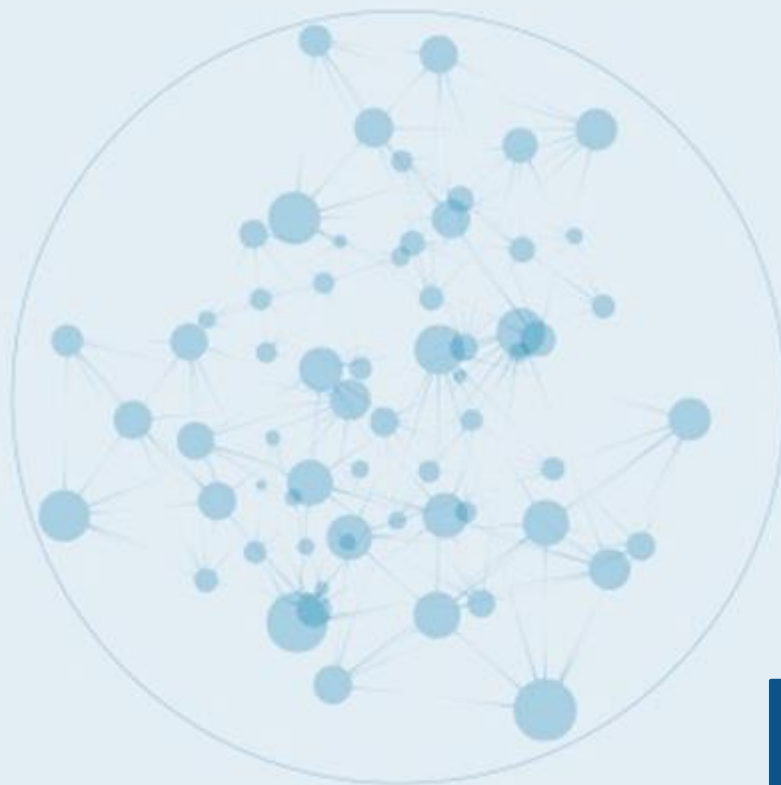




GREEN DIGITAL FINANCE

Mapping Current Practice and
Potential in Switzerland and
Beyond



DISCUSSION
PAPER

September
2018

The UN Environment Inquiry

The Inquiry into the Design of a Sustainable Financial System was initiated by the United Nations Environment Programme (UN Environment) to advance 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, the Inquiry's work was extended for another two years in late 2015, and came to a close at the end of March 2018. It has published three editions of its global, landmark report: the first in October 2015, the second in October 2016, and the third in October 2017. It published its final, global report in April 2018.

More information on the Inquiry is at: www.unepinquiry.org or from: Ms. Mahenau Agha, Director of Outreach mahenau.gha@un.org.

The Sustainable Digital Finance Alliance

The Sustainable Digital Finance Alliance has been founded by UN Environment and Ant Financial Services to address the potential for fintech-powered business innovations to reshape the financial system in ways that better align it with the needs of sustainable development. The Alliance draws in allies from across the worlds of environment, development and finance, who, through their expertise, insights and networks can contribute to collaborative actions with timely and scaled potential. Building on the work of the UN Environment Inquiry published in 2016, *Fintech and Sustainable Development: Assessing the Implications*, the Alliance published its first paper *Scaling Citizen Action on Climate – ANT Financial's Efforts Towards a Digital Finance Solution* in May 2017.

More information is available at: info@sustainabledigitalfinance.org and www.sustainabledigitalfinance.org.

About this report

This paper was prepared by the UN Environment Inquiry with support from the Swiss Federal Office for the Environment (FOEN). It contributed to, and built on a round table debate convened by the Swiss State Secretariat for International Finance (SIF) with the Swiss authorities, as well as the sustainable finance and fintech communities on “Digital Innovation for Sustainable Finance”.

The views expressed in this discussion paper are those of the authors and contributors, and do not necessarily represent the views of the FOEN or their institutions.

Comments are welcome and should be sent to simon.zadek@un.org.

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Executive Summary

Artificial intelligence (AI) could lift global GDP by US\$15-20 trillion by 2030.¹ Securing the resilience of such an achievement, notably its environmental and social sustainability, may well be accomplished by the digitalization of finance or ‘digital finance’. This implies an ecosystem of technologies, such as AI and big data, but also web-based and mobile platforms, distributed ledger technology (DLT) or blockchain and the Internet of Things (IoT), which is expected to annually connect an average of 125 billion devices worldwide by 2030.

For this to happen, three critical innovation areas need to be connected: mainstream finance, financial technologies (fintech) and sustainable finance. While the mainstream financial system has often been at the forefront of adopting new technologies, its application of digital finance innovations combined with sustainable finance goals is currently limited. While there are rapidly emerging and diverse global practices in sustainable digital finance, there tends to be a disconnect between the digital finance and sustainable finance agendas. Consequently, the potential of digital finance or fintech to advance sustainable or green finance remains under-leveraged. Digital technologies also create new risks and unintended consequences, including for the environment, which can limit their potential to scale sustainable finance. The opportunities and risks of digital finance to enhance sustainable finance are increasingly recognized globally, including by the G20 Sustainable Finance Study Group and the United Nations (UN). Various countries are exploring emerging practices, policy frameworks, challenges and opportunities to better leverage digital technologies for financing sustainable and inclusive growth.

As a global financial centre with a growing strategic interest in sustainable finance, and a country recognized as a leader in digital technologies and innovation, Switzerland is seeking an improved understanding of how digital finance can accelerate the greening of financial flows. This implies the integration of environmental risks and opportunities into day-to-day financing and investment decisions, as well as the development of financial services and products that make a substantial contribution to environmental objectives. It also involves the use of policy approaches that harness green digital finance applications to realign financial flows towards low-carbon and resource-efficient economies. To help improve understanding of what it would take to reach such an ideal state, UN Environment, with support from the Swiss Federal Office for the Environment (FOEN), undertook a stocktaking to map emerging green digital finance practices in Switzerland and globally in 2018.

The stocktake began with a review of the international and Swiss green digital finance landscape. Switzerland has an active sustainable finance ecosystem, with Zurich and Geneva ranked 8th and 26th respectively in the 2018 Global Green Finance Index.² Switzerland also compares favourably as an international hub for fintech innovation. In 2017, it came out on top of the Global Innovation Index, and ranked 7th in the 2016 Global Fintech Hub Review.³ In particular, the enabling Swiss environment of relatively liberal regulation, accessible finance and deep talent pool, has led to the early adoption of cryptocurrency and tokenization. It has also proven to be a thought leader in the development and application of this decentralized way of exchanging value. Yet, while recognition of the important role that digital technologies can play in responsible finance is growing, the number of fintechs in Switzerland that currently focus on social or green outcomes is limited.

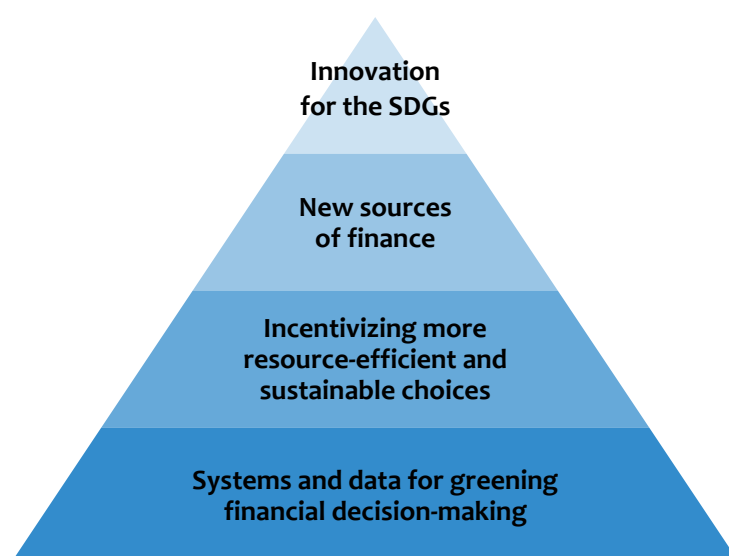
The Swiss banking (especially private banking and wealth management), investment and insurance sectors are internationally recognized. The banking sector is progressively offering more green products and services, and there is increased cooperation between established financial institutions and fintech start-ups. In the investment sector, Switzerland is well regarded for its experience in screening

companies and their value chains in terms of environmental, social and governance (ESG) considerations. It is also known as an innovation hub for institutions working in impact investment, in particular microfinance. With one of the largest insurance sectors in the world, Switzerland leverages digital innovations, including satellite data, better analytics and more advanced modelling, to improve climate risk identification and management.

Progress in mainstream finance remains slow, however, and outcomes remain suboptimal, in part due to the disconnect between mainstream finance, fintech and sustainable finance. The possibilities for innovation are wide-ranging. These include opportunities for banks to improve customer experience and engagement in ways never imagined before; inherently linked with planning, budgeting and lifestyle choices. They also include possibilities for investors to make use of sustainability analytics, software-based advisory services, matchmaking platforms and investee engagement around business models and governance in radically new ways. Finally, they include possibilities for insurance to combine top-down and bottom-up, real-time data to deliver integrated risk management and targeted services in ways that signal paradigm change.

To unpack and better understand these possibilities, the study employed the analytical framework shown in Figure ES1. Firstly, the framework serves to illustrate that digital finance ‘greens’ financial decision-making through its unprecedented power to make more data available more cheaply, quickly and accurately. This enables better pricing of environmental risks and opportunities, while also reducing transaction costs (specifically search costs for information). Secondly, the framework highlights that digital finance promotes inclusion and innovation; this advances more resource-efficient consumption and production patterns, unlocks new sources of finance, and enables new business models in environmentally friendly sectors by promoting entrepreneurship and making investments in these sectors commercially viable. It, therefore, promotes more inclusive economic growth, based on easier engagement of consumer-citizens, as well as greener growth, based on its ability to scale green innovation. These benefits enable the financial sector to more closely interact with the real economy and better align financial flows with a low-carbon and resource-efficient pathway.

Figure ES1: A Framework for Understanding Green Digital Finance



Source: Adapted from Sustainable Digital Finance Alliance (2018). *Digital Technologies for Mobilizing Sustainable Finance*

Based on this framework, a mapping of green digital finance practices both in Switzerland and more globally, revealed a number of rapidly emerging and diverse applications to sustainable finance. In Switzerland, big data and machine learning and artificial intelligence (MLAI) solutions are particularly strong at improving the availability and use of data, and better integrating ESG considerations into financial decision-making (layer one from the bottom). As a hub for cryptocurrency, innovative crypto- and token-based digital solutions that reward citizens for promoting and making more resource-efficient choices are emerging (layer two). Switzerland’s “Crypto Valley” Zug has enabled fintech companies to unlock new sources of finance through the global boom in initial coin offerings (ICOs), raising CHF271 million in 2017.⁴ However, the use of ICOs to unlock new sources of finance for businesses with environmental or social outcomes is limited. Online investment platforms are demonstrating potential to unlock new sources of finance for green projects by creating marketplaces that match sustainable technology businesses with financial institutions or other market participants (layer three). Finally, digital finance is unlocking new business models in the real economy that make alternative investments more commercially viable (layer four). In particular ‘product-as-a-service’ business models, enabled by mobile payment platforms and digital, IoT embedded assets, are revolutionizing the decentralized renewable energy sector.

Table ES1 presents an interpretation of key findings from the mapping within the Swiss context. It highlights recognized strengths of Switzerland and lead areas in terms of technologies, financial market subsectors and key environment-related themes addressed by Swiss players.

Table ES1: Mapping Analysis within the Context of Switzerland

Internationally recognized strengths of Switzerland	Progressive areas of green digital finance value addition	Leading technology application areas	Leading subsectors of the Swiss financial industry	Key thematic focus areas for Swiss players
Top innovator, including expert research and education community	Innovation for the SDGs, based on new business models	DLT, blockchain and cryptocurrencies	Investment and insurance, e.g. venture capital, private wealth and risk coverage for new business models	Circular economy business models Green infrastructure, sustainable cities
Top finance manager and trader, including strong ecosystem infrastructure	Unlocking new sources of finance	Matchmaking platforms and DLT, including crowd lending / investing / trading	Banking and impact investment, e.g. for small business support	New markets in cleantech, e.g. renewable energy technologies
High consumer awareness, including civil engagement and international exposure	Incentivizing more resource-efficient behaviour	Crypto, online and mobile services, including payments and banking infrastructure	Banking, e.g. cooperative and retail banking	Online commerce & support for eco-fair products, waste management, sustainable mobility
Stable, reliable regulator and enforcer, including public-private collaboration	Greening financial decision-making	Analytics, including big data and MLAI for integrated risk management and IoT for bottom-up data monitoring	Investment and insurance, e.g. hybrid integration in investment management and underwriting	Negative screening, considering e.g. environment, health and safety Positive screening, considering e.g. green growth areas Climate risk and disaster management

With respect to emerging trends in (i) leading technologies, (ii) financial market subsectors and (iii) environmental themes addressed, the first of these show that green digital finance practices in Switzerland leverage a mix of underlying technologies that are at various stages of maturity. The headline findings are:

- In line with Switzerland's leadership in investment screening, most green digital finance applications in Switzerland leverage big data and MLAI technologies to 'green' investment decision-making. Growing interest from the Swiss fintech community in investment management can be combined with the application of analytics in the form of big data and MLAI technologies to build on established leadership. Fintech start-ups need to be challenged to take on the environmental and climate agenda in offering analytical services to the mainstream investment sector.
- Matchmaking platforms have emerged as ways of unlocking new sources of finance, notably for renewable energy projects, but adoption is still low. Blockchain and MLAI standardize and improve the transparency of due diligence processes, while online technologies also reduce transaction costs of bringing investors and project developers together. Targeted support may need to be considered to help such platforms grow, such as the support provided by the Canton of Vaud through its Innovaud programme that supports innovators and start-ups in cleantech.
- Switzerland's leadership in cryptocurrency creates unique opportunities to establish itself as a global "green crypto-financial centre". The cities of Zug (Crypto Valley) and Chiasso (Cryptopolis) are establishing themselves as internationally recognized DLT centres. Impactful application of cryptocurrency and tokenization to the sustainable use of natural capital assets can offer a unique opportunity for Switzerland to combine its leadership in sustainable finance and DLT, to spearhead green digital finance currencies and tokenization. This will enhance the additional benefits of DLT, notably its ability to create new markets.
- Mobile and online financial services are entry points to incentivizing consumers to make more resource-efficient choices. Growing fintech services in banking infrastructure (including open banking and personal finance) can be linked with payment as well as lending or deposits to support more sustainable online purchasing, household financial planning and crowd financing in support of circular economy projects.

Second, in terms of financial market sectors, there are opportunities to connect green products and services from more established banking institutions with generic digital finance innovations introduced by fintech start-ups. There are also opportunities to expand the insurance sector's focus to leverage the IoT and DLT to unlock new business models that address security, health and safety risks as well as related environmental challenges (beyond climate and natural disasters). In the area of investment, private wealth management institutions can be connected with digitally advanced impact investment and the institutional investor community engaged in integrated ESG approaches that employ new analytics. Of special note:

- As the Swiss banking sector seeks to expand its international reach, it has a window of opportunity in taking green products and services to scale on the back of digital technologies. Growing to scale, including beyond Switzerland, is decisive for these banks. However, links between their sustainability services and digital finance applications remain limited.

- As the number of fintech companies incorporated in Switzerland annually increases significantly, Swiss venture capital investment in the fintech sector reached CHF129.9 million in 2017. Yet the increasingly vibrant fintech start-up community in Switzerland is still limited in terms of taking on a green and sustainable development agenda. A few pioneers highlighted in this study are the exception to the rule. One challenge therefore is to connect the sustainability-themed products offered by Swiss banks with the digital finance solutions offered by fintech start-ups.
- The insurance sector in Switzerland has been leading innovators in addressing climate risk and experimentation with new fintech innovations, such as parametric or indexed-based weather insurance. Today this incorporates key services for sectors such as agriculture and commodity trade, including use of satellite data and the roll-out of catastrophe bonds. Key opportunities include the use of blockchain, as well as IoT in offering more efficient and expanded services.
- More progress in the Swiss insurance offer remains to be made in the use of IoT to support the development of safer and more sustainable communities. The insurance sector has room to better leverage IoT to deliver innovative risk management offers to the real economy. Examples would include the use of IoT applications to monitor responsible chemicals management, including management of inventories and transport of hazardous substances.
- While impact investing (including microfinance) is growing, it remains a 'niche of niche'. With an annual growth rate of close to 30% since the mid-2000s, sustainable investments managed from Switzerland have made significant progress and displayed stronger growth than the overall Swiss investment market. Yet, the overall volume of sustainable investments is still a niche market, and impact investment remains the 'niche of the niche'. This is a challenge for using Switzerland's globally recognized role in cross-border wealth management.
- Pension funds in Switzerland are seen as lagging behind in terms of commitment to ESG-themed investment strategies. Smart use of digital finance technologies can speed up progress with ESG-themed investment strategies and help move towards a Swiss flagship brand as a responsible investment market. This includes taking publicly available scientific data on climate change, resource use and sustainable lifestyles, and translating it into decision-useful information for long-term focused investors.

Third, in terms of environmental focus areas, digital finance improves the efficiency and effectiveness of both negative and positive screening for investment purposes, and could offer innovative solutions to complex themes such as water, biodiversity, chemicals and the circular economy with its transformed and more transparent value chains. Headline findings are:

- Digital technologies help improve the integration of standard ESG exclusion criteria, and expand ESG considerations to include negative and positive consequences. MLAI facilitates the further development of ESG rating methodologies, benchmarking and indices. Blockchain and IoT can be employed to trace and monitor the presence or movement of polluting and harmful substances. In terms of positive screening and the creation of sustainability-themed services, Swiss banks and investors can collaborate with start-up partners in employing DLT-based solutions in support of, for example, green property, water, agrifood and clean energy funds.
- Digital technologies could offer innovative solutions to complex environmental challenges such as water, biodiversity, chemicals and the circular economy. Emerging digital technologies offer the opportunity to screen and connect structured and unstructured data held by public and

private institutions that relate to issues such as new chemicals introduced to the market, or plastic waste. Swiss financial institutions can team up with leading Swiss research organizations to define new ways of using this information in developing new services.

- Digital technologies enable new approaches for the insurance sector to track disasters and facilitate integrated risk management. The Swiss insurance industry can take the lead in the expanded use of publicly available environmental data (PAED) to assess the systemic consequences of not only climate change, but also risks related to biodiversity loss, resource stress and hazardous substances. While tracking these themes through top-down modelling approaches, the industry could also address the same agenda through IoT and related applications to analyse real-time and bottom-up generated data for the purposes of offering new insurtech services.

A number of challenges could prevent Switzerland from fully leveraging the potential of digital finance. From an environmental perspective, digital technology creates unintended side effects through hardware and software production, use and termination. Of particular concern are energy demands from global data centres and DLTs, as well as the environmental impacts associated with the extraction of raw materials used for producing these new technologies. While the issues of energy and materials use are beginning to be addressed, the robustness and scalability of these solutions remain to be seen. Furthermore, different sets of crime-related risks associated with the use of digital technologies create threats to protecting sensitive consumer and corporate financial data. Several of the technologies are still nascent, and scaling such technologies in the coming years will require new standards and regulations.

The challenge for governments and their financial supervisory authorities is to find the appropriate balance in regulation, ensuring stability and security without stifling innovation and market action. Globally, their challenge is to lift what is seen as the level playing field and advance agreement on new international standards and regulatory norms. Both the Swiss Government's Sustainable Development Strategy and Financial Market Policy for a competitive Swiss financial centre recognize the importance of international standards as well as comparable and consistent regulations as the basis for greater and more sustainable economic growth. It is also in this spirit that it needs to continue to engage with the work by the G20 and the UN Secretary-General on sustainable finance, the Sustainable Development Goals (SDGs) and the role of fintech in advancing these.

A number of national and international actions could be taken forward by different stakeholder groups – governments and regulators, market actors, academic and research institutions – to better leverage the potential of digital finance to scale up green financial flows. Box ES1 provides a summary of such potential actions. Swiss players will need to consider the encompassing challenges and advantages of pursuing strategies that focus only on the environment versus broader sustainable development agenda, on national versus international initiatives, as well as on purely digital (financial) technology versus fintech integrated with a sustainable finance agenda. While the entry point may be “green” or “local” or “digital”, taking it as a route into more integrated and holistic strategies will be critical in realizing the full transformative potential of sustainable digital finance.

Box ES1: Summary Recommendations

Governmental Institutions and Regulators (Finance and other)

- Develop international standards, guidance and information platforms for green and sustainable digital finance, including criteria that define green digital finance solutions, assessment tools for measuring impact and mechanisms to promote market transparency.
- Consider special provisions for green digital finance through regulation and supervision (e.g. of the financial market), including regtech-based processes, tax incentives, sandboxes and government programmes designed to promote market access, competition and innovation.
- Provide policy support to more deliberately combine Switzerland's leadership role in DLT/cryptocurrency and green finance to become a global 'green crypto-financial centre' in support of the SDGs.
- Establish through the Sustainable Digital Finance Alliance (SDFA) a multi-stakeholder platform to develop and implement an action plan for green and sustainable digital finance as well as guidelines for green digital finance services globally.
- Apply green digital solutions through governmental operations and services, including key finance-related operations such as sustainable public procurement and public infrastructure investment.

Market Players: Financial Institutions, Fintechs and Industry Bodies

- Promote investment in enterprises and skills related to green digital finance, including thematic funds and expertise around DLT-based green bond and fund structures.
- Connect growing interest from the Swiss fintech community in investment management and analytics, with established leadership from Switzerland in the screening and monitoring of companies and their value chains for responsible investment, including use of blockchain to assure supply chain standards.
- Take impact investment to scale, connecting Switzerland's globally recognized role in cross-border wealth management with greater investment in green digital finance linked to the SDGs.
- Raise awareness and understanding among the Swiss pension funds and insurance sector of sustainable investment and the related potential of green digital finance.
- Support collaboration by stock exchanges to introduce and scale best practice, standards and effective market regulations in support of green digital finance, as well as digital platforms as a mechanism for listing and trading digitally defined social and natural capital assets.
- Further develop collaborative approaches between large financial institutions and new green fintech entrants, combining economies of scale with entrepreneurial expertise and supported by industry-wide, pre-competitive initiatives.

Academic, Research Institutions and Innovation Hubs

- Promote multi-disciplinary collaboration on green digital finance among academia and researchers, including the coverage of green digital finance in teaching curricula, special courses, certified training and research.
- Promote multi-disciplinary engagement that joins finance, technology and environmental departments, and at the same time address their collective ability to process and interpret

public science to meet the long-term information needs of market players.

- Integrate green digital finance into innovation ecosystems, challenging incubators and innovation hubs to develop solutions for the implementation of the internationally agreed environmental and sustainable development goals, offering related award schemes tied to sponsorships and financing rewards.

1 Introduction

Artificial intelligence alone could lift global GDP by US\$15-20 trillion by 2030.⁵ In the financial sector, the digitalization of finance ('digital finance' – see Box 1 for definitions), which includes an ecosystem of technologies such as big data, artificial intelligence, mobile platforms, blockchain, and the Internet of things, is demonstrating its ability to overcome a number of barriers to scaling sustainable finance and drive environmentally sustainable growth. McKinsey (2016) estimates that digital finance could boost the GDP of emerging economies by US\$3.7 trillion by 2025, translating into GDP growth in India, Brazil, Mexico and China of almost 12%, 5.5%, 5% and 4.2% respectively.⁶ In recognition of this potential power global investment in financial technology increased more than 2,200% from US\$930 million in 2008 to more than US\$22 billion in 2015.⁷ By the end of 2017, annual global fintech funding reached over US\$31 billion.⁸

As a global financial centre with a growing strategic interest in sustainable finance and a country recognized as a leader in digital technologies and innovation, Switzerland is searching for improved understanding of how digital finance can accelerate the greening of financial flows. This implies the integration of environmental risks and opportunities into day-to-day financing and investment decisions, as well as the development of financial services and products that make a substantial contribution to environmental objectives. It also involves the use of policy approaches that harness green digital finance applications to realign financial flows towards low-carbon and resource-efficient economies.

To help improve understanding of what it would take to reach such an ideal state, UN Environment, with support from the Swiss Federal Office for the Environment, undertook in 2018 a stocktaking to map emerging green digital finance practices in Switzerland and globally, resulting in this study. It seeks to address this improved understanding that the Swiss government and many of its G20 peers are seeking.

1.1 Why Digital Technologies for Green Finance?

Financing environmentally sustainable growth requires substantial investment – an estimated additional US\$1 trillion annually in clean energy investments to limit global warming to below 2°C and between US\$5-7 trillion a year to achieve the SDGs.⁹ But the financing required for sustainable development should be available considering the size of the global economy (approximately US\$75 trillion in 2016), estimates that investing in the SDGs will further global economic growth (generating an estimated additional US\$12 trillion in market opportunities), and given the fact that in 2016, banks helped their clients raise US\$7 trillion in the global debt capital markets and US\$655 billion in the global equity capital markets.¹⁰ Yet while some progress has been made in 'green' finance,¹¹ current levels remain vastly inadequate – only 5-10% of bank loans are 'green' in countries where measured; less than 1% of total bond issuance is made up of labelled green bonds; and less than 1% of the holdings by global institutional investors are green infrastructure assets.¹² The G20 Green Finance Study Group Synthesis Report (2016) highlighted the barriers that limit the mobilization of green finance, namely inadequate internalization of environmental externalities; maturity mismatches; lack of clarity of green finance definitions; information asymmetries; and the lack of adequate analytical capabilities by financial institutions to understand the opportunities and financial risks associated with green investments.

Digital finance is demonstrating its ability to address some of these barriers through its unprecedented power to make more data available more cheaply, more quickly and more accurately to better inform financial decision-making; as well as its ability to promote inclusion and unlock innovation.¹³ However, while the financial system has often been at the forefront of adopting new technologies, its application of digital finance to sustainable finance is currently limited. Similarly, while there are rapidly emerging

and diverse global practices in sustainable digital finance, there is a marked disconnect between the digital finance and sustainable finance agendas. Consequently, the potential of digital finance to advance financing for sustainable development remains under-leveraged, and its impact on scaling sustainable finance is still a work in progress. Advances in digital technologies also create new risks and unintended consequences, including for the environment, which could limit the potential of digital technologies to effectively scale sustainable finance.

The opportunities and risks of digital finance to enhance sustainable finance are increasingly recognized at the international level. Under the Argentine Presidency in 2018, the G20 Sustainable Finance Study Group is exploring applications of digital finance to sustainable finance across capital markets, private equity and venture capital (PE/VC). The United Nations Secretary-General has recently mandated a Task Force on Digital Finance for the SDGs to identify the opportunities for digital finance to support all SDGs. Similarly, at a national level, a number of countries are exploring national practices, policy frameworks, challenges and opportunities to better leverage digital finance for sustainable development.

Box 1: Definitions

Digital Finance and Fintech

While there is no single agreed definition, the term digital finance is used to encompass a broad range of new financial products, financial businesses, finance-related software, and new forms of digitally enabled customer communication and interaction.¹⁴ Similarly, while there is no universally accepted definition of the term “fintech” (which stands for financial technology), it is commonly understood as a “*technologically enabled financial innovation... (that) gives rise to new business models, applications, processes and products... (which) could have a material effect on financial markets and institutions and the provision of financial services.*”¹⁵

Key technologies underlying digital finance include:

- *Big data* – aggregates large amounts of increasingly complex data from many different internal and external sources, unlocking opportunities for real time business insights.¹⁶
- *Machine learning and artificial intelligence*– use advanced computer science and algorithms to analyse vast data sets, derive patterns to predict behaviour and prices and automate decisions or provide recommendations, increasing decision-making capabilities.
- *Mobile technology* – mobile phones with applications that create access to a vast range of goods and services, as well as ‘mobile money’ which allows consumers to store national currency and make payments without having a traditional bank account.
- *Advances in web-based financing applications* – including peer-to-peer (P2P) platforms that allow for electronic money transfers directly between two parties via a P2P service; and investment crowdfunding platforms that allow for small amounts of money to be raised from a large number of people to fund a venture or project.
- *Distributed ledger technology or blockchain* – shared database of trusted transactions distributed across large peer-to-peer networks. The encrypted, distributed nature of data on the blockchain and system of consensus makes it inherently secure, immutable, verifiable and transparent to store transactions and records. Blockchain technology enables the existence of cryptocurrency, which is a decentralized medium of exchange that is digital and

uses encryption techniques to create, transfer and store verifiable units of value. Blockchain also enables ‘smart contracts’ that allow for pre-agreed conditions to be programmed and contractual arrangements to be executed automatically once the conditions are met.¹⁷

- *Internet of Things*– using low-cost connected sensors and AI to deliver machine learning that automates discoveries and enables ‘intelligent’ computers capable of non-routine tasks.

Sustainable and Green Finance

According to the G20’s Green Finance Study Group (2016), green finance can be understood as the “*financing of investments that provide environmental benefits in the broader context of environmentally sustainable development*”. Opportunities in green finance cover all financial sectors and asset classes, including bank lending for renewable energy and energy efficiency, green equity investment, green bonds and climate risk insurance.

In 2018, the G20 Sustainable Finance Study Group highlighted that there is a need to consider additional aspects of green finance in line with the concept of sustainable development (e.g. job creation, growth enhancement, technological development) alongside environmental ones. Hence sustainable finance can be broadly understood as financing, as well as related institutional and market arrangements, that contribute to the achievement of strong, sustainable, balanced and inclusive growth. It can do this through supporting the SDGs, adopted in September 2015 by the 194 member countries of the UN General Assembly as a set of common goals to end poverty, protect the planet and ensure prosperity for all.

The Swiss Sustainable Finance (SSF) association defines sustainable finance as “*any form of financial service integrating environmental, social and governance (ESG) criteria into the business or investment decisions for the lasting benefit of both clients and society at large. Activities that fall under the heading of sustainable finance include but are not limited to the integration of ESG criteria in asset management, sustainable thematic investments, active ownership, impact investing, green bonds, lending with ESG risk assessment and development of the whole financial system in a more sustainable way.*”¹⁸

Sustainable digital finance

The definitions above suggest that sustainable digital finance may be understood as an intended application of digital finance or fintech towards achievement of the SDGs. This includes aspirations captured in the business community through related terms such as “sustainability”, “corporate social responsibility”, “multicapital or shared value” and the ESG agenda.

Note: In line with FOEN’s mandate over environmental issues, this report focuses on green finance and green digital finance applications. However, the report aligns with terminology from data sources and examples related to broader sustainable development solutions, and refers to sustainable finance or sustainable digital finance where appropriate.

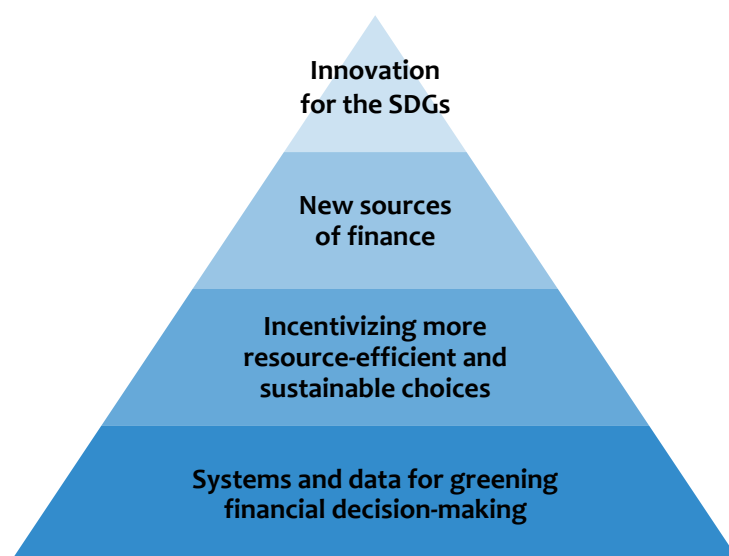
1.2 Methodology and Structure

In order to respond to the research question that seeks to better understand how digital technologies can enhance green finance within the Swiss context and provide policy insights, UN Environment, with support from FOEN, has undertaken a stocktaking of the green digital finance ecosystem. The aim is to map green digital finance practices both internationally and in Switzerland and draw recommendations for harnessing the potential of green digital finance to realign financial flows to a low-carbon and more resource-efficient pathway.

A five-step methodology was used in the research undertaken. First, the **scope** of the research was defined, based on relevance to the Swiss context, and its contribution to global thought leadership in this area. A review of the international and Swiss green digital finance landscape was carried out (Sections 2 and 3). Based on this, the current research focuses on how digital technologies can improve financial decision-making and access to green finance, such as increasing the availability and use of environmental data as well as the integration of ESG factors. It also looks at how digital finance can transform current consumption and production patterns towards resource efficiency and sustainability, by creating opportunities for greater citizen engagement; as well as the relationship between digital finance and business model innovations in the real economy. Covering the whole spectrum of the financial industry, the report focuses on banking, investment and insurance. This includes private banking and wealth management, subsectors that Switzerland is well known for. In terms of the technology ecosystem, the report focuses on the underlying technologies outlined in Box 1, as these relate to financial decision-making and access to green finance. It also covers the opportunities and challenges related to cryptocurrency in light of Switzerland’s leading position in this area.

Second, an **analytical framework** was developed to conceptualize the relationship between digital applications and green finance. These applications can be understood through a four-layered framework (Figure 1). The first, bottom layer in Figure 1 includes digital finance applications that ‘green’ financial decision-making, notably by making large amounts of data available at high speed and low cost for better ESG integration and pricing of environmental risks and opportunities, as well as by improving measuring and validating the ‘greenness’ of investments. Moving up the pyramid, digital finance promotes inclusion and innovation, incentivizing more resource-efficient consumption and production action, unlocking new sources of finance through direct citizen engagement, and matching investors and green financing opportunities. At the top of the pyramid, digital finance unlocks innovation and new business models in the real economy that promote entrepreneurship and make investments commercially viable in green sectors, particularly for venture capital and impact investing. Overall, digital finance promotes more inclusive economic growth, based on easier engagement of consumer-citizens, as well as greener growth, based on its ability to scale green innovation.

Figure 1: A Framework for Understanding Green Digital Finance



Source: Adapted from Sustainable Digital Finance Alliance (2018). *Digital Technologies for Mobilizing Sustainable Finance*

Third, a **mapping** of the situation in Switzerland and globally was undertaken to provide an overview of current practices and leading examples within this framework (Section 4 and Annex 1 for illustrative options). Semi-structured interviews and discussions were carried out with Swiss market players (see Annex 2 for a list of questions and consulted market players), including a meeting in Zurich in February 2018.

Fourth, the analytical framework and mapping were **validated**. The State Secretariat for International Finance (SIF) organized a round table with the Swiss authorities and industry (financial institutions and the fintech community) on “Digital Innovation for Sustainable Finance” in May 2018. The round table provided perspectives and insights from both the sustainability as well as the fintech community. UN Environment and the Sustainable Digital Finance Alliance provided technical support to the round table.

Finally, findings from the mapping, interviews and round table, were **analysed** through the lens of the analytical framework, as well as within the Swiss context, in terms of technologies, financial market sectors, and environmental areas. The analysis also provides insights into key challenges (Section 5) and recommendations for policymakers and regulators; market players (financial institutions, fintech players and industry bodies); and universities and research institutions (Section 6).

2 Green Digital Finance: The International Landscape

2.1 Digital Finance – Growing Importance within Global Financial Centres

Interest in digital finance is increasing and competition is growing between global financial centres to become leading international innovation and fintech hubs. When in July 2018 the French Central Bank sent letters to British digital finance companies asking about their Brexit contingency plans, it was clear that the race to become Europe's main fintech hub was heating up. Evidently, key features of digital technologies such as interoperability, ecosystems and scalability go hand in hand with the ability to process financial transactions transnationally.

The promotion of *Place financière de Paris*¹⁹ as an international hub for green finance, with Government support, includes the aim to promote green fintech projects (see Box 2 on national initiatives). London has its own Green Finance Initiative (GFI), which is exploring the possibilities of green fintech. A 2016 study by EY for the UK Government compared the fintech ecosystems of seven regions: the UK, California, New York, Germany, Singapore, Hong Kong and Australia, considering (i) Talent, (ii) Capital, (iii) Policy and (iv) Demand. It ranked the UK, California and New York ahead of Singapore and Germany. For the UK (London and broader) it noted the strength of the UK policy environment (supportive, innovative approach and accessibility of the Financial Conduct Authority (FCA), effective tax incentives and numerous government programmes designed to promote competition and innovation) as distinct advantages.²⁰

In Stockholm, the Stockholm School of Economics highlighted that 18.3% of EU fintech investments during 2010-2015 and 15.9% of EU fintech investments over 11 years up to 2015 was in Stockholm. This positioned Stockholm as the second highest funded city in the EU for the period 2005-2015, second only to London and ahead of third-placed Amsterdam.²¹ The capital flowing into Stockholm fintech firms comes from many sources, including investors from the EU and US such as Sequoia, Accel, and Greylock, Intel Capital, Mastercard Worldwide and American Express Ventures. At the country level with EUR16.2 per capita investment in fintech during 2014-2015, Sweden comes out as the European leader ahead of the UK (EUR10.85) and Germany (EUR6.43) per capita.

The latest Global Fintech Hub Review (2017) by Deloitte with 44 hub members of the Global Fintech Hubs Federation confirms the advanced position of Zurich (see Section 3.1) alongside other urban centres in a leaders group that includes the Silicon Valley, New York, Chicago, Toronto, Singapore, Hong Kong, Tokyo, London, Frankfurt, Dublin, Stockholm, Amsterdam, Paris and Sydney.²² Cities launching fintech hubs in recent years included Sydney, Hong Kong and Singapore. KPMG found that the number of fintech start-ups in Australia has increased from less than 100 in 2014 to 579 companies in 2017.²³ Its two largest sectors by number of fintech companies and capital investment are payments (128 companies) and lending (80 companies). The Accenture Asian FinTech Innovation Lab was launched in Hong Kong with eight start-ups and institutional support from foreign banks such as Bank of America, Bank of China (Hong Kong), Barclays, Credit Suisse and UBS. In Singapore, the Monetary Authority of Singapore launched an initiative called the Fintech and Information Group, and pledged to spend US\$225 million in the fintech sector over the next five years.²⁴

2.2 Sustainable Digital Finance – Growing Interest and Initiatives Worldwide

The potential and risks of digital finance to enhance sustainable finance are increasingly recognized both internationally and nationally.

Internationally:

- *The G20 Sustainable Finance Study Group* under the Argentine Presidency (2018) and co-chaired by the UK and China, is exploring applications of digital finance to sustainable finance across capital markets, private equity and venture capital. Initial findings show that sustainable digital finance practice is largely market-driven, with growing policy-based encouragement. While there are growing applications, the potential of digital finance to enhance sustainable finance remains under-leveraged and is mostly small scale.²⁵
- *The UN Secretary-General has recently mandated the establishment of a Task Force on Digital Finance for the SDGs.* The Task Force, which will be made up of high-level members from the UN, private and public sectors, aims to identify the opportunities for digital finance to support all SDGs, suggest how public and private partners can leverage these opportunities, and highlight the added value role of the UN. It is envisaged that the Task Force will be launched during the UN General Assembly in September 2018, and deliver its recommendations to the Secretary-General in September 2019.
- *OECD, UN Environment, World Bank:* With support from the German Ministry of Environment, the OECD, UN Environment and the World Bank are taking a strategic foresight scenario planning approach to explore financing climate-smart infrastructures futures. Part of this work is a case study specifically focused on the role that digital finance.
- *Financial Centres for Sustainability (FC4S):* The FC4S is a network of 16 financial centres with a mission to exchange experience and take common action on shared priorities to accelerate the expansion of green and sustainable finance. As part of its action plan, it will share experience on green digital finance, including through testing the Green Assets Wallet, a new approach to improve efficiency and transparency in the green debt market (see Box 6 for details).²⁶
- *World Bank Blockchain Lab:* The Bank launched a blockchain lab in 2017 to serve as a forum for learning, experimentation and collaboration on distributed ledger technology. The blockchain lab brings together internal and external participants to work on blockchain use cases. Its core focus areas include land registry, digital identity, aid distribution and financial infrastructure. The lab's objective is to explore and build with its non-profit and technology partners, and to produce proofs of concept that can then be rolled out in the field. It also enables greater understanding of the technology itself, as well as its accompanying security, legal and policy implications.²⁷
- *World Bank Group, International Telecommunication Union (ITU) and Committee on Payments and Market Infrastructures (CPMI) Financial Inclusion Global Initiative:* aims to advance research in digital finance in three areas (security of ICT infrastructure and trust in digital financial services; digital IDs for financial services; and acceptance and use of e-payments); and accelerate digital financial inclusion in developing countries.²⁸
- *International Finance Corporation's (IFC) Global Innovative Retail Payments Program:* increases access to banking services through developing innovative and sustainable retail payments services as a point of entry for low-income populations. The programme supports the development of innovative and sustainable retail payment solutions using technologies such as mobile phones, EFTPOS (Electronic funds transfer at point of sale) and payment card infrastructure to deliver payment services at low cost to the base of the pyramid as well as other users. Implementation is in close cooperation with the World Bank Payment Systems

Development Group (PSDG), to create the enabling environment that will help ensure the sustainability of payment services solutions.²⁹

At the national level, a number of countries, including Switzerland, are convening sustainable digital finance platforms that bring together the financial sector, the fintech community and policymakers to explore national practices, policy frameworks, challenges and opportunities to better leverage digital finance for sustainable development (Box 2). Paris, in particular, is also positioning itself as an international hub for green finance, including through special interest in fintech and support from the Government. Then Environment Minister Nicolas Hulot and Finance Minister Bruno Le Maire have published a “French Strategy for Green Finance”.³⁰ While the strategy does not extensively address fintech, it highlights goals such as creating a European taxonomy on green finance, greening Euronext and closer cooperation with fintech innovation pioneers in, for example, crowdfunded projects. Roll-out of the strategy includes action by a Finance Innovation work stream to promote “Fintech for Green” projects. It argues that Paris as a leading (green) finance capital should embrace the disruption introduced by digitalization.³¹ From the French business community, the association *France Digital* actively promotes the connection of investors with digital start-ups (including those active in banking and insurance).³²

Box 2: Examples of National Initiatives focused on Sustainable Digital Finance

- *Brazil:* The Brazilian Banking Association (FEBRABAN) and LAB Brazil convened a round table bringing the financial sector and fintech community together to discuss how fintech can be leveraged by financial institutions to scale sustainable finance.
- *China:* Tsinghua University and the Paulson Institute have convened multi-stakeholder round tables to explore the topic of green fintech. Tsinghua University is integrating digital finance into workshops and capacity-building initiatives on green finance. In the private sector, tech giants, Ant Financial Services and Tencent are both leveraging digital finance to promote environmental outcomes. For example, in 2016, Ant Financial Services launched the Ant Forest mobile application to green citizens’ consumption patterns by using mobile payment platforms, big data and social media (see Box 6 for more details). Recently, Tencent and the World Wide Fund for Nature (WWF) announced a strategic partnership to empower ecological conservation using digital technology.³³
- *Singapore:* Sustainable finance is being incorporated in the programme of the Singapore Fintech Festival. An internationally leading fintech hub, Singapore, among others, has a regulatory sandbox for fintech innovation and its Monetary Authority (MAS) has signed related agreements with peer regulators from various governments.
- *Sweden:* Stockholm Green Digital Finance was launched at the G20 GreenInvest Meeting in Berlin in May 2017. The Centre was set up to serve as an independent innovation platform and test bed to demonstrate creative solutions for scaling green finance and investment.³⁴ More information on the Centre’s Green Asset Wallet is included in Box 6.
- *UK:* The City of London Green Finance Initiative is exploring the possibilities of green fintech. Members of the City of London GFI and the Green Finance Committee, China Society for Finance and Banking (GFC) are discussing applications of technology-driven innovation to enhance green finance outcomes.³⁵

- *France:* The French Government’s Strategy for Green Finance provides for action by a Finance Innovation workstream to promote “Fintech for Green” projects. The business association, France Digital, actively promotes the connection of investors with digital start-ups.

3 Green Finance and Digital Finance: The Swiss Landscape

3.1 Switzerland in an International Context

Switzerland is a global centre for financial services, green technologies and innovation. Zurich and Geneva are ranked 6th and 15th respectively in the 2016 Global Financial Centres' Index (Zurich moving up from 7th in 2015 and Geneva dropping from 13th), and 8th and 26th respectively in the 2018 Global Green Finance Index.³⁶ Switzerland also has a growing strategic focus on sustainable finance, which is predominately market-led, with the government primarily assuming the role of mediator and facilitator. In February 2016, the Federal Council defined principles for a consistent financial market policy for Switzerland in connection with the environmental dimensions of sustainability. These principles are based on the primacy of market economy solutions and the subsidiarity of state action. The Swiss Government's strategy for a competitive Swiss financial centre includes 'Enabling Innovation and Improving Market Access' among its five priority action areas.³⁷

In an example of Swiss innovation-focused and decentralized approach, the FOEN and the SIF initiated pilot tests in 2017 to analyse the climate alignment of investment portfolios. All Swiss pension funds and insurance companies could voluntarily have their portfolios of stocks and corporate bonds tested, anonymously and free of charge, for their compatibility with the internationally agreed climate goal of limiting global warming to well below 2°C compared with pre-industrial levels.³⁸ The cantons of Geneva and Vaud required their respective pension funds to comply with sustainable development and responsible investment objectives.³⁹

The Swiss market displays leading cleantech innovations, which support Switzerland's top ranking in the Country Environmental Performance Index (EPI) of the Yale Centre for Environmental Law and Policy.⁴⁰ Considering ongoing challenges in areas such as biodiversity and habitat, the EPI shows that Switzerland is no exception with regards to the general tension between environmental health, which rises with economic growth and prosperity, and ecosystem vitality, which comes under strain from industrialization and urbanization. Swiss technology solutions developed in response to this dilemma can be applied in many parts of the world.

Switzerland also has an active sustainable finance ecosystem. The Swiss Sustainable Finance (SSF) unites over 90 members and network partners from financial service providers, investors, universities and public sector entities by informing, educating and catalysing growth in sustainable finance.⁴¹ The annual European Responsible Investing Fund Survey⁴² shows the historical development of sustainable funds and mandates in Switzerland since 2005, at an average annual growth rate of around 28%. It passed CHF160 billion by 2016, and with the addition of assets managed by asset owners themselves, a total of CHF266.3 billion. The latest "Swiss sustainable investment market study 2018"⁴³ by the SSF with the Centre for Sustainable Finance and Private Wealth at Zurich University found that the total volume of sustainable investments in Switzerland has reached CHF390.6 billion by 2018.

OnValue's 'Mapping of Sustainable Finance in Switzerland' in 2013 identified 220 organizations regularly active in the Swiss sustainable finance market.⁴⁴ This includes organizations active in asset management, pension funds, banking, financial research, insurance, academia, think tanks and applied research, philanthropy advisers and foundations, as well as governmental organizations. Asset managers (73 organizations) and pension funds (approximately 60 organizations) represented the two largest categories of actors. While the pension funds category is served by various generic industry associations, the 2015-founded Swiss Association for Responsible Investments (SVVK-ASIR) is focused on sustainability

and has nine pension fund and insurance providers as members.⁴⁵ Asset managers include a “general” category, managing traditional asset classes, impact investing and the specialized area of alternative investments. While the impact investment community tends to be more focused on a social and development agenda, the alternative investment players tend to address more typically green topics such as cleantech. A FOEN-commissioned report by PwC (2014) highlighted the support services provided by various Swiss sustainable finance actors and platforms, including the promotion of the Principles for Responsible Investment (PRI) under institutional investors, the provision of research and think tank analysis, as well as networking and awareness-raising.⁴⁶

In terms of innovation and fintech, Switzerland consistently receives top level rankings in global country ratings on factors such as innovation. Switzerland was awarded the top position by the 2017 Global Innovation Index, and ranked 7th in the 2016 Global Fintech Hub Review.⁴⁷ Its top ranking in the Global Competitiveness Index of the World Economic Forum (WEF)⁴⁸ includes the number one position on Business Sophistication and Innovation. Its absorptive capacity for new technologies is also perceived to be high, with an overall second place ranking in the tech readiness of citizens and businesses. Considering subcomponents of the Innovation pillar of the WEF Global Competitiveness Index, the country receives top rankings for capacity for innovation, quality of scientific research institutions, company spending on R&D, university-industry collaboration in research and development (R&D), as well as patents applications per capita.

With respect to digital technologies, Switzerland compares favourably with international ratings of countries and cities that serve as possible international hubs for fintech innovation. The Global Fintech Hub Review with members of the Global Fintech Hubs Federation confirms the strengths of Switzerland and Zurich, such as the proximity to expertise and innovation culture.⁴⁹ The latest annual study “Overview of Swiss Fintech” (2018)⁵⁰ conducted by the Institut für Finanzdienstleistungen Zug (IFZ, Institute for Financial Services) of the Lucerne University of Applied Sciences, covers 220 Swiss fintech companies. It includes an assessment of leading cities internationally as potential hubs in this domain, considering the business ecosystem and PEST environment – *i.e.* Political/Legal (stability, regulations), Economic (venture capital, supporting programmes), Social (associations, customer base, talent and skills, media and publicity) and Technological (technological literacy, ICT development, innovation) dimensions. Based on its assessment of leading fintech hub cities worldwide, the IFZ ranking places Zurich and Geneva in second and third position after Singapore.

The Swiss fintech sector benefits from new incubators, accelerators, and associations that provide important resources and support for their growth and development. Incubators and accelerators support the development of new start-ups. They also serve as testing grounds for the definition of new (more sustainable) business models and feedback from market incumbents. This involves connecting new IT capabilities with business and consumer needs, and is a critical area where new technological innovation needs to connect with environmental pressure points that societies and consumers face. For example, Fusion is an accelerator based in Geneva focusing on start-ups in the three areas of fintech, lifetech and proptech.⁵¹ In 2017, Fusion admitted seven start-ups to 12-month programmes of their fintech work stream. F10 is an incubator and accelerator based in Zurich and organized by SIX, focusing on fintech, insurtech and regtech startups.⁵² One of its programmes aims to bring existing products onto the market by fostering collaboration between participants and F10 corporate members (including Generali, Julius Baer Group, PwC, Raiffeisen, SIX and the Zürcher Kantonalbank). Its 14 start-ups selected in 2017 for support in converting their existing prototypes into products included Riskifier, which provides an investment risk profiling tool. Riskifier offers “AI-powered insights” and investor risk profiling that

includes the use of an EU Markets in Financial Instruments (MiFID II) compliant digital solution with embedded guidelines, inconsistency checks and alerts.⁵³

In terms of not-for-profit associations, the Swiss Finance and Technology Association (SFTA) brings together a fintech network of 600 members comprising entrepreneurs, professionals, investors and policymakers. The SFTA supports the Swiss fintech ecosystem locally and internationally, provides advocacy on public policy issues, and arranges mentorship opportunities within the network.⁵⁴ The Swiss Finance Startups (SFS) was founded to create synergies, join forces, drive innovation, inspiration and change in the world's financial epicentre. More than 120 fintech start-ups and more than 50 partners have already teamed up under the umbrella of the SFS. Together, they foster the Swiss spirit of innovation and are at the forefront of the digitalization of the financial industry.⁵⁵

Yet, linking fintech innovation with sustainable finance and smart regulation remains new territory. According to the 2016 Swiss Fintech Report, Switzerland scores below average compared to other financial centres when it comes to governmental and institutional support. In the UK and Singapore, the government offers more proactive support to entrepreneurship and innovation, while New York offers one of the strongest financing clusters worldwide.⁵⁶ The number of fintechs that currently focus on social or green outcomes is also limited. Only four out of 41 start-ups are tagged as 'social or ethical' within the Swiss Finance and Technology Association membership.⁵⁷ At the same time, recognition of the important role that digital technologies and fintechs can play in responsible finance is growing in Switzerland (see Boxes 3 and 4). Making these connections can build on leading fintech innovation areas found in Switzerland, such as DLT and cryptocurrencies. Switzerland has become a recognized leader in cryptocurrency and tokenization, which have a number of relevant green applications with potentially high-impact outcomes (see Box 5).

Box 3: Digital Technologies and Sustainable Finance in Switzerland

Switzerland has been an early supporter of exploring the sustainable digital finance agenda. In 2016, MAVA, a Swiss foundation that supports conservation and nature, supported the UN Environment Inquiry to undertake the first study into the implications of fintech for sustainable development. Building on this work, the UN Environment Inquiry and the Sustainable Digital Finance Alliance (a Swiss-based public-private partnership – see Box 4 for more details) convened a meeting with Swiss fintechs in Zurich involved in sustainable finance, which highlighted the need for greater dialogue with financial stakeholders and policymakers to better integrate fintech into sustainable finance.

CleanTech21 in Zurich, one of the earliest foundations to promote a sustainable market economy, organizes the Climate Hacks around the UN climate change conferences, marrying climate challenges with blockchain, AI and IoT experts to deliver scalable and investable solutions that are then incubated.⁵⁸

The Sustainable Finance Geneva (SFG) network of professionals regularly hosts events on new developments in sustainable finance, with support from the *Fondation Genève Place Financière*. These include events on fintech innovation, which it hosts with the local tech accelerator Fusion. In the last two years, SFG has also published brief reports with case studies of innovations in sustainable finance, including the use of digital finance by local players.

In 2017, the grassroots think tank *foraus* and the SFTA, together with broad support from the finance industry, NGOs and fintech associations, organized a three-part event series that, for the

first time, combined different innovative design-thinking formats, and brought together participants from all relevant domains to develop innovative ideas and marketable solutions around climate fintech. Forty per cent of the teams had concrete results. In 2018, the team will scale up the event at both the policy and products levels. Regular exchanges will be set up within small groups of experts. Based on the ideas created within this process, policy suggestions and challenges for product and service hackathons hosted in partnerships will be developed.⁵⁹

In April 2018, the Responsible Finance and Investment Summit hosted by the RFI Foundation and the Swiss Arab Network in Zurich explored the role of blockchain technology in responsible finance. Discussions from this first round table will be incorporated into a “Partnership Agreement on Blockchain for Sustainable and Inclusive Finance” that is expected to be signed in September 2018 by financiers and civil society.

Box 4: The Sustainable Digital Finance Alliance

The Sustainable Digital Finance Alliance⁶⁰ (‘the Alliance’) is a unique Swiss-based public-private partnership, co-founded by UN Environment and ANT Financial Services to harness the power of digital finance for sustainable development. The aim of the Alliance is to catalyse market innovation and policy action that leverages digital finance to, on the one hand, address the barriers to scaling sustainable finance, and on the other hand, promote innovation that unlocks sustainable investments in the real economy.

The Alliance is guided by a high-level Advisory Board comprised of global leaders from the private sector, public institutions and academia. The Advisory Board is co-chaired by Erik Solheim, Executive Director of UN Environment and Eric Jing, CEO of Ant Financial Services. It includes Piyush Gupta (CEO, DBS Group), André Hoffmann (President, MAVA Foundation), Nick Hughes (co-founder, M-KOPA), Caio Koch-Weser (Chair, European Climate Foundation), Rachel Kyte (CEO, Sustainable Energy for All and Special Representative of the UN Secretary-General), Philippe Le Houérou (CEO, International Finance Cooperation), Ma Jun (Director, Center for Finance & Development, Tsinghua), Phumzile Mlambo-Ngcuka (Executive Director, UN Women), Patrick Njoroge (Governor, Central Bank of Kenya), Henry M. Paulson, Jr. (Chairman, Paulson Institute), Alex Pentland (Head MIT Media Labs), and Vijay Shekhar Sharma (CEO, PayTM).

The Alliance’s Executive Board is comprised of Bruno Oberle (Professor at École Polytechnique Fédérale de Lausanne, Chair of Green Economy and Resource Governance, and Head of the EPFL International Risk Governance Center), Simon Zadek (Principal of UNDP Project Catalyst and Senior Advisor on Sustainable Finance to UN Environment), and Chen Long (Head of Strategy, ANT Financial Services Group).

In order to integrate the digital finance agenda with the sustainable finance agenda at both international and national levels, the Alliance:

- provides thought leadership through research of sustainable digital finance practice, potential and challenges;
- builds networks of sustainable digital finance hubs through convening and multi-stakeholder engagement; and
- promotes innovative market-led sustainable digital finance initiatives

The Alliance supports a number of international and national initiatives aligned to its goal. The Alliance is the umbrella knowledge partner of the G20 Sustainable Finance Study Group, supporting it as it explores the topic of digital applications and sustainable finance. In addition, the Alliance is also supporting a new high-level UN Digital Finance Task Force being established by the UN Secretary-General to identify how best to harness the potential of digital in financing the 2030 Agenda and the Paris Agreement. At the country level, the Alliance is engaged with a number of national policymakers, fintech hubs and financial centres to convene multi-stakeholder dialogues around the topic of sustainable digital finance and identify innovative practices.

The Alliance has a rich network of partners. In addition to its high-level Advisory Board, the Alliance draws on its 'Technology and Innovation Group of Friends' – a technical network including private sector companies and fintech hubs (e.g. hiveonline on blockchain technology); research institutes and think tanks (e.g. Cambridge Institute for Sustainability Leadership); and the multilateral development system (e.g. the UN Innovation Network). The Alliance is also well connected with the investment and financial community through both the private and public sectors.

Box 5: An Overview of Cryptocurrency and Tokenization in Switzerland, and Why It Matters for Sustainability

The enabling Swiss environment of relatively liberal regulation, accessible finance and a deep talent pool has led to the early adoption of cryptocurrency, tokenization and ongoing thought leadership regarding the development and application of this decentralized way of exchanging value. A cryptocurrency is a mathematically encrypted digital form of money operating independently of a central bank, being verified by network consensus protocols.⁶¹

The Canton of Zug, dubbed 'Crypto Valley', has become synonymous with Silicon Valley as a locus of cryptographic and distributed ledger technology, spawning a supportive advisory ecosystem of capital raising and specialist legal, tax and regulatory advice to navigate the complexities of operating in this arena. The Canton is home to the founder of the cryptocurrency Ether (ETH) and the Ethereum exchange platform, and to more than 200 start-ups; ATMs offer Bitcoin, the Zug Council accepts cryptocurrency as a means of payment as does the Swiss Railways. Listing on a Swiss Crypto exchange is seen as desirable for investor confidence. The growth in use of this emergent cryptographic way of transferring value is reflected in other Swiss financial centres of the country, spurring job creation.

Currently but a drop in the ocean of finance, innovations in sustainable applications indicate a trend to a radically new disintermediated system of creating and transacting value that holds great promise for accelerating the sustainability agenda if adopted at scale. As an indicator, the pathfinding P2P lending is estimated to be worth US\$897 billion by 2024 and the current market capitalization of cryptocurrencies is US\$298 billion, with global initial coin offerings (ICO)/initial token offerings (ITO) issuances going from US\$0.2 billion in 2016 to US\$4.6 billion in 2017, of which US\$890 million were Swiss. It is important to note that approximately 30% of these fail.⁶²

Another trend still in its infancy is the more complex cryptographic tokenization or digitization of social and natural assets. Here, tokenizing presents a form of fractional securitization of a physical asset such as forestry, water and land rights. It can also be something more abstract that does not represent a conventional physical asset but tokenizes a benefit such as renewable energy, carbon

mitigation, or health outcomes. Tokenizing therefore emerges as a way to ascribe value to social and natural capital assets or ‘the commons’. It signals the beginnings of a tradeable, fungible asset class by listing on a crypto trading platform and making it possible to exchange tokens for other tokens. An example is SolarCoin, listed on the Swiss Lykke Exchange where the token represents a reward per 1 MWh of solar electricity produced.⁶³

Accelerating potential use of cryptocurrency and tokenization in the real economy

While myriad applications are in development, crypto-assets or tokens are currently predominantly used as quasi-equity, for fundraising via ICO/ITO, reconciliation and settlement often via smart contracts, rewards, incentivization, and for services offered (utility tokens). The benefits are forensic traceability, fractional and shared ownership, global accessibility depending on regulation, greater efficiency, accelerated settlement with no middleman and real-time, secure, immutable data generation and recording. Early adopters are the energy and mobility industries like Swiss exchange-listed *Power Ledger* with its token (POWR) and energy trading token *Sparkz*, and energy franchiser *Restart* whose RED platform and MWAT token have generated revenues of US\$20 million in less than two years.⁶⁴ By using cryptocurrencies for P2P energy trading, consumers can trade with neighbours, receive money for excess power and trade carbon using smart contracts. Companies can optimize buying and selling network assets with near immediate autonomous settlement to wallet, which lowers costs and ensures a more efficient use of energy and a better return on investment. For an indication of the speed and scale of global adoption, the Energy Web Foundation tracks more than 200 energy applications using blockchain, including major companies Engie, Shell, Duke Energy, Innogy and Singapore Power Group. Of 122 startups surveyed, one fourth have held or plan to hold an ICO or token sale. Research by the German Blockchain Association suggests that tokens are most useful when fungible between a range of functions, eventually fully interoperable.

‘Democratizing’ green finance

The potential ‘democratization’ of finance is underestimated, and so is the ability to financially engage a growing millennial and generation Z population, for whom environmental issues are important considerations. A recent workshop hosted by the UBS Foundation and IXO – a Swiss DLT platform that tracks impact and automates tokenized payments using smart contracts when the impact criteria are met, enabling complete transparency and traceability⁶⁵ – brought global expertise around designing smart impact bonds and funds for social and environmental benefit where participation and payments are tokenized, allowing for broader participation and transparency. Innovations such as these have the potential to open up the CHF6.6 billion green bond market, environmental funds and ‘green’ company equity to a wider group of private investors. The Swiss Impact Investment Association based in Zug is designing an SDG Smart Impact Fund to invest in water, agritech and cleantech where environmental gains are tokenized and form part of the impact performance.

Exchanging ideas, building knowledge

A characteristic of cryptocurrency protocol is the open source availability of coding and knowledge-sharing, encouraging rapid iteration and innovation on an unprecedented scale, spawning supportive knowledge-sharing and incubation organizations. The non-profit Enterprise Ethereum Alliance (EEA), formed in 2017, already has 150 research, start-up and corporate members.

The Zug-based Crypto Valley Association, one of the early networks to support adoption of crypto assets, now has a Blockchain for Good initiative with chapters in Geneva and Lausanne, hosts lively meetups focused on achieving the SDGs and brokers innovators with investors. Swissnex, supported by the Departments of Economic and Foreign Affairs, has a similar role for international technology knowledge exchange and investment.

Trust Square in Zurich, is focused on developing DLT business models and applications in conjunction with corporates, entrepreneurs, investors and research partnerships with major universities such as ETH, Basel, Zurich and Applied Sciences Rapperswil. Holding regular public events and seminars, its participants are committed to democratizing finance for the common good. As Swiss host to the venture production studio ConsenSys, Trust Square can call on an 800+ network of expertise across 6 continents.

Contribution by Inge Relph, Head of Innovation, ERA Foundation

3.2 Overview of Swiss Banking, Investment and Insurance Sectors and Sustainable Digital Finance

New innovation possibilities offered by digital technologies for the **banking** sector include improved experiences of existing customers (including transactions, payments and fraud prevention), improved engagement of new customers, as well as software-supported analysis of customer creditworthiness. These new services can be combined with environmental considerations to roll out green digital finance applications.

A sustainability rating of the 15 largest Swiss retail banks by WWF Switzerland and Inrate (2017) has shown how their product and service offering is progressively taking on the sustainability agenda.⁶⁶ A number of cantonal and cooperative banks such as the Zurich Cantonal Bank, Bern Cantonal Bank and the Raiffeisen Group appear to be more ambitious in addressing the sustainability agenda. The Zurich Cantonal Bank was among the first to develop an ESG Factsheet with every fund. Smaller banks such as the Freie Gemeinschaftsbank and Alternative Bank Switzerland (ABS) are even more ambitious in moving beyond only special products and services to alternative business models (based on alternative value propositions).

Large Swiss banks are increasingly facing the prospect of disruptive innovation and new entrants in their markets due to digital advancements. Yet the dominant trend emerging today is one of increasing cooperation between established financial institutions and fintech start-ups. Large banks offer the start-ups access to a network of clients at scale, while the latter offer them the latest in fintech innovations and services. More than half of the Swiss financial institutions cooperate with fintech companies, and over 80% of them intend to increase partnerships over the next three to five years.⁶⁷ Examples of non-Swiss banks creating collaborative platforms for fintech development and investment in recent years include the Canadian Bank of Nova Scotia, the Spanish bank BBVA and the Indonesian Bank Central Asia (BCA).

Cooperation is also advanced through hubs such as the FinTech Forum (2013), the first hub for fintech firms, investors and financial institutions in Germany, Austria, Switzerland and Central Europe. Additionally, at the level of individual banks, cooperation can be advanced through partnerships with university research centres. UBS bank is partnering with the Swiss AI Lab IDSIA (Istituto Dalle Molle di Studi sull'Intelligenza Artificiale) at the University of Applied Sciences of Southern Switzerland (SUPSI) to develop a new centre for AI, analytics and innovation in Manno.⁶⁸ In so doing, UBS recognizes the potential of AI in developing banking with a new perspective on data, safety, smartness and efficiency.⁶⁹

Fintech can help identify creditworthy companies through means not usually applied by banks, working with entrepreneurs who do not have conventional collateral as guarantee. For example, blockchain can be employed to offer a reputation-based system using smart contracts. Trends faced by banks include Internet penetration (e.g. half the Swiss population are using e-services today, including e-banking solutions), emerging biometric security technologies and growing use of gamification (which can be used to advance financial literacy, and green awareness and mobilization – see the Ant Forest case in Box 7).⁷⁰ With this come disruptive innovations such as mobile money and mobile, virtual banking that can be tailored to small business development and microfinance in both developed and developing markets. A growing number of apps offer personal digital identities with the promise of control over personal and financial data.

New innovation possibilities offered by digital technologies for the **investment** sector include research and analytics, quant investment strategies, software-supported advisory services and matchmaking platforms. Wealth management start-ups such as the Swiss WealthArc⁷¹ use big data, AI and cloud computing for platforms that target for example millennials well-versed in technology. Incorporating these new innovation possibilities into green or sustainable investment approaches remains a work in progress. For example, it remains to be seen whether greater automation and digital analytics will result in ESG information being more effectively integrated, considering the growing prominence of exchange-traded funds (ETFs) and the short holding periods (less than 24 hours) of a large portion of listed equities. Investors are still discovering new approaches to effectively combine digitally enabled, automated analysis and advice, with more human-based analysis and interpretation. Environmental challenges tend to be more easily quantifiable than more complex socio-economic challenges, which lend themselves to greater reliance on automated analysis, provided that recognized standard indicators exist. At the extreme end of automation lie indexed funds and the use of robo-advisors. Digital investing via robo-advisors is expected to expand significantly in Switzerland in the coming years, particularly for consumers who cannot afford traditional wealth management.⁷²

Impact investing, which can be critical for incentivizing the private sector to offer innovative sustainable solutions in vulnerable and developing communities, is an important part of the Swiss sustainable finance ecosystem. With an annual growth of 17%, impact investing accounted for CHF12.1 billion and covered 3% of all sustainable investment assets in Switzerland by 2018.⁷³ The Swiss Impact Investment Association⁷⁴ showcases investments and companies with societal impact and offers a platform for best practice impact investments. Sustainable Finance Geneva has embarked on launching an impact investment-focused and digitally enabled social stock exchange or ‘Nasdaq of social businesses’.

Through its State Secretariat for Economic Affairs (SECO), the Swiss government has been promoting impact investing (including microfinance) since the 2000s. In 2003, SECO co-invested alongside private investors in the first microfinance fund of Zurich-headquartered responsAbility Investments AG, a global asset manager in the field of development investment.⁷⁵ It offers debt and equity investment solutions to private, institutional and public investors, focused mostly on non-listed firms in emerging and developing economies. Since 2003, responsAbility itself has invested US\$8 billion. The SECO also finances a technical assistance facility linked to an investment fund launched by responsAbility Investments to accelerate access to off-grid energy solutions in Africa and Asia.

Recognized impact investment institutions from Switzerland established in the early 2000s include BlueOrchard and Symbiotics.⁷⁶ Founded in 2001 as the world’s first commercial manager of microfinance debt investments, BlueOrchard firm provides investors globally with investment solutions in the area of

credit, private equity and sustainable infrastructure. Since 2001, BlueOrchard has invested more than US\$5 billion across 80 emerging and frontier markets. The firm provides capacity-building via tailored technical assistance and systematically assesses the social performance of each investee with a proprietary assessment tool. BlueOrchard is also a specialist in blended finance mandates, through which public development finance is leveraged to crowd in private sector financing in developing countries. Founded in 2004, Symbiotics has invested more than US\$4.6 billion on behalf of over 20 funds in 81 emerging and frontier economies. It performs a credit risk and social performance assessment prior to each investment. It has developed *Syminvest.com*, a unique database and tool to support its investment decision-making process and operations. More recently, it launched *Plumseeds.com*, an online platform that gives professional investors access to impact bonds on a deal-by-deal basis.

Over the last two decades, Switzerland has therefore become known as an innovation hub for institutions working in impact investment and microfinance in particular. Many see Geneva as an important place for the commercial funding of microfinance, based on events since the late 1990s when local pioneers worked with the UN Conference on Trade and Development (UNCTAD) to prepare for the UN 2005 “International Year of Microcredit”. The Geneva-based IT company Infobahn developed in 2000 a virtual microfinance market, which later became the online microfinance information exchange MIXMarket.⁷⁷ From the International Year of Microcredit emerged the above-mentioned, recognized Swiss impact investment managers BlueOrchard, responsAbility and Symbiotics. Bamboo Finance is another Swiss impact investor established in the 2000s.⁷⁸ With its Bottom of the Pyramid (BoP) approach, it has grown to managing over US\$290 million in equity investments in over 20 countries on behalf of private and institutional investors. Its focus areas include support for fintechs, small banks and clean energy entrepreneurs. The “responsAbility Fair Trade Fund”, launched by Credit Suisse and responsAbility, is an example of how large banks can support microfinance through a collaborative chain of intermediaries. This fund allows retail and institutional clients to invest in fixed income securities issued by agricultural cooperatives in developing countries.

The venture capital industry in Switzerland is another important player to follow, as Swiss venture capital matures. Its invested capital has grown from just over CHF300 million in 2012 to CHF937.7 million in 2017. Of this, Swiss venture capital investment in the fintech sector reached CHF129.9 million in 2017. The Swiss Venture Capital Report 2018 by Startupticker indicates that the fintech industry is becoming more mature, and the number of fintech companies incorporated in Switzerland annually over the last decade increased, including 32 fintech companies founded in 2017.⁷⁹

The Swiss **insurance** industry generates a gross value added of CHF20 billion annually and the premium volume of the Swiss private insurance industry in 2016 totalled over CHF60 billion.⁸⁰ Switzerland is one of the biggest insurance markets in the world, with very high insurance density. The industry plays an important role in overall economic growth and social progress, among others through its investment and helping entrepreneurs by taking on part of their risks. Analysis in recent years has cautioned that the Swiss insurance market is saturated. In addition, insurance providers face new regulations and new entrants that use digital innovations to access consumers and offer lower prices. Similar conditions exist in other developed markets, which means that higher competition may leave 45% of Swiss insurers driven out of the market by 2030.⁸¹ This underlines the importance for major insurance providers in Switzerland to pursue new growth opportunities in emerging markets (with their growing urban middle classes), and new opportunities in the employment of digital finance, specifically with a green agenda in mind.

New innovation possibilities offered by digital technologies for the insurance sector include satellite data, better analytics and more advanced modelling to improve risk identification and integrated risk management, as well as to develop more targeted ways of serving customers. Blockchain also offers new possibilities for providing verification (e.g. of binary events), assurance against fraud and improvements to the efficiency of the insurance value chain, including speeding up the claims settlements process. The insurance industry in Switzerland is leading industry-wide collaboration on the use of blockchain. For example, the B3i initiative,⁸² launched in 2016 with 15 members including Swiss Re, Zurich, Munich Re and Allianz, is exploring new possibilities in the use of blockchain-based smart contract systems.⁸³ Such a system brings different parties in the insurance value chain together on one platform, which paves the way for seamless processes including reduced documentation, reduced dependence on manual checks and faster settlement for vendors or customers.

4 How Digital Technologies Can Enhance Green Finance: An Analytical Framework and Mapping of Global and Swiss Applications

Switzerland has a vibrant fintech community, and initial findings from the mapping exercise show that there are rapidly emerging practices and diverse digital finance applications to green finance. These applications can be understood through the four-layered framework presented earlier in Figure 1. The first, bottom layer of the pyramid covers digital finance applications that ‘green’ financial decision-making. Moving up the pyramid, digital finance promotes inclusion and innovation, which in turns helps to incentivize more resource-efficient consumption and production action. It therefore promotes more inclusive economic growth, based on easier engagement of consumer-citizens, as well as greener growth, based on its ability to scale green innovation. Digital finance also enables the creation and mobilization of new sources of finance. Pushing the boundaries of innovation, it furthermore unlocks new business models in the real economy that promote entrepreneurship and make investments in green sectors, particularly for venture capital and impact investing, commercially viable. The following four subsections of this report explore these four levels of value creation by green digital finance for sustainable development.

4.1 Digital Finance ‘Greening’ Financial Decision-making

Data is the backbone of financial decision-making, be it the provision of lending, investment or insurance. Better data about environmental risks and opportunities, as well as how ESG data is used by financial decision makers, can create greater transparency and reliability in addition to enabling ‘greener’ planning and implementation. However, such data may simply not be available. For example, regulation in Switzerland does not require mandatory climate disclosure by institutional investors or public disclosure by investment companies about how they integrate ESG objectives into their decision-making.⁸⁴ Banks are also not required to tag or label green and sustainable loans. Information asymmetries make it expensive to generate private data to price environmental risks, quantify environmental and social benefits, and measure the ‘greenness’ of intangible, unpriced assets for ESG integration. Even where the data is available, there are gaps in the market due to the absence of relevant tools and capabilities to meaningfully analyse the data.

Publicly available environmental data can help improve access to environmental information. PAED is defined as environmental data that is reported by non-corporate entities, such as government agencies, international organizations, non-governmental organizations, and science institutes, which is useful for comparative analysis of organizational performance. Such data can inform financial decision-making, whether directly as data inputs into financial analysis of risks and opportunities, or indirectly as background information on major trends and developments. PAED may also enable the development of market-based hedging tools against environmental risks.⁸⁵

In order to enhance access to PAED and reduce search costs, UN Environment and the Organisation for Economic Co-operation and Development (OECD) recently prepared a catalogue of PAED. This catalogue brings together a wide range of PAED and indicates their sources with hyperlinks to the datasets (see the detailed inventory [here](#)). The catalogue represents an initial effort with a relatively limited scope, focusing exclusively on historical PAED and largely on national-level data. It provides a useful starting point for more comprehensive efforts that would in turn deliver more decision-useful information and further benefit financial decision-making.

In Switzerland, the Swiss Data Science is the leading centre for research on big data.⁸⁶ While there are a wide range of PAED sources and datasets, mostly historical and national-level data, there are challenges to effectively using PAED in economic and financial analysis. To start with, the quality and reliability of data matters. The FOEN has published quality requirements for environmental data to guide organizations that publish and assess environmental information about products, companies and national economies. Such quality requirements for a fair and true view include relevance for decisions, focus on environmental impacts along the whole life cycle, reliability, transparency, comprehensibility, coherence and comparability, availability of information and up-to-date information.⁸⁷

Digital technologies can help address information asymmetries and measurement challenges by producing, gathering, analysing and verifying large quantities of data (including non-standard data) related to environmental and social performance, at high speed and low cost. For example:

- *Data production:* IoT produces large quantities of performance data at a low cost. This allows real-time monitoring, low-cost tracking and tracing the performance of green assets, and higher-quality future investment decisions.
- *Data gathering and processing:* The technology underlying big data can increase the use of PAED and other public data (such as from news articles related to companies) by pulling vast data sets of non-standardized data from multiple sources, and allowing these to be standardized and presented in ways that make sense for financial users.
- *Data ‘translation’ and analysis:* Leveraging vast amounts of data, machine learning and AI facilitate the development of ESG rating methodologies, benchmarking and scorecards, which enables more efficient and transparent integration of ESG considerations into investment decision-making.
- *Data verification:* Blockchain technology allows the ‘greenness’ of finance to be verified and audited more easily in a secure, transparent and immutable manner, increasing confidence and lowering costs associated with labelling green assets.

In the insurance field, blockchain technology through smart contracts could improve the market in catastrophe bonds and swaps by increasing their reliability, auditability and speed. Such contracts transfer the financial risk of a natural disaster from an insurance company to investors (bonds) or another insurer (swaps). Blockchain technology requires less manual processing, authentication and verification through intermediaries to confirm the legitimacy of payments to and from the investors. Blockchain-based smart contracts automate the payout process when a triggering ‘cat’ (catastrophe) event occurs. These benefits would increase liquidity into the ‘cat’ bond market.⁸⁸ Recently the Swiss private bank Lombard Odier bought its first catastrophe bond using blockchain. As one of the first secondary market transactions completed on blockchain, Lombard Odier investment managers reported that the distributed ledger technology meant the deal was cheaper and far faster than a traditional investment bank-brokered bond sale.⁸⁹ Allianz Risk Transfer (ART) and Nephila Capital ran a pilot in 2016 that showed that processing and settlement could be significantly accelerated and simplified by using blockchain-based contracts.

In both the lending and the investment fields, digital technologies open up new possibilities for the screening of companies to assess their credit risk, quality of management and expected value while considering negative, positive and integrated criteria. Innovators in Switzerland have made a historical contribution to the development of new approaches to investment management, including ways of

screening and analysing the performance of companies for investment decision-making purposes. Based on years of experience and data collected since the 1990s, these innovators are well positioned today to increase the use of digital technologies in the assessment of companies, their operations, performance and reputation. Recognized pioneers from the 1990s and early 2000s are the Ethos Foundation, Inrate, RobecoSAM and Covalence.

As an asset manager and promoter of shareholder activism, Ethos serves 140 institutional investors in Switzerland. Inrate was one of the pioneers in Europe to initiate the assessment of ESG aspects of company performance for the purposes of doing non-financial ratings. It was also leading in the calculation of the carbon footprint of financial portfolios. Established in the 1990s, Sustainable Asset Management (SAM, today RobecoSAM) used its innovative rating and investment management approach to launch the internationally recognized Dow Jones Sustainability Indices (DJSI) in 1999 with the S&P Dow Jones Indices. Since then it has introduced additional products such as water and energy funds, cleantech private equity strategies, country sustainability ranking as well as an ESG sovereign bond index.

Box 6: Digital Finance and Financial Decision-making – Example Applications

Leveraging digital technology's 'data power' to inform greener and more integrated risk assessments

Switzerland

In 2017, the FOEN and the SIF initiated pilot tests to analyse the climate alignment of financial portfolios. All Swiss pension funds and insurance companies could voluntarily have their portfolios of stocks and corporate bonds tested, anonymously and free of charge, for their compatibility with the 2°C target. The pension fund association ASIP and the Swiss Insurance Association SVV supported the tests carried out by the 2° Investing Initiative. The offer attracted widespread interest. 79 pension funds and insurance companies, which represent about two thirds of the total market in terms of assets under management, accepted this invitation. The tests showed that the Swiss financial sector remains insufficiently focused on climate-friendly investments. The testing of climate compatibility can contribute to the realignment of financial flows.⁹⁰

Carbon Delta⁹¹ uses a combination of publicly available and proprietary data and computer modelling to identify how much a company's value is possibly affected by climate change risks and opportunities. The assessment is at the overall company and security level. Its Climate Value-at-Risk (VaR) is an assessment method to quantify climate change risks in a framework that is applicable across investment portfolios, enabling climate change to be factored into investment decisions. Carbon Delta covers 22,000 publicly traded companies. The databases and tools it uses include the ones offered by public and research institutions such as the International Panel on Climate Change (IPCC), the Potsdam Institute for Climate Impact Research, and the Climada open-source natural catastrophe model developed by Swiss Re and run by ETH. Carbon Delta won the Risk, Intelligence & Security award at the European Fintech Awards 2017, selected from the European FinTech Awards Top 100 companies. It was recently commissioned by the UN Environment Finance Initiative to develop a climate risk tool for 20 global financial institutions.

Zurich-based RepRisk⁹² provides research and business intelligence related to responsible business conduct risks. Its software analysis involves a media and stakeholder screening of 80,000 sources based on the use of a proprietary IT tool. Analysts filter the screening results and, among others, score incidents according to a proprietary process. RepRisk can conduct assessments at the site or

asset level, looking at specific company activities and assets such as a factory abroad. It can also combine its assessment of the relevant publicly disclosed information with satellite data to consider factors such as proximity of a site to areas that face for example water scarcity or special biodiversity risks. Combining artificial intelligence with human analysis in 16 languages to translate big data into curated and actionable metrics, RepRisk counts alongside companies such as MSCI and Sustainalytics as one of the top ESG assessment agencies in the world. Its use of big data and AI enables it to deal with a wide scope of companies including not only large, listed companies but also mid- and small caps and private companies in 189 countries and territories.

Raiffeisen Bank advises property-owning clients on how to improve energy efficiency based on the Internet tool eValo, which was developed by an association co-founded by Raiffeisen. Based on a few details about the property and its energy consumption, eValo determines the energy efficiency class of a property and shows potential renovation scenarios and the related costs. eValo reduces complexity and in this manner facilitates decision-making about renovations to improve energy efficiency and reduce CO₂ emissions. Making full use of the advantages of increased digitalization and data availability, eValo was enhanced to simplify its use and to allow visualization of property in 3D.⁹³

Switzerland's geographic information systems (GIS) for natural disaster prevention and contaminated sites are very sophisticated and used for risk assessment and financial analysis. Highly granular information on contaminated sites has been an enabling factor for attracting direct foreign investments and boosting the mortgage business.⁹⁴ This digital environmental data infrastructure will be further developed by Swisstopo and the FOEN. In the near future, there will be a digital, publicly available data system, which will provide information on current property rights restrictions due to public law. This information is a supplement to the well-established register of real estate, which includes property rights restrictions under private law. This kind of information assures planning security for the next five to 10 years and thus helps greatly to have a well-functioning and attractive real estate market.⁹⁵

Global

Based on the EU-funded “Developing Sustainable Energy Investments (SEI) Metrics Project”, the 2° Investing Initiative⁹⁶ provides a free and open-source portfolio test for listed equity portfolios to factor climate goals into investments decisions. It introduces a framework for assessing the alignment of an investment portfolio with the 2°C climate goal. The assessment consists of comparing the energy and technology exposure of a portfolio with the 2°C roadmap of the International Energy Agency (IEA), thereby translating the climate goals and related scenarios into a ‘2°C benchmark’ for investors. The framework enables the assessment of an investment portfolio vis-à-vis a 2°C benchmark. The output of the assessment is an ‘energy and technology exposure gap’. This gap quantifies the over- and under-exposure to energy and technologies under a 2°C trajectory. Over 200 institutional investors around the world have signed up to test their portfolios, including large asset managers, pension funds, insurance companies, banks and sovereign wealth funds. Since its launch, over 2,000 portfolios have been tested for 2°C alignment with over US\$3 trillion in assets under management.

Palantir⁹⁷ integrates massive volumes of different sets of data to help national governments and organizations prepare for and respond to natural disasters and economic crises. It integrates publicly available data, damage assessments, satellite imagery, weather reports, geospatial

information on key infrastructure and relief resources, as well as reports from news agencies and governments – all available in a unified environment for users to search, analyse and explore.

Improving ESG integration into ratings and investment decision-making

Switzerland

Geneva-based Covalence⁹⁸ is a pioneer in the assessment of company disclosure and of what others say about them. Tracking the reputation of companies on an ongoing basis, its features include permanent online monitoring, the automation of data extraction and classification, and the use of a team of analysts working with universities worldwide. Covalence offers extra-financial ratings of large market capitalizations worldwide. It provides data on sensitive issues affecting 3,400 companies, and has worked with over 600 analysts in 40 countries since 2001. As of 2013, it uses AI, including natural language processing. It investigates disclosure by companies (including indicators reported by companies) as well as information from third-party sources that reflects the views of stakeholders including NGOs. It assesses online, publicly available content and social networks such as Twitter. Machine learning enables the comparison of third-party news with what corporates disclose, tracking positive/negative sentiments and classification of text in terms of key ESG themes.

The Centre for Social and Sustainable Products (CSSP)⁹⁹ is the technology and innovation incubator behind yourSRI.com – a fintech platform that screens about EUR15 trillion of assets under management per day, enabling investors with one click to create ESG and climate investment ratings, investment KPIs and investment reports for mutual funds, exchange traded funds (ETFs) as well as discretionary investment mandates. yourSRI.com brings together traditional financial data (Thomson Reuters/Lipper), ESG data (MSCI ESG Research) as well as carbon data (ISS-Ethix) to automatically determine a fund's ESG score as well as its carbon footprint. In this way, yourSRI.com creates transparency for investment decision-making to more easily integrate ESG and carbon considerations. To increase accessibility, yourSRI will launch a country-specific ESG and Climate Fund Rating investor information platform in local languages and with a country investment focus in many European countries in late 2018 (e.g. yourSRI Germany, yourSRI France, yourSRI Italy).

Digital finance has unlocked a new business model that makes yourSRI accessible and affordable to retail investors. The traditional business model with financial data providers is a costly license business-to-business (B2B) model, with access to everything. With digital finance, yourSRI offers every user access to all ratings and KPIs free of charge and then through a 'pay per view' revenue-sharing model, users who require additional details only pay for the additional reports they view. This business-to-consumer (B2C) model rather makes yourSRI affordable to both institutional and retail investors.

Through an application programming interface, yourSRI.com becomes the data engine for other providers, including:

- Fossil Free Funds¹⁰⁰ – a US search platform enables investors to find out if individual investments or an employer-provided 401(k) is being used to extract and consume fossil fuels. To independently analyse and calculate carbon footprints for the mutual funds, Fossil Free Funds uses the "Carbon Footprint Analysis Tool" of yourSRI.com, which provides the information on corporate emissions worldwide.
- Climetrics¹⁰¹ – an independent European fund rating that enables investors to integrate climate impact into their investment decisions. Climetrics provides investors with a rating –

symbolized by green leaves “issued” on a scale of one to five – based on a comprehensive, three-level methodology.

Global

The Solactive Sustainable Development Goals World Index is hosted by the German index provider Solactive. Eligibility for inclusion in this platform is determined based on a methodology that maps the SDGs against companies’ products, services and behaviours.¹⁰² The European ratings agency Vigeo-Eiris developed the methodology, using indicators linked with diverse sectors, from health care to water management, public transport, energy efficiency and microfinance. Banks (as is done by BNP Paribas) for example can use the methodology to assess the links between their lending and SDGs, and to launch thematic funds on topics such as water management, agrifood and sustainable cities.

Deutsche Bank¹⁰³ has launched a tool that uses big data to rate 5,000 companies’ performance on ESG factors. The web-based tool studies the language contained in companies’ US Securities and Exchange Commission filings, as well as scouring press releases and news articles related to the company for combinations of keywords that relate to factors that could affect their performance and valuation. The tool compares the results with similar studies of other companies and the algorithm tracks the performance of these case studies, in terms of their returns, their risk and changes in valuation multiples to provide transparency to portfolio managers. The tool enables investors to incorporate intangible information that the market is not fully pricing.

Sustainalytics¹⁰⁴ with its headquarters in Amsterdam, leverages big data and AI to provide cheaper incorporation of ESG considerations into investment decision-making. Sustainalytics’ data services enable investors to integrate environmental and social research into their internal or third-party systems (such as Bloomberg). Data delivery is automated and allows the creation of databases, reports and dashboards to facilitate data analysis and decision-making.

TruValue Labs¹⁰⁵ in San Francisco offers a customizable AI-powered engine that helps investors identify sustainable investments they are interested in. It uses machine learning and natural language processing to analyse unstructured data in real time, extracting relevant metrics and turning them into material insights for investment decision-making.

Similarly, the Dutch-Anglo eRevalue¹⁰⁶ in London uses its Datamaran AI technology to scan annual financial and non-financial reporting by listed companies to determine their key material topics. Datamaran fully automates previously manual processes for benchmarking, materiality analysis and ESG risk identification.

Natural Capital Project in the US offers Integrated Valuation of Ecosystem Services and Tradeoffs (InVEST)¹⁰⁷ a free and open-source software suite to inform and improve natural resource management and investment decisions. InVEST quantifies, maps and values the goods and services from nature that contribute to sustaining human life.

Lowering the costs of validating positive impact and climate-friendly investments through blockchain

Switzerland

The Blockchain for Social Impact Coalition (BSIC)¹⁰⁸ promotes the development of blockchain products and solutions to address social and environmental challenges associated with the SDGs. Its four focus areas are financial inclusion, energy and environment, supply chains as well as vulnerable

populations. One of its members is the Zug- headquartered IXO Foundation.¹⁰⁹ Building Smart Impact Bonds, its transnational information network seeks to enable anyone interested to become the creators of their own impact projects and support for example environment-related SDG projects of their choice. The IXO Protocol uses emerging Web3 standards to enable high-definition impact data to be collected in a new data format referred to as Verifiable Impact Claims. Impact Claims are submitted to the IXO Network to be evaluated through an efficient, incentivized mechanism. Evaluations are assisted by software agents that work as smart oracles, pulling in triangulation data from external references, to algorithmically predict whether a claim is true. Over time, this is optimized through machine-learning and predictive analytics.

Global

Experience from China with Energy Blockchain Labs¹¹⁰ and IBM has shown how blockchain and IoT can be used to digitize and automate the process of green finance certification. IoT chips embedded in green assets such as panels in solar power plants can gather information for green finance certification. AI algorithms and smart contracts process the resulting data and evaluation results are transmitted via blockchain to ensure the evaluation process is transparent, standard-compliant, and tamper-resistant. Certification results are stored on blockchain in a distributed way, which allows access to all relevant parties, including project managers, financial intermediaries and regulators.

In Sweden, a “Green Asset Wallet” innovation project aims to increase sustainable investment through a blockchain platform that reduces information asymmetries and increases efficiency and transparency in the green debt market.¹¹¹ It brings together a diverse set of partners – commissioned by the German Ministry for Economic Cooperation and Development (BMZ), incubated by Stockholm Green Digital Finance, and built by a consortium of financial institutions, research institutes and fintech partners from Nordic and emerging market economies. The platform will validate delivery and green claims of investments by verifying evidence; put impact reporting on the blockchain to support issuers and investors demonstrate positive impact; and enable new entrants to build a track record and their credibility.

4.2 Digital Finance Incentivizing More Resource-efficient Consumption and Production Patterns

Digital finance is demonstrating its potential to incentivize more sustainable and resource-efficient consumption and production patterns. Digital technologies provide information and transparency at scale and a low cost on the environmental impact of consumption choices. Big data and AI can calculate the carbon footprint of financial transaction data, highlighting to citizens for the first time the environmental impact of their purchases in real time. Combined with social media, this creates opportunities for large-scale awareness and mobilization campaigns that could systematically shift consumers towards more sustainable consumption purchases and promote investment in greener production. Digital finance enables more personalized services, more participatory engagement and tailoring to interests such as environmental care, important considerations for a younger generation of Millennials that Swiss financial institutions have recognized as a “supertrend” along with the Digital Revolution.¹¹²

Upstream in the value chain, digital technologies can unlock financial incentives that reward sustainability in supply chains. By providing more detailed and reliable information about the environmental impact of company supply chains, IoT and blockchain technologies can help financial institutions incentivize sustainability in supply chains with access to faster and lower cost working

capital. Additionally, blockchain can also facilitate the speedier sale of green bonds for the development of infrastructure that support more sustainable consumption and production patterns.

New payment technologies such as mobile payments and integrated billing can be employed to support more resource-efficient consumer choices, such as a greater use of cleaner and public transport offers. Mobility services, including the use of electrical vehicles with loading stations at shopping centres for example, have become increasingly popular in Switzerland in recent years.

Opening banking is also likely to offer consumers more choice. The European regulatory agenda is advancing open banking, with the EU Payment Services Directive 2 (PSD2) including an Access to Accounts (XS2A) provision that requires banks, upon request by customers, to provide third parties access via application programming interfaces (APIs) to customers' data. Consulting services in Ecosystem Relationship Management (ERM) are emerging to help banks find the best ways of collaborating with fintech start-ups from a growing industry of applications (apps) for functions such as personal loans, automated investing, credit monitoring, budgeting and processing payments. Such personalized services open the way for new services to help consumers advance more sustainable consumption and production patterns, combining awareness-raising of the sustainability agenda with new functionalities.

Cryptocurrencies are creating innovative incentives for greener consumption and production patterns. Green action can be rewarded with cryptocurrencies that can be used as a means of payment or traded in market exchanges. Blockchain also enables transparent P2P trading of decentralized energy. Such direct trading of solar energy between residents also creates incentives for more small-scale solar installation. Innovation in this domain can build on the experience of early pioneers such as Opower in the US, founded in 2007 and acquired by Oracle in 2016.¹¹³ Opower developed a customer engagement platform for utilities, relying on statistical algorithms to perform pattern recognition analysis and behavioural psychology techniques (peer comparison) to move households to reduce and clean their monthly electricity consumption.

Box 7: Digital Finance and Resource-efficient Consumption and Production Cycles – Example Applications

Incentivizing resource-efficient consumption

Switzerland

My Drop in the Ocean¹¹⁴ is a Swiss social enterprise that has created a global complimentary currency called DIO. The platform brings together consumers and businesses to encourage smart consumption and responsible decisions. It is designed to return value to nature by rewarding consumers and businesses for their sustainable actions. The platform creates a link between the value of environmental costs and the issuing of a digital currency that can be used by consumers to pay for purchases at participating businesses. This includes consideration of lifestyle ecological footprints, among others the carbon footprint of transport use.

Climatecoin, issued by the Climatecoin Foundation¹¹⁵ in Zug provides a cryptocurrency that allows all citizens to participate in climate mitigation and adaptation. Democratizing the carbon markets through blockchain technology, it set out to become the first carbon-zero cryptocurrency in the world. The Climatecoin Foundation presents itself as a token-as-a-service business model, which allows contributors to purchase a token stapled to a carbon credit certificate (giving it a floor value)

that will allow buying or exchanging carbon credits of a different nature using the Climatecoin Portal. In terms of fungibility, the trading implies that one CO₂ token is totally equivalent to another unit of the same CO₂ token with the same functionalities and utility purposes. Token holders will be able to mitigate their carbon footprint by selecting and purchasing carbon credits from a wide variety of mitigation projects, using the Climatecoin trading portal.

Promotion of public transport use by the Swiss railway company SBB/CFF/FFS includes online ticket sales with Ecocalculator information on CO₂ savings compared to travel by car.¹¹⁶ With offers such as P+Rail, bicycle parking spaces and partnerships with car mobility and bicycle sharing providers, the SBB promotes climate-friendly travel.

The environmental savings account of the Zürcher Kantonalbank¹¹⁷ is a trend-setter that lends itself to digital support and tracking progress in a transparent manner. Customers forego a portion of their interest, which is invested in improving life, environment and air quality in the Zurich area. Customers are informed annually on how the funds were used. This ensures transparent reporting on the sustainability impacts achieved.

Global

The Ant Forest¹¹⁸ mobile application in China, initiated by Ant Financial Services in association with UN Environment, is the world's first large-scale pilot to green citizens' consumption patterns by using mobile payment platforms, big data and social media. The app encourages citizens to reduce their carbon footprint through a three-part approach: (a) providing individualized carbon savings data to people's smartphone, (b) connecting their virtual identity and status to their earnings of 'green energy' for reduced carbon emissions, and (c) providing carbon offset rewards through a physical tree planting programme. Over the first 16 months from August 2016 to December 2017, 280 million people across China voluntarily joined this app, which resulted in over 2 million tons of cumulative carbon avoided and over 13 million trees planted.

Bundles,¹¹⁹ in the Netherlands, is a start-up that sells washing cycles instead of washing machines. Through a leasing model, it offers appliances that use relatively little energy, water and detergent and last twice as long as the average appliances. A device monitors how the washing machine is used. Statistics are displayed in an app, providing customers with insights into the overall cost of doing the washing, including energy, water and detergent. To stimulate 'good behaviour', customers who use the machine optimally are rewarded with reduced monthly fees. In collaboration with Rabobank, Bauwinvest and Miele, Bundles has been taken beyond the start-up phase to explore ways to structure long-term funding that creates relationships within the supply chain using a circular economy approach. It is funded through crowdfunding and equity support.

Incentivizing resource-efficient production

Switzerland

SolarCoin¹²⁰ is a reward currency that values and incentivizes solar production. By tokenizing and listing it on an exchange (Swiss-based Lykke, and others) and making it fungible with fiat currency, trading in SolarCoin, currently circulating in 62 countries, becomes available to anyone with a digital wallet. Producers are rewarded with SolarCoin for producing verifiably solar energy at a rate of 1 SolarCoin per MWh of solar energy produced. SolarCoins can be used as a means of payment or traded in market exchanges. This fungibility goes some way to addressing the liquidity barrier of traditional impact investments and opens the marketplace to a global audience. SolarCoin also uses

a low-energy proof of stake algorithm designed to use less than 0.001% of the power of Bitcoin on a similar scale. A further iteration of the use of SolarCoin is the establishment of a social enterprise Power One for One, where SolarCoin rewards can be donated and paid forward in a circular economy to help bring local solar production to the 1.3 billion people without electricity.

The Energy Web Foundation (EWF)¹²¹ based in Zurich is building Origin, an open-source blockchain platform for renewable energy and carbon markets. Origin will track the green attributes of certified renewable energy, across many locations, on a single platform, increasing incentives for renewable energy production through lower transaction costs, greater transparency and increased market participation. It aims to create transparency at the kWh level rather than the existing MWh that is relatively high for residential customers.

Global

Electron in the UK is building a trading platform that will allow electricity consumers to be paid to adjust their consumption to help balance supply and demand. Japanese utility Tepco was an early-stage investor in the company and has formed a consortium with nine other energy companies to further develop this 'flexibility trading' platform.

4.3 Digital Finance Unlocking New Sources of Finance and Matching Investment Opportunities

Digital technologies enable citizens to play a more direct role in the financial system, unlocking new sources of finance and increasing access to finance. Crowdfunding and P2P platforms provide low-cost ways of reaching millions of users. Such platforms enable a new pool of 'bottom-up' investors to directly participate in the financial system, increasing access to finance particularly for small and medium-sized enterprises (SMEs). Big data, AI and automation have also enabled new providers to offer targeted and more convenient services that transform credit evaluation, offering loans to a broader base of customers and businesses. As fintech solutions are efficient and effective at a lower scale, small businesses are expected to be one of the main beneficiaries of the disruptive power of digital technologies.

Online investment platforms are also creating marketplaces that bring together and facilitate 'matchmaking' between sustainable technology businesses and financial institutions or other market participants. Such platforms offer a combination of curated deal flow, data on deals, and AI to match investors to their preference. Marketplaces for borrowers can consolidate the offerings of various lending sites towards SMEs. Marketplaces for investors allow investors to automatically invest across platforms based on specified criteria, often via APIs. Information platforms dedicated to green and sustainable finance can be used to link lenders and investors to projects developers.

In addition to matching investors with entrepreneurs and small businesses, it is also important to consider ways in which digital technologies can be used in private wealth management to connect private investors with emerging green businesses. The European Responsible Investing Fund Survey has shown that Switzerland's share in the European universe of registered environmental themed funds is around 5% (EUR1.3 billion by 2013). In its report commissioned by the FOEN, PwC (2014) has recommended that Switzerland seeks to be a hub (not a domicile) for sustainable fund management and that Switzerland supports high net worth individuals (HNWI) investment strategies.¹²² In its report to the UN Environment Inquiry, the Swiss Government (FOEN, 2015)¹²³ has argued that the future of private banking includes catering to HNWI who are taking the ESG agenda more seriously and are looking for solutions that match their aim of achieving positive impacts through their investments. Private banking and wealth management is the largest source of income in Swiss banking, and represents an important opportunity

considering that Switzerland is the global leader in cross-border wealth management, with a global market share of 25%.¹²⁴

Switzerland's "Crypto Valley" Zug has enabled the country to benefit from the global ICO¹²⁵ boom. According to the 2017 IFZ Fintech Survey, Swiss fintech companies have raised CHF271 million in this way.¹²⁶

Box 8: Digital Finance, New Sources of Finance and Matchmaking – Example Applications

Inclusive finance and improved access in emerging markets

Switzerland

The Geneva-headquartered Temenos¹²⁷ helps banks worldwide with new software applications and the use of cloud technologies to reach clients in new ways. Specializing in software for finance and banks, Temenos supports over 2,000 firms, including 38 large banks, to process the daily transactions of more than 500 million banking customers. Temenos estimates that while the use of the cloud in microfinance is still nascent, by lowering infrastructure costs it can lower the cost of borrowing to the end customer by more than 90%. Temenos works with 240 small banks across 36 countries in Africa, Southeast Asia and parts of Latin America, where formal commercial banks have neither the means nor the interest in serving relatively low value accounts. It addresses the problem of the costs of servicing relatively low value accounts, deposits or loans in a way that it is profitable for the provider and affordable to the client. Its supply-side solution enables banks to reach out to the underbanked community.

Global

M-Akiba¹²⁸ is a Government-of-Kenya-issued retail bond that offers Kenyan citizens the opportunity to directly invest infrastructural development projects, both new and ongoing. It builds on M-Pesa, which revolutionized financial inclusion through 'mobile money' and M-Kopa, which leverages the M-Pesa mobile money platform and digitally enabled solar assets to take off-grid clean energy to poor and excluded communities.

Matchmaking

Switzerland

Greenmatch¹²⁹ is a Swiss company that digitalizes the investment process for renewable energy. Greenmatch offers tools to value and assess renewable energy projects, calculate scenarios and manage project proposals on a software-as-a-service (SaaS) basis. This makes it easier for investors (from public utility companies to banks, institutional investors, private equity funds, asset managers and citizens' energy cooperatives) to accelerate the evaluation of project pipeline. It reduces the barriers for investing in complex renewable energy projects. It also offers a marketplace, offering projects created in Greenmatch directly to potential buyers. In this way, anyone as a project seller can reach the entire Greenmatch community.

Blue Yellow¹³⁰ is a Swiss company that digitalizes green energy investments through combining a platform for buying and selling renewable energy projects with quantitative fintech solutions. Project developers, utility companies, municipal authorities, governments or asset managers can sell their renewable energy projects directly to investors worldwide through the Blue Yellow platform. Bringing the investment process online to a centralized platform leads to higher standardization and

commodification of the investment process. The platform and quantitative fintech solutions help to reduce information asymmetries, lower the cost of capital for renewable energy projects, and make smaller projects viable for financial investors.

Raising finance through cryptocurrency

Switzerland

Swiss Sela-labs¹³¹ are piloting DLT and token use to unlock development financing for sustainable economic development in Nigeria with the first-ever community clean-up of an oil spill in the Niger Delta. Sela creates a marketplace of trustworthy individuals who propose their own development projects and connects them with capital, eliminating many of the risks associated with funding grassroots projects.

Global

WePower¹³² in Lithuania is a blockchain-based green energy trading platform that helps developers of wind or solar energy projects raise capital by selling energy tokens that represent energy they commit to deliver. WePower uses blockchain technology to record when, and in what volume, green energy financed in this way was produced and supplied into the grid. Each energy token carries data on the type of energy generated, the time of production and delivery, and the price.

Power Ledger in Australia uses blockchain technology to allow residents to trade solar-sourced electricity between themselves. The price of the power is higher than the feed-in tariff but lower than residential retail rates, thus providing an incentive for more developers to install rooftop solar systems. The company raised AUD17 million (US\$13 million) in just 72 hours in August 2017 and, a few weeks later, announced a trial of its trading platform with Australia's leading energy retailer, Origin Energy. It has subsequently announced trials in India and Europe to develop low-cost, low-carbon, distributed energy markets on 'microgrids'.

4.4 Digital Finance Unlocking Innovations in the Real Economy

Business model innovation is an area where digital finance most clearly has the potential to bring more than just efficiency improvements and alternative products and services. Innovative business models are increasingly beginning to emerge in both the services and real economy, unlocked by advances in digital finance. Such business models are well suited for private equity, venture capital and impact investment. A well-known example is the 'product-as-a-service' business model, enabled by mobile payment platforms and digital, IoT embedded assets. This business model allows customers to use products through a lease or pay-for-use arrangement versus the conventional buy-to-own approach. IoT technology makes it easy and cheap to remotely regulate the use and functionality of devices. The 'product-as-a-service' model has revolutionized the decentralized renewable energy sector, particularly in emerging markets.

Similarly, digital finance unlocks sustainable business models at the interaction between the circular and shared economy. For example, the sharing platforms model is centred on sharing products and assets with a low ownership or use rate. This creates environmental benefits in some cases (car sharing lowers traffic congestion and pollution) and enables companies to maximize value creation. Other innovative business models with environmental benefits include the resource recovery business model, which leverages technological innovations to recover and reuse resource outputs, eliminates leakages and maximizes economic value (for example, closed-loop recycling), and the product life extension model,

which helps companies extend the life cycle of their products and assets, reducing waste and creating new sources of revenue.¹³³

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

IoT applications have especially significant implications for the insurance industry and their business models. This involves new possibilities in the use of sensors at the level of individuals, vehicles and locations as well as the use of geographic information systems to support for example disaster management. To date, insurance approaches use financial models dependent upon statistical sampling of past performance to forecast future outcomes, relying on backward-looking claims data and historical risk studies. IoT sensors can help insurers change this and move from historical proxy data to current source data. Data science today enables predictions based on real events, in real time, using large data sets. Through constant monitoring, underwriters can recommend real-time pricing and policy term services in for example the area of health and well-being to manage mortality and morbidity risks.¹³⁴

These applications can be used to address not only security, health and safety risks but also related environmental risks and opportunities. In the non-life insurance industry, developments in Europe have shown that especially in this region, the use of new technologies such as IoT telematics and online platforms is driving distribution and pricing changes.¹³⁵ The possibility of remote assessments through digital technologies of people (e.g. image recognition) or locations (e.g. properties) could make life easier for underwriters.

New applications include the possibility of using blockchain to support more resource-efficient and cleaner maritime transport. EY, Guardtime and Microsoft have developed a blockchain platform for the marine insurance sector in collaboration with A.P Moller-Maersk.¹³⁶ This is of special interest to maritime industry companies, including Geneva-headquartered MSC (a winner of the 2016 Green Shipping Awards). Related to the use of geographic information systems, the digital images that drones capture, can speed property assessments during underwriting and property loss assessment while processing claims. This is especially relevant in cases such as natural disasters where the properties are difficult to access. Insurers are well aware that digitalization offers new ways of drastically reducing “time-to-settle” (claims), the metric that customers most care about.¹³⁷

Box 8: Digital Finance (including Insurtech) Unlocking Innovations in the Real Economy – Example Applications

Switzerland

Swiss Re offers insurance coverage for “sustainable energy solutions”, for example wind farms in different parts of the world. Signalling areas where digital technologies are also increasingly relevant, Swiss Re offers (i) insurance-linked securities (ILS) or catastrophe bonds, enabling large

risks to be transferred to the capital markets, and (ii) index-based insurance products, using an index to determine and automatically trigger payments.

Zurich Insurance provides coverage for solar projects in countries such as China and South Africa. In Europe, it offers customized coverage for private home owners and SME companies to build renewable energy facilities (e.g. photovoltaic, solar thermal, biomass and geothermal installations). Supporting electrical vehicle use in Europe, it offers additional accidental damage cover for batteries used in electric vehicles, insurance discounts for use of such vehicles, as well as tailored breakdown assistance for private electric car users. Both the renewable energy facilities and electrical vehicles offer opportunities for the introduction of digital technology or insurtech applications such as IoT to further improve the sustainability service offered, and include reliance on real-time performance data.

CelsiusPro¹³⁸ offers global insurance digitalization solutions for insurers with focus on weather, agricultural and parametric natural catastrophe (NatCat) products. The offering includes: seamless front-to-back solutions from data sourcing, pricing, policy management and settlement to climate and NatCat monitoring tools. The company uses publicly available data from institutions such as NASA and national meteorological offices on for example rainfalls, storms, earthquakes and vegetation to support the digitalization of traditional insurance offerings in notably emerging markets. These include weather and yield index as well as parametric NatCat insurance schemes, introduced through local insurance companies at affordable rates to for example farming communities.

Global

Opus One Solutions in Canada offers a dynamic software platform that gives utilities, owners of distributed energy resources and other market participants visibility into electricity distribution grid in real time. This unlocks new customer and utility business models, and helps utilities determine where investments add the most value with the transition towards distributed grids.

Crédit Agricole Assurance and Airbus in France are opening up new opportunities for grassland insurance. Grasslands are sensitive to climate variation and are at the heart of livestock farming. Satellite imagery allows precise calculation of losses, which allows the development of innovative insurance products for farmers for the first time in this area.

M-Kopa's¹³⁹ proprietary platform combines GSM technology with a solar power kit to allow instalment and 'pay-as-you-use' financing for low-income customers in Kenya. In 2014, the Commercial Bank of Africa fronted a US\$10 million commercial-grade syndicated debt facility as part of a US\$20 million funding round. This investment marked the first time that a commercial loan was secured through mobile money provider M-Pesa receivables and was unique in that the loan book consisted of low-income borrowers, many without bank accounts. Lenders included the Bill and Melinda Gates Foundation, LGT Venture Philanthropy, Imprint Capital and the Netri Foundation. M-KOPA has raised US\$45 million in total equity funding and debt financing.¹⁴⁰ It has connected 600,000 to affordable solar power as of January 2018 with a projected US\$450 million in savings by current customers of over the next four years.

5 Analysis of Findings, Challenges and Unintended Consequences

5.1 From Analytical Framework to Analysis

In order to move from the analytical framework in section 4 to the analysis in this section, Table 1 summarizes the findings from the mapping exercise within the Swiss context. It highlights recognized strengths of Switzerland and lead areas in terms of technologies, financial market subsectors and key environment-related themes addressed by Swiss players. Table 1 also helps to prepare for suggested recommendations provided in Section 6, considering areas of strength for which the Swiss economy is internationally recognized and early developments in applying these to the domain of fintech and the environment as well as SDG agenda.

Table 1: Mapping Analysis within the Context of Switzerland

Internationally recognized strengths of Switzerland	Progressive areas of green digital finance value addition	Leading technology application areas	Leading subsectors of the Swiss financial industry	Key thematic focus areas for Swiss players
Top innovator, including expert research and education community	Innovation for the SDGs, based on new business models	DLT, blockchain and cryptocurrencies	Investment and insurance, e.g. venture capital, private wealth and risk coverage for new business models	Circular economy business models Green infrastructure, sustainable cities
Top finance manager and trader, including strong ecosystem infrastructure	Unlocking new sources of finance	Matchmaking platforms and DLT, including crowd lending / investing / trading	Banking and impact investment, e.g. for small business support	New markets in cleantech, e.g. renewable energy technologies
High consumer awareness, including civil engagement and international exposure	Incentivizing more resource-efficient behaviour	Crypto, online and mobile services, including payments and banking infrastructure	Banking, e.g. cooperative and retail banking	Online commerce & support for eco-fair products, waste management, sustainable mobility
Stable, reliable regulator and enforcer, including public-private collaboration	Greening financial decision-making	Analytics, including big data and MLAI for integrated risk management and IoT for bottom-up data monitoring	Investment and insurance, e.g. hybrid integration in investment management and underwriting	Negative screening, considering e.g. environment, health and safety Positive screening, considering e.g. green growth areas Climate risk and disaster management

It is important to note that elements in Table 1 reflect an early assessment of the current situation in Switzerland. As Section 5.2 analyses developments related to them, it adds suggestions for “what could be”. It highlights areas where current practices by established financial institutions and innovations focused on by Swiss fintechs could be expanded to address the green and sustainable development agenda. The concluding section will build on this and suggest recommendations by each stakeholder group in Switzerland.

5.2 Analysis of Main Findings

As a global leader in sustainable finance, digital technologies and innovation, Switzerland is well positioned as an international hub for green digital finance. The section below sets out key findings and

potential opportunities that emerge from an analysis of our mapping exercise in Switzerland, highlighting trends in terms of leading financial technologies, leading financial market subsectors and leading environmental themes that emerge. The related recommendations for taking action are fully fleshed out in Section 6.

Key developments in terms of technologies: *Green digital finance practices in Switzerland today leverage a mix of underlying technologies, which are at various stages of maturity (see Table 2). In line with Switzerland's leadership in investment screening, most green digital finance applications in Switzerland leverage big data and MLAI technologies to 'green' investment decision-making. Matchmaking platforms have emerged as ways of unlocking new sources of finance, notably for renewable energy projects, but adoption is still low. Switzerland's leadership in cryptocurrency creates unique opportunities to establish itself as a global "green crypto-financial centre". Mobile and online financial services are entry points to incentivizing consumers to make more resource-efficient choices.*

- **In line with Switzerland's leadership in investment screening, most green digital finance applications in Switzerland leverage big data and MLAI technologies to 'green' investment decision-making:** Connecting the mainstream investment management practices and emerging fintech innovations targeting the investment sector through a green thematic holds great potential. Existing investment management practice includes the application of exclusion criteria based on environmental destruction, screening based on environmental norms such as climate care, definition of best-in-class practices, investment in green funds such as water and energy, as well as impact investing (supported notably by private banking and wealth management). Swiss fintech start-ups are improving their ability to raise venture capital (VC), and their preferred product focus areas hold the potential to support the mainstreaming of responsible investment practices. Following life sciences (biotech, medtech) and related industries, Swiss start-ups from the ICT (including fintech) sector have been the most successful sector in raising VC in the last two years. The link between such capital mobilization and investment in cleantech is more limited. Most fintechs in Switzerland are focused on product areas related to investment management and banking infrastructure, followed by DLT/blockchain, deposits and lending, as well as payments and analytics.¹⁴¹ These fintech start-ups need to be challenged to take on the environmental and climate agenda in offering analytical services to the mainstream investment sector, in Switzerland and globally.
- **Matchmaking platforms have emerged as ways of unlocking new sources of finance, notably for renewable energy projects, but adoption is still low:** Switzerland's strong capacity in financial and investment analysis has catalysed innovation to address challenges in evaluating green and cleantech investments through digital technologies. Blockchain and MLAI standardize and improve the transparency of due diligence processes, while online technologies also reduce transaction costs of bringing investors and project developers together. The result is an efficient digital solution to unlocking new sources of finance for green projects. However, these platforms are still small-scale, with low rates of adoption. Investors may be reluctant to invest in projects that have not been through their own due diligence process, and targeted support may need to be considered to help such platforms grow. An example is targeted support provided by the Canton of Vaud through its innovaud programme which supports innovators and start-ups in cleantech.¹⁴²

- **Switzerland’s leadership in cryptocurrency creates unique opportunities to establish itself as a global “green crypto-financial centre”:** Switzerland’s favourable approach and regulatory environment towards cryptocurrency and tokenization, combined with its strong innovative capabilities, has enabled Switzerland to take the lead in the area of cryptocurrency and its underlying technologies. The cities of Zug (Crypto Valley) and Chiasso (Cryptopolis) are establishing themselves as internationally recognized DLT centres, with the number of incorporated fintech companies in Zug second only to Zurich’s. Switzerland’s decentralized political system creates an inherent understanding about how a decentralized network system operates. The Swiss government continues to look towards advancing DLT, blockchain and cryptocurrencies. According to the Swiss Federal Councillor, Switzerland aims “to be the crypto-nation” and Zug recently demonstrated the successful test of a blockchain-based voting platform.¹⁴³ Given the number of potentially impactful applications of cryptocurrency and tokenization to the environment and sustainable use of natural capital assets, this creates a unique opportunity for Switzerland to combine its leadership in sustainable finance and DLT to spearhead green digital finance cryptocurrencies and tokenization and become a “green crypto-financial centre”. This will involve creating green currencies and enhancing the additional benefits of DLT – notably its ability to create new markets.
- **Mobile and online financial services are entry points to incentivizing consumers to make more resource-efficient choices.** As an advanced European economy with strong public interest in topics such as eco-fair trade and sustainable lifestyles, there are windows of opportunity to link increased personalization of mobile and internet-based financial services, with the sustainable consumption and production agenda. Growing fintech services in banking infrastructure (including open banking and personal finance) can be linked with payment as well as lending or deposits to support more sustainable online purchasing, household financial planning and crowd financing in support of circular economy projects. Collaboration between fintech start-ups and large financial institutions (e.g. retail banks), considering how they jointly can provide improved services to consumers and small businesses, would be helpful in taking this forward.

Table 2: Prevalence in Switzerland of Digital Financial Technologies Used to Achieve Sustainable Outcomes

	Financial decision-making	Resource-efficient choices	New sources of finance	Business innovation
Machine Learning/AI	Prevalent	Early prevalence	Early prevalence	Early prevalence
Big data	Early prevalence	Early prevalence	Early prevalence	Early Prevalent
Mobile / Online Platforms	Prevalent	Prevalent	Early prevalence	Prevalent
Blockchain & Crypto	Nascent	Early prevalence (crypto)	Early prevalence (crypto)	Nascent
IoT	Nascent	Nascent	-	Nascent

Key developments in terms of the financial sector: There are opportunities to connect green products and services from more established banking institutions with generic digital finance innovations introduced by fintech start-ups; expand the insurance sector's focus to leverage IoT and DLT to unlock new business models that address security, health and safety risks as well as related environmental risks and opportunities; and connect private banking and wealth management institutions with digitally advanced impact investment, and engage the institutional investor community in ESG integrated approaches that employ new digital technology analytics.

- **As the Swiss banking sector seeks to expand its international reach, it has a window of opportunity in taking green products and services to scale on the back of digital technologies:** The Swiss banking sector can be viewed in terms of the big two banks (UBS, Credit Suisse), many medium-sized, including cantonal and private banks, as well as a few small, specialist banks established with sustainability themes as their *raison d'être*. As part of an effort to create an added value in an increasingly competitive and regulated international banking environment, all of these banks have experimented with offering sustainability/green thematic services. Growing to scale, including beyond Switzerland, is decisive for these banks. However, the connection between these new sustainability and green services offered by banks with digital finance remains limited.
- **An increasingly vibrant fintech start-up community in Switzerland is still limited in terms of taking on a green and sustainable development agenda:** Growing numbers of fintech start-ups in Switzerland are heavily focused on the generic business benefits of using digital technologies (including e-banking). Yet a limited number have an explicit focus on the sustainability or green agenda, as illustrated by the few pioneers highlighted in this study. The challenge is therefore to connect the sustainable and green thematic products offered by major Swiss banks (including cantonal and private banks), with the digital finance solutions offered by fintech start-ups. Here lies the potential to scale green lending and related services on a global scale. This includes rolling out innovative banking business models that provide new outbound services such as green mortgages through intermediaries as well as new inbound services such as support for cleaner electrical transport use.
- **The insurance sector in Switzerland is at the forefront of leveraging digital technologies to improve products related to managing climate risk:** In a market dominated by Zurich Insurance and Swiss Re, the insurance sector in Switzerland has been leading innovators in addressing climate risk and experimentation with new fintech innovations such as parametric or indexed-based weather insurance. Today this incorporates key services for sectors such as agriculture and commodity trade, including use of satellite data and the roll-out of catastrophe bonds. Key opportunities include use of blockchain as well as IoT in offering more efficient and expanded services. The B3i initiative provides a promising example of industry collaboration between peers to explore new possibilities and innovation at scale in the use of blockchain-based smart contract systems. Special consideration needs to be given to better addressing environmental risks based on the advantages of such DLT-based systems in the insurance value chain – e.g. more efficient processes including disaster relief and faster settlement of claims by, for example, victims of natural catastrophes.
- **More progress in the Swiss insurance offer remains to be made in the use of IoT to support the development of safer and more sustainable communities:** There is room for the insurance sector

to better leverage IoT to deliver new business models and innovative risk management offers to the real economy. This includes opportunities at the level of products-as-service-systems, transport and locations such as real estate and factories to improve resource efficiency, monitor safety and improve maintenance. Consider for example, the use of IoT applications to monitor responsible chemicals management, including management of inventories and transport of hazardous substances.

- **While impact investing (including microfinance) is growing, it remains a ‘niche of niche’:** With an annual growth rate of close to 30% since the mid-2000s, sustainable investments managed from Switzerland have made significant progress and displayed stronger growth than the overall Swiss investment market. These include sustainability-focused mandates, special themed funds such as sustainable property and renewable energy, and asset owners becoming more active. Progressive mainstreaming shows growing emphasis on integrated approaches – i.e. the integration of ESG criteria in financial analysis and investment decision-making. Yet, the overall volume of sustainable investments is still a niche market (around 8.7% of the overall Swiss investment market according to the Forum Nachhaltige Geldanlagen 2017 and Swiss Sustainable Finance 2018), and impact investment remains the ‘niche of the niche’.
- **Pension funds in Switzerland are seen as lagging behind in terms of commitment to ESG-themed investment strategies:** Switzerland is not seen as a global leader in sustainability-oriented investment management, and Swiss institutional investors in the form of pension funds have been seen as lagging behind their peers in Europe in committing to ESG-themed investment strategies. The question is, therefore, how to move beyond internationally recognized niche strategies – such as ESG screening and impact investment – to a Swiss-made, flagship brand as responsible and green investment market. The vehicle for making this happen can be digital technologies, notably combining local sustainability expertise with fintech innovations to roll out integrated strategies at global scale. This includes employing big data and MLAI analytics to process PAED, taking publicly available scientific data on matters such as climate change, resource use and sustainable lifestyles and translating it into decision-useful information for long-term focused investors.

Key developments in terms of environmental focus areas: Growing international regulatory interest in banking and investment management practices combined with high levels of awareness among Swiss citizens of global sustainability trends, result in a Swiss regulatory environment where the exclusion of certain things is increasingly well established. This can be seen in the environmental themes addressed in negative screening for investment management purposes. Fintech innovations can improve the efficiency and effectiveness of these, not only for negative, but also positive screening and integration purposes. There are opportunities to also consider new focus areas in positive and integrated assessments, including complex themes such as biodiversity, chemicals and circularity, which digital and fintech innovators may well be tasked to address.

- **Digital technologies help improve the integration of standard ESG exclusion criteria, and expand ESG considerations to include negative and positive consequences:** Key environmental themes for exclusion criteria in sustainable investment management by Swiss financial institutions are nuclear energy, severe environmental destruction, GMOs, coal, animal testing as well as “others” such as pesticides, palm oil, drift-net fishing, ozone depleting substances (ODSs) and hazardous chemicals. MLAI facilitate the further development of ESG rating methodologies,

benchmarking and indices, which enables more efficient and transparent integration of ESG considerations into investment decision-making. Blockchain and IoT can be employed to trace and monitor the presence or movement of substances or products containing substances such as hazardous chemicals, ODSs and GMOs. Digital technologies are also expanding ESG considerations to include the assessment of the carbon footprint of portfolios and investments, as well as used to trace and monitor footprints on the use of fossil fuels or cleaner alternatives. In terms of positive screening and the creation of sustainability-themed lending and funds, Swiss banks and investors can also collaborate with start-up partners in employing DLT solutions such as assurance certifications and crypto-currencies in support of for example green property, water, agrifood and clean energy funds.

- **Digital technologies could offer innovative solutions to complex environmental challenges such as water, biodiversity, chemicals and the circular economy:** In ESG discussions, the environmental themes have often been viewed as more easily quantifiable (compared to social themes) and therefore easier to incorporate in science-based analysis for finance purposes. Yet themes such as biodiversity, chemicals and circularity hold enormous complexity in themselves. Consider for example the estimated 2,000 new chemicals that are introduced to the market annually and millions of metric tonnes of plastic waste produced annually. Emerging digital technologies offer the opportunity to capture and trace these volumes. This includes big data analytics to screen and connect both structured and unstructured data sets held by various public and other institutions, including Internet-based data reflecting the concerns of consumer-citizens. Swiss financial institutions could team up with leading Swiss research institutions to define new ways of tracking, and using this data with a view to offer green banking services, investment and insurance.
- **Digital technologies enable new approaches for the insurance sector to track disasters and facilitate integrated risk management:** The link between the systemic risks of a global financial system and global climate change has been addressed by the FSB Taskforce on Climate-related Financial Disclosures (TCFD). With respect to both climate mitigation and adaptation, the insurance industry has special interest in tracking its implications and inter-relation with historical data on natural catastrophes and various types of disasters (including related industrial disasters as illustrated by the Fukushima nuclear disaster in Japan). The leading Swiss insurance providers have recognized expertise in applying geospatial data and modelling to assess these developments and possible future scenarios. Building on this expertise, the industry could take the lead in expanded use of PAED to assess the systemic consequences of broader themes such as biodiversity, resource stress and hazardous substances. Addressing these themes through top-down modelling approaches, the industry could also lead in addressing the same agenda through IoT and related applications to analyse real-time and bottom-up generated data for the purposes of offering new insurtech services.

5.3 Challenges and Lessons Learned

A number of challenges limit Switzerland from fully leveraging the potential of green digital finance. Lessons can be learned from other country experiences. These challenges and lessons learned are outlined below and are often not unique to Switzerland. Yet, what puts Switzerland in a promising position to take leadership in addressing these, relates to factors such as the hosting of relevant

international agencies and organizations responsible for environmental governance, international standards setting, financial regulation, research and education, as well as public-private collaboration.

5.3.1 Unintended Consequences

From an environmental perspective, digital technology creates unintended or side effects through hardware and software production, use and termination.¹⁴⁴ Hardware production requires a combination of natural resources including cobalt and lithium, the exploitation of which brings ecosystems degradation and intensive water use by mining operations. High energy consumption is another concern. With data centres as the backbone of the Internet, global data centres have an estimated annual carbon footprint equal to, if not greater than, the airline industry. Experts predict that the energy demand associated with data centres is likely to triple in the coming decade. While ‘smart’ devices may promise increased home energy efficiency, these devices are likely to increase energy and data centre demand.¹⁴⁵ Similarly, blockchain’s energy footprint is enormous. The Governor of the Bank of England has cited estimates of up to 52TWh for bitcoin mining – double the electricity consumption of Scotland.¹⁴⁶ Issues of excess energy use are beginning to be addressed through new solutions with data centres and crypto mining companies ‘greening’ by using hydropower and solar energy. However, the robustness and scalability of these solutions remain to be seen.

In the insurance sector, big data, MLAI and IoT also give insurers a more granular risk assessment of micro-segments of risk transfer in their markets. When insurers can buy data about activities and exposure of individual clients, the risk of a person or a population becoming uninsurable becomes real. This scenario may also apply to the biophysical risks of climate change impacts in cities, energy and water resource provisioning and in agriculture.¹⁴⁷ This raises dilemmas faced in insurance when moving from a traditional risk-pooling and solidarity concept to user-based insurance that tailors for individual profiling (potentially at an unfair cost or excluding certain market segments).

Similar to this dilemma in insurance, the experience of microfinance has also highlighted some unintended consequences resulting in over-indebtedness of poor and financially illiterate clients. This and digital financial inclusion is being addressed by microfinance actors under the Responsible Finance Forum. The use of fintech to roll at a low cost, and a massive scale, green financial services to poor communities, needs to be done carefully so that it does not result in predatory lending and financial crisis.

5.3.2 Cybersecurity and Crime

Crime-related risks associated with use of digital technologies include data security, for example the threat of hacking and challenges in protecting sensitive consumer and corporate financial data. Data breaches are creating growing calls for greater digital and data protection and more consumer education.¹⁴⁸ The EU’s General Data Protection Regulation (applicable as of May 2018), which offers safeguards for the protection of personal data and the integrity of the EU financial system against money laundering and terrorism finance, must be complied with by a technology-enabled EU financial marketplace.¹⁴⁹ In addition, there are a number of relevant regulatory developments related to the financial sector in the EU, and voluntary standards in banking regulation as agreed under the auspices of the Basel Committee on Banking Supervision (BCBS), based in Switzerland at the Bank for International Settlements (BIS).

The BCBS has among others initiated a stock take on the materiality of banks’ direct and indirect exposures to crypto-assets. The Financial Stability Board (FSB) has published a framework, developed

with the BIS Committee on Payments and Market Infrastructures, for monitoring the risks to financial stability from crypto-assets. The International Organization of Securities Commissions (IOSCO) is also examining regulatory issues around “crypto-asset platforms” such as crypto exchanges. In the face of a total ban or heavy regulation, as well as hacks on exchanges, the price of major digital currencies such as Bitcoin, Ethereum, Ripple and Litecoin has seen significant volatility in recent times.

Amid growth in banking regulations since the global financial crisis, governmental institutions and central banks have also developed special interest in a new breed of fintech: “regulatory technology” or regtech.¹⁵⁰ This refers to IT innovations that help firms of the financial services industry to meet financial compliance rules. This includes automating and digitizing Anti-Money Laundering (AML) rules that aim to reduce illegally obtained income, and Know Your Customer (KYC) processes that identify and verify the clients of financial institutions to prevent fraud. The approach has been promoted by the UK’s Financial Conduct Authority, working with regtech firms on a range of different applications such as AI and machine learning to improve the efficiency of compliance in financial services and cut the costs of enforcement. In Switzerland fintechs such as Net Guardians are using MLAI to track regulatory compliance.

Regtech applications to combat fraud and crime can also be applied to the environmental field. This includes finance involved in the illegal trade in products of endangered species and banned substances as promoted by Geneva-based UN secretariats of multilateral agreements such as the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and the Basel, Rotterdam and Stockholm (BRS) Chemicals Conventions. In 2016, an assessment by UN Environment and Interpol estimated environmental crime at US\$258 billion each year, including money made through illegal logging, poaching, fisheries, mining and the dumping of toxic waste.¹⁵¹ Improved enforcement in this domain, including the use of digital technologies, is an area where the Swiss Trading and Shipping Association (STSA) can play a supportive role.¹⁵²

There are also risks associated with cryptocurrencies, including illicit financial flows and possible tax evasion. While the Swiss government is supportive of cryptocurrency, it recognizes the need to ensure that standards and the integrity of financial markets are not compromised.¹⁵³

5.3.3 Standards and Regulation

Several of the technologies (particularly DLTs) underlying digital finance are still nascent. Scaling such technologies in coming years will require new standards and regulations. This raises the question of standard setting at global, regional and national levels. The Swiss Government’s Financial Market Policy recognizes the importance of international standards, mindful that “(g)iven the strong international orientation of the financial sector, it is in the interests of Switzerland to take account of legal developments in important partner states.”¹⁵⁴ Switzerland can, among others, establish related agreements with peer regulators from other countries, as was done with, for example, the Monetary Authority of Singapore. Its involvement in work by the G20 and the UN on sustainable digital finance can also serve to establish new agreements with peers.

At a global level, the International Organization for Standardization (ISO), headquartered in Geneva, has established a Technical Committee 68 on Financial Services (TC68) as well as a new Technical Committee 307 (TC307) on Blockchain and Distributed Ledger Technologies. The ISO Standards Advisory Group (SAG) has noted that fintech is not typically jurisdiction-specific and can be considered a global or trans-border ‘industry’. Hence, standards to support competition, manage risk and promote interoperability

need to be addressed from a global perspective. Having industry-wide standards and network interoperability is critical for scaling green digital finance applications. Institutions such as the IMF, the BIS, the European Banking Authority (EBA), as well as the new ISO fintech Technical Advisory Group (TAG) created by ISO/TC68 in 2017, have recognized the need for a transnational and global perspective.¹⁵⁵ The evolution of the ISO 14000 series includes the development of the newly proposed Framework and Principles for assessing and reporting investments and financing activities related to climate change (ISO/NP 14097).

Clarity on common terminology with regard to digital technologies will be needed (such as the process initiated by Standards Australia on blockchain), as well as clarity on the meaning of “sustainable” or “green” when dealing with sustainable finance products and services. This is, for example, being addressed at the European and voluntary industry level by initiatives such as the Luxembourg Finance Labelling Agency (LuxFLAG – which includes an environmental label);¹⁵⁶ the Climate Bonds Initiative;¹⁵⁷ and the Responsible Finance Forum¹⁵⁸ which in June 2018 launched Guidelines for Investing in Responsible Digital Financial Services. The EU has also published its new Sustainable Finance and Fintech Action Plans, which among others, provide for creating a taxonomy or classification system for labelling and other purposes.¹⁵⁹

The public and regulatory bodies implied first and foremost are those responsible for national reserves, capital markets and insurance, including institutions such as central banks or monetary authorities, financial market supervisory authorities or securities exchange commissions, banking commissions or prudential supervision and resolution authorities, as well as governmental departments of finance or treasuries. While supporting market growth and innovation, these institutions, among others, need to consider issues such as capital requirements, accountability, consumer protection, money laundering and cybersecurity. Governmental institutions and financial market authorities, therefore, face the challenge to find the appropriate balance in pursuing regulation to ensure stability and security, without stifling innovation and market initiative. Key questions include how adequate existing regulations are in supporting the development of the digital technology market, and whether special provisions are needed to encourage applications and innovations in green digital finance. When seeking to promote a more enabling ecosystem, regulators need to consider whether green digital finance start-ups need special support. Responding to such questions requires closer collaboration between finance and telecom regulatory mandates, as well as with environmental regulators. Regulators need to consider for example whether new entrants in the financial markets, such as a green digital finance start-up or a large non-financial retailer such as Amazon, should be classified and dealt with as “banks” (requiring a normal banking license).

Supporting innovation in digital finance may well be combined with support for its application in green finance, included in a top-down or policy-driven fintech for sustainable development pathway. Using the green agenda as an entry point can be well illustrated by the cases of France and Sweden, two countries who recently agreed to boost their collaboration in the green finance area.¹⁶⁰ France has strengthened carbon disclosure requirements for corporate and financial institutions under Article 173 of its Law on energy transition and green growth. Similar requirements have been implemented for Swedish non-financial firms in 2016 and proposed for Swedish investment funds to enter into force in 2018. As part of the Government’s “French Strategy for Green Finance”, France has set up a number of voluntary measures to promote green finance and related fintech applications. These include dedicated green and Sustainable and Responsible Investment (SRI) labels and a benchmark green sovereign bond (EUR7 billion for 22-year bonds). French investor action includes that of the public bank Caisse des Dépôts

launching a “2°C roadmap” long-term strategy. The national Green Finance strategy will also promote “Fintech for Green” projects.

The traditional Swiss approach to regulation is to rely on market innovation and ensure a level playing field for financial institutions. For example, there is no regulatory requirement for more comprehensive consideration of material ESG factors in investment or lending decisions.¹⁶¹ Beyond governance requirements, Swiss financial market regulation follows conventional EU and Basel regulatory approaches, including business-as-usual risk approaches to “sustainable investments” as “alternative investments” with related capital adequacy and fiduciary duty requirements. The continuation of the conventional market-based policy approach can be seen in financial sector policies and regulations, including financial market regulatory reform through FIDLEG (Finanzdienstleistungsgesetz – Financial Services Act), FinfraG (Finanzmarktinfrastrukturgesetz – Financial Market Infrastructure Law), and FINIG (Finanzinstitutsgesetz – Financial Institution Law). At the same time, the Swiss Government’s Sustainable Development Strategy (2016) recognizes the opportunities that sustainability offers in strengthening the competitive Swiss marketplace and its financial sector. A stronger integration of this recognition and sustainability goals into Switzerland’s Financial Market Policy, including the role of green digital finance for sustainable and inclusive growth, is needed.

5.3.4 Knowledge and Cross-sectoral Collaborative Engagement

Key Swiss education and research institutions in the digital innovation domain include the technical universities of Zurich (ETH Zurich), Lausanne (EPFL) and Lugano (SUPSI). Additionally, recognized economics, finance and management research institutes at the universities of Geneva, St Gallen, Basel and Luzern can be involved in research on market demand and trends in the application of fintech, including its supportive ecosystems and circular economic growth contribution in countries worldwide.¹⁶²

Universities have taken note that finance students and managers of the future are likely to demand course work in fintech. The Techfoliance Europe network lists 30 courses at universities worldwide dedicated to fintech, including the Cambridge Centre for Alternative Finance (CCAF), the Wake-up fintech school in France, the Fintech University created by the Spanish bank BBVA, and a Blockchain University in the US.¹⁶³ Examples of similar programmes from Switzerland include the Swiss FinTech Innovation Lab at Zurich University and the Institute for Financial Services in Zug, which is part of the Luzern University of Applied Sciences and runs a FinTech Forum that addresses themes such as AI and big data, blockchain, open banking and robo-advisors.

Quite often, new fintech start-ups develop out of university level projects and entrepreneurs who recently graduated. Switzerland is no exception to this. Addressing the need to secure relevant talent pipelines, the EY study for the UK Government noted that universities can play a key role in providing the relevant graduate pathways, promoting the fintech sector and adapting curriculums (e.g. towards entrepreneurship) as well as spearheading research (e.g. into data analytics).¹⁶⁴ It found that the US and UK lead for the strength of academic networks and research facilities, overall university-industry collaboration as well as genuine engagement with the fintech industry. Cutting-edge value added in Switzerland can take the form of connecting real engagement with the fintech industry with its existing genuine engagement with the environmental industry (including industrial ecology, life cycle management, conservation and natural resource economics).

The value of private sector collaboration with university institutions have been mentioned by various interviewees in this Swiss study. This can build on advantages such as the high concentration of financial

institutions in Switzerland and the reputational benefits associated with the Swiss brand as a good location to be based for international work and research. With respect to the IT sector, international firms such as Google, Microsoft, Cisco and IBM all having large development centres in the Zurich area confirms this value. This concentration of software developers and engineers present a high potential for future business development and attraction of talented employees.

Large financial institutions are increasingly looking at collaboration with new fintech entrants in their market. In 2017, the Chief Operating Officer of UBS Wealth Management confirmed support for collaboration and embracing fintechs.¹⁶⁵ Examples of such collaboration by banks abroad can be found in, among others, Canada, Indonesia and Spain. Canada's Bank of Nova Scotia has opened a new financial technology space designed to develop blockchain and AI.¹⁶⁶ In Indonesia, Bank Central Asia (BCA), its largest private bank, announced in 2017 that it has invested US\$15 million in financial technology start-ups. In what has been called an example of the "platformification of banking", the Spanish BBVA bank runs portals that provide fintechs the opportunity to produce solutions that can be used as plug and play on the bank's platform, creating a win-win-win situation for the bank (offering a range of products and services), customers (need fulfilment) and fintechs (new business and new incumbent relationships).¹⁶⁷

Collaborative engagement models preferred by fintechs include labelled solutions, joint in-house solutions, full outsourcing by financial institutions of certain functions as well as APIs. An example of the latter is UK insurer Aviva, which collaborated with China's Tencent and an investment management firm to create a digital insurance company in Hong Kong. The opening up of banking services is also leading to an emerging API ecosystem paving the way for non-bank aggregators and fintechs to sell customers services without providing current account services. A 2016 survey by Temenos and Capgemini found that a clear majority of banks (69%) now see open banking – the use of APIs to allow for collaboration – as more of an opportunity than a threat.¹⁶⁸ This can involve banks introducing new outbound services such as micro-banking and green mortgages through intermediaries as well as new inbound services such as support for electrical vehicle use.¹⁶⁹

Finding the right partners is not easy for both fintechs and established financial institutions. One challenge is the cultural fit between both sides. Fintechs benefit from association with regulators, who can set up incubation labs that provide a safe environment for testing new products or business models, and that ensure data protection and security. Regulators can also support the opening up of markets, as new IT developments leave the distinction between the financial services economy and the real economy increasingly blurred.

6 Ways Forward for Green Digital Finance in Switzerland

The analysis of findings in Section 5.1. highlights a number of potential opportunities to accelerate and scale digital green finance solutions in Switzerland. A number of recommendations that could be taken by various stakeholders to take forward the green digital finance agenda in Switzerland are outlined below. The Swiss Finance Institute at Geneva University¹⁷⁰ points to three forces that could drive the issue of sustainability within the financial sector in Switzerland in coming years. These are (a) increasing demand for sustainable finance products, (b) the changing policy, legal, and regulatory framework, and (c) voluntary efforts within the industry. Looking at each force through a digital finance lens, and building on the opportunities highlighted in this study, this section sets out key recommendations for governmental institutions and regulators, market players (established business, fintech start-ups and industry bodies), as well as universities, the research community and innovation hubs.

Exploring the roles of key players, our recommendations consider as context the internationally recognized strengths of Switzerland as captured in table 1, namely:

- **Top innovator**, including expert research and education community
- **Top finance manager and trader**, including strong ecosystem infrastructure
- **High consumer awareness**, including civil activism and international exposure
- **Stable, reliable regulator and enforcer**, including public-private collaboration

The recommendations below start by focusing on public institutions and regulators, including governmental regulations and private standards. These are closely connected with high levels of consumer awareness and citizen activism, as well as appreciation for public-private collaboration. The recognized position in finance and trade provides an important context for the recommendations targeting market players, including the wealth of business organisations and associations based in Switzerland. Finally, the recognized innovation as well as research and education position are key for interpreting the recommendations for universities, the research community and innovation hubs based in Switzerland.

The full list of recommendations is presented in summary format in Box 9 (below). Fundamentally, the recommendations point to what interviewees described as the importance of collaboration between three poles – namely the public sector, private sector and research sector in Switzerland.

6.1 Governmental Institutions and Regulators

- **Develop international standards, guidance and information platforms for green and sustainable digital finance:** This would encourage investment, promote scale and market transparency, and better manage unintended consequences and risks. Developing such standards could be done with a global perspective, linked to internationally recognized terminology and criteria for “green”, “sustainable” and related due diligence, as well as with principles around interoperability, integrated risk management and cybersecurity. For example, developing criteria that define green digital finance solutions would help create wider understanding of such solutions and the important role they play in achieving environmental goals. This in turn, would better enable such solutions to access finance from environmental-themed funds. Assessment tools that can measure the change in green finance that digital applications bring, would also be useful to better understand the impact of green digital finance, and increase visibility and financing of effective solutions.

- **Consider special provisions for green digital finance applications through regulation and supervision, including regtech-based processes:** While letting the industry take the lead, options for more active policy support for developing a green fintech ecosystem include a supportive financial supervisory authority, tax incentives, sandboxes and government programmes designed to promote competition and innovation.¹⁷¹ Experimentation with alternative, sustainable business models can be supported or undermined by the way public and financial market regulatory bodies refine their approach to issues such as capital requirements, consumer protection and cybercrime. Supportive government programmes could include opening up the financial sector to new financial approaches and entrants, helping to attract foreign fintechs, as well as assisting fintechs to start-up in secure ecosystems. Support can also include simplified processes to set up new funds, considering the example of Luxembourg, committed to sustainable digital finance. Since 2016 the Swiss Federal Council has initiated fintech regulatory plans addressing innovation (including sandbox exemptions), revised settlement accounts (processing of non-interest-bearing funds within specified number of days) and licenses (e.g. special banking authorisation with softer capital and audit requirements). In implementing these, Swiss agencies can learn from fintech peers such as Singapore through its participation at international fora. Swiss enabling regulation also needs to embrace ‘regtech’, introducing greater efficiency and effectiveness as regulatory and compliance processes become digitized.
- **Explore policy support to combine Switzerland’s leadership role in DLT/cryptocurrency and green finance to become global ‘green crypto-financial centre’:** The crypto-ecosystem in Switzerland could benefit from targeted policy support. Such support may include greater regulatory clarity around the definition of token types and use of digital assets and tokenization that support green financing and SDG outcomes (including differentiating tokenized social and natural capital-themed assets, projects and instruments from pure financial instruments and currencies). This clarification will allow a greater flow of investment from funds, especially pension funds currently unable to make unregulated investments. Other actions could include: supporting the development of expertise around DLT-based bond and fund structures to attract capital markets to social and natural or SDG-inspired investments; exploring mechanisms to incentivize the growth of compliant start-ups to address the high set-up costs and legal fees due to regulatory uncertainty in the area of cryptocurrency; establishing a sandbox related to cryptocurrency to look at accountancy practices that would incentivize offsetting corporate, city and government carbon footprints against investments in start-ups, renewable energy technologies and SDG innovation.
- **Establish through the S DFA an integrated multi-stakeholder platform to develop and implement an action plan to promote green digital finance:** Effectively developing standards and tools would benefit from multi-stakeholder partnerships involving both public and private players, established institutions as well as start-ups. Partnership platforms or forums also need to engage the growing number of Swiss fintech associations established in recent years, including the Bitcoin Association Switzerland, Cryptopolis Association, Crypto Valley Association, digitalswitzerland, Multichain Asset Managers Association, International RegTech Association, Swiss Crowdfunding Association, Swiss Finance Startups, Swiss Finance & Technology Association and Swiss Fintech Innovations. Following the model of the Responsible Finance Forum and its work on digital inclusion, and building on the roundtable convened by the SIF in May 2018 with sustainable finance and fintech partners, a multi-stakeholder green fintech platform could be established through the S DFA. Such a platform could develop an action plan to promote green digital finance in Switzerland and globally. One action could

be to define “Guidelines for Green Digital Finance Services”, which could pave the way for later, more formal standards development at ISO and regulatory level.

- **Apply broader green digital solutions through governmental operations and services:** The Government could send market signals in support of broader green digital solutions that promote resource efficiency by applying such solutions through governmental operations and services. This raises the example set by public institutions through sustainable public procurement (a question raised by interviewees). Greater use of digital technologies can introduce improved efficiency and also help governmental institutions to cut costs. Digitally enabled green applications could be introduced to improve services in municipal waste management, facilitate online operations such as payments, monitor and insure public infrastructure using IoT and big data, and leverage AI to process data including PAED held by different agencies.

6.2 Market Players: Financial Institutions, Fintechs and Industry Bodies

- **Promote investment in enterprises and skills with respect to green digital finance:** The idea of establishing a ‘Nasdaq of social businesses’ in Geneva and creating thematic funds are ways of mobilizing higher levels of investment in fintechs with green and sustainable development goals. This can support new enterprises to turn societal problems into business opportunities. It can also involve the mobilization of investment by HNWI for the purposes of strategic philanthropy, considering the needs of private investors and their families. Market players could also actively invest in developing skills around green digital finance, for example, the development of expertise around DLT-based green bond and fund structures to attract capital markets to social and natural capital investments.
- **Connect growing interest from the Swiss fintech community in investment management and analytics (including big data and MLAI) with established leadership from Switzerland in the screening and monitoring of companies and their value chains for responsible investment purposes:** The annual 2018 survey of Swiss fintech companies by the Institute of Financial Services Zug reports that, in terms of business (technology product) focus areas the investment management area accounts for roughly a quarter of the companies involved. This can be compared with the percentage of Swiss fintech companies focused on the related areas of DLT/blockchain (15%) and analytics (12%). This creates an opportunity to combine expertise in these areas, with established Swiss experience in integrated investment assessment and the green or ESG responsible investment agenda. Such collaboration may take the form of new hybrid approaches where automated analysis is combined with relevant human expertise. It can also benefit from greater traceability, assurance of standards and transparency in supply chains enabled by blockchain applications, including new ways of monitoring the greening of supplies and value chains.
- **Take impact investment to scale, as globally recognized leader in cross-border wealth management and innovator in investment for positive impact.** The private banking and wealth management sector provides an international window of opportunity for Switzerland to take a leading role in scaling green digital finance through impact investment. The industry and relevant partner institutions, including governmental economic cooperation and finance authorities, may consider ways of connecting Switzerland’s globally recognized role in cross-border wealth management with greater investment in green digital finance linked to the SDGs. Engagement with individual private banks and wealth management champions, including those active in impact investment, as well as professional bodies such as the Swiss Private Bankers Association (Geneva),¹⁷² Association of Swiss Private Banks

(Geneva),¹⁷³ and the Association of Swiss Asset and Wealth Management Banks (Lugano)¹⁷⁴ would be useful in exploring this potential and defining a possible plan of action.

- **Raise awareness and understanding of sustainable investment and the related potential of green digital finance in the Swiss pension fund sector:** Inspired by the example of peers such as CERES in the US, the Swiss Association for Responsible Investments needs to be strengthened for this purpose. It can serve as a collective body for active pension funds, with more Swiss pension funds participating. At over CHF800 billion assets under management, the pension fund industry in Switzerland includes over 50 public pension funds, over 20 industry-wide pension funds and significantly more corporate pension funds.¹⁷⁵ In their selection of investments in different asset classes, including equities, bonds and real estate, research and awareness-raising on new developments in sustainable finance (including the use of new digital technologies, tools and approaches) would be valuable. Such leadership-focused services are provided by CERES in the US to its investor network that includes public pension funds, labour and socially responsible investment funds, foundations, endowments and family offices.¹⁷⁶
- **Support collaboration by stock exchanges, including the SIX Swiss Exchange with the Sustainable Stock Exchanges (SSE) initiative to introduce and advance best practice, standards and market regulations in support of green digital finance:** The SIX is active in this field; since 2014, it has facilitated the trading of green bonds, 14 of which are valued at CHF6.6 billion today.¹⁷⁷ Its description of support for Swiss-made fintech focuses mainly on services provided by SIX, including regtech services and modern payment solutions. There are opportunities to strengthen participation in collaborative efforts to establish green digital finance industry-wide standards. Furthermore, collaboration with and by stock exchanges could include evaluation of the potential for digital platforms to serve as an alternative mechanism for listing and trading digitally defined social and natural capital assets, making related innovations more visible and accessible to a broader investor audience.
- **Further develop collaborative approaches between large financial institutions and new green fintech entrants:** This can also be supported by industry-wide, pre-competitive initiatives such as the B3i initiative on blockchain innovation by the insurance industry. Established financial institutions bring their advantages such as economies of scale, customer trust and expertise in areas such as risk management, while fintech entrepreneurs bring skills such as out-of-the-box innovation ability, speed and agility, advanced data analytics and a greater feel for the interests of the Internet generation. These respective strengths in a symbiotic relationship have been confirmed by the World Fintech Report 2018 by Capgemini and LinkedIn.¹⁷⁸

6.3 Academic, Research Institutions and Innovation Hubs

- **Promote innovation and multi-disciplinary collaboration with respect to green digital finance among academia and researchers:** The academic and research community could consider (i) how green digital finance as an innovation area is promoted through teaching curricula, special courses and research; and (ii) how multi-disciplinary engagement that brings together finance, technology and environmental departments, could be encouraged within academic institutions as well as with market actors. For example, there are opportunities to assess the role of research institutions as key intermediaries for interpreting PAED, and communicating it in formats that speak to the finance and business community. Another example is creating a repository of valuations of natural and social capital assets where they are known. However imperfect, some baseline valuation of the relevant

tangibles and intangibles will encourage externalities to be benchmarked and better priced into financial accounting and investment decision-making.

- ***Integrate green digital finance into the DNA of innovation ecosystems, challenging incubators and innovation hubs to develop solutions for the implementation of the internationally agreed environmental and sustainable development goals:*** The establishment of incubators and innovation hubs to date has focused on hosting fintechs and connecting their experimental offerings with established market occupants. In doing so, incubators and innovation hubs serve as transitional bridges between university-level research and market applications. Missing in this is a third component, namely a substantive agenda that highlights long-term market and societal needs. Incubators and innovation hubs therefore need to be challenged to develop solutions for items of the sustainable development agenda, for example challenges such as climate and the circular economy. Such innovation challenges can be introduced through initiatives such as award schemes, the results of which are tied to sponsorships and financing rewards. Lessons can be learned from related programmes such as the Kickstart Accelerator and Venture Kick of *digitalswitzerland* that is operated by the Impact Hub Zürich, the Swisscom Startup Challenge and the UBS Future of Finance Challenge.

Box 9: Summary Recommendations

Governmental Institutions and Regulators (Finance and other)

- Develop international standards, guidance and information platforms for green and sustainable digital finance, including criteria that define green digital finance solutions, assessment tools for measuring impact and mechanisms to promote market transparency.
- Consider special provisions for green digital finance through regulation and supervision (e.g. of the financial market), including regtech-based processes, tax incentives, sandboxes and government programmes designed to promote market access, competition and innovation.
- Provide policy support to more deliberately combine Switzerland's leadership role in DLT/cryptocurrency and green finance to become a global 'green crypto-financial centre' in support of the SDGs.
- Establish through the Sustainable Digital Finance Alliance a multi-stakeholder platform to develop and implement an action plan for green and sustainable digital finance as well as guidelines for green digital finance services globally.
- Apply green digital solutions through governmental operations and services, including key finance-related operations such as sustainable public procurement and public infrastructure investment.

Market Players: Financial Institutions, Fintechs and Industry Bodies

- Promote investment in enterprises and skills related to green digital finance, including thematic funds and expertise around DLT-based green bond and fund structures.
- Connect growing interest from the Swiss fintech community in investment management and analytics, with established leadership from Switzerland in the screening and monitoring of companies and their value chains for responsible investment, including use of blockchain to assure supply chain standards.
- Take impact investment to scale, connecting Switzerland's globally recognized role in cross-border wealth management with greater investment in green digital finance linked to the SDGs.

- Raise awareness and understanding among the Swiss pension funds and insurance sector of sustainable investment and the related potential of green digital finance.
- Support collaboration by stock exchanges to introduce and scale best practice, standards and effective market regulations in support of green digital finance, as well as digital platforms as a mechanism for listing and trading digitally defined social and natural capital assets.
- Further develop collaborative approaches between large financial institutions and new green fintech entrants, combining economies of scale with entrepreneurial expertise and supported by industry-wide, pre-competitive initiatives.

Academic, Research Institutions and Innovation Hubs

- Promote multi-disciplinary collaboration on green digital finance among academia and researchers, including the coverage of green digital finance in teaching curricula, special courses, certified training and research.
- Promote multi-disciplinary engagement that joins finance, technology and environmental departments, and at the same time address their collective ability to process and interpret public science to meet the long-term information needs of market players.
- Integrate green digital finance into innovation ecosystems, challenging incubators and innovation hubs to develop solutions for the implementation of the internationally agreed environmental and sustainable development goals, offering related award schemes tied to sponsorships and financing rewards.

ANNEX 1: Table of Financial Value Chain Innovations and Examples

Value chain activity	Options for green application	Company examples
BANKING		
Risk identification, rating, evaluation & costing	Digitally enabled analytics and application of ESG criteria in credit risk assessment, due diligence and screening, application of policies on sensitive sectors, development of green and sustainable loan portfolios, and environmental stress testing	<ul style="list-style-type: none"> - UBS Environmental & Social Risk (ESR) Framework (Zurich) https://www.ubs.com/global/en/about_ubs/ubs-and-society/how-we-do-business.html - RepRisk (Zurich) https://www.reprisk.com - Net Guardians big data incl regulatory risk (Vaud) www.netguardians.ch - Palantir big data including financial compliance (Palo Alto) https://www.palantir.com
Service / product development, pricing and roll-out	<p>Green finance products, including green credit lines and special loans, green crowdlending, green leasing, green mortgages, green services and infrastructure projects, and green bonds, targeting different banking line segments including households, entrepreneurs, fintechs, businesses, corporate and trade finance</p> <p>Financial inclusion products (incl environmental, social ethical banking), targeting e.g. farmers, entrepreneurs and consumers faced with resource stress/scarcity challenges, enabling easy access and payment methods</p>	<ul style="list-style-type: none"> - Zürcher Kantonalbank Environmental Savings Account https://www.zkb.ch/de.html - SEB Green Bond Fund & Green Assets Wallet (Stockholm) https://sebgroup.com/large-corporates-and-institutions/our-services/markets/fixed-income/green-bonds - responsAbility Credit Suisse Fair Trade Fund (Zurich) https://www.responsability.com/de - 1bank4all (Basel) https://1bank4all.net - Pintail (Zurich) http://pintail.net/?lang=en
Client advice and support	Using digitally enabled functionalities to improve client interaction (including online services) and trust, as well as digital innovations to track ESG and greentech developments to offer relevant advice and support in client onboarding and engagement to advance the shift to sustainable technologies	<ul style="list-style-type: none"> - Temenos banking software systems / Cloud (Geneva) https://www.temenos.com/en/ - Fidor Bank social banking (Munchen) https://www.fidor.de
Monitoring and assurance	Transparent assessment and reporting of regulatory compliance and ongoing sustainability impact, including use of e.g. blockchain for assurance of environmental or climate certifications and traceable verification	<ul style="list-style-type: none"> - BNP Paribas & Vigeo EIRIS tracking SDGs (Paris) https://group.bnpparibas/en/hottopics/global-goals/bnp-paribas-sdgs - GlobalanceBank wealth footprint (Zurich) https://www.globalance-bank.com/en

INVESTMENT		
Research and analysis (including ratings)	ESG research and analytics, including data mining and questionnaires, portfolio assessments ratings (applying e.g. environmental and climate data)	<ul style="list-style-type: none"> - RobecoSAM (Zurich) and DJSI, http://www.robecosam.com - RepRisk (Zurich) https://www.reprisk.com - Covalence (Geneva) https://www.covalence.ch - CarbonDelta (Zurich) https://www.carbon-delta.com
Asset allocation (including strategy) and asset selection (including screening, best-in-class, thematic)	<p>ESG themed approaches, including quant-based applications and portfolio optimization (consolidation vs diversification) considering e.g. environmental and climate criteria</p> <p>Client advisory and portfolio development based on e.g. environmental themes, risk & opportunity preferences including impact areas such as electromobility</p>	<ul style="list-style-type: none"> - RobecoSAM (Zurich) http://www.robecosam.com - OLZ AG (Bern) https://www.olz.ch/en - 3d-eyes (Zurich) https://3rd-eyes.com/en/ - Yova (Zurich) https://yova.ch
Risk management, monitoring, engagements and assurance	Transparent management, assurance and reporting of portfolio results, including use of e.g. blockchain for assurance of environmental or climate certifications and traceable verification of projects such as renewables assets (e.g. solar or wind farms).	<ul style="list-style-type: none"> - Pexapark (Schlieren) https://www.pexapark.com - yourSRI.com (CSSP, Vaduz) https://yoursri.com
Investment capital raising and matchmaking	Fundraising platforms to connect investors with e.g. environmental and climate-related projects such as green supply chain management, eco-fair products and clean energy generation or initiatives/environmental NGOs	<ul style="list-style-type: none"> - Bloomio (Zug) https://www.bloomio.com - Raisenow (Zurich, Berlin) https://www.raisenow.com/gb-en - Plumseeds (Symbiotics Geneva, Amsterdam, London) https://www.plumseeds.com/en/home - Wemakeit (Zurich, Lausanne) https://wemakeit.com - WeCan.Fund (Geneva) https://wecan.fund
INSURANCE		
Risk identification and quantification	Data collection and analysis to support risk identification, structuring and pricing of insurance products, e.g. satellite	<ul style="list-style-type: none"> - RepRisk (Zurich) https://www.reprisk.com - CarbonDelta (Zurich) https://www.carbon-delta.com

	data to develop climate & natural catastrophe insurance (weather, agricultural, parametric / index-based NatCat products)	<ul style="list-style-type: none"> - CelsiusPro (Zurich) https://www.celsiuspro.com - Swiss Re and Sunlight Agriculture Mutual Insurance Company of China http://www.swissre.com/media/news_releases/nr_20160803_chinaparametric.html
Risk mitigation, including underwriting, service/product development and roll-out	Preventative measures at home, office, vehicles and industrial sites, e.g. digital and remote monitoring of systems, behaviour and infrastructure (such as sensors detecting leaking pipes, heating systems not switched off, preventing waste and accidents)	<ul style="list-style-type: none"> - Zurich Risk Advisor (Zurich) https://www.zurich.com/it/products-and-services/tools-for-business/zurich-risk-advisor - Hartford Steam Boiler Inspection & Insurance / Munich Re (Munich) https://www.munichre.com/HSB/home/index.html - Mobileye / Intel (California) https://www.mobileye.com
Client advice, comparison, risk transfer, claims management	Online advice, comparison services for customers (comparison / brokering of different insurance offers), independent certification of the sustainability of insurance products, online instant claims management	<ul style="list-style-type: none"> - Comparis.ch (Zurich) https://en.comparis.ch - Knip (Zurich, Berlin, Belgrad) https://www.knip.ch - Certified Sustainable Insurance Partners (CSIP, California) http://csip-inc.org/#/home - Lemonade (B-Corp, New York) https://www.lemonade.com

ANNEX 2: Interviewees and Interview Questions

Philipp Aeby, Chief Executive Officer, RepRisk, Zurich

Eric Borremans, Head of ESG, Pictet Group, Geneva

Sybille Chevalier-Gianadda, Deputy Director, Sustainable Finance Geneva (SFG)

Klaus-Michael Christensen, Swiss Impact Investment Association

Sabine Döbeli, Chief Executive, Swiss Sustainable Finance (SSF)

Vincent Dufresne, Co-founder and Chief Financial Officer, Symbiotics, Geneva

Peter Fanconi, Chairman, BlueOrchard, Zurich

Bertrand Gacon, Head of Impact Investing and SRI, Lombard Odier, Geneva

Jiri Havran, CEO and Founder, Blue Yellow

Moris Isik, Co-CEO and Founder, Green Match, Zurich

Mounir Khouzami, Co-founder and President, Swiss Arab Network

Antoine Mach, Managing Partner & Co-founder, Covalence, Geneva

Oliver Marchand, CEO & Co-Founder, Carbon Delta, Zurich

Oliver Oehri, Founding Partner, Center for Social and Sustainable Products AG, Zurich

Vivek Pradhan, Deputy Head of Market Innovation, Symbiotics, Geneva

Inge Relph, Head of Innovation, ERA Foundation

Mark Ruegg, Chief Executive Officer, CelsiusPro, Zurich

Fabio Sofia, President, SFG and Managing Director, WeCan.Fund, Geneva

Fabian Steiner, Foraus

Karina Storinggaard, Co-founder, Think Yellow

Interview questions

1. Which digital technologies do you view as holding the greatest potential (risk and opportunity) for *transforming your business* (work area), and why?
2. How do you see digital technologies or fintech supporting *green* lending/insurance/investment – supporting the shaping of more climate-resilient, circular and biofriendly economies?
3. Do you use publicly available environmental data to inform your investment decision-making? What PAED sources do you use, and what level (asset, company, industry)? How does fintech help you to use PAED in your financial decision-making (for example, does it help you access or ‘translate’ PAED to use in financial decision-making)?
4. What *areas of the Swiss financial sector* do you see as actually/potentially being the greatest source of emerging best practices in the use of fintech for greening (ESG) purposes?
5. How advanced do you believe *Swiss banking practices* are in the use of fintech, including the screening of clients in due diligence, financing green project work and offering Internet-based or digital services to citizens interested in more sustainable production and consumption practices?
6. How advanced do you believe *Swiss investment practices* are in the use of digital technologies, including the use of AI and big data to screen investees and industries for the purposes of green negative/positive screening, pricing environmental risks and identification of best (in class) practices?
7. In how far do you see Switzerland as possible global innovation hub in the application of digital technologies (including mobile devices) to advance *green impact investment* in poor communities? Can you give us concrete examples/applications that showcase its leading role in this?
8. Do you believe the *Swiss insurance industry* is a leader in applying digital technologies to access and use PAED, using latest science to develop long-term scenarios and prepare others (B2B/B2O, B2C) for more resilient futures?
9. What emerging best practice from Switzerland in the use of *blockchain and cryptocurrencies* in support of greening projects and operations can you site? What potential do you believe is there for leading Swiss innovation in this field? What are some of the key barriers and risks that you see to further leveraging green fintech
10. What type of *regulations and standards* do you recommend to be developed/supported by Swiss institutions in order to strengthen the reliability, credibility and accountability of digital technologies or fintech as a promoter of sustainable finance for greening economies?
11. What would you say needs to happen to establish Switzerland as *internationally recognized innovation hub* in the area of green digital finance, and strengthen that position in the *coming five years*?

Endnotes

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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.unepinquiry.org