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Green Finance and Climate Policy

EDITORS
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SUMMARIES AND PRESENTATIONS
总结与报告

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GREEN FINANCE AND CLIMATE POLICY

INTRODUCTION

AI Ming and Steven Barnett[1]

Climate change poses an existential threat. Addressing it, therefore, is one of the biggest and most important challenges confronting the global economy. With this in mind, we decided to host the "PBC-IMF High-Level Seminar on Green Finance and Climate Policy." The goal of the seminar was to advance the discussion on tackling climate change. To do this, we brought together a mix of policymakers, academics, regulators, and financial sector executives to share ideas and experience.

The seminar opened with insightful and inspiring remarks by PBC Governor Yi Gang and the IMF Managing Director Kristalina Georgieva. This was followed by three sessions. Session I addressed the role of central banks and financial regulators in green finance. Session II focused on the role of financial institutions and investors in green finance. And, Session III focused on a securing a green global recovery, by discussing the policy mix for climate change mitigation

[1] Conference organizers, AI Ming is Deputy Director General, International Department, People's Bank of China, and Steven Barnett, is Senior Resident Representative to China, International Monetary Fund.

We were pleased to have a such a distinguished group of speakers and participants. Their involvement led to a constructive and lively seminar. Importantly, in our view, it also succeeded in our goal of advancing the discussion on tackling climate change. And, with that in mind, we thought it was valuable to share with a wider audience the proceedings of the seminar, which we have done in this eBook.

We hope you find the speeches, presentations, and summary of the remarks as informative and enlightening as we did.

Opening Remarks

Yi Gang[1]

Madame Managing Director, Ladies and Gentleman,

Good morning and good evening. It gives me great pleasure to co-host this high-level seminar on "Green Finance and Climate Policy" with the IMF. I wish to begin by extending a warm welcome to all the participants on behalf of the PBC.

The international community is forming a broad consensus on tackling climate change. China has announced the goal of peaking carbon emissions by 2030 and achieving carbon neutrality by 2060, also known as the 30/60 goal. This requires a comprehensive economic transition, and green finance can be an accelerator in this process.

The PBC attaches great importance to green finance. In 2016, we led the effort in drafting the Guidance on Building a Green Financial System and developed a specific timetable and a roadmap for this purpose. By making sure that all the policies are implemented, we have put in place an initial policy framework for green finance. As a result, China's green finance market has since enjoyed fast development. By the end of 2020, green loans and green bonds in China totalled 1.8 trillion US dollars and 125 billion US dollars respectively, ranking as the world's largest and second largest. More than 40 carbon neutral bonds have been issued, with a total volume of over 10 billion US dollars.

The 30/60 goal has set a higher bar for the financial sector. To meet this goal, we need to overcome a host of challenges.

[1] YI Gang is the Governor of the People's Bank of China.

First, on the society front, public awareness of emission reduction has to be raised.

Second, on the market front, the carbon market has to play a greater role in price discovery. Only when carbon emission is priced in, can we achieve effective resources allocation. China's carbon market is still in its initial stage, and its financial nature needs to be further clarified.

Third, on the institutional front, climate information disclosure needs to be improved. The disclosure should be expanded to cover listed companies, financial institutions and other market players, and move from a voluntary to a compulsory basis.

Fourth, on the risk management front, there needs to be greater attention to the fossil fuel-related transition risks. Fossil fuels, mainly coal, account for 80% of China's energy consumption. By 2060, this ratio is expected to fall below 20%. China's financial institutions have invested heavily in carbon-intensive assets, and the risk of asset price adjustment caused by the green transition must be closely monitored.

Ladies and Gentlemen, friends,

Looking forward, I believe we have to make progress in the following areas.

First, we must mobilize public and private funds to support the green economy in line with market principles. It is estimated that by 2030, China will need to invest 2.2 trillion yuan per year to reduce carbon emissions, and this amount will further grow to 3.9 trillion yuan from 2030 to 2060. Government funding alone is far from enough. We need to encourage more private capital participation. To do this, we need to lay the groundwork on two fronts.

One is about information disclosure. The PBC plans to set up a mandatory disclosure system with uniform standards, and promote greater information sharing between financial institutions and companies. We will also strengthen international coordination under the G20 framework. The other is about green finance taxonomy. The PBC is about to finish revising the green bond catalogue by removing fossil fuel projects. We are also working with international counterparts to harmonize taxonomies.

Central banks have a role to play in providing policy incentives. The PBC plans to launch a support toolkit to provide low-cost funds for carbon emission reduction. The PBC will also support green finance through a host of measures ranging from commercial credit ratings, deposit insurance rates to collaterals for open market operations.

Second, we must evaluate the potential impact of climate change on financial stability. It will take 70 years for the EU, 45 years for the US, and about 30 years for China to move from carbon peak to net zero. The time is shorter and the curve is much steeper for China. It means our financial institutions are faced with grave risks and should begin their green transition right away.

The PBC is looking at the possibility of including climate factors in financial stress tests, and gradually incorporating climate risks into the macro-prudential policy framework. The PBC is reviewing green loan and green bond performance of financial institutions on a quarterly basis. The financial institutions are encouraged to evaluate and manage their environmental and climate risks.

Third, we must let the carbon market play its role of price discovery. China's national emissions trading system will be up and running by the end of this June. Regulators are soliciting opinions on its operational rules. These rules suggest that there will be fewer emission quotas that are freely allocated to polluters previously, and financial regulators should be involved in the supervision of the carbon market. The carbon market should be a financial market in nature and allow carbon financial derivatives trading. This will make sure that all risks are fully priced in so that the carbon price plays a better role of serving either as an incentive or a constraint.

International coordination matters a lot if we are to succeed in the above undertakings. The Fund plays a unique role in this regard. The Fund plans to integrate climate change into its surveillance and include climate risk scenario analysis in its financial sector assessment. It is also leading the efforts on closing the data gaps under the Network for Greening the Financial System (NGFS). We support all these efforts, and look forward to more research findings and policy advice from the Fund.

We stand ready to strengthen capacity building cooperation with the Fund. The PBC has provided experience sharing to developing countries in drafting green taxonomy. The Fund also places great value on capacity building. We could offer joint climate risk management training programs via the China-IMF Capacity Development Center.

In a nutshell, central banks could contribute to the net zero goal in many ways, such as developing a strong policy system, a diversified market system, and enhancing international coordination. Much still needs to be done and today's seminar is just a beginning. I look forward to working with all of you to produce more deliverables. Thank you.

Opening Remarks

Kristalina Georgieva[1]

1. Introduction and Outlook

Good evening! [wǎn shàng hǎo]. I would like to thank Governor **Yi Gang** for inviting me here today, and to the People's Bank of China for co-hosting this important event.

Given the challenges facing us at this pivotal moment, I would like to draw inspiration from three Chinese sayings.

The **first** is this: ***"Dispel the clouds and see the sun"*** (拨云见日)

Last year, the world was clouded by the worst pandemic in a century and the deepest recession since the Second World War.

Now the outlook is starting to become sunnier. With the recovery underway, the IMF recently lifted its global growth forecast to 6 **percent** for this year and **4.4 percent** in 2022.

We are in a much better place because of extraordinary efforts. Think of the scientists from around the world who worked together to create vaccines in record time.

And think of the exceptional policy measures—including about $**16 trillion** in fiscal action and a massive liquidity injection by central banks, including the **People's Bank of China** (PBC).

Without these coordinated measures, the global contraction last year would have been **three times worse**—this could have been another Great Depression.

[1] Kristalina Georgieva is the Managing Director of the International Monetary Fund.

We now see the recovery across the Asia-Pacific region, where growth is projected at **7.6 percent** this year.

This year, China's economy is expected to grow at **8.4 percent**, largely because of stronger net exports. And we project that China will contribute on average **more than one-quarter** to global GDP growth through 2026.

And yet, while a few economies—led by the United States and China—are powering ahead, others are still struggling to emerge from the shadows of this crisis.

We see a **multi-speed recovery** in which weaker and poorer countries are falling behind—because they have more limited access to vaccines and very little room in their budgets to fight the crisis and secure the recovery.

We also see a multi-speed recovery within countries. Young people, women, the lower-skilled, and small businesses in contact-intensive sectors have been among the hardest hit—and they will need more support.

This is critical to heal the economic scars of the crisis. But it will only take us so far.

2. Securing a Green Recovery

If we are to achieve a more sustainable and inclusive recovery, we must turn this crisis into opportunity by **building greener and more climate-resilient economies.**

The existential threat of climate change is one of our most important problems. Left unchecked, it will bring untold disruption. To achieve the goal of reducing climate risks and averting future calamities, action during this decade will be critical.

Which brings me to a **second** Chinese proverb: ***"One generation plants the trees; another gets the shade."***

The Asia-Pacific region is already experiencing faster-rising temperatures and more weather-related natural disasters than anywhere else—with

coastal areas and small island countries being especially affected.

In low-income countries, climate change is already a key driver of rising poverty, accelerating spread of disease, and worsening food insecurity.

The good news is that taking action on climate change now will do more than avoid disasters in *the future*: by accelerating the historic transformation to greener economies, we also can provide a major boost to the recovery.

In our research,[2] we analyzed how economic policy tools can pave a road toward net zero emissions by 2050, in a matter that supports economic growth, employment and income equality. For illustration, a policy mix of carbon taxes and green investment stimulus could increase the level of global GDP in the next 15 years by about **0.7 percent** and create around **12 million** new jobs through 2027.

Let us take a closer look at some of the key economic policy tools for climate mitigation.

(a) Carbon Pricing

While there is no one-size-fits-all for countries' policies, there is a growing consensus that **carbon pricing** is the most efficient and cost-effective approach to curbing emissions. [3]

By raising energy prices overall, carbon pricing creates incentives for households and firms to shift towards greener options, promoting energy efficiency. It also boosts green investments, and spurs innovation, by leveling the playing field between renewables and fossil fuels.

Asia is home to the majority of the world's population and has been the main driver of global growth in recent decades. Not surprisingly, it also accounts for **almost half of the world's carbon emissions**. Yet, **new IMF research** shows that a moderate and progressive carbon price—starting from a low base but rising steadily—could help countries in the region deliver on their commitments under the Paris Climate Agreement over

[2] WEO October 2020

[3] IMF Fiscal Monitor, October 2019

the next 10 years. [4]

In addition, carbon taxes can generate substantial revenues, which could be used to support households, affected by the low carbon transition, and to scale up public investment in health, education, and retraining and re-skilling of displaced workers.

Countries can achieve similar result using other instruments too. China's existing coal tax is a good example, which could eventually be scaled up to curb CO2 emissions.

China is also taking a major step forward by introducing a **national carbon emissions trading system for the power sector**. It is designed slightly differently from what we see in other countries—instead of a cap on the total emissions a firm can generate, there are limits on emissions relative to a firm's energy output.

Over time, the system can become more comprehensive by: (i) shifting the focus to a cap on total emissions, (ii) gradually adopting more ambitious targets, (iii) ensuring compliance, (iv) extending it beyond the power sector; and (v) generating revenue from these allocations, which today are free.

A range of other tools, such as "feebate" schemes, that reward efficient practices and discourage high-carbon activities, can contribute to lowering CO2 emissions in certain sectors as well. In some cases, tighter regulations of emissions and energy efficiency will be needed, along with better green technology policies.

China's continuing reforms towards high-quality, sustainable, and balanced growth can also contribute to lowering carbon emissions. Shifting away from investment-heavy to consumption-led growth, and supporting the expansion of services and high-tech sectors—as envisaged in the just-approved 14th Five-Year-Plan—will reduce the energy demand and carbon intensity of growth, thus, making it easier to achieve your climate goals.

[4] IMF Departmental Paper (2021): Fiscal Policies to Address Climate Change in Asia and the Pacific: Opportunities and Challenges

These efforts would result in a big cut to emissions—which would be amplified by synchronization across markets. That is why the IMF is advocating for **carbon price floors** in the world's largest emitters to ensure more substantial climate change mitigation.[5]

(b) Green Financing

The sheer size of the task ahead calls for trillions of dollars in **green investment**. This suggests, in China as elsewhere, there is room to foster more private-sector green financing **by efficiently steering capital from "brown" to green investment**, for example, through price signals and regulatory incentives.

Domestically, countries need to set up environmental information disclosures, green finance standard systems, and other support policies to mobilize more private sector investment.

Data has an important role. In a recent survey of 425 investors [6] with ~$**25 trillion** in assets under management, **53 percent** cited **the poor quality or availability of ESG data** and analytics as the **biggest barrier** to deeper and broader implementation of sustainable investing.

Climate change is in itself a threat to financial stability. Countries and companies—and therefore their banks—face higher risks from extreme weather events and from the transition to a low-carbon economy. Risk management needs to be improved to assess climate-related risks and safeguard financial stability.

Boosting green finance also means ramping up international support for poorer countries—where climate resilience can be a question of life and death, and the price tag can be much higher.

Globally, the average increase in public investment to finance climate adaptation is about **3 percent** of GDP per year. But Tonga, for example,

[5] Parry and others (2021): A Proposal for an International Carbon Price Floor Among Large Emitters (IMF Working Paper, forthcoming).

[6] Blackrock, February 2021

will need **14 percent** of GDP per year over the next decade.

Vulnerable countries will need more domestic revenue mobilization—but also more external concessional financing, and more help to deal with debt. These challenges have become even more pressing during the pandemic.

Here China is playing an important role—by participating in the recently extended G20 Debt Service Suspension Initiative and in the Common Framework for orderly debt restructuring, and by its support for the IMF's Catastrophe Containment and Relief Trust.

3. Stronger International Cooperation

Which brings me to a **third** proverb: ***"One beam, no matter how big, cannot support an entire house on its own."*** [7]

The world shares the same goal—to limit global warming to well below two degrees Celsius—so, we must cooperate. Reaching agreement on possibly differentiated carbon price floors, as I mentioned above, is one major example of cooperation.

The international community also needs to step up to provide the climate finance and technology transfers that developing economies need to enhance their own climate efforts.

Another immediate priority is to improve the quality of **climate disclosure and to harmonize global green finance standards**—*everywhere*—and we need to share best practices across borders. This is essential for the planet, *and* for financial stability.

The PBC is spearheading these efforts in China, and it has important work ahead.

At the IMF, we are working on these and other issues with the Network of Central Banks and Supervisors for Greening the Financial System, the Financial Stability Board, and other standard-setting bodies. A new IMF dashboard helps in providing data for macroeconomic and financial

[7] 独木难支

policy analysis.

This is one of the ways in which we are stepping up our engagement on the macro-critical aspects of climate change—which is now at the heart of our mandate.

The upcoming COP26 summit in November will be an important opportunity for countries to come together and accelerate climate action. And before that, China will host the Biodiversity COP15 in May.

One thing is clear: only by working together, can we foster a green recovery and a resilient post-pandemic world. I look forward to our discussions on this topic.

Thank you. Xièxiè

SESSION I

GREEN FINANCE AND THE ROLE OF CENTRAL BANKS AND FINANCIAL REGULATORS

A Framework for Understanding the Role of Central Banks and Supervisors in Green Finance

MA Jun[1]

Thank you so much, Tobias. First of all, let me thank IMF and PBC for co-hosting this very high-level seminar on the important topic of climate change and green finance. And it's my great pleasure to be part of the discussion.

On the role of central banks and supervisors, there are so many different opinions. We've been hearing these from the Chinese discussion in a lot of international platforms, such as G20, IPSF, NGFS and so on. I think there are many different roles that the central banks and supervisors can play. Different people talk about this from different perspectives, some at high level, some at technical level, some from more operational level.

I'm trying to say that we need to put all these into a framework so that we can understand the role more properly. I'd like to propose thinking about the role of central banks and supervisors from two different angles. One is enhancing the mobilization of capital for green and low carbon investments, or the role for mobilization, and the other angle is to provide a risk control mechanism for the financial sector to prevent environmental and climate risks turning into financial risks.

On the mobilization side, I think the central banks and supervisors could do four things:

[1] MA Jun is Founder and President of Institute of Finance and Sustainability (based in Beijing). He is also Chairman of Green Finance Committee of China Society for Finance and Banking.

1. **Defining the green and sustainable finance taxonomy.** In China, we've been doing this for the past 7 years. China had the first green lending taxonomy in 2013, the green bond taxonomy in 2015, and the green industry taxonomy in 2019. These taxonomies have provided important basis for many things, including disclosure, education, performance measurement, and so on so forth. The most important benefit of having taxonomy at the national level is to prevent green washing.

2. **Introducing disclosure requirements on environmental and climate related information.** And these requirements need to become mandatory overtime. Initially, it could be voluntary and moving gradually to semi-mandatory. Finally, I think they need to be mandatory. Because only by requiring issuers, including corporates and financial institutions, to be transparent on the use of proceeds, we will make sure that the green funds raised will be used for the right purposes. In addition, the disclosure needs to cover environmental benefits, such as the reduction of carbon emission, air and water pollution, land contamination, and the negative impact on biodiversity. All these have been done in China already, in our banking system.

3. **Providing incentives.** Because many of the green projects do have environmental benefits but may not be as profitable as the private sector would like to see. That's why we need some incentives, such as green lending facilities and the local level interest subsidies and guarantees. They help enhance the return to investors. We can potentially consider additional instruments, such as, for example, cutting risk weights for green assets. And if we were doing this, I think we can provide a across-the-board reduction of funding cost for lending to all green projects.

4. **Facilitating the development of a range of financial products,** including green lending, green bonds, green ABS, green ETF, green insurance products, and carbon finance products. Just take green bonds as an example. In 2015, when China initially began the bond market,

the regulators did a couple of things. One is setting standards, such as the taxonomy. And another is introducing the disclosure requirements on the environmental benefits of green bonds and certainly setting standards on how to verify green bonds. So, these are the enabling environment, which will make the green bond market function more properly than other ways.

Let me move on to the second aspect of the central banks and supervisors' role, which is **providing risk control mechanism.** For example, we need to control transition risks. Because so many industries, including coal related industry, oil related industry, and high carbon manufacturing industry are facing transition risks. All these sectors will need to transit towards low carbon and zero carbon in next 30 to 40 years. Otherwise, they would lose value and their loans would become non-performing. So, this presents a very big risk to the financial system if we don't do it properly. And that's why we need to do at least five things from this angle as a supervisor or the central bank.

1. **Defining taxonomy on brown assets.** We need to get central banks and other supervisors to know how to classify brown assets. I think they need to include all the fossil fuel industry, steel, cement, aluminum, chemical, paper, and so on. All of these are major emitters of carbon and they need to be included in the taxonomy of brown.

2. **Requiring disclosure of brown assets.** This is not done yet in China, but I think some of the banks are beginning to think about that. And only by knowing the risk exposure of the financial assets to the brown industries, will they be able to begin thinking about managing these risks. And we should introduce requirements for the disclosure of brown assets, not only related with carbon, but also other assets that may be destructive to the environment. For example, those include assets that are polluting (like air or water pollution), contaminate the land, or destroy biodiversity. In fact, I am co-chairing a study with Nick Robins, that is a joint between NGFS and the INSPIRE, on how to enhance the role of financial institutions in protecting biodiversity. And one of the aspects of that study will be the disclosure requirement

on the impact to biodiversity.

3. **Requiring financial institutions to conduct environmental and climate risk analysis.** And they need to know, based on disclosure, how much of these assets will become non-performing loans in 5 to 10 years. And how much value these assets would lose from the perspective of bond and equity investors. The methodologies are there as the NGFS produced two papers last year on environmental risk analysis (ERA). One of them is called *Case Studies of Environmental Risk Analysis Methodology*, which is some 600 pages and provides a collection of methodologies from more than 30 institutions. I think it provides a very good reference guide for financial sectors.

4. **Providing disincentive for the financial sector to invest in brown activities.** But how do we do that? Just to give you one example: We should consider raising the risk weight for brown assets. By doing that, it will increase the financing cost of lending and investing in brown assets and thereby gradually shrink the role of brown assets in the financial industry.

5. Finally, I think central bank regulators should think about how to facilitate a transition finance mechanism. Namely, how to enable more financial resources to invest in currently high carbon industries and activities in a way that helps them transit towards low carbon activities.

Thank you very much, Tobias.

Tackling Climate Change: The Role of Central Banks

Sabine Mauderer[1]

Climate change is posing far-reaching challenges and will have life-changing consequences all over the globe. Meeting these challenges will require collective efforts and concerted actions. All stakeholders have to contribute, including central banks.

The public sector plays a key role by sending clear price signals to the markets to incentivise the development and use of less carbon-intensive products and technologies. Adequate carbon pricing is the most efficient tool that governments have at their disposal. Putting a price on carbon sends a strong signal to market participants who very well understand it. It is crucially important that adequate carbon prices schemes move up the political agenda of the international community. International fora, such as the G20, provide a good stage to make progress on this issue.

Central banks will not stand on the sidelines in the fight against climate change. Central banks can serve as catalysts, supporting and pushing forward efforts and measures to mitigate climate change, especially through their analytical expertise. Their work can have clear signalling effects and their role should not be underestimated. However, they cannot compensate for the absence of ambitious and targeted government policies, for instance in the energy sector.

Climate risks are financial risks—this insight has prompted central banks and supervisors from across the world to set up a global network to explore options for managing climate-related financial risks—the Network for Greening the

[1] Sabine Mauderer is Member of the Executive Board of the Deutsche Bundesbank.

Financial System (NGFS).

The People's Bank of China and the Bundesbank were among the eight founding members of this coalition in December 2017. Since then, the group has grown into a truly global network of 90 central banks and supervisors.

The NGFS's work focuses, inter alia, on micro-prudential and supervision aspects as well as on macro-financial and financial stability issues, which is a particularly important dimension to consider in the context of climate change.

In July 2020, the network published its "Guide to climate scenario analysis for central banks and supervisors" which lays out a set of climate scenarios as a common starting point for analysing climate risks to the economy and the financial system. The guide includes three representative scenarios that cover a range of lower and higher risk outcomes for both transition and physical risk: orderly transformation, disorderly transformation, and absence of additional mitigating action (hot house world scenario). The goal is to show the economic impact of climate-related risks on a global scale but also for single jurisdictions.

The NGFS also attends to the challenges that arise from climate change for the conduct of monetary policy. Climate change will certainly have an impact on monetary policy. It will affect key macroeconomic determinants such as inflation and growth as well as market dynamics. Extreme weather events such as floods, droughts, and heat waves brought on by climate change are likely going to become more frequent. This will influence, for instance, energy and food prices. Climate-related factors will have to be introduced in workhorse models to account for their interactions with other risks within the usual monetary policy horizon.

Central banks have also been pondering the question as to how they can reflect climate-related risks in their monetary policy operational frameworks. The NGFS has taken up this issue as well and published a comprehensive report in March 2021.

The report "Adapting central bank operations to a hotter world" lays out nine concrete options for central banks in three main monetary policy fields: credit operations, collateral, and asset purchases. Each of the nine options is assessed

across four criteria: (1) consequences for monetary policy effectiveness, (2) contributions to mitigating climate change, (3) effectiveness as risk protection measures, and (4) operational feasibility.

The report finds that all nine assessed options are generally feasible. However, much work lies ahead. In particular, the lack of meaningful, reliable data is a clear obstacle across the board at the current juncture. Bridging the data gap and improving the quality of available data is essential. To this effect, the NGFS will give strong emphasis to the work on disclosure of climate-related risks in the months to come.

The NGFS report merely presents possible options available to central banks to consider climate-related risks in their monetary policy operations. It does not provide recommendations to central banks, acknowledging that there is no one-size-fits-all approach.

Central banks' mandates and their room for manoeuvre differ considerably. Ultimately, each central bank has to make strategic decisions on the scope of their actions. Many possible options are on the table.

No action is not an option.

How are central banks helping to make the recovery from the Covid-19 pandemic more sustainable and inclusive?

Luiz Awazu Pereira da Silva[1]

Without the timely, coordinated, countercyclical and massive policy response to the Covid-19 pandemic by fiscal and monetary authorities around the globe, the downturn could have been much worse. On top of their own unprecedented monetary policy response, central banks are facilitating a sustainable and inclusive recovery in many ways. First, by raising awareness that climate-change related risks are a significant threat to global financial stability. Second, by showing that collective coordinated action, changes in supply and demand behaviour, and other public policies including adequate carbon pricing are required. Third, by fostering policies that ensure low financing costs of mitigation and transition and providing guidance that this will be maintained for an appropriately long horizon. Fourth, by developing analytical tools as public goods to improve the measurement, assessment and mitigation of such risks (such as new risk models, climate stress testing, climate scenarios, disclosure of carbon exposures, and analysis of the redistributive impact of climate policies). And fifth, by engaging with the financial private sector to

[1] Luiz Awazu Pereira da Silva is the Deputy General Manager of the Bank for International Settlements (BIS). The opinions expressed here are those of the author and may not be attributed to BIS. These remarks are based on my article in A Dombret and P Kenadjian (eds), *Green banking and green central banking: What are the right concepts?*, forthcoming and my presentation at the People's Bank of China–International Monetary Fund High-Level Seminar on Green Finance and Climate Policy, 15 April 2021.

develop new financial instruments to accelerate adaptation and transition towards a net zero goal, which is increasingly endorsed by many countries.

For a long time, we believed that there was an infinite supply of natural resources and that their use entailed little to no cost. The consumption of air, water, forests, and natural capital in general had very few restrictions and, amid those restrictions, technology would make it possible to use natural resources ad infinitum. Scepticism about "limits to growth" started in the 1970s with concerns about energy consumption from fossil fuels, and by the late 1980s, repeated warnings by climate scientists led to the creation of the Intergovernmental Panel on Climate Change (IPCC), which was established with the support of the UN Environment Programme and the World Meteorological Organization. The link between global warming and human activity – in particular through the emission of greenhouse gases (GHG) – continued to be analysed and gained traction thanks to further research by prominent social scientists.[2] By the end of the 1990s and 2000s, the cumulative growing evidence about GHG effects had changed social awareness of the risks related to climate change, the sustainability of the way we produce and consume, and the need for transitional solutions to a less risky, carbon-based economy, for all. Finally, this evolution of mindsets received further support, especially after the Global Financial Crisis, amongst the central banking community.[3]

The reasons for central banks to become involved with climate change had to overcome two extreme viewpoints. On the one hand, by limiting its involvement a central bank was simply respecting its strict explicit mandate and preserving its independence. On the other hand, central banks were summoned to involve themselves even with no explicit mandate since they would be acting on a greater-than-the-Global Financial Crisis "emergency."

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[2] The Stern Review on the Economics of Climate Change, issued on 30 October 2006 by Nicholas Stern, was the first economic report on climate change characterised as the greatest and widest-ranging market failure ever. The report had a large public repercussion. In 2005, Jared Diamond published *Collapse: how societies choose to fail or succeed*, which describes the causes of historical societal collapse, especially as related to the impact of man-made or other environmental changes.

[3] In a seminal 2015 speech, "Breaking the tragedy of the horizon – climate change and financial stability", Mark Carney stated that "[c]limate change is the Tragedy of the Horizon" and that "once climate change becomes a defining issue for financial stability, it may already be too late".

De facto, many central banks have since pragmatically been addressing many climate issues interpreted within their mandates, while also recognising that there is no silver bullet against global warming and that they alone cannot mitigate all climate change-related risks.

Indeed, the impact of climate change directly undermines the objectives of most central bank mandates. Financial stability is potentially threatened by severe weather events, with massive losses of capital related to physical and transitional climate change-related risks. Moreover, price and macroeconomic stability are affected by climate change-related shocks and uncertainty, including food prices, shortages, mass migration, savings, lower employment, and financial crises. Finally, and more importantly, central banks need to take into account rapid changes taking place in the real economy and financial sector. Both are moving faster than the official sector: demand is increasing among investors and consumers for greater commitments to sustainability, transparency, and consistency; and the supply of green portfolios is growing, coupled with an evolving taxonomy, a higher volume of green financial assets, and an increased appetite to hold and manage them.

"The green swan" contribution to the debate: it *is* about risk!

The publication *The green swan: central banking and financial stability in the age of climate change*[4] tried to move the climate change debate in the financial sector from an ethical to a risk-based discussion. The metaphor was inspired by Nassim Nicholas Taleb's black swans during the Global Financial Crisis – they represented the exceptional and rare nature of a sequence of financial meltdowns that nevertheless created a global financial crisis. A green swan also represents an event, but one that is bound to happen because it is the result of climate change and is therefore, according to today's science, a quasi-certainty. When and in what form the event will take place are unknown. However, in recent years we have seen numerous, glaringly obvious manifestations of these growing risks, including those related to natural weather catastrophes.

[4] P Bolton, M Després, L Pereira da Silva, F Samama and R Svartzman, *The green swan: central banking and financial stability in the age of climate change*, Bank for International Settlements and Banque de France, 2020.

In addition, cases of zoonosis – which can spark pandemics such as the one our world is currently witnessing – are also the result of the destruction of animals' natural habitat and the loss of biodiversity. The Covid-19 pandemic, which has paralysed the global economy over the last year, serves as a useful illustration of how expected events related to climate change, albeit unfolding at a very slow pace, can materialise suddenly and accelerate dramatically.[5]

The messages in *The green swan* come directly from today's best science. First, climate change calls for an epistemological rupture in risk models, breaking away from: (i) Gaussian distributions of risk (with fat tails or not); (ii) the linearity of transmissions of climate change-related risks; and (iii) the convenient extrapolation of the consequences of these events using historical data. Second, the best science warns us of: (i) the quasi-certainty of the occurrence of climate change-related catastrophic material and human losses; and (ii) the crossing for our societies of irreversible tipping points if we emit GHGs beyond the 420 billion tonne threshold of CO2 equivalents. Indeed, the latest IPCC reports calculate that this emission budget is the maximum limit (at the 66% confidence level) for average temperatures on the planet to grow by less than 1.5°C. In a nutshell, *The green swan* alerted us to the reality that, given these risks, the "wait-and-see" attitude behind our benign neglect is itself very risky.

The green swan highlights that the risk of waiting too long is not worth taking, and that we need to act even in spite of radical uncertainty because climate change-related risks are asymmetrical. That is, we are faced with the quasi-certainty of incurring huge future losses versus paying a small mitigation cost today. Therefore, it is better to prevent risks, to insure against future losses and to build buffers now even in the absence of supportive optimal carbon pricing, better models than our integrated assessment models (IAMs), other models in a general equilibrium framework or even an ideal understanding of all the ramifications of climate change. We also need to act by moving

[5] See L Pereira da Silva, "Green Swan 2 – climate change and Covid-19: reflections on efficiency versus resilience", speech based on remarks at the OECD Chief Economist Talk Series, Paris, 23 April 2020 and a research webinar at the BIS, 13 May 2020.

towards financing the transition to a less carbonised economy and thinking about its complex coordination issues. There is no entity within society that can perform this transition by itself, no matter its influence – be it central banks, governments, global banks, or private firms. We must work together for the common good – *all hands on deck*.

How central banks are and *should continue* contributing: providing public goods on climate change-related risks, and fostering global and local coordination

Beyond promoting awareness and building consensus, central banks are providing guiding frameworks for the public and private financial sector and civil society. The Network for Greening the Financial System (NGFS), which regroups the community of central banks and supervisors, has been instrumental in offering such public goods. In addition, public interventions by central bank Governors have been explicit about the importance of climate change for central banks in both advanced and emerging economies.[6]

The central banking community is addressing climate change in five key ways. First, they are continuing to improve analytical tools to assess climate change-related risks and test the resilience of our financial sectors, in particular developing new macro models – beyond IAMs or DSGEs – as well as new risk

[6] See C Lagarde, "Climate change and central banking", keynote speech at the ILF conference on Green Banking and Green Central Banking, Frankfurt, 25 January 2021; L Brainard, "Financial stability implications of climate change", speech at "Transform tomorrow today" Ceres 2021 Conference, Boston, 23 March 2021; Y Gang, "Make full use of China's monetary policy space and promote green finance", remarks at the Roundtable of China Development Forum, 21 March 2021; H Kuroda, "Addressing climate-related financial risks – from a central bank's perspective", remarks by at the International Research Workshop on Climate-related Financial Risks, Bank of Japan, 25 March 2021; A Bailey, "The time to push ahead on tackling climate change", speech at the Corporation of London Green Horizon Summit, 9 November 2020; F Villeroy de Galhau, "Paris 2020 Climate Finance Day", speech at the Paris 2020 Climate Finance Day, Paris, 29 October 2020; J Weidmann, "Climate change and central banks", address at the Deutsche Bundesbank's second financial market conference, Frankfurt am Main, 29 October 2019; A Díaz de León, "Climate change and its impact on the financial system", remarks at the Conference on Climate Change and its Impact on the Financial System, Mexico City, 5 December 2019; R Campos Neto, "BC# Sustainability Agenda", presentation at the launching of the Sustainability agenda, Brasília, 8 September 2020.

metrics, climate-related stress tests, and scenarios for 1.5°C with sustainable growth for the real economy and financial sector.

Second, central banks are continuing to discuss the scope and role of macroprudential tools and monetary policies, including those for collateral and asset purchase programmes. The Basel Committee, for example, has a task force on climate-related financial risks. These are not trivial issues, and the discussion has to weigh the pros and cons of introducing some form of shadow asset pricing while we still have not been capable of introducing an adequate global real carbon price.

Third, central banks are working on policies for disclosure and accounting standards, together with the Financial Stability Board and its Task Force on Climate-related Financial Disclosures (TCFD), and the International Financial Reporting Standards (IFRS) consultation on sustainability reporting.

Fourth, the central banking community is working to make the taxonomy on green investment products for investors and civil society more consistent, with an emphasis on such things as comparable environmental, social, and corporate governance (ESG) criteria and green bond standards.

And finally, the central banking community is seeking a greening of its own assets, such as reserves and pension funds, while offering investment options for investors that favour green finance.

But it doesn't end there. The central banking community is also working to strengthen coordination between local and global agents to avoid free riding and problems arising from collective action, while favouring greater cooperation and helping to find a reasonable balance of burden-sharing for mitigation and adaptation policies. Central banks realise that climate change actions require a significant amount of coordination[7], especially in the light of governments' commitment to a net zero emissions approach. It requires the involvement

[7] The need to addressing inclusion, the pandemic and climate change challenges is the priority of the G20 Presidency in 2021; see I Visco, "The G20 under Italy's leadership in 2021", keynote speech at The Global Foundation – Rome Roundtable 2020 "Which way the world after the pandemic? Our inclusive human future", 16–17 November 2020.

of governments, treasuries, and fiscal policy to address Pigovian carbon taxes, trading, and pricing emissions. It requires international institutions and development banks to help leverage the financing costs of transition and mitigation.[8] Lastly, but equally important, it requires real sector firms, banks, insurance companies, regulators, standard-setters, and ratings agencies to ensure consistency with the commitments established.

While recognising the dramatic cost Covid-19 has had on human societies and the global economy, one collateral effect is that the pandemic may have triggered a behavioural change. It showed, overwhelmingly, the evidence of the huge costs of green swans and, amid the pain and suffering, helped relay to societies, policymakers and the private sector the asymmetric risk-return that global warming entails, and the need for immediate action.

The "first-best" solution of combating climate change faces redistributive challenges

Acting now comes with a warning: there are distributional consequences of climate change policies and for the transition to be successful, the political economy must be considered. The risks and impact of global warming disproportionately affect poor countries and poor households in rich countries. The global and local short-term social effects of mitigation policies might be regressive on impact before the medium- to long-term welfare benefits materialise. Therefore, there is an urgent need to think about and design such policies keeping in mind compensation and transfers, as these are important elements to build support and fairness. This is not specifically a central bank role, but this concern can be present in the overall coordination process with fiscal authorities.

To change relative prices in our economies to favour less carbon-based production

[8] The coordination with United Nations agencies, eg UNEP, and the Bretton Woods institutions, as well as others, is essential. In November 2020, the first Finance in Common Summit assembled 450 public development banks whose annual total investments total about $2.3 trillion, about 10% of total global investments. The summit aimed at ensuring the recovery from the Covid-19 pandemic is in line with the principles of sustainable finance, the Paris Agreement and a key milestone ahead of the Glasgow Climate Change Conference (COP 26).

and consumption, the textbook solution is to *fix a price* and internalise the negative externality arising from the emission of GHGs. A carbon price via tax or an emission right is needed, but we now know that it not only presents technical difficulties – such as its transmission to the whole economy – but has a redistributive and therefore also a political impact, particularly because of the diversity of social groups potentially subject to this tax and their uneven capacity to absorb its costs. Any transition to a new carbon regime in a new society has a redistributive impact. In theory, changes happen seamlessly, free of adjustment cost and pain, and entail an instant reallocation of resources to different entities and sectors that emit less carbon. But there is de facto a transition cost with highly significant redistributive consequences. These effects must not be overlooked by economic policymakers as they can exacerbate the inequalities within our societies. If we were to implement good climate policies that could increase inequality and social fragility without considering compensation mechanisms, we could inadvertently trigger a backlash. That applies at both the national and international level. For example, the capacity to finance the transition to a lower carbon economy in India, Brazil, or Indonesia is not the same as in Norway, Switzerland, or France. That means while working on fixing a suitable price for carbon, we must also look at alternatives and use other complementary instruments, which are also required for this transition. That naturally raises the question of financing the transition and, subsequently, the role of finance. It is vital to know how to finance a transition to make it more likely that it will entail, not as many people fear, an economic contraction, but rather an expansion. It's not a minor issue.

Last but not least, while these are mostly issues for fiscal authorities, central banks are increasingly aware of how inequality can influence the effectiveness of their policies. For example, the issues of transmission across different groups and, implicitly, inequality have featured more prominently in major central banks' current reviews of monetary policy.[9] In practical terms, some central banks are extending their description of the monetary transmission channel to

[9] See J Powell, "New economic challenges and the Fed's monetary policy review", in *Navigating the decade ahead: implications for monetary policy*, proceedings of the Federal Reserve Bank of Kansas City Jackson Hole symposium, August 2020.

heterogeneous agents and thus are considering the role played by inequality.

Central banks can enhance the positive role of the financial system in the transition

For a start, it is vital to make the financial system more resilient in the face of the increasingly massive potential costs of accidents caused by extreme natural catastrophes (storms, hurricanes, forest fires etc). We need to reflect on the capital and other buffers that need to be put in place to face these climate shocks, so as to avoid a new global financial crisis. The central bank community is aware of this, and the pandemic has actually proved that the consolidation work undertaken after the Global Financial Crisis added resilience to the financial sector.

Then, we need to look at how to finance the numerous good ideas that are emerging from many quarters. Obviously, supporting innovation in new technologies (clean energy and climate-related R&D) is paramount, as is acting and investing in green infrastructure that uses better standards and lower-carbon production processes.[10]

Therefore, we need to develop new financial instruments to help us channel savings and invest them into these new fields and help alter investor behaviour. Green finance is, in general, the route the financial sector is thinking of taking in this transition. This sector is looking at new green instruments because it makes business sense as the demand is there. But the financial system's creativity is also responding to a reputational risk. Some governments, companies and portfolio managers are aware of a behavioural change among consumers and investors, for example in Norway with the sovereign wealth

[10] Chapter 11 of Bill Gates' *How to avoid a climate disaster* (2021) provides an extensive list of practical ideas and suggestions with related institutional changes.

fund, or BlackRock or Amundi.[11] There is a growing willingness on the part of the entire financial sector to improve the clarity and taxonomy of these new instruments and central banks and regulators are helping to incentivise this process. How exactly can we improve the definition of a green bond? How can we better illustrate and bring together the various concepts behind ESG criteria in a given financial instrument? What are the implications of the risks and returns of investing in such a product? These new demands can improve investor behaviour and the way in which certain financial institutions present these products to finance a transition. When we put all this together, we are assembling the various pieces of what could later be a consistent new macroeconomic policy for addressing climate change.

Conclusions: never "waste a crisis". Use the Covid-19 crisis as an opportunity to aim at sustainable and more inclusive recovery

Central banks have been acting in significantly to mitigate the pandemic's devastating effects. They have also coordinated with other actors, as mentioned above. They have been contributing to promote new ideas for green finance. Why is this transition so critical, and why is it important to find the means to finance it?[12] My short answer is because it will increase the likelihood of an expansionist outcome that, in turn, will help overcome the political economy

[11] Regarding governments, 113 countries have committed to be mostly carbon-neutral by 2050, representing about 50% of world GDP, and nine have set legally binding targets. Among asset owners, $5.1 trillion is committed through the Net-Zero Asset Owner Alliance, and among asset managers, $9 trillion is committed through the Net Zero Asset Managers Initiative. In June 2019, Norway's sovereign wealth fund (managing $1 trillion in assets) signalled a gradual fossil fuel divestment policy. In his annual letter to CEOs on 14 January 2020, BlackRock's Larry Fink said, "Climate change is become a defining factor in companies' long-term prospects … awareness is rapidly changing, and I believe we are on the edge of a fundamental reshaping of finance." BlackRock's assets under management are around $7 trillion. In Europe, at Amundi (about $1.7 trillion under management), Frédéric Samama has been instrumental in the Portfolio Decarbonisation Coalition, the creation of low-carbon indices, and one of the world's biggest green bond funds.

[12] See K Georgieva (IMF Managing Director), "Securing a green recovery: the economic benefits from tackling climate change), remarks at the PBC-IMF High-Level Seminar on Green Finance and Climate Policy, 15 April 2021; and F Elderson (NGFS Chair), "A green light to lead us on the path of economic recovery", remarks at the 11th edition of the Petersberg Climate Dialogue: Financing Climate Ambition in the context of Covid-19, 29 April 2020.

and redistributive challenges alluded to earlier. Chart 1 shows a hypothetical example of the opportunities the Covid-19 crisis can offer.

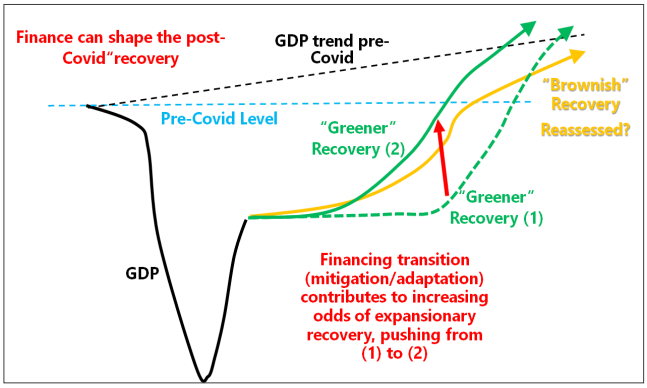


Chart 1: Post-Covid recovery: the role of green finance

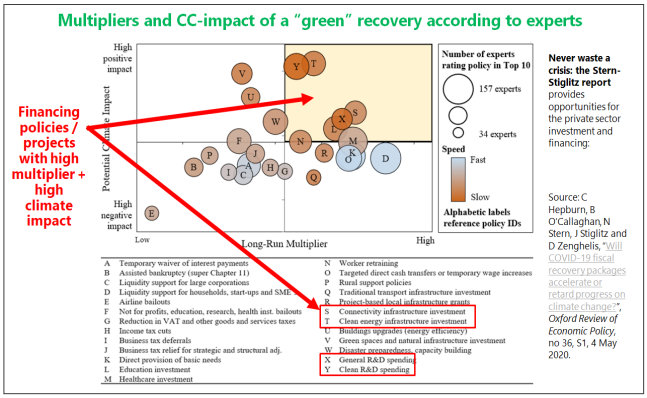
As we already know, the Covid-19 pandemic made global GDP growth (solid black line in the stylised Chart 1) fall dramatically. In an uneven way in many countries, we are beginning to witness a V-shaped recovery, or rather a "square root", as activity levels have yet to return to pre-Covid levels[13]. What type of recovery can we expect from now? Could it combine a rebound in activity, job creation, and a greener economy? At first glance, this crisis is so severe that it would be better not to set extra goals and instead accept a more "brown" recovery, with an upturn based on the traditional instruments and technologies that stimulate employment and economic activity. A recovery powered in part by green investment is represented by the green dotted line: it would be slower as it would take longer to mobilise the technologies that are slightly more expensive. This chart, admittedly rudimentary and simplistic and which is not a forecast, illustrates how more green finance (with debt and equity) in the transition with more green technologies can hasten the availability and impact of new technological solutions.[14] Green financing instruments for investment in innovation and more risk-taking may offer the possibility to increase the pace of the recovery, substitute our existing capital stock faster, incentivise shifts in consumption and push it higher, to that solid green line, which would enable a recovery trajectory that would be quicker over the medium term than the traditional recovery fuelled by the type of consumption and production we had pre-Covid.

[13] See IMF, *World Economic Outlook: Managing Divergent Recoveries*, Spring 2021.

[14] A more sober but still supportive view is J Pisani-Ferry, "A credible decarbonization agenda can help strengthen Europe's economy", PIIE, 9 December 2019.

The challenge is to use the current crisis as an opportunity to accelerate the transformation of our societies using new instruments to finance innovation, a kind of Schumpeterian creative destruction.[15] And indeed, in 2021 this is being implemented in the United States and Europe, with bold action being taken aiming at both sustainability and more inclusion.[16]

Is that path totally unrealistic? No, it isn't. If we move from a macroeconomic to a project perspective, a study by Nick Stern and Joseph Stiglitz[17] compares the different public policy measures that can be implemented to boost a recovery, for example research, infrastructure investments etc. Chart 2 shows the growth activity multipliers on the horizontal axis to the right, and the impact of the reduction in negative climatic effects on the vertical axis.



Never waste a crisis: the Stern-Stiglitz report provides opportunities for the private sector investment and financing:

Source: C Hepburn, B O'Callaghan, N Stern, J Stiglitz and D Zenghelis, "Will COVID-19 fiscal recovery packages accelerate or retard progress on climate change?", *Oxford Review of Economic Policy*, no 36, S1, 4 May 2020.

Chart 2: Possible projects for a green recovery

Different economic policy measures and eligible projects are points on this diagram, and we ideally would like these measures to be in the upper-right quadrant, where the projects have a strong impact on activity (high budgetary multiplier) and a strong mitigating impact

[15] This is the point made in P Aghion, C Antonin and S Bunel, "Innovation verte et croissance soutenable", in *Le pouvoir de la destruction créatrice*, 2020.

[16] The European Green Deal is a multi-year package of at least €1 trillion in investment as a strategy committing to zero net emissions of greenhouse gases by 2050, betting on turning climate and environmental challenges into opportunities, and making the transition just and inclusive for all. The Biden infrastructure plan is a $2 trillion plan to overhaul and upgrade US infrastructure while taking into account climate risk and resilience. In addition, US Treasury Secretary Janet Yellen reaffirmed President Biden's $1.9 trillion coronavirus relief package: "it's the right size to address the very significant problem that we have"; see J Yellen, ABC news interview by J Arnholz, 14 March 2021.

[17] C Hepburn, B O'Callaghan, N Stern, J Stiglitz and D Zenghelis, "Will Covid-19 fiscal recovery packages accelerate or retard progress on climate change?", Oxford Review of Economic Policy, no 36, S1, May 2020.

on climate risk. The study provides at least four good examples of that: greener infrastructure, the search for alternative energies, research and development led by the private sector but also by the public sector, and connectivity and virtual infrastructure.

That means there are projects for relaunching the economy and, at the same time, carefully choosing the effects of this relaunch from the perspective of a transition and fighting climate change. Therefore, having the debt and equity financing for these projects is key since most of these new endeavours will represent a higher risk. The private financial sector has a role to play, but green R&D innovation will also require a longer-term return horizon that the public sector can provide and the coordination of all these actions. This coordination must include governments, regulators, international organisations, and central banks. It is indispensable, not only on the supply side, ie technology, including financial technology, but also on the demand side, meaning the behaviour of each one of us. What will each of us consume and how will we receive price signals and information that will enable us to adjust our consumption to the low-carbon option?

The Covid-19 pandemic has produced the unprecedented contraction that we long feared with the consequences of physical and transition risks related to climate change. So what is the lesson? It's simple: never waste a crisis. The macroeconomic conditions are favourable. For example, interest rates are low at the moment, savings are higher in many rich countries, demand and awareness is increasing for green products, and there is growing ambition in the United States, European Union, China etc. There are also a number of projects, such as those involving green infrastructure, greener cities, carbon footprint tracing, new technologies and new ways to act using social networks. On the demand side, consumer information and incentives favour a lower-carbon economy and are increasingly aligned. For example, public awareness has risen to allow progress on carbon pricing, GHG emission taxation and emission certificates etc. On the supply side, green finance investors are asking for practical diversification for their portfolios and more projects to lower carbon content and finance the transition. There is more green research and R&D, and new technologies emerging, such as carbon capture.

Conditions seem to be emerging for an expansionary, green, and more inclusive recovery, and central banks have played an important role in shaping them. Today, due to the Covid-19 crisis, the urgency is to finance an expansionary, sustainable, and inclusive transition; find the good instruments and the best interlocutors; and coordinate and act in a way that actually reverses and stops the current trend of CO2 emissions. However, as a final point, we also have to change the way we think and we measure our performances. If natural capital is not free, we must innovate and change, from our national accounts to our models, and analyse the effects of climate on our economies. How can we measure the utilisation and depreciation of natural resources? How could we also value our activity with other metrics beyond market prices?[18] How can we better understand the risk in our models connecting the macroeconomy with the climate in measuring happiness and our wealth?[19] We need to use our time well, because time is not on our side. The pandemic has served as a glaring warning that we don't have eternity before us, that we really are living on borrowed time, and that we need to act decisively to put in place measures that can mitigate the catastrophic risks of global warming.

[18] This is the key question that, after pioneering work in alerting the central banking community about climate change, Mark Carney asks in *Value(s): building a better world for all* (2021).

[19] This change will occur through dialogue between macroeconomists and scientists specialising in climate change. The best models we have for transitions are the Nobel Prize-winning contributions by William Nordhaus, for example the IAMs. We also have to place more emphasis on research on new frontiers where we take disequilibrium into account, non-linear trajectories, cascade and amplifying effects, slightly reminiscent of the Mandelbrot set.

Net-Zero Central Banking The Next Phase in Greening the Financial System

Nick Robins[1]

Driving down greenhouse gas emissions to net-zero is essential to minimising the threat of catastrophic climate change. Nearly 130 governments have now adopted or are considering net-zero goals, including in the European Union, the UK, China, Japan, and the US. Leading banks and investors are also committing to align their portfolios with net-zero by 2050, including asset managers with some $32tn in assets and banks with a further $15tn in assets. As guardians of the financial system, central banks and supervisors are also starting to explore how they can support the net-zero transition.

There are two compelling reasons for financial authorities to take an explicit stance on net-zero. The first is that achieving a net-zero economy is simply the best way of minimising the risks of climate change to the stability of the financial system and the macroeconomy. The second is that central banks and supervisors need to ensure that their activities are coherent with net-zero government policy, which is now rapidly becoming a global norm.

As Frank Elderson, executive board member of the European Central Bank, and Sabine Mauderer, member of the executive board of the Deutsche Bundesbank, observed recently: 'While we cannot take on the tasks of governments, we also cannot be mere bystanders in the transition to a net-zero economy.'

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Over the past year, the first signs of net-zero central banking have started to emerge. Some central banks, such as the Banque de France, have included temperature goals in the way they manage their own asset portfolios. The Bank of England has launched a review into the climate impact of the issuers in its corporate bond purchase programme. This followed an updated statement of economic policy from the UK government, which now includes the goal of making the transition 'to an environmentally sustainable and resilient net-zero economy'. More broadly, leading figures in the world of central banking are also recognising that key conventions, such as market neutrality, need to be modernised in light of the persistent market failures that cause climate change.

The proliferation of commitments to net-zero across the financial sector makes the need for a strategic response by central banks and supervisors more urgent rather than less. Markets respond to signals from central banks.

The financial architecture for net-zero is still being formed, with specific disclosure, assessment, and governance tools under development. The efforts of central banks and financial authorities will be crucial in ensuring the consistency and credibility of net-zero financial efforts so that they reduce both institutional and system-wide climate risks.

To do this, a systematic approach is required (see figure 1). This begins with the need for central banks and supervisors to develop a net-zero roadmap including short-term actions and long-term expectations. Close liaison with policymakers will be crucial to ensure that real economy and financial system interventions work as one. Retrofitting a country's housing stock is a case in point, where building regulations, public finance, and the prudential supervision of mortgage providers have to be aligned.

Fig. 1: Implementing net-zero central banking: seven action areas

Source: LSE

Prudential supervisors should also make net-zero a core element at both micro and macro levels. In practical terms, this means requiring all regulated financial institutions to submit net-zero transition plans. Disclosure frameworks such as that of the Task Force on Climate-related Financial Disclosures will need be extended to include net-zero. Access to central bank monetary operations could also be made contingent on companies committing to a credible net-zero transition plan. This would give net-zero monetary policy operations a clear forward-looking approach and would reinforce the investment and engagement activities that institutional investors are taking.

Net-zero should not be the only environmental focus for financial authorities—resilience to climate shocks as well as responding to the loss of biodiversity are also critical. But it is a key area where scaled-up action is needed this year. The core responsibility for delivering net-zero rests with governments. Yet action by central banks and supervisors is required to complement these policy reforms so that the financial system allocates the capital needed for net-zero at speed and as smoothly as possible.

As the world gears up for the COP26 climate summit in November this year, the time for a coordinated international response from financial authorities to the net-zero transition has arrived.

Nick Robins is Professor in Practice - Sustainable Finance with the Grantham Research Institute at the London School of Economics.

SESSION II

ROLE OF FINANCIAL INSTITUTIONS AND INVESTORS

Role of Financial Institutions and Investors

TAO Yiping[1]

Thank you, Deputy Governor LI Bo. Distinguished Governor YI Gang, Managing Director Georgieva, ladies and gentlemen. It is my great honor to participate in this seminar and deliver a speech.

Let me begin with my point of view: Chinese financial institutions will play an important role in addressing climate change. To be specific:

- Firstly, addressing climate change presents both responsibility and an opportunity. Building on the philosophy of a community with a shared future for mankind, President Xi Jinping has made a solemn commitment to achieving "peak carbon emissions by 2030 and carbon neutrality by 2060" on behalf of the Chinese government and Chinese people. Based on these targets, Chinese government is actively monitoring climate change and has made a series of decisions and set up plans. As a result, a number of changes can be expected in our economic and social development. As an important part of modern economy, financial sector must adapt to changes and take its responsibility, expecially the duty to provide additional funds to combat climate change. According to a research done by Tsinghua University and other institutions, China needs over 100 trillion RMB worth new investment to achieve the goal of limiting global warming within 1.5℃ as proposed in the Paris Agreement. This is a major

[1] TAO Yiping is the Director and President of Industrial Bank CO., LTD.

development opportunity for financial institutions.

- Secondly, China has both the ability and the willingness honor the promise. With the traditional Chinese virtue to keep promises and advocate hard work, and to cater to people's ever-increasing demand for a better environment, green finance in China has been growing rapidly in the past few years. , President Xi raised the new development philosophy of promoting ecological civilization, green development, digitalization, and technological innovation when working in the Fujian province years ago. China Industrial Bank has been practicing this philosophy since its establishment. We were still a newcomer to green finance in 2006 and worked with the International Finance Corporation (IFC) to launch the first domestic financing product for energy saving and emission reduction. Clearly recognizing green development to be a major trend for the future, we spared no effort in this direction in the following decade. We became the first bank in China to adopt the "Equator Principles" in 2008. We have also led the domestic market and launched a series of green financial products and services, including loans with pollution rights as collaterals, loans with carbon assets as pledges, blue bonds, etc. By this March, we had provided over 30,000 enterprises with green financing of more than RMB 3 trillion; and the outstanding green finance has exceeded RMB 1.2 trillion. The energy conservation and emission reduction projects supported by our green financing are expected to reduce carbon dioxide emissions by 85.87 million tons each year, which is the equivalent of closing 196 thermal power plants with a capacity of 100 MW (megawatt) each. Meanwhile, thanks to the strong support of the PBoC, we have issued a total of RMB 139.5 billion of green and blue financial bonds in the domestic and overseas markets. This makes us the world's largest commercial financial institution in terms of scale of green bonds insurance and outstanding amount.

Going forward, financial institutions need to play a greater role in better tackling climate change. Now I would like to share some ideas with you:

- Firstly, we should work harder to improve the allocation of resources. Financial institutions should actively adjust their lending practices and credit structures in accordance with the plans to implement the CO2 emissions peak and carbon neutrality goals and in combination with their own development strategies. The objective is to encourage private funding to flow from sectors of high energy consumption and emissions to those of lower ones, and eventually adapt to, contribute to, and benefit from carbon neutrality. Furthermore, financial institutions should adapt ESG concepts and methods; take climate and environmental risks into consideration in the whole business process; and improve management of climate, environmental, and social risks.

- Second, we should strengthen innovation in carbon finance. China began the pilot program of carbon emissions trading in seven regions in 2011, which was later expanded to another two regions. In January 2021, the Ministry of Ecology and Environment issued the Interim Rules for Carbon Emissions Trading Management, accelerating the development of the national carbon market. In line with this, commercial banks can innovate and develop carbon financial products and services based on the market need to implement and trade emission quotas, and the need for investments in carbon assets or to revitalize stranded assets. This can encourage more enterprises subject to emission requirements in the market to reduce and offset emission. The ultimate goals include promoting price discovery in the carbon market, guiding the allocation of resources, and better managing environmental and climate risks.

- Third, we should move forward to achieve the goal of our own carbon neutrality. Recently, the Industrial Bank is making plans to join the UN Climate Neutral Now Initiative. Through this internationally recognized carbon neutrality system, we will establish our Bank's targets and roadmap for emission peak and carbon neutrality, and promote the Bank's science-based, low-carbon transformation. We also hope that, through our exploration and practices, we can provide

experiences to more banking institutions.

- Fourth, we should strengthen international exchanges and cooperation. Climate is the largest global public good. To tackle climate change, financial institutions around the globe should strengthen their cooperation and learn from each other. Industrial Bank hopes to continue to deepen exchanges and cooperation with international organizations and financial institutions in many areas, such as pilot programs of climate and environmental information disclosure, environmental (risk) stress testing, green financial product innovation, bridging with international green standards, and the updates of the Equator Principles.

- Finally, policy makers and regulatory authorities should strengthen relevant incentive and constraint mechanisms. These include: enhancing the support of monetary policy tools for green finance, increasing green central bank lending and rediscounting, implementing targeted cuts to required reserve ratios for low-carbon financing, reducing the risk weights of green financing assets for commercial banks, and ensuring seniority of green bond holders. Measures should be in place to encourage financial institutions to develop green finance and address climate change.

Thank you!

Unlocking the Financial Sector's Contribution to Reaching Net-Zero

Philipp Hildebrand[1]

The contribution of the financial sector will be critical to achieving a net-zero world by 2050 and I believe we have reached an inflection point. For one, global actors are increasingly aware of the need to include sustainability in their planning. Sustainability is no longer an option, but it is central to most policies and strategies today.

Contrary to expectations, the Covid-19 crisis has reinforced and accelerated the climate political and regulatory momentum with updated European climate ambitions, a stream of measures as part of the European Green Deal, China committing to become carbon neutral by 2060 and reach peak carbon emissions before 2030 as well as the UK's 10 points to drive a green revolution.

Although significant public spending commitments have been made in the last 12 months, these are not enough to fund the transition to a net-zero world in 2050 – a world in which we succeed in capping global temperate rise to below 2 degrees by 2100. In order to deliver on this, we need to mobilize huge quantities of private capital, estimates range from $3.5 to $6.9 trillion annually.

At the same time financial institutions are waking up to the reality that climate risk is an integral part of investment risk. As society and societal preferences are shifting, and government policies will shift with them, sustainable investing will become the new standard of investing. A changing society influences who we elect as our elected officials and what policies they pursue. It changes what people are willing to buy, how they spend their money. This is the thing

[1] Philipp Hildebrand is Vice Chairman of BlackRock.

that is changing asset pricing and changing asset markets. In the past people have said if we make the transition towards sustainable investing, then we have to accept lower returns of a certain magnitude. But what is misleading about this concept is that people are comparing against a fictitious benchmark. They are comparing against a world in which climate change doesn't exist which we know is not true. The real benchmark to compare against is one in which climate change occurs and no one does anything about it, and that is a very, very nasty set of occurrences. That is not a place where you are going to get fantastic returns across the board because there are material impacts on different regions and different economies.

It is for that reason why I believe the moment is propitious. The private sector has begun to respond to the challenge of reallocating capital. However, the market needs clear certainty and without clarity on definitions, private capital will not be able to mobilize in the vast scale needed.

To make this investment dynamic work, it will be imperative to create appropriate regulatory incentives, underpinned by globally-consistent standards on what constitutes legitimate climate transition investments.

As a first step we need to define what constitutes environmentally sustainable activities which already meet the objectives of the Paris Agreement. The EU's taxonomy framework lays this out very nicely and defines these as either key economic sector activities that make a substantive direct contribution to climate change mitigation or adaptations by either being very low emissions in their own right, or reducing the impact of carbon emissions elsewhere.

What the financial industry needs in order to deploy capital, however, is guidelines for pathways to transition to environmentally sustainable activities. Given the world is in many ways only at the start of the process of transitioning towards the Paris Agreement's goals, transition is an essential element on the path to a net-zero world and is where most of the capital will have to be allocated. Investors need clearly defined and globally agreed upon standards for these transition pathways to provide the security needed to invest large sums of capital.

Many market participants see the development of better reporting standards for corporates as an important enabler for investors to evaluate investments on the basis of their current and forward-looking contribution to or detraction from the climate goals. At the same time, companies have often complained of the many different climate or rather sustainability reporting frameworks they need to contend with. The current landscape is clearly sub-optimal for both investors and companies.

And finally, we need to consider how any framework could be used to guide public sector investment and spending decisions that can catalyze private investments. This important alignment of interest in an agreed framework being applied by both public and private sector is critical to delivering the scale of investment needed

In order to mobilize the vast amounts of capital necessary to achieve Net Zero by 2050 we need standards to provide clarity and transparency but these need to take into account the full spectrum of environmental solutions rather than being binary in addition to developing a global rather than a national standard. Only with planning certainty will investors feel comfortable to commit their resources.

Green Finance and Climate Policy: The Role of Investors

Fiona Reynolds[1]

2020 was an unprecedented and particularly challenging year, but we are hopeful that 2021 and the efforts to build back better will lead us to a brighter future.

In the wake of the pandemic, it is clear that COVID-19 will have a number of lasting legacies. One of these is the acceleration of responsible investment and the wider sustainability agenda, including the energy transition, driven by the external shock of the pandemic.

Investors around the world are increasingly supportive of policy actions to reach net-zero. Many are ready to contribute capital and collaborate with policymakers to design and implement policies that facilitate investment flows at scale. This includes in China where the pledge to reach carbon neutrality by 2060 represents a significant commitment of long-term ambition and priorities.

At PRI we published a policy briefing earlier this year on Delivering Carbon Neutrality in China. The briefing builds on research by Vivid Economics as part of PRI's Inevitable Policy Response programme. It provides recommendations to address overall climate ambition in China. The paper also makes recommendations on key sectors for decarbonisation, including power, road transport, buildings, and industry.

Alongside governments, investors have a critical role to play in helping to deliver on climate ambition, both in China and around the world. They have a number of powerful levers which they can use to help them do this. In short,

[1] Fiona Reynolds is the CEO of the Principles for Responsible Investment (PRI).

investors can use their leverage across four key areas: investment, engagement, reporting, and policy advocacy with government.

Firstly, on investment: large amounts of capital are necessary to facilitate the transition. This is particularly true in the main areas identified in the report, and there is rising demand for private capital. Investors will have opportunities to finance and invest in firms across all the priority sectors.

For example, in the renewables supply chain, investment opportunities include the developers and installers of renewables and the manufacturers of equipment in renewable technologies. Investors can finance industrial investment in energy efficiency measures and investors can provide financing through loans and investment to households and businesses to invest in energy efficiency improvements to buildings, heating, and energy management systems.

They must commit to net zero across their own portfolios. The UN Net-Zero Asset Owner Alliance is a great example of this in action. It demonstrates real accountability by the investment community, showing that climate change isn't all about risks—it is also about opportunities.

Another of investors' key levers on climate action is engagement with corporates.

The best example of this is Climate Action 100+ (CA 100+), the largest ever global investor engagement with 570+ investors, representing $54 trillion in AUM, who are engaging 167 high-emission companies, representing 80 percent of global industrial emissions. Over half (52 percent) of CA100+ focus companies have set a net zero by 2050 or sooner target or ambition.

The newly released Climate Action 100+ Net Zero Company Benchmark assesses the performance of focus companies against the initiative's three high-level goals: emissions reduction, governance, and disclosure. With ten sets of indicators, the benchmark helps investor signatories evaluate company ambition and action in tackling climate change.

Three of CA100+ focus companies are headquartered in China (PetroChina, Sinopec, and CNOOC) and have officially started research on the carbon neutrality pathway. PetroChina has even made a near zero emissions by 2050

commitment. In addition, seven local investor signatories are now leading or participating in engagements with Chinese CA100+ focus companies.

On reporting, last year 2,100 investors in over 50 countries reported to the PRI though our Reporting Framework on TCFD based indicators. This year, more investors need to report, including 25 Chinese investor signatories, and their responses will be made public. This is a key part of PRI's accountability framework.

In the past, TCFD and net-zero targets were trying to influence the mainstream—now they are mainstream.

Whether we are heading for consolidation or fragmentation of climate and sustainability reporting standards is a live issue for the industry and investors. We are cautiously optimistic that the direction we're moving in is towards consolidation. TCFD provides a strong foundation, but as Mark Carney has stated, investors and companies will need to go beyond that and provide net-zero transition plans.

Finally, on policy advocacy, investors are engaging with governments—including in China—as reaching net zero will undoubtably require changes to government policy settings.

There is an urgent need to know the plans for how China will transform its energy system to meet net-zero emissions. Investors are calling for policy change not in ten or 20 years from now, but today and over the next Five-Year Plan so that China will be on a smooth trajectory to meet this target.

Beyond the policy recommendations in the PRI report, an investor survey led by the PRI in May 2020 concluded that a standardised and forward looking ESG disclosure policy framework appears as an effective solution to help investors make informed investment decisions and allocate more capital in sustainable and green assets in China and therefore support the net zero transition.

So, to conclude, investors have a number of key levers though which they can help move the dial on climate change in China, and globally. At PRI our signatories tell us year-on-year that climate is their top priority and we're

committed to supporting them on this.

In the build-up to COP26, we look forward to continuing international collaboration and working even closer with Chinese policy makers, regulators, and investors to accelerate progress as they seek to transition to a net-zero and inclusive future.

A Critical Role for Hong Kong SAR and HKEX in the Global Sustainable Finance Journey

Calvin Tai[1]

The business case for sustainable business practices, and sustainable finance, is becoming stronger day by day, yet shifting to more sustainable business practices requires capital. Global financial markets have a pivotal role to play in financing the world's transition to a low-carbon economy.

The sustainable finance journey has already begun, and Asia needs to catch up in the evolution. Recently, regional leaders have made commitments to tackle climate change. Asia's three biggest economies, China, Japan, and Korea, which together emit around one third of all global carbon emissions, have made some brave commitments. Japan and Korea have pledged carbon neutrality by 2050, and China by 2060. The Hong Kong SAR government has committed to carbon neutrality by 2050.
These pledges are expected to accelerate the growth of sustainable finance in the region.

Hong Kong SAR is uniquely positioned to lead Asia's sustainable finance transition, and as a regulator, market operator, and a corporate, Hong Kong Exchanges and Clearing Limited (HKEX) has a critical role to play in the sustainability journey. We see ourselves as a regional change agent, providing the framework, guidance, resources, and support needed for the long-term development of a robust sustainable finance ecosystem.

[1] Calvin Tai was Interim Chief Executive as the date of the event, and currently is President and Chief Operating Officer of Hong Kong Exchanges and Clearing Limited.

Hong Kong SAR's Role

Hong Kong SAR is now the largest asset management market in Asia, the largest offshore liquidity pool for renminbi in the world, and one of the largest IPO fundraising centres in the world. With its world-class business infrastructure, sound regulatory environment, diversified pools of capital, liquidity, investors, financial products, and professional expertise, Hong Kong SAR is not only an international investment destination in its own right, but also an effective two-way gateway connecting Mainland China with global markets.

Hong Kong SAR's role as a connector between China and the rest of the world, and the strong government support for sustainability, will allow Hong Kong SAR to play a leading role in Asia's green finance transition. Hong Kong SAR's capital markets will play an important role in helping companies from the Mainland and the rest of the world raise the money they need to finance their transition to a more sustainable future. At the same time, our markets are providing international investors with access to the growing Asian green market.

Sustainable finance is also a key strategic priority in the Greater Bay Area region, and Hong Kong SAR has been designated as the green finance hub in the region within the GBA strategy. Last September, Hong Kong SAR Government joined forces with other GBA governments to form the Guangdong-Hong Kong- Macau Greater Bay Area Green Finance Alliance, with the aim to promote research and incubating green investments that will benefit the GBA region.

Reaching the goal of carbon neutrality will require a lot of capital. As demand for sustainable finance and investment products in the region continues to grow, much of the international investment in facilitating that transition is likely to come through Hong Kong SAR, creating huge opportunities for the city, and for HKEX.

Asia's Global Capital Market Leader

At HKEX we are committed to creating a sustainable finance ecosystem because we believe it is the right thing for both business and society. We

look to set an example and engage with all our stakeholders—in our role as regulator, market operator, and listed company.

As a regulator, HKEX provides the markets with a framework and clear guidance for ESG disclosure, application, and implementation through listing regulation, rules, and education. Our ESG journey started a decade ago, and we first introduced ESG disclosure requirements in 2013. In 2017, we further mandated disclosure of all environmental KPIs by listed issuers. In 2019, we added disclosure of issuer diversity policies to our ESG requirements—as well as employee gender ratios. In 2020 we revised Hong Kong's ESG Reporting Guide to reinforce the boards' commitment on ESG matters and require disclosures of all environmental and social KPIs.

As an exchange operator, HKEX is building and supporting a broad range of products to enable businesses to accelerate their sustainability journey, and for investors to diversify their portfolios. We have attracted a diverse range of green finance issuances and there is great appetite for more. In 2020 HKEX launched STAGE, the Sustainable and Green Exchange, Asia's first multi-asset platform to encourage greater transparency through additional voluntary disclosures, increased access to data and resources, and promote market education and stakeholder engagement in order to grow the under-served sustainable finance market in Asia.

As a corporate, HKEX seek to lead by example, promoting sustainability across our business, operations, and markets. We are a founding member of Hong Kong's Green and Sustainable Finance Cross-Agency Steering Group, which co-ordinates many of these efforts within the financial sector. HKEX has also invested in a minority stake in the newly established Guangzhou Futures Exchange.

Green finance is a key focus for the new exchange, with derivatives relating to the green sector and Belt and Road Initiative expected to be launched in due course.

Committed to our Role

As the gateway between China and rest of the world, Hong Kong SAR has a

key role to play in the sustainability transition of the region. HKEX is at the centre of that effort. We can play an active role in incentivising investors and issuers, and we are committed to fulfilling our role.

At HKEX we pledge to provide the connectivity, regulation, education, and capital raising platforms needed to create a robust sustainable finance ecosystem. Through ongoing dialogues, market development, and regulations, our aim is to work with market participants to build a centre of excellence in sustainable finance here in Hong Kong SAR, and to position Hong Kong SAR as the leading sustainable finance hub in Asia, and globally.

SESSION III

POLICY MIX FOR CLIMATE CHANGE MITIGATION

Fiscal Policies to Address Climate Change in Asia and the Pacific

Wenjie Chen and Kenneth Kang[1]

Climate Change in the Asia and Pacific Region

One of the main messages from a recently published IMF paper titled *"Fiscal Policies to Address Climate Change in Asia and the Pacific: Opportunities and Challenges"* is that **Asia-Pacific is very exposed to climate**.[2] Climate change poses an existential threat to many small island countries and coastal areas, while also disproportionately affecting the poor. Coastal mega cities, such as Mumbai, Dhaka, Hong Kong SAR, and Shanghai, are also at greater risk of flooding from rising sea levels.

At the same time, the **region has also become a major contributor to greenhouse gases**. This is hardly surprising given that Asia-Pacific is home to the majority of the world's population and has been the main driver of global growth in recent decades. Therefore, **Asia Pacific has a critical role in the global strategy for addressing climate change.**

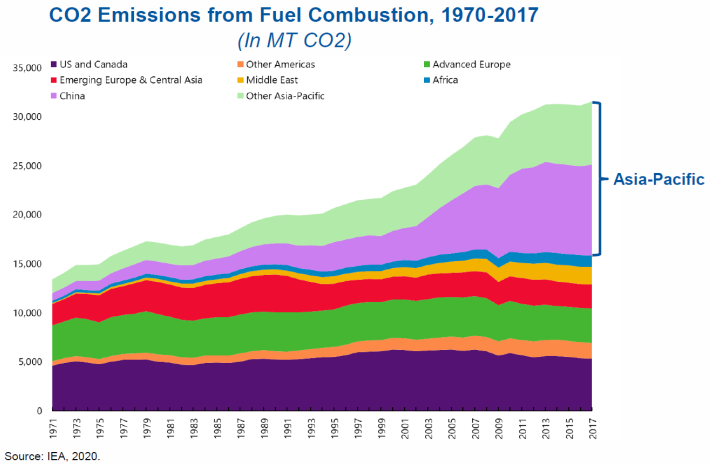
Climate Mitigation Policies

The climate literature has shown that raising the price for C02 is a highly

[1] Wenjie Chen is Senior Economist, and Kenneth Kan is Deputy Director, Asia & Pacific Department, International Monetary Fund;

[2] IMF Departmental Paper (2021): Fiscal Policies to Address Climate Change in Asia and the Pacific: Opportunities and Challenges

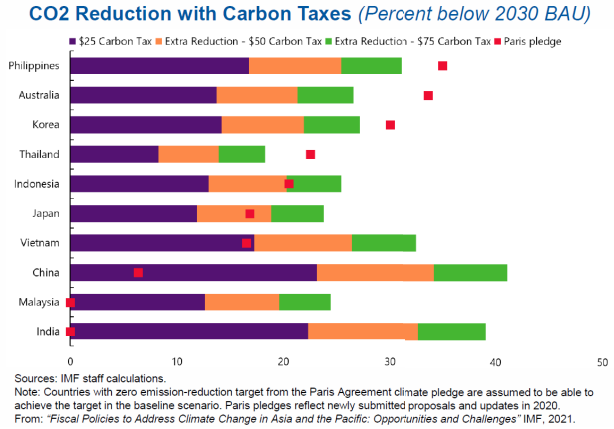
The Asia and Pacific region emits about half of global CO2



effective way of reducing emissions. One way to achieve this are through carbon taxes. Our work shows that even a relatively modest carbon tax of $25 per ton implemented collectively and gradually over the next 10 years can reduce regional emissions by over 20 percent and would easily achieve the region's overall Paris target. That being said, a much higher tax would be needed to limit global warming to 2 degrees or less.

In addition, a carbon tax has the **benefit of generating revenues to compensate the most vulnerable and finance priority spending**, including on health,

Modest carbon taxes could achieve the region's aggregate Paris target, but more is needed



education, and infrastructure. For example, a carbon tax of $50 per ton could generate **annual revenue of 1.4 percent of GDP** for the region, which could be used to compensate lower-income households affected by higher carbon prices or support the jobs transition to low-carbon sectors. The distributional impact of a carbon tax varies significantly across countries in Asia-Pacific, depending on their energy consumption patterns. For example, our analysis finds that a carbon tax is **moderately regressive** in Australia and China, but **moderately progressive** in India and the Philippines. Addressing the distributional consequences during the transition will be critical for maintaining public support for these efforts.

Depending on country circumstances, a carbon tax might not always be the best or the preferred choice, and only two countries in Asia have so far introduced a carbon tax—Japan and Singapore. **Therefore, other tools can and should be used to complement a carbon pricing system**. These include:

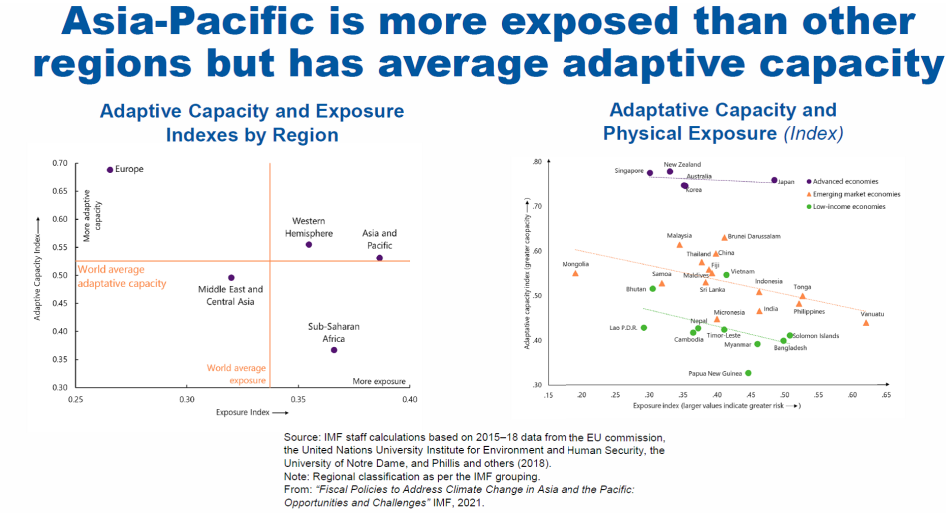
- Emissions trading systems (ETS) like the tradeable performance standard introduced in China this year or Korea's ETS started in 2015.
- So-called "feebates" that reward efficient practices while penalizing damaging behavior can help reinforce pricing schemes, such as Singapore's Vehicular Emission Scheme (VES).
- Other policy instruments include sector-specific emissions and energy regulations, a coal tax, and green technology policies.

As for China and other countries, climate mitigation strategies do not have to rely on climate policies alone. Continuing reforms towards **high-quality, sustainable, and balanced growth** will also contribute to lowering carbon emissions. Shifting away from investment-heavy to consumption-led growth, and supporting the expansion of services and high-tech sectors—as called for in China's 14th Five-Year-Plan—will reduce energy demand and the carbon intensity of growth, thus making it easier to achieve its climate goals.

Climate Adaptation Policies

But for the region, it is not just mitigation but also **climate change adaption** which is critical. We find that the climate adaptive capacity of Asia and Pacific is broadly in line with the rest of the world. However, that is not enough, as it is also the **region most exposed to climate risk**. It is the **low-income countries** in particular that are the most exposed with the least adaptive capacity.

Investing in adaptive infrastructure can yield high returns, as it reduces the



Source: IMF staff calculations based on 2015–18 data from the EU commission, the United Nations University Institute for Environment and Human Security, the University of Notre Dame, and Phillis and others (2018).
Note: Regional classification as per the IMF grouping.
From: *"Fiscal Policies to Address Climate Change in Asia and the Pacific: Opportunities and Challenges"* IMF, 2021.

damage and economic disruption from disasters, and support a quicker recovery.

Although worth pursuing, they are also **initially very costly**. Our research estimates the investment needs for climate-proofing infrastructure to be around **3 1/3 percent of GDP annually** for the region during the next decade, with the amount exceeding **5-10 percent of GDP** for some Pacific island countries.

Low-income and Pacific island countries are particularly vulnerable and need to invest in protecting infrastructure, making water resources more resilient, and improving early warning systems for natural disasters. Yet, for these highly vulnerable countries with limited fiscal space, more so after COVID-19, these large investments would be difficult to accommodate without **concessional loans or donor grants**.

Conclusion

This brings me to my last, but perhaps most important point, namely, that

tackling climate change is a **global effort**. We need to promote and finance the **transfer of green technologies to developing countries** and step up efforts to expand multilateral climate funds. The **IMF** is helping by integrating climate in our annual country assessments and scaling up capacity development to help countries integrate climate into their fiscal strategies and improve the effectiveness of their climate investments.

We look forward to working even more closely with countries in the Asia and the Pacific region on these fundamental challenges.

Policy Mix for Climate Change Mitigation

LI Zheng[1]

Since 2019, the Institute of Climate Change and Sustainable Development of Tsinghua University (hereafter the Institute) has organized 24 Chinese research institutions and thinktanks to jointly research and propose the medium- to long-term objectives and policy options to address climate change. The research project (hereafter the Project) consists of 18 sub-projects, covering major social and economic dimensions related to climate issues.

The Project studied the long-term low-carbon development goals and transformation pathways for China by 2050. Under the four scenarios of Policy, Enhanced Policy, 2℃, and 1.5℃. The total primary energy demand in China by 2050 is forecasted to be 6.2, 5.6, 5.2, and 5 billion tons of standard coal respectively. However, the corresponding energy-related carbon emission will reach 9, 6.2, 2.9, and 1.4 billion tons respectively. The emissions under the latter two scenarios are far lower than the policy and enhanced policy scenario because the latter are calculated in accordance to the Paris Agreement targets, which demand a fundamental shift in the energy mix. Based on the information from these scenarios while taking into account the great inertia of both the economy and the energy sector in their transformation, the Project proposes a two-step strategy for accelerated transformation. First, boost the target for the 2030 Nationally Determined Contributions (NDCs) and promote accelerated development of non-fossil energy sources, to ensure the peak of carbon emissions by 2030. Second, using the 2℃ and 1.5℃ scenario as a

[1] LI Zheng is Executive Vice President of the Institute of Climate Change and Sustainable Development, Tsinghua University.

target, further speed up the development of non-fossil fuel energy sources and the reduction of carbon emissions, to achieve the deep-decarbonization transformation.

First and foremost, to achieve such target, it is imperative to transform the energy system. We need to shift the current fossil fuels dominated energy mix into an non-fossil fuel energy sources mix. Under the 2℃ Scenario, non-fossil fuel energy will account for 70 percent of the total primary energy consumption in China by 2050, while the share of coal will fall below 10 percent, with end-use electrification rate of up to 55 percent. Under the 1.5℃ Scenario, non-fossil fuel energy will represent 85 percent of the total primary energy consumption in China, whereas the share of coal will drop below 5 percent, with end-use electrification rate of up to 68 percent.

Meanwhile, in addition to the energy system, other sectors including the industrial, agricultural, transport, and building sectors will need to be fundamentally transformed, to significantly reduce the emissions of carbon dioxide and other greenhouse gases (GHGs). Under the 2℃ Scenario, the carbon emission will be reduced by 80 percent by 2050, with the total GHGs falling by 70 percent. Under the 1.5℃ Scenario, the carbon sink will offset the carbon emissions by 2050, achieving net zero emissions, and the overall GHG emissions will be reduced by 90 percent.

For such a substantial transformation, huge investments are needed. For instance, to achieve the objectives under 2℃ Scenario and 1.5℃ Scenario, a total investment of RMB¥127 trillion and ¥174 trillion respectively is needed by 2050, respectively. Of which, the energy supply sector will receive the major part of said investment, standing at RMB¥99 trillion under 2℃ scenario and 138 trillion under the 1.5℃ scenario, an equivalent of 1.5-2.5 percent of total GDP in the corresponding period. Despite the huge costs, it is worth the investment, as it will bring new potentials for economic growth and create new jobs, thus contributing to high-quality development.

To achieve these objectives, a series of policies are needed, such as those related to legislation, strategy and planning, performance evaluation systems, economic and market policies, fiscal and taxation policies, statistics and

disclosure, and policies. These will encourage developed regions to achieve their targets ahead of schedule.

Mitigating Climate Change: Growth Friendly Strategies to Achieve Net Zero Emissions by 2050

Warwick J McKibbin[1]

Scientific opinion is that greenhouse gas emissions are on course to raise temperatures by 3 to 6 degrees by 2100. Thus the window for limiting emissions to 1.5 to 2 degrees C, or in other words, to net zero emissions by 2050, is closing rapidly. In a recent paper (Jaumont, Liu, and McKibbin(2021)), we explore policies that can mitigate climate change to achieve zero net emissions by 2050 while providing economic stimulus in response to the COVID 19 pandemic. This paper extends the research that was the basis of Chapter 3 of the October 2020 IMF World Economic Outlook. We explore if it is possible to design a stimulus package to respond to the COIVD19 crisis designed to boost green and resilient public infrastructure. This stimulus should ensure that the composition of capital spending in the recovery is consistent with decarbonization.

We ask: how can the world economy reach zero net carbon emissions by 2050 in a growth and employment friendly way? Secondly, can a well-designed and sequenced mitigation policy help with the economic repair from the COVID-19 crisis?

[1] Warwick J. McKibbin is the Vice Chancellor's Chair in Public Policy and is Director of the Centre for Applied Macroeconomic Analysis (CAMA) in the Crawford School of Public Policy at the Australian National University (ANU). He is also Director of Policy Engagement at the Centre for Excellence in Population Ageing Research (CEPAR) and a non-resident Senior Fellow at the Brookings Institution and

In a global economic model (the G-Cubed model) that is widely used for policy analysis, it is possible to reach zero net emissions by mid-century using a mitigation toolkit consisting of both carbon pricing and green supply policies. We focus on net-zero emissions by mid-century for the entire economy, which implies an 80% reduction in gross emissions from energy generation. The model is outlined in McKibbin and Wilcoxen (2013).

We explore a package consisting of four significant policies. One is green energy supply policies, including a 90% subsidy on renewable energy production and a 10-year green public investment program. In this program, government infrastructure spending starts at 1% of GDP and gradually declines to zero after ten years. After the 10th year, additional public investment is implemented to maintain the infrastructure capital stock that has been created. A second key policy is a carbon tax in each economy or region calculated to start at a level sufficient to reduce emission by 80% by 2050 if the tax is increased by 7% per year. The initial carbon tax is different across countries because of different economic structures, economic growth rates, different degrees of carbonization of the energy and production systems, and different stages of development. The carbon tax is designed to achieve a gradual reduction in CO2 emissions across all. Carbon taxes across countries start between $6 and $20 a tonne of CO2 and reach between $10 and $40 a tonne by 2030 and $40 to $250 a tonne of CO2 by 2050. A third aspect of the policy package is short-term compensatory transfers to households, for 1/4 of the carbon tax revenue goes to protect the purchasing power of poor households. The rest of the carbon tax revenue is used to pay for the green investment program. Fourthly we assume that macro policies are supportive so that monetary policy remains ultra-loose and the debt financing for the increasing budget deficits remains low.

We find under assumptions of no other climate policies to those announced in 2019 (what we call the business as usual) using the model that global carbon dioxide emissions rise steadily between now and 2050. A large part of that growth in emissions comes from emerging countries, particularly China, India, and other emerging countries. The composition of the change in CO2 emissions over that period is driven both positively and negatively by different

drivers. For example, energy intensity changes and changes in carbon intensity which are endogenous to the model dynamics, tend to reduce CO2 emissions over time. But the significant drivers of emissions increasing over time are population growth and real GDP growth per capita.

When implementing the policy package of green infrastructure, a subsidy to renewable energy, income transfers to households, and a carbon tax, we consider avoided damages, the impact on CO2 emissions, and the impact on GDP are different across policies. For example, the infrastructure program has a small but significant impact on reducing CO2 emissions and increasingly improving GDP over time. The transfers to households and the green energy subsidy to renewable energy have a negligible effect on CO2 emissions and a small impact on economic growth. However, the carbon tax has a significant impact on CO2 emissions yet leads to lower real GDP than otherwise would be the case with different results across economies. We also find that the employment effects by sector are very different across countries and within countries. Not surprisingly, we find falling employment in the fossil fuel sectors of coal oil and gas extraction sectors. We also find weaker employment growth in sectors such as transportation, manufacturing, construction. This composition of employment changes reflects the shift away from fossil fuel and capital-intensive energy generation. However, we find stronger employment in the renewable sector, low carbon sectors, agriculture and forestry, and particularly increasing employment in the service industries. The net effect on employment across all countries on aggregate is a stimulus to employment relative to what it would be over the first five years, which is very helpful to offset the impact of the Covid pandemic. But after the first five years, the economy's adjustment to higher carbon prices leads to reduced employment concentrated in the fossil fuel industries in fossil fuel-intensive industries. The fall in aggregate employment is eventually reversed by 2050 by lowering real wages across the economy.

In conclusion, the research finds that it is possible, at least in the economic model used, to reach zero net emissions by 2050 and boost incomes in the long run and avoid catastrophic climate risk. However, despite the capacity to achieve their emissions reductions by 2050, the window is closing rapidly.

We also find that a green investment stimulus can offset the economic costs of a carbon tax. It is possible to have both a net reduction in emissions driven by the green investment and the carbon tax and still balance the output losses of the carbon tax with short-term and long-term output gains from the green infrastructure programs.

We find that carbon pricing is critical to achieving carbon mitigation because carbon prices discriminate better across a whole range of economic activities in incentivizing energy efficiency and reallocating resources from high to low carbon activities throughout the economy. The argument that carbon taxes are not politically feasible and should be instead replaced by direct subsidies or other less efficient market or non-market interventions ignores the fact that there are many ways to price carbon. While carbon taxes have the advantage of raising revenue which can be used to finance other activities, this can also be a disadvantage since it creates vested interests who are more concerned with the revenue transfers than the carbon price itself. Other alternatives to pricing carbon in a way that avoids the range of political problems with carbon taxes include the Hybrid approach of McKibbin and Wilcoxen (2007), which has recently been extended to the Climate and Asset Liability Mechanism (CALM) in Australian Academy of Social Sciences (2020)). At an international level, International Carbon Price Consultations, as proposed by McKibbin, Morris, and Wilcoxen (2014), also appear feasible. The political problem of carbon taxes is usually stressed by political scientists who ignore the widespread economic evidence (in models and from actual policy implementation) of the effectiveness of carbon pricing. They appear to prefer a continuation of political negotiations that achieve very little economic effectiveness but satisfy some measure of short-term political expediency. Focussing on political solutions that rule out effective policies partly explains why global greenhouse emissions keep rising. The greater involvement of economic agencies rather than foreign ministries and environmental agencies in the challenge of international climate policy negotiations, the more likely it is that effective policies based on sound economics will be implemented in the major emitting economies.

Carbon pricing (combined with a portfolio of policies) and support of the carbon transition through green infrastructure are essential to reducing greenhouse

gas emissions. Carbon prices, especially credibly rising carbon prices that can be observed and traded in a futures market, change all economic actors' behavior on the demand and supply side of the economy. The gradual reduction in emissions from a well-designed carbon price and supporting policies is the lowest cost and most effective policy to address climate change.

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Addressing China' Construction Bias: A Climate and Macro-Economic Priority

Adair Turner[1]

It's a pleasure to join this IMF-PBOC seminar and in particular this panel on the policy mix for climate mitigation. Many important points about the key technological and investment priorities and the required policies have already been made. I would like to add to those perspectives by focusing on one crucial area where the actions required to reduce CO2 emissions overlap with the actions required to rebalance the Chinese economy onto a more sustainable macroeconomic basis.

To achieve a zero-carbon economy one must start with a clear long-term target. President Xi's commitment at the United Nations last September that China will achieve net zero emissions by 2060 was therefore a huge step forward and an important example of responsible global leadership. I hope and expect that China will subsequently move to a still more stretching target—zero by 2050—reflecting the fact that by mid-century China will have become a fully developed rich economy. The Energy Transitions Commission set out how that could be achieved in our 2019 report.[2]

With the long term overall target set, we need to identify the detailed sectoral actions required to get there, and it is clear that in China and across the world, decarbonising electricity generation and electrifying as much of the economy as possible, must play the central role . The good news is that that

[1] Adair Turner is Chair of the Energy Transitions Commission.

[2] https://www.energy-transitions.org/publications/china-2050-a-fully-developed-rich-zero-carbon-economy/

is now possible at low or nil cost, with wind and solar now the cheapest way to produce electricity in China and across the world.[3] Ideally China should therefore commit to ensuring that all growth of electricity demand is met from zero carbon sources, with no investment in new coal plants over the next decade, and with a plan to phase out existing coal plants gradually in the subsequent two decades.

But a comprehensive decarbonisation strategy must also address the sectors which cannot be simply electrified and in particular two heavy industry sectors (steel and cement)–which across the world account for about 15 percent of all CO2 emissions, but in China for a still higher 30 percent–account for about 3GT of cO2 per annum out of China's 10 GT total. It is here that China's climate change challenge overlaps with its macroeconomic challenge.

In the long run we will have to produce cement and steel in a zero-carbon fashion, and the technologies to do that—such as using hydrogen as the reduction agent in steel production—are now becoming available. But if China is to have any chance of meeting President Xi' second policy commitment—peaking China's CO2 emissions by 2030—it will also have to constrain the unnecessary use of steel and cement. To do that China must rebalance its economy away from excessive investment in infrastructure and property construction.

As is well known, China has an economic model skewed towards investment rather than consumption, with an investment rate of 45 percent of GDP which is far higher than observed by rapid growth countries (such as Japan or Korea) when they were at similar levels of income per capita. But in addition, within that total there is a huge bias towards investment in physical infrastructure and real estate which in 2008 stood at around 15 percent of GDP, but soared to reach over 25 percent of GDP by 2016. An excellent joint report by the World Bank and the DRC in 2019—Innovative China-New Drivers of Growth[4] describes this startling development and highlights its risks.

Much of that investment is valuable: China has built a superb high-speed rail

[3] https://www.energy-transitions.org/publications/making-clean-electricity-possible/

[4] Innovative China-New Drivers of Growth, report of the World Bank and the DRC of the State Council, 2019, https://openknowledge.worldbank.org/handle/10986/32351

network and good highway infrastructure. But a significant share of the total is wasted on unneeded real estate which will never be occupied. An April 2020 survey by the PBOC revealed the startling fact that 40 percent of Chinese urban citizens own more than one apartment, and other studies suggest that 15 to 20 percent of all apartments are unoccupied.[5]

This excessive investment creates two categories of risks—one financial and the other macroeconomic. As the PBOC and the CBIRC have warned for several years, credit fuelled real estate development threatens bad loans and financial instability, and they have therefore rightly sought to deploy multiple policy tools—such as loan to value limits and lending guidance—to slow this potentially dangerous boom.

But more fundamentally, unnecessary investment is simply a waste of China's national savings, and the scale of the waste threatens to grow further in the coming years. China's population will almost certainly peak in the next few years, with gradual decline thereafter: the urbanisation rate, currently at 62 percent, will be over 70 percent by 2030 and approaching developed country levels. Migration from the countryside to the cities will slow and demand for urban real estate decline. If China keeps investing in real estate at the current pace it will pour lots of unnecessary concrete and emit large amounts of CO2 to create assets of no value to the Chinese people.

Many Chinese economists have therefore correctly argued that China must rebalance its economy away from excessive construction investment. One priority, highlighted in the government's Work Programme of May 2020, could be to shift investment from "old" to "new" infrastructure—spending less on buildings and more on robots, 5G and fibre optic networks, and data centres. But since the cost of these technologies is relentlessly falling, there is a limit to how large investment in them can possibly be. Estimates from the China Centre for Information Industry Development, analysed by the Energy Transitions Commission in a recent report,[6] suggest that truly "new" high-tech infrastructure investment needs are unlikely to exceed 0.7 percent of GDP.

[5] 2019 China Urban Households Asset and Debt Survey, People's Bank of China, April 2020

[6] 2019 China Urban Households Asset and Debt Survey, People's Bank of China, April 2020

These investments are vital to build China's high productive economy of the future but cannot fully replace construction as a source of employment and economic activity.

Large-scale investment in renewable energy could play a somewhat larger role. To be on a path towards net zero emissions by mid-century, China should build around another 1000GW of wind and solar capacity by 2030.[7] But even such large capacity growth would be unlikely to cost more than 1.5 percent of GDP and cannot therefore fully compensate for the desirable decline in construction investment.

Alongside reallocating investment, China must therefore stimulate consumption as a share of GDP. That of course has been said for many years, but progress has been slow. Achieving it will almost certainly require better social welfare and health care provision to reduce the need for precautionary savings. And reducing infrastructure and real estate investment may require profound changes to the structure of local government finance, where the current reliance on land sales creates a bias towards expansive physical development and related construction.

Alongside the crucial priority of building a zero-carbon electricity system, China therefore needs to develop soon a clear strategy to address its macro-economic bias towards construction. Achieving that will be complex, but the result will be both a more balanced and productive economy and emissions reductions which are vital to China's climate objectives.

[7] https://www.energy-transitions.org/publications/china-zero-carbon/

BIOGRAPHIES

YI Gang

Governor
The People's Bank of China

Dr. YI Gang is the Governor of the People's Bank of China and the Deputy Director of the Financial Stability and Development Committee of the State Council. He sits on the Board of Directors of the Bank for International Settlements.

Dr. Yi joined the People's Bank of China in 1997 and has held a number of positions, including Secretary-General of the Monetary Policy Committee and Director-General of the Monetary Policy Department. In December 2007, he became a deputy governor and was appointed Administrator of the State Administration of Foreign Exchange in July 2009, a position he held until December 2015. He was appointed Governor of the People's Bank of China in March 2018.

Dr. Yi received a Ph.D. in Economics from the University of Illinois in 1986 and was a faculty member in the Department of Economics, Indiana University from 1986 to 1994. In 1994, he co-founded the China Center for Economic Research (CCER) at Peking University and has been a professor at the CCER since then.

His research interests include money, banking and the Chinese economy.

Kristalina Georgieva

Managing Director
International Monetary Fund

Kristalina Georgieva is the Managing Director of the IMF since October 1, 2019.

She was CEO of the World Bank from January 2017 to September 2019, during which time she also served as Interim President for three months.

Previously, Ms. Georgieva served as European Commission Vice President for Budget and Human Resources and as Commissioner for International Cooperation, Humanitarian Aid and Crisis Response.

From 1993 to 2010, she held a number of senior positions at the World Bank, including as Vice President and Corporate Secretary in 2008, and as Director for Sustainable Development, Director for the Russian Federation (based in Moscow), Director for Environment, and Director for Environment and Social Development for the East Asia and Pacific Region.

Born in Sofia, Bulgaria, she holds a Ph.D. in Economic Science and a M.A. in Political Economy and Sociology from the University of National and World Economy, Sofia, where she was an Associate Professor between 1977 and 1993. She also was visiting fellow at the London School of Economics and at the Massachusetts Institute of Technology.

Tobias Adrian

Financial Counsellor, and Director
The Monetary and Capital Markets Department,
International Monetary Fund

Tobias Adrian is the Financial Counsellor and Director of the Monetary and Capital Markets Department of the International Monetary Fund (IMF). In this capacity, he leads the IMF's work on financial sector surveillance, monetary and macroprudential policies, financial regulation, bank resolution, debt management, and capital markets. Prior to joining the IMF, Mr. Adrian was a Senior Vice President of the Federal Reserve Bank of New York where he contributed to monetary policy, financial stability policies, and to crisis management. Mr. Adrian has published in economics and finance journals and has taught at Princeton University and New York University. His research spans asset pricing, financial institutions, monetary policy, and financial stability, with a focus on aggregate consequences of capital markets developments. Mr. Adrian holds a Ph.D. from the Massachusetts Institute of Technology, an MSc from the London School of Economics.

Vitor Gaspar

Director
Fiscal Affairs Department, International Monetary Fund

Mr. Gaspar is Director of the Fiscal Affairs Department at the IMF. He joined in 2014. Before that, he was Portuguese Minister of State and Finance from 2011–13, and has held various positions in European and Portuguese institutions, including head of BEPA at the European Commission, director-general of research at the European Central Bank, director of Economic Studies and Statistics at the Central Bank of Portugal, and Director of Economic Studies at the Portuguese Ministry of Finance.

Mr. Gaspar holds a Ph.D. and a post-doctoral agregado in Economics from Universidade Nova de Lisboa; he graduated from Universidade Católica Portuguesa.

Philipp Hildebrand

Vice Chairman
BlackRock

Philipp Hildebrand, Vice Chairman of BlackRock, is a member of the firm's Global Executive Committee. He also oversees the BlackRock Investment Institute (BII) and BlackRock Sustainable Investing (BSI).

Mr. Hildebrand joined BlackRock in 2012. Prior to that, he served as Chairman of the Governing Board of the Swiss National Bank (SNB). In that capacity, he was also a Director of the Bank for International Settlements (BIS), the Swiss Governor of the International Monetary Fund (IMF) and a member of the Financial Stability Board (FSB), of which the Leaders of the G20 appointed him Vice Chairman in 2011. He was also Chairman of the Administrative Committee of the Board of Directors of the BIS, and part of the Steering Committee and the Plenary of the Financial Stability Board (FSB). Previously, Mr. Hildebrand was Chief Investment Officer of a Swiss private bank and a partner at Moore Capital Management in London.

Mr. Hildebrand is a Trustee of the British Museum, a member of the Group of Thirty and an Honorary Fellow of Lincoln College, Oxford. He sits on the International Advisory Board of Oxford University's Blavatnik School of Government and the International Leadership Council for Europe for the University of Toronto. He is a Chevalier de L'Ordre National du Mérite (France).

Mr. Hildebrand earned a BA from the University of Toronto, an MA from the Graduate Institute of International Studies in Geneva, and a DPhil from the University of Oxford.

Kenneth Kang

Deputy Director
The Asia & Pacific Department, International Monetary Fund

Kenneth Kang is a Deputy Director in the Asia & Pacific Department of the International Monetary Fund, covering countries in Northeast Asia, including China, Hong Kong, Korea, and Mongolia. Previously, he worked on a range of countries, including Italy, Japan, the Netherlands, and the euro area and served as the IMF's Resident Representative in Korea during 2003–06. He has a Ph.D. from Harvard University, and a B.S. from Yale University.

LI Bo

Deputy Governor
The People's Bank of China

Dr. Li rejoined the PBoC as Deputy Governor in April 2021. During his fourteen years of service at PBoC between 2004 and 2018, Dr. Li headed various departments including Legal and Regulation, Monetary Policy II, and Monetary Policy.

Dr. Li was the Vice Mayor of Chongqing Municipality before he rejoin the PBoC in 2021. Before that, he was the Vice Chairman of All-China Federation of Returned Overseas Chinese. Prior to joining the PBoC in 2004, Dr. Li was a practicing attorney with the New York law firm of Davis Polk & Wardwell.

Dr. Li holds a Ph.D. degree in economics from Stanford University and a J.D. magna cum laude from Harvard Law School. He is a member of the Chinese and New York Bar.

LI Zheng

Executive Vice President
The Institute of Climate Change and Sustainable Development, Tsinghua University

Prof. Li Zheng is Chang Jiang Scholars, Executive Vice President of the Institute of Climate Change and Sustainable Development and Director of the Laboratory of Low Carbon Energy, Tsinghua University. His research interests are energy and climate in general, including energy system modeling and analysis, decarbonization of power and industrial sectors, and low carbon development strategy and transition pathways. He is leading several national and international research projects on energy/climate policies and technologies.

MA Jun

Chairman of Green Finance Committee of China Society for Finance and Banking
Founder and President of Institute of Finance and Sustainability (IFS)

MA Jun is Founder and President of Institute of Finance and Sustainability (based in Beijing). He is also Chairman of Green Finance Committee of China Society for Finance and Banking, Special Advisor to the Governor of the People's Bank of China (PBC), and Co-chair of G20 Sustainable Finance Study Group. He was a member of the Monetary Policy Committee of the PBC between 2018-2020, Director of the Center for Finance and Development, Tsinghua National Institute of Financial Research. Prior to that, he was the Chief Economist at the Research Bureau of the PBC from 2014-17. He worked for 13 years at Deutsche Bank, where he was Managing Director, Chief Economist for Greater China, and Head of China and Hong Kong Strategy. From 1992-2000, he worked as public policy specialist, economist and senior economist at the International Monetary Fund and World Bank. From 1988-1990, he was a research fellow at the Development Research Center of China's State Council. Ma Jun received his Ph.D. in Economics from Georgetown University in 1994.

Sabine Mauderer

Member of the Executive Board
The Deutsche Bundesbank

Dr. Sabine Mauderer has been Member of the Executive Board of the Deutsche Bundesbank since September 2018. She is responsible for the Directorates Markets and Human Resources. Additionally she is a member of the Exchange Experts Commission, the Central Capital Market Committee, and the Steering Committee of the "Central banks and Supervisors Network for Greening the Financial System (NGFS)". Prior to her current responsibilities she held several positions at the KfW Banking group. Before that she worked as a senior adviser at the Federal Ministry of Finance. She was born in Schleswig in 1970. Sabine Mauderer graduated in law, holds a PhD by the Osnabrück University and an Executive MBA by the ESSEC & Mannheim Business School.

Warwick J. McKibbin

Vice Chancellor's Chair in Public Policy and
Director, Centre for Applied Macroeconomic Analysis (CAMA)
Crawford School of Public Policy, ANU College of Asia and the Pacific

Prof. Warwick J. McKibbin, AO, FASSA is the Vice Chancellor's Chair in Public Policy and is Director of the Centre for Applied Macroeconomic Analysis (CAMA) in the Crawford School of Public Policy at the Australian National University (ANU). He is also Director of Policy Engagement and ANU Node Leader of the Australian Research Council, Centre of Excellence in Population Ageing Research (CEPAR). Professor McKibbin is a Distinguished Public Policy Fellow of the Economic Society of Australia; a Distinguished Fellow of the Asia and Pacific Policy Society; and a non-resident Senior Fellow at the Brookings Institution in Washington D.C (where he is co-Director of the Climate and Energy Economics Project). He was awarded the Order of Australia in 2016 "For Distinguished Service to Education as an Economist, Particularly in the Area of Global Climate Policy, and to Financial Institutions and International Organizations" and the Centenary medal in 2003 "For Service to Australian Society through Economic Policy and Tertiary Education". Professor McKibbin is internationally renowned for his contributions to global economic modeling, the theory of monetary policy, climate change policy and economic modeling of pandemics. He has published more than 240 peer reviewed academic papers and 5 books as well as being a regular commentator in the popular press. He served on the Board of the Reserve Bank of Australia from 2001 to 2011 and worked at the Reserve Bank from 1975 to 1991. He regularly advises international institutions, Central Banks, governments and corporations across a range of developed and emerging economies.

Luiz Awazu Pereira da Silva

Deputy General Manager
Bank for International Settlements

Luiz Awazu Pereira da Silva became Deputy General Manager on 1 October 2015.

Before joining the BIS, Mr Pereira da Silva, a Brazilian national, had been Deputy Governor of the Central Bank of Brazil since 2010. Prior to that, he worked in various positions for the World Bank in Washington DC, Tokyo and southern Africa. He also served as Chief Economist for the Brazilian Ministry of Budget and Planning, and as Brazil's Deputy Finance Minister in charge of international affairs.

Fiona Reynolds

Chief Executive Officer
Principles for Responsible Investment

Fiona Reynolds is the CEO of the Principles for Responsible Investment (PRI). The PRI is a UN supported organisation, with over 3,000 signatories who collectively represent over US $100 trillion in AUM. She is responsible for the PRI's global operations.

Appointed in 2013, Fiona has 25 years' experience in the financial services and pension sector. She joined the PRI from the Australian Institute of Superannuation Trustees (AIST), where she spent seven years as CEO.

Fiona serves on the Board of the U.N. Global Compact, she chaired of the Financial Services Commission into Modern Slavery and Human Trafficking and is now a member of the Finance Against Slavery and Trafficking Global Steering Committee. Fiona is also a member of the International Integrated Reporting Council, the Global Advisory Council on Stranded Assets at Oxford University, the Advisory Board for the Green Investment Principles for the Belt and Road, the Global Steering Committee for the Investor Agenda on Climate Action and the Steering Committee for Climate Action 100+. She is also on the Investment Committee of the Laudes Foundation and the Advisory Board for BASF, and the Advisory Council of Bloomberg Green.

Fiona was named one of the 20 most influential people in sustainability globally by Barron's magazine and has twice been named one of Australia's one hundred women of influence by the Australian Financial Review.

Nick Robins

Professor in Practice - Sustainable Finance
Grantham Research Institute for Climate Change and the Environment, London School of Economics

Nick Robins is Professor in Practice for Sustainable Finance at the Grantham Research Institute for Climate Change and the Environment at the London School of Economics. He is co-chair of the International Network for Sustainable Finance Policy, Insights, Research and Exchange (INSPIRE) and co-chairs the joint NGFS-INSPIRE study group on Biodiversity and Financial Stability. The focus of his work is on how to mobilise finance for climate action in ways that support a just transition, promoting the role of central banks and regulators in achieving sustainable development and investigating how the financial system can support the restoration of nature. Nick is co-founder of Carbon Tracker and Planet Tracker and has previously worked at UNEP, HSBC, Henderson Global Investors and the European Commission.

David Sandalow

Co-Director
The Energy and Environment Concentration, School of International and Public Affairs, Columbia University

David Sandalow is the Inaugural Fellow at the Center on Global Energy Policy and co-Director of the Energy and Environment Concentration at the School of International and Public Affairs at Columbia University. He founded and directs the Center's U.S.-China Program and is author of the Guide to Chinese Climate Policy. Mr. Sandalow has served in senior positions at the White House, State Department and U.S. Department of Energy. He writes and speaks widely on climate change and energy policy.

Calvin Tai

Interim Chief Executive
Hong Kong Exchanges and Clearing Limited

Mr. Calvin Tai was appointed Interim Chief Executive of Hong Kong Exchanges and Clearing Limited on 1 January 2021, while continuing his role as Co-President & Chief Operating Officer. Mr. Tai had previously assumed various positions across the Group, including Head of Clearing, overseeing clearing and risk management of securities, derivatives and OTC clearing business; Co-Head of Equities, Fixed Income and Currency, Global Markets Division, overseeing trading operations, product and business development for equities, fixed income and currency markets; and Head of Trading Division, overseeing trading operations, product and business development for securities and derivatives market.

Mr. TAO Yiping

President and Director of the Board,
Industrial Bank Co.,Ltd.

Mr. TAO Yiping has over 30 years of experience in financial practice and management. He previously served as President of Fujian Branch and Shandong Branch of Bank of China (BOC) and has started serving as President of Industrial Bank since April 2016. Mr. TAO is also the executive council of China Finance 40 Forum (CF40).

Mr. Tao received a Bachelor's degree in planning statistics, and an MBA degree from Xiamen University.

Adair Turner

Chair
Energy Transitions Commission

Lord Turner chairs the Energy Transitions Commission, a global coalition of companies, NGOs and experts working to achieve a net zero economy by 2040. He is Chairman of insurer group Chubb Europe, Senior Fellow at the Institute for New Economic Thinking and serves on the Advisory Board of Board of Shanghai energy group Envision. From 2008-2013, Lord Turner chaired the Financial Services Authority, and played a leading role in the redesign of global banking and shadow banking regulation. Alongside a business career, he has held a number of public policy roles: he was Director General of the Confederation of British Industry (1995-2000); chaired the Low Pay Commission (2002-2006), the Pensions Commission (2003-2006), and the Climate Change Committee (2008-2012).

Bill Winters

Group Chief Executive
Standard Chartered

Bill Winters was appointed to the Board of Standard Chartered PLC as Group Chief Executive on 10 June 2015, having joined the Group in May 2015. He is based in London.

Bill has had a distinguished career in banking, having spent 26 years with JP Morgan in diverse leadership roles, becoming co-Chief Executive Officer of the investment bank in 2004 until he stepped down in 2009. Bill was the only career banker to be invited to be a committee member of the Independent Commission on Banking, established by the UK government in 2010 to recommend ways to improve competition and financial stability in banking. Subsequently, he served as advisor to the Parliamentary Commission on Banking Standards and was asked by the Court of the Bank of England to complete an independent review of the bank's liquidity operations. Bill founded the hedge fund Renshaw Bay in 2011 where he was Chairman and CEO until he stepped down from the company on appointment to the Standard Chartered PLC Board.

Bill presently Chairs the Taskforce for Scaling Voluntary Carbon Markets and Co-Chairs the B20 Action Council on Sustainability & Global Emergencies.

Bill is an independent non-executive director of Novartis International AG. Bill was previously a non-executive director of Pension Insurance Corporation plc before stepping down in October 2015.

He holds a Bachelor's degree in International Relations from Colgate University and an MBA from the Wharton School at the University of Pennsylvania.

ZHU Jun

Director General
International Department, the People's Bank of China

ZHU Jun is Director General of the International Department of the People's Bank of China, a role she assumed in 2015. Before that, Ms. ZHU has held a variety of positions in the International Department since 1997, including Director of the Research Division since 2006 and Deputy Director-General of the International Department since 2009. She worked in the Governor's Office between 1993 and 1997 before moving to the International Department. Ms. ZHU worked in the BIS as a visiting fellow in 1999, and returned to the BIS as an Economist from 2003 to 2005. Ms. Zhu graduated from Peking University with a Bachelor's degree in Economics in 1989, and received her Master's degree in Economics from Peking University in 1993.

PRESENTATIONS

DEUTSCHE BUNDESBANK
EUROSYSTEM

Green Finance and the Role of Central Banks and Financial Regulators

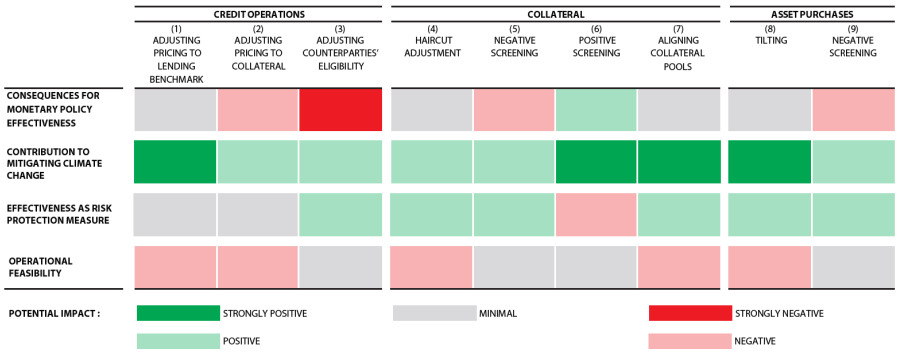
Dr Sabine Mauderer, Member of the Excecutive Board of the Deutsche Bundesbank

PBC-IMF High Level Online Seminar on Green Finance and Climate Policy, 15 April 2021, Session I

NGFS report on adapting central bank operations to a hotter world
Introductory remarks

- Relating to main policy fields of **(1) credit operations, (2) collateral and (3) asset purchases**, NGFS report outlines **nine specific options**.
- **Four assessment criteria for options**: (1) consequences for monetary policy effectiveness, (2) contributions to mitigating climate change, (3) effectiveness as risk protection measures and (4) operational feasibility. Results presented using **colour-coding system**.
- All in all, **adjusting central bank operational frameworks to reflect climate-related considerations more adequately is feasible.**
- However, report **does not make recommendations**, merely suggests assessment framework.
- **Each central bank needs to decide for itself which measures are most compatible with its mandate**. In particular, legal clarification of scope for any operational adjustments necessary.
- Central banks will also need to **overcome practical and analytical challenges**, including data gaps and data quality concerns. Objective assessment of climate risks should be based on generally accepted methods.

Adjusting operational frameworks to climate-related risks
Simplified assessment of selected generic options under review



The assessment is based on qualitative expert judgement, and more formal quantitative analysis may be needed. It aims to guide the reader through the report and should not be interpreted as recommending any measure. Colour-coding is used to avoid any "netting" across criteria. The table uses a limited number of colours for reasons of simplicity. More nuanced analyses of options are provided in Annex 1.

Source: Adapting central bank operations to a hotter world – Reviewing some options, Network for Greening the Financial System (NGFS), March 2021.

Dr Sabine Mauderer
15 April 2021
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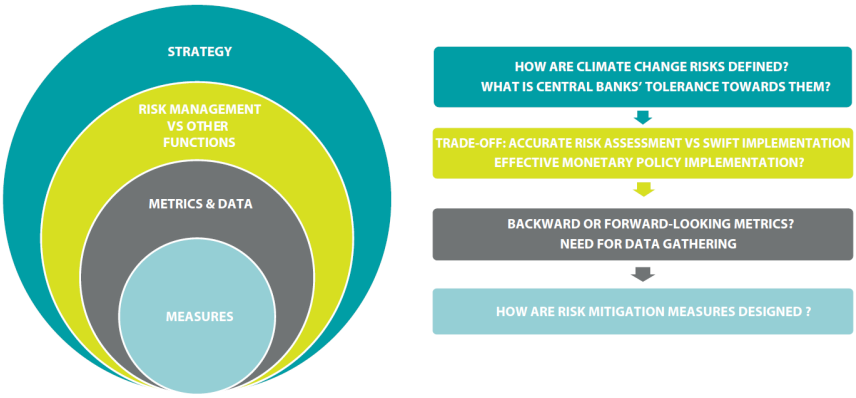
To take action, central banks must take strategic decisions in an environment of trade-offs and uncertainties



Source: Adapting central bank operations to a hotter world – Reviewing some options, Network for Greening the Financial System (NGFS), March 2021.

Dr Sabine Mauderer
15 April 2021
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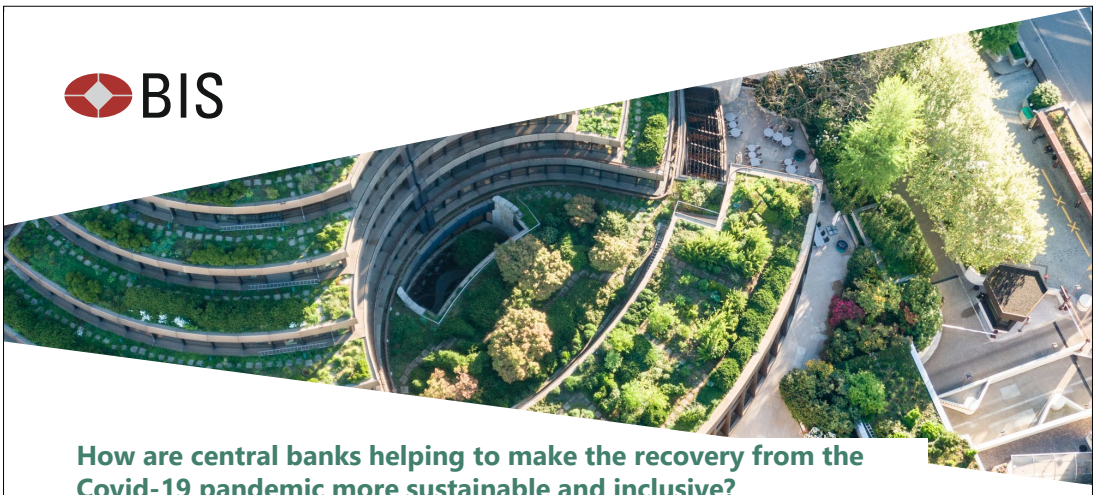


How are central banks helping to make the recovery from the Covid-19 pandemic more sustainable and inclusive?

Luiz Awazu PEREIRA DA SILVA, Deputy General Manager, Bank for Internacional Settlements (BIS)

PBoC-IMF High-Level Seminar on Green Finance and Climate Policy, 15-16 April

The views expressed in this presentation are those of the author and not necessarily the views of the BIS.

The "Why" do CBs need to help combat Climate Change.. becomes now a "How"

- **Recent positive evolution of mindsets among CB community**: (Carney, NGFS, Stern-Stiglitz, supervisors) overcomes two orthogonal views (a) do nothing (strict independence) or (b) do everything (listen to more vocal parts of civil society); convergence now seems to evolve around:
  - No "silver bullet", CBs alone cannot mitigate CC, avoid becoming again "only game in town";
  - Coordination with other actors (eg., Governments, private sector) is key.;
  - Address issues of consensus within mandates; communicate more about CC impact.
- **Indeed, within CBs mandates, impact of CC directly undermines fulfilling CBs objectives**:
  - Financial stability: potentially severe negative effects related to CC-risks, physical and transition risks (eg., weather events → massive losses of capital → threat of financial instability)
  - Price and macroeconomic stability: shocks and uncertainty on inflation (eg., heat → food prices → shortages, permanent higher inflation?), sectoral shocks, mass migrations, impacts on r* and U*, lower employment → materialization of CC-related risks → real and financial crises).
- **Moreover, other agents moving fast on CC (private real and financial sector, civil society):**
  - Demand for sustainability, transparency and consistency (eg., from investors, consumers)
  - Supply of "green" portfolios, taxonomy and volume (eg., from issuers, AMs)

BIS Restricted 2

Green Swan (new systemic risk concept) contribution to debate:

- "Green Swan" book message: move CC from "**ethical equity** issue" to "**risk** approach" (Covid illustrated "global sudden stop" accelerated version of gradual cumulative CC risks).
- Best science today says CC calls for **epistemological break in risk models**, break away from: (a) Gaussian distributions of risk (with fat tails or not), (b) linearity of transmissions of CC risks, (c) usual extrapolation of consequences using historical data.
- Best science warns of (a) **quasi-certainty** of occurrence of CC-related catastrophic material and human losses; (b) irreversible "**tipping points**" if we emit GHGs beyond 420Gt (1.5 C) CO2 budget (IPCC); our usual "*wait-and-see*" attitude is *very risky*.
- Need to act under **radical uncertainty** and **asymmetric risk** (future huge losses vs "small" cost of mitigation insurance today): better prevent, build buffers even without optimal carbon pricing, perfect models and ideal understanding of CC.

BIS Restricted 3

What can central banks do and are actually doing?
(1) Provide more and better information on CC-related risks.

Beyond awareness and building consensus, CBs are providing guiding frameworks for public and private financial sector, civil society. **The NGFS has been instrumental offering such public goods**

- Continue improving **analytical tools to assess CC-risk and resilience of economy and financial sectors**
  - New macro models -beyond IAMs or DSGEs-, CC-risk metrics, CC-related stress tests
  - CC-scenarios for 1.5 with sustainable growth and contributions by agent (real & financial sectors)
- Continue discussing scope and role of **macropru** (BCBS working group) and **monetary policies** (collateral, APP); not a trivial issue ("market neutrality" vs shadow-asset pricing)
- **Disclosure and accounting standards** (FSB-TCFD, IFRS sustainability reporting) → better identify risk
- Consistent **taxonomy on green investment** products, for investors and civil society (comparable ESG criteria, PRI, Green bonds standards, construction of 1.5 portfolio, etc)
- Seek **"greening" own assets** (eg reserves, pension funds); offer investment options for CBs (BIS-green fund); favoring new "green finance" approaches and instruments

BIS Restricted 4

What can central banks do and are actually doing?
(2) Foster global & local coordination with "all hands on deck" and action

- **CC requires global and local coordination between local and global agents**: to avoid free riding, collective action pbs, to favor cooperation over Nash, find fair burden sharing, Ostrom, Olson).
  - Coordination with *Governments*, Treasuries and fiscal policy (Pigovian carbon taxes, trading and pricing emissions) over Net Zero policies.
  - Coordination with *international institutions*, development banks to leverage financing costs of transition and mitigation.
  - Coordination with *real sector firms*, banks, insurance cies., regulators, standard-setters, ratings agencies to ensure consistency with Governments Net Zero commitments.

- **CC calls for immediate action from a risk not a moral perspective**, perhaps without full understanding of its effects and dynamics.
  - Covid-19 might have triggered **behavioural change:** overwhelming evidence of huge costs of Green Swans, convincing societies, policy-makers, private sector of asymmetric risks-returns and **need for immediate action.**

Conclusions: never "waste a crisis" use Covid-19 to aim at Green recovery

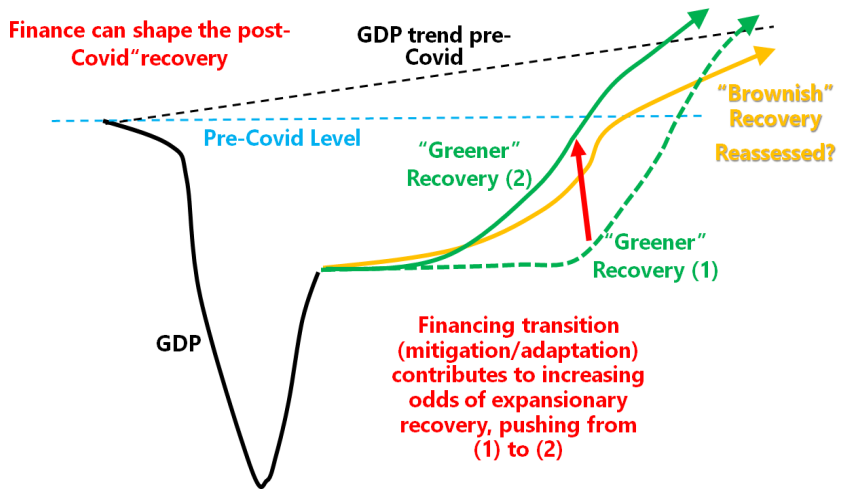
- **Covid has produced the unprecedented contraction that we feared with CC physical and transition risks.** So "never waste a crisis", recovery can aim at being as "green" as possible. Macro conditions favourable (low rates, higher savings in some AEs, low r* for a while, demand and awareness for "green", ambition in US, EU, China, etc); micro "projects" exist (infrastructure, cities, "carbon footprint tracing", new technologies and new ways to act using "social networks" etc).
- **Demand side: consumer becoming more selective, have now better information and incentives to favour lower carbon economy** (public awareness has risen to allow progress on carbon pricing, GHG emission taxation & certificates, etc).
- **Supply side: green finance investors offering new practical diversification projects/paths to lower carbon economy and finance the transition,** "green" R&D, new technologies, carbon capture, new "green" financial instruments, green infrastructure, "global funds" for MICs and LICs, etc. Schumpeterian creative destruction financing (debt, equity) of innovation (Aghion).
- **Warning: distributional consequences of CC policies and transition** are important; political economy of CC: risks and impact affect poor countries more and poor households in rich countries; international and local social ST effect of policies might be regressive on impact before MLT welfare benefits materialize. Urgent need to think and design policies with compensation & transfers as important elements to gather support and sense of "fairness" in implementation.

Thank You

(Annexes)

BIS Restricted 7

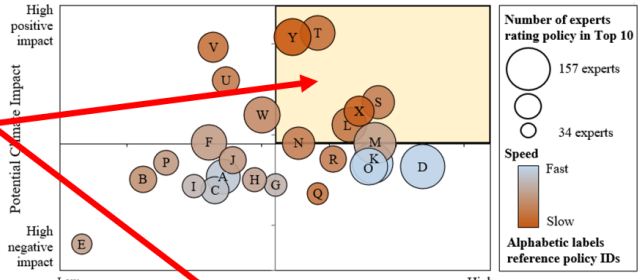
Possible paths for a post Covid-19 recovery



BIS Restricted 8

Multipliers and CC-impact of a "green" recovery according to experts

Financing policies / projects with high multiplier + high climate impact



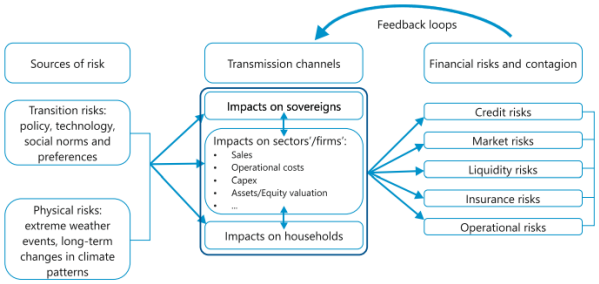
A	Temporary waiver of interest payments	N	Worker retraining
B	Assisted bankruptcy (super Chapter 11)	O	Targeted direct cash transfers or temporary wage increases
C	Liquidity support for large corporations	P	Rural support policies
D	Liquidity support for households, start-ups and SME	Q	Traditional transport infrastructure investment
E	Airline bailouts	R	Project-based local infrastructure grants
F	Not for profits, education, research, health inst. bailouts	S	Connectivity infrastructure investment
G	Reduction in VAT and other goods and services taxes	T	Clean energy infrastructure investment
H	Income tax cuts	U	Buildings upgrades (energy efficiency)
I	Business tax deferrals	V	Green spaces and natural infrastructure investment
J	Business tax relief for strategic and structural adj.	W	Disaster preparedness, capacity building
K	Direct provision of basic needs	X	General R&D spending
L	Education investment	Y	Clean R&D spending
M	Healthcare investment		

Never waste a crisis: the Stern-Stiglitz report provides opportunities for the private sector investment and financing:

Source: C Hepburn, B O'Callaghan, N Stern, J Stiglitz and D Zenghelis, "Will COVID-19 fiscal recovery packages accelerate or retard progress on climate change?", *Oxford Review of Economic Policy*, no 36, S1, 4 May 2020.

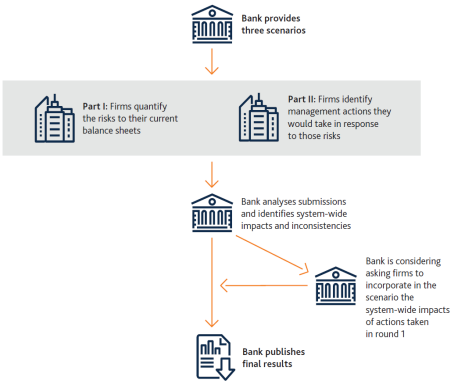
Concrete roles for central banks – models of transmission of CC-related risks

- **Analytical challenge**: understand how financial stability risks transmits
  - **Development of new models** (IAMs, general equilibrium or disequilibrium, links to human migration, global effects → some risks "not-diversifiable", etc)
  - **Complexity of transmission of CC**, irreversible "tipping-points", non-linearity, "cascading effects" into economy, feedback loops, etc.



Concrete roles for central banks – stress-testing

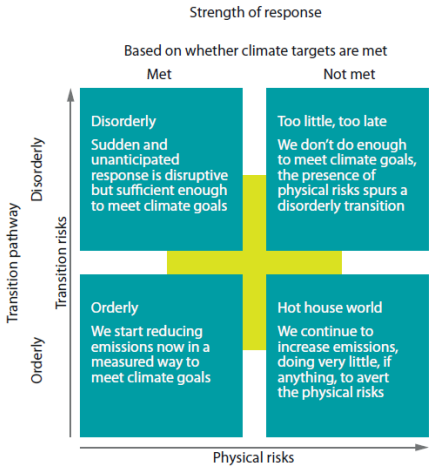
- **Assessment and management of climate-related risks** (in the banking and insurance sector)
  - **Stress-testing** a key instrument, given the forward-looking nature of risks
    - See NGFS
    - Several CBs, supervisors taking concrete actions to incentivise banks to enhance their risk management (see Bank of England 2021 climate-stress test on the right, also in emerging markets
  - **Disclosure of exposures** (TCFD, FSB)



BIS Restricted 11

Concrete roles for central banks – provision of climate scenarios

- **Scenarios are the key ingredient to stress-testing** and the NGFS has developed reference scenarios (on the right)
  - These scenarios are a public good (freely available) and increasingly used by the private sector as well (eg Blackrock "Aladdin" platform)
  - Further refinements (eg sectoral granularity, more financial variables) are in the pipeline
  - Reference scenarios can help to ensure comparability and information value in stress-tests



BIS Restricted 12

Concrete roles for central banks – improve taxonomy around "green"

- **Holdings of assets** for implementation of policies → hence definition of "green" is important
  - Reserve management
  - BIS green bond fund as a practical means for CBs to invest in green assets; official launch of EUR green bond fund last week
  - Moving towards sustainability and responsible investment (SRI) practices (eg SNB, BdF)
  - Pension funds
  - CBs are implementing SRI strategies; ESG disclosures in annual reports
- **Improving definitions** of "green" financial instruments, taxonomies (ESG, responsible investment)
- **Demand high from investors and civil society** to inform and guide decisions

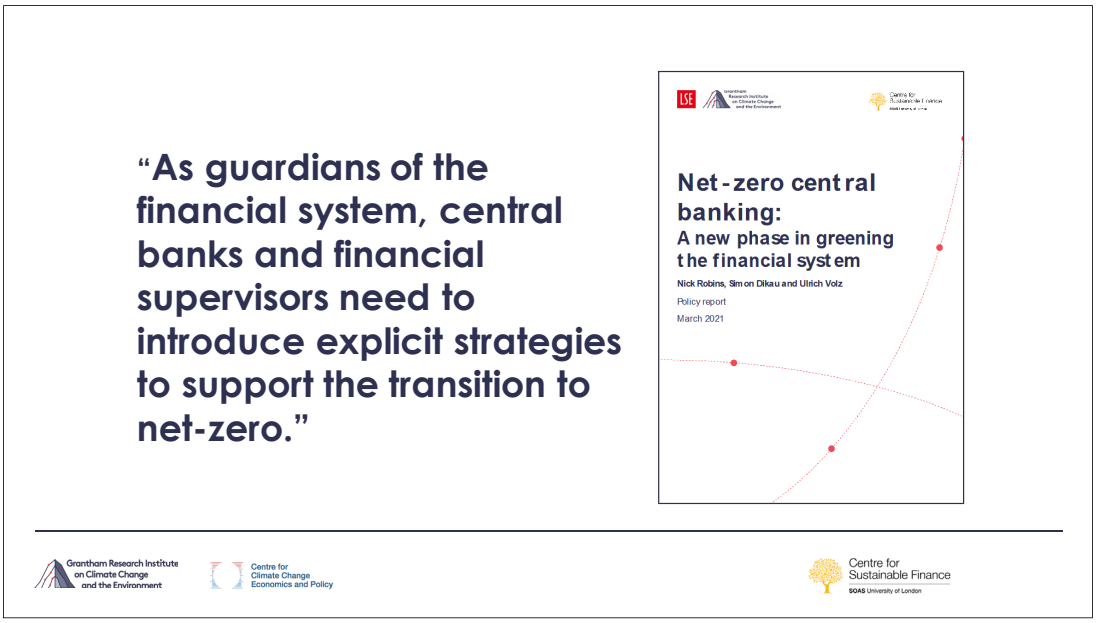
The five Cs – Contribute to Coordination to Combat Climate Change

- **NGFS** ("coalition of the willing") to coordinate among supervisors and central banks
  - Broad representation: Currently 83 members and 13 observers

- Coordinate and support international effort to *close data gaps* (NGFS workstream on bridging data gaps; FSB (SCAV) work to monitor and assess the implications of climate-related risks to financial stability; Irving-Fisher committee; G20 data gaps initiative etc)
- Help in developing green and sustainable finance standards
  - Engagement with issuers to improve green bond reporting to prevent green-washing
  - Support the development of ESG standards (see UBS white paper)

End


Net-Zero Central Banking
A new phase in greening the financial system
Nick Robins
Professor in Practice – Sustainable Finance
19 March 2021
Grantham Research Institute on Climate Change and the Environment
Centre for Climate Change Economics and Policy
Centre for Sustainable Finance
SOAS University of London


"As guardians of the financial system, central banks and financial supervisors need to introduce explicit strategies to support the transition to net-zero."
Net-zero central banking:
A new phase in greening the financial system
Nick Robins, Simon Dikau and Ulrich Volz
Policy report
March 2021
Grantham Research Institute on Climate Change and the Environment
Centre for Climate Change Economics and Policy
Centre for Sustainable Finance
SOAS University of London

The Race to Net-Zero Finance

- **The Science:** To limit global warming to 1.5°C, global net human-caused emissions of carbon dioxide need to fall by about 45 per cent from 2010 levels by 2030, reaching 'net-zero' around 2050.
- **The Policy:** In total, 127 countries responsible for around 63% of emissions are considering or have adopted net-zero targets.
- **The Financial Sector:** Asset owners with $5trn in assets, banks with $15trn in assets and asset managers with $9trn in assets have committed to net-zero by 2050.
- **Financial and Monetary Authorities?**

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A Dual Rationale for Action

Central banks and supervisors are increasingly incorporating climate change into prudential and monetary policies. Why take an explicit stance on net-zero?

1. **Financial Stability:** Net-zero is the best way of minimising the risks of climate change to the stability of the financial system and the macroeconomy.
2. **Policy Coherence:** Ensure that their activities are consistent with government net-zero policy, notably in countries where they have a secondary mandate.

Providing clarity, predictability and integrity across the system.

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A Sign of Things to Come

UK 2021
Chancellor's Remit Letter
Government Economic Policy
"To transition to an environmentally sustainable and resilient net zero economy"

Bank of England Response
Announced that it will provide more information on"adjusting the Corporate Bond Purchase Scheme (CBPS) to account for the climate impact of the issuers of the bonds we hold."

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Taking a comprehensive approach

i) Strategy and policy coordination
- Develop a net-zero strategy, with a roadmap of actions including long-term expectations and near-term actions
- Promote liaison and coordination between central banks, supervisors and policymakers on net-zero

ii) Prudential regulation
- Require all regulated financial institutions to submit net-zero transition plans
- Upgrade TCFD disclosure to include net-zero

iii) Scenarios
- Adjust long-term scenarios to be 1.5ºC aligned and complementary with short-term outlooks

iv) Monetary policy
- Incorporate net-zero into monetary policy frameworks and operations
- Set clear net-zero crtieria for collateral, refinancing and asset purchase programmes

v) Portfolio management
- Adopt a net-zero target for own portfolios and publish a transition plan detailing how to achieve it

vi) Just transition
- Explore the implications of net-zero for jobs and well-being
- Connect central banks' macrofinancial stability and employment objectives to the climate risk and net-zero agenda

vii) International cooperation
- Incorporate net-zero into international frameworks, including the integration of climate-related considerations into the IMF's surveillance function, technical assistance and lending facilities
- Coordinate with multilateral development banks, especially in emerging and developing economies where central banks and supervisors face particular challenges around net-zero
- Build on networks such as the NGFS to develop common strategies

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Recommendations for Action 1/2

1. **Strategy:** Develop a net-zero roadmap with long-term expectations and near-term actions. Close liaison and coordination with policymakers, providing independent advice.

2. **Prudential:** Align supervisory expectations and require all regulated financial institutions to submit net-zero transition plans. Upgrade TCFD disclosure for net-zero.

3. **Scenarios:** Adjust long-term scenarios to become more consistent with a net-zero pathway for 1.5°C and complement with shorter term outlooks.

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Recommendations for Action 2/2

4. Monetary: Integrate net-zero into policy frameworks and operations, including collateral, refinancing and asset purchase management (e.g. linked to credible corporate net-zero plans).

5. Portfolio Management: Responsible investment policies to include a net-zero target and plan to achieve it, like other asset owners.

6. Just Transition: Use stress test results to explore the implications of net-zero for jobs and regions, particularly concentration risks.

7. International Cooperation: Incorporate into key financial frameworks and processes (IMF, FSB, BIS, IAIS, IOSCO, NGFS). Partnerships to support developing and emerging economies.

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Next Steps

- **Implementation:** Each central bank and supervisor needs to develop its own approach to net-zero based on its specific mandate. We believe that no formal change to mandate is needed, clarification can help.
- **COP26:** The run-up to COP26 is the moment for central banks and supervisors to start to set out how they will support the transition to a net-zero financial system and economy.

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For further information

Net Zero Central Banking report
https://www.lse.ac.uk/granthaminstitute/publication/net-zero-central-banking-a-new-phase-in-greening-the-financial-system/

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Role of Financial Institutions and Investors

PBC-IMF High-Level Seminar on
Green Finance and Climate Policy

Keynote Speaker: Tao Yiping
President, Industrial Bank Co., Ltd.
April 15, 2021

兴业银行 INDUSTRIAL BANK CO.,LTD.

PART I: Green Finance to Combat Climate Change
PART II: Implementation of Green Finance in China
PART III: Roles of Financial Institutions and Suggestion

兴业银行 INDUSTRIAL BANK CO.,LTD.

Green Finance to Combat Climate Change

"30·60" Plan

- Announced in September 2020
- To reach a peak of carbon dioxide emissions by 2030 and become carbon-neutral before 2060

138 trillion RMB

- An estimate of 138 trillion RMB incremental investment needed to realize the 1.5 Degree Scenario
- Innovation towards green finance and climate finance is imminent

兴业银行 INDUSTRIAL BANK CO.,LTD.

PART I: Green Finance to Combat Climate Change

PART II: Implementation of Green Finance in China

PART III: Roles of Financial Institutions and Suggestion

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Industrial Bank: Leading Green Finance for 14 Years

- IB has been exploring sustainable finance business since 2006 and gradually adopting green finance as a strategic business of the Group
- China's first bank to adopt the Equator Principles in 2008
- Partnered with IFC CHUEE Program since 2006 and offers a wide range of green finance products, including carbon/emission right pledge financing, green ABS, forest right mortgage financing, environmental-protection and water conservation loans, blue bonds, etc., to fulfill demands from green industries and projects.
- Issued China's first green financial bond and China's first green asset-backed securities in 2016, and the first offshore dual-currency green financial bond in 2018
- 139.5 billion RMB worth Green and blue bonds issuance (onshore and offshore), largest commercial financial institution green bond issuer in the world

	Green Finance Product			
Corporate Finance	Green Project loans and liquidity loans	Carbon/emission right pledge financing	Receivable pledge financing	Cash Management
Retail Finance	Green mortgage loans	Green wealth management	Green credit card	Green consumer loan
Investment banking and financial markets	Green bond underwriting	Green ABS	Green equity fund	Green investment
Funds	Green industrial fund	Environmental and infrastructure PPP fund		
Trusts	Green entrusted loan	Green entrusted fund		
Financial Leasing	Green direct leasing	Green sale-and-lease-back	Green operating lease	
Securities	Green equity investment	Green bond underwriting	Green enterprise IPO	

兴业银行 INDUSTRIAL BANK CO.,LTD.

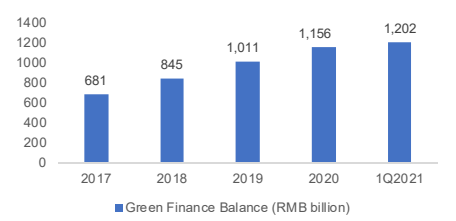
Industrial Bank: Leading Green Finance for 14 Years

- In 1Q 2021, IB had achieved a Green Financing balance of RMB 1.20 trillion and accumulatively provided green financing for 30,475 corporate clients

Green financing balance (1Q 2021): RMB 1.20 trillion

Accumulative no. of beneficiaries of green finance (1Q 2021): 30,475

Green financing balance growth rate (2017-2020): CAGR: +19.31 %



- In 1Q 2020, IB's Green Financing Portfolio is expected to realize the following environmental impact per year

Ton of Coal Equivalent (Tce) Reduction: 30.90 million ton

CO_2 Emission Reduction: 85.86 million tons

COD Emission Reduction: 4.14 million tons

NO_2 NOx Emission Reduction: 121 thousand tons

Equivalent of shutting down 196 130MW thermal power plants

SO_2 SO2 Emission Reduction: 998 thousand tons

Solid Waste Recycling: 45.96 million tons

Water Saving: 410 million tons

兴业银行 INDUSTRIAL BANK CO.,LTD.

PART I: Green Finance to Combat Climate Change

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PART III: Roles of Financial Institutions and Suggestion

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Roles of Financial Institutions and Suggestion

Carbon Finance Innovation

- Carbon finance product & service
- Emission reduction
- Value discovery of carbon
- Climate risk management

International Cooperation

- Information disclosure
- Environmental risk pressure test
- Green finance product innovation
- Green standard development
- Equator Principles implementation

1 **Finance to Steer Resources**

- Business strategy
- Credit policy
- Asset structure
- ESG & climate risk

2

3 **Carbon Neutrality**

- Carbon neutrality roadmap
- Transition to low carbon operation
- Experience sharing

4

5 **Policy Instruments**

- Favorable monetary and regulatory policies to green finance

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Thank You!

INTEGRATING RIGHTEOUSNESS INTO PROFITABILITY

For questions or additional information about IB, please contact our Investor Relations at:
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INTERNAL

IMF-PBC Seminar
Bill Winters

standard chartered

14/04/2021

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Our commitment to sustainability and sustainable finance
Setting clear targets and working with our clients to deliver

Summary of our Sustainability Commitments	
Climate Change	• **Scope 1 & 2 GHG emissions to net zero** by **2030**. • Source all of our energy from renewable sources by 2030 • Consult on our methodology and targets for achieving our **2050 net zero target for our financed emissions** in 2021 • Only provide financial services to **clients that are less than 5% dependent on earnings from thermal coal** by Jan 2030
Sustainable Financing	• Provide project financing services **for USD40 billion** of infrastructure projects and **USD35 billion** of clean technology projects that promote sustainable development that align to our verified Green and Sustainable product framework **by 2025**
Social and Entrepreneurship	• Provide **USD15 billion** of financing to **small business** clients by **2025** • Provide **USD3 billion** of financing to **microfinance institutions** • Raising **USD50 million** between 2019 and 2023 for the **Futuremakers program** (targeted at youth)

2

INTERNAL

The Policy Environment

Enabling banks to finance the transition and manage climate risk

3 <Document title - footer text>

INTERNAL

Role of carbon markets

The Taskforce for Scaling Voluntary Carbon Markets (TSVCM) will create a robust, liquid market for carbon credits

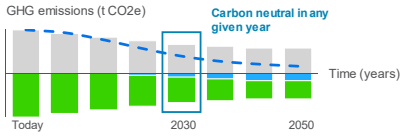
GHG emissions need to reduce by 50-55% by 2030 to remain on track for 2050 Paris targets.

Voluntary Carbon markets have the **potential to channel billions in private sector funding** towards critical emissions avoidance, reduction and removal projects from today.

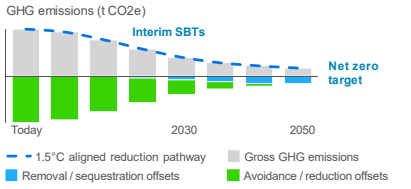
1500+ companies have committed to achieving Net-Zero emissions by 2050. **Robust and credible corporate claims are essential** to drive private sector demand for these projects.

The TSVCM recommends private sector actors to follow a clear mitigation hierarchy - 1.Reduce 2.Report 3. Offset.

Carbon neutral: *Offset unavoidable emissions within a given year*



Net-Zero: *Reach a state of no impact on the climate from GHG emissions*



4

PRI Principles for Responsible Investment

UNEP FINANCE INITIATIVE | United Nations Global Compact

An investor initiative in partnership with UNEP Finance Initiative and UN Global Compact

Green finance and climate policy: the role of investors

Fiona Reynolds, PRI

15th April

- RESPONSIBLE INVESTMENT -

The PRI

Investor-led, supported by the United Nations since 2006

1 We will incorporate ESG issues into investment analysis and decision-making processes.

2 We will be active owners and incorporate ESG issues into our ownership policies and practices.

3 We will seek appropriate disclosure on ESG issues by the entities in which we invest.

4 We will promote acceptance and implementation of the Principles within the investment industry.

5 We will work together to enhance our effectiveness in implementing the Principles.

6 We will each report on our activities and progress towards implementing the Principles.

2

UN PARTNERS:
UNEP FINANCE INITIATIVE
UN GLOBAL COMPACT

3800+

SIGNATORIES:
ASSET OWNERS
INVESTMENT MANAGERS
SERVICE PROVIDERS

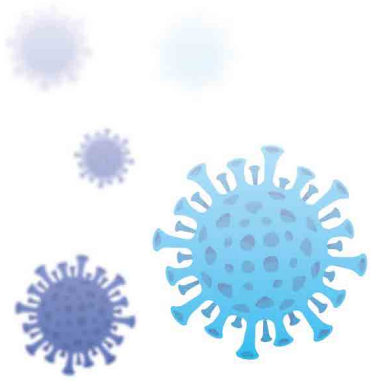
100+

US$ trn
ASSETS UNDER MANAGEMENT

PRI Principles for Responsible Investment

2

COVID-19 crisis accelerates the energy transition



We are determined to
build back better

PRI Principles for Responsible Investment

Delivering carbon neutrality in China

DELIVERING CARBON NEUTRALITY IN CHINA (Jan. 2021)

President Xi Jinping announced at the UN General Assembly in September 2020 that China will target carbon neutrality by 2060. PRI has developed this roadmap of climate policies for China, based on research by Vivid Economics as part of PRI's Inevitable Policy Response (IPR) project, and drawing on other leading sources of research.

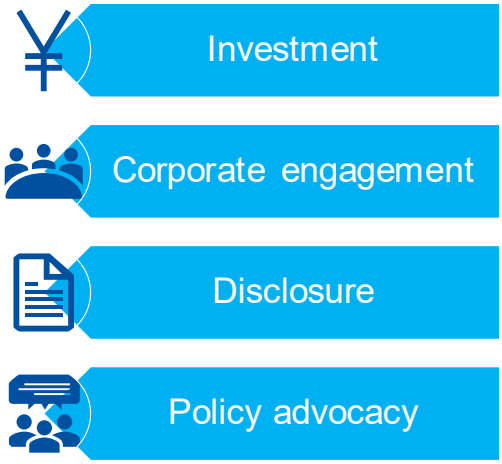
The policy recommendations address the overall climate ambition and key sectors for decarbonisation: power, road transport, buildings and industry.

Zero-carbon power	Industry	Buildings	Road transport
▪ Develop and implement a plan for zero or near zero carbon electricity ▪ Announce an end to approvals of all new unbated coal power plants ▪ Develop and implement an enabling regime to unlock investment ▪ Implement electricity market reforms	▪ Set strengthened mandatory energy efficiency targets for industrial plants in the 14th 5-year plan. ▪ Develop and implement strategies for low-carbon steel, chemicals and cement.	▪ New buildings – publish a comprehensive thermal efficiency plan for new buildings. ▪ Existing buildings – set a target for retrofit of all residential, commercial and public buildings by 2050.	▪ Announce an end to the sales of fossil fuel cars and vans by 2040. ▪ Develop and implement a comprehensive heavy road transport decarbonisation strategy.

4

PRI Principles for Responsible Investment

Investor levers for climate action



PRI Principles for Responsible Investment

5

Thank you

PRI Principles for Responsible Investment

6

Calvin Tai
Interim CEO, HKEX Group

15 April 2021

HKEX
香港交易所

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Where this document refers to Shanghai-Hong Kong Stock Connect and/or Shenzhen-Hong Kong Stock Connect (together, the "Stock Connect" programs), please note that currently, access to northbound trading is only available to intermediaries licensed or regulated in Hong Kong; southbound trading is only available to intermediaries licensed or regulated in Mainland China. Direct access to the Stock Connect is not available outside Hong Kong and Mainland China.

Where this document refers to Bond Connect, please note that currently, access to northbound trading is only available to foreign investors that are able to trade onshore bonds on the China Foreign Exchange Trade System & National Interbank Funding Centre.

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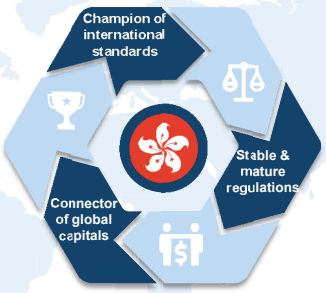
Hong Kong is uniquely positioned to lead the Asian Green Finance transition

Local government's support

- HKSAR committed to reach carbon neutrality before 2050
- Policy Address 2020 : to "develop green finance" and "build a low-carbon economy which is more resilient to climate change"

International investors' demand

- Gateway for international investors to access green and sustainable products in Asia



Mainland China's commitment

- Announced target to meet net zero by 2060
- Established Guangdong-Hong Kong-Macau Greater Bay Area Green Finance Alliance

Asia's strong need to catch up

- The global sustainable finance market has attracted about $30 trillion in investments but less than 1% of that is in Asia

4

Hong Kong's Green and Sustainable Finance Cross-Agency Steering Group

Steering Group Members

財經事務及庫務局 Financial Services and the Treasury Bureau
環境局 Environment Bureau
SFC 證監會
HONG KONG MONETARY AUTHORITY 香港金融管理局
HKEX 香港交易所
強制性公積金計劃管理局 MANDATORY PROVIDENT FUND SCHEMES AUTHORITY
保險業監管局 Insurance Authority

To co-ordinate the management of climate and environmental risks to the financial sector, accelerate the growth of green and sustainable finance in Hong Kong and support the Government's climate strategies

Launched the green and sustainable finance strategy for Hong Kong in Dec 2020

Mandatory TCFD-aligned disclosures by 2025

Promote climate-focused scenario analysis

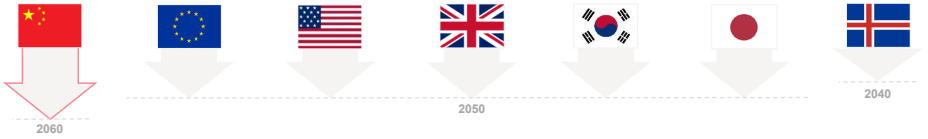
Promoting flow of climate-related information at all levels

Capitalize on Mainland / GBA opportunities

5

China's net zero pledge presents immense opportunities

China has ramped up its efforts to align with the Paris Agreement by announcing its net zero pledge in 2020



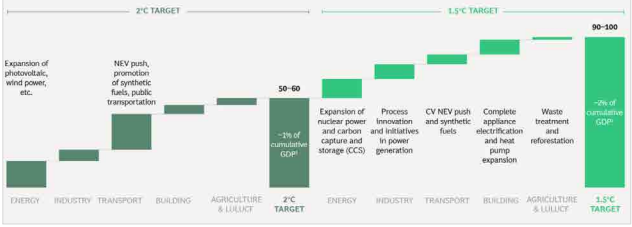
Significance

- Single biggest annual carbon emitter
- Under BAU, it will only reduce carbon emissions by a little more than 10% by 2050

Opportunity

- Push GDP growth in mid-long term
- Reduce demand for fossil fuels
- Be leader of technology provider for decarbonization, such as in the field of battery cells

Cumulative investment will need to reach 90-100 trillion RMB (~2% of cumulative GDP) between 2020-2050



Source: BCG analysis

6

A brief timeline of HKEX's green & sustainable initiatives

Ongoing CSR....

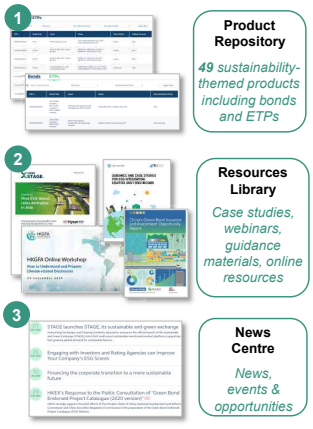
- Embedding sustainability in our business and our market
- Championing global and local dialogue in ESG
- Deepening community commitment with HKEX Foundation
- Driving environmental stewardship within HKEX and beyond

7

HKEX Sustainable and Green Exchange (STAGE)

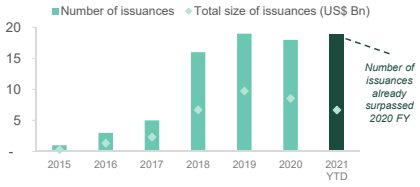
Platform launched on 1 December 2020

- *Access to critical data for sustainable investing*
- *Increase visibility and international standards adherence*
- *Connecting stakeholders to innovative products and ideas*



1. **Product Repository** — *49 sustainability-themed products including bonds and ETPs*
2. **Resources Library** — *Case studies, webinars, guidance materials, online resources*
3. **News Centre** — *News, events & opportunities*

Facilitating strong momentum of green bond issuance through HKEX in 2021[1]



Our Partners

WFE World Federation of Exchanges · Sustainable Stock Exchanges Official Supporter · TCFD Task Force on Climate-related Financial Disclosures · HKGFA · Climate Bonds Initiative · ICMA International Capital Market Association

1) YTD as of 31 Mar 2021. Including Green, Blue, Social, Transition, Sustainability-linked and COVID-19 bonds.

8

Resources

- HKEX ESG Reporting Guide & FAQ – regulatory listing rules and guidance for Hong Kong listed issuers
- HKEX STAGE – online portal for green products and other sustainable finance information
- CSR at HKEX Group – CSR report, strategy and sustainability across the organisation

www.hkexgroup.com
www.hkex.com.hk
www.hkexnews.hk
Twitter: @HKEXGROUP
LinkedIn: Hong Kong Exchanges and Clearing Limited (HKEX)
Wechat:

10

1

ASIA AND PACIFIC DEPARTMENT

FISCAL AFFAIRS DEPARTMENT

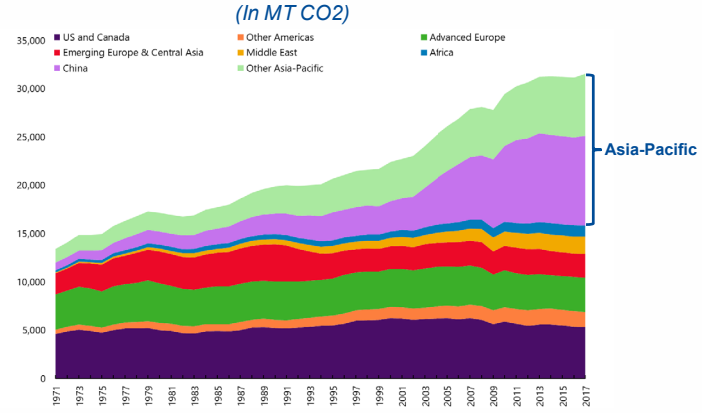
Fiscal Policies to Address Climate Change in Asia and the Pacific

PBC-IMF HIGH-LEVEL SEMINAR ON GREEN FINANCE AND CLIMATE POLICY, APRIL 16, 2021

Kenneth K. Kang,
Deputy Director, Asia and Pacific Department, IMF

The Asia and Pacific region emits about half of global CO2

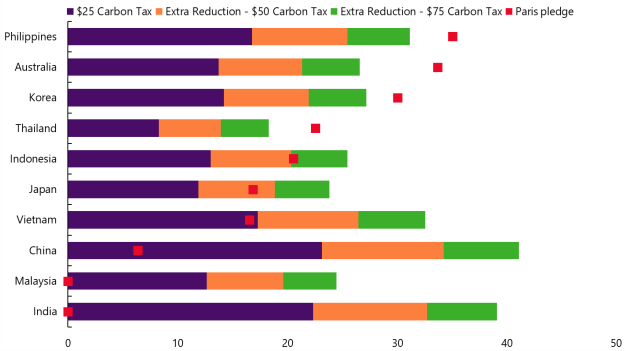
CO2 Emissions from Fuel Combustion, 1970-2017
(In MT CO2)



Source: IEA, 2020.
From: *"Fiscal Policies to Address Climate Change in Asia and the Pacific: Opportunities and Challenges"* IMF, 2021.

Modest carbon taxes could achieve the region's aggregate Paris target, but more is needed

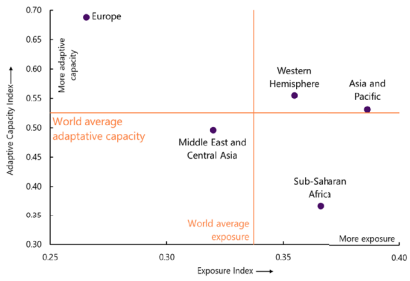
CO2 Reduction with Carbon Taxes *(Percent below 2030 BAU)*



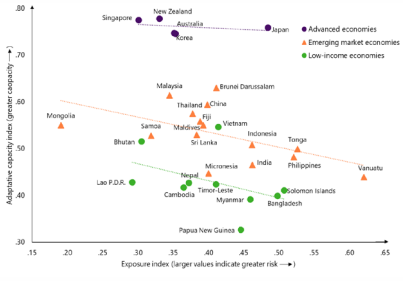
Sources: IMF staff calculations.
Note: Countries with zero emission-reduction target from the Paris Agreement climate pledge are assumed to be able to achieve the target in the baseline scenario. Paris pledges reflect newly submitted proposals and updates in 2020.
From: *"Fiscal Policies to Address Climate Change in Asia and the Pacific: Opportunities and Challenges"* IMF, 2021.

Asia-Pacific is more exposed than other regions but has average adaptive capacity

Adaptive Capacity and Exposure Indexes by Region



Adaptative Capacity and Physical Exposure *(Index)*



Source: IMF staff calculations based on 2015–18 data from the EU commission, the United Nations University Institute for Environment and Human Security, the University of Notre Dame, and Phillis and others (2018).
Note: Regional classification as per the IMF grouping.
From: *"Fiscal Policies to Address Climate Change in Asia and the Pacific: Opportunities and Challenges"* IMF, 2021.

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Institute of Climate Change and Sustainable Development, Tsinghua University

PBC-IMF High-Level Seminar on Green Finance and Climate Policy——

Policy Mix for Climate Change Mitigation

Prof. LI Zheng
Executive Vice president
ICCSD, Tsinghua University

ICCSD research framework

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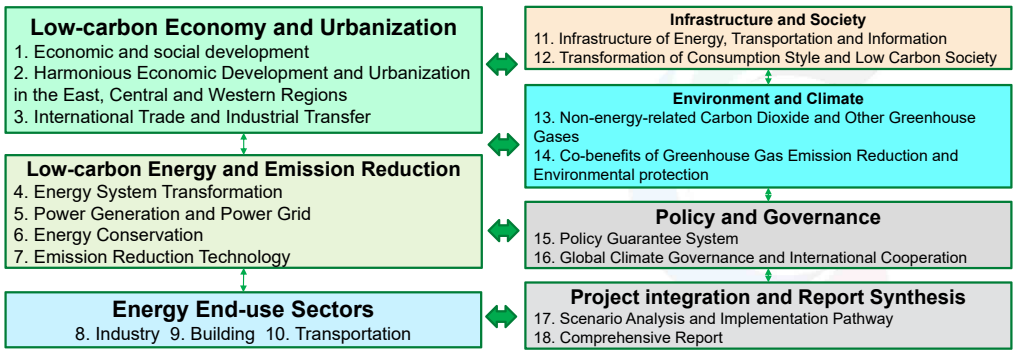
Institute of Climate Change and Sustainable Development, Tsinghua University

- At the beginning of 2019, ICCSD organized more than 20 prestigious institutes and think-tanks in China to study and propose the target and policy options for national middle and long-term climate strategies.
- 18 sub-projects cover major climate related societal and economic dimensions.



Low-emission development and transition scenarios

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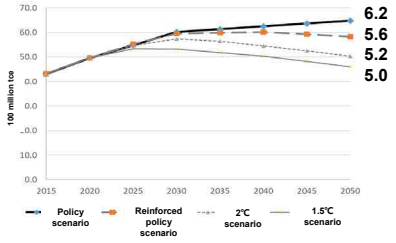
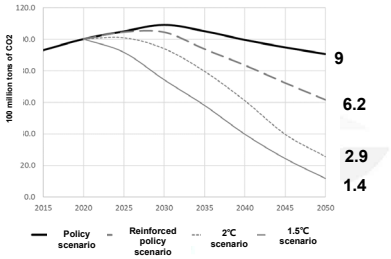
Institute of Climate Change and Sustainable Development,Tsinghua University

Energy demand from 2015 to 2050



CO_2 emissions from 2015 to 2050



Policy scenario: primary energy consumption will stabilize to about 6.2 billion tce by 2050, CO_2 emission will be about 9 billion tons.

Reinforced policy scenario: primary energy consumption will be about 5.6 billion tce by 2050, CO_2 emission will be about 6.2 billion tons.

2°C scenario: primary energy consumption will be about 5.2 billion tce by 2050, energy-related CO_2 emissions will be 2.9 billion tons, net CO_2 emission will be about 2 billion tons (taking into account industrial process emissions, CCS and agroforestry carbon sinks).

1.5°C scenario: primary energy consumption will be about 5 billion tce by 2050, energy-related CO_2 emissions will be 1.4 billion tons, net CO_2 emission will reach zero (taking into account industrial process emissions, CCS and agroforestry carbon sinks).

Long term pathways: two-stage acceleration

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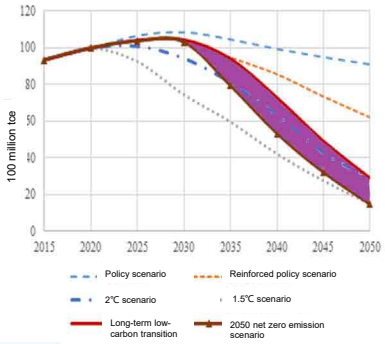
Institute of Climate Change and Sustainable Development,Tsinghua University

- If we carry on policy scenario and follow the reinforced policy scenario, an emission reduction pathway aligned with the global 2°C target will no longer be achieved in 2050.
- The inertia in the current energy and economic systems makes it difficult to quickly achieve the emission reduction pathway in the 2°C and 1.5°C scenarios.
- China's long-term low-carbon emission pathway - transitioning from the policy scenario to the 2°C and 1.5°C target scenarios.
- Striving to peak CO_2 emissions by 2030 and speeding up the transition towards the 2°C and 1.5°C emission reduction pathways.



Energy system subject to radical change

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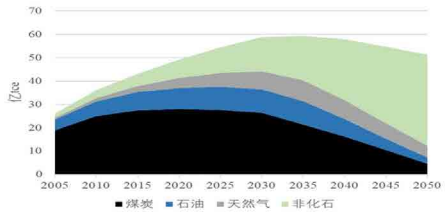
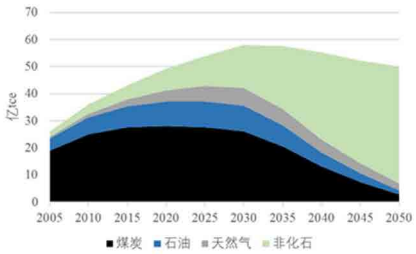
2D scenario



TPE: 5.2 billion tce
Non-fossil: 70%
Coal: <10%
Electrification: 55%

1.5D scenario



TPE: 5.0 billion tce
Non-fossil: 85%
Coal: <5%
Electrification: 68%

All sectors go all out to reduce its own GHG

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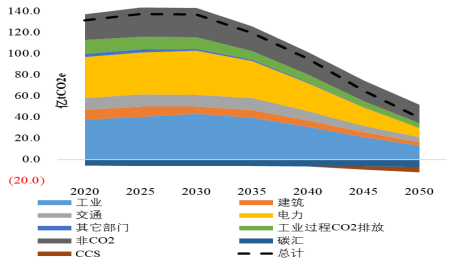
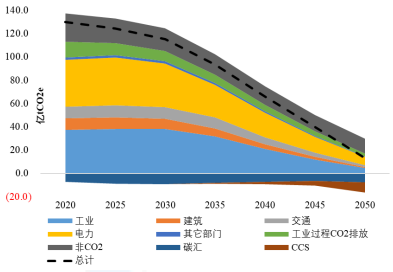
2D scenario



Energy CO2: 2.94 bt
Industrial CO2: 0.47 bt
CCS & CO2 sink: 1.21 bt
Net CO2: 2.19 bt
Non-CO2 GHG: 1.76 bt

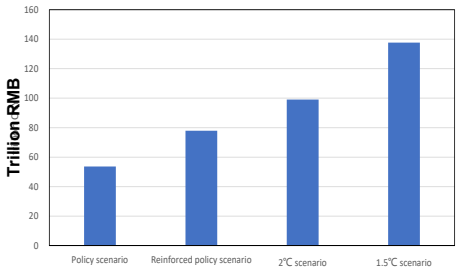
1.5D scenario

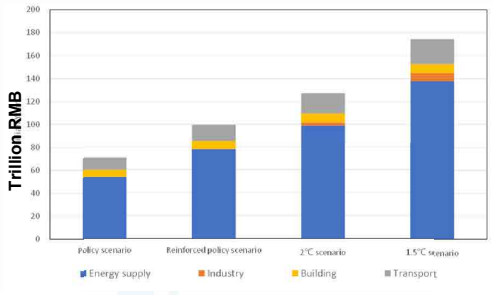


Energy CO2: 1.47 bt
Industrial CO2: 0.25 bt
CCS & CO2 sink: 1.66 bt
Net CO2: 0 bt
Non-CO2 GHG: 1.27 bt

Infrastructure investment requirement

清华大学气候变化与可持续发展研究院
Institute of Climate Change and Sustainable Development, Tsinghua University





Unit: trillion RMB	Energy Supply	Industry	Building	Transport	Total
Policy scenario	53.71	0.00	6.29	10.51	70.51
Reinforced policy scenario	77.89	0.39	7.42	13.99	99.69
2℃ scenario	99.07	2.66	7.94	17.57	127.24
1.5℃ scenario	137.66	7.18	7.88	21.66	174.38

A policy portfolio is imperative

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Legislation	Accelerate the introduction and implementation of Climate Law
Strategy & Planning	NDC update Ten-year carbon peaking action scheme Long-term GHG emission development strategy Co-governance of climate and environment protection
Performance evaluation system	Total amount and intensity dual control system for carbon emission Total amount control system Non-CO2 GHG control
Economic / Market	Carbon pricing / Improving design of Emission Trade System Expanding market coverage on other major energy intensive sectors Exploration on international cooperation on carbon market Carbon tax covering additional emission sources
Finance	Further develop policy system on green financing Initiating local pilot of green financing Enriching investment and financing instruments for climate
Statistics & information	Development of MRV Expanding industries recognizing carbon label and authentication policy
Local pilot	Early carbon peaking of pilot areas and developed regions Encouraging policy on long-term low GHG emission strategies Realizing carbon-neutrality in areas with permitting condition

COLUMBIA | SIPA
Center on Global Energy Policy

Green Finance and Climate Policy Seminar
绿色金融和气候政策研讨会

David Sandalow
April 16, 2021 2021年4月 16日

"We aim to achieve carbon neutrality before 2060."
"我们的目标是在2060年之前实现碳中和。"

-- President Xi Jinping, September 22, 2020
-- 习近平主席，2020年9月22日

View of Pudong, Shanghai (1983)
上海浦东 （1983年）

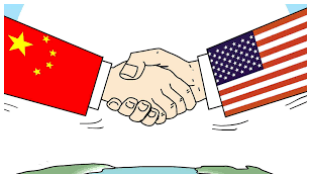
Pudong, Shanghai (2012)
上海浦东 (2012年)


升温2摄氏度后
After 2°C of warming
Source: Climate Central


升温4摄氏度后
After 4°C of warming
Source: Climate Central

Miami, Florida 迈阿密，佛罗里达

Miami, Florida 迈阿密，佛罗里达

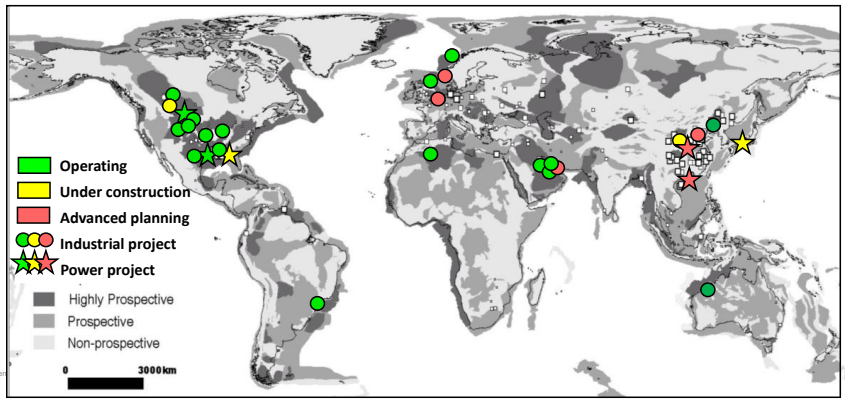



Nations Unies
Conférence sur les Changements Climatiques 2015
Paris France

Green finance
绿色金融

1. Harmonize taxonomies 分类标准趋同
2. Harmonize disclosure requirements
   披露标准趋同
3. Share emissions trading experience
   共享排放交易经验
4. Mobilize capital for green development in third countries
   为第三国绿色发展调动资本

Carbon capture, utilization and storage – industry of the future
碳捕获, 利用和储存 -- 未来产业



17

Food system emissions
食品系统排放

More than 30% of global emissions come from the food system.
超过30%的全球排放量来自食品系统.

www.energypolicy.columbia.edu | @ColumbiaUenergy

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- Green finance
  绿色金融
- Carbon capture, utilization and storage
  碳捕获，利用和储存
- Food system emissions
  食品系统排放

View of Pudong, Shanghai (1983)
上海浦东 （1983年）

Thank You

COLUMBIA | SIPA
Center on Global Energy Policy

Mitigating Climate Change: Growth Friendly Strategies to Achieve net Zero Emissions by 2050

Warwick J. McKibbin, AO, FASSA
Centre for Applied Macroeconomic Analysis (CAMA) and
Centre of Excellence in Population Ageing Research (CEPAR)
Australian National University
and
The Brookings Institution, Washington DC

16 April2021

Presentation to a PBOC and IMF Webinar, 16 April 2021

Based On

- Jaumotte, F., Liu, W. & McKibbin, W. J. (2021). Mitigating Climate Change: Growth-friendly Policies to Achieve Net Zero Emissions by 2050. mimeo Australian National University
- Also based on Mitigating Climate Change: Growth- and Distribution-Friendly Strategies, October 2020 WEO Chapter 3
- Many of the figures used in this presentation were provided by the IMF

Opportunity to green the recovery

- **Urgent to act on climate:** emissions are on course to raise temperature by 3-6C by 2100. The window for limiting warming to 1.5-2C (net zero emissions in 2050) is closing rapidly.
- **Opportunity to "green" the recovery**: Recovery stimulus can be designed to boost green and resilient public infrastructure; policies can ensure composition of recovery in capital spending is consistent with decarbonization.
- **Questions:**
- How can we reach net zero carbon emissions by 2050 in a **growth, employment and distribution friendly** way?
- Can well-designed and sequenced mitigation policies help with the economic repair from the Covid-19 crisis?

3

How to get to net zero emissions by mid-century?

- **Mitigation toolkit** carbon pricing vs. green supply policies
- **Objective** Net zero emissions by mid-century. Implemented as 80% reduction in gross emissions (except in OPC)
- **Model** ***G-cubed*** global macro model with sectoral detail (McKibbin and Wilcoxen 1999, 2013; Liu and others 2020)

4

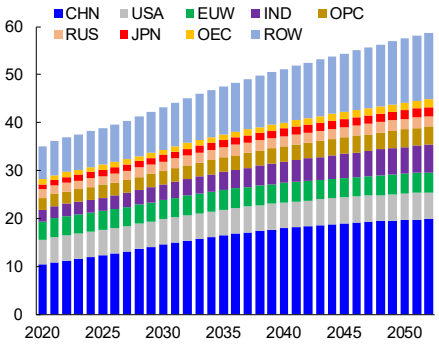
A comprehensive policy package to achieve NZE by 2050

- *Green supply policies:* 80% subsidy rate on renewables production, a 10-year green public investment program (starting at 1 percent of GDP and linearly declining to zero over 10 years; after that, additional public investment maintains the green capital stock created).
- *Carbon tax:* High annual growth rate of carbon prices (7 percent) to ensure low initial levels and gradual phase-in of carbon prices. Start at between $6 and $20 a ton of CO_2 (depending on the country), reach between $10 and $40 a ton of CO_2 in 2030, and are between $40 and $150 a ton of CO_2 in 2050.
- *Compensatory transfers to households:* ¼ of carbon tax revenues to protect the purchasing power of poor households.
- *Supportive macro policies*: the package implies a fiscal easing that requires debt financing for the first decade and occurs amid low-for-long interest rates (given low-inflation context).

5

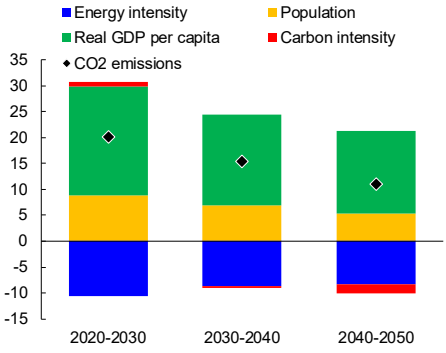
Business-as-usual emissions

Business-as-Usual Baseline CO2 Emissions
(Gigatons of CO2)



Source: IMF staff calculations.

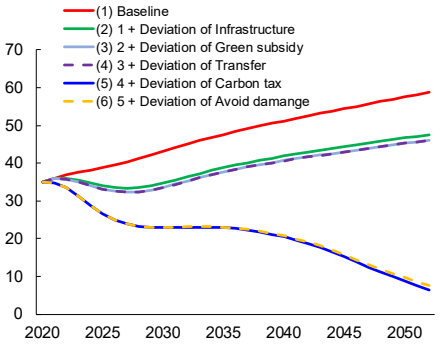
Decomposition of the Change in Global CO2 Emissions *(Percent change)*



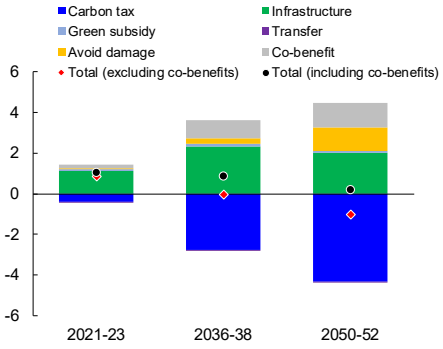
6

Policy package: CO2 emissions and output effects

Global CO2 Emissions
(Gigatons of CO2)



Impacts on real GDP
(deviation from baseline, percent)

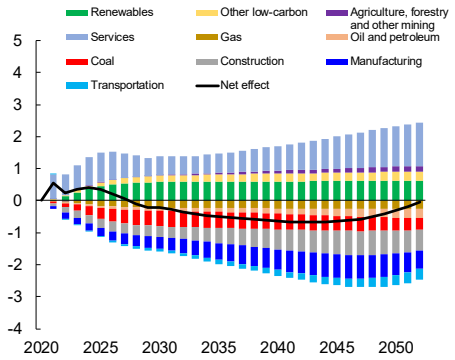


Source: IMF staff calculations.

7

Policy package: employment effects

Global Employment, by Sector
(Contribution to deviation of total employment from baseline, percent)



Source: IMF staff calculations.

8

Conclusions

- Net zero emissions by 2050
  - Feasible objective that would boost incomes in the long run and avoid catastrophic risk.
  - But the window is rapidly closing.
- An initial green investment push combined with steadily rising carbon prices would deliver the needed emission reductions at reasonable transitional output effects.
  - A green fiscal stimulus would support output and employment in the recovery from the Covid-19 crisis, and help lower the costs of adjusting to higher carbon prices.
  - Carbon pricing is critical to mitigation because higher carbon prices discriminate better and incentivize energy efficiency in addition to reallocating resources from high- to low-carbon activities.

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