Building a sustainable financial system: the state of practice and future priorities

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Abstract

Efforts to align the global financial system with climate security and sustainable development are entering a new phase. Five years ago, only a handful of central banks were addressing the significance of the environmental crisis for the delivery of their mandate. Today, a growing number of central banks, along with supervisors across banking, insurance, pensions and securities, are moving from the recognition of their role in building a sustainable financial system to the implementation of a growing range of measures. This paper charts the rise of central bank and supervisor action on climate change and wider sustainability issues, analyses the key features of the "new normal" and then highlights priority themes for policy and research in the years ahead.

1 Introduction: The rise of central bank action on climate and sustainability

The full resources and expertise of the global financial system will be needed to respond to the existential threat of climate change and wider environmental crises such as the decline in biodiversity, the human and ecological impacts of air and water pollution, as well as the degradation of natural resources. In 2007, the Stern Review concluded that climate change was "the world's greatest market failure" [Stern (2007), p. VIII]. Prices not only fail to reflect the costs of carbon pollution, but many climate damaging activities (notably in the energy and agricultural sectors) continue to be incentivised with perverse government subsidies, amounting to some 5.2 per cent of global GDP in 2017 according to Coady et al. (2019). Strategically, this implies that most, if not all, financial assets are mispriced to a greater or lesser extent, posing major challenges for central banks and supervisors seeking to encourage efficient capital allocation, safe and sound financial institutions and financial stability of the system as a whole.

Until recently, the debate, as well as practical strategies to promote sustainability, have focused on correcting market and policy failures in the real economy with fiscal policy as the first best solution (e.g. through internalising externalities through pricing reform), supplemented by the provision of public finance to fill market gaps (e.g. in the development and deployment of sustainable technologies). Initially, only a limited role was assigned to central banks and financial supervisors, with a focus largely on addressing information asymmetries in the marketplace through improved disclosure. The essential complementary role of financial regulation came to the

fore following the global financial crisis and the growing recognition of the system-wide scale of the threat posed by the disruption of the natural capital foundations for long-term economic development [Robins and Zadek (2016)]. According to the United Nations Environment Programme (UNEP) Inquiry into the Design of a Sustainable Financial System, by 2008, only around 50 sustainability measures had been adopted by central banks, financial supervisors and other public authorities worldwide; by the end of 2013, this had more than doubled to 131, which doubled again to 267 by the end of 2017 [McDaniels and Robins (2018)].[1]

An early signal for central banks and financial supervisors emerged in September 2015 through a speech by Bank of England governor Carney (2015) on the "Tragedy of the Horizon", which outlined the novel threat of climate change for financial stability, transmitted through physical, transmission and liability risk. The agreement of the Sustainable Development Goals (SDGs) by the world's governments in the same month laid out a comprehensive approach to integrating economic, social and environmental factors. In December 2015, the Paris Agreement on Climate Change went further, setting the goal in Article 2.1 c) of "making finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development" [UNFCCC (2016), p. 3].

From these foundations, central banks and supervisors have increasingly recognised sustainability as relevant to their core mandates and functions. Looking across 133 investigated institutions, 38 central banks and monetary unions are mandated to support their government's economic priorities, which may include the transition to low-carbon growth in the future, and 16 mandates include the explicit objective to enhance the "sustainability" [Dikau and Volz (2019a)].

Today, it is increasingly recognised that the macroeconomic implications and regulatory consequences of unabated climate change for central banks are significant, for prudential as well as monetary policies [Cœuré (2018)]. This process has been supported by the growth in international cooperation, initially through the G20's Green Finance Study Group, as well as the Task Force on Climate-related Financial Disclosures (TCFD) of the Financial Stability Board (FSB). When the possibility of consensus-based progress through the G20 became constrained following the election of the current US Administration, new coalitions were built, notably through the establishment of the Network for Greening the Financial System (NGFS) in December 2017 with eight initial members. The NGFS has since grown to 46 members and 9 observer central banks and supervisors, which represent over half of global greenhouse gas emissions [NGFS (2019a), p. 1]. The NGFS can be seen

1 There is no comparable assessment of the number of sustainable finance measures adopted since 2017. In 2019, the Principles for Responsible Investment estimates that there are now 730 measures across the world covering environmental, social and governance (ESG) factors, with a focus on the investment sector [PRI (2019)].

Table 1

RESEARCH AND CAPACITY BUILDING ON CLIMATE CHANGE IN INTERNATIONAL FINANCIAL INSTITUTIONS

BIS	The growing interest in climate-related risks at the BIS has been reinforced recently by Deputy General Manager Pereira da Silva (2019), who has stressed the importance of exploring the systemic risk implications for financial stability of climate change. Research at the BIS has focused on the pricing of environmental risk in syndicated loans [Ehlers *et al.* (2018)], green bond finance and certification [Ehlers and Packer (2017)], and the incorporation of environmental sustainability objectives into portfolios of central banks' reserve managers [Fender et al. (2019)].
IMF	The IMF, which has recently produced a comprehensive literature review of financial and monetary policy in light of climate change and enhancing green finance [Krogstrup and Oman (2019)], is also increasingly concerned with the economic implications of climate change [Lagarde and Gaspar (2019)] and ways to finance an appropriate response [Bredenkamp and Pattillo (2010) and Farid et al. (2016)].
IAIS	The Sustainable Insurance Forum, which was created as a global working group of insurance regulators, and has worked with the International Association of Insurance Supervisors to provide guidance for on the potential implications of climate change [IAIS and SIF (2018)].
IOPS	The International Organisation of Pension Supervisors (IOPS) has issued guidelines for the integration of ESG factors in the area of supervision of pension fund investment and risk management and thereby proposes to enhance disclosure of ESG factors by pension funds [IOPS (2019)].
IOSCO	The International Organization of Securities Commissions (IOSCO), which brings together the world's securities regulators, published a document outlining the importance of ESG related information for investors and the role of securities regulation [IOSCO (2019)].

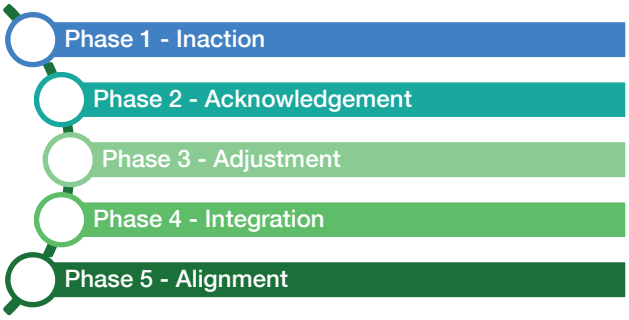
SOURCE: Compiled by authors.

as a "coalition of the willing" working to exchange experience and promote shared action on the impact of climate change and other environmental factors on their objectives and operations. International financial organisations, including the International Monetary Fund and the Bank for International Settlement, have also been increasingly active in addressing the challenges posed by climate change (see Table 1).

What is striking is how financial authorities have successfully developed a compelling narrative for their involvement, which respects their specific functions and mandates (notably around risk and stability), separate from political imperatives. US financial authorities such as the Federal Reserve are also beginning to recognise the importance of climate risk in spite of opposition in the political sphere [Powell (2019) and Rudebusch (2019)].

Traditionally, central banks believed that they had no role to play in confronting climate change and sustainability. This phase is now over. The next phase of acknowledging the challenge and the role that they can play is also coming to an end. We are moving into a more action-oriented phase focusing on adjusting existing central bank policies and activities. Beyond this lie full integration of climate change and sustainable development as key features of central bank and regulatory operations and the ultimate goal of the alignment of the financial system with the goals of Paris Agreement and the Sustainable Development Goals,

Figure 1
PHASES IN THE ENGAGEMENT OF CENTRAL BANKS AND SUPERVISORS IN CLIMATE AND SUSTAINABILITY



SOURCE: Compiled by authors.

facilitated, guided and driven by the actions of central banks and supervisors (see Figure 1).

The remainder of this chapter explores the key pillars of the emerging "new normal" for central banks and financial supervisors. The final section outlines the central challenges that exist, points to new horizons and concludes.

2 The new normal: the acknowledgment and incorporation of sustainability factors

It has been increasingly accepted by monetary and supervisory authorities that climate and sustainability-related factors are a source of financial risk and fall within the financial stability mandates of central banks and supervisors [NGFS (2018)]. The bulk of the focus has been on the threat of climate change and there is broad agreement on the two main transmission channels, namely physical and transition risk. Most of the policies and initiatives of this "new normal" can be clustered around five main areas of activity:

— Awareness raising and capacity building.

— Micro-prudential supervision.

— Macro-prudential action and financial stability.

— Monetary policy.

— Scaling up green finance.

Table 2
TIMELINE OF MAJOR SPEECHES ON CLIMATE CHANGE BY CENTRAL BANKERS, 2015-2019

Bank of England: Carney (2015)	"Tragedy of the horizon, climate change and financial stability"
De Nederlandsche Bank: Knot (2015)	"Incorporating sustainability into core business"
Banque de France: Villeroy de Galhau (2015)	"Taking account of climate related issues, public intervention necessary"
Reserve Bank of India: Gandhi (2016)	"Recognition of the challenge of financing sustainable development"
Financial Stability Board: Carney (2016)	"Launch of TCFD, introduction of disclosure framework and recommendations"
Bundesbank: Wuermeling (2017)	"Sustainable investing: the Bundesbanks' role as fiscal agent"
Bank Negara Malaysia: Lian (2017)	"Promoting green finance trough sustainable finance initiatives"
Bundesbank: Weidmann (2017)	"No preferential treatment of green bonds through monetary policy, instead greening of pension funds"
De Nederlandsche Bank: Knot (2018)	"Quantification of climate related risk for the Dutch financial system, need to incorporate into supervision"
Banque de France: Villeroy de Galhau (2018)	"Priority of developing forward-looking carbon stress tests, need for taxonomy"
Hong Kong Monetary Authority: Chan (2018)	"Promotional role for green bonds and finance, incorporation of ESG principles in own investment process"
European Central Bank: Cœuré (2018)	"'Greening' of central bank portfolios, acknowledgement of impact of climate change on the conduct of monetary policy"
Banco de España: Delgado (2019)	"Urging banks to develop risk models, developing stress tests"
Bank of England: Carney (2019a)	"Call for mandatory disclosure of climate-related risks"
Banca d'Italia: Visco (2019)	"Absence of further regulation, market forces pushing greenhouse gas concentrations to unsustainable levels"
De Nederlandsche Bank, NGFS: Elderson (2019a)	"In the process of incorporating a climate risk, financial sector cannot act fast enough without help from governments"

SOURCE: Compiled by authors.
NOTE: Out of the 4,426 central banker speeches archived by the BIS between 2015 and today (October 2019), 42 speeches address climate change or sustainability.

2.1 Awareness raising and capacity building

A first important step for central banks and financial supervisors lies in signalling the importance of sustainability factors both internally and externally to the wider market. Beyond the issuance of binding regulation and supervisory expectations, a central role for monetary and supervisory authorities lies in educating financial institutions with regard to the implications of climate change for their operations to ensure that climate change-related financial risks are understood and are disclosed and managed. The formation of in-house capacity and global cooperation with other institutions and researchers thereby plays an important role for enhancing the conceptualisation of climate-related risks with regard to financial stability implications, as well as understanding the needs and options for enhancing green finance. A clear evolution in central banks" approaches to market signalling on climate and sustainability issues can be identified in the speeches of central bank

governors since 2015, which have become progressively more activist and moved from the mere acknowledgment of climate change towards calls for mandatory rules (see Table 2).

2.2 Microprudential policy

Climate- and wider sustainability-related risks have direct implications for the goals of micro-prudential regulation to ensure the safety and soundness of individual financial institutions, cutting across the classic pillars of risk-weighted capital, supervisory review and market discipline through disclosure. The First Progress Report by the NGFS (2018) has reinforced central banks" acceptance that climate change and the transition towards a low-carbon economy are relevant sources of financial risk at the micro-prudential level. An important supervisory step lies in the calibration of micro-prudential instruments. Banco Central do Brasil (BCB) has been among the first central banks to issue regulation that addresses environmental and social risk, requiring commercial banks to incorporate environmental risk factors in their "Internal Capital Adequacy Assessment Process" (ICAAP) [Banco Central do Brasil (2011)].

Promoting market discipline through enhanced disclosure has been the main focus for central banks and supervisors, notably through the FSB's TCFD. Insurance supervisors have been at the forefront of micro-prudential action. For example, the California Department of Insurance has addressed transition risks of carbon-intensive "stranded assets" on the books of insurance companies by requiring firms to disclose their investments in fossil fuels and requesting them to divest voluntarily from thermal coal investments [Jones (2018)].

Disclosure often requires changes in legal frameworks alongside supervisory requirements for institutions to improve their reporting of climate risk management and governance. France's Energy Transition Law, for example, under Article 173, requires firms to disclose their climate-related risks or provide an adequate explanation [NGFS (2019b)]. A core aspect of the EU's Sustainable Finance Action Plan is improved disclosure by corporations and financial institutions (see Box 2).

Discussion has also focused on the effectiveness of differential capital adequacy ratios, which distinguish between low-carbon (or "green') and high-exposure (or "brown") assets. The aim of such measures would be to reflect key risks not adequately reflected in market prices. One explanation for this shortcoming can be attributed to the short-term time horizon of most banks and investors, within which the full materialisation of climate risks may not fall [Carney (2019b)]. So far, the rationale for higher capital ratios for carbon-intensive assets has found greater favour among the central bank community,

Box 1

THE TASK FORCE ON CLIMATE-RELATED FINANCIAL DISCLOSURES (TCFD)

Under the chairmanship of Mark Carney, the FSB convened the TCFD in early 2016 to develop *recommendations on climate-related financial disclosures.* Enhancing disclosure was seen as the first and best step at the time to implement the G20's directive of making sure financial markets account for climate change in their operations. Its work is being supported by Bloomberg and the Big Four accounting firms. Thus, while the TCFD was convened and endorsed by the FSB, it is a fully industry-led institution with minimal involvement by central banks and financial supervisors. The TCFD published its final recommendations on climate-related financial disclosures in summer 2017.

Closely following the risk taxonomy developed by the BoE's PRA, these recommendations provide companies with a *framework for how to think about climate change* within their organisation by separating this thinking into four distinct categories: *Strategy, Governance, Risk Management,* and *Metrics & Targets.* Following this categorisation, the recommendations lay out more specific guidance on disclosure for both financial and non-financial corporations. For the financial sector, guidance addresses the specificities of banks, insurance companies, asset managers, and asset owners. For non-financial corporations, specific guidance was issued for the energy, transportation, materials & building as well as for the agriculture, food, and forests products sector. One of the most prominent features of the TCFD's recommendations related to forward-looking disclosure aided by scenario analysis.

This element of scenario analysis can also be counted as one of the *main achievements* of the TCFD: Firmly establishing the notion of *forward-looking analysis and disclosure* in the debate around how the financial industry can and should account for climate change is a major contribution the TCFD made. This allows stakeholders as well as supervisors to get an insight not into how a company is doing under present conditions of pervasive market and policy failure but how it is planning to develop in a future characterised by a stern transition towards a low-carbon economy or by catastrophic climate-related impacts on ecosystems, societies and economies. The TCFD's second major achievement is the sourcing of industry consensus on how to think about climate change within a company. The *flexible and yet comprehensive framework* of the four categories of strategy, governance, risk management, and metrics & targets both standardise disclosure across and within markets while on a more fundamental scale instruct internal company practice around the issue of climate change. The TCFD recommendations firmly establish that *climate change is financially material* and therefore a matter of financial and not sustainability disclosure while at the same time providing a first suggestion of how exactly climate change is material and what therefore needs to be disclosed on this issue.

In some regards, however, the TCFD recommendations do *not suffice as disclosure framework,* particularly for central banks and financial supervisors. First, the recommendations *exclusively focus on climate change,* neglecting other crucial and material environmental issues. Thus, the TCFD framework is not suitable for a systemic view on financial markets as it does not fully capture a company's dual embeddedness in the wider financial system which in turn is embedded in a socio-ecological system. Second, the TCFD framework's main focus lies on *risks as opposed to opportunities.* Third, as of September 2019, *implementation is slow and disclosure practices are underdeveloped* even according to the TCFD's own Status Reports. The fact that the recommendations allow a grace period within which climate-related disclosure can be moved from the financial filings to separate climate or sustainability reports does not spur thorough reporting either. Thus, financial supervisors and regulators might learn from this experience and not resort to private self-regulation for the sake of speed as voluntary regulation might be faster in its development but slower and more limited in its implementation phase.

in other words a potential "brown penalising factor" rather than a "green supporting factor".

In addition, there is growing interest in the possible utilisation of pillar 2 mechanisms, such as capital buffers to deal with climate-related risks inadequately managed by financial institutions (such as stranding risk for coal-assets).

2.3 Macroprudential policy

Environmental and climate change-related risks also have implications for the financial stability of the system as a whole and are therefore relevant for macroprudential policy frameworks [Campiglio et al. (2018)]. While standard macroprudential approaches do not explicitly take climate risks into account, approaches "green macroprudential policy" have started to be developed [Monnin (2018); and Schoenmaker and Van Tilburg (2016)]. Apart from mitigating transition risk and the financial stability implications of a manifestation of stranded assets, green macroprudential policy also has allocative effects and can play a role in incentivising a transition to low-carbon assets. Instruments that could be adjusted to take account of systemic climate and sustainability risks include calibrated countercyclical capital buffers, capital instruments (risk weights) and caps. Countercyclical capital buffers, which are implemented to ensure that capital requirements for the banking sector take threats to overall financial stability into account, can be implemented to require banks to increase their capital buffer in order to protect the sector from periods of excessive carbon-intensive credit growth. Instruments under the structural pillar, so-called "large exposure restrictions", can be calibrated to address the exposure concentration to unsustainable investment and, if large banks are insufficiently incentivised to address climate-related risks, capital surcharges for SIFI could be adjusted accordingly.

The incorporation of climate risks into macroprudential frameworks again centrally relies on the understanding and disclosure of risk and effective disclosure requirements can play a vital facilitating role. The understanding of the exposure of individual institutions and the financial system to climate change-related risks can be enhanced through the incorporation of these risks into stress testing, which creates a foundation for the calibration of macroprudential policy instruments, such as countercyclical capital buffers [NGFS (2019b)]. Methodologies for the evaluation of climate risks through stress tests have been pioneered by Battiston et al. (2017) and Vermeulen et al. (2019). De Nederlandsche Bank (DNB) has been the first to conduct a climate risk-related stress test in 2018 for the Netherlands with the aim of quantifying the consequences of a disruptive energy transition for financial stability. A central finding has been that a disruptive transition could be associated with substantial losses for the financial sector [Elderson (2019b)]. Furthermore, the Bank of England has announced its intentions to apply stress testing of physical and transition risk to insurance companies [Bank of England (2019a)], which it also plans to extend to general financial institutions by 2021 [Bank of England (2019b)].

2.4 Monetary policy

Climate change can potentially directly affect price stability and therefore has implications for monetary policy, independently of whether policies to mitigate climate risks will be successfully implemented in the future. Climate change-related

shocks to the economy may either occur in the form of a demand shock, which is controllable for the central bank because growth and inflation move in the same direction, or as a supply shock, which is more difficult to address because inflation and output may move in different directions, thereby creating a potential trade-off for central banks between the stabilisation of inflation and output [Cœuré (2018), p. 2). Typically, climate change-related shocks are considered to manifest as supply shocks, caused for example by droughts, floods or heatwaves that can negatively affect agricultural production and create upward pressure on food prices [Parker (2018)]. In practice, different climate change mitigation scenarios also have diverse and specific implications for different monetary policy regimes [McKibbin et al. (2017)]. One factor worthy of further consideration is how monetary policy could need to adjust in light of the more capital-intensive nature of the low-carbon, climate resilient economy. The transition involves a higher rate of upfront investment – for example in energy efficiency or renewable energy technology – offset by lower energy and resource use in terms of operating costs. At the margin, this shift from an "Opex" to a "Capex" focused economy would be more sensitive to changes in the cost of capital (and thus interest rates). Historically low interest rates since the financial crisis have thus provided a strong positive tailwind behind the deployment of low-carbon solutions which could falter if rates normalise in the future.

Climate change has implications for both conventional and unconventional monetary policies. The introduction of quantitative easing (QE) following the financial crisis failed to take the environmental and the social quality of asset purchases into account. The result was an unintentional carbon bias in the corporate bond purchase programmes of the Bank of England and the European Central Bank which have been skewed towards carbon-intensive industries [Matikainen et al. (2017)]. This has prompted calls for the "greening" of QE along with central bank balance sheet and monetary policy operations. For example, the ECB's practice of buying new bonds as its existing stock comes to maturity, as well as its plans of renewed bond purchases, announced in September 2019, is seen to offer a "window of opportunities" for the central bank to replace the old bonds of its quantitative easing programme with new environmental green bonds [De Grauwe (2019)]. This experience also raises a fundamental question for central bankers on how to interpret the principle of market neutrality: should policy be neutral relative to the current market, which is subject to pervasive market failures, or relative to a sustainable market in which externalities are priced?

2.5 Scaling up green finance

Climate change is now recognised as not just generating risks to the stability of the financial system, but also requiring a substantial reallocation in financial flows to scale up investments in sustainable solutions [Elderson (2019a)]. According to HSBC, the world needs to invest $6-8 trillion per year by 2030 to keep the global temperature

rise below two degrees Celsius, while current levels only amount to $1 trillion per year at the very best [Klier (2019)].

Central banks can engage in the scaling up of green finance for two main reasons. First, the mandates of some central banks oblige them to support government priorities and/or sustainable development [Dikau and Volz (2019a)]. Second, due to the endogenous nature of climate risk, the scaling up of green finance can be seen as a long-term risk management strategy to alleviate the most severe physical climate shocks. At the same time, scaling up green finance mitigates systemic transition risk by creating capital market infrastructure capable of absorbing and allocating the capital freed by potential divestment from assets which are not aligned with climate change targets. To mobilise and scale up green finance, central banks have various policy instruments at their disposal. There are significant differences of mandates and broader policy frameworks among central banks and supervisors, as well as across advanced and emerging market and developing economies with regard to how they approach the issue of scaling up green finance. Central bank in advanced economies have started to green their own portfolios. Some central banks in emerging markets and developing economies have taken more active – and contentious – allocative approaches.

2.5.1 The greening of central bank portfolios

Increasingly the integration of environmental, social and governance (ESG) criteria in the portfolio management of central banks is recognised as an important step through which monetary institutions can "lead by example" while staying within their mandate [Cœuré (2018) and NGFS (2018)]. This brings central banks into line with the wider move towards responsible investment by leading asset owners: more than 2,000 institutions with an excess of $80 trillion in assets have now signed the Principles for Responsible Investment (PRI).

On the asset side of central bank balance sheets, there are four portfolios, which have been discussed with regard to their suitability for the incorporation of ESG criteria in order to promote green finance [Cœuré (2018)]. Traditionally, central banks manage three types of portfolios, including foreign assets (such as exchange reserves), pension funds and a portfolio of own funds, which provides the central bank with income to help cover its operating expenses. Additionally, the implementation of "unconventional" monetary policy measures has added a fourth asset portfolio to the balance sheets of some institutions, which, as discussed above, need to have sustainability factors incorporated to avoid an unintended carbon bias.

With regard to foreign assets, problems can potentially arise from the need to balance ESG objectives against liquidity, safety and return [Fender et al. (2019)]. Initial research has shown that the safety and return of green bonds support their incorporation into

reserve portfolios, however, their accessibility and lack of liquidity in markets currently pose some constraints (ibid.). Central banks" pension portfolios have been recognised as suitable for the incorporation of ESG standards, which constitutes a rather uncontroversial first step that has been taken already by several institutions, including the ECB [Cœuré (2018)].

The incorporation of ESG principles into central banks" own activities can achieve several objectives. First, it ensures that risks are appropriately accounted for in central banks" portfolios; second, it guarantees that central banks" operations are not subject to an unintended carbon bias; and third, it can also contribute to the scaling up of green finance. Again, this practice is still far from universally accepted, however it has been increasingly addressed by leading central bankers [Cœuré (2018) and Elderson (2019a)]. In practice, the DNB has been the first central bank to include ESG criteria in its investment processes, having applied ESG considerations to its own funds and foreign reserves portfolios [De Nederlandsche Bank (2019)]. DNB was also the first central bank to sign the PRI.

2.5.2 The development of green financial markets

Effective markets for green assets are of central importance under a "bottom-up" approach, which relies primarily on markets to play a central role in financing the economic transition to a low-carbon economy. An important facilitating role for central banks and supervisors lies in addressing the problem of missing markets and supporting the creation of new asset classes in listed equities and debt as well as unlisted assets such as infrastructure that are aligned with long-term system health.

Green bonds have been a particular focus and demonstrated strong growth through a combination of initial market-making by public development banks, demand from institutional investors, the development of voluntary guidelines and standards as well as measures from security regulators to ensure market integrity. One issue that has been highlighted is that the trade of green bonds is obstructed by a lack of transparency and standardization with regard to the reporting climate risks and missing markets, leading to low liquidity and turnover in these markets [Krogstrup and Oman (2019), p. 27)]. Deep, liquid and more advanced markets for green assets can, in turn, play a central role in increasing demand for and the supply of green securities, thereby contributing to reducing the cost of financing climate change mitigation efforts (ibid.). The importance of certification in the green bond market through independent third parties has been stressed as a central element that can enable firms to improve their environmental footprint [Flammer (2019)]. The development of market infrastructure, information and issuance guidelines can be centrally supported through green bond guidelines and taxonomies. Green bond guidelines and definitions of criteria define what the use of the proceeds from green bond issuances can be, and also regulate disclosure standards. Both measures can

strengthen the issuance of green bonds by preventing greenwashing and lowering transaction costs. With regard to disclosure, the introduction of disclosure requirements regarding environmental and sustainability-related information on bonds and other assets can contribute to the strengthening of the identification and acceptance of green assets. In practice, examples of support for the development of green bond markets include the EU's outline for a green bond standard as part of its Sustainable Finance Action Plan (see Box 2), as well as various efforts of the Peoples Bank of China's (PBOC).

This points to the wider efforts in China by the central bank and financial authorities to green its financial system, stretching back to the 1980s [Zadek and Chenghui (2014)]. In 2007, the PBOC, the China Banking and Insurance Regulatory Commission (formerly CBRC) and the Ministry of Environmental Protection jointly issued the Green Credit Policy in 2007. Efforts to develop definitions of green credit also trace back to 2007 to the jointly-issued Opinions on Implementing Environmental Protection Policies and Regulations to Prevent Credit Risks [NGFS (2019b)]. In 2016, alongside its inclusion of green finance into its presidency of the G20, China also issued comprehensive Guidance on Greening the Financial System in 2016.

2.5.3 Green credit allocation

The scaling up of green finance and "greening" of the economy may also be facilitated through more direct government guidance, following a "top-down" approach. The underlying justifying rationale can be seen in the existence of pervasive market failures, which may prevent markets from bringing about a low-carbon transition on their own. For example, due to a discrepancy between private returns and social or environmental returns, banks and other financial institutions may not allocate their resources to sustainable and green activities on their own, funding carbon-intensive and polluting industries instead. In this situation, as discussed by Stiglitz (1994), a market failure-alleviating and Pareto efficiency-improving role for central bank and financial supervisors can emerge. Because market failures may also lead to a lack of necessary long-term private investment, financial policies are widely seen as a necessary complement to fiscal policies [Krogstrup and Oman (2019)].

Monetary and supervisory institutions have a wide variety of allocative instruments at their disposal, in order to directly intervene into the allocation of credit and enhance the flow of resources to sustainable projects. Instruments include targeted refinancing lines, portfolio ceilings, differential interest rate ceilings, informal credit guidance and other quasi-fiscal tools, which can be implemented to intervene in the allocation of credit and direct resources to green sectors and industries [Dikau and Volz (2019b)]. The effectiveness and appropriateness of most of these instruments depends centrally on the structure and sophistication of the financial system and interventionist

Box 2

EUROPEAN UNION APPROACH TO SUSTAINABLE FINANCE

The EU Commission appointed at the end of 2016 a High-Level Expert Group (HLEG) on sustainable finance, which played a central role in mainstreaming sustainable finance as a normal policy goal for EU policymakers [Thimann (2019)]. The groups final report caused the European Commission to develop its own Action Plan [European Commission (2018)]. Building on the core recommendations and proposals of the HLEG, the Commission report focuses on two central aspects of sustainable finance, namely, first, the contribution of finance to sustainable growth and secondly, the incorporation of ESG factors into investment decision-making. The 10 actions proposed under the Action Plan include "necessary" (prudential rules, financial product standards, low-carbon benchmarks and "green" product labels), as well as "complementary" (public investment and policy, and private investment, corporate disclosure and provision of investment advice) elements.

The EU Commission Action Plan	Progress
Action 1: Establishing an EU classification system for sustainable activities. The taxonomy is a central, as well as concluding element of the Commission's Action Plan on Financing Sustainable Growth that provides the other 9 initiatives with a definition of climate change adaptation and other environmental activities	June 2019: EU taxonomy launched, which defines 67 low-carbon activities and 9 transition activities in high-emitting sectors. To classify under the taxonomy, investments have to substantially contribute to at least one of six environmental objectives, "Do no significant harm" to any objective and comply with minimum social safeguards
Action 2: Creating standards and labels for green financial products	June 2019: Voluntary and non-legislative EU Green Bond Standard (GBS) launched, which includes the publication of a green bond framework, mandatory reporting, as well as external verification through an accredited verifier
Action 3: Fostering investment in sustainable projects. It is recognised that it is necessary to mobilise private capital for sustainable projects, especially for infrastructure, to achieve a transition to a more sustainable economy and enhancing efforts are discussed	
Action 4: Incorporating sustainability when providing financial advice. Through the Markets in Financial Instruments Directive (MiFID II) and the Insurance Distribution Directive (IDD), financial institutions are required to offer and advice their customers on "suitable" products	April 2019: Publication of ESMA's technical advice to the European Commission on integrating sustainability risks and factors in MiFID II
Action 5: Developing sustainability benchmarks	June 2019: Introduction of the EU Climate Transition Benchmark (EU CTB) and the EU Paris-Aligned Benchmark (EU PAB)
Action 6: Better integrating sustainability in ratings and market research. Because it remains unclear to what extent the assessment of companies' ESG performance is considered by rating agencies, the European Securities and Markets Authority (ESMA) has been invited to explore solutions	July 2019: ESMA published its technical advice on sustainability considerations in the credit rating market and its final guidelines on disclosure requirements applicable to credit ratings
Action 7: Clarifying institutional investors' and asset managers' duties. The legislative requirement for institutional investors and asset managers to fulfil their "fiduciary duty" and to act in the best interest of their investors is discussed with regard to the necessity to include sustainability factors and risks	March 2019: EU Parliament and Council achieved political agreement on requiring ESG integration by financial market participants
Action 8: Incorporating sustainability in prudential requirements. Banks, insurance companies and pension funds are potentially exposed to climate change-related risks with implications for financial stability	June 2019: EIOPA has publishes a Consultation Paper on an opinion on sustainability within Solvency II
Action 9: Strengthening sustainability disclosure and accounting rule-making. While the EU Directive on the disclosure of Non-Financial Information (NFI) requires the disclosure of ESG aspects, efforts to strengthen disclosure requirements are discussed	April 2019: European Parliament endorses the legislation setting the building blocks of a capital markets union, including the regulation on disclosures relating to sustainable investments and sustainability risks
Action 10: Fostering sustainable corporate governance and attenuating short-termism in capital markets. Corporate governance is considered to potentially contribute to a sustainable economy, but short-term market pressures may make it difficult to lengthen the time horizon in corporate decision-making	June 2019: Publication by ESMA of a survey on undue short-term pressure on corporations from the financial sector

SOURCE: Compiled by authors.

policies, which have historically been discussed as a form of "financial repression", remain controversial and have been associated with distortive side-effects. Most of these instruments are no longer used in advanced economies today, where they fell out of favour in the 1970s. An active sustainability-enhancing role also raises questions with regard to the compatibility with current mandated objectives of central banks and financial supervisors. Generally, an interventionist allocative role of central banks and supervisors stands in contrast to the understanding of the neutrality of central banking policy towards different segments of the economy as well as to the concept of central bank independence. This raises the question of in how far an active contribution to the scaling up of green finance and the support for a transition to a low-carbon economy is compatible with current mandates. Independent of the scope of individual mandates, however, actively informing governments and the general public on the current failures and shortcomings of financial markets to account for climate change in order to facilitate the necessary interventions by the responsible institutions – whether by governments or parliaments – clearly lies within the mandate of every central bank.

In practice, some emerging market and developing economies have continuously utilised credit guidance policies to allocate credit to priority sectors, including green industries [Dikau and Ryan-Collins (2017)]. Examples include the central bank of Bangladesh, which has introduced several green credit allocation programmes, such as preferential refinancing for "green" loans, with the aim of enhancing commercial bank lending for sustainable investment [Barkawi and Monnin (2015)]. The overall approach of Chinese authorities, among them the PBOC, has been described as a "top-down" model, in which macroprudential and monetary policy play key roles and which differs from the Western "bottom-up" approach that attributes a central role to the private sector [Yao (2018)]. Among various initiatives, the PBOC has incorporated green finance into its macroprudential framework in order to incentivise the scaling up of green finance (ibid.). The Reserve Bank of India continues to maintain a Priority Sector Lending (PSL) programme introduced in the 1940s, under which commercial banks are required to allocate a percentage of their loan portfolio according to the central bank's economic priorities. Recently, the programme's targets were extended to also include renewable energy [Reserve Bank of India (2016)].

3 Challenges and new horizons

This growing body of action by financial authorities, alongside action by market participants and complemented by an increasingly incisive academic literature, is an impressive achievement in the space of only a few years. Yet these steps remain at an early stage, with limited breadth and depth. In the words of Bank of England Governor Mark Carney in October 2019: "Like virtually everything

else in the response to climate change, the development of a more sustainable financial system is not moving fast enough for the world to reach net zero" [Carney (2019c), p. 3].

The current phase of adjusting existing central bank and supervisory policies is only a few years old and it is still too early to evaluate the impact of these measures in terms of the classic three-fold policy priorities of their effectiveness, efficiency and equity (fairness). In addition, as these initiatives straddle the worlds of financial and sustainability policy, new tools will be needed to assess the achievement of two or more objectives. From a finance perspective, the focus will need to be on how these initiatives improve market efficiency and system resilience. From a sustainability perspective, the question is whether these measures lead to the enhanced delivery of social and environmental outcomes [McDaniels and Robins (2018)]. Furthermore, attention needs to be placed on identifying positive (and negative) unintended consequences of this greening process.

Many challenges lie ahead and to conclude this chapter, we would like to outline four of these, highlighting the role that academic research could play.

3.1 Clarifying core definitions, disclosures and differentials

As policy makers, supervisors and market participants have sought to build a sustainable financial system, a set of fundamental issues have come to the foreground. These include how to introduce a common language for green and sustainable finance that enables reliable classification and thus efficient market responses. This need lies behind the introduction of the EU's sustainable finance taxonomy (see Box 2), which builds on market practice (for example, in the green bond market). The strategic prize is the system-wide adoption of definitions that can be applied to national statistics and measurements, decisions by issuers, banks, investors and insurers, as well as the way in which financial supervisors oversee the system as a whole. Indeed, financial authorities need a clear way of identifying which assets and activities are "system enhancing" from a sustainability perspective and which are "system degrading". Agreeing such a taxonomy is by no means an easy process – even in terms of identifying activities that can be classified as "green" –, let alone "brown". But practical steps can be taken now within the EU and globally on priority areas. Ensuring that the definitions are dynamic is also recognised as a critical characteristic to enable this taxonomy building to be a learning process. Finally, a taxonomy of activities defined in terms of the transition to the low-carbon economy still needs to be supplemented by environmental, social and governance analysis by banks, investors and insurers as well as financial authorities.

Alongside this imperative lies the related priority of ensuring consistent, reliable and market-wide disclosure of key data points. The FSB's TCFD recommendations have

made a significant step forward, but their recommendations only relate to climate change. Further convergence is needed on common standards across the ESG and sustainability area, for example, through initiatives such as the Global Reporting Initiative (GRI). From a financial system perspective, consistent data and disclosure is also needed for sovereign bonds, one of the largest asset classes, but one that is omitted from existing reporting frameworks, such as the TCFD.

Importantly, the absence of comprehensive disclosures should not postpone efforts to assess and take action on sustainability factors until a world of "perfect information" is achieved. Serious attention therefore needs to be placed on how to take decisions under uncertainty in the context of incomplete data. This is particularly important for the critical question of evaluating the implications of sustainability factors for the risk and performance differentials of financial assets and institutions. Even in the context of profound market and policy failures, increasing evidence is available for assets on public equity and debt markets which suggests that assets with superior ESG performance offer better risk-adjusted returns [Benlemlih and Bitar (2018), Friede et al. (2015) and In et al. (2017)]. However, far less evidence is available for the performance of loans on bank balance sheets, not least because the underlying data is confidential and not disclosed. For the NGFS, the assessment of whether a financial risk differential exists between "green" and "brown" assets has also been listed as a key challenge [NGFS (2018)]. Here, there is considerable potential for joint research between central banks that have access to this data and academic institutions.

3.2 Reflecting on strategic principles to guide the greening of the financial system

Even in a world of shared definitions and perfect information, central banks would still face profound challenges over the strategic principles they should apply to the sustainability imperative. Climate change and associated environmental challenges do not easily fit within the framework of conventional regulatory wisdom for two interrelated reasons. First, time horizons are far longer and, second, impacts can be irreversible and real uncertainty is intrinsic, partially due to the longer time scales involved. The "tragedy of the horizon" that Governor Carney identified in 2015 still remains, although greater visibility over potential future shocks is emerging through the first wave of scenario analyses and stress tests. Looking ahead, specific attention needs to be focused on what long-term supervision and monetary policy could look like and how this could address continuing market imperatives for short-termism [Thomä and Chenet (2017)].

Further reflection also needs to take place on how core principles of central banking practice might need to change in the new era of the climate emergency.

The principle of market neutrality is one of these as discussed above in section 2.4. As Ignazio Visco, Governor of Banca d'Italia has noted "it may be inquired whether this principle [of market neutrality] should be fully preserved or be adjusted in a context in which, absent of further regulation, market forces are pushing greenhouse gas concentrations to levels that will soon be unsustainable" [Visco (2019), p. 5]. In addition, to account for intrinsic uncertainty and the fundamental threat of irreversible damage to vital ecosystem functions, new principles could be usefully adopted by central banks and financial authorities, such as most notably the precautionary principle, long a core feature of environmental policy. This states that the absence of information and inherent uncertainty that is intrinsic to a climate transition should not stop preventive action [Ryan-Collins (2019)].

3.3 Broadening the scope from climate change to sustainable development

To date, much of the focus of central bank initiatives has been focused on climate change. However, this is not the only environmental threat facing the financial system. In developing countries, environmental problems such as air pollution and water stress are more pressing, with climate change playing the role of a threat multiplier rather than a primary focus. In China, for example, the first environmental stress test was focused on air pollution rather than climate change. This points to the need to consider an integrated approach that looks at the intersecting issues of the ecological transition as a whole rather than just individual features such as climate change alone. Some central banks, such as DNB, have started to explore the strategic implications for their work of the full set of environmental challenges in the Sustainable Development Goals [De Nederlandsche Bank (2019)].

Beyond this, central banks will need to consider how they respond both to the social implications involved in greening the financial system, as well as the core social objectives of the SDGs such as ending poverty, reducing inequality and ensuring universal access to essential financial services.

One example of this is the imperative of ensuring a "just transition" to a zero-carbon economy, a commitment included in the Paris Agreement. Policymakers, key stakeholders (such as trade unions), as well as long-term investors increasingly recognise that the transition will need to be "fair and seen to be fair", making sure that workers, consumers and communities are not stranded or left behind in the process [CCC (2019)] and Robins et al. (2019)]. This joining up of the environmental and social dimensions of sustainability takes central banks and financial authorities back to their core system focus, where a close understanding of living standards, employment and regional prosperity is normal practice.

3.4 Building supportive international regimes for central bank action

Central bank and financial supervisory approaches to sustainability have grown up through a complex interplay of national action and international coordination. Leadership at the national level is needed to initiate the process of change and inspire efforts in other jurisdictions. But international coordination is also essential, both to ensure the rapid take-up of good practice so that individual authorities do not need to "reinvent the wheel" and also to prevent regulatory arbitrage between different approaches to sustainable finance. Here, the EU's Sustainable Financial Action Plan is the more comprehensive approach to international coordination and regulation.

To date, developing a habit of cooperation between authorities has been crucial to building momentum, with a focus, sharing experience and developing common approaches. Key initiatives have been the sector-focused coalitions such as Sustainable Insurance Forum and the Sustainable Banking Network as well as the more systemic NGFS (see Box 3) [IFC (2018), McDaniels et al. (2017) and NGFS (2019b)]. The FSB's TCFD is an interesting example of a regulatory authority initiating a market-led, voluntary process of norm setting; the FSB itself has yet to incorporate climate risks into its routine operations.

Clearly, one of the challenges for the future is when and how sustainability factors become incorporated into the core international regulatory regimes (such as the Basel framework for banking). This is both a technical question depending on the establishment of sufficient analytical foundations for action, as well as a political question relying on clear consensus from all G20 nations.

Responding to these and other challenges needs to be focus of the next phase of central bank action on sustainability. As part of this, there is a powerful agenda for academic teaching, research and policy dialogue. The Global Research Alliance for Sustainable Finance and Investment (GRASFI) is one network of academics working in this area. Another is the International Network for Sustainable Financial Policy Insights, Research, and Exchange (INSPIRE), established in 2019 [INSPIRE (2019)]. INSPIRE has been purpose-built to commission analysis and insights from best-in-class scholars and analysts in all parts of the world on key research questions linked to the NGFS work program. INSPIRE is hosted by the ClimateWorks Foundation and the Grantham Research Institute at the London School of Economics, and commissions research guided by an Advisory Committee along with inputs and exchange from the NGFS.

A sustainable financial system is not only necessary but entirely possible. Making this a reality is increasingly a shared global objective.

Box 3

NGFS RECOMMENDATIONS AND FUTURE PRIORITIES

The NGFS has published a first comprehensive report, accompanied by six practical best practice recommendations for central banks, supervisors, and financial institutions on how to enhance their role in the greening of the financial system and incorporating environment and climate-related risks into their operations [NGFS (2019b)]. The first four recommendations are aimed at central banks and supervisors, while recommendations 5 and 6 address broader issues.

1 The NGFS recommends the *integrations of climate-related risks into financial stability monitoring and microprudential supervision* through i) the assessment of climate risks, and ii) the integration of these risks into prudential supervision.

2 The *integration of sustainability factors into the management of central banks portfolios* is acknowledged as an important and potentially pathbreaking step.

3 Data gaps are recognised as a central challenge and the public *sharing of data* is considered to be an important enabling move.

4 The *creation of in-house capacity* and collaboration with other institutions is seen as a vital step that can contribute to rising awareness and establishing intellectual capacity.

5 Supporting the effort of establishing an internationally *consistent climate and environmental disclosure framework* as well as the work of the TCFD.

6 Encouraging the *development of a taxonomy* that enhances the transparency around which economic activities are "green" and which ones are most exposed to climate and environment-related risks.

In April 2019 the NGFS also outlined its next steps with regard to concrete deliverables (ibid.):

1 Publishing a *handbook on climate and environmental risk management* for supervisory authorities and financial institutions that outlines concrete steps to better understand and respond to climate and environmental risks.

2 Issuing *voluntary guidelines on scenario-based risk analysis* and the development of data-driven scenarios to assess climate-related risks.

3 Providing best practices guidance for *incorporating sustainability criteria into central banks" portfolio* management.

Through the publications of its technical supplement to the first comprehensive report, the NGFS provides an overview of the academic research that focuses on modelling the impact of climate change on the economy and the financial system, and thereby provides a range of options for central banks and supervisors to assess climate change risks [NGFS (2019c)].

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