G20 Green Finance Synthesis Report

2017

G20 Green Finance Study Group

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Contents

Executive Summary

The objective of the G20 Green Finance Study Group (GFSG) is to "identify institutional and market barriers to green finance, and based on country experiences, develop options on how to enhance the ability of the financial system to mobilize private capital for green investment". With the objective of supporting the G20 goal of strong, sustainable and balanced growth, the G20 Heads of State, at the 2016 Hangzhou Summit, recognized the need to "scale up green finance" and identified seven broad options, for voluntary implementation by countries in light of national circumstances, in addressing this goal.

During 2017, the GFSG has focused on two themes: first, the application of environmental risk analysis (ERA) in the financial industry; and second, the use of publicly available environmental data (PAED) for financial risk analysis and informing decision-making. In addition, the GFSG has taken stock of developments across G20 members and internationally against the seven options set out in the 2016 G20 Green Finance Synthesis Report.

ERA is an important cross-cutting theme that supports the GFSG's objective. The identification, pricing and management of material risks are key features of an efficient and resilient financial system. When it comes to environmental risks, private sector feedback received by the GFSG suggests many financial institutions face challenges in identifying, quantifying and applying analytical tools to assess the financial impact of these risks. Considerable differences can exist in terms of the capacity of financial institutions to apply ERA, notably between different countries and between different types of financial institutions such as banks, insurance companies and other institutional investors; thus, the application of ERA can be limited in terms of the implications for financial institutions themselves, their clients and the financial system as a whole. A number of case studies suggest if financial firms do not effectively take material environmental factors into account, they may misappreciate short- and long-term environment-related financial risks.

Financial institutions could combine two elements to assess environmental risks: 1) understanding and identifying the environmental sources of financial risks; and 2) translating these factors into quantitative and qualitative information to understand the potential magnitude of financial risk to investments and to aid investment decisions. The appropriateness of risk analysis tools and associated metrics may depend upon, among others: first, risk types (e.g., market, credit, business); second, the risk factors financial institutions are exposed to (e.g. physical or transition risks); third, the size of direct and indirect exposure to the specific environmental risks; and fourth, key country/sector-specific factors.

Based on a review of current practice, it is clear there is considerable scope for more dialogue, awareness and knowledge sharing on ERA. A stock take of practice by both financial institutions and financial authorities identified a diverse portfolio of ERA tools, methodologies and case studies that can help financial decision-makers to understand and integrate environmental risk into risk management and asset allocation decision-making. Case studies suggest that the application of these tools can result in improved credit and investment policies; reduced portfolio and firm-level risk; product innovation; reallocation of capital and enhanced stakeholder engagement.

The effective use of ERA faces a range of challenges. Research by GFSG knowledge partners and consultation with the private sector suggest barriers to wider adoption of ERA practices can include: a lack of clear and consistent policy signals; limited methodologies and relevant data;

capacity limitations within financial institutions; time horizons; terms of investment; and performance incentives.

Options for encouraging voluntary adoption of ERA include: ensure the consistency of policy signals; raise awareness of the importance of ERA for financial institutions that have significant environmental exposures; encourage better quality and more effective use of environmental data; encourage public institutions to assess environmental risks and their financial implications in different country settings; review and, if appropriate, clarify financial institutions responsibilities to consider environmental factors; and enhance capacity building on financial sector ERA.

PAED are important sources of information for ERA and broader financial analysis. PAED, as used in this report, refers to environmental data that are provided and reported by non-corporate entities and can be useful for financial analysis. The lack of, and difficult access to, relevant environmental data limits the ability of financial firms and other market participants to analyze and manage environmental risk exposures. It also hinders the reallocation of resources to financing green investment opportunities.

ERA can be supported by not only environmental data disclosed by corporates for assessing their "current exposures" but also economy-wide environmental information, implications (e.g., externalities) of environmental changes, possible future changes in climate and other environmental risk factors, as well as potential policy and market responses to environmental changes. Such information, some of which is forward-looking in nature, comes largely from public sources including governments, international organizations (IOs), science institutes or non-governmental organizations (NGOs). Such information can help financial and non-financial firms to assess the probabilities and impacts of both physical and transition risks as well as green investment opportunities. At the same time, it is important to note that forward-looking analysis always involves uncertainties around the precision of projections and country relevance, and therefore the selection of assumptions and scenarios used for generating projections should stay with data users.

Current PAED reviewed by GFSG knowledge partners can be broadly grouped into: (i) historical physical trends, (ii) forecasts and forward-looking scenarios, and (iii) costs of pollution and benefits of remediation. The nature of the data varies, with some reflecting current status, whereas others providing more forward-looking information. Some PAED examples include: physical asset (facility) level environmental data; water stress and other ecosystem pressures; natural disaster probabilities; scenarios of climate change, energy demand shift, changes in technology, production and consumption patterns; data on solar and wind resources; databases on green technologies; costs of air, water and land pollutions; and the benefits of environmental remediation.

Obstacles constraining the effective usage of PAED in financial analysis as identified by GFSG knowledge partners include: the nascent state of ERA methodology usage and green investment assessment; the lack of comparable future scenarios and uncertainties of future policy responses to environmental and climate challenges; PAED formatting that is unfriendly to financial sector users; high search costs (monetary and non-monetary); and uncertainty over the business models for PAED provision. The GFSG agreed that it would be useful to prepare a Catalogue that would describe and contain links to existing PAED databases.

Options for improving, on a voluntary basis, the availability, accessibility and relevance of PAED include: G20 members can work with other partners to share publicly available

methodologies for ERA and for quantification of environmental costs and benefits；governments could also support private sector efforts to improve the quality and user friendliness of PAED; the GFSG could support the further development of the Catalogue of PAED, prepared to date by UN Environment and the OECD; and country authorities could promote domestic sharing of PAED with a focus on its use for financial analysis.

An interim progress report has mapped developments against the seven 2016 GFSG options since the Xiamen GFSG meeting in June 2016. Considerable progress has been made in many G20 countries in a number of areas. Examples are national sustainable and green finance roadmaps, capacity building and knowledge sharing by financial institutions, and the development of local green bond markets and cross-border green bond flows. International cooperation in green finance has been evident across the G20 and between G20 countries, both through intergovernmental platforms and across diverse public-private initiatives.

In addition to the examples provided above, a number of other areas of inquiry are emerging and require further research. Examples of these areas include, among others: integration of green investment opportunities framework; more integrated national approaches to green finance; development of local currency green bond markets in emerging market economies; the role of public finance and development banks in supporting green investment, and the application of financial technology ('FinTech') in green finance.

Introduction

The G20 Green Finance Study Group ('GFSG' or 'Study Group') aims to "**identify institutional and market barriers to green finance, and based on country experiences, develop options on how to enhance the ability of the financial system to mobilize private capital for green investment".** With the objective of supporting the G20 goal of strong, sustainable and balanced growth, the G20 Heads of State, at the 2016 Hangzhou Summit, recognized the need to "scale up green finance" through financial system developments and identified seven broad options, for voluntary implementation by countries in light of national circumstances, in addressing this goal. These options include efforts to:

1. Provide strategic policy signals and frameworks;

2. Promote voluntary principles for green finance;

3. Expand learning networks for capacity building;

4. Support the development of local green bond markets;

5. Promote international collaboration to facilitate cross-border investment in green bonds;

6. Encourage and facilitate knowledge sharing on environmental and financial risk; and

7. Improve the measurement of green finance activities and their impacts.

During 2017, the GFSG has focused on two priority themes: first, the application of environmental risk analysis (ERA) in the financial industry and second, the use of publicly available environmental data (PAED) in financial analysis. In addition, the GFSG has taken stock of developments against the options (set out above) proposed by the 2016 G20 Green Finance Synthesis Report.

To inform its work, the GFSG has drawn on country experience and reached out to practitioners in the financial sector. It has also gathered experience of experts from international organizations, academia and civil societies.

This synthesis report summarizes findings from the GFSG, based on contributions from its knowledge partners and a number of private and public institutions, and discusses options for improving the application of ERA by financial firms and for improving the accessibility and usefulness of PAED for voluntary implementation by countries in light of their priorities, needs, and national circumstances.

1. Environmental Risk Analysis (ERA)

1.1. Why ERA?

The identification, pricing and management of material risks are key features of an efficient and resilient financial system. Physical and transitional environmental events may result in increasing risks to financial investments, financial institutions and the financial system.[1] Private sector feedback received by the GFSG suggests that many financial institutions face challenges in identifying and quantifying environmental risks and applying analytical tools to assess the financial impact of these risks. In particular, GFSG research has found some financial institutions have encountered difficulties in quantifying the potential materiality of environmental risks in spite of increasing evidence of the potential negative effects on asset values.

As recognized by G20 delegates in the Study Group's first year, ERA is an important cross-cutting theme that supports the GFSG's objective. ERA describes a portfolio of analytical tools and methodologies that could enable financial decision-makers to assess the financial implications of environmental risks and to integrate environmental risk into risk management and asset allocation decision-making.

In 2016, the GFSG undertook a stocktake of ERA practices of financial firms as well as financial authorities.[2] Although initiatives by financial institutions to assess environmental risks have been underway for several decades, they have been sporadic, confined to specific financial sub-sectors and far from a routine practice employed by firms in their investment decision-making processes.[3] The nascent nature of ERA among financial firms led the GFSG to conclude in its 2016 Green Finance Synthesis Report that "the GFSG/G20 could encourage further dialogue on environmental and financial risk, to facilitate knowledge exchange on methodologies for ERA and management within the financial sector."

As a result, in 2017 the GFSG has looked to deepen understanding of ERA by reviewing case analysis to categorize existing ERA practices adopted by banks, insurers, asset managers, rating agencies and research bodies. The GFSG, drawing on contributions from knowledge partners and a number of financial institutions, has examined and evaluated the effectiveness of ERA practices of the above stakeholders. More specifically, the work aimed to identify challenges to effective usage of ERA methodologies and suggest options to promote voluntary adoption of ERA practices as appropriate in light of national circumstances, needs, and priorties. The GFSG also engaged with the private sector including in a workshop in Frankfurt, Germany on January 16th and 17th 2017 as well as on a regular ongoing basis throughout the last eighteen months. This section provides the key findings of this work.

1.2. Increasing Momentum but not yet Widespread

Environmental factors are increasingly recognized by many as one of the important risk factors for sustainable growth of the global economy. The World Economic Forum's 2017 Global Risks Report named extreme weather events, water crises, biodiversity loss and ecosystem collapse (terrestrial or marine), major natural disasters, and the failure of climate change mitigation and adaptation among the top risks by impact.[4] Several leading insurance companies, asset managers and banks now recognize these physical and transition risks as potential drivers of financial losses as well as sources of increased market volatility and possibly financial sector instability.[5]

Some financial firms in a number of countries have gradually increased the analytical scope and sophistication of their ERA efforts.[6] They have started to consider a wider range of environmental factors, such as those from policy, consumer, market and technological responses (transition risks), as well as the impacts of environmental events and physical risks on a broader range of asset classes (such as loans, bonds, and equities).[7] In addition, a growing number of public institutions have recognized that some environmental factors may have implications for the resilience of financial institutions and potentially of the financial system as a whole.[8] Finally, analysis of environmental factors is beginning to reveal potential financial impacts that may be non-linear and disruptive, posing challenges for risk management.[9] However, research by GFSG knowledge partners has shown that these developments, while significant, are yet to ripple through and develop further in the financial sector's decision-making and behavior.[10] Reviewed case studies suggest that considerable differences can exist in terms of the capacity of financial institutions to apply ERA, notably between different countries and between different types of financial institutions such as banks, insurance companies and other institutional investors;[11] thus, the application of ERA can be limited in terms of the implications for financial institutions themselves and their clients.

1.3. Categorizing Environmental Risk Analysis Tools

The case studies that were reviewed indicate that financial institutions could combine two types of elements to better assess environmental risks:[12] 1) understanding and identifying the environmental sources of financial risks; and 2) translating these factors into quantitative and qualitative information to better understand the potential magnitude of financial risk and to aid investment decisions. The appropriateness of risk analysis tools and associated metrics may depend upon, among others: first, risk types (e.g., market, credit, business); second, the risk factors financial institutions are exposed to (e.g., physical or transition risks); third, the size of direct and indirect exposure to the specific environmental risks; and fourth, key country/sector-specific factors. Using these distinctions, the financial tools in Figure 1 below can take into account environmental risks and their potential effects on valuation.

Figure 1: Categorization of Risk Analysis Tools
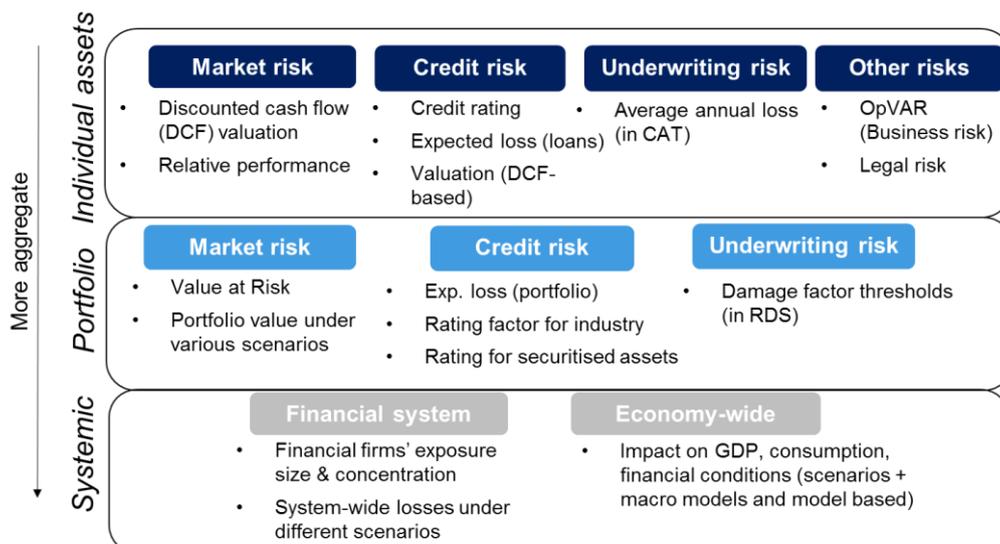
1.4. Applying the Tools: Case Study Analysis

To better understand the efforts of financial institutions, regulators and central banks to analyze environmental risks, the GFSG asked a group of specialists to review nine case studies provided by financial firms (see background paper: 'Enhancing ERA in Financial Decision-making'). Case studies were chosen to cover a representative range of physical and transition-related environmental risks (e.g. pollution, climate change, natural disasters, and natural resource depletion, as well as risks arising from policy and technology responses), methods (including financial risk models, scenario analysis, and credit ratings), time horizons and geographies (Table 1). While these cases may be seen as representative in their respective industries, they are illustrative in nature and should not be interpreted as GFSG's endorsement of the methodologies used.

Table 1: Summary of Case Studies

Environmental Risk Factor	Country	Sector	Activity	Financial Risk Tool	Results
Transition and Physical (impact of air pollution and water risk)	China	Banking	Assessing how government efforts in dealing with pollution (e.g., via higher levies on pollutants, carbon tax and ETS system) may affect borrowers' creditworthiness[13]	Default probability models linking pollution control measures to internal credit ratings of clients	Revision to credit policy based on expected rating migrations and loan losses for bank
Transition (impact of environmental regulation and carbon price)	Germany	Investment	Scenario analysis to assess impact of carbon & energy regulation on margins of carbon intensive firms[14]	ClimateXcellence model	Impact on company margin in terms of EUR cent per kWh
Transition (Impact of carbon price linked to low-carbon scenario	UK	Investment	Analysis of impacts of transition risks on German electricity utilities[15]	SOTP valuation methodology (DCF + EV/EBITDA)	Total and per share firm valuation
Transition (climate scenarios linked to various risk factors)	Intl.	Investment	Examining the effect of transitions risks on strategic asset allocation[16]	Integrated assessment model incorporated in asset allocation investment model	Median additional annual returns to 2050
Transition (Energy transition)	Netherlands	System	Regulatory Review of financial sector exposures to the energy transition and macroeconomic implications[17]	Exposure analysis based on survey data disclosed by firms	Share of total portfolios of major financial institutions held in fossil fuels and carbon intensive sectors
Physical (Natural Hazards)	Intl.	Insurance	Assessing natural hazard risks to geographic coordinates[18]	CatNet Online natural hazard risk assessment tool	Analysis of natural hazard risks at individual locations and portfolio level
Physical (Climate Change)	Intl.	Investment (Sovereign Debt)	Assessing Physical Effects of Climate Change on Sovereign Issuers[19]	Consideration of climate change factors within Sovereign Rating Model	Assessment of susceptibility of sovereigns to climate change risks
Physical (direct & secondary impacts of water scarcity)	Intl.	Banking	Assessing the impacts of drought on corporate lending portfolios[20]	Drought model (natural catastrophe, input-output model)	Overall expected losses for banking portfolios
Physical & Transition (direct & secondary impacts of natural capital degradation)	India	Banking	Examining natural capital exposure of an Indian commercial bank[21]	Environmentally extended input output model (EEIO), India Natural Capital Model	Estimation of natural capital costs apportioned to the loans and advances, Natural Capital Exposure ratio

A stocktake of practice by both financial institutions and financial authorities identified a portfolio of ERA tools, methodologies and case studies that can help financial decision-makers to understand and integrate environmental risk into risk management and asset allocation decision-making. The application of these tools pointed to improved credit and investment policies; reduced portfolio and firm-level risk; product innovation; reallocation of capital; and enhanced stakeholder engagement.[22] Case studies suggest that if financial firms do not effectively take environmental factors into account, they may misappreciate short- and long-term environmental related financial risks.

1.5. Using the Results of Environmental Risk Analysis

Financial institutions reviewed in the case studies are using the results of risk analysis in different ways. These include revising the governance of risk management, for example, by amending credit policies, introducing sector limits and establishing board-level ESG principles to affect corporate decisions and thereby reduce firm/investment-level environmental risks. In addition, some financial institutions use the results of ERA to drive product innovation targeted at clients of all sizes (including development of green products and services), and reallocate capital (including away from concentrated exposure to environmental risk and towards green investment opportunities). These results are also used by financial institutions to communicate with stakeholders, including clients, investees, market intermediaries and policy makers, so that these stakeholders can more effectively participate in green investment activities.

1.6. Challenges to the Effective use of ERA Tools

Research by GFSG knowledge partners and consultation with a number of private sector institutions suggest that challenges to wider adoption of ERA practices can include:

1. **Policy Signals:** A lack of clear and consistent policy signals to encourage the alignment of the economy and the financial system toward environmental sustainability remains a source of uncertainty for financial institutions.

2. **Technical Barriers:** Including limited availability and accessibility of ERA methodologies and relevant environmental data.

3. **Capacity:** Many financial institutions may be subject to capacity limitations, such as a lack of expertise and best practice examples, limited budget to assess environmental risk, as well as a lack of incentives to build such capacity.

4. **Time Horizons:** Some environmental risk factors may crystallize beyond the "normal" time or planning horizon of decision makers of financial institutions and regulators, thus reducing the incentives for them to take actions. In some other cases, financial institutions may not recognize that some environmental risks can develop within their "normal" time horizon.

5. **Terms of Investment:** Financial institutions may be constrained to address environmental risks based on real or misperceived requirements such as asset manager's obligations and duties.

6. **Performance Incentives:** Current performance review mechanisms adopted in many financial institutions, which are largely short-term in nature, may act as a barrier to taking a long-term view. Also, a common language for ERA would require a common effort, which single financial institutions are not able or willing to provide on their own.

1.7. Options for Encouraging Voluntary Adoption of ERA

Based on inputs from knowledge partners and expert contributions from the private sector, the GFSG broadly agreed that G20 member countries and financial institutions could consider the following options for encouraging effective ERA for voluntary adoption in light of their priorities, needs, and national circumstances:

1. **Ensure consistency of policy signals**. Member states could reduce business uncertainty by improving transparency on policy measures to be taken to align the economy and the financial system with environmental sustainability.

2. **Raise awareness of the importance of ERA for financial institutions.** G20 members could consider encouraging financial institutions to enhance the understanding of ERA and its costs and benefits by sending signals on its importance, and where appropriate cooperating with country- and sector-level industrial initiatives (e.g., banking, insurance and asset management associations) in developing and/or adopting ERA methodologies.

3. **Encourage better quality and more effective use of environmental data.** G20 members could consider voluntary options to enhance the quality of environmental data and to improve the availability and usefulness of such data.

4. **Encourage public institutions to assess environmental risks and their financial implications in different country settings.** G20 members could consider, on a voluntary basis, encouraging public institutions to conduct research and assessments of environmental risks and their implications for the financial sector.

5. **Review and, if appropriate, clarify financial institutions' responsibilities to consider environmental factors.** G20 members could consider reviewing experiences and best practice in this area, where appropriate, and seek to clarify institutional roles and contributions for considering environmental factors.

6. **Enhance capacity building on financial sector ERA.** G20 members could encourage initiatives that focus on knowledge sharing and resource pooling for the development and usage of tools and methodologies for ERA. These initiatives would enhance the general understanding of the financial and economic implications of environmental risks; promote cross-party dialogue on ERA among financial practitioners and academia; support the development and evaluation of ERA tools; help raise the awareness of the need for environmental risk analysis; and build necessary capacity within the financial industry.

2. Publicly Available Environmental Data (PAED)

This section summarizes the findings by the GFSG, based on contributions from knowledge partners and a number of private insititutions, on the importance of publicly available environmental data (PAED) for green finance, the challenges that limit the effective use of such data, and the voluntary options to improve the availability, accessibility and relevance of PAED.

In this section, we define PAED as environmental data that are reported by non-corporate entities, such as government agencies, international organizations, non-governmental organizations and science institutes, and that are useful for financial analysis. The work on PAED is also complementary to GFSG's research on ERA in 2017, as public data are also very important sources of information for conducting risk analyses by financial institutions.

2.1. Why Environmental Data?

Information is an important basis for the financial market to efficiently allocate resources across all asset classes. Without proper environmental information, investors, lenders and insurers cannot assess the financial relevance of environmental and climate aspects for their decisions. This can lead to inadequate understanding, pricing and management of environmental risks, and hence sub-optimal decision-making, which could in turn lead to volatility in asset valuations, including non-linear and unexpected impairments. The lack of environmental information also impedes the effectiveness of investors' corporate engagement over material environmental issues.

In addition to investors seeking competitive risk-adjusted returns, a growing number of 'values-based' investors are focusing on the alignment of their funds to long-term policy signals and societal goals, notably the Sustainable Development Goals (SDGs) and the Paris Agreement. However, this effort may also be challenging without proper environmental data. Government agencies that intend to provide incentives to green investments may also find it difficult to identify the right recipients for such incentives, when environmental information and the environmental cost/benefit analysis based on it are limited.

2.2. Why PAED?

Some financial institutions are recognizing that environmental risks may become material under some circumstances as evidenced by several studies.[23] Analysis of environmental risks requires environmental information disclosed by corporates for assessing the "current exposure". It also requires economy-wide environmental information, implications (e.g., externalities) of environmental changes, possible future changes in climate and other environmental risk factors, as well as potential policy and market responses to environmental changes. Such information, some of which is forward-looking in nature, comes largely from public sources including governments, IOs, science institutes or NGOs. Such information can help financial and non-financial firms to assess the probabilities and impacts of both physical and transition risks. At the same time, forward-looking analysis always involves uncertainties around the precision of projections and country relevance, and therefore data users should be aware of the assumptions and scenarios (of data preparers) used for generating projections, and could opt to use their own assumptions and scenarios as well.

Financial institutions are not only concerned with managing downside risks associated with environmentally unfriendly activities. They are also interested in increasing exposure to new investment opportunities, such as green projects or green assets that could deliver environmental benefits. In this regard, PAED is also an important input for identifying and evaluating green

financial opportunities. For example, banks, investment funds and insurance companies need to assess the future revenue and cost trajectories when making investment decisions. This might include projects or assets in areas such as environmental remediation, energy efficiency, clean energy, sustainable infrastructure and sustainable buildings. Much of the environmental information related to such investment decisions also comes from public sources.

2.3. Examples of PAED

The GFSG knowledge partners conducted a review of current examples of PAED sources that are useful for financial analysis.[24] For our purposes we grouped them into three types of data:[25] (i) historical physical trends (e.g., climate change, pollutions/emissions, water stress, etc.); (ii) forecasts and forward-looking scenarios (e.g., those based on physical trends as well as expected policy responses), and, (iii) costs of pollution or benefits of remediation. The nature of the data varies, with some reflecting current status and their relevance declining over time, whereas other provide more forward-looking information. In addition, projections vary as they are made by different organizations under different assumptions/scenarios. Examples of PAED include:

1. **Physical asset (facility) level data**: asset-level data refers to environmental information on physical assets, such as GHG emissions by power plants, oil operators (fields), refineries, and chemical plants, as well as SO_2, NO_X and waste water emissions by facilities such as power plants, steel, cement and textile factories. Such data are often collected as a mandatory requirement by the environmental authorities, and reported by either the collector or through a third party. These data are used by supply chain management for identifying "green suppliers", and by some financial firms to quantify the "greenness" or carbon footprint of companies, after the facility-level information is consolidated and mapped into companies and financial assets.

2. **Projections of water stress and other ecosystem pressures**. Water stress (shortage) situations may pose serious challenges to companies that depend on water supply. Rising scarcity of water implies higher costs of operations, and may result in asset impairment. Financial risk analysis and valuations of water-dependent sectors and companies therefore require quality forecasts of water demand and supply. In addition, a wide variety of ecosystems are under increasing pressure due to climate change and other environmental problems. Ecosystem collapses could lead to sudden and supply chain disruptions in industries such as agriculture, fishing and forestry, resulting in scarcity of natural resources and corresponding increase in price volatility. Data on the health of ecosystems and the quality of their services (e.g., through measures of biodiversity) as well as projections on ecosystem stress are thus essential for assessing the financial risk associated with these events.

3. **Projections of natural disaster probabilities.** Financial firms commonly use climate change scenarios and estimations of the probability and severity/impact of natural disasters (such as flooding, droughts, windstorms, wildfires and hurricanes) for environmental risk analysis. For example, the physical capital of corporates and commercial real estate assets may be located in geographical areas prone to natural disasters and other weather-related events that could jeopardize their economic viability and degrade the value of the associated financial assets. These physical events may also result in unexpected liabilities for insurance companies. Financial risk analysis should be able to integrate these factors and thus require data related to various natural events at the global, national and regional levels.

4. **Data on solar and wind resources.** Renewable energy has become a fast-growing green industry over the last decade. With the help of satellite technologies, many financial institutions are using data on renewable resources, such as maps of solar radiation and wind speed, to make projections on the financial outlook (productions, revenues and costs) of renewable projects.

5. **Database on existing green technologies:** existing green/clean technologies that help enhance resource efficiency and reduce pollutions/GHG emissions can be readily applied in many countries, especially in developing countries, to speed up the pace of their green development. Information on green technologies is thus critical in generating green investment opportunities.

6. **Forecasts of energy demand shift:** Energy demand shift, as a result of policy response to pollution and climate change, will significantly affect the commercial viability of traditional high-carbon energy projects. At the same time, it could significantly raise the demand for alternative energies such as wind, solar, hydropower and biofuels, and improve the commercial viability for sustainable buildings and green infrastructure. Energy demand forecasts are therefore critical to investors and other financial market participants for assessing financial risks and opportunities.

7. **Costs of air, water and land pollution and benefits of environmental remediation**: In assessing green investment demand, it is important to quantify the environmental benefits of green projects that can deliver environmental benefits, such as reductions in air, water and land pollution. On the other hand, air, water and land pollution from "brown projects" should be discouraged (e.g., by policy responses), based on estimated "costs" of pollution. The estimates of environmental benefits of green projects and costs of pollution can be divided into two categories. The first is an estimate of the reduction (or increase) in pollution in physical terms (e.g., number of tons of SO_2, NO_X, waste water or solid waste) by a green (brown) project. The second is an estimate of the social and economic costs of pollution, such as health costs of air and water pollution.

It should be emphasized that these examples are illustrative in nature. They are by no means exhaustive, and their contents are entirely those of the external specialists and should not be interpreted as representing the views or endorsement of the G20 or any G20 member authorities.

2.4. Challenges to Effective Use of PAED

As identified by the GFSG's consultation with knowledge partners and private sector institutions, a number of obstacles are constraining the effective usage of public environmental data in risk analysis and assessment of green investment opportunities:

1. **Data presentation unsuitable to financial sector users:** for example, some meteorological data and forecasts are written in units that are not commonly used or understood by financial analysts and their economic implications are not well explained in technical reports. Further, some public data are not standardized or comparable.

2. **The nascent state of environmental risk analysis and methodologies for green investment analysis:** Methods for environmental risk analysis have just been developed by a few banks, insurers, asset managers and academic institutions, and may not yet be publicly available to most other financial firms. Methods for quantifying environmental

benefits/costs of projects are also hugely complex, vary depending on sectors and regions, and are under-developed in many countries and several sectors. The lack of widespread use of such analytical tools and methodologies for many financial institutions might be one reason for the limited demand for environmental data.

3. **Lack of comparable scenarios and uncertainty over future policy responses to environmental and climate challenges:** Some key assumptions for risk analysis are made by individual financial firms on an ad hoc basis, leading to potential communication problems and a lack of comparability across financial firms/industries/countries. Financial institutions that have already conducted analysis of environmental risks and green investment opportunities also face the challenge that many other macro parameters – such as future demand for renewable energy and potential technology breakthroughs that may feature in scenario analysis, as well as likely policy actions taken against polluting sectors and incentives for green investments – are uncertain, resulting in lack of confidence in the assumptions for analysis.

4. **High search costs:** The analysis of risks and opportunities by financial institutions requires many different types of environmental data. However, these databases are typically located in many different sources, with some only existing in the text of certain publications. It is therefore time consuming for most financial firms that are relatively new to environmental analysis to search and obtain such data. Some public data, such as those at the facility level, are not yet mapped to financial assets and firms, and thus are difficult to use for financial analysis.

5. **Uncertainty over the business models for PAED provision:** despite having many characteristics of a public good, the public sector has not developed an effective or integrated approach in collecting, consolidating and disseminating relevant environmental data, while NGOs and many private data providers are also in an early stage of exploring ways to their provision.

6. **Lack of capacities to collect and process adequate information for PAED:** In many countries, especially in some developing countries, the availability of PAED is still constrained by inadequate institutional capacity due to lack of adequate resources, and lack of investment in technologies, platforms, training and knowledge exchange.

2.5. Options for Improving the Accessibility and Usefulness of PAED on a Voluntary Basis

The GFSG, based on inputs from knowledge partners and a number of private institutions, broadly agreed that G20 members could consider the following voluntary options for further improving the availability, accessibility and relevance of PAED:

1. **G20 members could work with other partners to promote the sharing of publicly available methodologies for ERA and for quantification of environmental costs and benefits.** Only with robust methodologies will financial institutions begin to seek data for implementation. It could be useful for selected IOs and/or specialized research institutions to host such information on a public website for easy access by financial institutions globally, although these methodologies would not be endorsed by the GFSG.

2. **Governments could also support private sector efforts to improve the quality and user friendliness of PAED.** Such efforts may include work on indicators, associated definitions and taxonomies, scenarios and forecasting methodologies, better mapping of PAED to financial assets, and publication of a periodical report on environmental data for financial analysis which would help enhance international comparability of data.

3. **The GFSG could support the development of the UN Environment-OECD Catalogue of PAED.** The PAED referenced in this Catalogue could include, among others, global databases on pollution, natural disasters, energy and other natural resources, and climate changes that are useful for financial analysis. This Catalogue, by providing the locations or web-links of PAED and being publicly available, will help reduce "information search costs" and provide a starting point for environmental risk and green investment analysis. Nonetheless it has to be acknowledged that such a catalogue can never be exhaustive, neither can it guarantee the accuracy of data sources. The responsibility for the selection and use of specific databases would always stay with the users of the Catalogue.

4. **Country authorities could consider encouraging domestic sharing of PAED with a focus on the need of financial analysis.** Such initiatives could be taken by domestic environmental agencies, financial regulators, third party data providers or NGOs in countries that have an interest. For instance, they could focus on developing easier access to domestic PAED and improving its relevance to financial institutions in the local contexts.

3. Progress Report

This section is a non-exhaustive update on progress in green finance development over the period since the Xiamen GFSG meeting in June 2016 to the current date. It is organized around the seven options outlined in the G20 Green Finance Synthesis Report released at the Hangzhou G20 Leaders Summit and focused on financial system developments:

1. Provide strategic policy signals and frameworks;

2. Promote voluntary principles for green finance;

3. Expand learning networks for capacity building;

4. Support the development of local green bond markets;

5. Promote international collaboration to facilitate cross-border investment in green bonds;

6. Encourage and facilitate knowledge sharing on environmental and financial risk; and

7. Improve the measurement of green finance activities and their impacts.

The focus of this review is on developments in G20 countries and on those taken forward by international organizations and through international cooperation, whilst recognizing that action has also been taken in many non-G20 countries.

3.1. Provide Strategic Policy Signals and Frameworks

Strategic policy signals and frameworks can help reduce perceived policy uncertainties for green investment, and thereby help accelerate the development of green finance. These complement the many broader market and policy initiatives that deliver or enhance green finance, such as Australia's memorandum of opinions on climate change and director's duties issued in October 2016;[26] Canada's Pan-Canadian Framework on Clean Growth and Climate Change;[27] or Korea's establishment of the First Climate Change Response Master Plan (December 2016).[28] At the international level, by February 2017, 132 countries representing 82% of global emissions had ratified the Paris Agreement.[29] Of the seven GFSG options, development in this area has been strong. Considerable momentum was generated internationally and regionally in the second half of 2016, and a number of national and international initiatives have been announced over the past year. Examples of financial market development relevant to this option include:

- Argentina: commenced a process in February 2017 examining how its financial system supports sustainable financing, including green finance.

- Australia: Australian Prudential Regulation Authority (APRA) stated its views on climate change as a "material" physical and transition risk that it will be consider much more closely in its monitoring of banks, insurers and asset managers.[30]

- China: State Council approved the "Guidelines for Establishing the Green Financial System" in August 2016, to incentivize and promote green loans, green bonds, green funds, green insurance, and mandatory environmental information disclosures, among others.[31]

- EU: High-Level Expert Group on Sustainable Finance launched to provide recommendations for a comprehensive EU strategy on sustainable finance as part of the Capital Markets Union

in December 2016 with an interim report scheduled for release in July 2017.[32]

- France: published in February 2017 a synthesis report by DG Trésor, Banque de France and the Autorité de Contrôle Prudentiel et de Résolution (ACPR) on climate-related risks assessment in the banking sector with a view to provide banks with a framework and guidance on how to further develop their expertise going forward.[33]

- Germany: the federal state of Berlin introduced a sustainability index to reallocate its pension fund investments as of 2017. The federal state of Hesse has announced the intention to make the city of Frankfurt a green finance hub.

- India: Reserve Bank of India, internally, is in the process of formulating a roadmap for green banking in India by looking into various aspects of green finance.

- Indonesia: the Financial Services Authority (OJK) announced in February 2017 that it will launch a framework and regulation for green bond issuance in Indonesia in 2017.[34] OJK has also issued voluntary financing guidelines for renewable energy, energy efficiency, organic farming and palm oil.

- Italy: released the results of a one-year national dialogue on sustainable finance, which identified 18 options for further action (February 2017).[35]

- Mexico: the Government announced its intention to establish a carbon market by 2018 and signed a collaboration agreement with the Mexican Stock Exchange to launch a voluntary pilot program of an emissions trading system that will comprise 60 domestic and international companies.

- Saudi Arabia: the country will launch a program that will invest US$30 to US$50 billion in renewable energy by 2023, according to Energy Minister Khalid al-Falih (January 2017).[36]

- South Africa: has convened a national steering committee to try and identify a sustainable finance roadmap for action which will be released for public consultation by the end of the year.

- Internationally:

  o Launch of the OECD Centre on Green Finance and Investment, whose mission is to support the transition to a green, low-emissions and climate-resilient global economy through effective policies, institutions and instruments for green finance and investment.[37]

  o The UN Group of Friends of Sustainable Development Goal Financing was launched at the UN, involving 30-40 member states, co-Chaired by the Canadian and Jamaican Ambassadors to the UN.[38]

  o UN Environment and the World Bank Group have launched an initiative to build out a Roadmap for Sustainable Finance, with the initial consulation briefing released at the IMF/World Bank Spring Meetings in April 2017.[39]

  o OECD adoption of a Recommendation on *Disaster Risk Financing Strategies* that provides high-level policy guidance on the financial management of disaster risks.[40]

3.2. Promote Voluntary Principles for Green Finance

Voluntary principles take advantage of market-led opportunities that allow the advancement of green finance without the potential cost and delays associated with some regulations. The promotion of voluntary principles has been most prominent amongst investors. Examples include:

- Brazil: the Brazilian Federation of Banks (FEBRABAN) and the Brazilian Business Council for Sustainable Development (CEBDS) launched the voluntary "Guidelines for Issuing Green Bonds in Brazil 2016"(October 2016).[41]

- Canada: the Canadian Association of Pension Supervisory Authorities amended its guidance to list ESG issues as typical risks to be evaluated by pension trustees.

- China: the Securities Regulatory Commission publicly encouraged Chinese investors to become Principles of Responsible Investment (PRI) signatories (October 2016).

- France: launched "the energy and ecology transition for climate" label to help identify green investment funds (November 2016).[42]

- Singapore: the Singapore Exchange (SGX) joined the Sustainable Stock Exchanges Initiative (SSE) in September 2016 as a partner exchange and Singapore's Stewardship Principles for Responsible Investors were launched in November 2016.[43]

- South Korea: the Financial Service Commission has prepared a draft Stewardship Code.

- Internationally: in January 2017, the Principles for Positive Impact Finance were launched in Paris by 19 leading banks and investors totaling US$6.6 trillion in assets. The Principles provide guidance for financiers and investors to analyze, monitor and disclose the social, environmental and economic impacts of the financial products and services they deliver.[44]

3.3. Expand Learning Networks for Capacity Building

Learning networks can facilitate green finance activities, improve information flows, and can help to improve analytical capabilities. Progress at national level within G20 members has been limited, but rapid expansions in multi-stakeholder partnerships have been evident across banking, insurance and investment. New platforms include thematic multi-stakeholder partnerships and platforms serving the green finance needs of developing countries. Examples include:

- China: the Central University of Economics and Finance launched the International Institute of Green Finance in September 2016.[45]

- Germany: Deutsche Börse announced it will launch a Sustainable Finance Initiative in May 2017.[46]

- Saudi Arabia: the Central Bank has indicated its intention to join the Sustainable Banking Network.

- UK: the Bank of England is in dialogue with other UK financial regulators on climate-related financial risks and green finance.

- Internationally: the IFC-hosted Sustainable Banking Network (SBN) has expanded from 24 to 31 countries has initiated work to develop tools for banking regulators and banking

associations on sustainable banking guidance development and implementation, with particular support to 7 member countries to develop or update sustainable banking regulations/guidelines. Market-led international networks including the Principles for Responsible Investment, the Sustainable Stock Exchange Initiative and UNEP Finance Initiative are providing increasing capacity development support to financial communities in both developing and developed countries.

3.4. Support the Development of Local Green Bond Markets

Green bond markets provide an alternative source of long term green finance, in addition to bank lending and equity finance. This is especially valuable in countries where demand for green infrastructure investment is high but supply of long-term bank loans is limited. Of the seven options, support for the development of local green bond markets has been very strong. Governments have been playing an active role across a range of scales (e.g., sovereign, national, municipal) and development banks are increasing their support. Partly as a result of government efforts in developing local currency bond markets, total green bond issuance in the world expanded rapidly to US$86 billion in 2016 from US$42 billion in 2015. Examples of government and international initiatives include:

- Argentina: La Rioja Province issued its first green bond in international capital markets.[47]

- Canada: the Province of Ontario issued its third and largest green bond to date in January 2017 while the Province of Quebec launched its first green bond issuance in February 2017.[48]

- China: green bond issuance (domestically and internationally) reached US$34 billion in 2016, up from US$1 billion in 2015, following the issuance of a domestic green bond catalogue and green bond guidelines. The China Security Regulatory Commission issued guidelines for green bonds issued by listed corporates in March 2017.[49]

- France: issued (January 2017) a landmark EUR-denominated long dated (22 years) sovereign green bond (EUR7 billion) with a view to promote the consolidation of best market practices (especially in terms of evaluation and impact reporting) and support the development of the green bond market.[50]

- Germany: besides the ongoing issuance activities of German Public Banks (e.g., KfW and NRW Bank) as well as investment activities (e.g., KfW Green Bond Portfolio), the Association of German Public Banks (VÖB) started the "Green Bond Initiative Deutschland" to raise awareness and support capacity building and knowledge sharing.

- India: steps have been taken by Securities and Exchange Board of India by issuing a concept paper on issuance of Green Bonds.

- Japan: the Metropolitan Government of Tokyo announces plans for issuing green bonds.[51]

- Mexico: the Mexican development bank Nacional Financiera issued the first green bond in local currency and the Mexican Banking Association has been playing a critical role in scaling up a local market.

- Russia: the central Bank of Russia conducts "Review of financial market regulation: green bonds".[52]

- Singapore: the Monetary Authority of Singapore introduced a Green Bond Grant scheme to encourage the issuance of green bonds. Under the scheme, qualifying issuances can offset the costs attributable to obtaining an external review for green bonds.[53]

- South Korea: the Ministry of Strategy and Finance is developing Green Bond Guidelines.

- Spain: the Comunidad de Madrid has launched a 5-year EUR-denominated sustainability bond adhering to the Green Bond Principles and a number of the SDGs. The April 18th 2017 issue raised EUR700 million. [54]

- Internationally: the IFC is developing the Green Bond Cornerstone Programme.[55]

3.5. Promote International Collaboration to Facilitate Cross-border Investment in Green Bonds

Opportunities for cross-border investment in green bonds can help reduce the funding costs of green bonds, potentially enhance the return of global investors, and support development of local bond markets. Advances in international collaboration have been slower than local green bond market development, as barriers including differences in local definitions, disclosure requirements and capital controls need to be resolved. Most developments in this option are currently being advanced through bilateral cooperation, particularly between developed and developing countries. Examples include:

- Canada: the provinces of Ontario and Quebec issued their recent green bonds as global bonds, which effectively encouraged cross-border investment in these issuances. 40% of Quebec's issuance was purchased by international investors.[56]

- France: authorized the launch of the first green bonds ETF tracking a portfolio of 116 investment grade green bonds (March 2017).[57]

- India: organized a bond focused green infrastructure roadshow to the UK (June 2016).

- South Africa: the Johannesburg Stock Exchange (JSE) is developing green bond listing requirements in line with international best practice.

- UK: collaboration with China led to the issuance of the first Chinese green covered bond listed on the London Stock Exchange (November 2016).[58]

3.6. Encourage and Facilitate Knowledge Sharing on Environmental and Financial Risk

Developing capacity on environmental and financial risk involves a complex and often costly set of skills and challenges, especially for small and medium-sized financial firms. Sharing knowledge therefore has elements of a "public good". Once an open and independent group develops knowledge and tools, the core elements could be shared for the benefit of all interested stakeholders. Examples of recent development include:

- Brazil: the Central Bank issued regulations on integrated risk management including environmental risk at the end of February 2017.[59]

- China: promoting environmental stress testing by financial firms became a key component of

China's 'Guidelines for Establishing the Green Financial System'.[60] This effort is led by the Green Finance Committee of China Society for Finance and Banking.

- France: DG Trésor and Banque de France were among conveners of a December workshop on understanding, assessing, pricing and managing climate related financial risks.

- Germany: the Federal Ministry of Finance released a commissioned research report on the potential impact of climate change on financial market stability.

- Indonesia: the Financial Services Authority (OJK) and the SBN co-hosted the 2016 International Sustainable Finance Forum and SBN 4th Annual Meeting in Indonesia in December, to facilitate knowledge sharing on sustainable finance among 30 countries.[61]

- The Netherlands: the Central Bank is conducting a thematic review into climate risk within its financial institutions.

- UK: the Bank of England is deepening its research on climate-related financial risks to the UK insurance sector, and is starting to consider the risks to the UK banking sector.

- Internationally:

  o The German Development Cooperation (GIZ) and Natural Capital Finance Alliance (NCFA) developed jointly with nine banks from Brazil, China, Mexico, US an environmental and drought stress testing tool.

  o The FSB-convened, industry-led TCFD in December 2016 published draft recommendations for disclosures by companies to help market participants understand climate-related financial risks.[62]

  o The OECD was mandated by the COP21 Presidency to explore the integration of ESG risks and opportunities in institutional investor decision-making. This report was released in May 2017.

3.7. Improve the Measurement of Green Finance Activities and their Impacts

Greater clarity on green definitions, measurement of green finance flows and associated impacts is important information for guiding green investment flows and for policy makers and regulators to achieve their policy objectives. The number of initiatives in this space has been relatively small. Developments have been most pronounced in relation to climate change, and within banking. Examples include:

- Mexico: the Mexican Bankers Association is developing a framework for climate finance reporting.

- Switzerland: the Federal Office for the Environment will offer in 2017 to all Swiss Pension Funds and Insurances the possibility to pilot-test the 2°C-alignment of their equity and corporate bond portfolios for free on a voluntary basis.

- Turkey: the Banking Regulation and Supervision Agency (BRSA) has started to develop a reporting template.

- UK: the UK Green Investment Bank published a report on the measurement of "green impact"

of projects for the first time (November 2016).

- International:

  - the SBN launched a "Sustainable Finance Measurement Working Group". The working group will develop technical guidance and tools to help assess the effectiveness of green finance policies and harmonize measurement frameworks and indicators.[63]

  - the EU countries are transposing into national legislation the EU Directive on non-financial reporting. This will require large companies listed on EU markets, or operating in the banking and insurance sectors, to disclose relevant environmental and social information in their management reports.[64]

The cases mentioned above are only selected examples of developments that are taking place across the G20 and beyond. Also note that this interim progress report has been prepared less than nine months after the Xiamen June 2016 GFSG meeting, and future iterations of the progress report will amplify further emerging developments. Many of the important green finance developments are grouped under the seven options identified by the GFSG, but they are not exhaustive.

In addition to the cases provided above, a number of other areas of inquiry are emerging and could be further explored. Examples of these areas include, among others: integration of green investment opportunities framework, more integrated national approaches to green finance, development of local currency green bond markets in emerging market economies, the role of public finance and development banks in supporting green investment, and the application of financial technology ('FinTech') in green finance.

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[1] There exists a major body of academic literature examining how environmental factors may affect asset value in the real economy and financial system (See: University of Cambridge Institute for Sustainability Leadership, Imperial College London, University of Oxford Sustainable Finance Programme, University of Zurich, and others).

[2] University of Cambridge Institute for Sustainability Leadership (2016) Environmental Risk Analysis by Financial Institutions. Input paper to the G20 Green Finance Study Group. http://unepinquiry.org/wp-content/uploads/2016/09/2_Environmental_Risk_Analysis_by_Financial_Institutions.pdf

[3] Research on environmental risk in 2016 found that the spread of ERA practice varies considerably across asset classes, and may be very difficult to measure in certain sectors, such as banking (for further information, please refer to the 2016 GFSG report on "Greening the Banking System". Investment consultancy Mercer assesses and rates investment manager strategies on their integration of ESG factors (including identification of environmental risks, implications of portfolio construction, and implementation), and has found that approximately only 10% of 5000 firms achieve highest level or mid-level ratings. For further information, please refer to: https://www.mercer.com/our-thinking/mercer-esg-ratings.html

[4] https://www.weforum.org/reports/the-global-risks-report-2017.

[5] An increasing number of private financial institutions have publicly acknowledged the current and potential future relevance of physical and transitions risks for value generation, business models, and broader sector-level and macroeconomic stability. There remain differences across financial sub-sectors in terms of understanding and consideration of the impacts of environmental factors on financial assets and markets - where inherent exposure to environmental risks may be more (as in the insurance sector) or less (as in banking) prevalent. An increasing number of firms are expressing support for coalitions or other initiatives aiming to integrate the consideration of environmental factors in decision-making, such as the Principles for Responsible Investment, the Principles for Sustainable Insurance, as well as institutional investor coalitions on climate risk, and Responsible Investment associations. Similarly, there has been an upswing in activity among mainstream financial industry associations (including national banking, investment, or insurance associations).

[6] For an overview of advances in ERA practice in the financial sector during recent decades, please refer to: University of Cambridge Institute for Sustainability Leadership (2016) Environmental Risk Analysis by Financial Institutions. Input paper to the G20 Green Finance Study Group. http://unepinquiry.org/wp-content/uploads/2016/09/2_Environmental_Risk_Analysis_by_Financial_Institutions.pdf. Since last year, a number of financial institutions have sought to deepen understanding of how environmental factors could serve as drivers of financial risk – including credit ratings agencies such as Moody's, which has set out a framework for assessing climate risks (detailed in the background paper).

[7] Case studies relating to transition risks reviewed for the GFSG in 2017 include the impacts of policies for pollution abatement (China), carbon and energy regulation (Germany), carbon costs linked to low-carbon scenarios (UK), and market and policy scenarios relating to climate change (international). Risks have been assessed at the physical asset level (i.e. geographic hazard risks), firm level (i.e. impacts on margins and credit ratings), financial asset level (i.e. impacts on share prices), portfolio level, as well as institution and system levels.

[8] Central banks and financial regulators in France, Germany, Italy, UK, at the EU level have undertaken assessments of the implications of environmental risks for the stability of sectors and the financial system as a as a whole. A number of insurance supervisors and regulators joined the Sustainable Insurance Forum to explore the implications of sustainability factors.

[9] CISL (2015) Unhedgeable Risk: How climate change sentiment impacts investment. Available at: http://www.cisl.cam.ac.uk/publications/publication-pdfs/unhedgeable-risk.pdf.

[10] See footnote 5.

[11] The case studies reviewed illustrate that there is no one set of common approaches being applied by financial institutions with respect environmental risks. For instance, firms may derive different conclusions when assessing widely-accepted risk factorswithin similar sectors or asset classes (i.e. energy sector public equity), due to the divergent assumptions, choice of variables, data, or methodologies.

[12] Bank of England, UN Environment Inquiry, University of Cambridge Institute for Sustainability Leadership (2017) Enhancing Environmental Risk Analysis in Financial Decision-making.

[13] ICBC (2016) Impact of Environmental Factors on Credit Risk of Commercial Banks – Research and Applications based on ICBC Stress Test. ICBC and China Green Finance Committee. http://www.greenfinance.org.cn/upfile/upfile/filet/ICBC%E7%8E%AF%E5%A2%83%E5%8E%8B%E5%8A%9B%E6%B5%8B%E8%AF%95%E8%AE%BA%E6%96%87_2016-03-19_08-49-24.pdf

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[21] YES Bank, Trucost, GIZ (2015) Natural Capital Risk Exposure of the Financial Sector in India. November 2015. https://www.trucost.com/trucost-news/indias-banks-risk-financing-environmental-impacts/

[22] Examples include: (i) credit and investment policies- ICBC (China): Stress testing the impact of environmental factors on a Chinese commercial bank's credit risk; (ii) reduced portfolio and firm-level risk- Allianz (Germany): Using scenario-analysis to assess the impact of carbon and energy regulation in equity analysis, and Barclays (UK)- Analysis of impacts of transition risks on German electricity sector by international investment bank; (iii) Product Innovation- Moody's (International): Assessing Physical Effects of Climate Change on Sovereign Issuers ; (iv) reallocation of capital- Mercer (International): Examining the effect of transitions risks on strategic asset allocation; (v) Enhanced stakeholder engagement- YES Bank/Trucost (India): Examining natural capital exposure of an Indian commercial bank.

[23] For more information on case studies, see: Bank of England, UN Environment Inquiry, University of Cambridge Institute for Sustainability Leadership (2017) Enhancing Environmental Risk Analysis in Financial Decision-making.

[24] See background report prepared for GFSG: "Improving the Availability and Usefulness of Publicly Available Environmental Data for Financial Analysis", prepared by specialists from China Green Finance Committee and UN Environment Inquiry, March 2017.

[25] We recognize that there are many different ways for classifying PAED, which could also be done by asset class, by level of consolidation/aggregation, by type of environmental factors, etc. We decide to retain our classification in this report by combining two considerations: the need to highlight the use of PAED for analyzing physical and transitional risks (for risk analysis purposes), and the need to assess green externalities (for the purpose of identifying green investment opportunities).

[26] More information is available here: http://cpd.org.au/wp-content/uploads/2016/10/Legal-Opinion-on-Climate-Change-and-Directors-Duties.pdf

[27] https://www.canada.ca/en/services/environment/weather/climatechange/pan-canadian-framework.html

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[43] http://www.stewardshipasia.com.sg/principles/singapore_stewardship_principles.pdf

[44] http://www.unepfi.org/events/banking-events/launch-of-the-principles-for-positive-impact-finance/

[45] http://en.cufe.edu.cn/news/94936.htm

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[47] See Climate Bonds Initiative database for more detail. Online at: https://www.climatebonds.net/cbi/pub/data/bonds

[48] http://www.ofina.on.ca/greenbonds/greenbonds.htm and http://www.finances.gouv.qc.ca/en/RI_GB_Green_Bonds.asp

[49] http://europe.chinadaily.com.cn/china/2017-03/03/content_28428916.htm

[50] http://www.gouvernement.fr/en/success-for-france-s-first-sovereign-green-bond

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[53] http://www.mas.gov.sg/News-and-Publications/Speeches-and-Monetary-Policy-Statements/Speeches/2017/Keynote-Address-at-the-Investment-Management-Association-of-Singapores-20th-Anniversary-Conference.aspx

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[57] https://www.etfstrategy.co.uk/lyxor-launches-industry-first-green-bond-etf-12957/

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[64] Decree Law n. 254/2016 entered into force on the 25th of January 2017.

Annex 1: List of Background Papers

The GFSG received three background papers listed below. These background papers do not necessarily represent the views of GFSG, nor are endorsed in any way.

Background papers:

1   Enhancing Environmental Risk Analysis in Financial Decision-making (Bank of England, UN Environment Inquiry, University of Cambridge Institute for Sustainability Leadership).

2   Improving the Availability and Usefulness of Publicly Available Environmental Data for Financial Analysis (China Green Finance Committee and UN Environment Inquiry).

3   Green Finance: G20 Progress Update 2017 (UN Environment Inquiry).

Annex 2: Acknowledgements and Contacts

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