Sustainable Digital Finance

The Role of FinTech, InsurTech & Blockchain for Shaping the World for the Better

(Appendices)

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Content

Appendix 1: Research Method

The paper uses Grounded Theory to develop a framework and futures areas of research an innovation by combining literature analysis from theory and practice (see Appendix 2) and by analyzing start-ups in this field (see Appendix 3). Grounded theory is a systematic methodology which is based on inductive reasoning (instead of deductive modelling) (see (Strauss and Corbin, 1994). It is suitable for developing novel concepts and theories where existing research is rare. It often begins with the collection of (qualitative) data. By reviewing the data, basic elements become apparent and are tagged with codes, which are extracted from the data. Based on these codes, the data can be grouped into concepts and categories. These categories may later become the basis for new theory as additional knowledge is created. Grounded Theory includes five steps (Wolfswinkel, 2013): (1) Definition of the scope of the analysis, (2) literature search and search of relevant start-ups in this field, (3) selection of the final sample, (4) corpus analysis and (5) presentation of the findings.

In the *first step* the relevant search terms were delineated and comprised “sustainability”, “sustainable”, “financial technology”, “fintech”, “insurance technology”, “insurtech” and “blockchain”. The term blockchain was specifically mentioned as it is often used separately and not necessarily in the context of FinTech.

For the *second step*, the online databases AIS Electronic Library, Business Source Complete and ScienceDirect were chosen for the academic literature analysis. The AIS Electronic Library provides access to relevant literature of journals and conferences which are not available in other databases like Web of Science etc. Business Source Complete and ScienceDirect on the other hand provide access to journals which are not part of AIS Electronic Library and complement it. With these three databases a broad universe of academic partners can be covered and thus the existing knowledge be identified. For the search itself, papers were excluded that provided work in progress papers from conference proceedings, panel introductions, papers which are not available in English, unavailable papers, teaching cases and pedagogical research papers. Each search result was recorded on an excel sheet with a number, the database in which it was found, the citation reference, the publication type (journal, conference), abstract, keywords and the link to the publication. Each publication was downloaded and read through. The search was performed in the time frame from February 2nd to February 22nd 2020.

In the *third step*, the selection of the final sample was performed. The initial sample contained 96 papers from which 54 relevant papers were identified as relevant for further analyses after reading through the papers’ abstracts and keywords and after deleting doubles (see Table 1; the total results are in brackets while the number before the brackets shows the relevant papers after reading through the abstracts and keywords). In a next step, all 54 papers were analyzed in more detail and finally 21 papers were selected as relevant for a more detailed analysis. The other 33 papers were eliminated because they were either not from peer reviewed sources, they provided no explicit link to “fintech”, “financial technology”, “insurance technology” or “insurtech” (e. g., one paper for example focused on the definition of future research fields of supply chain management and only mentioned fintech and blockchain as a potential field of future research while not explaining it in more detail), to “sustainability” or “sustainable” (e.g., one paper focused on blockchain and current research topics without drawing an explicit connection on sustainability) or to all of them (e.g., one paper focused on the use of blockchain in smart cities without drawing an explicit connection to sustainability and digital finance rather than only mentioning them). In an additional step, backward and forward search was taken out. This procedure led to an additional 8 papers. The total sample therefore includes 29 papers.

In the *fourth step*, grounded theory was applied, in order to understand the current literature more deeply. This step was conducted by using open coding and selective coding. For this, each paper was first open coded which means that descriptive elements like title of the paper, author(s), publication outlet (journal or conference name), type of publication outlet (journal or conference), abstract, keyword, theories, methods (empirical), methods (non-empirical) and definitions were entered into the Excel Sheet. In a next step, selective coding was used to abstract the papers with regard to specific categories used in the research papers and to identify patterns among them. This fourth step was also extended to start-ups since radical innovations frequently emerge from new market entrants rather than from the incumbents (Weiblen and Chesbrough, 2015). The analysis presented in Appendix 2 and 3, which was developed based on Grounded Theory, was extended here to an analysis of existing sustainable digital finance innovation solutions from start-ups according to the classification scheme that matched the following three criteria: ((1) sustainable) it contributes to the area of sustainability as supporting at least one of the 17 UN sustainable development goals, ((2) finance) it is related to any process concerned with financial services (payments, investments, financing, insurance) and ((3) digital) it is supported by IT. A variety of reports, online databases, blogs, tweets, alerts and events were screened for this purpose. This is in line with Grounded Theory, where the data set can be extended to practicioners' work (Rowe, 2014).

In the *fifth step*, the findings of the analysis are presented. The results of the analysis are presented in the Appendices 2 and 3 as well as the sections 2, 3 and 4 of the main paper.

Search terms Databases	("sustainability" OR "sustainable") AND ("financial technology" OR "fintech" OR "insurance technology" OR "insurtech" OR "blockchain")
AIS Electronic Library	8 (9)
Business Source Complete	23 (42)
ScienceDirect	23 (45)
Total	**54 (96)**

Table 1. Search Results of the Literature Analysis

Appendix 2: Research Results

A 2.1 Drivers

Drivers	Financial technology			Sustainability		
	Evolution of novel technologies	Convergence of technologies	New application areas and business models	Economic prosperity	Environmental protection	Social equity
(Vogel et al., 2019)	Blockchain-based product-life cycle model	Blockchain, smart contract, IoT	Supply chain management with product history, track and trace, and provenance data Smart contracts for insurance	Circular Economy to implement sustainability in product-life cycles that will interrupt the phase of pure resource extraction, production, usage, and waste	-	-
(Tavares et al., 201	Blockchain-based credit platform	Blockchain, smart contract	Blockchain-based online platform for negotiating forest credits, a title issued from environmental services	-	Increase transparency in accountability and certification of origin of resources	-
(Ning et al., 2019)	Blockchain-based targeted poverty alleviation system	-	Blockchain for targeted poverty alleviation that allows issuers, managers and users to trace, audit and use funds	-	-	Improve allocation of funds for poverty reduction by eliminating corruption, transparency and auditability
(Kirpes and Becker, 2018)	Blockchain-based peer-to-peer charging infrastructure for electromobility	Blockchain, smart contract, dApp	Peer-to-peer infrastructure which allows consumers to charge and pay electromobility	-	Increase the use of electromobility by a blockchain-based p2p infrastructure	-
(Nagel et al., 2019)	Blockchain-based smart city infrastructure	Blockchain, IoT	New p2p, m2m etc. (business) models for energy, transportation, building, health and government	-	Smart cities connect people, institutions and infrastructures to use resources more sustainably and efficiently	-

(Kamble et al., 2019)	Blockchain-based agriculture supply chain	Blockchain, smart contract	Blockchain for tracking product movements from the farmers to the retailers throughout the agriculture supply chain	Blockchain can integrate and manage all processes and transactions in agricultural supply chains on a real-time basis.	-	-
(Venkatesh et al., 2019)	Blockchain-based transparency of supply chain social sustainability	Blockchain, IoT, big data	Blockchain to allow sellers to monitor their supply chain social sustainability efficiently and effectively.	-	-	Improving suitable working conditions by protecting workers from exploitation, maintaining a healthy and safe environment etc.
(França et al., 2020)	Blockchain-based solid waste management	Blockchain, digital wallet	Blockchain and a digital coin allows small municipalities to pay voluntary citizens the collection of urban solid waste.	Stimulation of the local economy through the creation of a novel green digital currency and a complementary revenue stream for low-income persons.	Municipal solid waste is being recycled rather than being taken to a landfill.	-
(Bürer et al., 2019)	Blockchain-based energy models	Blockchain, smart contract, IoT	Blockchain allows incumbents and start-ups to develop novel business models like p2p generation and sales, etc.	Blockchain and smart contracts, linked to the internet of things could lead to new business models like p2p power generation and sales, virtual transmission, etc.	Blockchain is able to better manage and match power demand and supply and thus reduce power overproduction.	Blockchain can help to fund energy and projects in developing countries.
(Choi and Luo, 2019)	Blockchain-based sustainable fashion supply chain	Blockchain	Blockchain enhances data quality and increases social welfare in fashion supply chains.	Blockchain can increase data quality and thus leads to enhanced environmental sustainability in fashion supply chains.	-	-
(Sarkar and Swami, 2019)	FinTech enabled financial inclusion	FinTech	FinTech allows to better include people who are currently excluded from the financial system.	FinTech can increase the number of bank accounts and the number of digital transactions among poor people.	-	-

(Cole et al., 2019)	Blockchain-based sustainable supply chain management	Blockchain	Blockchain allows firms to verify sustainability for receiving preferential financing, subsidies and tax incentives	-	-	Blockchain can increase transparency of origins of materials, concerns over modern slavery, and how to extend sustainable practices and governance upstream in supply chains.
(Bendell, 2017)	Digital currency based SME and microentrepreneur financing	Digital currency	Cryptocurrencies allow improved SME and microentrepreneur financing in developing countries	Digital currencies allow to develop networks of credit in developing countries so that excess services that might have gone unused can be avoided.	-	-
(Anshari et al., 2018)	FinTech-based agriculture supply chain	FinTech	A digital marketplace with FinTech services linking agricultural producers with customers and wholesalers	FinTech as part of digital marketplaces could overcome frequent problems of financial issues faced by farmers and encourage public to invest into agriculture.	-	-
(Zhang, 2018)	Blockchain-based rural waste and energy management	Blockchain	A digital currency based voucher system for a rural waste to energy system for farmers in rural areas.	-	Digital currencies incentivize farmers and the establishment of a long-term trust between farmers and energy companies in the optimized segregation of rural waste.	-
(Yu and Shen, 2019)	FinTech in lending for the sharing economy	FinTech	P2P platforms enable individuals to collaboratively make use of underutilized inventory via fee-based sharing of idle capacity.	The sharing economy could democratize the financial sectors by p2p lending, through widening access to more participants.	-	-

(Li et al, 2019)	Blockchain-based energy management	Blockchain, smart contract	Blockchain for decentralizing the transactive energy management at the power distribution level (energy and financial flows).	Blockchain enables a networking of microgrids in the way electric energy is generated, delivered, and consumed in power distribution systems by bridging technical and financial management processes.	-	-
(Hagan et al, 2019)	Blockchain-based recycling of mined minerals / metals	Blockchain, smart contract	Blockchain for minerals / metals which are leased to manufacturers while ownership remains with the (developing) country of origin.	Blockchain enables to effectively monitor and track assets like minerals / metals which can be leased for a certain period of time and then returned.	-	-
(Yu et al., 2019)	Blockchain-based manufacturing	Blockchain, smart contract, IoT	Blockchain enables an improved utilization of manufacturing resources like machines via p2p sharing.	Blockchain transforms manufacturing from centralized to decentralized platforms allowing consumers to produce custom-tailored goods.	-	-
(Ahl et al., 2019)	Blockchain-based energy internet	Blockchain, smart contract, IoT	Blockchain facilitates distributed p2p platforms for the Energy Internet.	-	Blockchain enables the transformation of energy production and consumption by reducing greenhouse gas emissions which primarily are linked to 70-85% of energy production.	-

Table 2. Results of the Literature Analysis: Drivers

A 2.2 Ecosystems

Ecosystem Elements	Strategy				Organization			Systems		
	Network Type	Business Model	Product / Service	Provider Type	Interaction Processes	Fintech Processes	Organizational Design	FinTech Applications	InsurTech Applications	Blockchain Applications
(Vogel et al., 2019)	Supply chain (Product-life cycle model)	Operational excellence	Business services	Business, financial institution	B2C, B2B	Payments	Decentralized	•	•	•
(Tavares et al., 2019)	Government (online forest credit platform)	Product leadership	Government services	Government, financial institution	G2C, G2B	Investments, financing	Centralized	•	-	•
(Ning et al., 2019)	Government (targeted poverty alleviation platform)	Customer intimacy	Government services	Consumer, governments, financial institution	G2G, G2C	Financing	Decentralized	•	-	•
(Kirpes and Becker, 2018)	Peer-to-peer (electro charging infrastructure)	Operational excellence	Consumer services	Consumer, non-financial institution	C2C	Payments	Decentralized	•	-	•
(Nagel et al., 2019)	Government, business, peer-to-peer (smart city)	Customer intimacy, product leadership, operational excellence	Government, business and consumer services	Consumer, government, non-financial institution	C2C, G2C, B2C, B2B	Payments, investments, financing, insurance	Decentralized	•	•	•
(Kamble et al., 2020)	Supply chain (agriculture supply chain)	Operational excellence	Government and business services	Consumer, government, financial institution, non-financial institution	G2B, B2C, B2B	Payments, financing, insurance	Decentralized	•	•	•

(Venkatesh et al., 2020)	Supply chain (blockchain supply chain)	Operational excellence	Government, business and consumer services	Consumer, government, financial institution, non-financial institution	G2B, B2C, B2s	Payment, insurance	Decentralized	•	•	•
(França et al., 2020)	Government, business (smart city)	Operational excellence	Government, business and consumer services	Consumer, government, non-financial institution	G2C, G2B, B2C	Payments	Centralized	•	-	•
(Bürer et al., 2019)	Peer-to-peer (energy)	Operational excellence	Business and consumer services	Consumer, business, non-financial institution	C2C	Payments, investments, financing	Decentralized	•	-	•
(Choi and Luo, 2019)	Supply chain (fashion)	Operational excellence	Government and business services	Business, non-financial institution	G2B, B2B	Investments	Centralized and decentralized	-	-	•
(Sarkar and Swami, 2019)	Business (banking)	Customer intimacy	Business services	Financial institution, non-financial institution	B2C	Payments	Centralized	•	-	-
(Cole et al., 2019)	Supply chain (blockchain supply chain)	Operational excellence	Business services	Business, government, financial institution	G2B, B2B	Payments, financing	Centralized	•	-	•
(Bendell, 2017)	Business (SME and microentrepreneur financing)	Customer intimacy	Consumer services	Consumer	C2C	Payments, financing, investments	Centralized	•	-	•
(Anshari et al., 2019)	Supply chain (agriculture supply chain)	Operational excellence	Consumer and business services	Consumer, non-financial institution	C2C, B2C, B2B	Payments, investments, financing,	Centralized	•	-	-
(Zhang, 2019)	Government (waste and energy management)	Operational excellence	Government services	Government, non-financial institution	G2B	Payments	Decentralized	•	-	-

(Yu and Shen, 2019)	Peer-to-peer (lending for the sharing economy)	Customer intimacy	Business services	Business, non-financial institution	B2B	Investments, financing	Centralized	•	-	-
(Li et al., 2019)	Peer-to-peer (energy manage-ment)	Operational excellence	Consumer services	Consumer, non-financial institution	C2C	Payments	Decentralized	•	-	•
(Hagan et al, 2019)	Government (recycling of mined metals)	Product lead-ership	Government and business services	Business, financial in-stitution	G2B, B2B	Payments, investments	Centralized	-	-	•
(Yu et al., 2020)	Peer-to-peer (manufac-turing)	Product lead-ership	Business services	Business, financial in-stitution	B2B	Payments	Decentralized	-	-	•
(Ahl et al., 2020)	Peer-to-peer (energy manage-ment)	Operational excellence	Consumer and business services	Consumer, non-financial institution	C2C, B2C	Payments	Decentralized	-	-	•
(Zhu et al., 2020)	Peer-to-peer, busi-ness (energy manage-ment)	Operational excellence	Consumer and business services	Consumer, business, financial in-stitution, non-financial institution	C2C, B2C, B2B	Payments, investments, financing	Decentralized	•	-	•
(Kshetri, 2017)	Govern-ment, busi-ness (pov-erty reduc-tion)	Operational excellence	Consumer government and business services	Consumer, government, business, financial in-stitution, non-financial institution	G2C, G2B, B2C, B2B	Payments, investments, financing, insurance	Centralized	•	•	•
(Wu and Tran, 2018)	Peer-to-peer, busi-ness energy manage-ment)	Operational excellence	Consumer, government and business services	Consumer, government, business, financial in-stitution, non-financial institution	G2B, C2C, B2C, B2B	Payments	Decentralized	•	-	•

(Thomason, 2017)	Peer-to-peer, government, business (healthcare)	Customer intimacy, operational excellence	Consumer, government and business services	Consumer, government, business, financial institution, non-financial institution	G2C, C2C, B2C	Payments, insurance	Decentralized	•	•	•
(Fu et al., 2018)	Government, business (fashion industry)	Operational excellence	Consumer, government and business services	Consumer, government, business, non-financial institution	G2B, B2C, B2B	Payments	Decentralized	•	-	•
(Kamath, 2018)	Government (supranational blockchain governance)	Operational excellence	Government services	Government	G2B	Investments, Financing	Decentralized	•	-	•
(Mannaro et al., 2017)	Peer-to-peer (energy management)	Operational excellence	Consumer services	Consumer	C2C	Payments	Decentralized	•	-	•
(Schuetz and Venkatesh, 2019)	Peer-to-peer (financial inclusion)	Operational excellence	Consumer services	Consumer	C2C	Payments	Decentralized	•	-	•
(Mihaylov et. al., 2014)	Peer-to-peer (energy management)	Operational excellence	Consumer services	Consumer	C2C	Payments	Decentralized	•	-	•

Table 3. Results of the Literature Analysis: Ecosystems

A 2.3 Business Benefits

Benefit Category	Business Benefits			
	Revenues	Costs	Quality	Time
(Vogel et al., 2019)	• -	• Product rights: Decreased fraud and bad behavior • Product consumption: Increased product reusability	• Product provenance and history: Increased product quality transparency • Product innovation: Receive new insights into PSS for innovation	• Product life-time: Increased product lifetime due to information transparency (e.g., maintenance) and reduced adverse selection
(Tavares et al., 2019)	• Forest credit platform: Source of revenue for the government and redirection of investments in other public projects	• Increased efficiency in management of natural resources.	• Increased transparency in accountability and certification of origin of resources	• -
(Ning et al., 2019)	• -	• Reduction of corruption in the distribution of poverty funds • Reduction of monitoring costs	• Increased transparency and auditability of the funds flow, ensuring a proper use of funds • Improve the impact measurement of poverty alleviation programs	• Faster allocation of funds to target groups and appropriate projects
(Kirpes and Becker, 2018)	• A peer-to-peer charging infrastructure provides a potential revenue stream for private persons	• Reduction of costs due to reduction of inefficiencies of centralized systems by enabling p2p sharing of charging infrastructure without central authority	• -	• Almost instant payment settlement while at the same time trust from the consensus mechanism is ensured
(Nagel et al., 2019)	• Peer-to-peer transactions enable novel prosumer markets like in energy and transportation and thus increase sustainability	• Reduction of transaction costs in all smart city application areas	• Auditability allows for improved quality and sustainability of services	• Increase transaction speed due to disintermediation and tokenization in micro transactions
(Kamble et al., 2020)	• -	• Reduction of transaction costs and increased efficiency of transactions processes along the supply chain	• Reduction of risks for stakeholders and relieving the rural distress and social sustainability in developing countries • Improved auditability and accountability and reduction of fraudulent activities	• Reduction of settlement lead times and payment delays due to unnecessary human interventions, real-time approvals and payments in trade finance
(Venkatesh et al., 2020)	• -	• Reduced auditing costs due to scheduling of social sustainability audits in a transparent manner to all stakeholders.	• Blockchain technology makes it possible to easily trace the compliance history of individual suppliers. • Improved security of sensitive documents, including audit feedback and	• Reduction of implementation time for supply chains by integrating all possible stakeholders under a single framework to establish a sustainable production ecosystem

			• corrective action plans which tend to be manipulated • Improved inspections as in some cases, suppliers and other stakeholders manipulate the schedule to their advantage • Improvement of intra-and inter-departmental communication as it supports integration among various departments, which will significantly reduce organizational conflicts	• Reduction of the overall turnaround time of audits because processes of information gathering will be more streamlined and transparent
(França et al., 2020)	• Complementary revenues for low-income persons • Stimulation of the local economy through the creation of the green digital currency • Replication of the model to other larger municipalities	• 15-fold increase in the amount of municipal solid waste to be recycled rather than continue to be taken to the city's landfill	• Reduction of fraud compared to the analogue Green Card due to immutability of the digital transactions • Standardization of processes between collectors and local commerce, as well as reliability and trustworthiness in monetary transactions • Reliable and auditable data for accounting	• High adoption rate within short time from 3% of the non-digital Green Card to 90% for the digital currency
(Bürer et al., 2019)	• Peer-to-peer transactions enable novel prosumer markets	• Reduced costs due to decreasing overproduction of energy improving by demand-side management	•	• -
(Choi and Luo, 2019)	• Increased supply chain profit due to lower demand volatility	• Reduced product leftovers and environmental costs due to better market planning data	• Increase data quality due to transparency along the supply chain	• -
(Sarkar and Swami, 2019)	• Increase the total number of bank accounts	• Increase the total number of non-cash transactions	• -	• -
(Cole et al., 2019)	• Accelerate new product development by improving efficiency and delivering greater transparency between teams	• Automate contracts by smart contracts • Improve inventory management. • Reduce transaction costs by real-time auditing via stamping	• Improve quality management by better data quality • Reduce illegal counterfeiting by origin of product information • Improve product safety and security by providing records of safety testing	• Reduce cycle times by reducing intermediaries
(Bendell, 2017)	• -	• Reduce excess stock for products	• -	• Reduce cycle times due to trust in digital currency

(Anshari et al., 2019)	• Investors are encouraged to invest into agricultural producers by crowd-funding	• Reduced number of cash transactions.	• Improved business processes and data quality by connecting investors, landowners, farmers, and customers in a single platform	• -
(Zhang, 2019)	• Increasing employment opportunities. • Entrepreneurs might make profit from the energy and fertilizer coupons	• Reduces the need for farmers to purchase fertilizer and electricity, thereby increasing their disposable income	• Allow the energy market in rural areas to become more efficient and decentralized	• Route optimization of the trucks picking up waste from farms and exchange the filled smart bins with empty ones (traveling salesman problem)
(Yu and Shen, 2019)	• Increasing financial system access by widening access to more participants (e.g. lower income individuals and businesses)	• P2p lending platforms are more capable of identifying behaviors that predict defaults and fraud than traditional banks that more heavily rely on a set of risk prevention measures	• -	• -
(Li et al., 2019)	• Novel pricing schemes incentivize more investments in localized renewable energy generation • Networked microgrids provide market-based financial signals for incentivizing to share resources	• Networked microgrids respond more efficiently to dynamic operating conditions	• Networked microgrids offer a highly scalable and flexible solution to environmental concerns and operational goals • Networked microgrids are more reliable than individual microgrids, since each networked microgrid offers reserves for their peers to reduce the probability of power outages in the utility network	• -
(Hagan et al, 2019)	• Instead of providing a country with a one-off economic rent from sales of mined metals, keeping ownership with the country of origin could translate into long-term revenue	• Leased instead of sold metals documented on blockchain assets can incentivize the recycling of metals	• -	• -
Yu et al., 2020)	• Proof of participation bonds provides incentive mechanisms. Once all tasks in a block have been completed, some service charges can be delivered as a reward to the corresponding block recorder	• -	• Blockchain-based manufacturing allows consumers to submit custom-tailored product requirements and match them with manufacturing resources, which are confirmed and supervised by smart contracts • The system provides trust for both providers and consumers as smart contracts trigger automated payments dependent on full contract ful-	• -

			fillment	
(Ahl et al., 2020)	• Digital grid routers track and record all energy sources and carbon emissions and can provide data supporting renewables-trading, especially if reinforced with governmental policies	• Blockchain platforms with smart contracts can cost-efficiently decentralize transactions and support p2p energy-trading even for low-value transactions	• Blockchain facilitates concurrent electricity and financial flows based on automated buying, selling, and scheduling of transactions, in contrast to conventional power balancing groups • People are more likely to purchase renewable energy if assured of its origins. This confidence can be increased with transparency, certificates of origin, and data immutability on blockchain platforms	• -
(Zhu et al., 2020)	• The combination of blockchain technology and the micro grid can bring small clean energy suppliers into the energy market.	• Reduction of transaction costs in the financing process of energy projects and the energy retail trading process	• In the energy wholesale trading process, blockchain technology can provide security protection for transactions • In the consumption process, blockchain can facilitate improved public participation in new energy consumption and carbon emission reduction • Record details of energy transactions, which makes it easier to audit and supervise carbon emission quotas and improve the transparency of carbon emissions	• Blockchain and smart contracts can help to achieve stability of energy supply and predictability of energy prices
(Kshetri, 2017)	• Clear property rights of poor would allow entrepreneurs to use the assets as collateral and thus increase their access to capital	• Reduction of corruption and fraud due to improved auditability • Increase in efficiency and reduction in transaction costs due to decreasing number of institutions • Reduction of administrative costs between medical service providers and insurance companies by smart contracts providing warranties for down payment	• Strengthen the governments' enforcement powers and sanctions against individuals or organizations that breach regulations	• -

(Wu and Tran, 2018)	• A blockchain-based energy internet supports various novel services like open trading etc.	• A p2p energy trading model can provide an efficient, open, and trustworthy trading platform for the energy internet • A unified payment platform reduces transaction costs in electromobility vehicle charging	• Improved settlement in multi-energy systems based on decentralized blockchain platforms for energy production, transmission and utilization	• Reduction of processing time in carbon emissions certification and trading by digital asset carbon tokens on blockchains
(Thomason, 2017)	• -	• Reduction of fraud in pharmaceutical supply chains • Reduction of costs by tracking donor funds through smart contracts by delivering them directly to the recipients and thus provide access to healthcare services	• Blockchain can be used to ensure poor womens' and childrens' access to healthcare services based on a digital identity • Enables poor women and children, health care providers, health care entities and medical researchers to securely share electronic health data	• Getting medicines to poor women and children in a timely manner
(Fu et al., 2018)	• -	• Blockchain could protect the system from fraud • Blockchain provides automation, transparency and immutability	• Improve emission trading schemes by enhancing them by incorporating more details based on the manufacturing procedures of the products • Exposing the carbon emissions of the industry to the public and a feature to is established • Reducing the emissions throughout all key manufacturing steps	• -
(Kamath, 2018)	•	• Reduce corruption and bribery: blockchain enables Anti- Money Laundering (AML) and Know Your Customer (KYC) for SDG 17 and SDG 16 • Reduction of auditing costs: Instead of having a central authority auditing and verifying funding transactions, a citizen could check on transactions for donations, funds, and their uses • Reduction of administration costs through governance without a government by self-organization of societies	• Inter-governmental bodies, NGOs or civil society stakeholders could use an existing non-anonymous cryptocurrency or develop their own one. • In public procurement, assets verification is improved through blockchain and reduces geopolitical barriers in transferring assets and reconciling systems (SDG 17)	• Faster access to justice and rights (e.g., blockchain may ensure finances to transmit the person's bail funds, provides litigant with finances in a cryptographically-secured wallet at tailored interest rate payments, etc.)

(Mannaro et al., 2017)	• New business opportunities for small producers of energy • A robo-advisor can support prosumers of energy to choose the best selling and buying strategy in order to maximize their profits	• Electricity could be traded following the free market rules, at the price established when supply and demand meet at the equilibrium point	• -	• -
(Schuetz and Venkatesh, 2019)	• Blockchain holds the potential to connect rural Indians to local and global supply chains blockchain-based solutions by delivering financial products and service digitally to the "doorstep" through mobile banking apps	• Decreasing costs of engaging in financial transactions	• Provide more suitable financial products (e.g., mobile micropayments)	• -
(Mihaylov et. al., 2014)	• NRGcoins can be traded across countries and can serve as an international currency for green energy	• -	• Locally produced renewable energy is "converted" to NRGcoins. Their advantage over fiat currency is that they serve as the right to receive an equivalent quantity of energy in the future independent of the NRGcoin market value • The NRGcoin resembles tradable renewable energy certificates as a measure of produced renewable energy and as a way to support clean energy efforts	• -

Table 4. Results of the Literature Analysis: Business Benefits

A 2.4 Sustainability Benefits

Sustainability Benefits	Sustainability Goals																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
(Vogel et al., 2019)									•	•		•					•
(Tavares et al., 2019)									•				•				•
(Ning et al., 2019)	•							•	•								•
(Kirpes and Becker, 2018)									•		•	•	•				•
(Nagel et al., 2019)			•				•		•		•						•
(Kamble et al., 2020)												•					•
(Venkatesh et al., 2020)			•							•		•					•
(França et al., 2020)								•		•	•						
(Bürer et al., 2019)							•		•				•				
(Choi and Luo, 2019)									•			•					
(Sarkar and Swami, 2019)					•				•	•							
(Cole et al., 2019)									•			•					
(Bendell, 2017)								•	•	•							
(Anshari et al., 2019)								•	•			•					
(Zhang, 2019)			•				•		•			•	•		•		
(Yu and Shen, 2019)								•	•	•							
(Li et al., 2019)							•		•		•		•				
(Hagan et al, 2019)	•							•	•	•		•	•				•
(Yu et al., 2020)								•	•			•					•
(Ahl et al., 2020)							•		•				•				
(Zhu et al., 2020)							•		•		•		•				
(Kshetri, 2017)	•		•	•			•	•	•								
(Wu and Tran, 2018)							•		•		•		•				
(Thomason, 2017)			•		•				•								
(Fu et al., 2018)									•			•	•				
(Kamath, 2018)																•	•
(Mannaro et al., 2017)							•		•		•		•				
(Schuetz and Venkatesh, 2019)	•							•	•								
(Mihaylov et. al., 2014)							•						•				

Table 5. Results of the Literature Analysis: Sustainability Benefits

A 2.5 Cases

Literature	Description
(Vogel et al., 2019)	Blockchain-based product-life cycle model for sustainable product-service system to foster the circular economy and which is applicable across different industries. It allows all users to gain a transparent provenance and product history, the possibility to track and trace products along the supply chain as well as data analysis for product design. With this new models for waste management and a life time expiration become possible.
(Tavares et al., 2019)	Blockchain-based online forest credit platform (Amapá Green Treasure – AGT) which allows investors to invest in a "sustainability seal" what is obtained by calculating the footprint access to green economy policies (e.g., loans for public servants to get solar panels that have the seal). The credits are issued based on the environmental services of the State of Amapá in Brazil rendered in the last 12 months. The Forest Credit is not subject to risk in the case of deforestation as it is issued on the service already provided. The focus is to value the intact forest.
(Ning et al., 2019)	Based on China's Poverty Alleviation Plan, the blockchain-based targeted poverty alleviation platform focuses on the implementation of central government issued funds across different local governments and targeted people in Guiyang in Southwestern China. It provides target groups identification, project discovery, financial resources issuance, approach customization, human resources allocation and alleviation effect monitoring. With this, it improves traceability and auditability of funds and ensures a proper use of poverty funds.
(Kirpes and Becker, 2018)	To mitigate the lack of public charging infrastructures for electromobility, this paper suggests a blockchain-based peer-to-peer sharing platform for charging infrastructure. Therefore the blockchain-based platform supports the charging and payment process by the use of a digital wallet, a smart contract which calculates the amount payable and a blockchain which records the transactions.
(Nagel et al., 2019)	This paper focuses on smart cities and derives a taxonomy based on an evaluation of start-ups. This taxonomy identifies various application areas, business models and blockchain applications in the areas of energy, transportation, building, health and government. All of them have an impact on FinTech, InsurTech and sustainability. Among the examples are p2p energy trading systems and carbon asset management (energy), ride sharing and parking platforms including smart contract based payments (transportation), consumption tracking and automated payments as well as crowdfunding and tokenized ownership (building), health coins for rewarding health conscious lifestyles from insurers (health), automated tax payment and donation fund tracking (government).
(Kamble et al., 2019)	The agriculture supply chain is under severe pressure from various consumer organizations, social and environmental activists, agro-based companies and policy makers to achieve sustainability. But the existing supply chains (here at the example of India) show a low level of industrialization, inefficient supply chain management, lack of managerial skills and fragmented information sharing leading to low supply chain visibility. In addition, trade finance methods are complicated, time-consuming, inefficient, and involve much paperwork for managing transactions. Smart contract enabled services on blockchains can eliminate unnecessary human interventions which lead to payment delays. Blockchain-enabled agriculture supply chains provide opportunities to all involved partners to capture complete, and reliable data, which is a requirement for achieving traceability of farm products. The findings identified the increasing importance of tracking and authenticating the food supply chain to understand provenance and need for a high level of traceability.

(Venkatesh et al., 2019)	Global Supply Chains are becoming increasingly complex. It has become more challenging to manage social sustainability issues which are concerned by many overseas buyers and consumers. Social sustainability in global supply chains deals with issues related to providing suitable working conditions by protecting workers from exploitation, maintaining a healthy and safe environment with fair wages and equal treatment, offering employee training, and encouraging freedom of association. These systems suffer from multiple standards which are not always compatible with each other. Thus, they encounter many challenges like less transparency, unstandardized norms in implementing the minimum wage and payment schedule, not paying employee insurance and other entitlements (like gratuities) on time. The paper develops a blockchain-based supply chain social sustainability management (BSCSSM) system including five main layers: smart objects, communication channels, data analysis, blockchain network, and applications. These applications include traceability, supply chain transparency, labor and human rights, workplace health and safety.
(França et al., 2020)	This paper proposes a blockchain-based solution to improve the solid waste management in small municipalities by the example of a small Brazilian municipality in the State of São Paulo, which had already created a social currency based on cards - called Green Coin - to pay voluntary citizens the collection of urban solid waste. The new system works according to the following logical model: (1) the voluntary citizen sells his solid waste to the collecting agent of the City Hall; (2) the citizen receives, in his virtual wallet, the amount of Green Coins equivalent to the materials market prices in currency; (3) in possession of the Green Coins, the citizen purchases goods in the accredited trade; and (4) the trader exchanges the Green Coins of his virtual wallet every 2 weeks at the City Hall's finance office for the equivalent in currency.
(Bürer et al., 2019)	The existing energy creation, distribution and consumption model is built on unit volume and thus encourages unsustainable practices in the energy system. Blockchain may support the energy transition and could be transformative in developing countries where blockchain-based financing models could improve energy access to the poor. Under the traditional business model, new entrants also have difficulty to compete because of either the market's national focus or business models relying on increasing unit sales. Blockchain and smart contracts combined with IoT have suggested lead to new business models. Potential new models are in payments: connecting electric vehicle charging stations, trading: energy, renewable energy certificates (RECs), or carbon emissions, distribution: enabling peer-to-peer power generation and distribution and models to increase energy access in developing countries, investments: enabling microgrid investments and financing: using blockchain for financing social action like filling the solar finance gap in Africa by connecting underfunded African schools to directly receive digital donor payments in blockchain-enabled smart meters.
(Choi and Luo, 2019)	The fashion industry employs more than 60 million people globally and its worth is more than US$2.5 trillion. It is characterized by producing lots of pollutants and selling products in markets full of demand uncertainty. For pollutant control, governments have imposed different environment taxes on the fashion industry with a goal of enhancing environmental sustainability. For market uncertainty, traditionally, fashion companies employ market demand data to improve demand forecasting. In the emerging markets, e.g., in South Africa, India, and China, however, it is commonly known that data quality (including the market data) is a huge problem. The key feature of blockchain is that it can systematically store data and make it visible to all relevant parties. This facilitates information sharing and enhances supply chain transparency. t is believed that with blockchain, supply chain management can be improved with enhanced data quality. The paper demonstrates that the marginal negative impact of having poorer data quality on supply chain profit is higher under the decentralized scenario than under the centralized one. The government can act as a sponsor for fashion retailers to implement blockchain and create a win-win situation between profits and sustainability.

(Sarkar and Swami, 2019)	FinTech has the potential to financially include minority groups, unemployed people, rural people, etc. It can better cater the needs of the financially excluded population and fill up that gap which traditional banking could not achieve over the years by overcoming two aspects: (1) no accounts: Amongst demographic factors, the major reasons for people not having accounts or not opening such accounts were they being female, belonging to the lower age group of the population, having low level of education, belonging to poorest segment of the society and being out of workforce. Amongst other important variables, the major reasons for people not having accounts or not opening such accounts were people not having sufficient money, being out of workforce and not owning a mobile phone. (2) No transactions: Moreover, it was also found that people who were not using their accounts regularly for transactions are people with age group 40-50 years and 50-60 years, who received agricultural payments in cash, who sent domestic remittances through a mobile phone, who paid utility bills through a mobile phone, received wage payments into an account or through a mobile phone and those who received agricultural payments in a card. FinTech companies including startups and other companies may need some support from the government to establish and operationalize themselves.
(Cole et al., 2019)	Blockchain offers the opportunity to increase visibility, transparency and auditability using distributed ledger technologies to drive trust, openness, visibility and integrity. This provides certain uses cases in supply chains which foster sustainability: NGOs such as Fairtrade will no longer be needed to certify goods as the blockchain can do this. Intermediaries that add value outside of general functions such as logistics (e.g. knowledge development in sustainability) may lose their position in the supply chain network. Other application areas are origins of materials, including illicit subcontracting and product counterfeiting, concerns over modern slavery, and how to extend sustainable practices and governance upstream in supply chains. As an example, complex multi-tier sub-supplier networks have, in some cases, been costly to firms claiming to pursue a socially sustainable agenda when unethical practices have been uncovered in their supply chains, with damaging consequences for sales, shareholder wealth and reputation. Thus, the actions of supply chain partners can have a significant effect on focal firms; and this, coupled with stakeholder pressures, means large focal organizations are taking more interest in and responsibility for the actions of their suppliers. Hence, not only their own actions, but also the actions of suppliers, can directly impact, both positively and negatively, the reputation and performance of a firm. Improved transparency of the suppliers' behavior can therefore help to build more sustainable business relationships between parties in the supply chain.
(Bendell, 2017)	The systemic question of better financing SMEs at scale so that they can grow, create jobs and diversify economies, has not featured significantly. How can SME and microentrepreneur financing be improved and to what extent could this be achieved voluntarily rather than require regulator action? bank lending to SMEs has declined continually in many Western nations, as the banks find simpler and less risky profits to be made by lending for property purchases. In many countries banks lend mostly to those property owners. That structural factor in the monetary system is the key underlying cause of inequality in many countries. An example is a collaborative credit system (CCS) was introduced to a slum in Mombasa called "Bangladesh". This "Bangla-Pesa" currency was a voucher representing the excess goods and services of participating microentrepreneurs. If a woman uses this voucher to purchase maize flour it would essentially be a promissory note (IOU) promising to pay an amount in peanuts or other goods and services equal to the value of the flour. The person selling maize flour can then use the voucher to buy water. The water vendor can use the voucher to buy vegetables, and the vegetable dealer can use the voucher to buy charcoal for cooking. The women selling charcoal can then return to the original woman in this example and exchange the voucher for the peanuts she promised to repay when she used the voucher to purchase maize flour. In this situation, excess stock that might have gone bad (maize flour, vegetables and peanuts) and excess services that might have gone unused (well water collection) would be purchased through the exchange of a voucher which represented those excess capacity goods and services. Ripple and Stellar for example offer that functionality, too, so that in theory any member of the network could issue their own currency, if they are trusted by other members of the network to redeem their promises.

(Anshari et al., 2018)	Farmers, especially ones in developing countries, suffer from funding deficiencies, capital issues, limited access to financial institutions, and lacking access to the market. Usually, there are many layers involved in agriculture's supply chains from farmers to consumers creating additional costs for products. Digital marketplaces are a driver of change by removing some of these layers so that all actors may have direct access for transactions and exchange of information. For instance, customers can purchase products directly from farmers and pay them through their marketplace integrated AgroPay account while farmers could buy fertilizers from suppliers from the platform and also pay through AgroPay. Business customers (e.g. Hypermart) can order directly from first line processor whenever they need to get stock for agriculture freshly from the farm. With this, digital marketplaces have changed the role of business intermediaries by reducing the control of data flows from investors, farmers, and customers. At the same time, introducing FinTech services like AgroPay supports cashless transactions for all actors. In addition, crowdfunding allows farmers to access alternative sources of funding. For example, the first line processors might offer investors to choose their agriculture products from short-term investment on short-cycle plants such as peanut or vegetables to long-term investment on fruit trees such avocado or dates. Potential investors can be anyone that invests on agriculture products for a specific time frame from seeding to harvesting depends on type of product.
(Zhang, 2018)	On a daily basis, the waste to energy plant in Changzhi County, Shanxi, China, collects segregated waste from farms with smart bins over 80% full through large trucks carrying empty Smart Bins. Through calculations at time of collection, the waste received will translate into a certain amount of energy and agricultural products (i.e. briquettes and fertilizer) that the waste to energy plant owes each farm. As a result of this transaction, there will be an "atomic swap" of resources; farmers instantly receive digital coupons/cryptocurrency of energy and agricultural products when the waste to energy collects the segregated waste. Meanwhile, the waste is brought to the waste to energy plant, where through furnaces and condensers, energy and agricultural products are produced. Farmers can then decide to cash in their digital coupons (Energy and Fertilizer Coupons [E/F]) for respective goods or trade with others on the integrated blockchain system for money. Energy coupons can be automatically deducted based on their monthly energy consumption. Fertilizer coupons can be cashed in by setting an order on the digital platform indicating quantity, which the next collection truck will bring.

Table 6. Results of the Literature Analysis: Cases

A 2.6 Fields of Future Research

Benefit related Areas

Future Research Field: Benefits
Sustainability benefits: • Investigate the cost-benefit analyses of the environmental and social gains of using blockchain technology against the financial outlay associated with implementation and business-as-usual (Cole et al., 2019)
Business benefits: • Empirically evaluate if blockchain-enabled sustainable supply chain management is positively associated with higher levels of organizational performance (Cole et al., 2019) • Causes of limited growth in digital currencies (Bendell, 2017)

Table 7. Future Fields of Research in Benefit related Areas

Strategy related Areas

Future Research Field: Strategy
Networks: • Impact on different industries (Vogel et al., 2019) • Vertical integration (central and local governments) (Ning et al., 2019) • Value network impact of blockchain technologies on various interconnected energy innovation ecosystems (Bürer et al., 2019) • Establish relevant research platforms to study blockchain technology. The key study areas include encryption technology, distributed algorithms, and risk assessment (Zhu et al., 2020)
Business models: • Impacts on business model innovation in the energy sector (e.g., links between non-traditional players and traditional players that did not exist before because of blockchain) ((Bürer et al., 2019), (Zhu et al., 2020)) • Connection of international development and social finance organizations with blockchain ecosystems (Thomason, 2017) • Management of the conflict between (incumbent) management and (start-up) innovation (Zhu et al., 2020) • Socioeconomic research will be needed to understand the impacts of blockchain on the market, including on customers and the value of services offered to them, and at what cost to users ((Bürer et al., 2019), (Ahl et al., 2020), (Fu et al., 2018)). • Price-dependent demand distribution in blockchain where the fashion retailer decides on both retail pricing and order quantity (Choi and Luo, 2019) • Spot price prediction mechanisms in contracts would need improvement for more accurate bidding. This depends on data such as solar radiation, wind speed, and other weather forecasts ((Ahl et al., 2020), (Mihaylov et. al., 2014)) • Blockchain-based bidding mechanism for shared manufacturing infrastructures (Yu et al., 2020) • Scheduling of resources based on uncertain factors like dynamic availability of resources (Yu et al., 2020) • Sustainability of blockchain-based business models (Mannaro et al., 2017) • Economic impact of blockchain (Schuetz and Venkatesh, 2019)
Product / service: • Suitability for different product categories (Vogel et al., 2019) • Carbon emission evaluation functions for various supplies, energy, wastes, and labors need to be carefully derived and analyzed (Fu et al., 2018)
Provider type: • Identify more excluded segments of population for fintech-related financial inclusion. (Sarkar and Swami, 2019) • Ideas to further promote the environmental awareness of the individuals based on the provided system are desired (Fu et al, 2018)

Table 8. Future Fields of Research in Strategy related Areas

Process and Organizational Design related Areas

Future Research Field: Process and Organizational Design
Interaction processes: • Topology of future larger scale blockchain-based energy systems (private, semi-private, consortium) (Ahl et al., 2020) • Evaluate the impact of blockchain on improving the transparency of multi-tier networks, potentially working alongside organizations as they begin to adopt the technology (Cole et al., 2019) • How will more traditional subsidies in the energy sector relate to developments in blockchain, as well as subsidies for renewable energy (Bürer et al., 2019)
FinTech processes: • Research the policy environment which is necessary for FinTech financial inclusion ((Sarkar and Swami, 2019), (Hagan et al, 2019))
Organizational design: • Governance of blockchain applications ((Nagel et al., 2019), (Wu and Tran, 2018), (Kamath, 2018)) • Which new institutions may be needed to govern blockchains? ((Bürer et al., 2019), (Kamath, 2018)) • Required institutional adjustments (e.g. educational systems) ((Bürer et al., 2019), (Kshetri, 2017), (Wu and Tran, 2018)) • Analyze the role of both the government and the regulator ((Sarkar and Swami, 2019), (Zhu et al., 2020), (Kshetri, 2017)) • Smart supervision of regulators (Zhu et al., 2020) • Living labs and regulatory sandboxes as potential institutional foundations to support such ecosystems (Ahl et al., 2020). • Novel auditors (e.g., for instance, a blockchain-enabled smart meter to crowdsource utility credits may be subject to other, different risks such as tampering and physical tapping of meters in order to resell electricity to others.) (Kshetri, 2017)

Table 9. Future Fields of Research in Process related Areas

System related Areas

Future Research Field: Systems
FinTech applications: • Horizontal systems integration across different functions (Ning et al., 2019) • Creation and use of open protocols for all forms of complementary currencies (Bendell, 2017)
InsurTech applications: • -
Blockchain applications: • Standardization of blockchains ((Kirpes and Becker, 2018), (Yu et al., 2020), (Kamble et al., 2020), (Kshetri, 2017), (Wu and Tran, 2018)) • Token models (Kirpes and Becker, 2018) • Data security and privacy ((Kirpes and Becker, 2018), (Bürer et al., 2019), (Ahl et al., 2020) (Wu and Tran, 2018), (Kamath, 2018), (Mannaro et al., 2017), (Mihaylov et. al., 2014)) • Integration and interoperability of different blockchains on local, national and supra-national levels ((Kirpes and Becker, 2018), (Nagel et al., 2019), (Ahl et al., 2020), (Kshetri, 2017), (Kamath, 2018)) • Scalability of blockchains ((Nagel et al., 2019), (Li et al., 2019), (Kshetri, 2017), (Kamath, 2018)) • Large-scale blockchain data storage (Ahl et al., 2020) • Implementation challenges of blockchain technology across multiple tiers of the supply chain (Cole et al., 2019) • Edge computing as a potential application to decentralize rural waste transactions (Zhang, 2019) • Consensus mechanisms ((Ahl et al., 2020), (Wu and Tran, 2018)) • Connection to new systems such as cognitive and neuromorphic computing (Ahl et al., 2020) • Maturity of blockchain technology (Mannaro et al., 2017)

Table 10. Future Fields of Research in System related Areas

Other Areas

Future Research Field: Other Areas
Research methods: • Interdisciplinarity of research e.g. by enhancing Public Value Theory with a technology view (Tavares et al., 2019) • Studies with longitudinal data ((Vogel et al., 2019) , (Venkatesh et al., 2020))
Cases: • Analysis of real world blockchain cases ((Vogel et al., 2019), (Tavares et al., 2019), (Schuetz and Venkatesh, 2019)) • Template development to replicate a green digital currency for waste management in other countries. (França et al., 2020) • Comprehensive blockchain application taxonomy for consumer life (Nagel et al., 2019)
Country focus: • Conduct studies on enabling blockchain technology in different countries (Kamble et al., 2020)
Ethics and cultures: • Comparative study on blockchain enablers and barriers in different cultures and firm sizes (Venkatesh et al., 2020) • Explore how blockchain influences social sustainability challenges and the legal and ethical implications of its adoption (Venkatesh et al., 2020)
Technology adoption: • Explore enablers and their interrelationships that have an impact on blockchain adoption ((Kamble et al., 2020), (Schuetz and Venkatesh, 2019)) • Antecedents to adoption (Schuetz and Venkatesh, 2019)

Table 11. Future Fields of Research in Other Areas

Appendix 3: Analysis of Sustainable Digital Finance Start-ups

No.	Sustainable Digital Finance Provider	Strategy							Organization		
		Network Type				Business Model			Interaction Type		
		Peer-to-Peer Network	Business Network	Government Network	Supply Chain	Customer Intimacy	Product Leadership	Operational Excellence	C2C	B2C	B2B
1	Beedoo		■			■				■	
2	Bitlumens	■						■		■	
3	Bloomio		■			■				■	
4	Blue Yellow		■			■					■
5	Carbon Delta		■				■				■
6	CelsiusPro		■				■				■
7	Covalence		■				■				■
8	Energy Web		■					■		■	■
9	Greenmatch		■				■				■
10	Ground_Up		■				■				■
11	Guruvest		■			■				■	
12	Impaakt	■	■			■			■	■	
13	IUCN Green List & Porini		■					■			■
14	My Drop in the Ocean		■					■		■	
15	Pexapark		■				■				■
16	Plumseeds / Symbiotics		■				■				■
17	Raisenow		■				■				■
18	Raizers		■			■				■	
19	RepRisk		■				■				■
20	Selma Finance		■			■				■	
21	Share&Charge	■	■					■	■		
22	3rd Eyes		■			■					
23	yourSRI.com		■							■	■
24	Yova		■			■				■	

No.	Sustainable Digital Finance Provider	Organization																
		FinTech / InsurTech Process									Indirect as Part of other Process							
		Advice	Payments	Investments	Financing	Non-life Insurance	Life Insurance	Underwriting	Claims Management	Cross-Process	Mobility	Health	Education & Work	Entertainm. & Comm.	Shopping & Logistics	Living (Power, Food, etc.)	Leisure	Contribution to National Climate Policy
1	Beedoo	■		■	■													
2	Bitlumens		■													■		
3	Bloomio			■	■							■	■	■	■	■		
4	Blue Yellow			■	■											■		
5	Carbon Delta			■							■	■	■	■	■	■	■	
6	CelsiusPro	■				■			■							■		
7	Covalence	■		■														
8	Energy Web		■								■					■		
9	Greenmatch			■														
10	Ground_Up			■	■													
11	Guruvest	■		■														
12	Impaakt	■		■														
13	IUCN Green List & Porini									■								
14	My Drop in the Ocean									■								
15	Pexapark			■														
16	Plumseeds / Symbiotics			■	■													
17	Raisenow				■													
18	Raizers			■														
19	RepRisk					■												
20	Selma Finance	■		■														
21	Share&Charge		■								■							
22	3rd Eyes			■														
23	yourSRI.com		■	■														
24	Yova			■														

No.	Sustainable Digital Finance Provider	Systems			Sustainability Benefits							Description
		Applications			SDGs							
		FinTech	InsurTech	Blockchain	7 Affordable and Clean Energy	11 Sustainable Cities and Communities	12 Responsible Consumption and Production	13 Climate Action	14 Life Below Water	15 Life on Land	17 Partnerships for the Goals	
1	Beedoo	■			■	■	■	■	■	■	■	Beedoo is an Investment and Financing Platform for Sustainability Projects
2	Bitlumens	■		■			■	■			■	Bitlumens provides a Payment System for Solar Power based on Blockchain
3	Bloomio	■			■	■	■	■	■	■		Bloomio provides an Investment and Financing Platform for Sustainability Projects
4	Blue Yellow	■			■			■				Blue Yellow is an Investment Platform for Clean Energy Projects
5	Carbon Delta	■		■				■				Carbon Delta provides a risk measure for analyzing climate-related risks and gives insights in to how climate change is affecting the future business model and operations of companies.
6	CelsiusPro		■			■		■		■		Digital platform for insurers, firms and governements including four solutions: weahter index and agrictultural insurance (payment for weather-related claims), natural catastrophes (emergency payments for natural catrasprohes), an environmental monitoring system (management of climate related risks), and claims monitoring (automatization of the claims
7	Covalence	■									■	Covalence evaluates companies and their products with regard to Environment, Social and Governance (ESG) factors based on an AI scoring system. For example, the company provides an EthicalQuote reputation index with its ESG monitor tool.
8	Energy Web	■		■	■	■		■				Energy Web Foundation (EWF) is a global nonprofit organization that applies blockchain in the energy sector. It currently develops 13 dApps focusing on areas like charging-as-a-service for e-mobility, a digital renewable energy platform, a platform that allows companies to track their energy consumption behavior, etc.
9	Greenmatch	■			■							greenmatch provides solutions to manage investments in wind energy, photovoltaics, hydropower and biomass projects. It offers investment valuation, financial performance tracking and portfolio management and buying and selling projects on the digital marketplace.
10	Ground_Up	■									■	TheGround_Up Project is a digital platform which brings together investors and capital seeking companies in the field of sustainability.
11	Guruvest	■									■	Guruvest provides an investment management platform which analyzes clients' requirements with regard to ESG criteria and develops an investment portfolio based on these criteria combined with personal financial goals.
12	Impaakt	■									■	Impaakt provides real-time data of companies' with regard to SDG criteria. The "impact quote" reflects the social and environmental value of a company just like the stock exchange quote shows the financial value. The data is collected from professional data and from the "collective intelligence" of investors.
13	IUCN Green List & Porini	■		■						■		The IUCN Green List of Protected and Conserved Areas is the first global standard of best practice for area-based conservation. It is a programme of certification for protected and conserved areas. Together with the Porini Foundation, a blockchain based smart contract platform to implement and track the IUCN Green List Programme for nature conservation is being established.
14	My Drop in the Ocean	■		■	■	■	■			■		My Drop in the Oceans is a global currency platform founded on the belief that economic and social progress depends on fundamentally changing the way we value nature. The organization is centered around the concept that money is one of the most effective tools to empower human behaviour.
15	Pexapark	■			■							Pexapark provides a software for the management of wind and solar assets.
16	Plumseeds / Symbiotics	■									■	Plumseeds which works together with Symbiotics is a platform that issues impact bonds that provide finance to microfinance institutions, small and medium sized banks, and other companies located in emerging markets.
17	Raisenow	■									■	Raisenow proivdes a digital platform for fundraising for organizations. The platform includes donations forms, international and national payment, system integration and automation (e.g., with CRM systems).
18	Raizers	■			■							Raizers provides access to a savings product in the energy transition sector that was previously reserved for institutional investors. The investments are in photovoltaic fields, wind power plants, biomass and hydraulic installations or cogeneration plants in France, Switzerland, Belgium or Luxembourg.
19	RepRisk		■								■	RepRisk porivdes the ESG Risk Platform, which is a due diligence database on ESG and business conduct risks. The platform supports data-driven decision-making by using proprietary quantitative data (risk metrics and analytics) and qualitative research for companies, projects, sectors, countries, ESG issues, NGOs, etc.
20	Selma Finance	■									■	Selma is a robo advisor which allow clients to develop a sustainable investment portfolio based on their individual goals.
21	Share&Charge	■		■	■							Share&Charge is a pilot project together with Energie Wasser Bern and MOVE Mobility set out to reduce cross-supplier transaction costs for charging electric vehicles using blockchain technology.
22	3rd Eyes	■			■	■	■	■	■	■	■	3rd-eyes offers a software for wealth and asset management that allows investors to create goal-oriented and sustainable investment strategies with value-based portfolios.
23	yourSRI.com	■									■	yourSRI's "ESG Fund & Portfolio Screening" tools allow investors and investment specialists to identify the ESG footprint by tracking and measuring ESG & Controversies/UN Global Compact characteristics of all underlying holding companies.
24	Yova	■									■	Investments that do good: sustainable, socially responsible investing with Yova. We built Yova because we wanted our investments to promote clean energy and equal rights, without fuelling climate change or the weapons industry.

Table 12. Analysis of Sustainable Digital Finance Start-ups in Switzerland

Literature

Theory Based

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