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Green digital finance: Supporting environmental projects through financial technology

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Abstract---This study aims to exfoliate light on green digital finance as a new conception that surfaced as a result of the development of the field of finance that aims to support environmental and sustainability systems using fiscal technology. To achieve this thing, we used the descriptive approach. The results of the study concluded that fiscal technology has a part in easing and directing backing towards environmental systems in an effective and transparent manner through numerous operations similar as online crowd funding platforms, block chain technologies, and data analysis. still, this faces numerous challenges related to the digital divide and cyber security, which requires joint efforts from governments and the private sector to deal with it effectively.

Keywords---financial technology, green finance, green digital finance, Sustainability.

1. Introduction

Green finance has emerged as a response to the growing pressure for environmental conservation and climate change mitigation. The United Nations Conference on Environment and Development (Earth Summit) in Rio de Janeiro in 1992 adopted an agreement aimed at promoting sustainable development and protecting the environment. (United Nations, 1992). The Paris Climate Conference in 2015 further reinforced this by committing to reduce greenhouse gas emissions and enhance efforts to combat climate change, directing greater financial resources towards renewable energy projects and sustainability initiatives. (United Nations Framework Convention on Climate Change [UNFCCC], 2015).

Thus, the concept of green finance emerged as a form of funding primarily directed towards environmentally sustainable projects and investments, or those

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that reduce harmful environmental impacts. Green finance also contributes to achieving the global sustainable development goals, particularly Goal 13 on climate action within the UN's 2030 Agenda for Sustainable Development. (United Nations, 2015).

Globally, many economies have set their own environmental targets, and numerous new green finance solutions have been developed, including green bonds, green sukuk, green banks, green credit guarantees, carbon taxes, carbon trading, rural funds, and green funds from various countries. (European Commission, 2020). These solutions aim to accelerate carbon emission reduction targets and speed up the transition to a green economy. However, the current pace of green investments remains insufficient due to the slowdown in economic growth (due to the COVID-19 pandemic), rising interest rates, and economic uncertainties, highlighting the need for alternative methods to finance green projects. (OECD, 2021).

Financial technology (fintech) offers sustainable solutions through the five core functions of the financial system: value transfer, value storage, value exchange, value creation financing, and managing value at risk. By enhancing transparency, accountability, decentralisation, risk management, competition, cost reduction, efficiency, speed, and fostering cooperation and integration across sectors, fintech can provide valuable support. Applications such as artificial intelligence, blockchain, peer-to-peer lending platforms, big data, online and mobile payments, the Internet of Things, crowdfunding platforms, and asset tokenisation are potential tools for scaling green finance to achieve sustainable development goals. (World Economic Forum, 2020). Based on the above, our central research question arises:

How can financial technology contribute to the expansion of green finance?

To address this topic, we have divided our research into three main sections:

Section 1: Sustainable Finance and Green Finance

Section 2: Financial Technology

Section 3: Digital Green Finance: The Optimal Solution.

2. Sustainable Finance and Green Finance

Sustainable finance and green finance are concepts related to investment and financing that aim to achieve positive environmental, social, and economic goals, but they have different focuses.

A sustainable financial system is one that creates, values, and manages financial assets in ways that contribute to long-term wealth serving the needs of an inclusive and environmentally sustainable economy. "Sustainable finance" is recognized as the broader term, encompassing social, environmental, and economic aspects, while "green finance" refers to financial instruments used to fund environmentally sustainable projects and initiatives, focusing on a single goal: promoting the transition to a green economy through low-carbon, sustainable, and inclusive pathways (Green Finance Platform, 2021).

The Global Sustainable Investment Alliance defines sustainable investment as an investment approach that considers environmental, social, and governance (ESG) factors when selecting and managing portfolios (Global Sustainable Investment Alliance, 2020, p. 7).

The Swiss Federal Office for the Environment (FOEN) defines sustainable finance as financial products and services that integrate environmental, social, and governance (ESG) factors throughout the risk management and decision-making processes, provided to foster responsible investments that generate positive environmental, social, and governance impacts (Federal Office for the Environment, 2014, p. 5).

Therefore, sustainable finance is a concept that reflects investors' attention to environmental, social, and governance factors when making investment decisions in companies and projects that adhere to sustainability and social responsibility standards. On the other hand, green finance refers to funding projects and activities that are environmentally friendly and aim to protect the environment and reduce negative environmental impacts. This includes financing for renewable energy projects such as solar and wind energy, improving energy efficiency in buildings, recycling, and investing in sustainable public transport.

Regarding green finance, there is no single definition, but it generally refers to the financing of investments that provide environmental benefits within the broader context of environmentally sustainable development. These environmental benefits range from pollution reduction (air, water, land, or the environment) to improving energy efficiency. Among the definitions, we find broad, general data intended to assess green finance internationally, including:

- The People's Bank of China: "Green finance policy refers to a series of policies and institutional arrangements to attract private capital investments in green industries, such as environmental protection, energy conservation, and clean energy through financial services, including lending, private equity funds, bonds, stocks, and insurance" (People's Bank of China, 2015).
- GIZ (German Corporation for International Cooperation): "Green finance is a strategic approach to integrating sector financing into the process of transition to low-carbon economies with resource efficiency and in the context of climate change adaptation" (GIZ International Cooperation, 2011, p 4).
- The Indonesian Financial Services Authority (OJK): Sustainable finance in Indonesia is defined as the comprehensive support from the financial services industry to achieve sustainable development resulting from a harmonious relationship between economic, social, and environmental interests (Keuangan, 2014).
- Organization for Economic Co-operation and Development (OECD): Green finance is defined as financing that "achieves economic growth while minimizing pollution, greenhouse gas emissions, waste, and improving resource efficiency" (OECD, 2014).

Green finance is also viewed in terms of financing for green growth (United Nations Environment Programme, 2016, p. 5):

- The United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP): Growth emphasizing environmentally sustainable economic progress to promote low-carbon, socially inclusive development.
- Organization for Economic Co-operation and Development (OECD): Promoting economic growth and development while ensuring the continued availability of natural assets that provide the resources and environmental services on which our wellbeing depends.
- The World Bank: Growth that is resource-efficient, environmentally clean, and resilient in addressing natural risks, with the role of environmental management and natural capital in preventing material disasters.
- In addition to general definitions, there are those focused on specific sectors and financial instruments, such as banking services, bonds, or institutional investment:
- The Chinese Banking Regulatory Commission: Article 6 of the Green Credit Guidelines states that “the board of directors or supervisory board of banking institutions should build and enhance the green credit concept regarding energy conservation, environmental protection, and sustainable development, committing to facilitating inclusive activities , coordinated economic and social development, and establishing a sustainable development model that benefits society simultaneously” (Federal Office for the Environment, 2014, p. 39).
- Bangladesh Bank: “Green finance as part of green banking services significantly contributes to the transition to resource-efficient, low-carbon industries, i.e., the green industry and the green economy in general. Green banking is a component of the global initiative launched by a group of stakeholders to save the environment” (United Nations Environment Programme, 2016, p. 6).
- The South African Code for Responsible Investment (CRISA) states that “institutional investors should integrate sustainability considerations, including environmental, social, and governance factors, into their investment analysis and activities as part of delivering superior risk-adjusted returns to beneficiaries.”
- The International Development Finance Club defines green finance as referring to financial investments flowing into projects and initiatives for sustainable development, environmental products, and policies that encourage the development of a more sustainable economy.

The two primary objectives of green finance are to absorb environmental externalities and reduce perceived risks. Encouraging widespread, economically sustainable green finance ensures prioritizing green investments over conventional ones, which perpetuate unsustainable growth patterns. Green finance promotes transparency and long-term thinking in investments aligned with environmental goals and includes all sustainability criteria defined by the United Nations Sustainable Development Goals.

Among the major challenges of green finance is that the transition to a low-carbon economy requires significant investments, which can only be funded through high levels of participation. The consideration of sustainability evolves from risk management practices into a driver for innovation and new opportunities that create long-term value for businesses and society. However, mobilizing capital for

green investments remains limited due to many partial economic challenges; For instance, there is a mismatch in maturity periods between long-term green investments and the relatively short-term horizons of investors. Moreover, the coordination of financial and environmental policy approaches is often lacking. To expand and mobilize private sector finance, governments can collaborate with a range of stakeholders to increase capital flows and develop innovative financial methods across asset classes, particularly through capacity-building initiatives (Green Finance Platform, 2021).

Most importantly, there is a need for a coordinated definition of the term “green” and a classification of green activities to help investors and financial institutions allocate capital efficiently and make informed decisions. The definition of green finance must be more transparent to prevent "greenwashing." It is essential to establish a common set of minimum standards for green finance to redirect capital flows towards green sustainable investments and to analyze market risks and establish standards. Disclosure standards and regulations would help develop green finance assets. The voluntary principles and guidelines for green finance must be implemented and monitored, supported by regulatory incentives, for all asset classes.

3. Financial Technology (FinTech)

Financial technology, often referred to by the acronym FinTech, encompasses innovations aimed at competing with traditional financial methods in providing financial services. It can be defined as:

“Financial innovations that have the potential to generate new business models, applications, processes, or products, which significantly impact financial markets, institutions, and the delivery of financial services.” (Reserve Bank of India, 2017)

According to the Financial Stability Board: “FinTech is financial innovation that leverages technology to create business models or applications with tangible effects on financial markets and institutions, thereby facilitating the delivery of financial services. These innovations appear across various aspects of finance: retail and wholesale payments, securities infrastructure, investment management, insurance, credit provision, and capital raising, among others.” (Bina & Kribou, 2018, p. 39)

“FinTech is also described as a new era of global digital finance, encompassing everything from the application of artificial intelligence and machine learning to the use of big data, from biometric identity verification to seamless blockchain technology.” (Arner, 2018)

Financial technology services can broadly be classified into four key areas:

- Credit, deposit, and capital-raising services;
- Investment management services;
- Payment, clearing, and settlement services (retail and wholesale);
- Market support services (including gateways and data aggregators, ecosystems (infrastructure, open sources, APIs), data applications (big data analytics, machine learning, predictive modeling), distributed ledger

technology (blockchain, smart contracts), security (identity verification and authentication), cloud computing, IoT/mobile technology, and artificial intelligence (robotics, financial automation, algorithms)). (Basel Committee on Banking Supervision, 2018, p. 9)

The major technologies in financial technology include:

- Blockchain Technology: Distributed digital ledgers for transactions that are executed and shared across a network of participants. Blockchain ledgers record transactions and allow tracking of transactions back to their origins (Crosby, 2016). It is a decentralized software system open to all financial, informational, commercial, and equity exchanges worldwide, operating in a secure and transparent manner. Blockchain enables new forms of financing such as crowdfunding.
- Artificial Intelligence (AI): It involves technological patterns that simulate human performance by learning and drawing conclusions independently, understanding complex content, engaging in dialogues with humans, and enhancing human cognitive performance (Al-Sartawi, 2020).
- Cloud Services: A model for sharing a range of computing resources such as networks, servers, storage media, applications, and services from any location on demand (Archer, 2011).
- Big Data Analytics: Using automated algorithms, big data can be analyzed to uncover patterns and trends, particularly regarding human behavior and interactions. Big data analytics is characterized by three key features: volume, variety, and velocity, which are essential for customer segmentation, fraud detection, risk management, and personal financial services.
- Internet of Things (IoT): A system of interconnected devices that share data across a network, often referred to as “smart devices.” These IoT devices use software, hardware, data processing, sensors, actuators, and network connectivity, allowing them to exchange information without necessarily human interaction (Hinson & Sutherland, 2019, p. 2).

FinTech contributes to addressing challenges and issues within the traditional financial sector, which has predominantly relied on paper-based processes and cash transactions. It helps in:

- Enhancing financial inclusion through digital banking, branchless banking, mobile applications, and online platforms;
 - Improving the efficiency of financial operations, enabling faster and more cost-effective financial transactions;
 - Strengthening security and protection against fraud through blockchain technologies, dual verification, encryption, and facial recognition technologies;
 - Enabling crowdfunding through platforms;
 - Enhancing investment decisions and portfolio management through data analytics and AI;
 - Providing new methods of storing and exchanging currency through digital currencies;
- Financing sustainable and environmental projects.

4. Green Digital Finance: The Optimal Choice

Green digital finance is a recently coined term that has not yet acquired a fixed definition. Broadly speaking, it refers to the use of technology to explore financial solutions that also contribute to sustainability (green). It was defined by Marianne Haahr, CEO of the Green Alliance, as follows:

“Green digital finance is the harnessing of emerging technologies and digital tools to create new services, products, strategies, and business models that focus on green finance offerings.”

Emerging technologies typically referenced include artificial intelligence, big data, blockchain, and the Internet of Things. (Banco Bilbao Vizcaya Argentaria, 2022) Green finance can take a variety of forms, such as green bonds, green loans, green insurance, and other financial derivatives. However, it faces barriers that limit its mobility, particularly the insufficient integration of environmental externalities; misalignment of maturity; clear definitions of green finance; information asymmetry; and a lack of sufficient analytical capabilities within financial institutions to understand the opportunities and risks associated with green investments.

Digital finance demonstrates its ability to address some of these barriers through an unprecedented capacity to provide more data at lower costs, faster speeds, and with greater accuracy to support better financial decision-making. Moreover, it can enhance inclusion and unleash innovation. (The UN Environment Inquiry, 2018, p. 12). In short, green digital finance plays an important role in achieving sustainable development and protecting the environment by:

- Contributing to increased environmental efficiency;
- Financing renewable energy projects;
- Enabling global access to crowdfunding or crowd-investing for smaller environmental projects or more sustainable investments through digital platforms;
- Monitoring the environmental impact of projects and companies, thereby increasing transparency and helping track sustainability commitments;
- Improving reporting and evaluation processes related to the environmental and social performance of companies and projects.



The Green Digital Finance Alliance and the Swiss Green Fintech Network, supported by the Swiss State Secretariat for International Finance (SIF), launched the final version of the world’s first classification of green digital financial solutions. These solutions were categorized into eight categories as follows: (Green Digital Finance Alliance & Swiss Green Fintech Network, 2022).

Category 1: Green Digital Payment and Accounting Solutions:

These are payment platforms that use payment data through open banking standards, integrating green features as part of the payment experience. A green accounting program may be provided by an external vendor. Both the payment provider using the program and the accounting software provider are classified as green fintech companies. Key uses include:

- Solutions that can integrate user incentives to reduce their carbon footprint using reward systems such as green points;
- The use of transaction data to calculate carbon emissions in payment transactions or the environmental footprint in transactions, including plastic or water footprints;
- Automated compensation for green externalities in the market.

Table 01: Examples of Green Digital Payment and Accounting Solutions

| Company Name | Company Description | Objective |
|---|---|---|
| <p>Paygreen (2018)</p>  | <p>A Swiss fintech company offering a payment system where consumers can see the carbon footprint of the online store they are purchasing from.</p> | <p>Calculates the carbon emissions of a selected e-commerce store, and based on a set of measurement criteria, assigns a price to these emissions. The emission costs are charged to the emitters, not consumers. By using Paygreen as a payment system, users gain a better understanding of the store's environmental impact, encouraging online stores and producers to become more environmentally conscious.</p> |
| <p>Doconomy (2018)</p>  | <p>A Swedish fintech startup offering a digital banking service called the DO card.</p> | <p>Inspires consumers to change their behavior, reduce consumption, and compensate for their carbon emissions. The DO card tracks the carbon emissions from users' transactions and displays the data in a mobile app. It links the price of a product to its corresponding carbon emissions, measured in kilograms of CO₂, and recommends the amount to offset. With DO, users can directly offset their emissions or save and work to create a positive impact.</p> |
| <p>Ant Forest (UN Global Climate, 2019)</p> | <p>Ant Forest is a green initiative within the Alipay app, launched in 2016 by Ant Group, the parent company of Alipay, to encourage environmentally friendly lifestyles.</p> | <p>The mini-program provides feedback on more than 40 low-carbon lifestyle choices, such as using public transport, paying bills electronically, and buying energy-efficient household appliances. After making a low-carbon choice, users are rewarded with "green energy" points that can be converted into real trees planted or donated to support biodiversity conservation projects. As of August 2021, Ant Forest has enabled 600 million users to plant over 326 million trees and support conservation projects that provide</p> |

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| | | shelter to over 1,500 species in 18 protected areas across China. |
| ecolytiq (2020)  | A company specializing in privacy protection and personal data management, providing solutions for data matching and analysis to help businesses manage and protect their customers' sensitive information. | The ecolytiq program calculates the personal environmental impact, such as CO2 values, based on payment transactions. It also offers a library of valuable content and information about individual environmental impacts. Ecolytiq aims to enable consumers to reduce their long-term impact by providing not only the right content but also suitable compensation offerings from selected and certified organizations available through its marketplace. |
| Tomorrow (2018)  | A fintech bank and digital platform launched in 2018 with the mission to use money and personal finance to drive environmental change. | Offers deposit accounts to invest in and finance environmentally sustainable companies. It allows customers to analyze their carbon footprint based on their purchasing habits. A significant portion of credit card fees is directed towards rainforest conservation projects in Brazil. Account holders can track the number of trees planted or saved thanks to their purchases. |

Source: Compiled by the researcher based on the following report: Green Digital Finance Alliance & Swiss Green Fintech Network. (2022). Green Fintech Classification.




Category 2: Green Digital Investment Solutions

Green digital investment solutions refer to digital platforms that provide services for supervising, advising on, and automating green investment strategies and financial planning. These platforms include automated green portfolio allocation, risk assessments according to environmental standards, and use of algorithms where the investment manager is essentially a robot. The green digital investment solution, or green robo-advisory platform, selects stocks for portfolios based on the preferences and return requirements set by the investor.

The level of automation varies, with some platforms offering a one-time input from the investor while making all subsequent capital adjustments automatically, while others provide a high degree of capital customization.

Table 02: Examples of Green Digital Investment Solutions

| Company Name | Company Description | Objective |
|----------------------|---|---|
| Inyova (2017) | A Swiss investment platform that guides individuals and | Inyova offers a mobile app that can be used by both beginners and professional asset managers. As a |

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|  | <p>companies to achieve sustainable and responsible investments.</p> | <p>first step, investors select impact themes (e.g., renewable energy, future transportation, circular economy, plant-based foods) that align with their values. The platform then suggests a list of suitable companies. This green fintech solution is a standard example of automated design that can be integrated into investment platforms to align the financial system with green goals.</p> |
| <p>FNZ (2021)</p>  | <p>An international company specializing in providing technology solutions for the financial services industry, founded in New Zealand in 2003. FNZ is a major player in wealth management and fintech.</p> | <p>FNZ offers the FNZ Impact platform for wealth management and investment solutions for financial advisors, financial institutions, and active management companies. It provides a configurable suite of sustainability data sources, offering clients sustainability information. The platform offers automated and personalized sustainable solutions, such as environmental, social, and governance (ESG) reporting, consumer accessibility, data visualization, and preference settings. It also facilitates a seamless transition of savings into investments that align with sustainability preferences. Investment managers can monitor and report in accordance with their clients' sustainability preferences, with detailed information at the holdings level.</p> |
| <p>Cushon (2021)</p>  | <p>A UK-based fintech company working with employers to help people save and invest directly from their salaries. In January 2021, it launched the world's first carbon-neutral pension plan, <i>Net Zero Now</i>.</p> | <p>The <i>Net Zero Now</i> pension accelerates the industry's shift towards green investment portfolios and reduces holdings in companies that harm the environment. The name reflects the company's position ahead of major pension fund providers that have committed to reaching net-zero carbon emissions. Cushon aims to reduce the carbon footprint of its pension investments while aligning with the broader goal of achieving carbon neutrality.</p> |
| <p>Ethics (2018)</p> | <p>An asset management company that works</p> | <p>Ethics creates custom sustainability solutions to help investors and</p> |

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| Ethic | with wealth advisors to help them strengthen their relationships with investors. | wealth advisors build portfolios and direct funds towards environmental companies, aligning personal values with financial goals. The process starts with sustainability training and education, followed by financial analysis, portfolio creation, management, and continuous insights into client investments or institutional investments for their clients. |
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Source: Compiled by the researcher based on the following report: Green Digital Finance Alliance & Swiss Green Fintech Network. (2022). Green Fintech Classification.

Category 3: Green Digital Data and Analytics Solutions

Green digital data and analytics solutions provide investors with a wide range of information, such as integrating green data into credit decisions, digital green indexing, automated environmental assessments of companies, green asset classifications, automated carbon accounting, and environmental classification for small and medium enterprises (SMEs). These solutions also offer automated credit registration incorporating green data points, automated proof of impact reporting for green bonds, and automated monitoring of physical climate risks or natural hazards (e.g., deforestation risks, flood risks) related to capital allocation.

Artificial intelligence (AI) and machine learning (ML) algorithms are employed to extract and analyze unstructured data from internet sources, including expert reports, media signals, social media sentiments, corporate disclosures, and public or other company-related databases. Some solutions use cloud platforms to collect data directly from company assets via sensors and the Internet of Things (IoT) or from observational data based on satellites, airborne sensors, and other monitoring devices.

Table 03: Examples of Green Digital Data and Analytics Solutions

| Company Name | Objective |
|--|--|
| Impaakt (2022)  | A Swiss fintech company considered the "Wikipedia of Impact Investing." Impaakt offers a free, open-access peer review platform where a network of analysts measures the environmental impact of hundreds of companies worldwide. The platform provides a range of data, and anyone can publish company analyses. When new data is added, the community evaluates each piece of analysis, creating an impact score for the company visible on the platform. Businesses and investors can use this service to understand a company's exact impact, leading to better decision-making and ensuring capital is allocated to companies that generate positive impacts. |
| Satelligence | A Dutch fintech company (remote sensing) specializing in |

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| <p>(2022)</p>  | <p>providing highly detailed and semi-automated insights based on satellite data, offering actionable results on large areas for financial institutions to monitor deforestation risks. The solution uses machine learning techniques like Random Forest or Gradient Boosting to extract land cover information or make future predictions. Deep learning models filter out complex noise from radar sensor images. Statistical techniques like iterative Bayesian updates detect changes (deforestation monitoring). Contextual data from various sources are used to validate and calibrate algorithms and model supply chains. Through a web application, with access to reports and progress updates, the solution helps financial institutions make better-informed decisions, thereby reducing environmental impact in their investment portfolios.</p> |
| <p>Novisto (2021)</p>  | <p>A Canadian venture capital firm investing strategically in fintech and financial services companies. Novisto offers a data management and analysis program that helps organizations improve data collection effectiveness, enhance the quality of environmental data, benchmark their performance against peers, and communicate more effectively with internal and external stakeholders. It enables organizations to manage Environmental, Social, and Governance (ESG) governance and create value from non-financial donations.</p> |




Source: Compiled by the researcher based on the following report: Green Digital Finance Alliance & Swiss Green Fintech Network. (2022). Green Fintech Classification.

Category 4: Green Digital Crowdfunding Platforms

Green digital crowdfunding platforms enable the collection of capital from large numbers of individuals or legal entities in small amounts to fund green businesses, projects, or green transformation assets. These platforms connect funders with users via the internet, offering various types of crowdfunding, including green donations, green rewards, green equity, and green loan crowdfunding.

Table 04: Examples of Green Digital Crowdfunding Platforms

| Company Name | Objective |
|---|--|
| <p>RaiseNow (2022)</p>  | <p>A Swiss fintech company providing donation solutions for nonprofit organizations worldwide. Through its international payment platform, nonprofit organizations can access multiple channels for fundraising, easily reaching donors. The platform integrates strong automation for donation collection, allowing organizations to store all their data in one place, track donations in real-time, and receive support from a team of experts.</p> |
| <p>Bettervest (2019)</p> | <p>A German crowdfunding platform focused on raising capital for energy transition projects in the private sector. By investing in</p> |



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|  <p>bettervest</p> | <p>environmentally and economically viable energy efficiency measures, these projects help reduce costs, energy usage, and CO2 emissions. Individuals can invest small amounts starting from €50 in renewable energy, energy efficiency, and resource efficiency projects initiated by companies, NGOs, and local municipalities. Investors benefit financially from the cost and energy savings.</p> |
| <p>Trine (2019)</p>  | <p>A Swedish company that enables private and professional investors to collectively fund solar energy projects. Trine uses an online platform to allow individuals and companies to invest in solar energy projects that have a positive social and environmental impact. They partner with local project developers to identify and fund these initiatives.</p> |
| <p>Ulule (2015)</p>  | <p>A French crowdfunding platform established in 2010, enabling creators—whether in technology, entrepreneurship, culture, or charity—to raise funds from the public. People interested in a project can contribute financially in exchange for rewards or specific considerations defined by the project creator.</p> |



Source: Compiled by the researcher based on the following report: Green Digital Finance Alliance & Swiss Green Fintech Network. (2022). Green Fintech Classification.

Category 5: Green Digital Risk Analysis and Insurance Technology

Green digital risk analysis and insurance technology platforms help with dynamic pricing and underwriting for green assets, enhance green insurance products and services, and offer solutions to mitigate climate and nature-related risks. These solutions rely on AI data capabilities, IoT, and satellite imagery to facilitate the modeling, prediction, and scenario forecasting of physical climate and nature risks, helping investors understand and assess these risks and price them accordingly. Predictive analytics and real-time alert systems can be used in the insurance industry to mitigate or prevent risks using sensor capabilities. Smart contracts are also included to enable simple climate- or nature-related insurance processes, including underwriting and payments.

Table 05: Examples of Green Digital Risk Analysis and Insurance Technology Platforms

| Company Name | Objective |
|--|---|
| <p>°CelsiusPro (2021)</p>  | <p>A Swiss company specializing in parametric insurance solutions to mitigate the effects of adverse weather, climate change, and natural disasters. CelsiusPro's parametric insurance solutions rely on data from independent external agencies, official weather stations, and satellites. Payments are tied to reported data (e.g., rainfall) and do not require loss proof.</p> |
| <p>Jupiter (2022)</p>  | <p>A US fintech company providing climate risk analytics for businesses impacted by climate change. Jupiter produces localized risk estimates based on expected climate changes</p> |

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| | using forward-looking risk analysis from dynamic earth system models, combined with data-driven dynamic downscaling techniques. These models, integrated with machine learning, land use data, elevation data, and system-wide observations, offer businesses enhanced flexibility and risk management. |
| Cervest (2015)  | A climate intelligence platform that uses Earth Science AI™ to enable institutions to manage and mitigate environmental risks at the asset level. Cervest integrates public and private data sources, applying deep peer learning and statistical science for seamless climate risk insights. The platform helps evaluate, re-price, and reconnect capital assets to ensure climate resilience, particularly for critical assets like hospitals, data centers, airports, and warehouses. |
| Arbol (2018)  | A global climate risk platform based in New York that provides full-service solutions for companies seeking to analyze and mitigate climate risk exposure. Arbol offers boundary-triggered products based on objective data points rather than subjective loss assessments. The key difference between Arbol and traditional InsurTech platforms is its comprehensive ecosystem for addressing climate risk, including a vast climate data infrastructure, scalable product development, AI-driven pricing, blockchain-powered operations, and access to non-traditional risk capital. This creates greater transparency, efficiency, and scope for parametric coverage. |


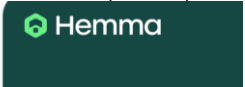

Source: Compiled by the researcher based on the following report: Green Digital Finance Alliance & Swiss Green Fintech Network. (2022). Green Fintech Classification.

Category 6: Green Digital Deposits and Lending Solutions

Green digital deposit and lending solutions offer options for saving and lending money to financially environmentally beneficial projects. This includes digital loans for green behavior-linked projects or businesses, such as financing for green consumer purchases (e.g., zero-emission vehicles or other green products). It also includes digital green mortgage solutions, such as those used for properties or ships that leverage IoT, sensors, and real estate data to calculate loan requirements and support green transformation funding. Additionally, this category covers digital lending solutions for transition financing, where technology is used to monitor the green behavior of borrowers.

Table 06: Examples of Green Digital Deposit and Lending Solutions

| Label | Objective |
|-----------------------|--|
| Pensumo (2019) | Pensumo is a Spanish fintech company that offers a pension programme for users who adopt more environmentally conscious consumption behaviours by purchasing from retailers committed to sustainability. |

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|  | <p>Pensumo collaborates with small stores that prioritise sustainable and local products, encouraging users to shop at these stores. When purchasing from a Pensumo partner store, users have the opportunity to allocate a portion of their spending to the Pensumo pension fund. Consumers take a photo of the receipt and upload it to the app, which is programmed to recognise and verify purchases from approved Pensumo partner stores.</p> |
| <p>Hemma (2022)</p>  | <p>Hemma is a Swedish fintech company that leverages the digital user experience to assess homes and provide automated advice on energy efficiency upgrades. The issuance of energy efficiency mortgages and the digital lending solution enables the lending bank to automatically monitor the energy performance of the asset and report it in accordance with European Union classification requirements.</p> |
| <p>Tandem Bank (2015)</p>  | <p>Tandem Bank offers green services in savings, lending, and green consumer finance, as well as smart products and new technologies to eliminate financial barriers and facilitate money management. These include green mortgages, green home improvement loans, and even everyday options to help users maximise the benefits of their investments.</p> |

Source: Prepared by the researcher based on the following report: Green Digital Finance Alliance & Swiss Green Fintech Network. (2022). *Green Fintech Classification*.



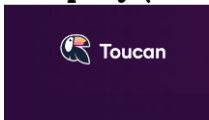
Category 7: Green Digital Asset Solutions

Green Digital Asset Solutions involve the tokenisation of green assets, which includes the digital representation of real (physical) and intangible assets (such as a carbon credit or biodiversity), or green-credentialed cryptocurrency tokens (tokens programmed only for spending on green products) , or tokens for green utilities (which can serve as rewards for reducing carbon emissions), or solutions for capital market infrastructure designed for green use cases, such as issuing traditional green asset classes in tokenised form. This category includes platforms for green security token offerings (platforms specifically designed to enable proof of green impact), offering tokenised securities to provide fractional ownership of green assets.

These solutions are built on public, private, or hybrid blockchains and offer varying degrees of automation through smart contracts for settlement, clearing, distribution, and payments.

Table 07: Examples of Green Digital Asset Solutions

| Label | Objective |
|--------------------------------|--|
| <p>TREECYCLE (2022)</p> | <p>TREECYCLE is a Swiss fintech company managed by the Global TREE Project (GTP), which sells asset tokens linked to actual eucalyptus trees. The asset token is named "TREE." Each asset sold generates 100 tokens, of which 70 go to</p> |

| | |
|--|---|
|  | <p>TREE token holders. As a mixed token offering, TREECYCLE will provide a maximum supply of up to 10 million security tokens designated as TREE, with a base cost of USD 23 each, totalling up to USD 230 million. To support sustainable development, 40% of the revenues generated from each harvest are distributed proportionally to the eucalyptus tree holders, while 50% is reinvested in purchasing land and seedlings for planting eucalyptus trees in Paraguay, ensuring that the eucalyptus tree is a passive growth asset.</p> |
| <p>Universal Protocol (2022)</p>  | <p>Universal Protocol launched the tradable carbon credit, UPCO2. Each UPCO2 token represents one tonne of carbon dioxide pollution avoided through an approved REDD+ project, which prevents the loss or degradation of rainforests. Each token is backed by a voluntary carbon unit, a digital certificate issued by an international standards agency, which allows certified projects to convert their greenhouse gas reductions into tradable carbon credits.</p> |
| <p>Green Token Company (2022)</p>  | <p>This company focuses on the development of environmentally focused tokens and cryptocurrencies, referred to as "green tokens" or "vertical cryptocurrencies." These tokens are generally designed to reduce carbon usage by employing consensus mechanisms and working in environments that support sustainable operations, and are used through cryptocurrencies such as Bitcoin.</p> |




Source: Prepared by the researcher based on the following report: Green Digital Finance Alliance & Swiss Green Fintech Network. (2022). *Green Fintech Classification*.

Category 8: Green Regulatory and Supervisory Technology Solutions

Green Regulatory and Supervisory Technology Solutions refer to applications of innovation supported by technology for regulatory requirements, compliance, and reporting implemented by an institution or a financial supervisory authority. Regulatory technology is used by financial service institutions in five key areas: combating money laundering, preventing fraud, preparing prudential reports, ensuring information and communication technology security, and assessing creditworthiness. Financial supervisory institutions leverage green digital technology to monitor markets and oversee banks, brokerage firms, and other financial institutions. When technology is specifically used for green prudential reporting and the automated evaluation of financial products and services according to green standards and classifications, it can be applied in the following cases:

The use of digital technology to analyse green and financial data disclosed to calculate the percentage alignment of a financial product's green classification. The use of artificial intelligence capabilities in natural language processing to automatically monitor the quality of green banking disclosures.

Table 08: Examples of Green Regulatory and Supervisory Technology Solutions

| Label | Objective |
|---|---|
| <p data-bbox="186 320 430 405">Green Regulatory Tech (2022)</p>  | <p data-bbox="455 316 1257 721">A green regulatory technology company based in Belgium, it assists businesses, credit institutions, and asset managers in complying with new EU sustainable finance regulations by digitising data capture and reporting processes. It provides digital solutions for preparing EU classification disclosure reports, the EU Sustainable Finance Disclosure Regulation (SFDR), and the EU Corporate Sustainability Reporting Directive (CSRD). It is a cloud platform that connects companies, auditors, financial institutions, and data providers. It offers an assessment of a company's activity to calculate eligibility/compliance with the EU classification based on sales turnover, capital assets, and operational capital.</p> |
| <p data-bbox="186 727 430 787">Bank of Spain (2022)</p>  | <p data-bbox="455 727 1257 1069">The Bank of Spain benefits from artificial intelligence's natural language processing (NLP) capabilities to track TCFD disclosures. The Spanish central bank has developed an algorithm based on TCFD classification to automatically extract information for AI-assisted analysis of the Spanish banking sector, creating a TCFD compliance index for each of the four key areas of the TCFD framework (2014-2019) using corporate reports. The index utilises text mining to provide an overview of the development of financial disclosures related to climate in corporate reports from the Spanish banking sector.</p> |
| <p data-bbox="186 1075 430 1160">Cloud-based ESG Reporting Tool (2022)</p>  | <p data-bbox="455 1075 1257 1443">A customisable cloud-based tool for environmental, social, governance, and sustainability (ESG) risk and impact reporting, designed to meet BSIE (basic sustainability impact and engagement) compliance requirements. It offers data across 16 mandatory indicators and 23 optional negative impact indicators for over 30,000 companies. It provides portfolio-level aggregation for multi-asset capabilities and search with coverage of 200,000 funds. All of this is used to automatically generate compliance-ready reports. Additionally, it offers EU sustainable finance classification disclosure data and options for climate-related financial disclosures.</p> |

Source: Prepared by the researcher based on the following report: Green Digital Finance Alliance § Swiss Green Fintech Network. (2022). *Green Fintech Classification*.

5. Conclusion

Undoubtedly, technological applications such as artificial intelligence, the Internet of Things, machine learning, blockchain, and data analytics have contributed to the development and expansion of green financial solutions that ensure long-term sustainability. These include carbon trading platforms, investments in renewable energy, green bonds, forest planting, peer-to-peer

lending platforms, crowdfunding platforms, mobile and online green payments, asset tokenization, and many other concepts that promote environmental and social sustainability through green digital finance.

Study Results

- Green Digital Finance refers to the use of technology and digital platforms to direct funding towards environmental projects and activities in a more efficient and transparent manner. This development reflects a trend of leveraging technology to address environmental and sustainability challenges.
- Some international companies and institutions have started using green digital finance technologies, such as cryptocurrencies, blockchain, crowdfunding platforms, digital payments through online and mobile applications, to invest and facilitate the flow of green finance, enhancing transparency in tracking the use of funds in sustainability projects.
- Green Digital Technology represents an effective way to enhance green finance and increase sustainability. These technologies make it easier for individuals and businesses to contribute to environmental conservation and sustainable development. On one hand, they provide easy access to available green finance services; On the other, blockchain ensures transparency in financial transactions and the recording of green finance data, increasing trust and security in this area. Crowdfunding platforms enable individuals to directly invest in environmental projects, which further directs investments towards these projects. Additionally, AI and data analytics improve decision-making regarding directing investments into environmental projects and monitoring their performance effectively.
- Financial Technology contributes to expanding green finance for renewable energy projects, enabling more efficient monitoring and management of energy facilities.
- Financial technology contributes to increasing transparency in green finance transactions and combating fraud and manipulation.

Study Recommendations:

- Efforts should be made to raise digital awareness to avoid the digital finance gap for those without access to digital technology or digital financial services.
- Achieve financial security by addressing cybersecurity risks and data theft.
- Efforts should be made to ensure that the manufacturing and operation of digital technologies do not harm the environment due to electricity consumption and the necessary resources.
- Avoid overlooking actual efforts to conserve the environment (such as implementing real environmental projects) due to excessive focus on green digital finance.

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