SUSTAINABLE FINANCE STUDY GROUP

Synthesis Report

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Contents

ACRONYMS AND ABBREVIATIONS

ABS	Asset-backed securities
AI	Artificial intelligence
CDP	Cassa Depositi e Prestiti (Italy)
CLO	Collateralized loan obligation
DCMs	Debt capital markets
ESG	Environmental, social and governance
EU	European Union
GDP	Gross domestic product
GFSG	Green Finance Study Group of the G20
IADB	Inter-American Development Bank
IFC	International Finance Corporation
IoT	Internet of things
MLAI	Machine learning and artificial intelligence
OECD	Organisation for Economic Co-operation and Development
P2P	Peer-to-peer
PAED	Publicly available environment data
PE	Private equity
SBG	Sustainability Bond Guidelines
SBP	Social Bond Principles
SDGs	Sustainable Development Goals
SFSG	Sustainable Finance Study Group of the G20
SMEs	Small and medium-sized enterprises
SPV	Special purpose vehicle
TCFD	Task Force on Climate-related Financial Disclosures
UK	United Kingdom
US	United States
VC	Venture capital
WEF	World Economic Forum

EXECUTIVE SUMMARY

G20 members have adapted, under Argentina's Presidency, the work of the Green Finance Study Group (GFSG) to the broader concept of sustainable finance, leading to the change of its name to the Sustainable Finance Study Group (SFSG). Sustainable finance can be broadly understood as financing as well as related institutional and market arrangements that contribute to the achievement of strong, sustainable, balanced and inclusive growth, through supporting directly and indirectly the framework of the Sustainable Development Goals (SDGs). A proper framework for sustainable finance development may also improve the stability and efficiency of the financial markets by adequately addressing risks as well as market failures such as externalities.

In 2018, the SFSG seeks to identify voluntary options to expand private investment in sustainable activities that achieve positive environmental impacts and social and economic co-benefits (*e.g.* job creation, growth enhancement, technological development, poverty reduction, and social inclusion).

Private capital is often an important source of sustainable finance. Public finance alone may not be sufficient to meet the demands for sustainable finance as the global economy continues to grow and poses increasing burdens on our resources and ecosystems. For these reasons, G20 members have sought to introduce and incentivize private investment in projects that are aligned with sustainability objectives.

Over the past years, many countries have introduced new initiatives and financial products to expand sustainable finance. Despite this encouraging momentum, the deployment of private capital for sustainable finance is still constrained due to a variety of institutional and market barriers. These include the limited use of appropriate investment vehicles, and the lack of information or information asymmetry regarding the outcome of sustainable investments. Unleashing this capital more effectively presents an important opportunity that the G20 can contribute to realizing, enabling benefits to its members and others.

Under Argentina's Presidency, Finance Ministers and Central Bank Governors have mandated the SFSG to develop and assess options for voluntary adoption by members to help deploy financing, including by: creating sustainable assets for capital markets; developing sustainable Private Equity and Venture Capital (PE/VC); exploring potential applications of digital technologies to sustainable finance, taking into account countries' circumstances, priorities and needs.

The SFSG stocktaking, analysis and layout of voluntary options intend to address specific sustainability-related challenges in these three areas. Key findings from the research are:

a) **Creating sustainable assets for capital markets.** Currently, private sector financing of sustainable projects has been largely originated by banks and

resides on their balance sheets in the form of loans. While acknowledging that banks may have legitimate reasons for retaining these assets on balance sheets, a range of debt capital market products can provide pathways for institutional investors to finance or refinance these sustainable loans. Examples of these products include sustainability-targeting bonds, covered bonds, asset-backed securities (ABS), mortgage-based securities, and collateralized loan obligations (CLOs). Other pathways to develop sustainable debt capacity involve institutional investors underwriting sustainable debt on their own or investing in funds that underwrite sustainable assets, and investing through digital platforms for deal origination. All pathways and products should be in compliance with international agreed regulatory standards.

Several challenges were identified in developing sustainable assets for the debt capital markets. Among these were: insufficient market awareness of the benefits of sustainable investments; the lack of underwriting capacity; the lack of clarity for identifying sustainable investments accurately and efficiently; and lack of effective impact reporting.

Voluntary options emerging from the research to mitigate some of these challenges include:

1. Raise awareness of the benefits of sustainable debt products through communication and educational initiatives.

2. Encourage dialogue to improve the quality and transparency of sustainability taxonomies, taking into account national and regional circumstances, priorities and needs.

3. Facilitate technical trainings for the analysis of sustainable investments, the development of the internal capacity of institutional investors to underwrite sustainable debt products, and capacity-building for asset managers in managing portfolios of sustainable assets.

4. Encourage the development of digital platforms that bring together sustainable assets and investors.

5. Seek to identify the unintended consequences of sustainable assets including effects on financial stability and risk-adjusted returns.

b) Developing sustainable Private Equity and Venture Capital. While early-stage companies and small and medium-sized enterprises (SMEs) with positive environmental, social and economic impacts are critical to driving sustainable growth, many of these companies face difficulties in obtaining adequate investment capital. The growth of sustainable investment strategies among PE/VC funds provides an opportunity to address the lack of adequate funding for environmentally sustainable business models and technologies, yet their deployment is still hindered.

Challenges identified for developing sustainable PE and VC include: actual or perceived low risk-adjusted returns of some investments in sustainable

technologies and business models; the early stage of some sustainable technologies and business models and their end market; misaligned return horizons; establishing clear definitions; standardization and verification; limited market scale and sophistication; complexities in quantifying the pricing of externalities and at times mixed incentives to pricing them; and an unevenly developed PE/VC marketplace among countries.

To overcome these challenges, the following voluntary options were identified:

1. Promote the establishment of incubators/accelerators for sustainable start-ups and the integration of sustainability considerations in existing or general incubators.

2. Facilitate multi-stakeholder dialogues to work on the interpretation of sustainability in investment obligations.

3. Support the launching of demonstration projects and dissemination of good practices and lessons learned.

4. Encourage the clarification in the use of standards for managing sustainable investments by PE/VC, taking into account national and regional circumstances.

5. Promote the development of a range of sustainable products and fund structures suitable for a broad range of private equity investors.

c) Exploring potential applications of digital technologies to sustainable finance. A mapping exercise across G20 members highlights emerging practice in applying digital technologies to sustainable finance. Potential benefits from these applications for sustainable finance include: make more extensive, accurate and relevant data available more cheaply and quickly; improve pricing of environmental risks and opportunities and at a lower cost; reduce search costs; improve measuring, tracking and validation of the application of sustainability criteria; unlock innovation and inclusion in accessing sustainable finance options, including the increased involvement of citizens; encourage new sources of finance with an interest in sustainable development outcomes; and facilitate new investment configurations and business models. Realizing such potential requires overcoming a number of challenges, including: risks and unintended consequences associated with the digitalization of finance; the limited understanding of digital technologies and their interplay with sustainable finance; limited availability, quality and use of sustainability-related data for financial decision-making; nascent business models.

Voluntary options in this domain are:

1. Raise awareness about the potential opportunities and risks of the application of digital technologies to sustainable finance.

2. Explore the relevance of supervisory arrangements for applying digital technologies to sustainable finance.

3. Encourage investment in digital technologies that advance sustainable finance, such as technologies that improve the assessment and availability of sustainable finance-related data.

The above-mentioned findings can help countries in their voluntary efforts in deploying sustainable finance. Specifically, it can be useful to make available the considerable source of long-term capital from institutional investors for the refinance of the growing pool of sustainable loans on banks' balance sheets; in overcoming the lack of funding for the development of sustainable technologies and of sustainable business models by early-stage companies and SMEs.

INTRODUCTION

The G20 members have adapted the work of the Green Finance Study Group (GFSG) under Argentina's Presidency to the broader concept of sustainable finance. Sustainable finance can be broadly understood as financing as well as related institutional and market arrangements that contribute to the achievement of strong, sustainable, balanced and inclusive growth, through supporting directly and indirectly the framework of the Sustainable Development Goals (SDGs). Moreover, sustainable finance looks after financial market stability and its overall efficiency. In adopting the more encompassing term of sustainable finance, G20 members have renamed the work stream as the "Sustainable Finance Study Group" (SFSG or the Study Group).

In 2018, the SFSG is focusing on pursuing positive environmental impacts of investments that could generate social and economic co-benefits (*e.g.* job creation, growth enhancement, technological development, poverty reduction and social inclusion).

Private capital is often an important source of sustainable finance. Public finance alone may not be sufficient to meet the demands for sustainable finance as the global economy continues to grow and poses increasing burdens on our resources and ecosystems. Mobilizing private investment in areas such as sustainable infrastructure, sustainable technologies and business model innovations, among others, can deliver substantive environmental, social, and economic benefits.

An increasing number of initiatives across G20 members have resulted in expanded sources of private capital for the financing of sustainable projects and in a broader alignment of financial markets with sustainability targets. The biennial 2016 Report by the Global Sustainable Investment Alliance (GSIA) estimated that US$23 trillion of assets are professionally managed globally under sustainable investment strategies and reported a 25% increase from 2014 estimates. The 208 respondents of the Global Impact Investment Network (GIIN) 2017 Annual Impact Investor Survey collectively manage nearly US$114 billion in impact assets, a figure that serves as the most detailed and available "floor" for the size of the impact investing market. In aggregate, 205 respondents invested US$22 billion into nearly 8,000 impact investments in 2016 and planned to increase capital invested by 17% to US$26 billion in 2017.[1] Based on the 2017 GIIN's annual survey, the Global Steering Group (GSG) expects that the size of the impact investment market globally has reached US$150 billion in May 2018 and will reach US$307 billion by 2020 – at a compound annual growth rate of 18% from 2015 to 2020.[2]

Based on these organizations' assessments and other quoted reports, there is an increasing pool of private investors allocating, re-allocating or wanting to allocate capital towards a diverse array of sustainable investments across all asset classes, using a variety of instruments and sustainable investment strategies. Notwithstanding, in 2017, based on the GSIA tracking, sustainable investment stood at 26% of all professionally managed assets globally. So, despite the encouraging momentum, the deployment of private capital for

sustainable financing is still constrained due to a variety of institutional and market barriers. Unleashing this capital more effectively presents an important opportunity that the G20 can contribute to and benefit from.

Under Argentina's Presidency, Finance Ministers and Central Bank Governors have mandated the SFSG to develop and assess options for voluntary adoption by members to help deploy sustainable financing, taking into account national circumstances priorities and needs, including by:

a) creating sustainable assets for the capital markets;

b) developing sustainable Private Equity and Venture Capital; and

c) exploring potential applications of digital technologies to sustainable finance.

The SFSG stocktaking, analysis and setting out of voluntary options intend to address specific sustainability-related challenges in these three areas.

The report highlights, based on experts' inputs, that the deployment of sustainable private capital across different asset classes faces at least the following generic and specific constraints:

Generic Constraints: These constraints are characterized by market and policy features that impede or slow down the flow of finance (with or without sustainability benefits) in general. Examples of such general constraints include, among others, the lack of legal arrangements such as those for special purpose vehicles that can host securitized assets, the absence of exit mechanisms such as a developed initial public offering (IPO) market for PE/VC investments, and the uneven layout or distribution of technology infrastructure (*e.g.* high-speed broadband) and mobile devices across countries. Addressing generic constraints would significantly contribute to promoting the deployment of sustainable finance; however, they fall out of the scope of the Study Group and as such are not the main focus of this report.

Specific Constraints: These constraints refer to specific market and institutional issues that impede the delivery of financial services aligned with sustainability objectives. Examples of these challenges are:

- *Lack of internalization of environmental and social factors:* when investors consider positive and negative sustainability-related outcomes as externalities, they do not factor them into the risk/return profile of such investments, thus leading to a distorted risk/return assessment from a societal perspective. The lack of internalization of such externalities could result in private underinvestment in more sustainable activities.[3]

- *Misaligned return horizons:* some sustainable projects deliver their financial and sustainable benefits over longer periods of time than the ones generally considered by business-as-usual industry benchmarks. Additionally, some sustainable investments have a higher capital expenditure (capex) and operational expenditure (opex) upfront cost.[4] Such a maturity misalignment tends to reduce the availability of financing

to long-dated sustainable projects[5] and also leads to a suboptimal allocation of capital among the financing entities that are best positioned to participate at different tenors and maturities.

- *Lack of information and information asymmetry:* some sustainable development outcomes are not fully transparent or are hard to assess due to the lack of definitions, information disclosure and the specific analytical capacity in the financial industry. Such information gaps increase the search costs for sustainable projects and reduce financial flows to them.[6]

- *Lack of general clarity for identifying sustainable investments*: the lack of consistent and reliable labeling of sustainable assets also constitutes a challenge to sustainable investment.[7]

- *Insufficient sustainability-related analytical capabilities:* financial institutions (*e.g.* banks, institutional investors, asset managers, private equity funds) are in the early stages of developing methodologies and tools to identify and assess financial risks associated with sustainable investments and many other institutions are yet to be engaged in this process.

Some or all of these factors can result in missed financing opportunities for sustainable projects, suboptimal asset allocations, or in unintended negative impacts on sustainable development outcomes. Overcoming these constraints requires a combination of market-based initiatives and policy interventions at different levels. Some common components identified by SFSG for effective actions by market players include:

- *Principles and standards*: encouraging dialogues to improve the quality and transparency of sustainability principles for, and definitions and measures in, financial decision-making, to enable better risk-reward assessment and possible policy interventions.

- *Data and analytic capabilities*: improvement of the availability of quality and low-cost data and analytical tools for understanding the sustainable features of financial decisions, and the incentives and capabilities to make use of such data.

- *Long-term vision:* encouraging critical market technical underpinnings, such as indices, ratings, listing requirements, performance assessment methods and standards, so that financial decision makers can take due account of the longer-term implications of their investments for sustainability.

- *Innovation:* supporting financial market developments that enable financial decision makers to better advance and assess the risks and returns of emerging, innovative investment opportunities that deliver sustainable development outcomes, such as a more circular economy or expanding the life cycle of products and the access to a wider customer base through platform-based collaborative consumption modes [8] enabled by digitalization.

CREATING SUSTAINABLE ASSETS FOR THE CAPITAL MARKETS

G20 members could substantially benefit from supporting the creation of sustainable assets for the capital markets as they pursue the goal of achieving a strong, sustainable, balanced and inclusive growth.

This report focuses on the creation of sustainable financial assets for the debt capital markets. For the purpose of this section, sustainable assets, sustainable loans, sustainable debt and sustainable bonds refer to specific financial products or debt linked to assets or investments that target environmental and social sustainability; however, the more general consideration of financial sustainability is also contemplated.

Currently, private sector debt financing of sustainable projects has been largely originated by banks and resides on their balance sheets in the form of loans.[9] For the foreseeable future, bank lending will remain a key provider of investment financing, but it will most likely fall short to cope on its own with the massive financing gap for sustainable investments such as sustainable infrastructure, battery technology, resource-efficient agriculture and sustainable shipping.[10] If sustainable investments are to ramp up on the scale that is needed – at least doubling, even quadrupling levels in certain sectors –, there may be debt-funding capacity problems should banks remain the primary provider of sustainable debt linked to sustainable assets.

At the same time, the debt capital markets (DCMs) are the world's largest and deepest pool of capital valued at over US$100 trillion in outstanding securities. The timely and efficient shift to these capital markets from banks will free up limited banks' balance sheets capacity for recycling capital back into early-stage sustainable projects financing where banks are best suited to handle the risk of greenfield projects.[11] That said, it is acknowledged that some banks may have legitimate reasons for retaining sustainable loans on their balance sheet. However, for the many banks that will want or need to move sustainable loans into the debt capital markets, it becomes important[12] to build pathways to institutional investors. These investors possess structurally[13] long-term balance sheets that can naturally hold long-term debt related or linked to sustainable assets.[14] This impact will be maximized if the appropriate sustainable assets that meet institutional investors' preferences are available.

A range of debt capital market products can act as pathways to finance or refinance sustainable loans for institutional investors. Banks could analyze the benefits of re-purposing[15] capital market products that aggregate and transform sustainable loans into an asset-backed bond format preferred by institutional investors and in a manner consistent with financial stability and existing regulations. By aggregating and selling sustainable loans into the DCMs, banks and corporates will be able to refresh their balance sheets and apply the proceeds to underwrite new sustainable investments.[16] This process will serve to enhance both the volume and velocity of sustainable capital formation. A second pathway to develop sustainable debt capacity would see

institutional investors underwrite sustainable debt on their own or invest in asset management funds that underwrite sustainable assets.

What is more, there has been an increasing interest, demand and allocation by institutional investors of sustainable financial products, providing a suitable opportunity to explore these pathways.

In 2016, the GFSG's work covered the role of institutional investors in green investments[17] and the need to make the banking system more sustainable. Studying how to expand sustainable debt capacity through migrating sustainable loan exposure and cash flows on banks' balance sheets to the DCMs or by institutional investor's origination is a highly complementary and timely research topic.

This chapter reviews how pathways driven by investment products could be used for crowding in long-term private sector investors and enable capital apportionment consistent with sustainability objectives. Case studies are drawn upon to illustrate best practices in a wide array of countries. It also identifies challenges to increasing sustainable debt capacity and presents voluntary options for overcoming these challenges. Inputs are drawn from sector specialists and best practices facilitated by SFSG knowledge partners.

1.1 Background

The size of sustainable investments needed globally between now and 2030 to meet the SDGs is estimated by the World Economic Forum (WEF) to be over US$100 trillion between now and 2030, or US$8 trillion annually.[18] For sustainable investments (*i.e.* green mortgages, electric vehicle loans, green technology corporate lending, sustainable mass transport, electric storage technology, sustainable agriculture and clean energy, among other investments) in 21 emerging markets alone, the International Finance Corporation (IFC) estimates US$23 trillion[19] of financing is needed until 2030. In advanced market economies, fiscal constraints have led to a reduction in the share of public funds allocated to long-term sustainable investments to around 40% compared with 60-65% in emerging economies.[20] It is clear the amount of sustainable investment capital the world needs is sizable already in the short-term and needs to be catalyzed quickly.

Bank loans are, and will remain, a critical source of finance for new sustainable investments. In terms of overall volumes, bank lending remains the largest source of sustainable investments finance in global markets. Whether through short-term corporate lending or non-recourse specialized lending, banks provide, for example, roughly 80% of sustainable infrastructure finance.[21] In lower middle-income and low-income countries, state-owned banks and development banks play a bigger role, especially in supporting the de-risking of investments. An update to an Organisation for Economic Co-operation and Development (OECD) database on project interventions indicates institutional investors are increasingly interested in infrastructure investment and show how the official sector (*e.g.* Development Finance Institutions (DFIs) and other public institutions and actors) is involved in attracting this interest by

using risk-mitigating and transaction-enabling interventions. Loans are flexible in that they can be paired with many different types of sustainable investment finance structures, including public and private sponsorship models.

The banking sector remains the key provider of sustainable investment financing, but it is likely that it will not be able, on its own, to fill the financing gap for sustainable investments.[22] For instance, the People's Bank of China (PBoC) estimates that China will need to invest at least RMB2 trillion (US$320 billion) per year in green sectors[23] in order to meet the environmental targets under the 13th Five-Year Plan (2016-20). Public resources, however, will only cover a minority of these investments.[24] The EU Commission estimates a yearly investment gap of at least EUR180 billion (US$209 billion) to achieve its climate and energy targets by 2030.[25] According to recent estimates from the European Investment Bank (EIB), the overall investment gap in sustainable transport, energy and resource management infrastructure in the EU has already reached a yearly figure of EUR270 billion (US$313 billion).[26]

The demand for environmentally sustainable investments already exceeds supply "with investors representing US$24 trillion calling for the creation of more green investments (compared with a green loan market in 2014 of US$165 billion, representing only 15% of the value of all syndicated loans)".[27] There are various drivers behind this increasing demand by institutional investors for sustainable investment products, for example, the growing belief that consideration of environmental, social and governance (ESG) factors is important to long-term value for pension fund recipients; the role of reputation risk and portfolio-level risk related to sustainable issues is progressively a recognized concern of investors; client demand; the clarity arising from policy signals such as the SDGs.[28]

The spectrum of institutional investors is wide, involving pension funds, endowment funds, insurance companies, commercial banks, mutual funds and hedge funds. The presence of institutional investors in countries varies; some do not have large domestic institutional investors; many do not have sufficient capacity or remit to purchase sustainable bonds or loans. It is nevertheless possible and even routine in some areas for regional or international institutional investors to enter such markets if there are sustainable bond issuances that meet their investment criteria. For example, some emerging markets already have a strong representation of international insurance companies active in the country; and according to studies, emerging economies are expected to see a growth in their insurance market.[29] With such a large business in local currency, reserve funds as well as retained earnings could be invested long term for their policyholders – and it is likely that local sustainable bonds would be an attractive proposition for their investment portfolio. Sustainable bond issuance could be a factor in the expansion of institutional investors and could crowd in new institutional capital and act as a co-benefit tied to the sustainable bonds.

Hence, creating the financing capacity by expanding sustainable financial products and pathways could significantly contribute to meeting sustainable investment requirements of the near future.

1.2 Creating Sustainable Assets and Expanding Debt Capacity

To provide institutional investors with wider access to sustainable debt and to build sufficient capacity to meet sustainable development needs, there are two primary pathways. One is the debt capital markets, where banks issue sustainability-targeting corporate bonds or aggregate sustainable loans that can be sold in various bond formats in line with institutional investors' preferences. A second possible pathway is the origination of sustainable debt directly by institutional investors or through asset management funds.

1.2.1 Debt Capital Markets

The debt capital markets in the large global financial centers offer the ability to address the financing needs of sustainable projects into the hands of institutional investors at both scale and pace with large developed electronic sales and trading platforms. Although the debt capital markets are most often associated with these large financial centers in advanced economies, local currency bond markets (LCBMs) are growing in many emerging markets and can contribute to a more resilient financial system. There is an increasingly important role of LCBMs as a source of long-term funding for long-term investments such as sustainable infrastructure and housing.

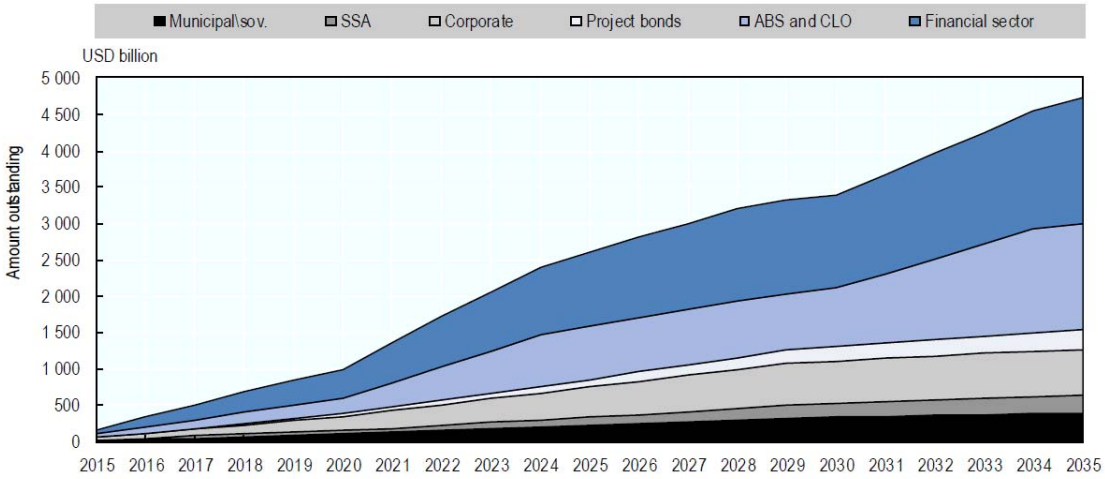
These markets imply liquidity, transparency and ratings, allowing institutional investors to access thematic bonds (*e.g.* green bonds, social bonds, sustainability bonds).[30] These bonds are "any type of bond instrument where the proceeds will be exclusively applied to eligible environmental and/or social projects" and are regulated instruments "subject to the same capital market and financial regulation as other listed fixed income securities."[31]

Bonds provide the advantage of already being a well-established asset class in the investment portfolios of mainstream institutional investors and have significant potential to transform the economy into one that is more environmentally and socially sustainable. For instance, green bonds issued by Italian companies reached a total volume of nearly US$6 billion by mid-January 2018. Of this total, 78% was issued from the private sector, 12% from the public sector and the remaining 10% from financial organizations. The Spanish global energy provider Iberdrola has issued green bonds to finance its emissions-free developments and to respond to growing liquidity needs as institutional investors are increasingly demanding green investments. From 2014 to date, the volume of their green transactions within the capital markets amounts to almost EUR8.15 billion (US$9.48 billion).[32] The French government has fueled the green bond market in France (see the EUR9.7 billion (US$11.3 billion) Sovereign Green OAT). French utilities are among the world's largest green bond issuers: SNCF réseau, the railways company, EDF and Engie, the energy companies, have issued several billions Euros in green bonds. Mid-sized companies such as Neoen, Akuo Energy and Foncière INEA are also starting to issue green bonds. Furthermore, several French asset managers have launched funds dedicated to green bonds, such as those by Mirova/Natixis, Amundi, Axa, BNP Paribas, Crédit Mutuel.

Bonds have long been the asset class favored by pension funds and insurance companies. OECD institutional investors manage up to US$84 trillion[33] in assets and asset owners – and OECD-based asset owners alone manage around US$54 trillion.[34] Bonds with longer maturities are potentially a good fit with institutional investors' long-term liabilities, allowing for asset-liability matching. For example, Ferrovie dello Stato Italiane issued the first European green bond by an incumbent railway operator to finance both new regional and high speed trains in November 2017. The EUR600 million (US$700 million) issuance had more than 60% demand from foreign investors and around 50% of final orders from institutional investors with a sustainability commitment. The execution allowed Ferrovie dello Stato Italiane to set its coupon at the lowest price ever obtained in a public bond issuance.[35]

There are many types of bonds and all variations that can be structured to target projects looking to generate environmental and social sustainability outcomes. Chart 1 shows the potential growth of different types of bonds in the financing for sustainable projects during the period of 2015-35, as projected by the OECD.[36]

Chart 1: Low-carbon Asset-backed and Financial Sector Bonds Have the Largest Potential to Scale up, 2015-2035



Note: SSA: supranational, sub-sovereign and agency; ABS = asset-backed security; CLO = collateralized loan obligation. The figure depicts the base case "low-securitization scenario". Bonds in the People's Republic of China, Japan, the EU and the United States.

Source: OECD (2016), A quantitative framework for analysing potential bond contribution in a low-carbon transition (a contribution to the 2016 G20 Green Finance Study Group); OECD (2017), Mobilising Bond Markets for a Low-Carbon Transition, Green Finance and Investment, OECD Publishing, Paris

Sustainability-targeting bonds: The three bonds described below have similar structures but the use of proceeds targets either environmental or social goals of sustainability, or both. These bonds are issued by entities that are tied to a sustainability-themed 'use of proceeds' but secured against the entire balance sheet of the issuer. Based on the available principles and guidelines[37] created and used by the market (*i.e.* the Green Bond Principles

(GBP), Social Bond Principles (SBP) and Sustainability Bond Guidelines (SBG)):

- Green bonds enable capital-raising and investment for new and existing projects with environmental benefits.

- Social bonds are bonds that raise funds and direct the 'use of proceeds' towards new and existing projects with positive social outcomes.

- Sustainability bonds look for the application of the 'use of proceeds' bond concept to bonds financing both green and social projects.

There are currently four types of bonds that fit under these three thematic categories:

- Standard Use of Proceeds Bond: A standard recourse-to-the-issuer debt obligation aligned with the GBP/SBP/SBG.

- Revenue Bond: A non-recourse-to-the-issuer debt obligation aligned with the GBP/SBP/SBG in which the credit exposure in the bond is to the pledged cash flows of the revenue streams, fees, taxes, etc. and whose use of proceeds goes to related or unrelated project(s).

- Project Bond: A project bond for a single or multiple project(s) for which the investor has direct exposure to the risk of the project(s) with or without potential recourse to the issuer and that is aligned with the GBP/SBP/SBG.

- Securitized Bond: A bond collateralized by one or more specific project(s) including but not limited to covered bonds, ABS, MBS and other structures and aligned with the GBP/SBP/SBG. The first source of repayment is generally the cash flows of the assets.

When banks issue the first of these types of bonds, they are using the proceeds to fund lending to defined projects. This applies to private commercial banks as well as national development banks and other forms of sovereign, supranational and agency issuers. KfW is an example of a frequent issuer of green bonds that are used to finance green lending activities (Box 1).

Most of the green bonds issued to date are bonds where the use of proceeds will fund environmentally sustainable projects or activities within an entity and will be secured by the entire balance sheet of the issuer. Such bonds are important providers of sustainable finance, as they give mainstream fixed income portfolio managers an opportunity for easily funding the entities that are directly financing the sustainable projects.

In addition to these corporate issuer-backed bonds that target sustainable projects, the bond market can play a significantly larger role when aggregating bank loans and issuing asset-level (backed, supported or linked) bonds targeting sustainable projects. The following are variations of these aggregated bonds covered by the paper:

Sustainability-targeting ABS, including green residential mortgage-backed securities (RMBS): These securitized bonds consists of banks or financial corporates identifying, tagging and pooling loans or receivables targeting environmental or social sustainability outcomes, and selling them as a bond inside a special purpose vehicle (SPV). These bonds tend to be "true sales" and move risk off of banks' balance sheets. Examples of this are the IADB case study in Mexico, where small energy efficiency loans were pooled and sold as ABS, and the case of Fannie Mae that pools and sells green residential mortgages (Box 1).

There is potential for a significant expansion in the origination and subsequent issuance of ABS as perceived risks fall.[38] The standardization of projects and policy support can enable the pooling of individual loans, which effectively ties bonds to a group of assets, rather than to individual assets or corporates. Compared to project bonds that generally back individual projects (or collections of larger scale assets concentrated in wind and solar farms), ABS are more efficient vehicles for aggregating pools of individual loans. A particularly innovative example of sustainable ABS can be found in the Mexican issuance of a bond supported by small energy efficiency loans. According to quantitative analysis by the OECD, annual ABS and CLO (see below) issuance is seen as having the potential to reach US$280-380 billion in the 2031-35 period in the baseline and enhanced securitization scenarios, respectively (or between 44% and 52% of annual issuance).

Sustainability-targeting CLO bonds: These bonds are issued by a CLO vehicle and act as its liability. Asset managers issue sustainability-targeting bonds to purchase sustainable loans, manage the loans and pay the bond coupon with proceeds from the pool of loans. Traditionally, CLOs were populated with leveraged loans and high-yield bonds. A CLO would purchase sustainable debt directly from a bank, involving a true sale and a reduction of risk exposure from the banks' balance sheets. This is a powerful structure that could be re-purposed for long-term sustainable loans, providing many benefits. First, loan amounts and tenors tend to be smaller than bond issuances and are increasingly accessible by a greater range of entities including SMEs and individuals. This implies better opportunities to address smaller-scale project finance. Second, the scaling up of these smaller loans makes the return on the income streams more commercially attractive. Third, a key characteristic of this structure is its flexibility. Unlike sustainability-targeting bonds, bank loans are governed predominantly by a set of (bilateral) contracts, so the loan documentation can be tailored to individual circumstances. This enables penalty mechanisms (as higher interest rates on the loans) in case it fails to use the proceeds for sustainability purposes or to accomplish established sustainability targets, disincentivizing the potential for risk of "greenwashing".[39] A simulated Sustainable Energy CLO case is being developed by SEB, White and Case, Standard & Poor's and Ock Ziff contemplating the institutional investors market in the European Union. The purpose of such exercise is to understand the risk and performance of such an entity.[40]

Sustainable project bonds: These are bonds issued specifically for and secured by a sustainable infrastructure project. The case of Windmere, an offshore wind farm project in Germany, is a good example of a project bond: a private placement bond falling under Rule 144A[41] was issued to institutional investors to take out the bank construction loan.

Sustainability-targeting covered bonds: These are sustainable asset-supported bonds that possess the guarantee of the issuer. Covered bonds carry the guarantee of an issuing bank and use pledged loans as additional collateral. In this case, the banks still own the loans but get superior pricing due to the credit enhancement of the green collateral. Although covered bonds do not transfer risk off of banks' balance sheets, it is still an important tool to reduce cost of funds and reach a deeper liquidity pool by expanding their investor base. The Bank of China issued a landmark covered green bond in London in 2016, which obtained superior pricing and widened its investor base (Box 1).

A healthy market for securitization can deliver significant financial and social benefits. For example, the Fannie Mae's Green Mortgage program (Box 1) provides low-priced mortgages to homes that are energy- and water-efficient. From a high-level perspective, as a means of efficiently channeling financial and economic resources, securitization supports economic growth and financial stability by enabling issuers and investors to diversify risk. By opening up new avenues for raising capital, securitization can aid in diversifying the funding base of the economy. It can also help free up bank capital, which could potentially allow banks to extend new credit to the economy.[42]

Efforts are already being put in place by policymakers geared at mitigating risks and ensuring that securitization markets contribute to economic growth and financial stability, such as the EU's Capital Markets Union Action Plan, the Solar Access to Public Capital Initiative in the United States and initiatives elsewhere, including in China.[43] This revitalization can be achieved in a large measure by standardizing the assets and by making safer, simpler and more transparent the securitization process and the market activity it spurs. The use of securitization as an instrument to achieve sustainable outcomes must, and would in principle, be undertaken in a prudent, judicious and transparent manner so that ABS markets emerge with integrity and with due consideration for any financial stability issues.

Beyond aggregated bonds, the bond market provides greater flexibility and more options for freeing up capital after it has been deployed for the early phase of sustainable projects (*i.e.* upon the "exit" from the development stage of sustainable infrastructure projects). Bonds can help in increasing the speed at which capital can be "recycled" back into development, construction and early-stage risks, and also helps to attract additional early-stage finance. Investors are more likely to invest their capital in construction phases if there is a credible and predictable low-cost exit once assets become operational.[44]

Although the amount of sustainable finance needed in the medium term to finance the path to a sustainable economy is staggering, the funds available from long-term institutional investors are sizable and most likely enough to meet the challenge of achieving the SDGs.[45] Hence, it is important for the pathways described above to be effective. Financial products or alternative debt originators could be designed to deliver sustainable debt following established market practices such as the Green, Social or Sustainable Bond Principles. This would facilitate the crowding in of sustainable long-term institutional investors.

Box 1: Examples of Sustainable Assets for the DCMs

1. Green Covered Bond: Bank of China expanded its international investor base and liquidity by having "green loans" on its balance sheet "tagged" and used as additional security in a green covered bond issued in London. Further, the green over-collateralization of loans allowed the bank to obtain superior pricing.
2. Instituto Costarricense de Electridad (ICE) B Bond: Costa Rica hydropower plant financing included an innovative structure by IADB invest that allowed the B bond to be sold to international institutional investors.
3. Invenergy B Bond: Uruguay wind farm that placed B Bond by IADB with US institutional investors under a 4(a)(2) structure.
4. Bank Negara Malaysia: Malaysia launched the first green *sukuk* in the world on 27 June 2017. The *sukuk* green Islamic bond targeted proceeds to be used to fund specific environmentally sustainable infrastructure projects, such as the construction of renewable energy generation facility.
5. Caja Rural Navarra Covered Bonds: The Spanish cooperative bank has issued sustainable covered bonds for a total amount of EUR1 billion (US$1.16 billion) according to its Sustainability Bond Framework.
6. Energy efficiency green ABS: IADB purchased receivables of small energy efficiency projects and issued a green ABS in Mexico. This was the first energy efficiency backed bond issued globally and was sold in the regions' local capital markets.
7. Fannie Mae Multifamily Green residential mortgage program: United States issuer of residential mortgages aggregated and issued into the US capital markets US$21 billion of green mortgages in 2017.
8. KfW 2018 Swedish Krona (SEK) Green Bond Issuance: German KfW issued a SEK green bond (EUR612 million equivalent, or US$710 million) and was able to broaden its green investor base with issuances in a non-Euro currency.
9. Garanti Bank Green Mortgage Covered Bond: Turkish Garanti Bank issued a US$150 million equivalent green covered bond.
10. Blackstone Group Windmere Financing: German offshore wind development that had construction financing taken out by a 144A bond sold to institutional investors in the UK market.

11. Enel Finance International N.V.: Placed two green bonds in January 2017 and 2018, backed by a guarantee issued by Enel S.p.A., of EUR1.25 billion (US$1.45 billion) each. The eligibility of funded projects was set in accordance to the Green Bond Principles. The issuances followed the Group's 2017-2019 Strategic Plan, which contemplated the refinancing of EUR12.4 billion (US$14.4 billion) for projects related to the low-carbon economy transition.

12. Cassa Depositi e Prestiti (CDP): The Italian National Promotional Institution controlled by the Ministry of Economy and Finance issued a EUR500 million (US$580 million) 5-year social bond on November 2017, with Vigeo Eiris as second party opinion. It was the first ever social bond issued in Italy and Europe that targeted areas affected by natural disasters. The proceeds fund Italian SMEs eligible under the CDP Social Bond Framework criteria, consistent with the ICMA Social Bond Principles.

13. Instituto de Crédito Oficial (ICO) issuances of social bonds: The Spanish financial agency under the Ministry of Economy has issued a total volume of EUR2 billion (US$3.2 billion) of social bonds since 2015. The funds raised via the social bonds are used to finance Spanish SME projects in those regions where income per capita is below the national average. ICO has been certified as a "responsible issuer" in order to launch its social bonds by Sustainalytics.

14. KfW: In 2017, EUR14 billion (US$16.2 billion) have been provided by German promotional bank KfW to increase energy efficiency in the residential building sector. KfW provides loans to commercial banks, who on-lend the funds to their customers. On the other hand, KfW refinances its activities primarily by issuing bonds in the international capital markets and receives high sustainability ratings scores. Thus, by investing in KfW bonds, investors support the availability of bank loans for sustainable projects.

15. Berlin Hyp: In April 2015, the German bank became the first issuer of a Green Mortgage Pfandbrief, *i.e.* a German law-based covered bond that is used to refinance loans for green buildings. Berlin Hyp offers its borrowers a discount of 10 basis points on loans for green buildings. As of May 2018, the volume of Berlin Hyp's green finance portfolio reached EUR3.3 billion (US$3.8 billion), representing an increase of 500% since the issuance of its first green bond.

16. Amundi Planet Emerging Green One (EGO): In March 2018, the World Bank Group's IFC and the French asset manager Amundi launched a fund targeted at investing in green bonds focused on emerging markets, expecting to deploy US$2 billion over its lifetime.

1.2.2 Origination of Sustainable Debt by Institutional Investors or Through Sustainable Funds

Underwriting of sustainable debt directly by institutional investors: Insurance companies and pension funds could provide a highly scalable pathway to

increase sustainable debt capacity. In this case, institutional investors would bypass banks and directly underwrite long-term sustainable loans on their balance sheets. Such underwriting activities by insurance companies are taking hold in some countries (Germany, UK and US, among others). It is important to note these firms operate within country-specific regulations. Not all jurisdictions have a sufficiently developed institutional investor base; however, as noted above, international insurance companies are actively entering emerging markets and can be a new source of local currency sustainable debt.

Development of sustainable asset funds and management companies: Independent funds would purchase or originate sustainable debt and manage the portfolio. Institutional investors would invest in funds and receive returns based on the cash flow of the sustainable loans. Hermes Asset Management Sustainable CRE and Iona Capital (Box 2) are two good examples of non-bank sustainable asset management companies that directly issue and retain sustainable credit and equity. Alternatively, the BBOXX case study shows a financial structure that supports a solar energy kit manufacturer that bundles up receivables and sells the aggregated debt obligations as a securitization to Oikocredit, a Dutch cooperative and social investor operating internationally (Box 2). From a policy perspective, the French legal framework has been modernized with amendments introduced in 2013 and 2016 to allow insurance companies and funds to underwrite loans under certain conditions. France has also worked on its securitization legal framework, enlarging the legal capacity of certain funds to acquire outstanding debts from the non-bank financial sector.

Generally, available data suggests intermediated investment through funds is a preferred way for institutional investors to enter the market: a data set on institutional investments with involvement of actors from the official sector shows that close to 90% of these investment activities were intermediated investments, both equity and debt.[46]

Private digital platforms for the origination and distribution of sustainable loans: Current and emerging crowdfunding or other digital platforms targeting sustainable investments could aggregate sustainable loans and sell them to institutional investors. Digital technologies, such as digital contracts and blockchain technology, are progressively applied to functions that could make possible the selling of sustainable debt quicker, more transparently and cheaper. Topic 3 of the Synthesis Report explores this possible application of digital technologies further.

Box 2: Examples of Investors' Origination of Sustainable Debt

1. Iona Capital: UK-based asset manager that directly underwrites subordinate debt in environmental infrastructure projects. Iona's investments allow UK institutional investors to access sustainable projects cash flows.
2. Hermes Investment Management: UK-based Hermes underwrites its own sustainable debt and equity for energy-efficient and sustainable

commercial real estate. The asset manager has determined its focus on ESG factors delivers superior returns and a reduced risk of default.

3. BBOXX: Kenya and UK securitization where future receivables from Kenyan purchasers of solar energy were bundled and a US$500 million bond was issued and sold to Oikocredit.
4. Prudential Insurance: UK insurance and pension provider that has developed internal capacity to underwrite sustainable infrastructure via its internal fund.
5. Crédit Agricole CIB: A socially responsible US$3 billion private synthetic risk transfer was completed by the French bank to Mariner Investment Group LLC through a Green Capital Note. Crédit Agricole CIB aims to redeploy the freed up regulatory capital in new lending for green sectors contributing to achieving the SDGs.

1.3 Challenges to Creating Sustainable Assets for Capital Markets

General challenges to creating assets for capital may include, among others, the need to have appropriate risk rating models, the creation of adequate risk management products (*e.g.* derivatives, insurance contracts) and the encompassing robust and effective market regulation. In addition to these generic challenges, a number of challenges are specific to the creation of sustainable assets for debt capital markets. Among these, the following were identified:

1. Lack or insufficient awareness of the potential benefits and investments opportunities: This prevents generating the institutional contexts and empowerment that could trigger an acceleration of possible actions in general, and in capacity-building in particular. Investors are recognizing a greater interest in environmental and social sustainability among their stakeholders (*e.g.* clients and fund members), but their focus is still largely driven by financial considerations (*i.e.* risk-adjusted rate of returns).[47] Increasing private sector research[48] on the correlation between ESG-mitigated risks and better returns within some asset classes is helping raise understanding among market stakeholders. Likewise, the existence and involvement of publicly capitalized green investment banks in sustainable investments has been conducive to investment activity. Data on institutional investments with involvement of actors from the official sector shows a significant number of transactions involving green investment banks.[49] Nevertheless, for the time being, the generally prevalent lack of awareness of the materiality of environmental and social factors retards to a large extent their internalization, thus leaving them as externalities and not factoring them into the risk/return equation.

2. Lack of capacity for underwriting sustainable assets: Banks, institutional investors and other key stakeholders in the financial markets lack knowledge, skills and empowerment to identify and evaluate eligible projects and risks to adequately structure, sell and manage these

sustainable financial products. That said, some investors, as well as diverse networks and organizations, are now beginning to develop the tools and training needed to go from raising awareness to action, such as sustainability definitions, evaluation metrics, forward-looking environmental risk assessments, and related reporting.

3. Competing sustainability classifications and taxonomies: As referenced by the work of the Task Force on Climate-related Financial Disclosures (TCFD), there are many disclosure frameworks (*e.g.* Green Bond Principles, Climate Disclosure Standard Board Framework, Asset Owners Disclosure Project).[50] While these initiatives provide further guidance to market players that wish to employ them, the existence of various tools that are not always coordinated or clear enough may miss to offer the consistency or transparency looked for by investors. The recommended disclosures of the TCFD, although directed at companies' climate-related financial risks rather than sustainability classifications, may provide a standardized common framework for disclosures in this area, helping promote alignment across existing regimes. Frameworks developed could benefit from following a proportionality approach. Several market participants are now in pursuit of a more common terminology for identifying sector-specific sustainability factors and measuring the capital differential of more sustainable enterprises.[51] In the EU, the European Commission tabled a legislative proposal to develop an EU classification system for sustainable economic activities to facilitate sustainable finance. The absence of commonly agreed classifications and taxonomies in sustainable finance may also give space for some level of 'greenwashing', possible misunderstandings, and further transaction costs to understand the originators' view on sustainability.

4. Inconsistencies among available sustainability standards and labels: Research by the IFC that built on the work of the G20 GFSG on institutional and market barriers to scaling up green finance revealed a lack of consistency in market terms and standards of green finance.[52] This extends to the broader space of sustainable finance. A certified label signals compliance with standards and procedures that align with stated sustainability criteria and taxonomies. The lack of, or underdeveloped certified labels hinders the identification of sustainable loans to be market-refinanced or securitized. This, in turn, challenges the ease with which investors can compare different investment products and make informed choices. In the bond space, for example, countries are beginning to, or have already, set standards and coordination bodies. For example, China has established a Green Bonds Standard Committee, a regulatory supervision body that oversees the practices of bond verifiers. ASEAN has issued its green bond guidelines. In South America, Argentina, Brazil, Chile and Peru have issued or are in the process of issuing their own green bond guidelines to provide a market standard for potential issuers. The EU is exploring the possibility of developing EU green bond standards and extending the EU Ecolabel to certain financial products. While these steps help formalize the green bond market, variability in standards across regions carries its own risks as it may confuse investors and increase

transaction costs for cross-border capital flows looking for sustainable investment opportunities.

5. Complexity of project financing in public services sectors with high sustainability impact: Public services (*e.g.* sewage treatment, energy, mass transportation) can deliver important positive environmental, social and economic impacts. The full benefits of investment projects in these industries are often hard to measure due to multiple stakeholders involved in the investments. In these cases, the investment process may be lengthier and restrain investors from deploying available sustainable financing capital.

6. Superficial or unsophisticated sustainability-related impact reporting: The uneven development and use of sustainability metrics for impact reporting, both quantitative and qualitative, hinder the availability of transparent and relevant information generating ambiguity for issuers and investors. This would also challenge the integrity of the market. Further, lending to impact funds and impactful companies has not ramped up as much as other sets of sustainable debt products such as green bonds. These investments are often perceived as lower-yielding than other sustainable investments.

To ensure that the whole array of environmental, social and economic benefits brought by sustainable finance are realized, the work towards addressing the aforementioned challenges must be diligent in assessing possible unintended consequences. The development of sustainable debt to long-term institutional investors using the pathways, products and structures outlined above needs to be vigilant to avoid negative unintended consequences such as market instability caused by overleveraged structured products. In that regard, the development of structured finance should be done in an orderly way, paying due regard to the financial risks involved and in compliance with all international agreed regulatory standards such as the Basel Committee on Banking Supervision (BCBS) standards pertaining to Simple Transparent and Comparable securitization, or Simple Transparent and Standardized securitization in the EU.[53]

1.4 Voluntary Options for Creating Sustainable Assets for the Capital Markets

G20 members could benefit from the development and use of existing products and financing techniques to increase sustainable capital market products and alternatives thereof. Among these pathways are: debt capital markets, direct sale of sustainable assets, or digital platforms. Based on the cases analyzed, best practices, and consultation with players from the private sector, the following voluntary options could be considered by countries to address the challenges identified above:

1. Raise awareness of the benefits of sustainable debt products through communication and educational initiatives. Policymakers, financial trade organizations and leaders within financial and investment companies

could actively develop different types of initiatives to raise awareness on the need for sustainable finance and the products and pathways advanced herein. To ensure sufficient expertise and competency, initiatives spreading sustainable finance literacy for professionals such as pension advisors could be put forward. Understanding of the whole array of benefits (*e.g.* reduction of negative impacts on the environment, creation of jobs, better risk management of financial institutions) could be incorporated in such initiatives, together with insights on the materiality of different environmental and social factors. Organizations and forums such as the G20, the Financial Stability Board (FSB), the Bank for International Settlements (BIS), the OECD and other key international organizations can continue to communicate their research and projections and the implications to the well-being. Task forces that bring together key private and public stakeholders can be useful platforms to catalyze ideas and actions at different levels (*e.g.* national, sub-national, regional). Examples in this space include the multi-stakeholder green finance task forces in the UK[54] and in the Netherlands.[55]

2. Encourage dialogue to improve the quality and transparency of sustainability taxonomies, taking into account national and regional circumstances, priorities and needs. Relevant players could individually or collectively convene to improve the quality and transparency of sustainable taxonomies and standards. The support of organizations with convening power such as the G20, and with technical capacity such as UN Environment and the OECD, among others could facilitate the needed space and resources for effective exchanges.

3. Facilitate technical training and capacity-building among key stakeholders in the sustainable debt market:

    i. *Facilitate technical training for the analysis of sustainable investments.* Development of the necessary skills to identify and evaluate the risks and opportunities of sustainable finance. This can be done by universities as well as educational divisions of trade organizations. Curricula should be developed to teach underwriters and investors alike on how to collect sustainable data and conduct sustainable risk analysis. Trainings should also cover subjects of evaluation metrics and tools.

    ii. *Promote the development of the internal capacity of institutional investors to underwrite sustainable loans on their own.* In this case, as demonstrated by certain institutional investors, in-house capacity could be built to originate, monitor and service a portfolio of sustainable debt products.

    iii. *Promote capacity-building for asset managers in managing portfolios of sustainable loan assets for long-term investors.* Like institutional investors, asset managers can move into the sustainable loan market for smaller institutional investors that may not have the sufficient internal capacity to manage or originate sustainable loans on their own.

Institutional investors eager to obtain exposure to sustainable investments can drive this opportunity.

iv. *Promote the development of asset managers who oversee sustainable CLOs.* CLOs have been a powerful means to move loans from banks' balance sheets into the DCM via the issuance of liabilities to gain the funds to purchase the sustainable loans. The asset managers could oversee the loan portfolio like banks would. By taking the loans into their SPV, the banks are able to gain balance sheet capacity via a true sale. Bond trade organizations, informed banks and financial service law firms could drive the development of this opportunity. The development of sustainable CLOs should pay due regard to financial risks and ensure that sufficient transparency and simplicity are a part of the structures.

v. *Promote the development of knowledge on sustainability-related risks and risk-adjusted returns in the debt capital market.* This could substantially facilitate the issuance of bonds, covered bonds and sustainable asset-supported bonds targeting sustainability outcomes.

4. Encourage the development of digital platforms that bring together sustainable assets and investors. This type of leapfrogging technology could allow banks to renew and refresh their balance sheets to sustainable investors tapping into reductions of operational and market risk and transaction costs for all counterparties, generating an opportunity to facilitate access to long-term investors. It therefore allows the emergence of additional capacity to underwrite new sustainable loans. Many of these technologies, and their possible applications, are currently nascent, Chapter 3 provides a mapping and preliminary assessment of their potential usefulness for creating and transacting sustainable assets.

5. Seek to identify the unintended consequences of sustainable assets including effects on financial stability and risk-adjusted returns. Develop or apply financial modeling and other risk identification techniques, as studied by the GFSG in 2017 during the German Presidency, to help devise potential unintended consequences related to sustainable bonds supported by sustainable assets. These unintended consequences could be negative in the form of excessive leverage that may lead to financial stability issues or inferior performance resulting in poorer than expected risk-adjusted returns. These potential consequences should be considered alongside the desired positive impacts as well as potentially unanticipated positive consequences.

DEVELOPING SUSTAINABLE PRIVATE EQUITY AND VENTURE CAPITAL

Sustainability-driven innovation offers an opportunity to boost economic growth, improve living standards, and generate a variety of employment options, while keeping our ecosystems healthy. Such innovation is constantly created by businesses, at all stages of development. These businesses develop, apply and adapt breakthrough technologies and innovative business models. While young and small sustainable companies with a positive environmental, social and economic impacts are critical to driving sustainable growth, many of these companies face difficulties obtaining adequate investment capital – the right quality, the right quantity, and at the right time. Private equity and venture capital, characterized by offering young and small companies a combination of risk capital and expertise, is often the most suitable form of investment for them.

This chapter reviews the international experience of sustainable PE and VC funds, discusses the key challenges to further develop the sustainable PE/VC market, and provides options to overcome these challenges that could be considered by countries on a voluntary basis. The work draws from inputs by knowledge partners.

1.1 Background

Sustainable technologies (such as those for water and waste treatment, energy saving, energy storage, and carbon capture) and sustainability-driven business models (such as incentivizing the return of 'used' products, extending the life cycle of their products and assets, sharing platforms, or product-as-a-service) offer a number of important benefits. First, the development and application of sustainable technologies and business models provides new and more efficient ways to strengthen environmental conservation. Second, they can create new business opportunities for sectors and firms, thus enhancing economic growth. Third, such technologies and business models are to a large extent embedded within SMEs, helping them to remain competitive or expand into new markets. In sum, the development of sustainable technologies and sustainable business models can contribute to multiple aspects of sustainability such as generating efficiency in resources usage, creating job opportunities and enhancing growth potential.

However, start-ups or growth companies developing or applying sustainable technologies and business models do not always have steady cash flows or sufficient hard assets as collaterals. Traditional financing channels, such as bank loans and bonds, often fall short of matching their needs. Moreover, most fast-growing companies with new sustainable technologies and business models are too small to be listed on stock exchanges or capture the interest of larger trade buyers. PE/VC funds are better positioned to back such innovations in sustainability, because they: provide equity capital, which can tolerate risks and adjust quickly to challenges; contribute managerial and technical expertise and key customer/supplier relationships; help maintain alignment of the long-term interest of the companies; identify and finance

promising SMEs and underserved segments of the economy; provide optimal transition to the next growth stage through allowing investors to visualize credible exit options such as IPOs or buyout by trade buyers.

Experiences from a number of countries suggest the availability of PE/VC funds can substantially boost the speed of development and the deployment of sustainable technologies and business models. However, the PE/VC market (and more so the sustainable PE/VC space) is not evenly developed across countries. This makes it largely unavailable for sustainable technologies and for growing innovative and sustainable business models in some regions.

1.1.1 Private Equity and Venture Capital

PE/VC, a subset of the family of equity capital (*i.e.* ownership interest or risk capital), encompasses a set of financing instruments that enable investors to take a stake in high-potential companies that are privately held (*i.e.* each owned by a small number of shareholders and not listed on a stock exchange). Capital from multiple investors is grouped into a PE/VC fund that invests in multiple high-potential private companies. PE/VC funds invest risk capital in these high-potential companies and help them grow by providing technical and managerial expertise to improve performance, operations, governance and strategic direction.

Like other forms of equity capital, PE/VC sits at the ownership level of a company's capital structure, meaning that it has the most subordinated claim on the company's cash flows. This makes PE/VC a riskier, but potentially higher-returning, investment instrument, which can also enable less risky forms of capital (such as bonds and loans) higher up the capital structure. Equity can increase in value by many multiples of the investment (*e.g.* Apple and Microsoft started in garages and are now corporate giants), whereas debt investment returns are limited to repaying the debt capital plus interest. That said, debt is first in line for claims on any value should a company default; equity is last and often wiped out in a default situation.

PE/VC funds typically hold investments for 3-7 years (in the context of a 7-12-year fund life), with a commitment to building lasting and sustainable value. PE/VC funds realize returns for their investors by exiting investee companies at a value higher than at entry, reflecting the value the fund manager has added. PE/VC fund managers are remunerated mainly upon exit, by receiving a share of the increase in value they have helped to create, and are thus incentivized to help their investees grow and increase profits. Typically, private equity funds will exit their stake in a company by listing on the public markets, or selling to a financial or strategic buyer (a trade sale) or in some cases back to the company or its management.

PE/VC funds are usually specialized in a segment or stage of development of companies. VC is private equity that targets earlier-stage companies. For instance, the earliest stage of VC (the A round of funding) is often short and serves to get the company to a level sufficient to obtain second and third stages (the B or C round) of financing. Later rounds of funding (C, D and

onwards) may develop over longer periods of time, backed by funds that specialize in these later stages. Regular PE (referred to plainly) is generally focused on later-stage companies. PE and VC each have their own techniques and investment horizons.

1.2 Developing Sustainable Private Equity and Venture Capital Markets

This section presents key takeaways drawn from the consultation with knowledge partners and experts on current practices for developing and deploying PE/VC to sustainable investments. The following are the initial findings:

a. Integration of sustainability factors into PE/VC decision-making can contribute to financial outperformance, besides better environmental and social outcomes. An internal study of IFC real sectors' portfolio from 2010 to 2015 found that clients with better sustainability performance tend to outperform clients with weaker sustainability performance on all financial indicators (for ROE, the outperformance was 210 bps; for ROA, 110 bps; and for IRR, 770 bps). Changes in sustainability performance and financial returns tend to move in the same direction. Yet, while there is correlation, causation is difficult to demonstrate.

b. Incubators can help create an innovation ecosystem and pipeline for venture investors looking for innovative sustainable start-ups. The articulation of sustainability considerations at this level (*i.e.* incubators' themes, selection processes, etc.) could be instrumental in accelerating the translation of emerging sustainable start-up ideas into sustainable investment opportunities, and thus, resulting in growth of SMEs. The US Department of Energy and several state governments set up funds to foster early-stage research and start-up funding for early commercialization of sustainable projects such as new energies (*e.g.* Department of Energy's Advanced Research Project Agency-Energy, the Tata Center, MIT's Energy Initiative and The Engine, Prime Coalition, NYSERDA and Chicago's Clean Energy Trust). These labs provide shared centralized facilities, equipment helping to shorten the ramp-up development periods and reducing capital costs. In China, via cooperation with government funds or green industrial funds, some sustainable PE/VC funds get access to project and technology resources, subsidized rent and other concessions and investment opportunities.

c. Patient capital funds' structures that allow sufficient investment time for growth can be beneficial for sustainability-oriented projects. Compared with traditional and mature projects, sustainable projects in nascent sectors require longer time to demonstrate their commercial viability. Patient capital – which has a longer time horizon – is therefore important to meet the capital demand from such projects. Patient capital values learning from previous mistakes, allows for additional time and resources for portfolio companies to scale, and understands the need to build out supporting infrastructure and frameworks in nascent sectors or for new business models. For early-stage investments, accelerators and

follow-on fund models (*e.g.* US-based Y-Combinator, 500 Startups, TechStars, and Argentina-based NXTP Labs) provide funds with a lower risk of failure, because they would be coming into a company with a concept, model and revenue already proven. This is especially true when the follow-on fund backs promising companies from the 'in-house' accelerator, as the team will have known the companies since inception. The benefit works 'upstream' as well, as the manager can use some of its fees to continue the accelerator's work. In Italy, Venture Capital Fund of Funds, led by the Italian National Development Bank CDP, provides an active contribution to the launch and development of innovative start-ups, notably supporting and fostering sustainable innovation among SMEs.

d. Diversified options for exiting sustainable start-ups are critical. Corporate strategic investors, large incumbent companies and forward-looking utilities have committed to sustainability and to bringing forward their knowledge, commercial relationships, and access to customers at a lower cost. Some have even developed their specific corporate venture capital streams or funds. This helps start-ups succeed and create confidence in the PE/VC investment and exit environment. In the US, nearly half of Fortune 500 companies have renewable energy or carbon reduction targets, along with some cities such as Los Angeles, Atlanta and Salt Lake City. This consumer-driven interest reinforces the belief that many of these PE/VC-backed sustainable technologies and business models will find robust end markets.

Box 3: Examples in the Sustainable PE/VC Industry

a. IFC PE/VC investment funds (global): IFC Venture Capital Group invests in early-stage healthcare, edutech, internet and cleantech companies that offer innovative technologies or business models geared to emerging markets through direct investments and funds. IFC's Private Equity Funds Group focuses on sustainable growth equity funds in emerging markets, which have a generalist strategy, that provide expansion capital to SMEs and established mid-market companies across many sectors. In 2009, IFC set up the IFC Asset Management Company (AMC) to be a sustainable PE/VC fund manager, raising capital from global investors. AMC's fund of funds team co-invests its LPs' capital, totaling more than US$1.2 billion through two commercial funds of funds: the climate-focused Catalyst Fund and the diversified Global Emerging Markets Fund.

b. The Yozma Fund of Funds approach (Israel): The government-created fund introduced a limited amount of concessional finance through the fund of fund's "waterfall" structure. It targets high-growth companies in the communications, information technologies and life sciences sectors. The original Yozma funds had US$2 billion under management by 2001, up from US$200 million in 1993 (public and private investments).

c. NXTP Labs accelerator (Argentina): This accelerator focuses on seed stage projects, investing through its structured program in return for a minority equity stake, and it then makes subsequent investments in the best performing companies. NXTP Labs supports tech start-ups, and has

evolved to increasingly embed sustainability criteria to select and help grow the incubated companies.

d. VC Fund of Funds by Cassa Depositi e Prestiti (Italy): It contributes to the launch and development of innovative start-ups, notably supporting and fostering sustainable innovation among SMEs. CDP supports the industry throughout its life cycle, up to the turnaround phase, through liquidity, equity and risk-sharing instruments.

e. Ecotechnologies Fund (France): The EUR150 million (US$174 million) fund was launched by France's Environment & Energy Management Agency within the framework of the actions of the Program of investments for the future (PIA) and is managed by Bpifrance Investissement. It provides late-stage VC investments to environment-related startups based in France, with tickets falling between EUR1-10 million (US$1.6-16 million), and looking for private co-investors to join on a *pari passu* base.

f. Moringa Fund (France/Emerging Markets): The EUR84 million (US$98 million) private equity investment fund targets early-stage and development-stage companies operating or developing agroforestry farming with high environmental and social impacts across sub-Saharan Africa and Latin America. The fund, managed by Moringa Partnership, makes equity and quasi-equity investments of EUR4-10 million (US$4.6-16 million).

1.3 Challenges to Developing Sustainable Private Equity and Venture Capital

The general challenges that lead to underdeveloped sustainable PE/VC markets include, among others, the lack of exit mechanism (such as a well-functioning stock market), the lack of innovation capacity, weak protection for intellectual property rights, inadequate market size for commercializing technologies and disruptive business models, especially for smaller economies, and the uneven development of an entrepreneurship culture across countries.

In addition to these generic challenges hindering the development of the entire PE/VC industry, a number of challenges are rather specific to sustainable PE/VC funds. Among these, the following have been identified:

1. Actual or perceived low risk-adjusted return for sustainable PE/VC investing. Most commercial investors look to invest with fund managers that have long track records, including multiple fund generations. However, funds with a sustainable theme tend to have a relatively brief track record. Early examples of undersized, understaffed and poorly managed sustainable funds have tainted some commercial investors' perception of sustainable investing. In addition, commercial investors perceive sustainable PE/VC funds as necessarily having long holding periods, illiquidity, additional investment restrictions and limited exit prospects, thinking of these sustainable investments as a less commercially attractive proposition. Furthermore, investors may believe specialized

capabilities, with the associated additional costs, are needed to screen for, monitor and measure an investment's sustainability, again reducing the prospect for commercial returns. While much of this has been improved as the market grew and experiences were multiplied, misperceptions still remain.

2. Early stage of many sustainable technologies and business models and their end markets. Very often, disruptive sustainable investments may be in nascent industries with technologies and business models still in the development phase, in which most start-ups need more time for field testing and for proving their commercial viability. For instance, incorporating new technologies into electric grids, building energy management systems or municipal water systems must be extensively tested and proven reliable – all of which takes time. The adoption rate of existing energy, water and waste incumbents can be slower than expected. Many new sustainable technologies lack a supportive value chain and are very expensive to scale. Without certainty around end-market demand, equipment manufacturers may be unwilling to scale up capacity and enable lower costs. Similarly, investments reliant on preferential industrial policies can suffer from any hint of variation in the duration, stability, and consistency of these policies, adding to the uncertainty of exit and making sustainable PE/VC funds less willing to participate.

3. Misaligned return horizons between relatively short-term PE/VC funds structure and longer-term sustainable projects in certain sectors. Some sustainable sectors, particularly those that are highly capital-intensive and have utilities and other heavily regulated incumbents as customers, have long business/sales cycles, and the development pathways are characterized by slow but steady growth. Sectors such as these (*e.g.* forestry) are generally not suitable for traditional 10-year PE/VC funds.

4. Lack of clarity in definitions, standards and verification of sustainable technologies/business models. A lack of standardized verification for what constitutes a sustainable way of investing and consistent environmental and social risk management standards and practices are challenges for investors in the space, including PE/VC funds. This can contribute to an information asymmetry between investors and specialized fund managers focused on the less explored sustainable investment space. This is particularly relevant in the case of PE/VC funds whose sustainable investment strategy is for example ESG integration (in the case of a thematic investment strategy, the fund may create its own frameworks and definitions, and have a theory of change that guides the selection of investments).

5. Limited market scale and sophistication. Few markets have the scale and sophistication for the sustainable PE/VC markets to grow. In relation to exits, sustainable projects and SMEs are often sold to large corporates via active merger and acquisitions (M&A) markets, which are often located only in large economies. Sustainable PE/VC can benefit from ancillary

services (often in the form of incubators or accelerators), including accounting, marketing and legal services, but they are not well developed or developed enough in most developing countries. Many sustainable technologies face the initial hurdle of small and immature markets. In addition, these technologies need to be developed by high-caliber universities and research institutes, which are not always available in smaller economies or, when they are, may be disconnected from market players (*e.g.* industry associations, enterprises and corporates).

6. Complexity in quantifying the pricing of externalities and at times mixed incentives to pricing them. In most jurisdictions, there is a lack of regulations and laws that price in the externalities associated with conventional (as opposed to sustainable) investing. This includes, for instance, regulations and laws regarding pollution and environmental and social (E&S) footprints. Environmental benefits generated by sustainable investments are difficult to quantify, let alone monetize, due to the lack of uniform and authoritative quantification methodologies. Objective, well-recognized standards help improve the pricing of externalities and level the playing field around the risk management aspect of investing. In the case of PE/VC, positive externalities are of particular importance, since they pay attention to the upsides and hence increase the value of the investment – as opposed to only looking at managing or reducing the risks.

1.4 Voluntary Options for Developing Sustainable Private Equity and Venture Capital

This section focuses on options that are largely specific to developing sustainable PE/VCs, as the generic issues have been discussed extensively in the literature.

1. Promote the establishment of incubators/accelerators for sustainable start-ups and the integration of sustainability considerations into existing or general incubators. Governments and corporates could establish incubators/accelerators for sustainable tech companies and companies employing sustainable business models as a way to reduce operating costs of the start-ups and substantially enhance the survival rate of these companies. These incubators/accelerators may provide support in financing, marketing, legal, accounting and logistics issues and the necessary coaching for running a company. Efforts could also be made to encourage existing incubators/accelerators to devote more resources to support sustainable companies.

2. Facilitate multi-stakeholder dialogues to work on the interpretation of sustainability in investment obligations. Relevant stakeholders could engage in working groups that bring trustees with different interpretations together to discuss their differences, highlighting why they should take due account of broader societal sustainability concerns over a long investment horizon, and eventually analyze possible policies to add environmental, social and other sustainability issues into investment processes and decision-making.

3. Support the launching of demonstration projects and dissemination of good practices. An important way to reduce risk aversion and thus encourage private capital participation in sustainable PE/VC investing is sending the market signal via profitable demonstration projects. Various approaches may be employed to accelerate the achievement of such signaling, *e.g.* the IFC Catalyst Fund, which explicitly sought to create a commercially structured fund with the help of governments to mobilize private capital and eventually demonstrate that investing in the green and climate space in emerging markets can be profitable. With a different approach, social impact bonds (SIBs)[56] could offer a complementary option of financing through private capital the piloting or demonstration of solutions to social or environmental issues currently addressed by the public sector. Various solutions underlying the SIBs are put forward by social enterprises, which are enterprises or SMEs that look to achieve a social benefit through the sale of goods or services on the market, generating an income.

4. Encourage the clarification in the use of standards for managing sustainable investments by PE/VC, taking into account national and regional circumstances. Improving the transparency, via for example better disclosure, in the use of sustainability or environmental and social standards for PE/VC risk management, and providing related capacity-building, are critical. This helps measure risks, results and impact, thereby supporting fund managers in delivering the sustainability goals and benefits of their investments; and allows, in turn, investors to track and compare investment opportunities.

5. Promote the development of a range of sustainable financial products and fund structures suitable for a broad range of private equity investors. Vehicles like the fund of PE/VC funds and managed accounts can be used to add diversification and to enable access to smaller, specialized PE/VC funds, particularly for those institutional investors that have a very large minimum ticket size. Fund structures that blend public and private capital in a manner that prioritizes returns to private investors may be implemented in order to mobilize capital from commercial investors who are skeptical that sustainable PE/VC can deliver the returns they expect. According to Convergence Finance's deal origination platform database,[57] the most frequently sought forms of concessional capital are subordinated loans, subordinated equity, first-loss capital, equity and guarantees. One market-accepted solution to the lack of scale and sophistication in some markets is to develop investment structures (such as funds of PE/VC funds) that aggregate exposures to individual PE/VC managers and to their underlying investments. Collective investment vehicles like this permit investors to invest at scale and rely on specialist investment professionals to select the most promising PE/VC managers in markets with minimal track record and relatively little sophistication to 'seed' and develop the PE/VC market in countries (or sectors) where PE/VC activity is nascent. Governments can use these market-accepted structures to stimulate development in strategic areas by the use of limited concessionality or first-loss provisions.

APPLICATIONS OF DIGITAL TECHNOLOGIES TO SUSTAINABLE FINANCE

This section summarizes findings by the SFSG on the opportunities to better leverage digital technologies for financing sustainable development, as well as the challenges that limit the effective use of digital technologies for this purpose, and how they might be overcome. The findings are based on a mapping across G20 members, which highlights emerging practice in applying digital technologies to sustainable finance. These findings draw from contributions by G20 members, technical convenings, outreach to experts and literature review undertaken by the Sustainable Digital Finance Alliance.

This chapter focuses on how digital technologies help overcome key challenges and take advantage of opportunities related to the two other work stream focus areas: (i) creating sustainable assets for capital markets, notably measuring and validating sustainable investments, and bringing together sustainable assets and investors; and (ii) deploying sustainable PE/VC, notably facilitating additional sources of sustainable capital and helping visualize the investment opportunities.

1.1 Background

1.1.1 Why Digital Finance?

One of the key challenges faced by the global financial system today is to mobilize private capital to support sustainable growth while at the same time fostering a resilient financial system. However, a number of constraints limit mobilizing such finance at scale, including information asymmetries, high search costs of sustainable investment opportunities, and the difficulties investors face in fully identifying, assessing and pricing risks associated with unsustainable investments as well as upside opportunities.[58]

Digital technologies can help overcome such challenges by improving the quality and timeliness of relevant information, and by reducing the cost of acquiring this information. It can also help increase the involvement of citizens in bringing their broader interests and concerns into shaping financial decision-making.

Digital technologies have as well a broader role in supporting innovations that accelerate the transition towards a sustainable development pathway. Such innovations are mainly underpinned by technological developments, but also by the growing incidence of a more decentralized infrastructure, business models involving greater shared and rentalized capital, and closed-loop value chains that mitigate or derive greater economic value from what were previously often negative externalities.

Furthermore, digital technologies are demonstrating their ability to address these challenges and drive sustainable, inclusive economic growth. According to a McKinsey Global Institute Report, digital finance could boost GDP growth in India, Brazil, Mexico and China by almost 12%, 5.5%, 5% and 4.2%

respectively.[59] With an annual data generation that is expected to reach 44 zettabytes (that is, trillions of gigabytes) by 2020, data has become an economic asset that delivers financial benefits, with inherent cross-border properties and implications.[60] It is estimated that Artificial Intelligence (AI) alone could lift global GDP by an estimated US$15-20 trillion by 2030,[61] and global mobile connections could reach 8.9 billion within three years. The number of Internet users has already more than tripled in a decade, reaching 3.2 billion in 2015.[62]

1.1.2 What is Digital Finance?

A broad range of technological developments in the digital space offer opportunities to boost sustainable finance. These digital technologies are captured in the concept of digital finance. Digital finance, which underpins the nexus between digitalization and finance, includes a broad range of technologies and digital elements such as big data, AI, online and mobile platforms, blockchain, and the Internet of Things (IoT).

While there is no single agreed definition, the term digital finance encompasses a broad range of new financial products, financial businesses, finance-related software, and new forms of digitally enabled customer communications and interactions.[63]

A number of international organizations have provided definitions of digital finance, including:

- International Telecommunications Union (ITU) (2016): The Digital Financial Services ecosystem consists of users who have needs for digital and interoperable financial products and services; the providers who supply those products and services through digital means; the financial, technical, and other infrastructures that make them possible; and the governmental policies, laws and regulations which enable them to be delivered in an accessible, affordable, and safe manner.[64]

- World Bank (2016): Digital finance refers to the impact that the Internet and related digital technologies have on the financial sector.[65]

- OECD (2017): Digital financial services can incorporate any financial operation using digital technology, including electronic money, mobile financial services, online financial services, i-teller solutions, and branchless banking.[66]

This Report inclines to the definition used by the Financial Stability Board that points also to the broader use implications of digital finance.[67] The Secretary-General of the International Association of Insurance Supervisors usefully offers an aligned working definition of fintech (financial technology) as a technologically enabled financial innovation that "gives rise to new business model, applications, processes and products. These could have a material effect on financial markets and institutions and the provision of financial services."[68]

Sustainable digital finance can be usefully thought of as the application of digital technologies in financing sustainable development. In the current context, this would be an element in seeking to support directly or indirectly the objectives under the framework of the 2030 Agenda and the associated SDGs.

While new technologies and combinations of these technologies continue to unfold, the following are component pieces underpinning digital finance to date:[69]

- Big data aggregates large amounts of increasingly complex data from many different internal and external sources, unlocking opportunities for real-time business insights.[70]

- Machine learning and artificial intelligence (MLAI) use advanced computer science and algorithms to analyze vast data sets, derive patterns to predict behavior and prices, and automate decisions or provide recommendations, increasing decision-making capabilities.

- Mobile technology has evolved rapidly from being a simple two-way pager to being a mobile phone, GPS navigation device and web browser. Advancements in mobile technology have unlocked 'mobile money' allowing consumers to store national currency and make payments without having a traditional bank account. It also enabled computer programs to run on mobile through mobile applications that create access to a vast range of goods and services.

- Distributed ledger technology (DLT) or blockchain is a shared database of trusted transactions distributed across large peer-to-peer (P2P) networks. The encrypted, distributed nature of data on the blockchain and system of consensus makes it inherently secure, immutable, verifiable and transparent to store transactions and records.

- Internet of Things (IoT) through low-cost connected sensors and AI is resulting in machine learning that automates discoveries and enables 'intelligent' computers capable of non-routine tasks. By 2025, it is estimated that the IoT's economic impact will be around US$1.1 trillion.[71]

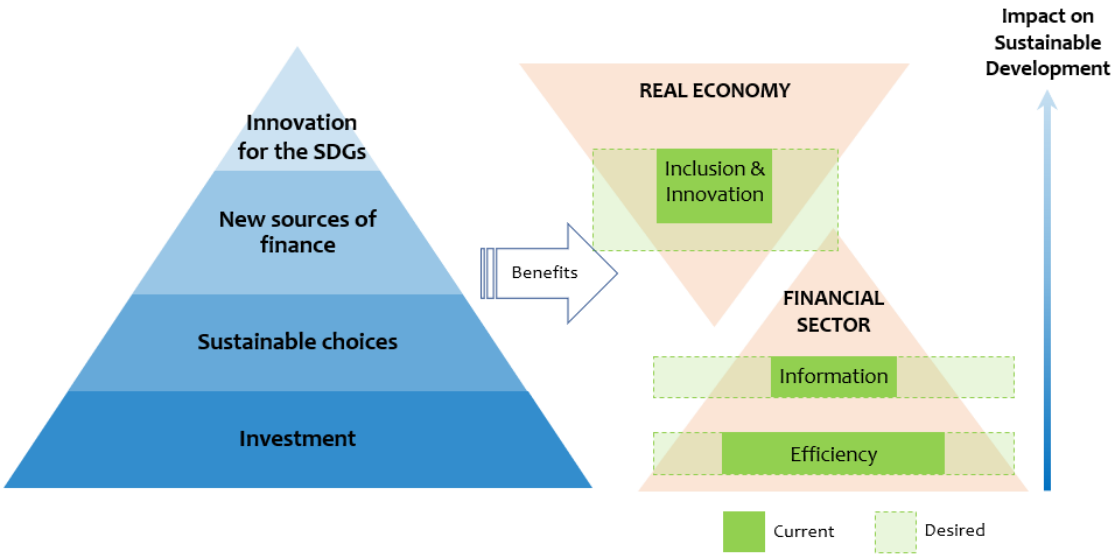
Advances in digital technologies have unlocked new financial applications and business models. For example, P2P platforms allow for electronic money transfers directly between two parties via a P2P service, offering an easy alternative to traditional payments. Similarly, investment crowdfunding platforms allow for small amounts of money to be raised from a large number of people to fund a venture or project, and include both equity and debt stakes. This opens up new investment opportunities for lenders and investors and sources of capital for borrowers. The latter is particularly interesting in the context of piloting, for example of sustainable technologies and emerging business models targeting some unexplored market (*i.e.* it could work as a complementary type of VC, especially interesting where VC and incubators are not very common).

Digital finance in its broadest context is also considered to include monetary innovations, such as so-called virtual or digital assets (also known as crypto assets). However, this aspect is excluded from the work of the SFSG in 2018.

1.2 Mapping of Potential Applications

The mapping across G20 members and the private sector showed rapidly emerging practices and diverse digital finance applications to sustainable finance. These practices demonstrate the capabilities of digital finance to address the challenges related to the mobilization of sustainable capital through the use of different technological ecosystems. The mapping also revealed that the application of digital technologies to sustainable finance impacts the financial and real economy at different levels and brings about different benefits to advance sustainable development (Chart 2).

Chart 2: Harnessing Digital Finance to Enhance the Mobilization of Sustainable Finance



- At the bottom of the pyramid in Chart 2, digital finance's power to make large amounts of data available at high speed and low cost increases opportunities for investments in sustainable assets, notably for institutional investors by improving pricing of environmental risks and opportunities at a lower cost; reducing search costs; and improving, measuring, tracking and validation of the application of sustainability criteria.

- Moving up the pyramid, digital finance unlocks greater inclusion and innovation in access to sustainable finance options, including the facilitation of citizens' active involvement in sustainable finance and mobilization of new sources of finance for sustainable development, at the institutional and retail levels.

- At the top of the pyramid, the interaction between innovations in digital finance and innovations in the real economy facilitate new investment configurations and business models, reducing sustainable business models risks, and creating opportunities to scale sustainable investments, particularly

by PE/VC. At the same time, interactions between sustainable development and the efficient use of capital at the top of the pyramid may be more complex and create unintended trade-offs.

Sustainable digital finance practice is largely market-driven, with growing policy-based encouragement. The mapping revealed that digital finance's 'data power' is underleveraged, while its 'innovation power' is small scale. Table 1 provides a summary of cases from the mapping exercise.

1.2.1 Applications of Digital Technologies to Sustainable Finance

a. Digital Finance and Investment Decision-making

Digital finance can enable more sustainable investment decision-making by both increasing efficiencies and by making more data available cheaper and faster. Hence, accuracy becomes more robust and eases the mobilization of sustainable financing.

Digitization and automation of back-end processes can offer large-scale reductions in costs and increases in flexibility and accuracy of back office tasks, making them more efficient.[72] Within capital markets, digital finance has enabled greater automation on the buy-side, reducing cost frictions. Processes automation in bond issuances allows borrowers to connect directly to more diversified sources of funding. While not yet widely adopted, such automation has the potential to reduce the costs of design and financing of green bonds and loans at greater scales, and pull environmental benefits such as widespread paperless operations.[73] Similarly, it has been estimated that robotic process automation of repetitive tasks, particularly in operations and finance, could reduce costs by 50 to 70% for high-frequency tasks.[74] It has an established track record of producing tangible, measurable results in the capital market and banking industry.[75] It is important to put in place robust governance standards to ensure that automation processes are managed and maintained and that systems are aligned with business and people strategies. Blockchain could also further reduce the costs of back office functions and security clearing, with estimated savings in bank infrastructure costs of around US$15 to US$20 billion a year.[76] Given the fast growing pace of these applications, human oversight of these machine learning underlying algorithms should be reinforced and coding standards and best practices should be followed.

Data is the backbone of investment decision-making as it helps investors better understand and quantify risk as well as risk-adjusted returns. The lack of specific data that is easily available makes it expensive to measure and generate private data for tagging or labeling loans as sustainable. Hence, few banks are able to do so (as noted in Chapter 1). This creates difficulties for institutional investors to understand the risks of unlabeled or vaguely labeled sustainable loans and to assess the true risks and nature of the investments. Similarly, PE/VC investors face difficulties in quantifying environmental benefits as well as in assessing and classifying investments' effects on society[77] (as pinpointed among the barriers identified in Chapter 2). While

publicly available environmental data (PAED) can help improve access to environmental information, there are still challenges to effectively using PAED in financial analysis.[78]

Digital finance's 'data power' helps address these challenges in the following ways:

- Big data, machine learning and AI make it possible to gather and process large quantities of environmental and social performance data, at high speed and low cost, enabling pricing to be appropriately adjusted. It is important for such data to be cleaned or scrubbed in order to detect and remove errors and inconsistencies to improve the data quality. Such technologies are being used by banks[79] to offer lower costs of capital for real estate loans used for energy-efficient modifications. Such loans could be bundled for institutional investors. MLAI supports the development of sustainability rating methodologies, benchmarking, and scorecards by leveraging vast amounts of data. This also enables more efficient and transparent integration of environmental, social and economic considerations into investment decision-making.

- Digital finance technologies can reduce data costs associated with measuring, tracking and validation of sustainable assets.[80] Blockchain technology allows the "application of sustainability criteria" to be verified and audited in a secure, transparent and immutable manner, increasing confidence and lowering labeling costs. While this reflects an area of high potential, many of these technology solutions are nascent, mostly in pilot stages. There are a number of ongoing pilots. For example, the Shenzhen Green Finance Committee in China, in partnership with the Energy Blockchain Labs, International Institute of Green Finance, and the China Emissions Exchange are piloting the use of blockchain and IoT chips embedded in green assets to digitize the green certification and verification process.[81] Another example is the Green Asset Wallet, commissioned by the German Ministry for Economic Cooperation and Development (BMZ) and incubated by Stockholm Green Digital Finance. This pilot brings together a consortium of financial institutions, research institutes and fintech partners to develop a blockchain platform that will enable cost-effective and immutable validation of green investments claims and verification of green impact.[82]

- IoT makes the performance tracking and tracing of sustainable assets more cost-effective and efficient. The availability of large quantities of cheap performance data enables real-time monitoring and improves future investment decision-making processes.

- The technology underlying big data can increase the use of PAED by pulling vast datasets of non-standardized data from multiple sources, and allow these to be standardized, and presented in ways that make sense for financial users.

	Investment	Incentivizing sustainable choices	Unlocking new sources of finance	Interaction between innovations in the financial sector and real economy
Big data MLAI Mobile platforms	ING Real Estate Finance (EU) digitizes commercial real estate assets and analyzes energy efficiency modifications, which enables lower costs of capital for sustainability loans. Sustainalytics[83] (UK) provide predictive analytics for smart climate investing and cheaper incorporation of environmental, social and economic considerations into investment decision-making. TruValue Labs (US) is a customizable AI-powered engine that helps investors identify sustainable investments they are interested in. It uses machine learning and natural language processing (NLP) to analyze unstructured data in real time, extracting relevant metrics and turning them into material insights for investment decision-making.[84]	Ant Forest (China) creates incentives to green citizens' consumption patterns by using mobile payment platforms, big data and social media. Bundles (EU) has moved beyond the start-up phase to structure long-term financing. It sells washing cycles instead of washing machines, with devices monitoring use and statistics displayed in an app and incentivizes more water efficient washing practices.[85]	Crowdear (Argentina) is a rewards-based crowdfunding platform. The main objective is to unlock new sources of finance to encourage entrepreneurs to focus on projects applying technology to education, health, and environment outcomes.[86] Brazil Innovation Lab for Climate Finance crowds in innovative sustainable investment solutions, many of which leverage digital finance. For example, Community Solar, is an online marketplace of community solar and wind projects that connects energy consumers paying a monthly rent and investors receiving the fee.[87] Cleantekmarket's (Australia) platform connects clean technologies projects and organizations with finance and other market participant.[88] EcoCrowd[89] (Germany) is a crowdfunding platform specialized in green projects and sustainable initiatives. EcoFinance's[90] (Russia) online service allows the under-banked to send loan applications via SMS or the web, with funds accessible in minutes. YOLK[91] (South Korea) used crowdfunding to raise finance for a solar charger. StartMe (South Africa) enables entrepreneurs, schools and communities to utilize a crowdfunding platform to raise funding for projects. The incubator the Swave (France), dedicated to Fintechs, is explicitly working on how to reorient financial flows toward a greener economy.[92]	Canada plans to invest US$950 million in supercluster innovation centers to develop AI solutions applied to supply management systems, which will have a ground-breaking impact on sustainable and inclusive economic growth.[93] BioMachines (Indonesia) is helping with sustainable cocoa farming by using sensor technology to gather environmental data from laboratory and field-based experiments, and enable knowledge transfer to cocoa farmers. Such data driven practices can unlock access to finance for farmers.[94] Simpa Networks (India) uses a rooftop leasing model made possible with mobile payments and control technology to unlock investments in solar home solutions for last mile markets.[95] Telecom Italia (Italy) is building a new wireless network for IoT. Smart meters for homes and utilities are expected to be among the first devices to be connected in order to improve water and electricity consumption.[96] Sustainable Smart Cities Project (Japan) helps to better balance demand and supply side across various sectors, making infrastructure investment more efficient by limiting large scale investment in the supply side.[97] Mexico City (Mexico) is using a "Smart grid" system which includes traffic management and incident detection, operating 20,000 sensors and cameras around the city. It has helped reducing electricity theft. Disaster and environmental monitoring are also included to keep supplying data into making the city even smarter.[98] Istanbul (Turkey) has deployed the "Smart Cities" to implement IoT technologies to improve transportation administration and the environment, which will transform infrastructure financing.[99]
IoT	The Shenzhen Green Finance Committee (China) is piloting the use of blockchain and IoT chips embedded in green assets to digitize the green certification and verification process.			
Blockchain	Nespresso (France) has launched a blockchain-based register to track climate-positive actions to share positive social and environmental impacts with shareholders.[100] The Islamic Development Bank (Saudi Arabia) plans to use blockchain to develop sharia-compliant products, to meet demand from Muslim investors, with firms from Indonesia to Canada, and allowing instantaneous clearing and settlement of transactions and assets exchanges.[101]		The Institute for Technological Research SystemX in and the Caisse des Dépôts (France) have worked on the use of blockchain to support the development of the green bond market in a much more automated and digitalized manner.[102]	

b. Digital Finance and Sustainable Choices

Digital finance is demonstrating its potential to increase the involvement of citizens in their roles along the financing value chain. Digitalization of purchasing decisions can influence consumers' behavior by reducing search costs in selecting products and services that align to their personal values. Similarly, digitalization can also facilitate access to very different sustainable investment options. Such opportunities are facilitated by the growing deployment of the IoT that provides low-cost data on sustainability impacts. Combined with social media, windows for awareness and mobilization campaigns are created enabling consumers to make finance-related choices more aligned to sustainable development outcomes. For example, the Ant Forest mobile application in China creates incentives for green consumption patterns at scale by using a mobile payment platform, big data and social media.[103] Leveraging MLAI, the company Impacton makes proven sustainable solutions available to citizens and groups interested in financing replications in new locations.[104] Changes in citizen the demand for more sustainable investment and consumption products in turn influences the development of such products and patterns. Digital technologies can further unlock financial incentives that reward sustainability in supply chains. By providing more detailed and reliable information about the environmental impact of companies' supply chains, IoT and blockchain can help financial institutions incentivize sustainability through the supply chains.

As pension and insurance policyholders, citizens can be more easily informed. As a result, they can demand and be offered more choices for the deployment of their long-term savings, taking sustainable development preferences into account. Similarly, digitalization provides citizens with greater opportunities to engage more directly in lending through the growing number of crowdsourcing and P2P platforms, as well as becoming more effective borrowers to advance sustainability-aligned small businesses.

c. Digital Finance and New Sources of Sustainable Finance

Crowdfunding and P2P platforms provide low-cost access to finance through mass collaboration. This is of particular relevance for SMEs, which according to the IFC, account for about 90% of business and more than 50% of employment worldwide, and are key engines of job creation and economic growth in developing countries.[105] Such platforms, when consumer protection and financial stability issues are carefully addressed, could well enhance the benefits sought in Chapter 2 as they complement or enhance the capital offer by the PE/VC market, facilitating SMEs' access to a new pool of 'bottom-up' investors and finance.[106]

Big data, AI and automation have also enabled new providers to offer targeted and more convenient services that transform credit evaluation, offering loans to a broader base of customers and businesses. For example, Mercado Crédito in Argentina analyzes more than 400 variables in order to provide loans to small enterprises that usually cannot get credit from big banks in order to unlock innovation for social impact.[107]

Online investment platforms are also creating marketplaces bringing together and matchmaking sustainable technology businesses with finance and other market participants. Such platforms, which offer a combination of curated deal flow, data on deals, and AI to match investors to their preference, are helpful to both the PE/VC ecosystem and institutional investors. For example, Cleantekmarket in Australia is an online ecosystem that enables any organization active in the cleantech sector to connect with others and access finance through its platform.[108] Convergence Finance has developed an online platform that generates blended finance data, intelligence, and deal flow to increase private sector investment in emerging markets by allowing investors to quickly search databases for credible deals.[109] Another example is the Groundup Project, a Swiss-based financial technology company that offers a deal sourcing platform for impact ventures leveraging AI. It standardizes and validates information about impact ventures, provides insights into business risk and reward, visualizes trends and aggregated data.[110]

Bearing in mind these opportunities, it is crucial to note the importance of expanding access to sustainable finance products. Digital technologies within the financial inclusion agenda are understood in terms of their role in increasing access to financial services, which is covered by the work of the Global Partnership for Financial Inclusion (GPFI). [111] Under Argentina's Presidency, the GPFI focused on how digitization could be a tool to financially include those individuals and small businesses operating in the informal economy.

d. Digital Finance and Innovations in the Financial and Real Economy

Digital finance also facilitates new investment configurations and business models, which PE/VC funds are particularly well suited to scaling. The following are some current examples:

- Off-grid energy services: One of the most well-known examples is mobile payment platforms enabling off-grid companies with new sustainable business models on solar assets. This enables payments to be adjusted to the cash profile of low-income groups, while smart technology (including low-cost chips, circuits and IoT) articulated into cleantech products eases remote regulation of the use and functionality of solar devices. For example, Simpa Network in India uses a rooftop leasing model enabled by mobile payments and control technology to unlock investments in solar home solutions for last-mile markets. This model creates opportunities for company receivables to be securitized for institutional investors.

- Circular business models: Digital finance has also unlocked sustainable business models arising from the interactions between the circular and sharing economy. These could be well suited for PE/VC allocations. This includes the sharing model (which enables companies to maximize value creation), the resource recovery business model (which recovers and reuses resource outputs, eliminating leakages), and the product life extension model (which reduces waste and creates new sources of revenue).[112] Data, real-time transactions and the inherent scalability of

digitally enabled business models help mitigate some risks for PE/VC investment.

- Insurance sector: IoT and machine learning unlock 'usage-based insurance', allowing pricing to be based on actual behavior rather than on traditional factors like location. This may however, undermine the insurance model of risk pooling, leaving some groups without access to insurance. Environmental IoT sensors with two-way communication also provide predictive alerts on potentially dangerous conditions, improving insurers' loss ratios.[113]

Indeed, IoT deployments can have positive effects on a wide range of sustainability goals. According to the WEF, an analysis of more than 640 IoT deployments showed that 84% of existing IoT deployments can address the SDGs, even though the impacts on sustainability were not their main driver.[114] The impact of IoT is significant because at its core, IoT is about collecting data, measuring and remote controlling previously unconnected 'things', reaching people and objects that other technologies could not, which unlock new opportunities for financing. Sensors and cloud-based analytics can be used to evaluate the performance of operations and maintenance techniques, enabling better informed capital planning for infrastructure investments. With estimates that the average annual number of connected IoT devices worldwide will reach 125 billion by 2030, IoT could play a significant role in encouraging financing for sustainable development.[115]

1.2.2 Implications and Unintended Consequences

The mapping of practice across G20 members and the private sector reveal three implications:

- Digital finance's '**data power**' increases the availability and accessibility of accurate, low-cost information that could increase sustainable investments. This power is underleveraged by the financial sector. The extent to which the data unlocked by digital technologies is applied to overcome informational asymmetries is limited. This raises the question about how digital finance can be more widely mainstreamed by the financial sector to increase sustainable investments.

- Digital finance's '**innovation power**' is still mostly at a small scale in sustainable development sectors, making capital deployment in these sectors relatively small. This raises the question about how the real economy can better leverage digital finance to drive innovation that makes investments in sustainable business models, sectors and outcomes more viable at scale.

- Digital finance may create **economic, social and environmental unintended consequences**. Economically, digital finance creates trade-offs in certain industries, which could result in job losses and greater inequalities. Socially, the explosion of online platforms raises questions related to the use and protection of consumer data, as well as social exclusion of some minorities.[116] Environmentally, digital technologies may

bring unintended effects if not properly understood and managed, including ecosystem degradation, large water requirements and high energy consumption from global data centers and the use of decentralized ledger technologies.[117]

Table 1: Summary of Illustrative Examples of Digital Applications for Creating Sustainable Assets for Capital Markets and Deploying Sustainable PE/VC

Creating Sustainable Assets for the Capital Markets	
Challenges & Opportunities	Examples of Associated Digital Finance Applications
Lack of, or insufficient awareness of the potential benefits and investments opportunities.	**Big data, machine learning and AI** gather and process large quantities of low-cost data related to environmental and social performance enabling investors to better price environmental risks and opportunities. Greater transparency also empowers citizens to become more active along the financing value chain. As pension and insurance policyholders, they can be more easily informed and, as a result, demand and be offered more choices for the deployment of their long-term savings, taking sustainable development preferences into account. *Example: ING Real Estate Finance (EU) developed a tool using big data to help their borrowers identify the energy improvement measures for their buildings that provided the most attractive financial returns and greatest carbon emission reductions. Based on this information, ING offers lower costs of capital for real estate loans used for energy-efficient modifications. Such green commercial loans could be repacked into green commercial mortgage-backed securities or other bundling for sale to institutional investors via the capital markets to help banks free up capacity.*
Sustainability classifications and taxonomies: Risk of 'greenwashing'; challenges in measuring and validating the 'greenness' of investments **Standards and labels:** Lack of, or underdeveloped certified labels hinders the identification of sustainable loans to be market-refinanced or securitized.	**IoT** provides real time access to large quantities of cheap performance data, which makes measuring and tracking the performance of green assets cost-effective and efficient. The decentralized nature of blockchain allows the "greenness" of investments to be verified, traced and audited in a secure, transparent and immutable manner. Combined, these two technologies can reduce the data costs and increase investor confidence in measuring, labeling and verification of sustainable assets. *Example: In China, Beijing Nenglian Zhonghe Technology Co., Ltd. combines IoT and blockchain to create a green asset information service platform for financial markets. Data from green assets is collected through IoT, stored in real-time on the blockchain, and converted into financial information. The characteristics of the blockchain meet the financial markets requirements for asset information that is trusted and traceable, thereby unlocking investment.*
Encourage the development of virtual tech platforms that bring together sustainable assets and investors.	Online investment platforms are creating marketplaces bringing together and 'matchmaking' sustainable technology businesses with finance and other market participants. Such platforms offer a combination of curated deal flow, data on deals, and AI to match investors to their preference. *Example: Convergence Finance has developed a platform that generates blended finance data, intelligence, and deal flow to increase private sector investment in global development in emerging markets. By allowing investors to quickly search databases for credible deals or investors that match their investment needs, the Convergence platform broadens investors' networks and simplifies their screening process.*

Developing Sustainable Private Equity and Venture Capital	
Challenges & Opportunities	Examples of Associated Digital Finance Applications
High risks associated with new sustainable technologies/business models.	**Mobile payment platforms combined with IoT** have unlocked new business models, including 'product-as-a-service'. This business model allows customers to use products through a lease or pay-for-use arrangement versus the conventional buy-to-own approach. Payments can be adjusted to the cash profile of the poor, while smart technology makes it easy to remotely regulate the use and functionality of devices. Such models make investments in sustainable technologies commercially viable. *Example: Simpa Network in India uses a rooftop leasing model made possible with mobile payments and control technology to unlock investments in solar home solutions for last-mile markets. As customers build up a financial track record, such companies are able to offer financing for consumers for other products. This model does create opportunities for company receivables to be securitized for institutional investors.*
Lack of definition, standardization and verification of sustainable technologies/business models. A lack of standardized verification for what constitutes a sustainable way of investing and consistent environmental and social risk management standards and practices	Leveraging vast amounts of data, **machine learning and AI** facilitate the development of environmental, social and economic rating methodologies, benchmarking, and scorecards, which enables more efficient and transparent integration of ESG considerations into investment decision-making. *Example: Sustainalytics in the UK leverages big data and AI to provide cheaper incorporation of ESG considerations into investment decision-making. Sustainalytics' data services enable investors to integrate environmental and social research into their internal or third-party systems (such as Bloomberg). Data delivery is automated and allows the creation of databases, reports and dashboards to facilitate data analysis and decision-making.*

1.2.3 Challenges

Several generic challenges can prevent the application of digital technologies to sustainable finance at length. First, weak digital infrastructure, such as high-cost and unreliable broadband connectivity falls short to allow or support the benefits that digital finance can offer. Second, high technology costs, risks and limited robustness reduce the potential of scale. Technologies such as blockchain and IoT are still in proof of concept stage. Reaching consensus in bitcoin-like blockchain networks comes with high energy costs, which limit scalability.[118] Similarly, throughput capacity for blockchains is very small[119] and networks operate in isolation. Further, as the number of devices connected to the Internet scale, so will the potential of cyber risks.

In addition to these generic challenges, specific challenges playing out in developing sustainable digital finance are:

- *Limited awareness and understanding of digital technologies and their interplay with sustainable finance:* Research that teases out the full potential and risks of digital finance to enhance the mobilization of sustainable finance, particularly with regard to specific thematic areas, is still in its early stages. The combination of sustainable finance, which

is relatively new, with digital finance, which is rapidly changing, creates gaps in understanding the nexus between the two areas.

- *Limited availability, quality and use of sustainability-related data for financial decision-making:* Large data sets, notably of environmental performance data may not be available, or at the quality required for financial investment decisions. Adoption may be slow due to the lack of standards and methodologies for translating behavioral data into environmental performance data. There are also costs to adoption and limited capabilities to analyze such data to make investment decisions.

- *Nascent business models:* Many sustainable technology providers currently testing and providing solutions are start-ups, which have a higher risk of failure. For larger market players, sustainable IoT implementation comes from company 'innovation' budgets, and it will take time before mainstream larger business budgets to convert these into large scale deployments.[120]

1.3 Voluntary Options for advancing sustainable digital finance

As the mapping shows, new opportunities are emerging to better leverage data and the innovation potential of digital finance for sustainable finance at scale. The following options come up as helpful steps in realizing the potential benefits of these opportunities at scale:

1. Raise awareness about the potential, opportunities and risks of the application of digital technologies to sustainable finance

    - *Governments, international organizations and think tanks could take forward a comprehensive research agenda.* The goal of such an endeavor would be to provide greater levels of granularity on specific areas of sustainable digital finance that respond to the analytical needs of various stakeholder groups. Such research questions could include: How can digital technologies accelerate advances in specific areas of environmental and social impact or in the achievement of targets under specific SDGs? How can digital technologies help financial institutions better identify, analyze and integrate environmental and social risks into financial decision-making? How can financial centers leverage digital finance to improve sustainability? How can digital finance transform the future of financing for new sustainable infrastructure business models? What are the risks or unintended consequences of sustainable digital finance?

    - *New and existing multi-stakeholder engagement platforms could be co-convened*. The financial sector, policymakers, sustainable development experts and the fintech community could be convened to look at national or regional sustainable finance strategies through a digital finance lens and fintech strategies through a sustainable finance lens. Specific work streams within national platforms could catalyze dynamic forces for change. For example, a 'green bond tech' task force could enable green bond issuers to join forces with big data, AI and blockchain

experts to identify opportunities for technology to reduce costs and scale green bonds. National platforms would also be able to raise awareness about the value of environmental data and increase demands by citizens for greater integration of sustainability considerations into investment decisions by pension funds, asset managers and banks. As a number of national platforms emerge, a network could be created to improve cross-border learning and sharing.

- *International cooperation could continue the momentum created by the G20 SFSG on the topic of digital technologies and sustainable finance*. Such cooperation could take place between national governments through existing forums such as the G20. For example, task forces within international forums could look more deeply at cross-border challenges, risks and opportunities. Work at the international level would create the high-level visibility needed to engage industry players, particularly large multinationals with inherent capacity to scale, and small innovative companies. International multi-stakeholder platforms could promote cross-border sharing, identify new opportunities to develop and deploy sustainable digital finance solutions and scale best practice pilots across countries. Such platforms would also be better equipped to link environmental research mitigating the carbon intensity of the blockchain with innovative pilots leveraging blockchain to enhance the mobilization of sustainable finance.

2. Explore the relevance of supervisory arrangements for applying digital technologies to sustainable finance.

    - *Foster close interactions between innovative sustainable digital finance solutions and regulators/supervisors.* This would help ensure that supervisors are on-boarded appropriately and as early as possible in the development and life cycle management of these applications. A level playing field has to be assured (same risks, same rules). Existing mechanisms could be leveraged to achieve such interactions.

3. Encourage investment in digital technologies that advance sustainable finance, such as technologies that improve the assessment and availability of sustainable finance-related data.

    - *Encourage the integration of sustainability elements into the existing fintech ecosystem.* One way to support this can be by launching competitions, hackathons, incubators and accelerators that focus specifically on crowding in solutions related to sustainable business models.

    - *Improve the visibility and transparency of new fintech solutions.* The creation of specific labels that better define sustainable digital finance solutions could facilitate the identification of such solutions as well as provide greater transparency around their benefits and impacts.

    - *Define the requirements to scale innovative pilots using blockchain and IoT to address information asymmetries and lower information search*

costs. This would enable stakeholders to identify constraints, required partnerships and potential solutions early on, increasing the likelihood of scale, which in turn facilitates uptake by institutional investors.

- *Develop more standardized tools and instruments for translating a wide range of financial transaction data into environmental data*. This would help encourage investment is sustainable digital solutions that provide consumers with information about the environmental and social impact of their purchasing decisions. As a result, consumers would find it easier to make well-informed decisions and opt for sustainable choices. Currently the methodology for translating financial purchases data into environmental data is limited.

- *Create new financial products that are easily accessible online and through mobile applications* (*e.g.* online retail sustainable bonds) *within the applicable legal framework for investment services*. This can increase citizen involvement in the sustainable investment value chain.

- *Scale virtual tech platforms that bring together sustainable assets and investors within the applicable rules on trading facilities.* This type of leapfrogging technology could allow emerging markets' banks to renew and refresh their balance sheets to sustainable investors and therefore allow for additional balance sheet capacity to underwrite new sustainable loans. Many young and innovative firms, driven by entrepreneurs, could grow this opportunity, especially if sustainable VC is more widely available. Further, local and federal governments could provide the environment for these companies to grow and succeed.

CONCLUSION

The findings that have emerged from the SFSG's stocktaking and analysis together with the voluntary options developed under Argentina's G20 Presidency can help countries in their efforts in deploying sustainable finance.

Specifically, it can be useful to make available the considerable source of long-term capital from institutional investors for the refinance of the growing pool of sustainable loans on banks' balance sheets; to overcome the lack of funding for the development of sustainable technologies and of sustainable business models by early-stage companies and SMEs; and to tap on the opportunities arising from current applications of digital technologies to facilitate the deployment of sustainable capital across asset classes.

ENDNOTES

[1] The survey is based on an analysis of the activities of 209 of the world's leading impact investing organizations, including fund managers, foundations, banks, development finance institutions, family offices, pension funds, and insurance companies.
[2] On a national level, each GSG's National Advisory Board has the responsibility to do the market sizing at least every 3 to 5 years.
[3] Green Finance Study Group (2016). Synthesis Report. http://unepinquiry.org/wp-content/uploads/2016/09/Synthesis_Report_Full_EN.pdf
[4] Green Finance Study Group (2016). Synthesis Report. http://unepinquiry.org/wp-content/uploads/2016/09/Synthesis_Report_Full_EN.pdf
[5] Most banks are financed by a combination of on-demand and short-term fixed deposits and corporate borrowings from other financial institutions or via commercial paper. Few of these forms of bank financing meet the long-term tenors of many sustainable finance investments such as infrastructure (hedging is required). Hence, there is often a maturity mis-match or the extra cost of a hedge.
[6] Green Finance Study Group (2016). Synthesis Report. http://unepinquiry.org/wp-content/uploads/2016/09/Synthesis_Report_Full_EN.pdf
[7] Green Finance Study Group (2016). Synthesis Report. http://unepinquiry.org/wp-content/uploads/2016/09/Synthesis_Report_Full_EN.pdf
[8] There is no univocal definition of the "sharing economy" or "collaborative economy" or a uniform description of its comprehensiveness. Furthermore, there is limited research done so far on its environmental impacts. Yet, there are some studies that show that there are elements of the sharing economy that could enhance the sustainability features of businesses or the economy. For example, it allows for the 'optimization of usage', implying that the waste of other important values such as time (*e.g.* with sharing cars or tools) or space (*e.g.* AirBnb) is minimized (http://sustainablefinancelab.nl/wp-content/uploads/sites/232/2016/04/FinanCE-Digital.pdf). Also, environmental impacts are very dependent on the type of collaborative business model studied, and the type of 'traditional' transaction it is compared to (https://publications.europa.eu/en/publication-detail/-/publication/8e18cbf3-2283-11e8-ac73-01aa75ed71a1/language-en/format-PDF/source-68097620).
[9] This is inclusive of large infrastructure projects that are often underwritten by a consortium of banks and following the end of construction permanent financing put in place via a syndicated bank loan.
[10] OECD (2017). Mobilising Bond Markets for a Low-Carbon Transition, Green Finance and Investment. http://dx.doi.org/10.1787/9789264272323-en
[11] Carney, M. (2016). The Sustainable Development Goal imperative. https://www.bis.org/review/r160523b.htm
[12] *Ibid.* Currently less than 1% of institutional investor's holdings are green bonds.
[13] Many institutional investors, such as pension funds and insurances companies have long-term structured liabilities tied to their clients and their retirement needs. These liabilities are well suited for long-term secure assets such as sustainable debt.
[14] Although some banks can hold long-term debt (especially state-owned or guaranteed), many rely upon on demand deposits and short/mid-term corporate financing to fund their balance sheets. Hence, there is a general maturity mismatch between many sustainable investments and many banks.
[15] Many debt capital market products such as asset-based securities and covered bonds have a long history with certain debt assets such as credit card receivables, auto loans or corporate loans. However, these products have not been used for sustainable debt assets. Hence, they can be "re-purposed" to advance sustainable lending.
[16] Carney, M. (2016). The Sustainable Development Goal imperative. https://www.bis.org/review/r160523b.htm
[17] An OECD contribution in 2016 to the G20 Green Finance Study Group, "Progress Report on Approaches to Mobilising institutional Investment for Green Infrastructure", includes 33 examples of green infrastructure investments involving both institutional investors and the public sector (including public financial institutions) and provides conclusions on how governments are helping to mobilize institutional investment in green infrastructure. This database has been updated for 2018 and includes more than 140 transactions.
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[33] Including investment funds and asset managers
[34] Including OECD asset owners (Penson funds insurance companies, and global public pension reserve funds), and excluding investment funds, as of December 2016. Source: OECD Global Pension Statistics, Global Insurance Statistics and Institutional investors databases and OECD staff estimates.

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[54] See: https://www.gov.uk/guidance/green-finance#green-finance-taskforce

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