005) argued that credible central banks need to adjust interest rates less aggressively to keep inflation close to its target—dubbed the “Maradona theory of interest rates.”

There are different ways of establishing credibility and getting to enjoy these benefits

Climate policies will not be fully credible unless there is broad political support for them. The experience with inflation targeting demonstrates that to address a problem, it needs to be acknowledged by politicians across the political spectrum. Backtracking on ambitious climate agendas is more difficult if politicians share the same goals and expect to be held to account by both ends of the political spectrum. Knowing that opposition parties are likely to implement similar policies also gives businesses the certainty they need to invest in green infrastructure that has economic lifespans of several decades.

This broad-based consensus needs to be supported by clear communication and advocacy. The evidence around climate change is unequivocal. Often, however, the basic truths around climate change are obscured by political point-scoring and international finger-pointing. To achieve broad-based public support for climate policies, politicians will need to more clearly communicate the key facts around climate change—including that we are close to exhausting our remaining carbon budget, and that we already see changes in our environment that are unprecedented in the history of mankind.

The next step is to cement credibility by building a climate policy track record. Governments need to

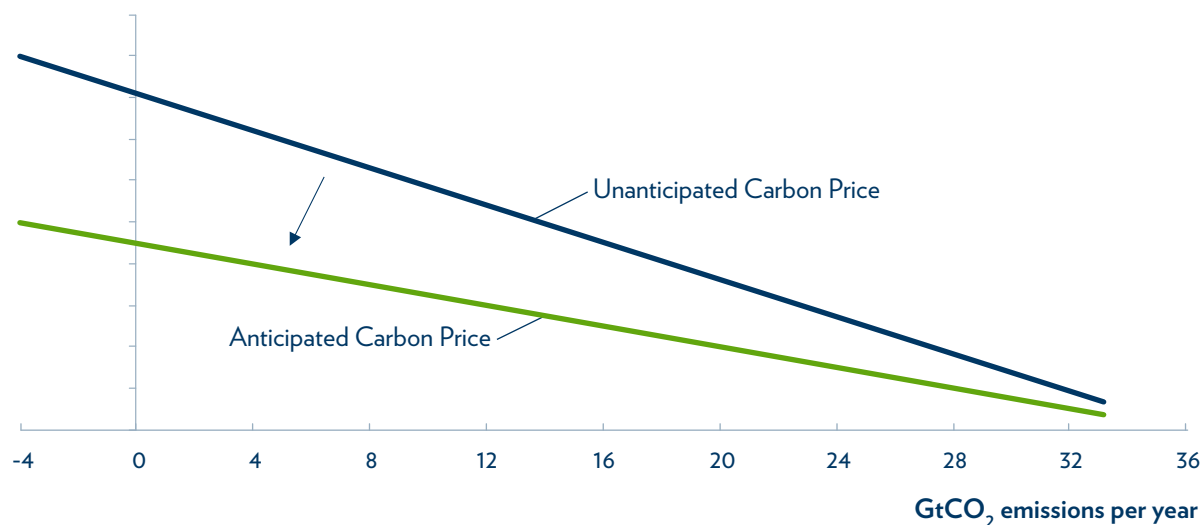
31 The impact of carbon concentrations on physical losses are estimated to be highly nonlinear. So the benefits of any additional reductions in emissions depend in part on how sharply emissions are expected to fall in the baseline.

32 This assumes a (discounted) social cost of carbon of US\$115 (in 2010 US dollars). We multiply this by the reduction in total emissions we would achieve by starting the transition to net zero one year earlier (35GtCO₂—a conservative estimate of the current level of annual CO₂ emissions) to estimate the total net present value benefit of accelerating the emissions. This yields a total benefit of US\$4tn (in 2010 USD)—or around 5% of 2019 world GDP. Note that the US\$115 estimate of the social cost of carbon is based on Nordhaus (2018) and uses a discount factor of 2.5 percent to discount future physical risks. This discount factor is lower than the baseline assumption in Nordhaus (2018), resulting in a higher social cost of carbon. Stern (2006) sets out reasons for why in the context of climate change it is appropriate to use low discount factors. The benefits of an earlier adjustment do not consider any costs of transitioning more quickly, and aiming for a lower end-point carbon concentration. However, as explained in footnote 30, transitioning to a given end point more quickly tends to be cheaper, which may offset the cost of pursuing a stricter end-point target. The estimate does not consider the benefits of reducing GHGs other than CO₂.

33 FT 2020.

34 IEA 2019.

EXHIBIT 2.3: Credible policy frameworks can reduce the carbon prices necessary to achieve a given goal



Note: Illustration only.

formulate intermediary goals that are consistent with their long-term strategies and demonstrate that they are taking steps to achieve these intermediary goals—for example by setting appropriate carbon prices. Politics is not a one-shot game, and businesses are more likely to trust a government that has repeatedly delivered on its green promises in the past. However, accumulating a robust policy track record can take time. The areas of fiscal and monetary policy provide ample evidence that it can take years to convince a skeptical public that policymakers are willing to resist short-term temptations, and governments that are slow to embrace ambitious targets may ultimately have to put in place more stringent policies to build a reputation for being environmentally responsible.

In addition, governments can choose to accelerate the process of building credibility by delegating decisions to independent “Carbon Councils.” Determining the goals of climate policy, such as the commitment to reach net zero by 2050, requires democratic accountability and can only be done by elected governments. Governments can, however, delegate the decision of how to calibrate the instruments that are necessary to achieve this target to “Carbon Councils”—independent committees with expertise in climate science,

environmental policy, business, or economics. Delegating these responsibilities helps insulate decisions with significant long-term implications from short-term political pressures and allows countries to gain credibility more quickly and more effectively. Such an institutional setup mirrors the design of monetary policy frameworks.³⁵ Moreover, a number of countries have already put in place similar structures (see Box 2.1).

Such a setup should be accompanied by appropriate accountability mechanisms. It is for elected governments to formulate the mandates of Carbon Councils, enshrine them in legislation, and determine appropriate accountability mechanisms. This is particularly important as climate policy can have significant distributional implications, which puts a premium on political accountability.³⁶ Appropriate accountability mechanisms may include making committee members personally accountable to their parliaments. This resembles setups for monetary policy, where policymakers including the heads of the European Central Bank, Federal Reserve Board, Bank of Japan, or Bank of England all regularly provide testimony to their respective parliaments.

³⁵ Debelle and Fisher 1994.

³⁶ Tucker 2018.

How much direct control governments should delegate to Carbon Councils will differ across the different areas of climate policy. At one end of the spectrum, governments could grant Carbon Councils the direct power to calibrate policy tools independently. This would maximize the independence of Carbon Councils and would be most likely to insulate the calibration of climate policies from short-term politics. At the other end of the spectrum, governments could decide to grant these councils only the right to issue “comply or explain” recommendations, and leave the decision to accept or reject these recommendations with the government. While such a setup would stop short of full independence, it would help address concerns around leaving important distributional decisions to unelected officials.

In the case of carbon prices, countries should consider delegating full control to Carbon Councils. As part of agreeing countries’ transition strategies, voters and politicians will have developed a shared understanding of the broad trajectory for carbon prices that is consistent with achieving carbon neutrality by 2050. These prices will need to be reviewed as we learn more about the environmental dynamics and the economy’s responsiveness to carbon prices. Governments can fully delegate these recalibration decisions to Carbon Councils to ensure that they are taken based on objective, scientific evidence. Even if they do so, governments would still retain full control over how the proceeds of these prices are used. This ensures that it will be elected governments that shape the distributional consequences of carbon prices, and makes delegating the calibration of carbon prices to independent Carbon Councils considerably less contentious.³⁷

In the case of other climate policy levers, governments may want to retain more control. The additional policy tools that countries will have to deploy to achieve their climate goals are difficult to fully determine ex ante. They might include introducing enhanced environmental standards for manufacturing firms, or accelerating the phase-out of the internal combustion engine. All these policies have important distributional

implications that are more difficult to offset than in the case of carbon prices. Hence, governments may want to retain ultimate control over this wider set of policies. They can still empower Carbon Councils to catalyze action by issuing “comply or explain” recommendations. In the area of macroprudential policy, “comply or explain” recommendations have proven to be an effective way of combining flexibility with political oversight and democratic legitimacy.

RECOMMENDATION 2

Businesses need clarity on future climate policy. Governments need to take a number of complementary steps to ensure that climate policy is both predictable and credible.

- a. For policy to be predictable, the goals of climate policy need to be communicated effectively.** Clear communication and advocacy can help businesses plan, and can also increase public support for green policies.
- b. Policy strategies have to command broad political support to be fully credible.** Climate policy is too important to be used to score political points. Instead, responsible politicians will work with opposition parties to try to establish common goals.
- c. Countries should cement credibility by building a climate policy track record.** To do so, governments have to formulate intermediary goals and demonstrate that the steps they are taking achieve these intermediary goals.
- d. Governments can build credibility more quickly by delegating key decisions to independent Carbon Councils.** The success of central bank independence shows that such delegation is a powerful way of boosting policy credibility.

³⁷ Delegating the calibration of carbon prices is possible regardless of the mechanism via which carbon prices are implemented. Under direct carbon pricing, Carbon Councils instruct fiscal authorities to charge polluting businesses the agreed carbon price. Alternatively, countries may choose to implement Emissions Trading Schemes. Under an Emissions Trading Scheme, the Carbon Council determines the number of pollution permits that will be made available by the government, and the price for these permits is then determined by the market.

BOX 2.1: INTERNATIONAL EXAMPLES OF “CARBON COUNCILS”

In 2008, the United Kingdom set up an independent, statutory “Committee on Climate Change” (CCC), which is tasked with advising the UK government on emissions targets. The CCC produces an annual report on progress toward meeting these targets, to which the government is obliged to respond. Its current membership includes a previous minister and previous senior civil servants, academics from a mix of scientific and economic backgrounds, and experts from the energy industry.

The CCC assesses appropriate long-term emission reduction targets and recommends specific five-year “carbon budgets.” These intermediate targets provide transparency about the trajectory toward net zero, and help hold governments to account. As a result, the CCC has become a cornerstone of climate policy in the UK.

Even though the UK government decided not to grant the CCC any executive powers beyond issuing public recommendations, the CCC has successfully influenced the climate policy of seven UK governments.

In 2008, the CCC successfully convinced the UK government to commit to cutting emissions by 80 percent by 2050.

Following advice contained in the CCC’s first official report in 2008, the UK government amended the UK’s Climate Change Act to require emissions to be cut by 34 percent rather than 26 percent by 2020.^a

The CCC’s first three carbon budget recommendations, covering 2008–2012, 2013–2017, and 2018–2022, were all adopted by the UK government and are all expected to be met.

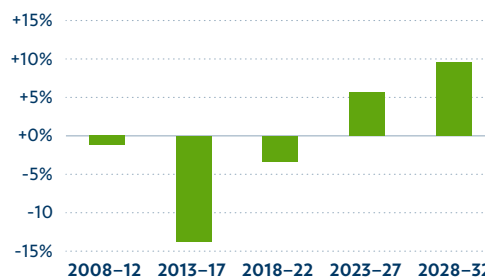
The CCC’s recommendations for the subsequent 2023–2027 and 2028–2032 budgets have both been adopted by the UK government. The most recently agreed budget calls for emission to be reduced to 43 percent of their 1990 levels by 2032.

In 2018, the UK government consulted the CCC on whether to increase the level of its climate ambitions and agree a net-zero target. In line with the CCC’s advice, the UK government formally agreed to achieve carbon neutrality by 2050.

These positive experiences do not mean that the relationship between the government and the independent

expert committee has always been free of tension. For example, the CCC repeatedly criticized the governments’ plan to “bank” any emission reductions in excess of what was required by previous carbon budgets and offset them against emissions in future periods. Doing so is possible under section 17 of the Climate Change Act, but was viewed by the CCC as inconsistent with its advice. This issue has become more prominent over recent years, as the UK is currently expected to overshoot the recommended carbon budget during both 2023–2027 and 2028–2032 (see Exhibit 2.1.1). This demonstrates that in some instances, Carbon Councils that have their own executive powers might decide to act more aggressively to address climate risks than governments are willing to do.

EXHIBIT 2.1.1: The UK’s actual and projected performance against its five-year carbon budgets



Source: UK Carbon Budgets, July 2019, Commons Research Briefing CBP-7555, House of Commons Library.

Committees similar to the CCC have also been set up in other countries. This includes the French “Haute Conseil Pour Le Climat,” which was set up in 2018 and is charged with assessing the French governments’ climate policies, and a committee of independent experts that supports the German government’s assessment of progress against its climate goals.

Experiences in other countries demonstrate that the creation of such expert committees is not a substitute for a broad political consensus to address climate change. In 2011, the Australian government formed an

independent Climate Commission to provide reliable and authoritative information about climate change in Australia. The Commission was disbanded two years later following the election of a new government. While

Source: a. Muinzer 2018.

members of the commission soon set up a new and influential “Climate Council,” this is an independent nonprofit organization with no statutory footing.

CHAPTER 3.

STRATEGY AND GOVERNANCE

To manage the risks and seize the opportunities that the transition to net zero brings, companies across all sectors of the economy need robust climate strategies and governance. Companies need to set out clear transition plans, ensure senior management leadership and appropriate board oversight, and communicate these plans clearly throughout all levels of their organization. Ultimately, credible transition plans will be rewarded by cheaper and more plentiful access to capital.

The economic fallout from the Covid-19 pandemic requires companies to reset their strategies. As companies recover from the devastating impact of Covid-19, they need to rebuild their business models in a way that is future-proof and consistent with the imperative of a net-zero carbon economy. Doing so can help turn an existential risk into an opportunity to protect long-term return prospects.

To succeed in the transition, companies need clear transition plans. At a minimum, boards have to agree and set out targets for their Scope 1, 2, and, where appropriate, 3, emissions, and set credible milestones. Companies should also set out the methodologies they use for assessing Scope 3 emissions and any challenges they face in reducing emissions along their supply chain. Boards and Management will also need to set out how they plan to build resilience against the physical consequences of climate change. These targets need to be discussed and ratified by boards. An increasing number of firms are actively developing their transition plans, and have a good understanding of the risks and opportunities ahead. Over 400 companies

have already set targets that are judged consistent with limiting warming to 2°C by the Science-Based Targets Initiative. This needs to become more widespread as all sectors of the economy internalize the transition to net zero.

All firms' climate change transition plans differ. Each firm's transition path to the same net zero destination will depend on the market, the sector, the business makeup, and the firm's wider business strategy. Governments and regulators cannot determine the myriad climate change transition plans. Instead, each firm's board, leadership, and employees must determine the shape of the transition firm to firm.

Transition plans matter both for internal and external communication. They help set the tone at the top and ensure that strategies are clear to the entire organization. Further, they can clarify a company's approach to customers, investors, and creditors, and signal that the firm is taking the transition to a net-zero economy seriously and demonstrating as much through its business, products, and processes.

Boards and senior management must lead on determining, aligning, embedding, and monitoring climate transition plans and each firm's glidepath to net zero

Company boards must review and approve companies' transition plan. Boards should ensure the plan is part of regular discussions and deliberations; the firm's strategy should be fully understood by the board.

Ideally, companies would put in place a designated board committee responsible for sustainability issues. That committee, or the entire board, should be tasked with overseeing the execution of the company's climate transition plan. Whatever format is selected, the governance structure adopted by the board needs to ensure consistent oversight. That oversight should feed regularly into the full board's deliberations, and foster discussion on business strategy changes and adjustments as the transition smooths, steepens, or becomes bumpy in the years ahead. Board oversight responsibility should be reflected in published charters. Boards should also consider whether they have adequate expertise on climate issues. For companies where climate risks and opportunities are a material part of their business, boards should consider engaging in periodic education/workshop sessions on climate-related risks, opportunities, and policy shifts to ensure boards members are equipped for their roles.

The CEO and senior management team are responsible for developing the transition plan and leading its implementation. On a day-to-day basis the CEO and senior management must be responsible for implementing the transition plan, including by ensuring that all parts of the business internalize the strategy. Boards should recruit senior executives who can oversee climate change transition goals, embody the tenants of the strategy, align their businesses with the net-zero goals and deliverables, and communicate those effectively, internally and externally.

Some companies have been analyzing climate risks and opportunities for many years. Other firms have only more recently focused on the issue, driven by the shifting frequency of severe weather events, mounting investor demands, or regulatory changes underway.

These firms may need to draw in external expertise to ensure that they fully understand the risks and opportunities that the transition to a net-zero economy brings.

To implement their transition plans, many organizations need to pursue a fundamental mindset shift and consider climate-related risks and opportunities in their day-to-day activity, at all levels of the organization. Leading companies are already demonstrating how to do this. For those firms, the necessary transition ahead appears relatively well understood and smooth. In contrast, firms that fall too far behind, that fail to take the climate transition seriously, and that refuse to plan and assure their long-term economic viability and strength, face a cliff-edge disjunctive break rather than a smooth transition.

To support a fundamental mindset shift, senior executives must clearly articulate the climate change strategy internally...

Leaders should clearly and consistently communicate the company's climate transition plan to employees throughout the company. Setting the "tone at the top" matters, but the same messages should also come from middle management and be echoed through all levels of the firm.³⁸ Business units and employees throughout the firm should be educated on and trained on how to apply the climate strategy adopted by the firm to their businesses. This ensures that high-level strategies translate into concrete actions, and given that employees are increasingly worried about their own environmental impact, it will likely pay dividends in terms of employee engagement and commitment.

Companies must ensure alignment of their climate change strategy across all elements of the business. Decisions around a company's day-to-day operations can be an important additional signalling mechanism. In the financial sector other decisions, such as whom to lend to or invest in, can have more direct effects. Signalling matters. When leaders change their own behavior and the firm's environmental practices, their stakeholders will take note and respond accordingly. For example, an institution's travel policies, energy use,

³⁸ See *Banking Conduct and Culture: A Call for Sustained and Comprehensive Reform* (Group of Thirty 2015) and *Banking Conduct and Culture: A Permanent Mindset Change* (Group of Thirty 2018) for further information on ensuring cultural and behavior changes are implemented from the Board down through all levels of a firm.

or telecommuting policies may contribute to, or not, employees' desire to reduce their own GHG footprint.

Reporting annually on progress against companies' interim targets reinforces the message that transition plans are key for a company's future success. It affects the extent to which senior management and managers throughout a firm continue to adjust goals, risk tolerances, and internal business-unit level planning processes to achieve the identified company-wide goals. In this manner, a regular reporting process supports the transition and may indeed speed the rate of transition.

Firms must link compensation and performance management to their transition plans

Incentives matter to outcomes. Firms should link climate transition goals to executives' compensation, and embed it within the annual balanced scorecard performance management and review process. Shifting incentives to include climate goals will change how a firm's employees view the importance of these goals. Shifting the balance of incentives will hence impact behavior and conduct around the climate transition within the firm. Shifting incentives also sends wider signals on a firm's values and societal goals.

Leading firms have already begun to add sustainability and climate goals to their end-of-year assessments. This trend will likely accelerate as the urgency of the climate change transition increases. Altering what and who is applauded and rewarded illuminates how the firm wants to do business going forward. It will help make concrete the importance of the chosen transition plan.

Ultimately, credible transition plans will be rewarded by better access to capital

By disclosing credible transition plans, companies can demonstrate that they are prepared for the inevitable transition to a net-zero carbon economy.

Companies that demonstrate that they are prepared to seize the opportunities ahead will be rewarded via

cheaper and more plentiful access to capital: investors are beginning to understand that companies that are prepared for the transition to net zero are more likely to succeed in the long run. We present five case studies, below, that illustrate the actions selected companies are taking toward net-zero operations.

RECOMMENDATION 3

As companies recover from the devastating impact of Covid-19, they need to rebuild their business models in a way that is future-proof and consistent with the imperative of a net-zero carbon economy. Doing so can help turn an existential risk into one of opportunity for dynamic firms and sectors.

- a. To succeed in the transition, companies need clear transition plans.** At a minimum, companies will have to set out targets for their Scope 1, 2, and 3 emissions, and set credible milestones.
- b. Boards must review and approve companies' transition plans.** A designated board committee or the entire board should be tasked with overseeing and monitoring the company's climate transition plan.
- c. The CEO and senior management team are responsible for developing the transition plan and leading its implementation.**
- d. Firms should regularly publish and broadly communicate progress against their transition plan.**
- e. Firms should ensure that performance measurement and compensation systems explicitly take account of the organization's climate change transition objectives.**

CASE STUDY A

Firm A tasked its Board of Directors Risk Committee with leading oversight of climate change hazards and facilitating regular debates among all Board members. The discussions have changed the way the firm thinks about climate risk, models environmental considerations, and ultimately the way the firm operates.

The firm's board participates in biannual four-hour meetings on climate change, permitting an in-depth, detailed assessment of the firm's strategic stance and the risks and opportunities around the transition to a net-zero economy. Addressing the topic this extensively ensures all board members more fully understand the firm's strategy, exposure, and its plans going forward.

The firm aims to lead in the transition, and the board has embedded its climate change strategy throughout all levels of the company. The firm believes the climate change strategy must be an integral part of its overall business strategy. It takes the view that, to succeed, climate risk must be an ongoing business topic for the board and senior management.

The firm adheres to the disclosure recommendations by the TCFD (see Chapter 4), and the process of drawing up these disclosures has helped further develop the Board's internal thinking on climate-related risks and opportunities.

CASE STUDY B

This organization operates with a ten- to fifteen-year planning horizon, and the institution's leadership views climate change as the most urgent and critical global issue of our time.

The firm measures all new investments against the Sustainable Development Goals and Environmental, Social, and Corporate Governance (ESG) metrics. This screening process is viewed as an important part of its sustainable stewardship approach to investing.

The firm uses internal shadow carbon pricing to help drive behavioral change among its employees, and in its investment decision making.

The firm's offices will be carbon neutral by the end of 2020 and the firm aims to halve emissions in its full portfolio by 2030 and reach net zero by 2050.

To reach its goals, the firm purchases carbon offsets. It also aims to generate offsets as part of its new businesses and to invest increasingly in technologies and solutions for the common green future.

The firm adheres to TCFD recommendations.

CASE STUDY C

This firm's leadership has been supporting customer assessment and quantification of climate-related risks for decades. The firm's senior management has observed a change in attitudes among investors toward climate change in the last ten years, with an accelerated emphasis in the last five years.

Investors and firms are increasingly moving climate change out of the Corporate Social Responsibility space and into the risk management space. The CEO

now sees many more firms viewing climate change as a fundamental risk to their existing business—but also as an opportunity to unlock new markets.

What has been driving this shift? The firm's CEO believes the pressure is coming from investor and asset owner demands. This pressure is likely to rise further as investors have access to better and more consistent data and metrics.

CASE STUDY D

This organization first considered the severe weather and physical risks associated with climate change almost fifty years ago. Since then, it has developed expertise in scenario analysis and modelling of severe weather events. The analyses are science based, and the models allow for insurance products to adjust as the understanding of risks advance.

The firm analyzes both natural and man-made climate variability. It also studies hazards that are not yet fully understood or included in quantitative risk models. The firm's analysis aims to look beyond the horizon usually visible. This is central to its business model and strategy, which requires the firm's board and management to understand risks at an early stage and be ready to change business assumptions and risk models as needed.

In addition to analyzing the physical climate change impacts its businesses face, the firm has taken other steps to ensure it is responding to climate change risk. For example, it has disinvested from coal and will not provide insurance for coal projects.

The firm is adjusting its own operations to contribute to the transition to a net-zero economy. It has significantly cut CO₂ emissions per employee, purchases the vast majority of its electricity from renewable sources, and is purchasing sufficient carbon offsets to be net carbon neutral.

CASE STUDY E

The firm introduced a new company purpose that established ESG and climate change goals business wide, including executives and employees, to exemplify its commitment to being a leader in sustainable finance. The firm was responding to a growing concern about climate change from investors, clients, environmental nongovernmental organizations, government policy changes, and demands from its own staff to act.

The Chair and Board led the move. They viewed climate leadership as something that would help make the business financially sustainable in the long run. Small, incremental steps were viewed as insufficient to address the climate change challenge. The board agreed that the firm's climate change strategy had to be reflected in all dimensions of the bank's business.

At the level of senior management, the departmental head responsible for execution of the climate change strategy sits on the Executive Committee.

The firm's product mix is shifting in response to the change in strategy at the board and management level. This involves taking difficult decisions about what the firm will and will not do.

The firm is developing common tools and metrics with leaders in the industry to support portfolio analysis and to assess portfolio alignments with global climate goals.

The firm has commenced divestment from coal. This came with some short-term costs, but the firm believes it needed to be consistent throughout its business lines, even at the cost of losing some brown business.

The firm adheres to TCFD recommendations and audits its progress against its stated climate change goals.

CHAPTER 4. DISCLOSURE

Climate transition plans need to be accompanied by disclosure of high-quality, decision-useful information on the climate-related risks and opportunities that companies face. Disclosure of comparable metrics will allow the financial system to systematically allocate capital toward more sustainable and climate-resilient technologies and companies.

Over the past five years, authorities, financial institutions, and nonfinancial companies have worked together to significantly increase disclosure of companies' emerging transition strategies and the risks and opportunities they are facing. This has been achieved through widespread dissemination of the framework developed by the Task Force on Climate-related Financial Disclosures (TCFD). The TCFD was created by the Financial Stability Board at the behest of the G20 to address a significant market failure: that investors lacked the necessary information about climate-related risks and opportunities needed to make informed investment decisions. Although previous data and reporting frameworks existed before the TCFD, it has become the go-to framework globally because it is streamlined, developed by the private sector with a focus on financially material information, and applicable to companies across all sectors.

Since the TCFD recommendations were released in mid-2017, support for the recommendations has grown significantly. At the time of its launch, the TCFD had 100 supporters, representing a market cap of US\$3.3 trillion. As of June 2020, it had more than 1,300 supporters, with a market cap of US\$12 trillion.

The financial sector has been a driving force behind this push for enhanced disclosure of climate-related risks and opportunities. Investors with balance sheets of US\$150 trillion are now asking companies to implement the recommendations of the TCFD and disclose

comprehensive information on climate-related risks, or face potential shareholder resolutions, votes against management, or divestment.

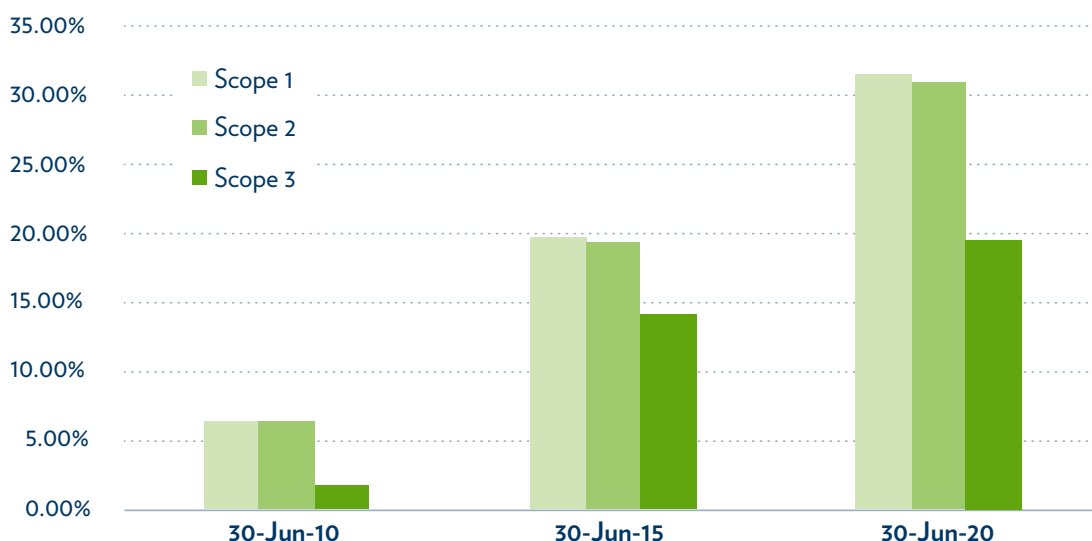
The number of firms disclosing climate risks is still rising. As of September 2020, there are 1,440 global companies who are disclosing climate-related financial risks and are supporters of the TCFD, representing a market cap of \$12.6 trillion. Four-fifths of the top 1,100 global companies are now disclosing climate-related financial risks in line with some of the TCFD recommendations, and over 30 percent of large and mid-caps across developed and emerging markets are disclosing Scope 1 and 2 emissions (see Exhibit 4.1). Large listed companies disclosed total annual Scope 1 emissions of over 6.5 GtCO₂eq—around 20 percent of all CO₂ emissions worldwide.

...and investors are increasingly differentiating among firms based on this information

The TCFD recommendations are still relatively new, but there is already evidence that investors are taking TCFD disclosures into account, and that there is a positive relationship between disclosure and financial performance. Three-quarters of major investors surveyed by the TCFD are already using available TCFD disclosures when investing.³⁹ In addition, preliminary research by the Bank of England and

³⁹ TCFD 2019.

EXHIBIT 4.1: The share of MSCI ACWI constituents disclosing GHG emissions has been increasingly steady



Source: MSCI ESG Research.

Note: MSCI ACWI = MSCI All Country World Index.

PricewaterhouseCoopers (PwC) found that some TCFD disclosures were positively correlated with the stock price of firms that have disclosed to date, with the disclosures about a firm's targets, Scope 1, 2, and 3 emissions, risk management, resilience, and impacts exhibiting the strongest correlations. These results are likely to reflect both the impact of disclosures themselves, and the fact that companies that have adopted the TCFD recommendations have generally more advanced transition plans.⁴⁰

But more remains to be done to encourage more widespread disclosure, and pressure from the financial sector can help encourage firms to sign up to the TCFD

Disclosures remain far from the scale the markets need to mainstream green finance and systematically channel investment to sustainable and resilient technologies and companies. More companies need to sign up to the TCFD recommendations to allow both asset managers and investors to get a full picture of how companies perform relative to their peers.

Asset managers and creditors should demand TCFD-consistent disclosure from all companies they invest in and lend to. Given the importance of climate-related information for the assessment of material economic risks and opportunities, doing so is in banks' and asset managers' own self-interest. Leading asset managers such as BlackRock and J.P. Morgan Asset Management are already asking firms that they invest in to disclose under the TCFD framework, citing the financial risks associated with climate change and noting that it is the top issue clients around the world raise with them. By continuing to push for disclosure and divesting from firms that provide no or incomplete information, the financial sector can further increase the supply of TCFD disclosures.

Stock exchanges can provide further momentum. The United Nations Sustainable Stock Exchanges initiative is launching a new workstream, spearheaded by the London Stock Exchange, to support exchanges in providing guidance to issuers on climate disclosure in line with the TCFD.⁴¹ Stock exchanges should work toward making annual climate disclosures that reflect this guidance a continued listing requirement.

⁴⁰ Carney 2019.

⁴¹ SSE 2020; <https://sseinitiative.org/all-news/sse-launches-climate-disclosure-work-with-mark-carney-and-lseg/>.

In turn, disclosing firms should ensure that climate risks and opportunities are not only disclosed, but also fully integrated into their transition plans. Companies should ensure that climate-related disclosures are drawn up in collaboration with their risk management and finance functions and are signed off at the board level—seeing this not only as a response to external pressure and a compliance exercise, but an opportunity to develop a competitive advantage and better prepare themselves for future challenges (see Chapter 3).

Central banks need to lead by example and publish fully TCFD-compliant disclosures

Central banks should lead by example by publishing their own TCFD-compliant disclosures. As noted by the Network of Central Banks and Supervisors for Greening the Financial System (NGFS), a coalition of central banks and supervisors that share best practices with respect to climate risks,⁴² this has several benefits. First, it increases central banks' accountability and transparency to stakeholders, which is important for their credibility as public institutions. Second, it shows that central banks are “practicing what they preach,” and demonstrates that central banks are taking climate-related impacts seriously. This is particularly important as central banks control large balance sheets and have considerable clout in setting expectations for the private sector. Third, central banks can help develop best practice in data collection, analysis, metrics, and tools such as scenario analysis that can be used by the private sector. The Banque de France and Bank of England have already disclosed in line with the TCFD, and other central banks should follow suit.

Voluntary disclosure alone will not be sufficient—public authorities should set clear expectations and a timeline for making disclosure mandatory

While there is increasing momentum behind voluntary disclosure, there are limits to what decentralized private sector action can achieve. The average company that has committed to follow the TCFD recommendations

currently only reports 3.6 of the 11 disclosure items recommended by the TCFD. Only 25 percent of companies reviewed by the TCFD disclosed information aligned with more than 5 of the 11 recommended disclosures, and only 4 percent disclosed information aligned with at least 10 of the recommended disclosures.

To support the progress being made on the voluntary and private sector side, authorities around the world need to set out a timetable for making TCFD-compliant disclosure mandatory. There are already encouraging signs, with the UK government setting an expectation that all listed companies and large asset owners will disclose in line with the TCFD recommendations, and similar momentum in the EU with the Non-Financial Reporting Directive. The New Zealand government is consulting on the adoption of mandatory disclosure on a comply-or-explain basis. Financial regulators are also encouraging the firms under their supervision to disclose in line with the TCFD recommendations, including the Bank of England, the European Central Bank, and the Central Bank of Mexico.

Given that the disclosure of climate-related risks and opportunities is only the first step in transitioning to net zero, there is no time to lose. All large, listed companies should report a full set of TCFD disclosures in the 2021/22 reporting round. To provide clear incentives for companies to start disclosing information as soon as possible, authorities should commit to making disclosure mandatory by 2023.

As disclosure becomes more widespread, the public and private sector should work together to improve the quality and decision-usefulness of disclosures, and ensure that best practice is harmonized across jurisdictions

For disclosures to be decision-useful for investors, they need to be clear, comparable, and consistent. Ernst & Young's 2019 review of TCFD disclosures found that the quality of disclosures was relatively poor, with an average quality score of 31 percent on a scale of zero to 100.⁴³ A specific concern was a lack of comparability. Seventy-two percent of users surveyed by the TCFD for their 2019 status report asked for disclosure

42 NGFS 2019.

43 Ernst & Young 2019.

of standard industry-specific climate-related metrics, as well as a general increase in the availability of disclosure.

Enhanced disclosure of common, quantitative metrics will help investors more systematically identify climate leaders and laggards. These metrics are likely to include information on the financial impact of a range of both transition and physical risk scenarios, as well as information on current Scope 1, 2, and 3 emissions and forward-looking targets. As companies come under increasing pressure to set and disclose net-zero targets, these targets should be ambitious and credible, and underlying assumptions (for example, about future availability of Carbon Capture and Storage technologies) should be clearly spelled out. Given the complexity in estimating Scope 3 emissions, companies should also set out the methodologies they use for assessing current Scope 3 emissions.

The private sector should help identify a consistent and harmonized set of metrics. The move toward higher standardization will need to be based on feedback from the buy side—the consumers of disclosure. As authorities set out a glidepath toward making disclosure mandatory, and investors increasingly differentiate among companies on the basis of their disclosures, best practices will emerge.

However, ultimately the process toward greater standardization will need to be driven by international standard-setters such as the International Financial Reporting Standards (IFRS) Foundation or the International Organization of Securities Commissions (IOSCO). The IFRS Foundation has already indicated its intention to publicly consult on the topic, citing developments in sustainability reporting and the increasing demand for global standards that offer comparable, decision-useful, and auditable information on climate change. A number of organizations including CDP, the Climate Disclosure Standards Board, the Sustainable Accounting Standards Board, and the Global Reporting Initiative have expressed their support for the IFRS Foundation's plans. In addition, IOSCO launched a Sustainability Taskforce in April 2020, with a primary focus on improving the quality of climate-related disclosure. This taskforce is engaging the IFRS Foundation and other standard-setters to take this work forward.

Harmonizing the wider set of Environmental, Social and Governance (ESG) metrics that firms disclose can provide further clarity on what firms should disclose. There is a risk that climate-related disclosures get lost in the sea of wider sustainable disclosure standards. Initiatives such as the World Economic Forum's work to develop a mutually agreed upon list of core metrics that cover environmental, social, and governance issues can help avoid fragmentation, and can help raise the profile of all sustainability disclosures, including those related to climate risks and opportunities.

RECOMMENDATION 4

Companies across the whole economy need to disclose their transition plans and explain how they will realign their businesses with the transition to a net-zero economy. In disclosing these plans, companies should build on existing standards by the Task Force on Climate-related Financial Disclosures (TCFD). To increase the quantity and quality of these disclosures:

- a. All asset managers and creditors should demand TCFD-consistent disclosure from the companies they invest in and lend to.**
- b. Stock exchanges need to develop common guidance on climate disclosure that is consistent with the TCFD recommendations.** Stock exchanges should work toward making annual climate disclosures that reflect this guidance a continued listing requirement.
- c. Central banks need to lead by example and publish fully TCFD-compliant disclosures.**
- d. Governments need to set out clear timelines for making TCFD-compliant disclosure mandatory by 2023.** This will accelerate disclosure by climate laggards, and further embed TCFD as a common international standard.
- e. Users of TCFD disclosures should help identify best practices for clear, comparable, and consistent disclosures.** International standard-setters should help turn these best practices into global standards.

CHAPTER 5. RISK MANAGEMENT

Corporate disclosures of climate-related risks are the first step in allowing financial institutions to identify the risks they face. To fully understand these risks, however, financial firms need to aggregate the information disclosed by individual companies, and they need to go beyond the static to the strategic. Fully understanding climate-related risks is the first step toward pricing them, and by factoring a forward-looking assessment of future climate policies into today's insurance premia, lending decisions, and asset prices, the financial system accelerates and amplifies the effects of public climate policies.

Just like pandemics, climate change is not a “black swan.” Rather, it is what is sometimes referred to as a “grey rhino”—a highly obvious, highly probable, but still neglected danger.⁴⁴ The challenge is not to spot the risk, but to understand its likely shape and implications.

Finance is starting to factor climate-related risks into today's decisions. Insurance companies are at the forefront of considering climate-related risks in their risk models. Many of the largest banks have decided to stop lending to high-carbon industries such as thermal coal, and financial markets are starting to price in the risks associated with transitioning to a net-zero economy. However, often the assessment of climate-related risk is not fully embedded in financial institutions' risk-management systems and does not consider all the channels in which climate change can pose financial risks.

Financial institutions need to build on progress so far to systematically assess the impact of various climate scenarios on all their exposures. They need to consider the two main channels through which

climate change, and society's response to it, poses risks to the financial sector:

- Physical risks arise from the increasing severity and frequency of climate- and weather-related events. These events severely damage property and other infrastructure, disrupt business supply chains, impact agricultural output, and can lead to loss of life and migration. This reduces asset values, results in lower profitability for companies, damages public finances, and increases underwriting losses for insurers. Indirect effects on the economic environment, such as lower output and productivity, exacerbate these direct impacts. The more severe and frequent heat waves in India, for example, could result in an impact on GDP by 2.5 percent to 4.5 percent by 2030.⁴⁵
- Transition risks arise from the process of adjusting to a net zero world, which requires significant structural changes to the economy.

⁴⁴ In fact, the relationship between two of these grey Rhinos – climate change and global disease—is well established and growing. Rising global temperatures extend the reach of vector-borne illnesses, and localized air pollution and environmental degradation increase health risks for local populations.

⁴⁵ McKinsey Global Institute 2020.

These changes will prompt a reassessment of a wide range of asset values, leading to stranded assets in high-carbon sectors and a fall in income and creditworthiness of some borrowers. In turn, this entails credit losses for lenders and market losses for investors. The level of transition risk depends on how orderly the transition is. A delayed or disorderly transition will require more abrupt adjustments, and possibly lead to a climate Minsky Moment.⁴⁶

Which of these risks crystalize will depend in large part on the policy response to climate change: a decisive shift in policy will limit the size of physical risks but may lead to some transition risks. Conversely, a business-as-usual scenario may reduce transition risks in the near term but will lead to much more severe physical risks in the future.

The magnitude of these risks can be substantial: up to 15 percent of the value of a representative portfolio could be at risk in the transition to a low-carbon economy.⁴⁷ Taking the fossil fuel sector as an example, 52 percent of gas and 35 percent of oil will have to be left in the ground to have a 50 percent probability of limiting global warming to 2°C. Estimates of the value of such stranded assets vary, ranging from US\$900 billion for existing oil reserves to over US\$10 trillion if we include existing buildings, industry, and energy infrastructure.⁴⁸ Financial institutions can manage their risks by limiting exposure to at-risk sectors, and diversifying their portfolios. For example, exposures to renewable energy and green infrastructure can provide a hedge against transition risks in the fossil fuel sector.

Climate risk management needs to dramatically improve...

Climate risks have distinct characteristics that mean current risk management frameworks and tools are inadequate to measure and manage them. There are a number of dimensions in which climate risks differ from other risks that financial institutions have to consider.

- Impact is far-reaching in breadth and magnitude: Climate change will affect all agents in the economy, across all sectors and geographies. The risks will probably be correlated and their impact nonlinear and irreversible.
- Risks are foreseeable: While the exact outcome is uncertain, the interrelated nature of physical and transition risks means there is certainty that some combination of physical and transition risks will crystallize.
- Magnitude of the future impact is dependent on actions today: Emissions released into the atmosphere today lead to climatic changes decades into the future. The risks are spread over time horizons far longer than the usual three- to five-year planning horizons of most firms.
- Unprecedented by definition: The levels of CO₂ in the atmosphere today are higher than at any point in the past 800,000 years. This means that past data cannot help us reliably measure and manage the physical impact of climate change. Transition risks are equally unprecedented: the global economy has never before gone through such a widespread structural change, brought about by citizens and governments across the world.

Specific operational challenges include the fact that financial institutions' risk models typically consider short time horizons and rely on past data to estimate the severity and frequency of potential tail risks.

...both through scenario analysis conducted by financial institutions themselves...

To effectively manage these risks, financial institutions need to take a strategic, forward-looking approach. Considering static information such as the carbon emissions of companies that financial institutions are exposed to is a natural starting point, but it may tell

46 A "Minsky Moment" is often used in economics as a synonym for a sudden reassessment of optimistic assumptions that previously supported elevated asset prices, triggering a financial crisis. <https://www.economist.com/schools-brief/2016/07/30/minskys-moment>.

47 At the portfolio level, transition opportunities may offset about two-thirds of losses (UNEP Finance Initiative 2019).

48 FT 2020; IRENA 2017.

you little about the risks that a company will face going forward. Financial institutions need to also consider companies' transition plans, as well as potential future changes in the climatic and regulatory environment. Given the unprecedented nature of climate risk, there is no history to draw from.

Scenario analysis is particularly useful to consider the unprecedented risks that financial institutions may

be exposed to. It allows financial institutions to consider a range of different scenarios for how the world might adapt to the threat of climate change, to assess the resilience of their business models to these scenarios, and to make plans for how they would adapt their business models in light of this. The NGFS has published a set of Reference Scenarios for this purpose (see Box 5.1). This open-source resource allows financial

BOX 5.1: NGFS REFERENCE SCENARIOS

The Network of Central Banks and Supervisors for Greening the Financial System (NGFS) was established in January 2018 to help strengthen the global response required to meet the goals of the Paris agreement and to enhance the role of the financial system to manage risks and to mobilize capital for green and low-carbon investments in the broader context of environmentally sustainable development.

To facilitate central banks' and banking supervisors' work on climate-related financial stability risks, the NGFS is developing a scenario analysis framework for assessing those risks. It has published Reference Scenarios capturing different settings along two

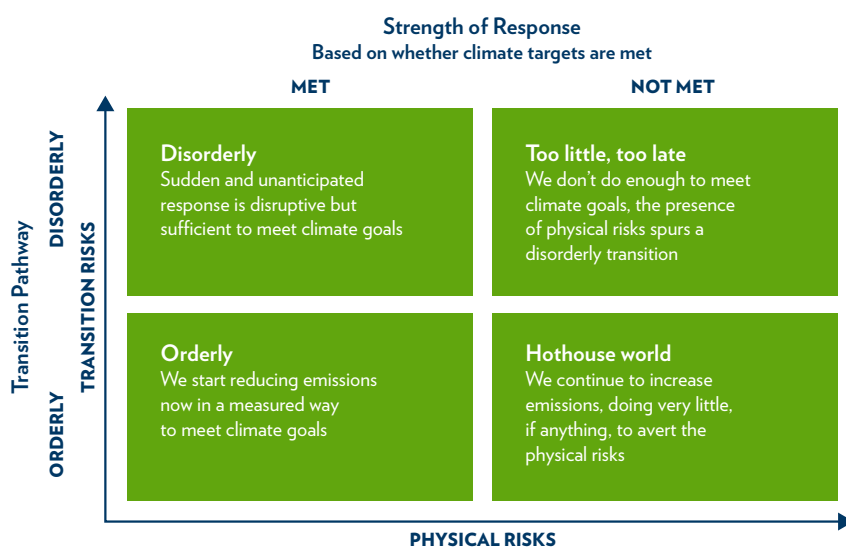
important dimensions: the strength of the greenhouse gas mitigating policy response, and how smoothly and foreseeably those actions are taken. This yields the scenario matrix in Figure 5.1.1.

The first phase of the work yielded a set of harmonized transition pathways, including indicative economic impacts for each of these scenarios.

In the next phase of its work, the NGFS plans to continue work with a consortium of academic partners to refine and expand the scope of these scenarios. Areas of focus will include (a) expanding the scenario modelling to explore further dimensions of risks, (b) improving sectoral granularity and regional coverage, (c) calculating probabilistic losses from natural catastrophes, and (d) expanding the set of macro-economic outputs.

While the work is focused on supporting central banks and banking supervisors in designing severe but plausible climate stress tests, these scenarios will be available to all interested companies and can also support firms' own scenario analysis.

FIGURE 5.1.1: NGFS scenario analysis framework



institutions to test themselves against an orderly and disorderly transition to net zero, as well as a hothouse world where climate goals are not met. Using these consistent scenarios will help investors compare the results across firms. These scenarios should be used as a baseline, with additional scenario analysis conducted where financial institutions face particular vulnerabilities.

In conducting such scenario analysis, financial institutions rely on high-quality, forward-looking disclosures by the real economy firms that they lend to, invest in, or insure. Getting all real-economy firms to disclose their current Scope 1, 2, and 3 emissions as well as their forward-looking targets will help financial institutions in their scenario analysis (see Chapter 4). The long time horizons and the fact that many real economy firms are actively transitioning toward more sustainable business models mean that targets play a particularly important role. To have better visibility on the sensitivity around these targets, financial firms should also encourage their counterparties to conduct their own scenario analysis and disclose the results. Currently, three out of five companies that already use scenario analysis to assess the resilience of their strategies and view climate risks as material do not disclose information on the resilience of their strategies.

Where counterparties do not disclose relevant information, or their transition plans are not credible, financial institutions should engage with them and seek improvements. This will not only improve financial institutions' understanding of the risks they face and allow them to react accordingly, but will also lead to better climate risk management by their counterparties, helping to accelerate the transition across the real economy. Encouraging the use of the NGFS Reference Scenarios among counterparties will further promote consistency, and allow firms to make judgements about the relative preparedness of their counterparties.

... and through climate stress tests conducted by central banks and supervisors

Financial institution's own scenario analysis is an important step toward measuring and managing the specific climate-related risks that they face, but it is not sufficient. It will not allow us to assess the aggregate impact of climate risks on the financial system, taking into consideration feedback loops and compounding

impacts. In addition, firms' own analysis will not be fully comparable across institutions.

Hence, central banks and supervisors need to assess the resilience of the financial system as a whole to climate risks by incorporating them into their stress-testing frameworks. In a climate stress test, all relevant financial firms will have to report in a consistent manner how they expect to adjust their business models under a range of common scenarios. Aggregating these responses will provide an assessment of the systemic risks from climate change.

Publishing the results of the climate stress test will help investors compare which financial firms, and by extension real economy companies, are best positioned for the transition to net zero and will benefit from the opportunities that will bring. It will also reveal those that have not yet developed strategies that are consistent with that transition, and that are likely to be left behind. Given the unique characteristics of climate risks, central banks and supervisors will need to extend and adapt their existing stress-testing frameworks. To adequately capture the full extent of the risk, climate stress tests must include the following features:

- **MULTIPLE SCENARIOS** – to assess the risks of orderly or disorderly policy action to reach the Paris Agreement, as well as the risks if the Paris Agreement is not met and more severe physical risks crystallize as a result.
- **BROADER PARTICIPATION** – including both banks and insurers, as actions of one affect the outcomes of the other.
- **EXTENDED MODELLING HORIZONS** – because climate change, and the policies to mitigate it, will occur over much longer time frames, and decisions taken today create risks in decades to come.
- **INTEGRATED CLIMATE AND MACROFINANCIAL VARIABLES** – including pathways for temperature, emissions, and climate policies to capture the underlying physical and transition risks in each scenario.
- **COUNTERPARTY-LEVEL MODELLING** – requiring firms to assess the vulnerability of their

individual counterparties' business models to identify those that are preparing for the transition.

Central banks and supervisors across the globe should seek to harmonize their climate stress tests. Climate-related risks are global in nature. Hence, all central banks and supervisors across the globe should commit to stress testing their financial systems, and while the risks from climate change are different in every jurisdiction, central banks and supervisors should seek to establish common practices in conducting these tests, including by using the NGFS Reference Scenarios as a starting point. This helps ensure comparability across countries. It also allows financial institutions that operate across multiple jurisdictions to focus on the substantive differences among the countries they operate in, rather than on methodological differences.

International organizations and standard-setters should support the assessment of climate-related risks by incorporating climate risk management into their work programs and frameworks. A number of international organizations and standard-setters have already commenced important work programs on climate risks:

- The Financial Stability Board is undertaking a review of the approaches to measure climate-related financial stability risks at the macroprudential level, including a mapping of risk transmission channels.
- The International Monetary Fund (IMF) is increasingly embedding climate-related aspects into their surveillance, including assessing the adequacy of climate disclosure and risk management as part of Financial Sector Assessment Programs (FSAPs) and Article IV consultations.
- The Basel Committee on Banking Supervision (BCBS) has set up a working group on climate-related financial risks, with the aim of tackling issues pertaining to risk measurement and to serve as a platform for different supervisory approaches to be shared.
- The International Association of Insurance Supervisors (IAIS) and the Sustainable Insurance

Forum are considering the risks to the insurance sector and monitoring implementation of risk management recommendations.

By using the NGFS Reference Scenarios to incorporate scenario analysis and climate risk management into their frameworks, these organizations can also promote harmonization.

Additional work is needed to close data gaps and improve modelling capabilities

There are still challenges in sourcing complete climate data sets. The data needed to effectively measure and manage climate risks are unlike typical financial risk data. Climate risk data must be:

- Forward-looking
- Highly granular, to the counterparty and asset level
- Include data not typically used for financial risk analysis, such as temperature and emissions data.

While climate disclosures, as outlined in Chapter 4, can go some way in addressing this, these requirements mean that some gaps are likely to persist. This can inhibit firms' ability to conduct scenario analysis and identify vulnerabilities.

Financial institutions, real economy firms, and the public sector need to work together to address these gaps. In particular, the insurance sector has long-standing expertise in assessing the physical impacts of climate change.

Together, these steps will help accelerate and amplify the transition to net zero

Understanding climate-related risks is the first step toward pricing them. Financial institutions that understand the full range of climate-related risks can consider them throughout their business, whether they are deciding how to price a new loan, insurance contract, or investment.

By pricing transition risks, financial institutions ensure that the allocation of capital across the system

reflects these risks. Companies that manage transition risks well will enjoy access to cheaper and more plentiful capital, while laggards will see their access to finance dry up. This can provide strong incentives for companies to take the transition to net zero seriously, and will help accelerate and amplify the effectiveness of public policies.

RECOMMENDATION 5

To manage risks to their business, financial institutions will need to assess and aggregate the impact of climate-related risks on their counterparties. They also need to move beyond the static to the strategic and consider how they may be able to react to various climate scenarios. To support this by the end of 2022:

- a. Financial institutions should run their own scenario analysis.** This will help explore idiosyncratic climate-related risks that they may be exposed to. Using the scenarios designed by the Network of Central Banks and Supervisors for Greening the

Financial System (NGFS) as a starting point will help maintain consistency across firms.

- b. Financial institutions should also encourage the companies that they lend to, insure, or invest in to conduct similar scenario analysis, and they will need to work with the public sector to identify and address any data gaps.**
- c. Central banks and supervisors need to start running regular climate stress tests that are comparable across firms and allow authorities to assess system-wide feedback loops.** These tests should consider risks to current balance sheets, as well as the way in which financial institutions may be able to adjust their business model in response to various climate-related scenarios. Central banks and supervisors should seek to establish common practices in conducting these tests, including by using the NGFS Reference Scenarios as a starting point.

CHAPTER 6.

RETURNS

The transition to a net-zero carbon economy brings not just risks—it also presents an impactful and long-lasting investment opportunity. Financial institutions and investors are increasingly identifying and seizing these opportunities. But more is needed to mainstream green finance, including commonly accepted metrics that capture the “fifty shades of green” and will allow the financial system to allocate unprecedented amounts of capital to sustainable technologies and companies. This will help accelerate and amplify the transition to net zero.

Banks are well placed to help their customers seize the benefits of realigning their businesses with the net-zero economy. In many cases, transitioning to a low-carbon business model requires substantial investments. Leading financial institutions are already supporting their clients in transition from high carbon to green, and from green to greener—both by providing capital and advice.

Identifying companies that are serious about addressing climate-related risks and seizing the opportunities that the transition brings can require judgement. Credible, public transition plans can help financial institutions judge who is addressing challenges proactively, and who is lagging behind. This helps accelerate a whole economy transition and provides leading banks with new and profitable investment and commercial opportunities.

Better understanding climate-related risks can also open new insurance markets. (Re)insurance companies have a wealth of experience in modelling climate-related risks. By sharing risk models, data, and new technologies to improve the understanding and quantification of natural disaster risks in developing countries, they can develop new insurance products and address the US\$160 billion insurance protection gap that currently exists in developing

countries. This will help grow the market for climate insurance, bringing significant benefits for insurers and policyholders alike.

Similarly, investors can generate significant risk-adjusted returns by assessing climate-related factors. As climate regulations become more widespread and climate events multiply, the integration of climate-related risks and opportunities in investment considerations has significantly gained ground. This understanding of climate-related factors as a driver of financial returns is only reinforced by the inclusion of the financial sector in the TCFD framework, along with the highest emitting industrial sectors.

Sustainable investing is already generating handsome returns...

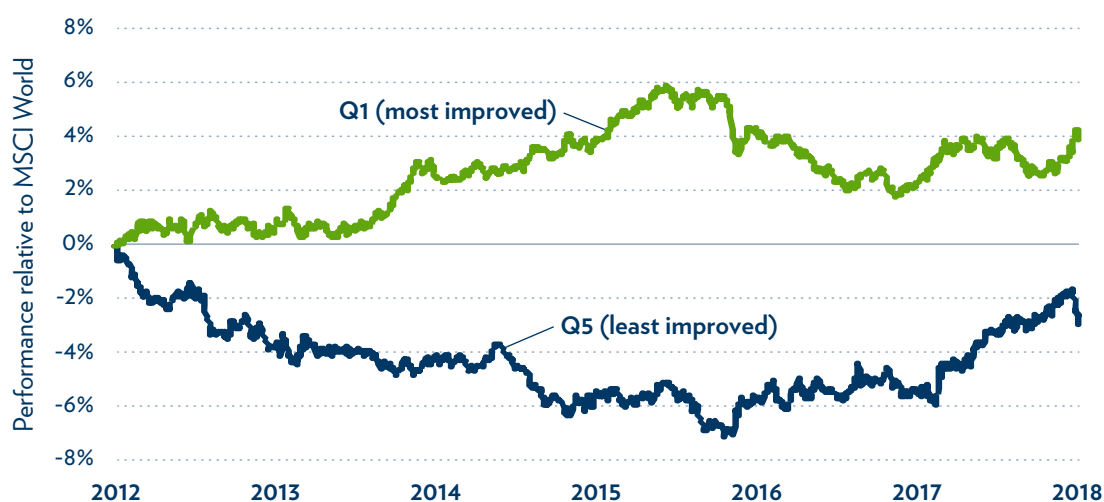
Identifying transition opportunities in particular can help investors generate excess returns. In contrast to the physical consequences of climate change, which lead to the destruction of physical assets, the transition produces winners and losers: an oil company's transition risk is a solar company's opportunity. By identifying those companies that stand to benefit from the transition to net zero, investors are likely to earn excess returns.

There is already evidence that by investing in “greener” companies, investors can reap significant financial rewards. Reductions in companies’ carbon footprint are a good proxy for future transition opportunities. A number of studies have established that these opportunities are starting to be reflected in companies’ market values.⁴⁹ Garvey, Iyer, and Nash (2018) show that by reducing their carbon emissions and increasing operational efficiencies, companies can also increase their current profitability. As a result of these effects, a portfolio designed to minimize transition risks (associated with a 50 percent reduction in emissions intensity and 30 percent increase in exposure to clean technology relative to the standard benchmark) would have experienced a significantly enhanced risk-adjusted return during 2012–2018 (see Exhibit 6.1).

As markets continue to price in transition risk and opportunities, the spread in performance between climate leaders and laggards can be expected to rise.

Investors can further enhance their risk-adjusted returns by identifying and pricing physical risks. Expected loss in value of physical property, plant, and equipment due to extreme weather can pose significant risks. For example, research by BlackRock shows that the macroeconomic impact of climate-related events on the top 15 municipal areas in the United States can reduce annual GDP by up to 45 percent of the value of outstanding municipal debt (Exhibit 6.2). Despite the clear and present danger, markets have been inefficient in pricing these risks. For example, Bertolotti et al. (2019) demonstrate that the impact of extreme weather events on companies’ valuations is only temporary and quickly forgotten, and while credit rating agencies are starting to account for physical risks, risks still do not appear to be fully priced in.⁵⁰ This means that investors can increase their risk-adjusted returns by assessing these downside risks and adjusting their portfolios accordingly.

EXHIBIT 6.1: Performance of a portfolio consisting of the top compared to bottom 20% of companies based on changes in carbon intensities



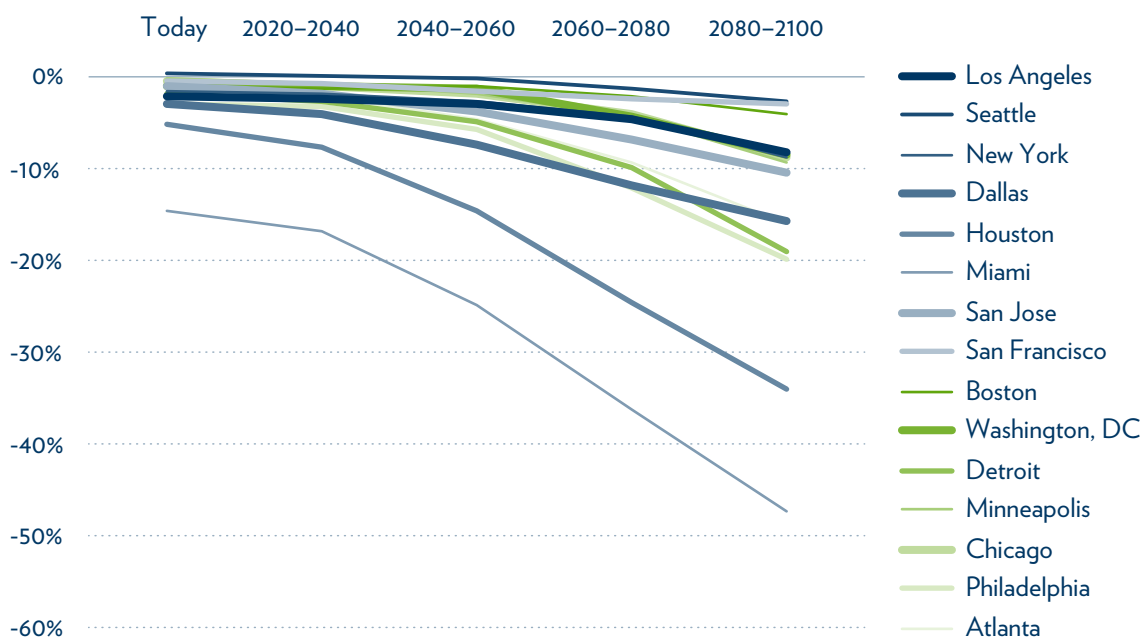
Sources: BlackRock Investment Institute, Asset4, and MSCI, April 2018. Data are from March 2012 through March 2018.

Note: The analysis calculates the carbon intensity of all Morgan Stanley Capital International (MSCI) World companies by dividing their annual carbon emissions by annual sales. Companies are ranked and bucketed in five quintiles based on their year-on-year changes in carbon intensity.

⁴⁹ See, for example, Nishitani and Kokubu (2012) and Liesen et al. (2017).

⁵⁰ Mathiesen 2018.

EXHIBIT 6.2: Estimated climate-related fall in annual GDP as a percentage of outstanding debt for top 15 US statistical areas, 2018–2100



Sources: BlackRock Investment Institute, with data from Rhodium Group, March 2019.

Note: The cities shown represent the top 15 US metropolitan statistical areas by GDP. The chart shows projected annualized GDP losses (upper bound of the 66 percent or “likely” range) due to cumulative changes in the climate since 1980 under a “no climate action” scenario. Today is represented by a 2010–2030 estimate. All losses are divided by current outstanding debt to give a sense of the risks that debtholders may be exposed to.

...but more work is needed to mainstream sustainable finance

While there is increasing evidence that sustainable strategies can generate superior risk-adjusted returns, more work is needed to deepen the market for sustainable finance. Thanks to the improvement of corporate disclosure and investments in alternative data sets and analytical tools, investors are in a much better position to incorporate climate risks and opportunities than they were just a few years ago. This progress is, however, still hampered by the lack of systematic and comparable data and metrics.

Commonly accepted metrics that capture all “fifty shades of green” will help mainstream sustainable finance, and embed climate-related considerations in every investment decision. The number of deep green

investment opportunities is limited. For example, the size of the market for green bonds is almost US\$1 trillion, and by end-2018, early-stage capital funding for “clean-tech” ventures had reached US\$11.5 billion. While impressive, this is a small fraction of the over US\$100 trillion of sustainable investments needed between now and 2050. To drive real change and accommodate the growing demand for green investment opportunities, the financial system needs to support all companies that can help produce goods and services in more carbon-efficient ways. Developing metrics that differentiate among these “fifty shades of green” will help identify a wide range of ways in which we can accelerate the path to net zero, and will help turn incremental progress into transformative progress.⁵¹

⁵¹ Such continuous metrics are complementary to more binary classifications that distinguish between green and other assets, such as the EU’s Green Taxonomy.

This includes developing commonly accepted metrics that can be used to assess whether portfolios are aligned with the transition to net zero

Such metrics should measure how companies and portfolios are performing relative to their industry peers and what is necessary to limit warming to less than 2°C, and they need to capture both current and forward-looking measures of climate impact. Corporate disclosures are the building block for these metrics, but the financial system needs to put this information into context. Some companies have credible plans in place to significantly reduce their environmental footprint over the coming years. These companies should be supported in making the necessary investments, including by providing them with appropriately priced capital. At the same time, aggressive emission targets are easier to meet if companies have not made any progress so far and start from a high emission basis. Useful metrics should account for this and include both point-in-time and forward-looking considerations, and combine them into an overall picture of how companies are performing relative to their peers.

Focusing on how companies compare to their industry peers is not only helpful in accelerating the transition to net zero, but also allows investors to better assess transition risks and opportunities. A company that significantly lags behind its peers in reducing its emissions is more likely to lose market share as carbon prices increase than a company that is just as high carbon as its competitors. This is because the first type of company will find it harder to pass the cost of higher carbon prices on to its customers than the second.

New metrics that meet many of these criteria have started to emerge. However, they lack comparability, and there is no common view on which approaches are more decision-useful, which metrics are more robust, and how to bring them together in a coherent framework useful for investors. Measures of the “implied temperature rise” associated with a company or a portfolio are one promising candidate for such a coherent framework.

Expressing the “fifty shades of green” in an intuitive way will also help unlock additional capital from

values-based investors. Investing in companies that contribute to the transition to net zero already makes financial sense and helps deliver superior returns. There is also a significant desire by end-investors to go beyond what is financially optimal and to make investment decisions that align with personal values and policy preferences. In a recent survey, 87 percent of millennial respondents indicated the importance of ESG factors in their personal investment decisions.⁵² Such values-based decisions will further accelerate the transition to net zero. To make informed decisions, however, investors need intuitive metrics. Harmonized measures of the temperature rise that is implied by a portfolio (or similar metrics) are likely to meet the criteria set out above, while also being easy to understand: portfolios with a warming potential of less than 2°C are aligned with the goals of the Paris Agreement, while others are not.

While new metrics will be important to deepen markets for sustainable finance, this should not be a reason for investors to wait

Common metrics will help develop a shared understanding of who the climate leaders and laggards are. They help investors actively seize the opportunities associated with the transition to net zero, and they can be the foundation on which investors can build to assess the robustness and credibility of individual companies’ transition plans.

While additional metrics will be useful to deepen the markets for sustainable finance, the ongoing work is not a reason for investors to drag their feet. The time for investors to consider climate-related opportunities is now. By moving early, investors can seize the opportunities that the transition brings before they are fully priced in. Early investors will benefit the most as asset prices continue to adjust to the new reality.

By providing capital for sustainable technologies and companies, investors will systematically support the transition toward a net-zero economy. In doing so, they will accelerate and amplify the effectiveness of public policy, and will help avert the catastrophic impacts of unmitigated climate change.

⁵² *US Trust Insights on Wealth and Worth* (2018). In a survey of 5,300 investors across ten markets, UBS (2018) found that 58 percent of investors expect sustainable investing to be the normal in ten years’ time.

RECOMMENDATION 6

The financial system can play a key role in unlocking the commercial opportunities that the transition to net zero brings. This will accelerate and amplify the effects of policy. To do so:

- a. Financial institutions should support their clients in transitioning to net zero, by offering both capital and advice on how to realign their businesses with the net-zero economy.
- b. (Re)insurance companies need to share risk models, data, and new technologies to improve the understanding and quantification of natural disaster risks in developing countries and open new insurance markets.
- c. Banks, insurers, and asset managers should work with the TCFD to develop forward-looking metrics capturing the full “fifty shades of green” across portfolios and individual companies.

CONCLUSION

Mainstreaming and amplifying the transition to a net-zero economy is the greatest collective endeavor we face in the decades ahead. The process is already underway, but we all must step up, speed up, and engage in this necessary transformation. There is no time to waste.

Securing net zero will require governments to delineate comprehensive strategies that put their countries on a path to sustainability, together with business targets and deliverables in green finance that are increasingly ambitious. Enhanced policy clarity on related goals will permit others in the economy to more rapidly adjust and prosper through the transition.

To achieve net zero, all countries need to price carbon appropriately to internalize the cost of polluting sectors, alter incentives, and harness markets to spur the rate of transition. Ensuring national carbon markets work efficiently is a challenge, but we believe existing institutions together with newly formed ones can meet the task. Carbon Councils should be designed that embody the expertise, credibility, and predictability needed to supervise and oversee markets to ensure the delivery of real, positive planetary outcomes and dramatically lowered GHG emissions.

Companies' individual net zero strategies will play a key part in the rate of transition and the process of policy amplification and implementation. Changing business strategies is essential. Aligning and

embedding the goals throughout businesses will alter outcomes. Communicating the goals clearly, internally and externally, will speed the shift. Those that grasp this challenge will be rewarded. Those that lag will be penalized by the markets and investors.

Reporting and disclosure will play a key part in achieving net zero by 2050, in shifting our economy swiftly to fifty shades of green, and in changing firms practices from high-carbon to green to greenest. Once all firms are reporting, disclosure and auditing processes will be harnessed to support the net-zero goals.

Investors, who increasingly recognize and demand green assets, will also respond accordingly. The returns and performance of firms will reflect their commitment to and alignment with effective net-zero business strategies, with innovative investment in new opportunities and markets. Returns will speed this process of going green, and spur a new stage in our industrial transformation, leading to a carbon-neutral future.

We hope the recommendations we have laid out here help illuminate the interconnected pathways that together can help support the urgent, essential, and unavoidable transition to net zero.

We must push forward; we have no alternative. It is incumbent upon us all to act as policymakers, company leaders, investors, and individuals. We must all play our part in this crucial transition to secure a stable and temperate future for the planet and humanity.

ANNEX: MONETARY POLICY AS A PRECEDENT FOR THE IMPORTANCE OF CREDIBILITY

The challenge that governments face when trying to promise low inflation was formally described by Kydland and Prescott (1977). The model in Kydland and Prescott (1977) considers the strategic interplay between employers and employees who negotiate wages on the one side, and policymakers on the other side.

Employers and employees negotiate wages for the next year t in a way that incorporates their expected level of inflation π_t^e .

If actual inflation π_t ends up being higher than anticipated, labor will become cheaper relative to the general price level, demand for labor will increase, and unemployment will fall. This relationship is described by the Phillips curve $u_t = \lambda(\pi_t^e - \pi_t) + u^*$ where u_t is the level of unemployment, and u^* is the “natural” rate of unemployment that we would expect to see when an economy operates at its full potential. For any given expected level of inflation, there is hence a downward-sloping relationship between unemployment and inflation. The black line in Figure A.1 illustrates this relationship for the case where the expected level of inflation is zero.

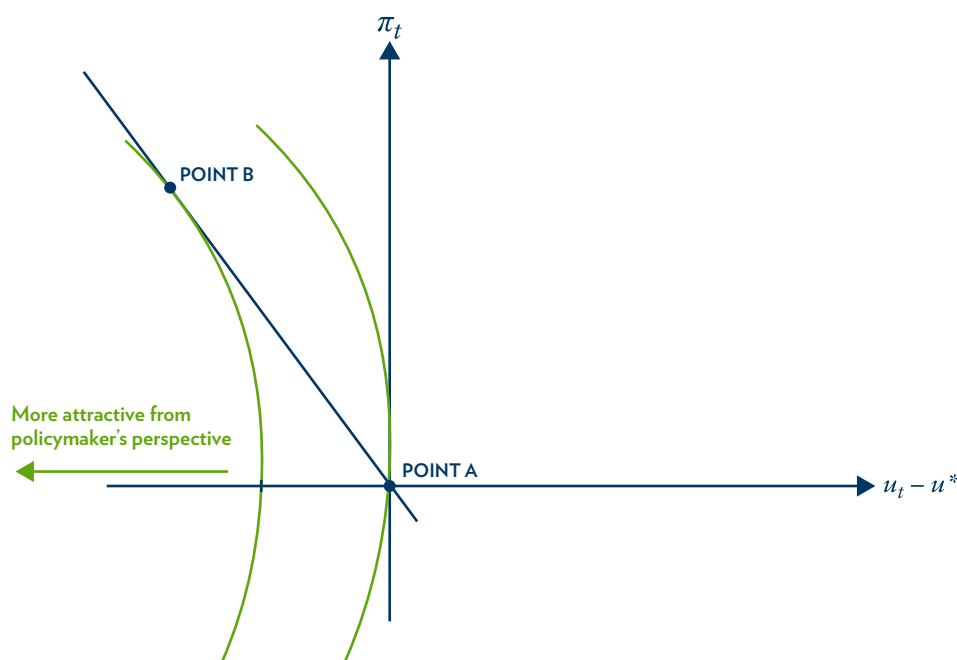
Policymakers aim to balance the harm caused by high unemployment against the harm caused by inflation. We assume that they want to achieve high levels of employment and inflation that is as close to zero as possible, but they are willing to trade off between these objectives. There are various combinations of inflation and unemployment that policymakers consider equally (un)attractive, depicted by the green “indifference curves” in Figure A.1.

A policymaker who can credibly commit to running tight monetary policy has a strong incentive to do so. By announcing that she will target zero inflation, she can anchor inflation expectations at $\pi_t^e = 0$ and is able to achieve the attractive combination of no slack in the labor market and zero inflation (Point A in Figure A.1).

However, once inflation expectations have been set and wages have been negotiated, the policymaker will be tempted to reduce unemployment below its natural level by running slightly more accommodative policy. Doing so allows the policymaker to end up on a more attractive “indifference curve” (Point B).

Unless employers and employees trust policymakers to resist any short-term temptations, they will anticipate this and factor a positive level of expected inflation into future wages.

FIGURE A.1: Governments are unable to credibly promise zero inflation

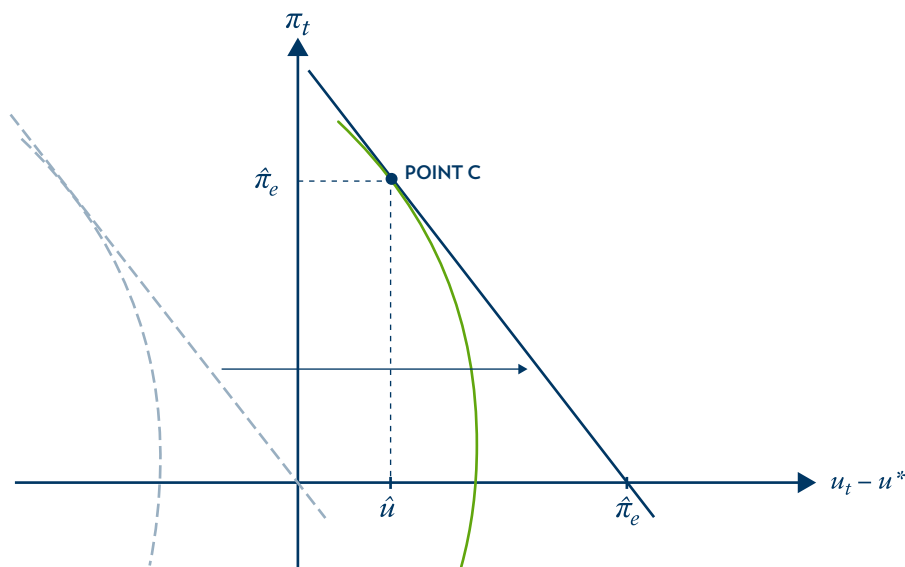


Given the higher level of inflation expectations, the policymaker is faced with a less attractive Phillips curve (Figure A.2). The same level of inflation now delivers a higher level of unemployment. As a consequence, we end up in a worse spot (Point C), which is characterized by higher inflation and more unemployment than if the policymaker had been able to commit to keeping inflation at zero (Point A).

This credibility problem is the reason why many governments have chosen to hand control over

monetary policy instruments to independent central banks that are less exposed to short-term political pressures. Rogoff (1985) argued that central banks that are headed by inflation-averse officials are particularly likely to resist the temptation to loosen monetary policy, and Walsh (1993) and Persson and Tabellini (1999) demonstrated that the credibility of the central bank can be further enhanced by linking central bankers' pay to low and stable inflation.

FIGURE A.2: As a result of this credibility problem, countries end up in a worse spot, with higher inflation and unemployment



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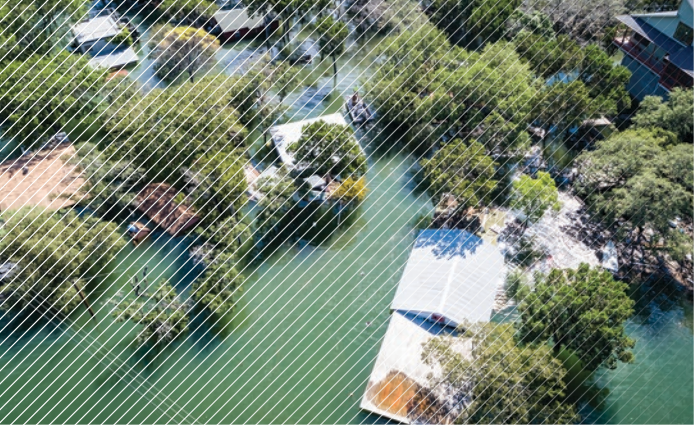
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