FINTECH, GREEN FINANCE AND DEVELOPING COUNTRIES

May
2017

Inquiry: Design of a Sustainable Financial System

UN environment

GreenInvest

GreenInvest was established at the G20 Leaders Summit in Los Cabos, Mexico, in 2013 to accelerate investment in green priorities in developing countries. Since then, green finance has risen up the agenda of both policymakers and markets. GreenInvest has been re-launched under the German G20 Presidency to strengthen the connection between green finance momentum and the insights, innovations and needs of developing countries. It aims to become the G20 platform for promoting policy dialogue, leadership and public-private initiatives with and for developing countries in advancing the mobilization and mainstreaming of green finance in the context of broader sustainable development objectives.

GreenInvest is financially supported by the German Federal Ministry for Economic Cooperation and Development (BMZ) and implemented by the UN Environment Inquiry.

For more information on GreenInvest, please contact *simon.zadek@unep.org*.

The UN Environment Inquiry

The Inquiry into the Design of a Sustainable Financial System has been initiated by the United Nations Environment Programme (UN Environment) to advance policy options to improve the financial system's effectiveness in mobilizing capital towards a green and inclusive economy—in other words, sustainable development. Established in January 2014, it published the first edition of 'The Financial System We Need' in October 2015, with the second edition launched in October 2016. The Inquiry has worked in 20 countries and produced a wide array of briefings and reports on sustainable finance.

More information on the Inquiry is at: *www.unep.org/inquiry* and *www.unepinquiry.org* or from: Ms. Mahenau Agha, Director of Outreach *mahenau.agha@unep.org*.

Reference material

Report of the Initial GreenInvest Consultation (Singapore Consultation): *http://unepinquiry.org/wp-content/uploads/2017/04/GreenInvest_Platform_Singapore_report.pdf*

Fintech and Sustainable Development – Assessing the Implications: *http://unepinquiry.org/publication/fintech-and-sustainable-development-assessing-the-implications*

The Financial System We Need: From Momentum to Transformation: *http://unepinquiry.org/publication/the-financial-system-we-need-from-momentum-to-transformation*

UN Environment and the World Bank Group, Roadmap for a Sustainable Financial System: *http://unepinquiry.org/publication/roadmap-for-a-sustainable-financial-system/*

Comments are welcome and should be sent to *chad.carpenter@me.com***.**

Briefing Note – Fintech, Green Finance and Developing Countries

Green Finance and Developing Countries: New Opportunities

30-31 May 2017, Berlin

Context

Green finance is a strategy for financial sector and broader sustainable development that is relevant around the world. But the context differs considerably for different countries. Developing countries, notably those with underdeveloped financial systems, face particular challenges in financing national development priorities.

Financial development shapes the context for green finance. Different sources of capital and financial institutions are particularly relevant in different countries. Financial systems in developing countries tend to be characterized by a dominant banking sector, and have large areas of the economy that remain unserved by the formal financial sector. Public finance and foreign direct investment can be particularly important as sources of long-term investment.

GreenInvest – established at the G20 Leaders Summit in 2013 – seeks to strengthen the connection between green finance momentum and the insights, innovations and needs of developing countries. It aims to promoting policy dialogue, leadership and public-private initiatives for developing countries in advancing the mobilization and mainstreaming of green finance in the context of broader sustainable development objectives.

The GreenInvest platform was relaunched under Germany's G20 Presidency at the Singapore Consultation in January 2017, which gathered participants from non-G20 developing countries, G20 countries, international organizations and the key networks on green and inclusive finance. The consultation launched a dialogue on topics such as international initiatives on sustainable finance, developing country contributions to the Financial Stability Board (FSB) Task Force on Climate-related Financial Disclosures, the greening of foreign direct investment (FDI) and the nexus between green finance and financial technology (fintech) – specifically for developing countries – as a policy and market opportunity.

The Berlin Workshop will advance these discussions by exploring two topics essential to the goal of mobilizing and mainstreaming green finance, and the achievement of broader development goals:

- How to maximize the positive impact of financial technology on green finance;
- How to 'green' foreign direct investment flows to and among developing countries.

This briefing note outlines the emerging themes from the background paper for the workshop, as well as possible next steps and questions to focus the discussions.

The draft background paper on fintech will also be made available for the workshop. The paper explores the potential impact of fintech on sustainable development in developing countries. It examines the potential benefits and risks of fintech for developing countries as they consider green and inclusive reforms – what do we know, what do we not know, what actions can be taken to make sustainable policy decisions. The draft background paper will be revised following the workshop.

Emerging Themes – What Have We Learned So Far?

Financial technology – 'fintech' – has emerged as a powerful disruptor that is rapidly reshaping the financial sector on a global scale. By changing the way people pay, lend and invest, fintech could challenge the viability of the financial sector, as well as its policies, regulations and norms. The breadth of fintech's transformative potential for sustainable development is increasingly understood and appreciated. Fintech is therefore not just another topic in the green finance space – it is transforming the future of the financial system itself. Furthermore, an enormous financial prize may be in store for countries that can successfully manage the opportunities and challenges arising from fintech.

Fintech could amplify the potential for leapfrogging – and developing countries are charging ahead

Fintech could potentially impact developing countries' strategic priorities and help them leapfrog over many stages of development. Accordingly, they are now leading the way on using fintech to promote green, sustainable finance. Many innovations have emerged in developing nations such as Kenya, Bangladesh, Mongolia, Colombia, Chile and Peru. In addition, a wide range of potentially scalable cases of fintech-powered financial services that will impact sustainability are under way, as noted in the Inquiry's recent paper " Fintech and Sustainable Development – Assessing the Implications" and the draft background paper for the Berlin workshop. Fintech is being used for everything from renewable energy funding and pollution reduction to environmental policy design and citizen engagement.

Fintech can also provide a benefit for small and medium-sized enterprises (SMEs), which have an untapped potential to create sustainable livelihoods and deliver economic growth. They can represent up to 95% of an economy while providing up to 70% of jobs and delivering on average 50% of GDP. In developing countries, fintech innovations – crowdfunding, crowd-lending, mobile payments, deal-sourcing platforms and other financial technologies – could help SMEs bypass traditional finance by bringing entrepreneurs closer to their funders, diversifying the types of funding and multiplying the channels for allocation.

But fintech comes with considerable risks and dangers

For all its promise, fintech also presents risks and dangers for developing countries at all levels of development – from emerging economies with sophisticated financial markets to small and vulnerable countries with poorly developed financial markets and a strong dependence on outside capital. Fintech could give rise to problems such as illegal financial transactions and other unwanted actions.

Taking action in the face of uncertainty

Figuring out whether and how to intervene becomes even more difficult when set against the potential unintended consequences. Technological developments have shattered many boundaries and undermined the concept that financial and capital markets are a separate, distinct system. Financial markets are already complex, and digital technology grows more advanced by the day – together they threaten to become overwhelming for policymakers, who need to vigilantly manage fintech's impacts on the financial stability of their country.

There are nonetheless many actions that developing countries can consider. These include policy and regulatory developments, institutional developments, capacity building, improved access to information and the utilization of best practices. Policymakers may need to reflect on action areas such as: integrating fintech for green finance into their development plans and roadmaps; enhancing the role of the private sector in using fintech for sustainable development; preparing their regulatory agencies to

adopt and use fintech; increasing public education and engagement; enlisting universities and academia for research; and pursuing international cooperation to develop the rules of the game.

Developing country policymakers should also consider taking a joint approach to fintech and green finance. Together they could strive to "connect the dots" of the complex, evolving fintech landscape.

Fintech vs Techfin

The complex fintech landscape could be understood as having two types of actors – fintech and techfin. 'Fintech' refers to technology companies jumping into the financial domain and applying new technologies to radically alter the financial landscape. In contrast, 'techfin' refers to companies adapting existing financial capabilities to the technology wave – a less disruptive, incremental approach. These actors can face different levels of regulation, types of investors, and levels of risk. Developed and developing countries should consider which actor is best suited for their economic development pathway. This may require reflection on the different types of capital, types of risks and the range of technologies that would be involved.

Next steps

Policymakers need to assess the potentially enormous benefits of fintech, along with any attendant threats, and take action to steer these innovations toward a green and sustainability economy.

The transition to digital technologies will require action on many fronts at once – early, deliberate steps to reshape capitalism to rebalance economic inequalities, while at the same time making progress on challenges such as climate change and the 2030 Sustainable Development Agenda.

Discussion questions

- Fintech may be laying the groundwork for the future infrastructure of the financial system – but faster and cheaper does not always mean 'greener'.
    - What steps are needed to make digital finance more 'green sensitive' – at the international, national and local levels?
    - What actions are most beneficial for developing countries?
- How do the distinctions between 'fintech' and 'techfin', respectively, help ensure that environmental and sustainability concerns are integrated into the future financial system?
- How can fintech innovators be encouraged to join the global transition to more sharing, accessible, cleaner, greener, sustainable economies for our common future?
- What can fintech do to help communities make more sustainable decisions?
- Can fintech help build more geographically distributed communities, encourage trust relationships and create peer-to-peer marketplaces?
- How will technologies such as blockchain help to rebalance economic power between large and small/micro producers?
- Numerous organizations work with green entrepreneurs (designing business plans, providing seed funds, raising awareness on green products and services, etc.). Can fintech help these green businesses move closer to potential investors?

- Can fintech help aggregate and connect portfolios of green SMEs that have viable projects in energy, agriculture, transportation, water, waste, and other sectors?
- How could the potential of crowdfunding be maximized in the developing world?

Contents

Highlights

Financial technology – 'fintech' – has emerged as a powerful disruptor that is rapidly reshaping the financial sector on a global scale. By changing the way people pay, lend and invest, fintech is challenging the viability of the modern financial sector, as well as its policies, regulations and norms. Policymakers need to assess the potentially enormous benefits of fintech, along with any attendant threats, and take action to steer these innovations toward sustainable development.

The 2030 Agenda for Sustainable Development and the Paris Agreement on climate change will require strong collective action – and the mobilization of finance for sustainable investment is one of the most urgent components. These global goals are estimated to require an unprecedented mobilization of both public and private finance, some US$90 trillion over the next 15 years.

The transformative potential of fintech for sustainable development is increasingly understood and appreciated. Although in the early stages, this power is being harnessed to build bridges between financial and environmental benefits, and provide a foundation for identifying and creating profitable green savings and investment opportunities. Fintech is not just another topic in the green finance space – it is a lens on the future of the financial system itself.

Fintech could impact developing countries' strategic priorities and help them leapfrog over many stages of development. Given that trillions of dollars that will be needed to finance sustainable development, it is essential that policymakers assess and consider leveraging opportunities presented by fintech to contribute to the greening of the global financial system and achieving a sustainable future for humanity.

Fintech applications can also be a beneficial for SMEs – they have an untapped potential to create sustainable livelihoods and deliver economic growth. In developing countries, fintech innovations – crowdfunding, crowd-lending, mobile payments, deal-sourcing platforms and other financial technologies – could help SMEs bypass traditional finance by bringing entrepreneurs closer to their funders, diversifying the types of funding and multiplying the channels for allocation.

Developing countries have been leading the way on using fintech to promote green, sustainable finance. Many innovations have emerged in developing nations such as Kenya, Bangladesh, Mongolia, Colombia, Chile and Peru, rather than wealthier developed nations. A growing number of potentially scalable cases of fintech-powered financial services for sustainability are under way.

An enormous financial prize may be in store for countries that can successfully manage the opportunities and challenges arising from fintech. Some studies estimate that investments in fintech companies have more than tripled to US$12 billion from 2013 to 2014, outpacing the overall growth in venture capital investments by 140 percent. Likewise fintech-led financial inclusion is also yielding huge benefits, possibly boosting the GDP of emerging economies by 6% in 2025 against baseline growth, corresponding to US$3.7 trillion in GDP.

For all its promise, fintech also presents risks and dangers for developing countries at all levels of development – from emerging economies with sophisticated financial markets to small and vulnerable countries with poorly developed financial markets and a strong dependence on outside capital. Fintech could give rise to problems such as illegal and illicit financial transactions, money laundering, fraud and criminality, tax evasion and other unwanted actions.

Developing country policymakers should consider taking a joint approach to fintech and green finance – together they could strive to "connect the dots". However, the challenges are many: figuring out whether and how to intervene becomes difficult when set against the potential unintended consequences. In addition, technological developments have shattered many boundaries and undermined the concept that financial and capital markets are a separate, distinct system. Financial markets are already complex, and digital technology grows more advanced by the day – together they threaten to become overwhelming for policymakers, who need to vigilantly manage fintech's impacts on the financial stability of their country.

There are many actions that developing countries can consider. These include policy and regulatory developments, institutional developments, capacity building, improved access to information and the utilization of best practices. Policymakers may need to reflect on key action areas such as: integrating fintech for green finance into their development plans and roadmaps; enhancing the role of the private sector in using fintech for sustainable development; preparing their regulatory agencies to adopt and use fintech; increasing public education and engagement; enlisting universities and academia for research; and pursing international cooperation to develop the rules of the game for fintech.

As developing countries consider possible actions, it may be helpful distinguish the two types of actors currently on the scene -- fintech and techfin. 'Fintech' refers to technology companies jumping into the financial domain and applying new technologies to radically alter the financial landscape. In contrast, 'techfin' refers to companies adapting existing financial capabilities to the technology wave – a less disruptive, incremental approach. These actors can face different levels of regulation, types of investors, and levels of risk. Developed and developing countries should consider which actor is best suited for their economic development pathway. This may require reflection on the different types of capital, types of risks and the range of technologies that would be involved. (*Note: this concept will be further developed following the workshop*).

UN Environment, through its Inquiry into the Design of a Sustainable Financial System, is working to better understand the potential of fintech to speed the transition to a greener and more inclusive financial system. The Inquiry has recently published "Fintech and Sustainable Development: Assessing the Implications", which identifies a host of ongoing experiments, and options for scaling and furthering innovation in leveraging fintech for environmental gains.

Digital technologies may soon provide societies with new ways to do virtually anything. Policymakers therefore need to find ways to channel the energy of fintech into the service of a green and sustainability economy. This calls for leadership that can take the world to the next level – to make the full transition to digital technologies, to reshape capitalism to rebalance inequalities, and to make tangible progress on climate change. With this, leaders can continue to lay the groundwork for the digital, global and sustainable civilization they urgently seek.

This discussion paper seeks to inform the GreenInvest Platform in its exploration of the potential impact of fintech on sustainable development in developing countries. It examines the many potential benefits and risks for developing countries – what do we know, what do we not know, what action can be taken to make green and sustainable policy decisions on fintech.

1 The Fintech Revolution

Financial technology – 'fintech' – has emerged as a powerful disruptor that is rapidly reshaping the financial sector on a global scale. Multiple forms of fintech – mobile payment platforms, high-frequency trading, crowdfunding, virtual currencies, blockchain, peer-to-peer (P2P) lending – are transforming the financial landscape, as part of a broader technological revolution that includes 'big data', machine learning and artificial intelligence, and the 'Internet of Things'. By changing the way people pay, lend and invest, fintech could potentially threaten the viability of the financial sector, as well as its fundamental policies, regulations and norms. Policymakers need to urgently assess the potentially enormous benefits of fintech, along with any attendant threats, and take action to steer these innovations toward sustainable development.

Recent multilateral agreements have underscored the urgent need for a global sustainable future. With the 2030 Agenda for Sustainable Development and its seventeen global goals (SDGs) and the landmark Paris Agreement on climate change, world leaders provided a new framework for pursuing global decarbonization and sustainable, climate-resilient development. The Paris Agreement states that temperatures must be held well below 2°C to avoid disastrous climate change and its impacts. Nations also committed to fostering adaptation and resilience, and to making financial flows consistent with resilient, low-carbon development.[1] At the same time, SDG 7 supports the access to affordable, clean and modern energy for all as a crucial prerequisite for development and human well-being.[2]

Achieving these global goals will require strong collective action and cooperation, and the mobilization of finance for sustainable investment is one of the most urgent components. The SDGs and the Paris Agreement will require an unprecedented mobilization of both public and private finance, some US$90 trillion over the next 15 years.[3,4] UNCTAD estimates that there are major financing shortfalls across most efforts to address the SDGs, as much as US$2.5 trillion annually for developing countries.[5] The next five years are therefore crucial for getting this enormous capital reallocation under way. The traditional financial sector may not up to the task of providing the capital for combating climate change; halting the rate of degradation of natural capital or eradicating extreme poverty – considering that less than 1% of global bonds are labelled 'green' and 1% of the holdings by global investors are 'environmentally friendly infrastructure assets'.[6]

Fintech could help accelerate the development of green and inclusive financial markets, and help realign finance to support sustainable development. It offers the prospect of quickening the integration of the financial system with the real economy, which will in turn enhance opportunities for greater decentralization and increased participation. It could also impact developing countries' strategic priorities and help them leapfrog over many stages of development. Recently, fintech has been applied to multiple challenges such as facilitated access to investment capital, domestic resource mobilization at small, medium and large scale, investment in small and medium-term enterprises (SMEs), access to credit, social enterprise and community-level initiatives, and the promotion of mini-credit and mini-insurance. Given that trillions of dollars will be needed to finance sustainable development, it is essential that policymakers assess and consider leveraging opportunities presented by fintech to contribute to the greening of the global financial system and achieving a sustainable future for humanity.

Fintech presents an enormous challenge and opportunity for policymakers – how can they manage the positive and negative aspects of its disruptive power? How can they maximize the opportunities for sustainability while minimizing the risks and unintended consequences? The UN Environment *Inquiry into the Design of a Sustainable Financial System* is working to understand the potential of fintech to

accelerate the transition to a greener and more inclusive financial system. Fintech is not just another topic in the green finance space – it is driving the future of the financial system itself. As spelled out in both editions of its global report, "The Financial System We Need", a sustainable future depends on a reset of the global financial system to ensure that private capital is redeployed to finance the transition to an inclusive, green economy, and that communities are empowered to make sustainable decisions.

The objective of this paper is to contribute to the GreenInvest Platform's discussions on fintech and set the stage for an exploration of the potential impact of fintech on sustainable development in developing countries. It examines the potential benefits and risks of fintech for developing countries as they consider green and inclusive reforms – what do we know, what do we not know, what action can be taken to make sustainable policy decisions.

The Inquiry and Fintech – a growing portfolio of work

The Inquiry is focusing on the policy and practice of fintech and its impact on sustainable development and a green economy with a growing portfolio of activities.

The **Green Digital Finance Alliance** is addressing the potential for fintech-powered business innovations to reshape the financial system in ways that better align it with the needs of environmental sustainability. At its core, the Alliance's members will comprise innovative financial institutions committed to using digital technology to advance green finance in lending, investment, and insurance, and help communities make sustainable choices.

The **GreenInvest Platform** aims to become the G20 platform for promoting policy dialogue, leadership and public-private initiatives with and for developing countries in advancing the mobilization and mainstreaming of green finance in the context of broader sustainable development objectives. Part of this work will focus on the impact of fintech.

The Inquiry is also working with the G7 on greening SMEs and fintech, as well as with the UN Group of Friends and the World Bank Group on fintech and sustainable development.

2 Fintech – Shaping the Global Financial Future

Fintech is rapidly reshaping the world of financial products and services, with new digital technologies offering the prospect of a more efficient, accessible and resilient financial system. Fintech started with digital payment solutions and blockchain technologies that promise to enable the disintermediation of banks and other financial intermediaries. The spectrum of financial technology now includes e-commerce, crowd lending and aggregation platforms, equity crowdfunding, simplified internet-based services in the insurance industry, roboadvisors (digital financial advice based on algorithms) and gamification in the investment space, and peer-to-peer (P2P) lending.

Definitions for a dynamic concept such as fintech can be challenging. The Financial Stability Board (FSB), in its work on fintech, provides a helpful description: "technologically enabled financial innovation that could result in new business models, applications, processes or products with an associated material effect on financial markets and institutions and the provision of financial services".[7] Its impact has been dynamic as well:

- **Financial sector:** Fintech companies and new market activities are redrawing the competitive landscape and blurring the lines between traditional actors. These fintech disrupters can cut costs and improve the quality and usability of financial services, as they are largely unburdened by regulators, legacy IT systems, branch networks, or the need to protect existing businesses. In short, fintech offers solutions that can better address customer needs by providing enhanced accessibility, convenience and tailored products. As clients become accustomed to the digital experience offered by companies such as Google, Amazon, Facebook and Apple, they increasingly expect the same level of customer experience from their financial services providers.
- **Banking:** Fintech has the potential to unbundle of the banking sector's core functions: clearing and settling payments, performing maturity transformation, sharing risk, validating trust and allocating capital. New entrants – payment service providers, aggregators and robo-advisors, peer-to-peer lenders, reputation platforms and innovative trading platforms – are driving this possibility. In consumer and commercial lending, online platforms allow individuals and businesses to lend and borrow between each other. Lending innovation also manifests itself in: alternative credit models, the use of non-traditional data sources, rapid customer-centric lending processes, reduce fraud and significantly lower operating costs.
- **Investments:** The emergence of data analytics has enabled firms to hone in on investors and deliver tailored products and automated investing. Fintech is levelling the information playing field between large and small institutions, as behavioural and predictive algorithms can now analyse transactions in real time. Wealth managers are increasingly using analytics solutions at every stage of the customer relationship. 'Robo-advisors' are already managing US$2.6 trillion of the total US$30.4 trillion of the Exchange Traded Fund (ETF) and mutual fund market.[8] Applications of blockchain technology to traditional capital markets models present the opportunity for alternative, non-traditional trading and investment with greater transparency and automation. Such innovations are providing a new generation of investors with the ability to compare their investments with peer groups and invest in a more socially responsible way.
- **Insurance:** The industry is grappling with changing customer behaviour, new technologies, and new distribution and business models. The sector sees usage-based risk models and new methods for capturing risk-related data as key trends, while the shift to more self-directed

services remains a top priority in order to meet existing customer expectations. A PwC survey shows that self-directed services are the most important fintech-enabled trend.[9] Insurance companies are investing in the design and implementation of more self-directed services for both customer acquisition and customer servicing. This allows them to improve their operational efficiency while enabling online/mobile channels demanded by emerging segments.

New estimates point to the enormous potential to ignite inclusive growth. This year, McKinsey Global Institute for the first time documented the impact of digital finance on economic growth. In its report, the institute argues that widespread adoption and use of digital finance could increase the gross domestic product of all emerging economies by 6 percent, or US$3.7 trillion, by 2025—the equivalent of adding to the world an economy the size of Germany's. The growth in GDP could lead to the creation of up to 95 million jobs.[10]

Fintech innovations are now driving financial inclusion strategies. Technology drove many of the advances in financial inclusion in 2016, from the proliferation of smartphones to new digital solutions for small merchants. Experts have recently noted that Myanmar has leapfrogged ahead of others interoperability, as mobile telephony and mobile money are being introduced at the same time, along with a regulatory framework.[11] In addition, Mexico made progress in supporting small stores in accepting small digital wallet payments. A fintech start-up in Sweden created a smart phone-based way of accepting payments called iZettle, which then generates automated financial reports for the shop. These reports offer insights into customers' buying patterns, saving time and improving sales. Products like Masterpass QR (a code-enabled mobile app), launched in India, Nigeria, and Pakistan this year, allow small merchants to scan the codes to accept digital payments via smartphone.

This combination of fintech innovations could have long-term societal implications. As the recent UN Environment Inquiry report "Fintech and Sustainable Development: Assessing the Implications" argues, blockchain technology (blocks of transactions and 'smart contracts' on an immutable distributed ledger) coupled with machine learning and artificial intelligence (AI – the use of advanced computer science to recognize complex patterns in data) and the 'Internet of Things' (IoT – low cost Internet-connected sensors contained in everyday objects) will lead to revolutionary innovations. Such innovation could build trust, incorruptibility, transparency and traceability in transactions in both the financial system and in the real economy – through entirely new business models such as asset financing models based on real-time accumulated risk versus fixed terms.

The surge of new business models, and a change to the competitive environment in which incumbent banks operate, will create challenges for both regulators and market players. Traditional business models may no longer suffice, and the new norm may require shifting to a model that provides a service wherein clients can acquire advice and interact with all relevant actors through multiple channels. Many institutions are already incorporating new technologies into their own architecture to prepare themselves for a new world, even as new innovations continue to drastically alter the marketplace. Regulators in turn may face many new challenges that exceed their institutional capacities, not to mention their limited government budgets. For both traditional financial institutions and regulators, fintech innovations could require a fundamental shift in identity and purpose.

As developing countries consider possible actions, it may be helpful distinguish the two types of actors currently on the scene -- fintech and techfin. 'Fintech' refers to technology companies jumping into the financial domain and applying new technologies to radically alter the financial landscape. In contrast, 'techfin' refers to companies adapting existing financial capabilities to the technology wave – a less

disruptive, incremental approach. These actors can face different levels of regulation, types of investors, and levels of risk. Developed and developing countries should consider which actor is best suited for their economic development pathway. This may require reflection on the different types of capital, types of risks and the range of technologies that would be involved. (*Note: this concept will be further developed following the workshop*).

3 Fintech through a Green Lens – an Opportunity to Advance Sustainability

Developing Countries – Leading the Way

The digital finance revolution promises a new world – but can it make this new world green and sustainable? Fintech innovations have already demonstrated their disruptive power in many sectors, such as expediting and enabling low-cost financial inclusion. Although in the early stages, this power is now being harnessed to build bridges between financial and environmental benefits, and provide a foundation for identifying and creating profitable green savings and investment opportunities. Fintech is therefore not just another topic in the green finance space – it is a lens on the future of the financial system itself. Indeed, fintech could potentially speed the development of green and inclusive financial markets, and help realign the financial system toward sustainable development.

The transformative potential of fintech for sustainable development is increasingly understood and appreciated. It could help overcome some of the pervasive barriers to deploying private finance for the wider good and improve environmental outcomes. On the supply side, digital finance reduces costs and increases speed. Trine, a Swedish tech start-up, enables savers in Stockholm to profitably fund distributed solar energy systems in rural sub-Saharan Africa. On the demand side, similarly, reduced financing costs and pay-as-you-go access to clean energy opens up new markets, particularly for poorer consumers.

Developing countries are leading the way on fintech and green finance. Many innovations have emerged in developing nations such as Kenya, Bangladesh, Mongolia, Colombia, Chile and Peru, rather than wealthier developed nations. A growing number of potentially scalable cases of fintech-powered financial services are under way:

- **Payments:** In developing countries, the lack of infrastructure has helped mobile phones become the preferred devices to communicate, get information and transfer money. By 2015, more than 270 mobile money services were operating in 93 countries, with an estimated 411 million accounts. In Kenya, 82 per cent of the adult population owns a mobile phone, and many rely on mobile-based transfer systems such as M-Pesa. M-Pesa gives people, who would otherwise be unable to access traditional services, a simple, reliable and fast way of moving and saving money.
- **Energy:** M-Pesa assisted the rise of M-KOPA, which sells household solar lighting systems through an instalment plan paid for via mobile. M-KOPA provides affordable solar power to low-income households on a pay-per-use instalment plan. In partnership with mobile money systems such as M-PESA in Kenya and IoT sensors in each solar array, M-KOPA monitors real-time performance and payment status. M-KOPA aims for 1 million homes in Kenya by 2018.
- **Insuring Risk:** By 2015, over 800,000 farmers in Kenya, Tanzania and Rwanda were insured by the Agriculture and Climate Risk Enterprise (ACRE) and similar vehicles against a variety of weather risks. Scaling this technology through a combination of IoT, blockchain and artificial intelligence could help provide risk coverage to an estimated 1.5 billion smallholder farmers in the developing world against increasing weather volatility.
- **Economic Identity:** BanQu provides a practical, low-cost solution to a severe global crisis – extreme poverty and a burgeoning refugee population. While the estimates vary, the world has over 2 billion people living in poverty and over 65 million refugees. The majority are without a basic identity that legitimizes their existence in society. This lack of identity directly prevents

them from breaking the cycle of poverty. For the millions of refugees, the problem is worse as they move across cities and across borders. BanQu is the first ever blockchain economic identity technology platform and network that enables a secure and immutable platform for creating economic opportunities for people around the world who are refugees and/or living in extreme poverty.

China's largest mobile payment system, Ant Financial Services (Ant), demonstrates how partnership has enabled mobile-based fintech solutions to flourish – while also promoting sustainability. Ant, a related company of Alibaba, is China's largest fintech company, providing financial products and services, such as payments, loans, insurance and wealth management, to 450 million small businesses and individuals. As one of the most popular mobile apps in China, Ant has utilized its platform to enhance public literacy about, and active involvement in, environmental protection and green lifestyle, for example by:

- Working with over ninety asset management companies to sell their green and sustainable investment products, such as public fund products that are linked with green stock indices (stock indices with a significant share of green enterprises).
- Working with the China Beijing Environmental Exchange in developing a carbon accounting scheme for individuals based on transaction data. In August 2016, it launched a CO_2 calculator and offset feature within its Alipay app – which notifies users of the amount of carbon emissions they have prevented by making online payments or other everyday activities such as taking public transport instead of driving. Once a user has accumulated a certain level of carbon emissions, Ant's partner organizations plant a tree in Inner Mongolia, helping to offset the carbon emissions. As of January 2017, one million trees have been planted through the scheme.

New technologies are also improving the monitoring of environmental quality and have made data more freely accessible. Fintech innovations are improving the ability of public authorities to monitor pollution and expanding civic engagement in many areas of environmental policy making, including forest monitoring, water quality assessments, identification of natural hazard risk, and air quality management. A recent report by the World Bank[12] notes some helpful examples of this change:

- **Environmental monitoring:** Fintech now offers new tools for monitoring the concentration of ambient pollutants. Ground level monitoring is common in high-income countries and some middle-income countries such as China, but not many other parts of the globe. New satellite-based sensors measure pollution concentrations from space. Remotely sensed data could be especially helpful for regions where there is little on-the-ground monitoring, such as in Africa.
- **Policy design:** Singapore is pioneering the use of "big data" to reduce pollution from idling vehicles. It is using new satellite positioning technologies to improve its Electronic Road Pricing (ERP) scheme. The system tracks the locations of vehicles and measures their distance travelled on congested roadways. By pinpointing traffic congestion, ERP tariffs can be automatically adjusted to individual driving behaviour, providing the drivers with incentives to use less congested routes.
- **Regulation:** New low-cost sensors and information technologies are reducing the cost to regulators of enforcing limits on emissions from factories and energy producers. Sensors can be placed within facilities or in downwind communities to continuously monitor emissions and transmit data via the Internet to regulators, allowing them to measure actual pollution loads over

time. This data supports market-based policies to reduce pollution. In India, regulators are installing sensor technologies at industrial facilities for an emissions trading scheme for pollution.

- **Citizen engagement:** The Institute of Public and Environmental Affairs in Beijing, a public advocacy group, has released a free mobile app to provide the public with pollution data. Users of the Pollution Map app can see current emission levels of local factories and other entities to determine whether the readings exceed legal limits. They can share this information on social media apps and submit reports on companies that are violating emission limits.

Fintech could impact developing countries' strategic priorities and help them 'leapfrog' over many stages of development. Recent innovations have explored essential areas such as improved financial inclusion, facilitated access to investment capital, domestic resource mobilization at small, medium and large scales, access to credit, social enterprise and community-level initiatives, promotion of mini-credit, mini-insurance and more. Fintech can also ease credit for SMEs, producing a spur of investments and GDP as a result. Fintech could increase private investment by allowing for an increased accumulation of capital, as companies would not need to spend so much to finance their investments. As enterprises become more active in trade, there also could be benefits for overall exports.

Fintech applications can be beneficial for SMEs in particular – they have an untapped potential to create sustainable livelihoods and deliver economic growth. They can represent up to 95% of an economy while providing up to 70% of jobs and delivering on average 50% of GDP. In developing countries, fintech innovations – crowdfunding, crowd-lending, mobile payments, reputation systems, deal-sourcing platforms and other financial technologies – could help SMEs bypass traditional finance by bringing entrepreneurs closer to their funders, supporting SME community collaboration, marketplace and peer community financing, diversifying the types of funding and multiplying the channels for allocation.[13] For example, SMEs are important in Latin America and the Caribbean, but most financial institutions face a gap in finance in the region that stands at approximately US$250 billion.[14] Fintech collaboration has thus far moved slowly, in part due to hurdles specific to the region's financial institutions, including greater rigidity of governance structures, difficulty faced by fintechs in identifying the appropriate contact or point of entry, and complexities of ensuring compatibility of innovative fintech solutions with legacy IT systems.

Fintech could potentially impact the entire financial value chain and improve financial access for SMEs. New fintech identification technologies allow for better 'know your customer' (KYC) procedures, which are especially relevant in developing countries. Banks increasingly rely on fintech-driven alternative credit scoring methods – based on psychometric tests or information from social networks and smartphone use – which allows for credit scores to be calculated for every enterprise, even if traditional financial data is lacking. With this, banks can get improved insights into which enterprises to finance, as well as employ new technology, such as mobile and Internet banking, to expedite loan disbursement. In addition, the loan portfolio can be better monitored if clients use cloud computing and business monitoring apps. This could help banks too – better selection reduces the risk of selection of 'bad' clients resulting in lower loan losses. If fintech improves KYC procedures, this in turn leads to lower due diligence costs and operating expenses for banks, and loan officers can efficiently identify and serve more lenders.

Fintech can connect entrepreneurs and investors across borders, with little intermediation and lower transaction costs. This disrupts the traditional flow of information and decision-making processes by bringing information to more investment decision-makers at the same time. By standardizing information, lowering transaction cost, enabling peer-to-peer transactions, supporting collaboration and

spreading risks across many funders, fintech can increase and diversify the opportunities for both entrepreneurs and funders. Fintech platforms create the necessary conditions for micro-customisation and data aggregation and can provide a more accurate guide for scaling investments into SMEs. It can also improve cash flow management, as international payments are settled within minutes, and reduce financial expenses as international investors often have lower funding costs than local investors.

Blockchain – A Disruptive Example

Blockchain or distributed ledger technology (DLT) illustrates the transformative potential of fintech, as well as its potential drawbacks. DLT allows users to maintain a database between multiple participants without the need for any third party validator or reconciliation. In simplest terms, blockchain is a multi-instance digital ledger that provides a secure way of recording transactions, and executing agreements and contracts – any multi-party exchange that needs to be recorded and verified. But rather than being kept in one place, the ledger is replicated across a network of computers, which provides an indisputable and irreversible record of transactions that exposes attempts at fraudulent activity. To change the data held on the distributed ledger, a hacker would need to access and change the majority of the computers containing the ledger at the same time. Blockchain technology therefore has the potential to prevent corruption while increasing transparency and accountability.

Blockchain, one type of DLT, is the technology underpinning the popular peer-to-peer digital currency bitcoin. Bitcoin is a so-called cryptocurrency, relying on cryptographic techniques for creation, issuance and peer-to-peer transactions over a distributed network of computers. Every node on the network has a copy of every transaction. These transactions are contained in 'blocks', with each block being cryptographically signed and linked to the previous block, forming a block chain. In the bitcoin blockchain, and its variants, each node on the network competes to create the next block by solving a very difficult computational problem and the winner is rewarded with an amount of cryptocurrency – this process is referred to as mining. Every other node then validates this new block and adds it to their copy of the blockchain. Once a block is confirmed by consensus of the majority of nodes (about 7,000 'bitcoin miners' at the last count), it becomes immutable and censorship resistant. This protocol is known as Proof of Work.

Proof of Work consensus presents a guarantee over the permissionless, or open blockchain, that validation is accurate; since bitcoin miners are rewarded in bitcoin, it is highly unlikely that the majority will collaborate to validate fraudulent transactions, undermining the digital currency and therefore their own interests. Other proofs have been developed to address the inherent challenge to Proof of Work of the massive consumption of computational power. Other blockchain transaction validation protocols being explored include Proof of Stake, where validation of the underlying source of funds offers a less computationally expensive validation option, while in permissioned, or closed, blockchains, internal consensus protocols need only rely on validations associated with trusted and known validator nodes.

The bitcoin blockchain is based on open source code. Due to this, there have been many hundreds of variants launched. No more than a few have had significant take-up and bitcoin remains in overall value (market capitalization) greater than the sum of all of the rest.

The potential for blockchain is far greater than financial transactions. Any asset that can be tokenized can be transacted over or stored on a DLT. For example commodities like gold and grain,

guarantees, bills of lading, digital provenance such as art and media, GPS data, chemical analysis or ownership certificates. New applications of blockchain technology are being explored for accelerating the distribution of aid funding and trace how it is spent; for securing land tenure and property rights by functioning as a neutral broker for determining ownership; for tracing provenance of traded goods to guarantee origin, ownership and quality; creating peer to peer marketplaces for renewable energy or food circles; and for ensuring that electronic medical records remain secure. Blockchain technology can also redefine the landscape of the investment management industry. Indeed, it has the potential to make securitization, trading and post-trading processes much more efficient, improve transparency and audit trails, and eliminate intermediaries. Blockchain could potentially allow entire industries to optimize their business processes and significantly reduce fraud and opacity by sharing data between businesses that have different or competing economic objectives.

A related fintech development is 'smart contracts' –program code stored on a blockchain that is self-executing and self-maintaining. Smart contracts execute business rules when pre-determined conditions have been met, making them powerful tools in automating transactional elements of processes. While still nascent, smart contracts have great potential for automating and accelerating costly manual processes and will become a powerful business tool.

The combination of blockchain immutability, transparency and disintermediation means that through digital asset records and smart contracts, marketplaces can be automated which support peer-to-peer transactions, rich and transparent behavioural profiling and the ability to manage execution of complex business conditions without human intervention. This presents a major change to many of the challenges facing banks and governments in supporting SMEs and particularly microbusinesses, as managing complex conditions and evidence, for example in credit assessment, can be fully automated. It also means that communities can collaborate directly without the intervention of a trust authority or intermediary, allowing them to adopt collective behaviours and decision making about their communities and environments.

Nonetheless, blockchain also presents several challenges and barriers to adoption. A lack of standards has led to a proliferation of different DLT implementations – Ethereum, Multichain, Hyperledger Fabric, Sawtooth Lake, R3's Corda, being just a few. This is considered acceptable at such an early stage in the technology's lifecycle. However, as it matures there will need to be global standards to ensure interoperability and universal adoption.

Public blockchains have scalability Issues and high system latency. The technology is currently in a nascent stage, and it may not operate at scale without compromising on security, speed or cost – e.g. Visa has the capability to process 56,000 transaction messages per second while bitcoin only processes approximately 7.

There is a very fluid regulatory landscape with a lack of a global regulatory body to set standards on global transactions. Preliminary regulations are being drafted in some parts of the US, which could impact adoption rates – however, the reduction of settlement risk and easy access to verifiable and fraud-resistant transaction data may provide incentives for regulators to react positively towards this technology. Any international or cross border implementation of a blockchain may need to meet specific and different local regulations (e.g. AML/KYC, systemic resilience, etc.).

New legal frameworks will be required to achieve a uniform legal approach across a distributed set

of peer parties with no centralised authority and to establish legal title to assets that are tokenized and recorded on a distributed ledger.

Despite these challenges, coupled with an uncertain regulatory framework, the application of blockchain continues at a staggering pace. PwC's Global Blockchain Team recently identified more than 700 companies entering this arena. Among them, 25 will likely emerge as leaders.

4 Fintech, Green Finance and Sustainable Development: Case Studies from Developed and Developing Countries

The fintech revolution is under way in the developing world, particularly for financial inclusion. BitPesa, a digital payment platform that enables businesses to make payments to, from, and within Africa, provides an inexpensive alternative to conventional bank transfers. Lendahand, a Dutch debt crowdfunding platform, facilitates the funding of MSMEs in emerging countries through local financial institutions by crowd investors. Once featured on their platform, socially engaged investors can fund a project – enabling global money flows unhindered by legacy systems and substantial fixed costs. Musoni, a cloud-based banking system aimed at microfinance institutions, has pioneered new technology in microfinance, and is now integrated with multiple mobile money transfer services. It helps financial organizations in Africa to leverage the latest technology. BitLand, a land registration pilot project in Ghana, where vast tracts of land are unregistered. Blockchain technology holds the promise of providing a new level of transparency for land records.

A 2016 report by the ING Economics Department also provides a helpful case study.[15] It demonstrates that fintech solutions, such as SMS and web-based loan applications, can effectively serve micro-enterprises. In 2013, ING Bank Turkey set out to financially include un-bankable small entrepreneurs. Within six months, ING implemented new product channels through which clients could open a bank account or apply for a loan. Since its inception in 2013, over 42,000 MSME clients have been issued for a total portfolio value of €1.5 billion. Today the pace of loan disbursement has accelerated to an average of 100 loans a day. Entrepreneurs can apply via an SMS or a web application and be notified about a pre-approved loan within a few minutes. Fintech also enabled ING to proactively approach clients through 'robo advice' and a 'tablet solution' with a mobile relationship manager. To date, ING has served over 30,000 clients from micro-enterprises and over 12,000 SME clients. Typical loan sizes are around €11,750 for microenterprises and €146,000 for SME's.

The UN Environment Inquiry's recent report "Fintech and Sustainable Development: Assessing the Implications" also presents many potentially scalable fintech case studies, drawn from both developing and developing countries, for that could assist policymakers as they develop their national strategies to address fintech and sustainable development:

4.1 International Aid Smart Contracts

Donors could issue 'international aid coins', using blockchain technology to offer reliable funding to the right recipients at the right time. Conditionality on the use of funds can be coded into the aid coins in the form of 'smart contracts', which could prevent them from being spent on items not deemed appropriate. This would provide for accountability and end-to-end traceability of international aid funds.

4.2 Flexible Energy Demand Matching

Fintech is enabling a flexible energy system that can manage renewables cost effectively. Customers use a real-time electronic platform that connects into buildings via their building management system or directly to assets such as air conditioning, refrigeration and battery storage. They have smart controls and sensors to automatically avoid expensive periods and schedule their consumption at cheaper times. This reduces the cost of the entire energy system. Tempus Energy is a pioneer in this field.

4.3 Renewable Energy P2P Marketplace

Local authorities are cautious investors and often hesitate at renewables. A renewable energy investment marketplace, pioneered by Abundance Investment (UK), highlights projects within a local area and encourages greater participation from local residents in implementation. It also shares the financial benefits more widely and evenly. This P2P approach calls for an investment-grade program of projects led by local government authorities in order to turn renewable energy projects into financially productive assets.

4.4 Community-distributed Energy Generation

Micro-generation allows consumers to produce energy in-house or in a local community. Trading this energy then becomes possible among consumers and 'pro-sumers' (i.e. energy producers who are also consumers). Blockchain, combined with IoT metering systems and next-generation batteries, can open the energy market to prosumers via an 'energy-coin' system. LO3 Energy, in partnership with Consensys (Ethereum co-founders), works with local utilities to create a market where neighbours can buy and sell the value of their energy generated. This can create resiliency for the electrical grid in the case of natural disasters.

4.5 Technology-centric Regulatory Sandbox

Academics, regulators and financial system actors have difficulty gaining access to both market data and proprietary trading data in order to study the effectiveness of markets. In response, the Healthy Markets Research Institute is building an open data repository that provides non-direct access to proprietary and public data. Improved understanding of a market's structure should lead to better reforms and more sophisticated approaches by market participants – especially investors focused on sustainable development.

4.6 Global Water Asset Registry and Risk Ratings

Fintech can help measure the variability of the demand and supply drivers for the planet's water resources. Satellite data in combination with AI technologies can create the water basin baselines necessary to understand the risks of water scarcity. This would then enable the management of water resources sustainably for energy generation, agriculture, industry and human consumption. Space Time Analytics has been pioneering this innovation.

4.7 Financial Market Early Warning System

To prevent the next financial system crisis, fintech innovations could pre-diagnose structural fragility arising from unsustainable practices in different sectors of the economy, and identify emerging risks before tipping points are crossed. Dynamic sustainable finance risk maps powered by AI and network science can provide the financial system cartography about systemic fault lines. The hope is to build a global culture for identifying systemic risks and protect the global commons. Financial Network Analytics is a pioneer in this field.

4.8 Climate Monitoring, Reporting and Verification

Fintech could provide for a globally trusted mechanism for the measurement, reporting, and verification (MRV) of climate change action. Actors currently make decisions with only partial knowledge of the options, benefits, costs and risks. At global and local levels, fintech can help build a "trusted MRV infrastructure" that can assimilate and analyse the disparate data sets that are held in public and private

databases into an AI-powered distributed ledger for full end-to-end auditability. The Planetary Skin Institute, with the University of Minnesota, NASA, INPE and others, started such a project in 2008.

4.9 SME Collateral Management over Blockchain

While SMEs make up 95% of the world's businesses, their credit gap is estimated at over US$2 trillion across over 200 million businesses. Similar to low-income citizens, a lack of sufficient collateral serves as a limiting factor on the ability of SMEs to secure a loan, particularly in developing countries. According to a World Bank study (cite), 80% of all enterprise loans require collateral, which on average needs to be valued at 200% of the loan amount. Assets in movement, such as receivables or inventory, frequently are not considered. Yet they comprise the majority of SME value that could be treated as collateral. Blockchain-enabled asset and interaction based reputation systems would enable SMEs to demonstrate the value held in their mobile inventories, alongside commitments to pay, creating a powerful trust building approach. The same technology enables microfinance, through execution of business rules, significantly reducing administration for large volumes of small loans and providing effective risk controls. This would enable closing the credit gap for inclusive prosperity, building on the findings of a 2013 study by IFC, which found those that implemented collateral registry reform saw an 8% increase in access to credit for SMEs, followed by lower costs of credit. Implementing asset and interaction based reputation systems can be initiated by governments, NGOs, banks or telcos seeking to support SME populations, in partnership with fintechs operating in this space.

5 Analysis – A First Assessment

5.1 The Size of the Prize

An enormous financial prize may be in store for countries that can successfully manage the opportunities and challenges arising from fintech. Deloitte estimates that investments in fintech companies have more than tripled to US$12 billion from 2013 to 2014, outpacing the overall growth in venture capital investments by 140 percent.[16] An example is the P2P lending platform, Lending Club, founded in 2006, which raised US$865 million on the NYSE, making it one of the largest US tech IPOs of 2014. P2P lending is expected to continue growing at an accelerated pace and extend to segments previously dominated by banks. This view is supported by a recent study by KPMG and the Cambridge Centre for Alternative Finance that found that the global P2P market grew by 271% to more than £106.4 billion (US$130 billion) last year, mainly due to China and the US.[17]

The fintech landscape is attracting attention from nearly every market and industrial sector geographically. Fintech investment in the EU is showing continuing promise. Total investments in the UK reached US$623 million, while Germany topped the US$80 million mark (the US continues to hold the largest share with over US$9 billion). PwC estimates that funding of fintech start-ups more than doubled in 2015 reaching US$12.2 billion, up from US$5.6 billion in 2014. These fintech innovators are aiming for a huge prize – a Goldman Sachs equity research report in 2015 estimated US$4.7 trillion in revenue for traditional financial services at were risk of being displaced by new technology-enabled entrants.[18]

Fintech-led financial inclusion could yield huge benefits. McKinsey Global Institute[19] found that, as more people obtain access to accounts and shift their savings from informal to formal mechanisms, as much as US$4.2 trillion in new deposits could flow into the financial system. These deposits could then unlock an additional US$2.1 trillion of loans to individuals and small enterprises. It is also estimated that digital financial inclusion could boost GDP of emerging economies by 6% in 2025 against baseline growth.

This corresponds to US$3.7 trillion in GDP, of which one third comes from increased investment and nearly two thirds from increased productivity of individuals, businesses, and the government. This is the equivalent of adding to the world an economy the size of Germany, or one that's larger than all the economies of Africa. This additional GDP could create up to 95 million new jobs across all sectors of the economy. Governments in emerging economies could collectively save at least US$110 billion annually, as digital payments reduce leakage in public expenditure and increase tax revenues as the informal sector decreases and more individuals and enterprises pay taxes.

5.2 Risks and Unintended Consequences

For all its promise, fintech also presents risks and dangers for developing countries at all levels of development – from emerging economies with sophisticated financial markets to small and vulnerable countries with poorly developed financial markets and a strong dependence on outside capital. Many positive expectations are based on the recent rapid growth in value-led, small-scale, early stage innovations. But pessimism has also arisen, largely based on concerns about the negative impacts of the accelerated commoditization of markets driven by fintech-powered efficiencies.

Fintech will certainly have broader unintended consequences, with potential downside risks for sustainable development. Cryptocurrency developments, in particular blockchain, have enabled illegal and illicit financial transactions, money laundering, fraud and criminality, tax evasion and other unwanted actions. Fintech developments will also cause significant loss of employment across the financial system

by transforming or rendering obsolete many existing businesses and underlying market functions and by allowing existing banks to adopt more automated services. Fintech innovations could also affect the role of central banks, particularly with the emergence of crypto-currencies alongside money currently controlled by state-monopolies. The unknowns also concern how blockchain, with other technology drivers in the real economy, will shape new markets that blur the boundaries between financial services and adjacent, real economy sectors such as retail and telecom, infrastructure delivery, and health and education.

Fintech further increases the need for strong cybersecurity, with the attendant costs. The investment industry faces obvious challenges. It manages a formidable amount of capital, private data, and market sensitive algorithms, but firms often face legacy issues with their IT architecture. With increased digital connectivity across the asset management value chain, security risks and points of vulnerability can go unmanaged and undetected, leaving the door open for cyber-criminals. If a breach occurs, there is a significant potential risk of damage to the reputation of financial institutions, business operations, distribution channels, investor and market confidence, and the consequential financial impact could be significant. Cybersecurity education will therefore be critical. It will also be key for organizations to implement digital fraud prevention, identity and access management, information leakage prevention, penetration testing, and data leakage avoidance.

Government regulators will need to be prepared to address other problems presented by the evolving digital industry, particularly consumer protection issues. Growing use of blockchain and ledger technology will enable recordkeeping and ownership verification of portfolio transactions or capital movements. Governments and regulators will therefore need to be at the forefront of 'smart contracts'. In the current disrupting payment environment, regulators struggle to keeping pace with rapid customer behavioural change and technological innovation. Payment intermediaries are waiting for regulators to fully react to the recent disintermediation of payments via P2P platforms.

Central banks need to be fully aware of, and prepared to address, the consequences of issuing Central Bank Digital Currencies (CBDC). While it is CBDC issuance will most likely happen in the next few years, because of the enormous advantages to fraud and corruption reduction and greater ability for Central Banks to control negative interest rates, the issuance of CDBCs will clearly result in a changed landscape for commercial retail banks initially, with consequences for employment and business models. It will be important for Central Banks not to be seen to be driving disruption to the banking industries that they regulate, but to manage the transition in collaboration with the banks in their jurisdiction.

Such consequences will need to be better understood and, where possible, managed. The definition of Financial Services needs to extend beyond traditional bank activities, as financial services move into the service ecosystem. Collaboration between regulators and the financial services industry needs to include emerging technologies and innovators, which means a change to the traditional approach and shifting focus towards small, nascent companies without history or even customers in some cases. Positive spillovers might be best handled through incentives and by providing greater regulatory space for innovation. Negative potential spillovers might require enhanced supervision or collaborative efforts among actors to strengthen collective responsibility.

5.3 Fintech's Unintended Consequences – A Closer Look

Fintech could have multiple unintended consequences in many areas. Its rapid development has raised policy questions about proper regulation and supervision. But financial system regulators may need to

concentrate their efforts on financial stability and not on fintech's unintended consequences, which span several areas and are often the purview of other sectoral regulators in the telecom, IT, natural resources arenas. The UN Environment Inquiry fintech report highlights many potential unintended consequences:

5.3.1 Computer-based Currencies Consume Huge Amounts of Energy

Maintaining Proof of Work-based digital currencies consumes a tremendous amount of computing power and energy. The report notes a widely circulated figure stating that the Bitcoin network consumes around 250 MW to 500 MW around the clock and that each bitcoin transaction uses about the same amount of electricity for validation as is required to power the average American home for 1.5 days. Another study concluded that the entire bitcoin mining network is on a par with Ireland for electricity consumption. This means that alternative protocols need to become established before cryptocurrencies can be scalable, while existing cryptocurrencies such as bitcoin will reach a scale limit.

5.3.2 The Rules on Ownership and Governance for Digital Data Are Still Unclear

The ownership of digital data has been a problem for some time. The US Digital Millennium Copyright Act has important consequences – individuals might not own the content that they created on their devices. Uncertainty also exists around the ownership of customer data and its appropriate use. The line between 'enhanced risk analysis' and 'use of data to deny service' to a particular customer must be defined. In contrast to paper cash, electronic transfers leave a trail that can aid law enforcement positively but also create unintended uses for malicious purposes.

5.3.3 Cashless Societies Can Raise Important Issues of Privacy and Control

In a cashless 'virtual currency' society, it would be possible for intrusive government authorities to decide what you can buy, rent or whom you can pay. WikiLeaks was founded through credit card donations until a financial blockade against the organization was mounted through traditional payments rails like Visa and MasterCard. As paper money disappears, financial censorship could become pervasive, via payments systems, back doors to the smartphones and other devices or even through new surveillance innovations.

5.3.4 Big Data Provides a New Level of Consumer Information (maybe too much)

Until recently, the lack of granular information (i.e. detailed data) led insurers to created risk sharing 'pools'. But with 'big data' (massive volumes of data that can be analysed for insights), insurers now gain a more detailed assessment of risks in their markets. When insurers can buy data from medical and health device providers about activities and exposure of their individual clients, the risk of a person or a population becoming uninsurable becomes real. This scenario also applies to risks of climate change impacts for cities with regard to their energy and water resource provisioning and in agriculture.

5.3.5 Computerized Decision-making Could Promote Unsustainable Investments

The use of robo-advisers effectively outsources decision-making by financial advisors. Computer programs can now assess information on subjects like risk aversion levels and available market opportunities. Clients may forget that these robo-advisors have an embedded 'value system' that may not correspond to their own (e.g. not investing in fossil fuel assets versus renewable energy portfolios). The strategy only needs to be coded into the algorithm and the client would be directed according to the bank's strategy without even realizing it.

5.3.6 Societal Impacts: Could Fintech Harm Traditional Business Relationships?

The impact of fintech goes beyond enabling new decision-making opportunities based on objective data and new business models. Behavioural norms will also be reshaped as personal and group identities are increasingly shaped through virtual experience. When a customer does not understand the difference between competing professional services, then price may become the deciding factor. The race for the cheapest price, the fastest transaction, and the shortest process may have the impact of destroying long-established relationships. If money can be framed in the context of social relationships, what are the impacts of a digital finance system that does not rely on durable social relationships?

5.3.7 Blockchain's Immutability and the 'Right to Forget': Could Mistakes Live Forever?

The combination of cheap storage and fast processors meant that remembering Internet transactions became simple and the norm. Blockchain technology, by its immutability, amplifies both the good and the ugly sides of this characteristic. A business deal with a company that is later at the centre of a corruption scandal would be immutable in the open ledger. It has been argued that all electronic data collected should be tagged to define when it should expire.

5.3.8 Alternative Digital Sources of Finance – Will Consumers Understand the Risks?

Even if alternative sources of digital finance and credit are monitored appropriately, many value propositions actually shift the risk to the end consumer – where there is potential for sizeable losses to be directly incurred by average investors who may not fully understand the digital product or its associated risks. The need for consumer protection could increase significantly as fintech innovations grow.

5.3.9 Fintech Automation Could Lead to Significant Unemployment

In a 2013 study, it was argued that the 'machine age' could place 47% of the US work force at risk of unemployment over a decade or two. It also addressed job polarization, wherein employment would grow in high-income cognitive and creative jobs and low-income manual occupations, but it would greatly diminish for middle-income routine jobs. Citi research estimates a 30% reduction in staff between 2015 and 2025 from automation.

5.3.10 New Digital Apps Allow for Mobile Money and New Ways to Commit Crime

The misuse of new financial technologies is inevitable. Loss of privacy is likely, despite efforts to create safeguards. Corruption cases using M-Pesa have already surfaced in Kenya, as customers often need scant identification. This makes it almost impossible for authorities to monitor. 'Silk Road' (an online black market) was hidden in the so-called 'dark web' where special cryptographic tools are needed for access, allowing drug dealers and customers to connect. Bitcoin's Mt. Gox exchange was also subject to fraudulent transactions. Recently the DAO (Decentralized Autonomous Organization) – a virtual hedge fund outside of the regulatory zone where members pool their personal funds – was hacked as a result of technical issues.

5.3.11 In an Increasingly Techno-centric World, Can Regulators Keep Up?

Regulation itself could be a casualty, as financial regulators struggle to oversee an ever more complex virtual financial system. One widely held concern is that traditional financial regulation does not always cover fintech start-ups or, if they do, they are held to different standards, such as reduced oversight. In addition, because fintech regulatory models will have to involve 'technical code' that may have significant overlaps with the IT/telecom regulator mandates, there will be a growing knowledge

imbalance between the regulators and the start-ups that use rapidly expanding digital technologies that regulators may not yet fully understand.

5.3.12 Could Fintech Change Financial Markets into Un-level Playing Fields?

High-frequency trading, 'dark pools' and alternative trading platforms have garnered much media attention, prompting a public debate on the appropriate use of trading algorithms and the 'actual versus perceived' liquidity in global capital markets. Despite regulatory action to ensure safety, this remains an area of intense scrutiny.

5.3.13 The Fintech Downside – What Happens When Technology Is Suddenly Obsolete?

Incumbent financial institutions that cannot evolve rapidly, and the people dependent on them for their livelihoods could be cut out of the financial value chain. Banking and their legacy systems are running the risk of obsolescence with the growth of fintech. What will happen when a whole sector of digital finance becomes obsolete without an analogue backup? In 2016, Google's 'Nest' home device business discontinued the service of an automation hub called Revolv, although some clients were still using the product. This action "bricked" the device – i.e. made it as useful as a brick. Questions emerge: what if your digital wallet is no longer supported, or any device you use for your financial digital transactions? How will clients retrieve this information? Similar to cash, digital services need to be regulated to ensure migration of assets (not just cash) in the event of a change or failure. Any regulator will also want to see evidence of wallet recovery, which is one of the biggest challenges in any distributed system with private key encryption.

5.4 Policy Actions for Developing Countries

5.4.1 Fintech Policies – A Starting Point

Fintech will change the relationship between the global financial system, the real economy and the governing role of public institutions. It will enhance the role of private sector actors in shaping the financial system, highlighting the need for widespread commitment from all actors to enhancing sustainable development. Governments have an essential role to play in reinforcing fintech, while managing the risks for financial stability. Harnessing technology for the greater good has always been hard, and aligning fintech with the ambitions of the SDGs and the Paris Agreement is now the imminent challenge.

Developing country policymakers should consider taking a joint approach to fintech and green finance – together they could strive to "connect the dots". Figuring out whether and how to intervene becomes even more difficult when set against the potential unintended consequences. Technological developments shatter many boundaries and undermine the concept that financial and capital markets are a separate, distinct system. Financial markets are already complex, and digital technology grows more complex by the day – together they threaten to become overwhelming for policymakers, who need to vigilantly manage the impacts on the financial stability of their country.

There are many actions that developing countries can consider. These include policy and regulatory developments, institutional development, capacity building, improved access to information and the utilization of best practices. They can also further define the policy space that lies between a purely 'laissez faire' approach, and one that imposes linear controls over the new economy. Some solutions will be framed by compliance, some by standards and the rule of law, and others by simply riding this technological wave.

As a starting point, policymakers could reflect on three interrelated solution arenas to guide their considerations on fintech:

- **The digital finance community** – such as technology innovators, entrepreneurs, investors, researchers, and financial industry leaders – needs to be rapidly brought on board to support sustainable development imperatives to prevent the emergence of a new generation of incumbent, problematic financial institutions.
- **Financial policymakers and regulators** need to fully embrace sustainable development as central to their engagement with the fintech community, most immediately in their ongoing 'regulatory sandbox' experiments.
- **The sustainable development finance community** does not appear – at least not yet – to fully appreciate the significance of recent fintech developments. They need to come 'up to speed' quickly and engage now, or risk becoming irrelevant.

Achieving sustainable development within the needed timeframe will call for strategic action from policymakers in all three areas. Fintech's impact on their achievement of the sustainability goals will depend on implementing policy interventions that enable fintech scaling while at the same time minimizing its negative unintended consequences.

5.4.2 Moving Forward at National Level

Policymakers should ensure that fintech is an integral part of financial system development plans and roadmaps focused on financing sustainable development. Developing countries can integrate digital finance into their sustainable development financing plans, and coalitions such as the Green Digital Finance Alliance can mobilize collective action by leading financial institutions and their stakeholders. While most green finance will come from the private sector, a combination of public finance and policy frameworks are needed to ensure that capital does indeed flow. This is the case in many developing countries, where governments shape a large share of capital deployment through state-owned financial institutions, development banks and policy-directed lending.

Policymakers should also enhance the role of the private sector in helping advance sustainable development. Non-financial corporations – as users of financial services – can pursue natural resource-light, climate resilient business strategies and practices. They can also measure and disclose information on their practices in ways that signal the role that sustainability considerations are playing in their business success. The goal would be to align both the corporate culture and emerging regulations with sustainability concerns. The Inquiry report "Fintech and Sustainable Development: Assessing the Implications" highlights some key actions on fintech for sustainable development and the private sector:

- **Establish a platform of leading fintech companies**, working with others to influence the right enabling businesses, policies and standards to effectively connect fintech and sustainable development.
- **Use regulatory 'sandboxes' to test new ideas.** This approach will allow businesses to test innovative products, services, business models and delivery mechanisms in a live environment and with proportionate regulatory requirements. This supports innovation and learning by developers and regulators.
- **Incentivize fintech aligned with sustainable development**, for example by:

- **Supporting venture capital and social impact funds** to fund start-ups with specific sustainable development ambitions.
- **Creating a 'challenge fund'**, similar in nature to the Longitude and X-Prizes, which would seek to create a global community of purpose that can pilot and create replicable solutions over time.

Policymakers could also increase public education on fintech. Citizens understand that finance is a keystone of the global economy and its behaviour effects their local economy and livelihoods. Individuals also understand that they can make a difference in the direction of the economy – as savers, pension and insurance holders and the buyers of financial services. With the fintech, individuals will now need to understand that they may be able to make more specific financial decisions. Chinese savers, for example, can now invest as little as RMB1, or about 15 US cents, in a green fund. Around the world, people can allocate savings directly to small businesses or to select green and sustainability-aligned funds.

5.4.3 Moving Forward at International Level

International cooperation will be needed to develop the rules of the game for fintech. Every country will drive the fintech agenda using their preferred regulatory instruments, but international harmonization will be essential for economic success, and for achieving sustainability. The World Economic Forum recently called for a regulatory response for fintech in the financial sector that focuses on key issues such as financial stability, the ethical use of consumer data, and the suitability of existing regulations, and creating a framework that allows for continued growth and innovation. Their recommendations[20] are relevant to a discussion on international action for fintech in all sectors and industries:

- **Foster a debate on ethical use of data:** Governments will need to "facilitate a public debate involving customers and practitioners to clarify the boundaries for which actors in the financial system can use consumer data for business purposes." Current standards for use of consumer data are not based on the current level of analytics. New guidelines should reflect the new technologies they are overseeing.
- **Promote public-private dialogue on the fintech transformation:** Governments could establish a global forum for public-private sector dialogue to discuss "technology-enabled transformation in financial services, particularly to identify areas where supervisor support is needed to develop technology for enhancing stability." These types of partnerships can help fill gaps that policy alone cannot.
- **Develop new standards with a view to monitoring and understanding technology-enabled innovation:** Regulators will need to balance the costs and the benefits of imposing regulations on new fintech firms. Regulations need to work for the entities being regulated, instead of imposing expensive, unworkable standards.
- **Promote proactive standard setting by the fintech industry:** A private sector industry standard-setting body could help redefine and enforce standards of good conduct in light of new technology-enabled innovations. The fintech industry could have a public-private partnership for regulation, instead of relying solely on government regulators to provide oversight and ensure compliance with standards.

Developing responses to fintech calls for cooperation between regulators to consider what will be needed to turn principals into practical on-the-ground steps. Efforts are under way to boost regulatory collaboration on financial technology:

- **Information sharing:** Regulators in Australia, the UK, Singapore, Canada, Kenya, South Korea, Switzerland and India have entered into various cooperation agreements with other regulators to share information about fintech developments and emerging trends in their markets. Many of the cooperation agreements also allow fintech businesses to access innovation hubs in other jurisdictions. The U.K.'s Financial Conduct Authority and the Hong Kong Monetary Authority recently agreed to work on joint innovation projects and to share experiences with others.[21]
- **Harmonization:** Regulators will need to work towards harmonizing their regulatory responses and approaches – but competition laws will also play a major role in determining how fintech businesses and entrepreneurs proceed in the coming years. One recent proposal raised the possibility of a "fintech passport" that could ease entry into other jurisdictions for businesses. Another possible solution raised was to develop "equivalence processes" around regulation.[22]
- **Supervision and enforcement:** The IOSCO Multilateral Memorandum of Understanding Concerning Consultation and Cooperation and the Exchange of Information (MMoU), which has 109 Securities Commissions as signatories, was the first global multilateral information-sharing arrangement among securities regulators and set a new international benchmark for cooperation critical to combating violations of securities and derivatives laws.[23] It will be updated in 2017 to cover the sharing of information accessed through Internet service providers. Global standards on how 'big data' is collected and reported, as well as other fintech-related issues, could improve the efficiency of regulatory compliance.
- **Joint strategy development:** EU lawmakers recently established an expert group to develop a comprehensive European strategy on sustainable finance, both to support investment in green technologies and to ensure that the financial system can finance growth in a way that is sustainable. The Commission will work to develop a coordinated policy approach that supports the development of finech in an appropriate regulatory environment.[24]
- **Industry-led cooperation:** Innotribe and Innovate Finance recently launched the Global FinTech Hubs Federation (GFHF) to bring together the established and emerging fintech hubs (cities and countries) globally and help foster innovation and collaboration around the world. The federation provides a cross border and open platform for global fintech players to share knowledge and build a global network. They seek to encourage global engagement, best practices, and knowledge sharing, as well as build bridges between all fintech hubs for entrepreneurs and investors to connect. Their first report put a spotlight on 21 hubs operating worldwide, including Mexico, South Africa, India, and Kenya, and concluded that strong government support at the early stage of ecosystem formation is essential.[25]

While international cooperation is essential for green fintech development, the agenda already has many competing priorities – so urgent action is needed. In addition to the work of the G20 and the GreenInvest Platform, other key international bodies could include: fintech hubs and financial centres, the Financial Action Task Force (which develops standards to combat money laundering), the International Monetary Fund, the World Bank and the Financial Stability Board. Action by bodies within

the United Nations system, such as UN Environment and the UN Development Programme, or intergovernmental organizations such as regional development banks will also be needed.

5.4.4 Policy Actions and Possible Barriers – A Closer Look

The Inquiry report on fintech highlights a number of detailed policy actions, questions for considerations, and possible barriers to implementation for consideration by policymakers:

5.5 Policy Actions

5.5.1 Build the Capacity of Regulators to Understand 'Technical Code'

The UK Government Science Adviser argues that two sets of rules or codes are involved in fintech applications. The first is the traditional code of law. The second is 'technical code' and includes the rules that regulate how software behaves in information-intensive industries. Regulating fintech will require an unusual mix of skills – including lawyers, mathematicians, cryptographers, computer scientists and real economy experts – to work together on many key issues. Regulators would be wise to invest in specialized human resources. 'Learning by doing' through regulatory sandboxes for technical code experimentation will be foundational in the future.

5.5.2 Promote 'Open Data' Policies as a Catalyst for Business Growth

Companies face an inherent tension between being 'open data' (allowing data to be freely available) or proprietary. They have their reasons for isolating, but open systems can act as catalysts for new businesses to be built on top of a popular platform. When a standard platform is widely adopted, companies often build solutions on top of that platform to meet a variety of needs. Challengers and incumbents alike can offer new products, pursue new business models and improve performance.

5.5.3 Promote Policies for Network Interoperability as the Key to Scaling

To maximize the power of distributed ledgers, the process for authentication and identification need to be interoperable with other computer systems and other blockchains. Policies that enable agreements about data and standards for interoperability will be foundational for scaling. The IoT is an example: interoperability between the different sensors of different manufacturers could be a nightmare if some basic operational functions are not agreed in advance.

5.5.4 Promote Policies That Maximize the Benefits of Blockchain for Regulators

The principal concern for regulators when confronted with cryptocurrencies and blockchains has been ensuring that these innovations do not undermine customer protection. Regulators are naturally cautious, given the role played by 'shadow banking' in the recent global financial crisis. Adoption of new common data standards to enable blockchain applications can significantly improve the cost-effectiveness of regulation. It provides a regulator with a full and immutable transaction record for both oversight and recovery. Mandating regulatory reporting requirements on industry-wide blockchains can greatly reduce compliance costs.

5.5.5 Use Public Sector Policies to Take a Leadership Role on Fintech

Integrating public sector demand for preferential procurement of SME products and services created a significant impact. Similarly, blockchain pilot projects in the public administration – especially ones that aggregate the demand for blockchain for public service applications – can lead to the public sector becoming a role model in the field. Policymakers could follow the best practices of Universal Service

Funds, where some countries have their telecommunications industries pay a part of their earnings to fund wider service for all. The barriers for blockchain would be similar.

5.5.6 Choose the Right Regulatory Framework for Fintech

The World Bank proposes a framework for choosing the right regulatory approach according to the level of digital transformation of each country/sector. Their framework segments the level of digital transformation into three types: 'emerging', 'transitioning' and 'transforming'. In countries with low access to technology, the goal is to facilitate connectivity so that the focus of regulation prioritizes the removal of the right barriers to prepare for a competitive regulation. When a country is already transitioning to a digital economy, the focus must be on increasing competition regulation and enforcement. With a transforming economy, regulators typically struggle with transnational and dominant players like Uber and Google. How to regulate without hurting consumers is the challenge for the developed economies.

5.6 Key Barriers for Scaling

5.6.1 Regulatory Barriers

Complex new policies and regulations may be needed to address fintech – Fintech innovations in financial markets typically require the explicit blessing of regulators ex ante. New regulatory principles may therefore be needed where blockchain technologies are to become an integral part of the financial system and the real economy. New policies may also be required to promote technological innovation. 'Hands-off' regulatory regimes in telecom and IT industries, natural resources and accounting may need to be revisited to implement an innovation. Regulatory sandboxes may be needed to deal with this complex barrier. In addition, numerous policy issues crop up when scaling – digital identity, cross border standards and integrity of systems.

Note: The following three examples assume bitcoin protocols and standards as the default protocol. Central bank-issued digital currencies will almost certainly use different protocols and standards.

5.6.2 Bitcoin Network Costs: Where Will the Energy Come from and Who Will Pay for It?

The escalating costs of reaching consensus in bitcoin-like networks will be a barrier for adoption, in particular given the large energy footprint of bitcoin mining operations. One study suggests that to encrypt all permutations for Germany's spectrum of bank and financial products would cost more energy annually than is produced by the country as a whole. This is worrisome, as the bitcoin network is small relative to the size of the financial system and the real economy globally.

5.6.3 Requirement of a Validation Network: Both Old and New Practices Are Needed

Distributed ledger innovations can replace two of the three functions of the trusted third party: safeguarding against fraudulent transactions and preserving an immutable public record of transactions. But they cannot substitute for confirming the existence of the asset to be exchanged, and the rights of those participating in the transaction. A 'validation or trusted notary function' is still required.

5.6.4 Scalability of Blockchain and Technology Robustness: Is the Capacity Available?

Questions over the scalability for blockchain applications, which will need to be orders of magnitude larger – must be addressed. For blockchains to become mainstream in industrial and financial system scale applications, very high standards for scalability, security, robustness and performance must be set by policymakers and public/private institutions alike. Scalability has limits across network bandwidth,

storage and even processing power. In the limit, for blockchain-enabled infrastructure to move forward, it needs to offer a more efficient and scalable solutions over the current infrastructure.

5.6.5 Operational Risks Call for a Backup Plan When Technological Failure Happens

Operational risks increase with the adoption of new technologies. A significant amount of work will be needed to ensure that these operational risks are minimized and contingency plans are in place. The risk of technical failure during implementation will require participants to be able to recover quickly, or to revert to the traditional system of market infrastructures, technologies and processes, as a risk mitigation fallback.

5.6.6 Incumbent Business Model Risks: What Happens to the Existing Institutions?

The business models of numerous institutions (both of the financial system and the real economy) are potentially threatened by the introduction of shared and immutable records of ownership and transactions. The industry may need to rethink its market infrastructures in order for more participants to distribute more products, including to the unbanked and under-banked. This means shifting from limited participation with high margins to higher participation and low margins.

5.6.7 Security, Privacy and Resilience to Cyberattacks: Is Your Country Ready?

The opportunity for blockchain to provide greater security is possible. But the corresponding cybersecurity risks will also be particularly acute, especially considering the expected exponential increase in Internet connected devices expected by 2020 – making many devices highly hack-able.

Note: the following examples assume that banks will be the backbone of future financial services and that infrastructure is a prerequisite. But a growing number of commercial financial applications that are not banks, and infrastructure working via ecosystem and microservices architectures, managed by the major platforms. Therefore, interoperability and governance standards need to be agreed.

5.6.8 Cost-sharing Across the Network: All the Players Must Pitch In

Banks will need to share infrastructure build-out costs equitably if new systems are to be truly inter-operable industry utilities. This is potentially subject to organizational disputes, which can result in free riders or never-ending battles of equitable allocation of costs among participants by revenues or market share. The alternative is clubs to build-out the industry-wide market infrastructures via industry consortiums.

5.6.9 Governance of the Network: Many Questions Will Need to Be Answered

Dealing with network governance issues will be key to questions such as: who will pay for what, when and how; who admits new participants to the blockchain; who validates transactions; and who determines who can see transactions and in what level of detail.

6 Conclusion

The GreenInvest Platform will pursue the key questions relating to the fintech, green finance, sustainable development and developing countries under its research agenda in the coming year. Key questions will include: how could fintech impact the flow of foreign direct investment to green priorities; what are the key challenges and players; what are the 'knowns' and 'unknowns'; and how can action on these be taken forward?

The new emerging world looks set to run almost entirely on digital technologies, with smarter and increasingly interconnected computers operating on a global scale. This transformation will have to be sustainable – in its energy usage and its impact on the planet. These shifts are well under way, as demonstrated by the direction of global investments, the morphing of the advanced economy, and the positioning of major international companies. Governments and policymakers can accelerate or impede changes – but they likely cannot stop them. Therefore, they will need to prepare and adapt their laws and policies for fintech.

There are a number of key action areas:

- **National plans:** How can policymakers sufficiently integrate fintech for green finance into their financial system development plans and roadmaps focused on financing sustainable development? Given how fast fintech is spreading, plans that fail to address fintech could miss a key opportunity on sustainability. Such national plans should also contemplate how regulators could incorporate fintech innovations into their requirements for measuring and reporting on sustainable development.
- **Private sector engagement:** How can policymakers enhance the role of the private sector in advancing the use fintech for achieving green and sustainable development? The goal would be to help align both the corporate culture and the emerging regulations with sustainability concerns. Policymakers could leverage their convening power to promote dialogue among various stakeholders. Such a dialogue should include a wider range of actors, such as non-bank financial firms, and non-financial firms, such as tech companies and network operators.
- **Regulatory agency actions:** How can policymakers prepare their regulatory agencies for fintech? They may need to step up their efforts to monitor the evolution of digital technologies and its implications for financial markets. This can help them make informed decisions. They also need to integrate fintech systems into their agencies to improve communications and develop strong databases. Capacity building is needed to help supervisors and overseers. Without the proper skills and tools, unchecked fintech could turn into a regulator's worst nightmare.
- **Public education and engagement:** Policymakers should also increase public education and engagement on fintech. As demonstrated by several examples, the much of the public (particularly younger citizens) is increasingly incorporating fintech innovations into their lifestyles, which they increasingly wish to be green and sustainable. Policymakers should search for ways to synergize these trends.
- **Academic engagement:** Policymakers can enlist the help of universities and academia by encouraging them to focus greater research efforts on the evolution of the fintech market and innovation programs. They can help generate empirical evidence on the economic impact of greater integration of digital financial tools.

- **International cooperation will be needed to develop the rules of the game for fintech.** Every country will drive the fintech agenda using their preferred regulatory instruments, but international harmonization will be essential for economic success, and for achieving sustainability. International best practice is already playing a key role in promoting sustainability. As reported by the Inquiry, central banks, finance ministries and regulators are already starting to make sustainability factors a routine part of financial practice through measures to build competence and strengthen accountability. The same change is needed for fintech.

The use of technology in finance is not new – but a step change now seems inevitable with the increasingly application of new financial technologies in tandem. The linkages between fintech and green finance are at an early phase of evolution, but with digitization now revolutionizing the way that financial services are delivered, it has great potential. Therein lies the opportunity – fintech, with other technological innovations, can help make great strides in supporting the management of the real economy's environmental impacts. Linking sustainability goals with fintech, which enables physical flows to be monetarized in real time, will enable innovation and greater upstream accountability.

Digital technologies may soon provide societies with new ways to do virtually anything – and anything virtually. Policymakers therefore need to find ways to channel the energy of fintech into the service of a green and sustainability economy. This calls for leadership that can take the world to the next level – to make the full transition to digital technologies, to reshape capitalism to rebalance inequalities, and to make tangible progress on climate change. With this, leaders can continue to lay the groundwork for the digital, global and sustainable civilization they urgently seek.

References

Bell, S. and Teima, G. (2015). Small and Medium Enterprises (SMEs) Finance. The World Bank. *http://www.worldbank.org/en/topic/financialsector/brief/smes-finance*

Brookings (2016). The Importance of Investing in Built-to-last Infrastructure. *https://www.brookings.edu/2016/03/29/the-importance-of-investing-in-built-to-last-infrastructure/*

Carney, Mark (2016a). The Promise of FinTech – Something New Under the Sun? *http://www.fsb.org/wp-content/uploads/The-Promise-of-FinTech-–-Something-New-Under-the-Sun.pdf*

Carney, Mark. (2016b). Enabling the Fintech Transformation: Revolution, Restoration, or Reformation? *http://www.bankofengland.co.uk/publications/Pages/speeches/2016/914.aspx*

Castilla-Rubio, J. C. (2009). Planetary Skin. A Global Platform for a New Era of Collaboration. *https://newsroom.cisco.com/dlls/2009/ekits/Planetary_Skin_POV_vFINAL_spw_jc.pdf*

Citi GPS: Global Perspectives & Solutions (2016). Technology at Work v2.0. Oxford Martin School/Citi. *http://www.oxfordmartin.ox.ac.uk/downloads/reports/Citi_GPS_Technology_Work_2.pdf*

Deetman, S. (2016). Bitcoin Could Consume as Much Electricity as Denmark by 2020. Motherboard. 29 March 2016. *http://motherboard.vice.com/read/bitcoin-could-consume-as-much-electricity-as-denmark-by-2020*

Deloitte (2016). How can Fintech facilitate fund distribution? *https://www2.deloitte.com/content/dam/Deloitte/lu/Documents/technology/lu_how-can-fintech-facilitate-fund-distribution.pdf*

Deloitte and All Street Research (2016). "Connecting Global FinTech: Hub Review 2016". *http://thegfhf.org/wp-content/uploads/2016/10/Connecting-Global-FinTech-Hub-Review-2016-.pdf*

Elliot, Nicholas (2017). How Fintech Could Cause a Revolution in Compliance. Dow Jones Institutional News. *https://www.dowjones.com/insights/fintech-cause-revolution-compliance/*

Euroclear and Oliver Wyman (2016). Blockchain in Capital Markets. The Prize and the Journey. *http://www.oliverwyman.com/content/dam/oliver-wyman/global/en/2016/feb/BlockChain-In-Capital-Markets.pdf*

European Commission (2016). Press release on "State of the Union 2016: Completing the Capital Markets Union – Commission accelerates reform". *http://europa.eu/rapid/press-release_IP-16-3001_en.htm*

European Commission (2012). Factsheet on the "Right to Be Forgotten" Ruling. *http://ec.europa.eu/justice/data-protection/les/factsheets/factsheet_data_protection_en.pdf*

FAO (2012). Smallholders and Family Farmers. *http://www.fao.org/leadmin/templates/nr/sustainability_pathways/docs/Factsheet_SMALLHOLDERS.pdf*

Financial Conduct Authority (2015). Regulatory Sandbox. *https://www.fca.org.uk/publication/research/regulatory-sandbox.pdf*

FinTech Law Watch (2016). Will there be an Asia Pacific 'Fintech Passport' in the future? Comments by Australian Securities and Investments Commission (ASIC) Chairman Greg Medcraft.

Frey, C. B., Osborne, M. O. (2013). The Future of Employment: How Susceptible Are Jobs to Computerization? *http://www.oxfordmartin.ox.ac.uk/downloads/academic/The_Future_of_Employment.pdf*

G20 Green Finance Study Group (2016). G20 Green Finance Synthesis Report. *http://unepinquiry.org/wp-content/uploads/2016/09/Synthesis_Report_Full_EN.pdf*

Government Office for Science, UK (2014). The Internet of Things: Making the Most of the Second Digital Revolution. A report by the UK Government Chief Scientific Adviser. *https://www.gov.uk/government/uploads/system/uploads/attachment_data/le/409774/14-1230-internet-of-things-review.pdf*

Greenham, T., McCann, D. and Ryan-Collins, J. (2014). Financial System Impact of Disruptive Innovation. UN Environment Inquiry/New Economics Foundation. *http://unepinquiry.org/wp-content/uploads/2014/09/Financial_System_Impact_of_Disruptive_Innovation.pdf*

GSMA (2015a). State of the Industry. Mobile Finance Services for the Unbanked. *http://www.gsma.com/mobilefordevelopment/wp-content/uploads/2015/03/SOTIR_2014.pdf*

GSMA (2015b). The Mobile Economy. *http://www.gsma.com/mobileeconomy/global/2015/GSMA_Global_Mobile_Economy_Report_2015.pdf*

GSMA (2015c). mAgri. Weather Forecasting and Monitoring: Mobile Solutions for Climate Resilience. *http://www.gsma.com/mobilefordevelopment/wp-content/uploads/2016/02/Weather-forecasting-and-monitoring-mobile-solutions-for-climate-resilience.pdf*

IBM (2015). Device Democracy: Saving the future of the Internet of Things. *https://public.dhe.ibm.com/common/ssi/ecm/gb/en/gbe03620usen/GBE03620USEN.PDF*

ING Bank (2015). A Billion to Gain? Microfinance clients are not cut from the same cloth. *http://www.ingcb.com/insights/research/microfinance-emancipating-the-worlds-poorest*

ING Economics Department (2016). Fintech for micro, small and medium sized enterprises: Creating jobs at the bottom of the pyramid through financial and digital innovation. *https://www.ing.nl/media/ING_EBZ_FinTech-for-MSMEs_tcm162-111437.pdf*

International Energy Agency (2015). World Energy Outlook Special Briefing for COP 21. *http://www.iea.org/media/news/WEO_INDC_Paper_Final_WEB.PDF*

International Monetary Fund (2014). Financial Access Survey. *http://data.imf.org/?sk=e5dcab7e-a5ca-4892-a6ea-598b5463a34c&sId=1412015057755*

International Organization of Securities Commissions (2017). IOSCO web page: *https://www.iosco.org/about/?subsection=mmou*

International Finance Corporation (2013). How Movable Collateral Gets Credit Moving. *http://www.ifc.org/wps/wcm/connect/7b0e2e804782fa9644f7299ede9589/How%2Bmovable%2Bcollateral%2Bgets%2Bcredit%2Bmoving.pdf?MOD=AJPERES*

International Finance Corporation (2011). Mobile Money Study 2011. Summary Report. *https://www.ifc.org/wps/wcm/connect/fad057004a052eb88b23dd29332b51/MobileMoneyReport-Summary.pdf?MOD=AJPERES*

KPMG (2016). Global insights from regional Alternative Finance studies. *https://home.kpmg.com/content/dam/kpmg/uk/pdf/2016/10/global-alternative-finance-report-web.pdf*

Law360 (2017). Global Standards Setter Wants Worldwide Fintech Regs. *https://www.law360.com/articles/889743/global-standards-setter-wants-worldwide-fintech-regs*

Lloyd's (2015). Technology: Bitcoin. Risk Factors for Insurance. Emerging Risk Report. *https://www.lloyds.com/~/media/les/news%20and%20insight/risk%20insight/2015/bitcoin%20%20nal.pdf*

Mastercard Center for Inclusive Growth (2016). Closer to Achieving Inclusive Growth through Financial Inclusion in 2016. *http://mastercardcenter.org/insights/2016-closer-achieving-inclusive-growth-financial-inclusion/#sthash.Rsk3t2UO.dpuf*

McKinsey Financial Services Practice (2015). Global Banking Annual Review 2015: The Fight for the Customer. *https://www.alliancepartners.com/apsite/docs/McKinsey_Global_Banking_Annual%20Review_2015_d.pdf*

McKinsey Global Institute (2016), Digital Finance For All: Powering Inclusive Growth In Emerging Economies. *http://www.mckinsey.com/global-themes/employment-and-growth/how-digital-finance-could-boost-growth-in-emerging-economies*

McKinsey Global Institute (2015). The Internet of Things: Mapping the Value Beyond the Hype. *http://www.mckinsey.com/~/media/McKinsey/Business%20Functions/McKinsey%20Digital/Our%20Insights/The%20Internet%20of%20Things%20The%20value%20of%20digitizing%20the%20physical%20world/The-Internet-of-things-Mapping-the-value-beyond-the-hype.ashx*

McKinsey Global Institute (2013). Infrastructure Productivity: How to Save $1 trillion a Year. *http://www.mckinsey.com/~/media/McKinsey/Industries/Capital%20Projects%20and%20Infrastructure/Our%20Insights/Infrastructure%20productivity/MGI%20Infrastructure_Full%20report_Jan%202013.ashx*

Morgan Stanley (2016). Global Financials/Fintech. Global Insight: Blockchain in Banking: Disruptive Threat or Tool? *http://www.the-blockchain.com/docs/Morgan-Stanley-blockchain-report.pdf*

New Climate Economy (2015). Seizing the Global Opportunity - Partnerships for Better Growth and A Better Climate. *http://newclimateeconomy.report/2015/wp-content/uploads/sites/3/2014/08/NCE-2015_Seizing-the-Global-Opportunity_web.pdf*

Oliver Wyman/Inter-American Investment Corporation (2016). Harnessing The Fintech Revolution: How Digital Innovations Are Revitalizing MSME Finance In Latin America And The Caribbean. *http://cdn.iic.org/sites/default/files/documents/pub/en/iic_-_oliver_wyman_-_harnessing_the_fintech_revolution_0.pdf*

PwC Global FinTech Report (2016). Blurred lines: How FinTech is shaping Financial Services. *https://www.pwc.com/mx/es/industrias/archivo/20161104-folleto-fintech-05.pdf*

Schneider, J. and Prasad Borra, S.K. (2015). The Future of Finance Part 2: Redefining the Way We Pay in the Next Decade. Goldman Sachs. *http://docslide.us/download/link/gs-the-future-of-finance-redefining-the-way-we-pay-in-the-next-decade-150310*

Schwab, K. (2016). The Fourth Industrial Revolution: what it means, how to respond. World Economic Forum. *https://www.weforum.org/agenda/2016/01/the-fourth-industrial-revolution-what-it-means-and-how-to-respond/*

The Economist (2016). The DAO of Accrue. 21 May 2016. *http://www.economist.com/news/nance-and-economics/21699159-new-automated-investment-fund-has-attracted-stacks-digital-money-dao*

The Economist (2015). The FinTech revolution. *http://econ.st/1H2hwbP*

The World Bank (2016). Digital Dividends – World Development Report. *http://www.worldbank.org/en/publication/wdr2016*

The World Bank (2010). Payment systems worldwide a snapshot. Outcomes of the Global Payment Systems Survey 2010. *http://documents.worldbank.org/curated/en/441671468332987906/pdf/701580ESW0P1230bal0Survey0Book02010.pdf*

UNCTAD (2014). World Investment Report 2014. *http://unctad.org/en/PublicationsLibrary/wir2014_en.pdf*

UN Environment Inquiry (2015). The Financial System We Need. *http://unepinquiry.org/publication/inquiry-global-report-the-financial-system-we-need/*

UN Environment Inquiry (2016). Green Finance for Developing Countries: Needs, Concerns and Innovations. *http://unepinquiry.org/wp-content/uploads/2016/08/Green_Finance_for_Developing_Countries.pdf*

UN Environment Inquiry (2016). Fintech and Sustainable Development: Assessing the Impacts. *http://unepinquiry.org/publication/fintech-and-sustainable-development-assessing-the-implications/*

UN Environment Inquiry and Ethical Markets (2015). Perspectives on Reforming Electronic Markets and Trading. *http://unepinquiry.org/wp-content/uploads/2015/12/Perspectives_on_Reforming_Electronic_Markets_and_Trading.pdf*

United Nations (2016). Transforming Our World: The 2030 Agenda for Sustainable Development (Goal 7). *https://sustainabledevelopment.un.org/content/documents/21252030%20Agenda%20for%20Sustainable%20Development%20web.pdf*

United Nations (2015). Transforming our world: the 2030 Agenda for Sustainable Development. *https://sustainabledevelopment.un.org/content/documents/21252030%20Agenda%20for%20Sustainable%20Development%20web.pdf*

United Nations Framework Convention on Climate Change (2016). The Paris Agreement, Article 2c. *http://unfccc.int/paris_agreement/items/9485.php*

Vodafone (2016). Vodafone M-Pesa reaches 25 million customers milestone. *https://www.vodafone.com/content/index/media/vodafone-group-releases/2016/mpesa-25million.html*

World Economic Forum (2016a). The Role of Financial Services in Society: Understanding the impact of technology-enabled innovation on financial stability. *http://www3.weforum.org/docs/WEF_FS_RoleFinancialServicesSociety_Stability_Tech_Recommendations_2016.pdf*

World Economic Forum (2016b). The Role of Financial Services in Society. Understanding the Impact of Technology-Enabled Innovation on Financial Stability. *http://www3.weforum.org/docs/WEF_FS_RoleFinancialServicesSociety_Stability_Tech_Recommendations_2016.pdf*

World Economic Forum (2016c). Global Risk Report 2016: Resilience Insights. Global Agenda Council on Risk & Resilience.

http://www3.weforum.org/docs/GRR/WEF_GAC16_Risk_Resilience_Insights.pdf

World Economic Forum (2015). The Future of Financial Services. How Disruptive Innovations Are Reshaping the Way Financial Services Are Structured, Provisioned and Consumed. *http://www3.weforum.org/docs/WEF_The_future__of_nancial_services.pdf*

World Economic Forum (2015b). Deep Shift: Technology Tipping Point and Societal Impact. Global Agenda Council on Future of Software & Society. *http://www3.weforum.org/docs/WEF_GAC15_Technological_Tipping_Points_report_2015.pdf*

http://www3.weforum.org/docs/WEF_GAC15_Better_Growth_with_Forests.pdf

World Economic Forum (2013). The Role of Financial Services in Society. A Multistakeholders Compact. *http://www3.weforum.org/docs/WEF_FS_RoleFinancialServicesSociety_Report_2013.pdf*

World Economic Forum (2005). The Future of Fintech. Paradigm Shift in Small Business Finance. Global Agenda Council on the Future of Financing & Capital. *http://www3.weforum.org/docs/IP/2015/FS/GAC15_The_Future_of_FinTech_Paradigm_Shift_Small_Business_Finance_report_2015.pdf*

Endnotes

[1] United Nations Framework Convention on Climate Change (2016).
[2] United Nations (2016).
[3] International Energy Agency (2015).
[4] Brookings (2016).
[5] UNCTAD (2014).
[6] G20 Green Finance Study Group (2016).
[7] Carney, Mark (2016a).
[8] Citi GPS: Global Perspectives & Solutions (2016).
[9] PwC Global FinTech Report (2016).
[10] McKinsey Global Institute (2016).
[11] Mastercard Center for Inclusive Growth (2016).
[12] The World Bank (2016).
[13] ING Economics Department (2016).
[14] Oliver Wyman/Inter-American Investment Corporation (2016).
[15] ING Bank (2015).
[16] Deloitte (2016).
[17] KPMG (2016).
[18] The Economist (2015).
[19] McKinsey Global Institute (2016).
[20] World Economic Forum (2016a).
[21] Law360 (2017).
[22] FinTech Law Watch (2016).
[23] International Organization of Securities Commissions (2017).
[24] European Commission (2016).
[25] Deloitte and All Street Research (2016).

Inquiry: Design of a Sustainable Financial System
International Environment House
Chemin des Anémones 11-13
Geneva,
Switzerland
Tel.: +41 (0) 229178995
Email: *inquiry@unep.org* - Twitter: @FinInquiry
Website: www.unep.org/inquiry/