

FINTECH AND THE CIRCULAR ECONOMY: EMERGING SYNERGIES FOR SCALING SUSTAINABLE IMPACT

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***Abstract:** The transition to a circular economy is a strategic priority to address global environmental challenges, promote resource efficiency and support sustainable economic development. At the same time, the rapid growth of financial technologies (FinTech) is resulting in changes to conventional financial systems, offering new ways to access capital, increased transparency and decentralized trading models. This paper focuses on the synergies emerging between FinTech and the circular economy, emphasizing how digital financial tools can support the financing, implementation and scaling of circular business models. The paper explores technologies that could accelerate circular innovation, such as blockchain, tokenization, artificial intelligence-based investment platforms and crowdfunding. The study's approach is based on an in-depth literature review, institutional reports and documented case studies (such as Plastic Bank, Power Ledger and Circulor). This highlights both the opportunities and obstacles that arise at the intersection of these fields. We believe, FinTech has the potential to help the circular transition by facilitating traceability in supply chains, facilitating access to finance for circular startups and increasing the credibility of sustainability claims. All the while, barriers are identified including interoperability issues, lack of digital infrastructure and regulatory uncertainty. The article contributes to the literature on sustainable finance by providing a conceptual framework for understanding these synergies. It also provides applied insights for entrepreneurs, policy makers and researchers who are interested in using FinTech to support the circular economy.*

Keywords: *green blockchain, sustainable financial technology, circular start-ups, challenges*

INTRODUCTION

In recent decades, the global agenda has focused on issues such as environmental degradation, loss of natural resources and climate change. In these circumstances, the traditional linear economic model based on the processes of extraction, production, consumption and disposal is increasingly being challenged as it is considered unsustainable in the long term. The circular economy, on the other hand, advocates a systems approach that reduces environmental impact by optimizing resource use, recovering waste and designing products for reuse, remanufacturing and recycling [13]. The transition to this circular model is vital both for the preservation of ecosystems as well as for increasing economic competitiveness and innovation. While these structural changes are happening, the financial sector is also facing a technological revolution. FinTech, a term describing the integration of digital technologies into financial services, has accelerated the democratization of access to capital, brought new mechanisms for financial intermediation, and improved transparency and efficiency in the distribution of resources. Its services include robo-advisers and digital payments, decentralized blockchain-based platforms and crowdfunding or tokenization solutions.

This convergence between the transition to the circular economy and the rapid expansion of FinTech creates a space for innovation where digital financial tools can become catalysts for sustainability. On the one hand, scalable, flexible and accessible

financing models are needed for the circular economy to reach its potential. On the other hand, FinTech offers exactly these conditions: traceability, accessible microfinance, decentralized governance and smart risk assessment.

MATERIALS AND METHODS

This paper utilizes a qualitative methodology with exploratory and analytical dimensions, focused on identifying and interpreting synergies between digital financial technologies (FinTech) and circular economy models. The study is built on a proprietary conceptual framework developed iteratively, drawing on academic literature reviews, institutional reports and documented case studies. The research has been structured in three complementary stages, namely: literature review, comparative analysis of active FinTech platforms implementing solutions with potential to support the circular economy (Circular, Plastic Bank, Power Ledger - as main case studies, Everledger, Provenance, WePower, Grid+, Empower - as comparative examples) and the development of the conceptual framework reflecting the process of integration of FinTech into circular economic cycles.

As methodological limitations we can say that the study is predominantly qualitative and does not include empirical validation through primary data (e.g. interviews or questionnaires), which may limit the generalizability of the conclusions. In addition, data on some platforms may be influenced by commercial sources and self-reports.

RESEARCH RESULTS

1. Financing FinTech as a circular economy accelerator

FinTech presents itself as a potential catalyst for the implementation and scaling up of circular initiatives in a global context where an accelerated transition towards a more sustainable economic model is needed. Digitalization of finance offers new ways to access capital, transparency in transactions and the ability to track and validate sustainable impacts [3,7]. Each of these characteristics makes FinTech an ideal ally of the circular economy, particularly in the following aspects:

✓ *Expanded access to capital for circular initiatives*

A significant obstacle to the development of circular models is the problem of obtaining finance, especially in the early stages. Because of their innovative business models and lack of financial track record, traditional banks often consider circular projects risky [2,8]. FinTech is responding to this challenge by:

- *Crowdfunding and equity crowdfunding*: enabling circular startups to raise capital directly from the public, cutting out traditional financial intermediaries.

- *Peer-to-peer (P2P) funding*: Provides flexible lending alternatives with lower costs and faster approval processes.

These mechanisms reduce the barrier to entry for circular entrepreneurs and increase the chances of innovative projects scaling up quickly.

✓ *Increasing transparency and traceability in supply chains*

A fundamental principle of the circular economy is the accurate knowledge of the origin, composition and routing of materials and products.

FinTech technologies, especially blockchain, provide:

- *Immutable transaction ledger*: enabling the recording of every stage in a product's lifecycle, from resource extraction to recycling.

- *Smart contracts*: Automates real-time validation of compliance with sustainability standards.

So consumers, investors and authorities can quickly check whether a company complies with circular economy principles.

✓ **Automation and decision intelligence for sustainable investments**

FinTech investment platforms benefit from implementing AI algorithms to increase efficiency:

- *Automated project screening*: algorithms can quickly analyze large volumes of data to identify startups and initiatives with circular potential.

- *Predictive risk assessment*: AI models can estimate the financial and environmental impact risks of investments more accurately than traditional assessments.

This automation reduces the time and costs associated with traditional due diligence, accelerating investment flows to sustainable projects.

✓ **Democratizing sustainability investments**

FinTech lowers the investment participation threshold, making it possible to involve the general public in financing circular initiatives:

- *Microinvestments*: enabling users to invest small amounts in circular projects, increasing financial inclusion.

- *Tokenization*: transforms circular assets into tradable digital tokens, facilitating liquidity and attracting global capital.

Through these tools, FinTech is transforming support for the circular economy from a privilege reserved for institutional investors into an opportunity accessible to all.

2. FinTech technologies with potential impact

There is a wide range of digital tools that can be used directly to support the circular economy as a result of technological advances in the FinTech industry. These technologies help overcome the limitations of the traditional financial system and strengthen regenerative business models, from ensuring traceability in supply chains to diversifying financing mechanisms [4,9]. Four main groups of FinTech technologies stand out for their ability to help the circular transition:

✓ **Blockchain and tokenization**

Blockchain is a distributed ledger technology that provides a secure, transparent and immutable medium for recording transactions. In the circular economy, it enables full traceability of products and materials throughout their entire lifecycle, increasing trust in sustainable processes [1,5].

Tokenization, as an extension of blockchain, consists of tokenization, the digital representation of a tangible or intangible asset [18]. In the circular economy, it can be used for:

- Creating rewarded eco-tokens based on sustainable behavior (e.g. recycling, reuse).
- Facilitating the trading of circular assets such as secondary raw materials.

A relevant example in this regard is **Circular**, which is a blockchain-based digital traceability technology company recognized for its role in promoting transparency in complex supply chains, particularly in critical industries such as automotive, electronics, energy and mining [17]. Circular is a notable example of FinTech application in support of the circular economy, offering digital solutions that facilitate responsible tracking of materials from source to end product.

Companies that have deployed Circular include Volvo Cars which has deployed Circular to track the cobalt used in electric car batteries, ensuring it is responsibly sourced and that the process meets environmental standards, or Polestar (Volvo's electric brand) which uses Circular to report the carbon footprint of key materials and improve transparency in the battery supply chain.

Table 1.

Platforms using blockchain and their features

Platform	Core technology	Applicable fields	Main functionalities	Key differentiators
Everledger	Blockchain + AI	Diamonds, wines, batteries, art	Traceability, certified provenance, anti-fraud protection, ESG scores	Focus on luxury goods and artifacts
Provenance	Blockchain (Ethereum)	Fashion, food, cosmetics	Product traceability, transparent labeling, verification of ethical and environmental claims	Focus on luxury products and artifacts
IBM Food Trust	Blockchain (Hyperledger)	Global food chains	Real-time traceability, stock monitoring, automated alerts, food safety audits	Massive corporate infrastructure and partnerships
MineHub	Blockchain	Mining, logistics	Documentation management, raw material traceability, compliance	Specializing in industrial mining
Circularise	Blockchain + Zero-Knowledge Proofs	Plastics, automotive	Confidential traceability, ESG reporting without disclosing commercially sensitive data	Unique ZKP technology for data protection

Source: Developed by the author based on the platforms using blockchain

✓ **Crowdfunding and P2P platforms**

Crowdfunding and peer-to-peer (P2P) financing offer a decentralized alternative to traditional bank financing [19]. By cutting out intermediaries, these platforms facilitate fast and direct access to capital for circular enterprises, especially startups and community projects.

Types relevant to the circular economy:

- *Reward-based crowdfunding*: supports projects through voluntary contributions in exchange for symbolic rewards or products.

- *Equity crowdfunding*: Allows investors to acquire shares in sustainable businesses.




- *P2P lending*: Provides direct lending between individuals, digitally backed by regulated platforms.

An emblematic example of an initiative that combines social innovation with the circular economy and digital technologies, in a business model that capitalizes on plastic waste as an economic resource and a vector for social inclusion is **Plastic Bank**.

Plastic Bank rewards the collection of plastic waste in disadvantaged communities, using a blockchain platform that ensures material traceability and transparency of rewards [15]. Funding for this model was made possible through crowdfunding and social investment. How it works. People from poor communities (called eco-recyclers) collect plastic waste from polluted environments (e.g. beaches, landfills) and the plastic is taken to local partner collection centers. - Collectors receive Plastic Bank Tokens, stored in a blockchain digital wallet. These tokens can be exchanged for cash, basic goods (food, water), health insurance or schooling. It is also worth mentioning that the collected waste is processed and turned into Social Plastic and brands (e.g. SC Johnson, Henkel, Coca-Cola) buy this material to reintegrate it into product packaging, replacing virgin plastic. Plastic Bank is recognized by the World Economic Forum as a model of “circular business with social innovation”.

Table 2.

Recognized companies using crowdfunding and peer-to-peer (P2P) financing

Company	Location	Blockchain	Key features	Focus area
	Developing countries	Own blockchain	-Digital token for plastic collection -Social Plastic for consumer brands	Plastic waste and poverty reduction -Recycling logistics
	United States	Ethereum	-Smart contracts for waste haulers -AI-powered platform	Global deposit network
	Norway	EOSIO	-Traceability of collected waste	Global deposit network

Source: Developed by the author based on the websites of Plastic Bank, RecycleGO, Empower

✓ **Investment platforms based on artificial intelligence (AI)**

AI adds value to the investment process by automating project selection, impact assessment and sustainable performance prediction. Within FinTech platforms, AI algorithms can:

- Analyze ESG (Environmental, Social, Governance) data to identify the most promising circular startups.
- Monitor social and environmental impact indicators of portfolios in real time.
- Customize investors' portfolios according to their sustainability preferences.

Potential applications:

- Automated ESG scoring for circular projects.
- Personalized recommendations for green investments with predictable returns.

✓ **Decentralized trading of renewable resources**




P2P energy-trading platforms use blockchain to facilitate direct trade of renewable energy between prosumers (consumers who also produce energy). These schemes boost circularity in the energy sector by:

- Optimizing local renewable energy consumption.
- Reducing reliance on inefficient centralized infrastructures.
- Creating circular micro-economies based on clean energy.

A relevant example in this respect is Power Ledger. Power Ledger is a revolutionary blockchain-based energy trading platform that supports the transition to a decentralized, renewable and circular energy system [16]. It is an eloquent example of the application of FinTech in support of energy sustainability, reducing reliance on traditional grids and encouraging prosumers (consumers who also produce energy) to actively participate in the energy market [20].

Table 3.

Comparison of decentralized energy platforms based on blockchain

			
Country	Australia	Lithuania	USA
Blockchain Technology	Permissioned (EVM-based)	Ethereum	Ethereum+ hardware agent
Main focus	Peer-to-peer energy trading	Green energy tokenization	Direct energy sales
Key Mechanisms	POWR+Sparkz tokens Microgrids	Smart contracts	Households and businesses
Target users	Prosumers communities	Producers & investors	Households & businesses

Source: Developed by the author based on the information from the websites of PowerLodger, WePower, Grid+

3. Emerging opportunities

Incorporating FinTech technologies into the circular economy offers numerous strategic opportunities that can accelerate environmental innovation and financial inclusion. In addition to the technological opportunities, they offer institutional, economic and social benefits that contribute to the creation of sustainable and durable ecosystems. In this context we have identified four key areas where emerging synergies can have a systemic impact [11,12,14].

✓ **Funding circular startups and scaling emerging models**

Limited access to capital for start-ups is one of the biggest challenges for the circular economy. Traditional financiers view circular models as being linked to hard-to-value assets, nascent markets and longer payback periods. FinTech reduces these barriers by:

- fast and flexible access to finance through crowdfunding, digital microcredit and tokenization.
- social validation of ideas by involving individual investors, which increases the legitimacy of circular projects.
- building communities of supporters around initiatives, increasing both social and financial capital.

This democratization of capital opens up scaling opportunities for circular models that previously would have been limited to niches.

✓ **Increasing the transparency and credibility of sustainability**

One of the major challenges of corporate sustainability is the phenomenon of greenwashing, where companies overestimate their positive environmental impact. FinTech can combat this problem by:

- Blockchain for traceability: enabling true tracking of material flows and product origin.
- Sustainability tokens: Can reward verified behaviors (e.g. recycling, remanufacturing, emissions reduction).
- Automated validation through AI: Algorithms can compare sustainability claims with actual operational data.

This level of transparency reinforces consumer and investor confidence in the veracity of green commitments.

✓ **Stimulating community participation and collective responsibility**

Circular models are often local and community-based in nature. FinTech technologies facilitate community participation in economic cycles by:

- Micropayments and digital rewards: Provide direct incentives for selective collection, reuse or collaborative economy.
- Decentralized Governance Platforms (DAOs): Enables the democratic involvement of citizens in decision-making on investments or development of local circular projects.

This collective involvement supported by technology increases local ownership and acceptance of sustainable projects.

✓ **Innovation in business models and green financial products**

FinTech provides the infrastructure for new circular business models to emerge, such as:

- The "product-as-a-service" (PaaS) model, where products are rented and returned in continuous cycles, tracked and billed through integrated digital systems.
- Dynamic circular insurance: premiums are adjusted in real time based on the user's environmental performance.
- Customized green portfolios: Investors can allocate capital based solely on automated ESG scores that are in line with circular economy goals.

These models are made feasible by the financial digitization and connectivity offered by FinTech.



Figure 1. Emerging synergies between FinTech and circular economy

Source: Developed by the author based on specialized literature

4. Obstacles and challenges

The FinTech and circular economy approach promises to accelerate the transition to a sustainable economic model. However, there are obstacles to the widespread adoption of these technologies. These challenges are both technical and structural, and can limit the positive impact of FinTech tools if not addressed strategically.

A significant technological challenge is the limited interoperability between different blockchain solutions, FinTech platforms and sustainability reporting systems. Also access to high-performance digital infrastructure (high-speed internet, mobile devices, cloud systems) remains a challenge in many regions - especially in emerging economies or rural areas.

Emerging technologies, such as tokenization of assets or DAOs (decentralized autonomous organizations), often face a legislative vacuum or conflicting regulations between jurisdictions. At the same time although many FinTech platforms integrate ESG scores, in practice, these metrics are not yet universally standardized or tailored to the specifics of the circular economy.

5. Conceptual framework proposal

In order to understand and capitalize on the potential synergies between FinTech and the circular economy, a systemic approach that integrates the technologies, the actors involved and the critical stages of implementation is needed. Based on literature review, case studies and market dynamics, we propose a three-phase conceptual framework to support researchers, entrepreneurs and policy makers in the design and evaluation of digital circular interventions [6,10]. These phases are presented in the following figure.

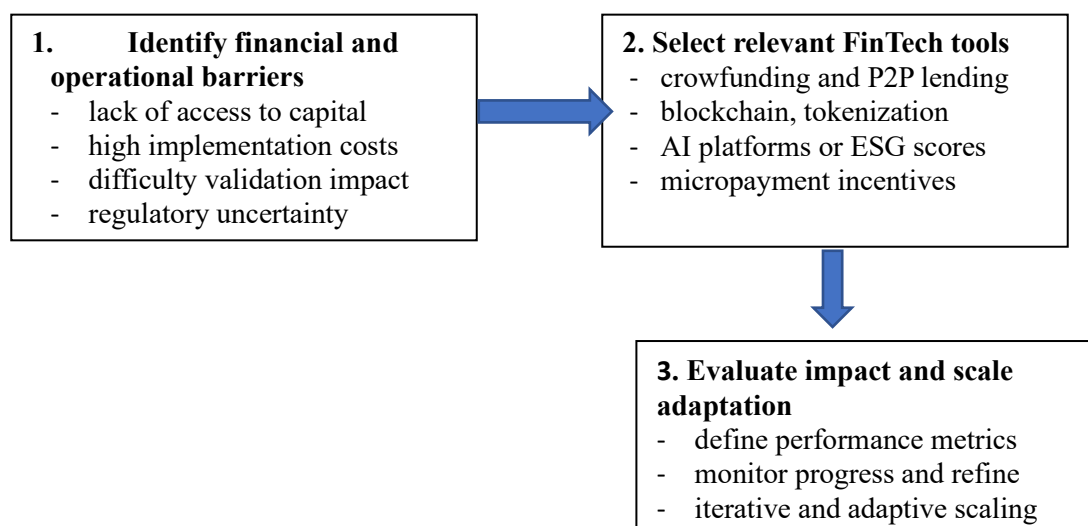


Figure 2. Phases of the conceptual framework

Source: Developed by the author

CONCLUSIONS

The relationship between FinTech and the circular economy represents an innovative area of convergence, capable of transforming both sustainable financing models and the dynamics of emerging markets. Against the backdrop of the global environmental emergency and the accelerating digitization of the financial sector, these synergies open promising prospects for achieving the goals of sustainable development and economic resilience.

The analysis revealed a dynamic environment in which digital financial tools such as blockchain, tokenization, artificial intelligence used in investment decisions and crowdfunding platforms are helping and revitalizing local and international economic ecosystems. The selected case studies (Circular, Plastic Bank and Power Ledger) provided concrete evidence of the applicability and effectiveness of these technologies in real-life

contexts, demonstrating that initiatives of this type can lead to tangible results in terms of reduced environmental impact as well as social and financial inclusion.

At the same time, the study highlighted numerous barriers that stand between the promising potential of FinTech and a coherent integration into the circular economy. Among them, lack of interoperability between platforms, unequal access to digital infrastructure, inconsistencies in international regulations and ambiguity in methods to assess sustainable performance can reduce the efficiency of implementation. As a result, an integrated, collaborative approach involving private sector, public sector and civil society institutions is needed to establish a framework for collaborative action.

The main contribution of the paper is to propose a structured conceptual framework that can guide the strategic selection and implementation of FinTech tools in support of circularity. This framework provides a clear direction for analysis, which is applicable in academia as well as in entrepreneurial and public policy planning initiatives. At the same time, it provides insights for future empirical testing, applied research and the creation of standardized indicators to enable comparable impact assessment.

Thus, the synergy between FinTech and the circular economy is proving to be fertile ground for systemic innovation, with the potential to transform not only markets, but also the relationships between economic actors, resources and society. If deployed with rigor, responsibility and long-term vision, FinTech can become a fundamental pillar of a regenerative economy, capable of responding to the challenges of the 21st century through flexible, inclusive and sustainable solutions.

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