Financing the Green Transition:
The Role of Decentralized Finance (DeFi) and Crowdfunding in Circular Business Scaling

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APRIL 2026

[1] This paper is based on the author's Master's thesis submitted to Maastricht University in 2025.

Abstract

Moving to circular economy business models brings financial challenges, especially when trying to grow these models that focus on using resources in a smart and sustainable way. Traditional ways of getting money often do not work well with the special risks and difficulties of circular projects. This means we need new and creative ways to finance them. This paper studies how decentralized finance (DeFi) and crowdfunding can help solve these problems and support the growth of circular business models. By analyzing 14 research case studies, the findings show how these new tools make funding easier for businesses, involve different stakeholders and communities in circular economy projects. DeFi and crowdfunding offer more opportunities and flexibility in financing. However, their success depends on rules and how society accepts them. Additionally, growing circular business models needs teamwork between different parts of ecosystem and flexible policies that connect new technologies with social and institutional preparation. This research provides useful advice for managers, policymakers, and financial institutions who want to create sustainable ways to fund the circular economy business models.

Keywords: Innovative Financing Mechanisms, Circular Economy**,** Decentralized Finance, Crowdfunding, Circular Business Mode

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1. Introduction

Scaling circular business models (CBMs) requires financing mechanisms that can cope with high upfront investments, longer payback periods, uncertain residual values, and unconventional collateral structures. Circular business models (CBMs), which aim to retain material value through reuse, refurbishment, remanufacturing, and resource recovery are central to this transition. However, despite their environmental and socio-economic benefits, CBMs are facing persistent financing challenges, including high upfront costs, slow cash flows, perceived investment risk, and limited collateral value due to non-traditional asset structures. Traditional bank lending and centralized instruments often struggle to underwrite these characteristics, creating persistent funding gaps for firms pursuing reduce–reuse–recycle strategies, servitization, and materials looping (Austin & Rahman, 2022; Toxopeus et al., 2021).

The study explores how Decentralized Finance (DeFi) and crowdfunding which are two rapidly growing alternative financing mechanisms are enabling firms to overcome structural financing barriers and scale their circular operations. By examining these mechanisms through the lens of sustainability, stakeholder engagement, and financial innovation, this research contributes to ongoing discussions about green entrepreneurship, sustainable investments, and governance mechanisms enabling environmentally responsible business models. The findings are grounded in a rigorous qualitative meta-synthesis of 14 peer-reviewed case studies across Europe, Asia, and emerging economies, offering comparative, cross-contextual insights relevant to managerial, business, and banking/governance perspective.

This paper is extracted from the author's master's thesis submitted to Maastricht University in 2025 and presents a focused analysis of sustainable financial instruments for scaling circular and green business models.

1.1 Problem Statement

These innovative financial mechanisms have been demonstrated to enhance resource mobilization, whilst also fostering stakeholder engagement and cultivating community ownership. These factors are pivotal in facilitating the expansion of circular economy transfer. This paper investigates the role of DeFi and crowdfunding in decreasing financial barriers and enabling the scalability of circular business models. The objective of the present study is to contribute to a more comprehensive understanding of innovative financing mechanisms that

facilitate the shift to a circular economy. This will be achieved by discussing current literature, finding gaps, and analyzing case studies.

1.2 Research Aim and Questions

Despite growing attention to green finance, the specific roles of DeFi and crowdfunding in scaling CBMs and the conditions under which they are effective remain underexplored. Prior work points to the difficulty of fitting CBMs into conventional lending "technologies" and metrics, the signaling potential of early customer commitments, and the promise of blockchain-based instruments and platform features in improving traceability and contract execution (Toxopeus et al., 2021; Mollick, 2014; Zhu et al., 2020).

The purpose of this study is to analyze how innovative financing mechanisms such as DeFi and crowdfunding can support the scaling of circular business models within the broader transition to a green economy. The research is guided by the following questions:

1. What financial challenges constrain the scalability of circular business models?
2. How have DeFi and crowdfunding been applied to support circular economy initiatives in real-world settings?
3. What impact do these mechanisms have on stakeholder engagement, community participation, and institutional readiness?

2. Literature Review and Theoretical/Conceptual Framework

2.1 Literature Review

Transitioning from a linear economy to a circular economy involves significant costs. These costs include public funding for green projects, new product financial support, innovation and research, and capital investments (Austin & Rahman, 2022). The most confirmed definition of the circular economy has been defined by the Ellen MacArthur Foundation (EMF, 2013): "Circular economy is one that is regenerative and restorative by structure and strives to keep products, elements, and substances at their largest value and price at all periods, differentiating between biological and technological phases."

Nußholz (2017) suggests the circular business model definition: "A circular business model is how a company creates, captures, and delivers value with the value creation logic designed to improve resource efficiency through contributing to extending the useful life of products and parts (e.g., through long-life design, repair, and remanufacturing) and closing material loops."

In March 2020, the EU's CE Finance Expert Group published a circular economy categorization that explains different classes of actions greatly participating in a circular economy (European Commission, 2020). Based on this categorization four circular business models are defined:

1. Value and resources recovery business models: This business model proposes that waste and unwanted products, parts, and materials be collected and returned to their original producers. This approach helps keep materials in circulation and enables their repurpose. It encompasses a wide range of items, including food, animal feed, fertilizers, construction materials, chemicals, and even water, which can be reused or recycled.
2. Circular design and production business models: This business model explains the case in which design and manufacturing focused on the enhancement of material efficiency, durability, functionality, modularity, upgradability, and easy disassembly. It helps to reuse eco-friendly materials or compostable materials, as well as the process technology that enhance these circular benefits.
3. Optimal use business models: This business model, suggests to give the old or unwanted products a new life by reusing, repairing, refurbishing, repurposing, and remanufacturing them. This can be done through different models, such as service-based goods, reuse practices, and collective sharing. These models can be based on leasing services, pay-per-access, deposit return schemes, or subscriptions. This supports the creation of a circular economy, where resources are used and reused continuously. Additionally, it allows for the restoration of degraded land, making it productive once more.
4. Circular support, facilitators and enablers, marketplaces business model: Critic advice, awareness, software, digital tools, marketplaces, and services that help all other types of circular economy businesses.

Wang and Zhi, (2016) consider the green finance economy as "a financial gateway of resources for the protection of the environment and circular economy." This suggests that the commercial economy should allocate resources for public benefit owned social investments to drive economic development.

Recent studies emphasize that financial institutions and banks play a pivotal role in supporting the transition toward a circular economy, as they are key actors in providing capital for circular business models (Marco-Fondevila et al., 2023). Despite this importance,

the potential of financial instruments, such as innovative lending structures or environmental accounting tools, to actively facilitate circular economy projects remains underexplored in current research (Marco-Fondevila et al., 2023).

Emerging evidence also highlights the significance of the banking sector in aligning business practices with both circular economy objectives and sustainable development goals (SDGs), particularly within developing economies. For example, Zahid et al. (2024) demonstrate that financial institutions in Pakistan are increasingly incorporating circular economy principles into their operations, contributing to a broader sustainability agenda in the region.

Access to external finance, particularly from traditional banking institutions, remains a significant challenge for companies engaged in circular business model innovation (Toxopeus et al., 2021). Toxopeus et al. (2021) identify three main strategies that firms can employ to improve their chances of securing bank financing:

1. Signaling future cash flows through customer contracts or pre-orders,
2. Building strong relationships with financial stakeholders,
3. Designing standardized, long-lasting assets that can serve as collateral.

While the study primarily focuses on bank financing mechanisms, it also notes that crowdfunding campaigns, especially those demonstrating early customer commitment, can positively influence a bank's lending decision by serving as a signal of market demand. However, the study does not explore crowdfunding as a direct financing instrument for circular ventures, highlighting a gap in the literature on how crowdfunding and digital finance platforms might independently support the scaling of circular business models.

A decentralized provision of financial services, often facilitated by blockchain technology and smart contracts, operates outside of traditional financial institutions and regulatory frameworks (Zetzsche et al., 2020). The method of increasing capital from a substantial population, usually by internet-based platforms is called crowdfunding (Muzamwese et al., 2024).

Transferring these eco-friendly business models requires adapting production and consumption patterns and related technological innovation. These transformative developments require innovative financial mechanisms (The Ellen MacArthur Foundation, 2013). Crowdfunding and decentralized finance (DeFi) act as novel mechanisms that can

enable the circular business model transition by overcoming the key financial challenges. AI tools can forecast the future value of the products and make decisions easy for the funding of businesses by reducing risks. AI can help businesses build trust with investors through data analysis from markets and their correct asset valuation. In addition, using DeFi infrastructures, can enhance the efficiency, transparency, and security of transactions, which enables businesses to handle slower cash flow and high upfront costs. These tools make the adoption of circular economy processes easier for businesses (Fallahi et al., 2022).

Song and Zhao (2023) explain how DeFi can play an important role in the circular economy through overcoming financial barriers and improving sustainability. Mechanisms for DeFi include blockchain-based platforms and peer-to-peer financing that offer investment opportunities and support resource efficiency. This innovative mechanism leads to sustainable systems based on the principles of circular economies, such as closed-loop processes for a better environment and economics. DeFi transforms the circular economy at all levels, that is, from macro to meso to micro. At the macro level, it shapes the institutional and policy frameworks by allowing the creation of transparent and efficient decentralized financial systems for large-scale initiatives. At the meso level, it enhances inter-organizational collaboration and supply chains through blockchain-based material tracking and reverse logistics. At the micro level, DeFi incentivizes consumers with tokenized rewards for recycling or returning goods, thus promoting sustainable behaviors and participation in circular practices (Kouhizadeh et al., 2019).

In recent years, individuals and businesses have tended to use DeFi more especially during and after the COVID-19 pandemic. Using innovative financial mechanisms like DeFi provides a great opportunity for transparent financial services without intermediaries and improving access (Ozili, 2022). DeFi and crowdfunding provide flexible economic development that increases economic productivity and optimizes the use of financial capital.

Chen et al. (2022) highlight the pivotal role of the regulatory environment and public finance mechanisms in enabling circular economy transitions, particularly within the agricultural sector. Their study emphasizes that policy guidance, government subsidies, and public financial support act as critical catalysts for fostering circular practices among businesses. By framing public finance as both a funding source and a regulatory tool, the authors underscore how aligned financial incentives and policy directives can lower market entry barriers for circular initiatives. While Chen et al. do not address private sector

crowdfunding or DeFi, their findings reinforce the importance of a supportive regulatory environment in shaping financing opportunities and risk perceptions within circular economy ecosystems as a key moderating variable in this research.

Seles et al. (2022) focus on the organizational and systemic enablers that facilitate a firm's transition toward circular economy models. Their work underscores the significance of stakeholder engagement, organizational capabilities, and societal readiness as core factors in achieving circular business innovation. Although they do not directly study financing mechanisms, their insights are highly relevant for understanding public awareness and acceptance. By illustrating how the broader acceptance of circular principles among stakeholders, partners, and consumers can impact the success of circular initiatives, the study provides valuable context on why innovative financing models like DeFi and crowdfunding may thrive or struggle in different environments.

In this research, scaling circular business models is conceptualized as a multifaceted process that extends beyond the simple growth in the number of businesses or market share. It refers to the expansion of a business model's market reach, operational capabilities, and systemic influence, while also enhancing environmental and social outcomes. Scaling involves not only growing in size but also deepening impact, adapting business models to new contexts, and embedding them within supportive financial, institutional, and social ecosystems (Bocken et al., 2016).

Financial access and policy support are critical in this process. Steinmueller (2010) emphasizes that the success of technological innovation and business model expansion is not solely market-driven but highly dependent on enabling policies, institutional arrangements, and coordinated systems of support. In the context of circular economy, scaling is often facilitated by public incentives, regulatory frameworks, and technological policies that create a fertile environment for innovation and sustainable business growth.

Moreover, social networks and community engagement play a key role in resource mobilization, especially in financing mechanisms like crowdfunding. Lin (1999) argues that access to resources is frequently mediated by social capital, the trust, networks, and relationships that individuals and organizations leverage to achieve their goals. Applying this to circular business models, scaling often relies on the ability to mobilize support through social networks, both for funding and for market adoption. Therefore, scaling in this research is understood as a dynamic process involving market expansion, impact

amplification, institutional integration, and social capital mobilization. It highlights the interplay between innovative financing mechanisms, supportive policy environments, and network-based resource mobilization in advancing circular business models toward broader societal and environmental impact.

The Quadruple Helix Model provides a comprehensive framework for fostering innovation ecosystems by engaging industry, academia, government, and civil society in collaborative value creation. According to the RiConfigure (2021), Quadruple Helix Collaborations (QHC) enhance problem-solving capacity by integrating diverse perspectives, enabling early risk identification, and fostering responsible research and innovation. However, QHCs also face challenges such as funding asymmetries, unclear role distribution, and governance complexity especially when aligning the diverse expectations of stakeholders. As demonstrated by D'Itria and Colombi (2023), the Quadruple Helix fosters systemic innovation by interlinking technological, regulatory, market, and societal dynamics.

In the context of scaling circular business models, adopting a QHC approach can be instrumental in fostering collaborative financing mechanisms such as crowdfunding and decentralized finance (DeFi) ecosystems which is ensure that innovation pathways are not only market-driven, socially legitimate, transparent, and responsive to societal needs but is also significantly moderated by the regulatory environment and the degree of public engagement and trust in these platforms.

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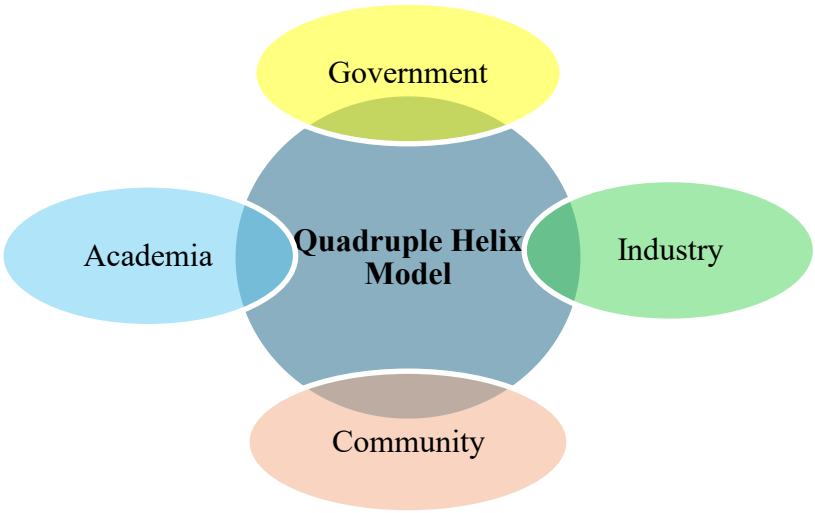

Figure 1 Quadruple Helix model

Source: Author

2.2 Theoretical/Conceptual Framework

The conceptual model (Table 1) for this research problem could look like the table below. Based on this model, decentralized finance (DeFi) is one of the independent variables that explore the potential of DeFi instruments and platforms to fund circular economy projects and businesses. The other independent variable is considered crowdfunding which analyzes the effectiveness of different crowdfunding models in raising capital for circular business initiatives.

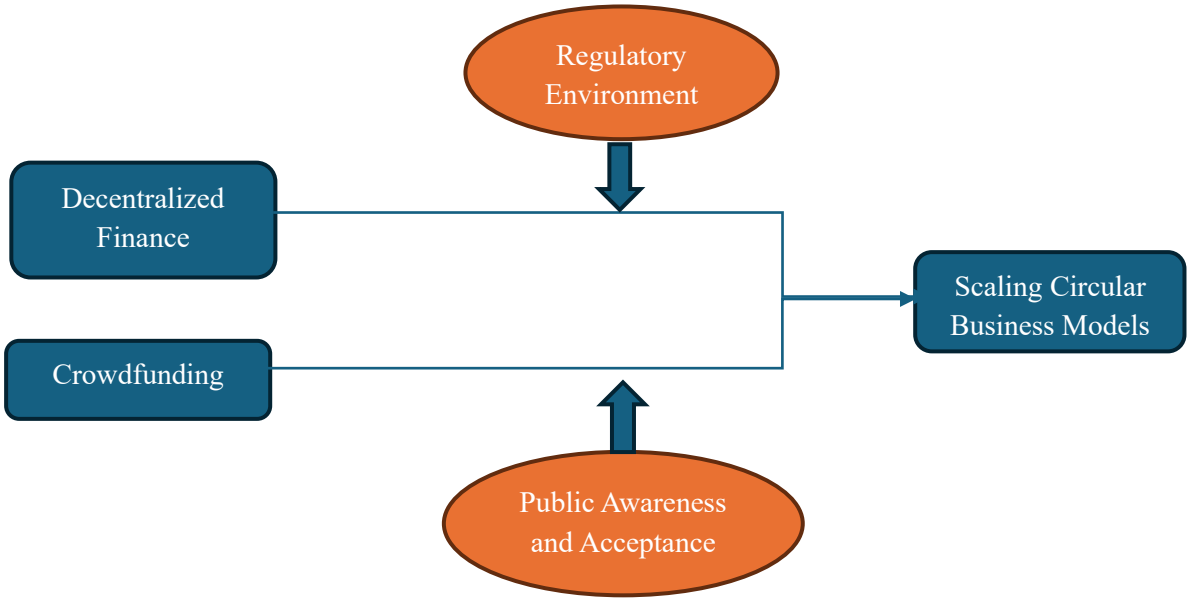

Figure 2 Conceptual Model

Source: Author

The dependent variable is scaling CBMs and examining the impact of DeFi and crowdfunding on the growth and expansion of businesses operating on circular principles. The regulatory environment is recognized as one of the moderating variables that understand how existing and emerging regulations surrounding DeFi and crowdfunding impact their application in the circular economy context. The other moderating variable is public awareness and acceptance which assesses the influence of public perception and knowledge of DeFi and crowdfunding on their adoption in financing circularity.

3. Methodology

1.1 Qualitative meta-synthesis (QM)

To address the proposed research questions, a qualitative case analysis is used. These methods will allow me to explore how DeFi, crowdfunding, and circular business model innovation finance impart to scaling circular economy projects.

The qualitative case analysis approach allows the examination of real-world examples of circular economy projects that have used these finance mechanisms. It is suitable for understanding the success or challenges of these projects by considering contextual factors. While the case analysis will provide qualitative insights, descriptive statistics will summarize key numerical patterns, such as funding amounts raised or project success rates. This method is suitable for identifying trends across multiple case studies and quantifying the impact of each financing instrument (Habersang et al., 2024). The qualitative meta-synthesis methodology will serve as an umbrella, synthesizing findings from various qualitative studies to form a broader understanding (Finfgeld-Connett, 2018).

The selected articles were examined through a qualitative meta-synthesis approach, also known as meta-ethnography (Noblit & Hare, 1988). This method involves a structured, iterative process designed to synthesize and analyze findings from a wide range of qualitative studies on a specific subject (Atkins et al., 2008). Its purpose is to reinterpret and reorganize insights from various studies to develop a clearer, more comprehensive understanding and generate new thematic insights (Finfgeld-Connett, 2018). Researchers apply this method by conducting interpretive, analytical content analysis of previously reported findings such as key elements and components and categorizing them based on identified central themes (Finfgeld-Connett, 2018; Thomas & Harden, 2008; Turkeli & Schophuizen, 2019). Unlike aggregative reviews that simply compile results, meta-synthesis is interpretive in nature, aiming to integrate and contrast

qualitative findings across studies (Erwin et al., 2011; Grant & Booth, 2009). The outcome an enriched understanding of key concepts within the selected topic can foster the creation of new theories, overarching narratives, or interpretive frameworks (Grant & Booth, 2009). To address the research question of this paper, the six-step meta-synthesis process outlined by Erwin et al. (2011) is applied, which consists of the following steps:

1. Defining a clear research question: Putting considerable effort into crafting a precise research question is essential because it sets the boundaries for the literature review and lays the groundwork for the meta-synthesis.
2. Framing the literature: In this step, a thorough list of studies is gathered, covering research that could potentially be included in the qualitative meta-synthesis. This involves identifying relevant keywords related to the topic and searching through multiple databases (Erwin et al., 2011). Well-known, peer-reviewed international databases include Web of Science (WoS) by Thomson Reuters, Scopus by Elsevier, and Google Scholar by Google Inc (Turkeli et al., 2018).
3. Searching: At this stage, the list of literature is narrowed down using specific keywords relevant to the research. For this meta-synthesis, the chosen database is Web of Science (WoS) by Thomson Reuters. The core collection query used is (“*circular* *econom*” (topic) OR “*circular* *econom*” (title)) using refine by (“*case* OR “case study” Or “case analysis”) and (“finance*”).
4. Choosing and evaluating relevant studies: This step involves defining the final set of publications for the meta-synthesis, along with the criteria used for their evaluation. To maintain transparency, researchers must clearly outline the specific features guiding the inclusion or exclusion of studies. This requires a thorough understanding of the literature to identify commonalities and establish relevant comparison criteria, such as the presence of a well-defined research question or sufficient evidence supporting the study’s claims, that support meaningful selection decisions (Erwin et al., 2011; Turkeli and Schophuizen, 2019, Walsh and Downe, 2005).

   For this thesis, the inclusion and exclusion criteria for publications were as follows: (1) the study focuses on, or at least incorporates, the circular economy; (2) a case study approach is central to, or included in, the research; and (3) finance is a primary or contributing aspect of the study. Applying these criteria resulted in a final selection of 12 publications for the meta-synthesis. Additionally, the works of Zahid et al. (2024) and Fallahi et al. (2022) were included due to their particular relevance to this research.

5. Overview and integration: The final set of selected publications is summarized and analyzed based on their key findings, core elements, and structural components, while being assessed for their alignment with or divergence from the theoretical concepts outlined at the beginning of this thesis (Turkeli and Schophuizen, 2019).
6. Presenting the combined findings from the studies: At this stage, key themes and concepts extracted from each study are presented and integrated by comparing their similarities and differences, placing them within a new interpretive framework through a lines-of-argument synthesis (France et al., 2019, Turkeli and Schophuizen, 2019).

A systematic qualitative meta-synthesis (QMS) was conducted to integrate empirical findings from 12 case studies published between 2017 and 2025. The criteria for inclusion were empirical case-based research, focus on circular economy or sustainable innovation, explicit discussion of financing mechanisms, and analysis of DeFi, crowdfunding, community-based finance, or hybrid models. The synthesis followed an iterative six-step process (defining the question; framing/searching literature; inclusion/exclusion; overview/integration; and lines-of-argument), enabling reinterpretation across heterogeneous contexts and instruments (Noblit & Hare, 1988; Erwin et al., 2011; France et al., 2019). The analysis followed the six-step meta-ethnographic model proposed by Noblit & Hare (1988), identifying cross-cutting themes on financing instruments, platform technologies, regulatory environments, and stakeholder collaboration.

The selected studies represent diverse geographies (EU, China, India, Brazil, Australia, Pakistan) and sectors (energy, agriculture, product design, waste management, digital platforms) that enabling broad generalizability.

4. Key Findings

4.1 Contexts and Application Areas of Innovative Financing Mechanisms

The reviewed literature highlights the crucial role of the audience in the circular economy, as innovative financing mechanisms are applied across a diverse range of contexts. These include sector-specific applications, geographic variations, and business model archetypes, each offering insight into how DeFi, crowdfunding, and other tools are leveraged to scale circularity. For instance, Austin and Rahman (2022) highlight the systemic market failures faced by European SMEs in adopting 3R strategies (Reduce, Reuse, Recycle) and argue for a combination of financial and policy tools to support them, recognizing the potential impact on

the audience. Similarly, Pereira et al. (2022) explore how livestock waste in Brazil can be transformed into sustainable energy solutions, showing how circular innovations require place-based financial planning and multi-stakeholder integration, a process in which the audience's involvement is crucial.

In the blockchain domain**,** Zhu et al. (2020) examine China's energy sector and demonstrate how token-based financing and digital contracts can facilitate decentralized energy systems. Crowdfunding in product-oriented circular models is exemplified by Leone et al. (2022)**,** who utilize reward-based mechanisms to establish trust and value in circular product lines. Additionally, Panori (2024) provides a broader territorial intelligence perspective, analyzing EU regional ecosystems and the distributed application of CE financing tools across rural innovation clusters. Several studies have further explored financial applications across banking **(**Marco-Fondevila et al., 2023**)** and carbon reduction schemes **(**Rossetto, 2023; Teixeira & Lefèvre, 2025**),** each highlighting distinct needs for blended financial innovation tied to regulatory readiness and institutional capacity.

4.2 Financing Models and Instruments

Across the literature, a variety of innovative financing models and instruments are explored to support the growth and scalability of CBMs. These range from DeFi, crowdfunding, blended finance, and tokenization, to more traditional mechanisms being recontextualized for circular goals. Austin and Rahman (2022) focus on addressing market failures in SME financing through blended financial instruments and argue for a shift in public–private funding strategies to support the 3Rs. Similarly, Sani et al. (2021) identify that regional policy efforts must integrate legal, regulatory, and financial tools, including public grants and guarantee schemes, to enable circular transitions.

DeFi leverages blockchain-based infrastructure to deliver financial services without relying on traditional intermediaries that create new opportunities for circular economy ventures. Across multiple cases, DeFi was shown to enable transparent and programmable financing, primarily through the use of smart contracts that automate transactions and enforce conditions without manual oversight. At the same time, DeFi significantly reduces intermediation costs, lowering barriers for small firms that often struggle to access affordable capital through conventional banking systems (Zhu et al., 2020; Fallahi et al., 2022; Mehrotra & Jaladi, 2022).

4.3 Platform Characteristics and Technological Features

Studies have shown how important digital platforms and technology are for creating new ways to pay for projects that promote a CE. These platforms are often used for more than just financial transactions. They also help to create trust, process data, and make sure that stakeholders are working together. They also help to create trust, process data, and make sure that stakeholders are working together. Zhu et al. (2020) explain how smart contracts and distributed ledgers (which are part of blockchain) can make transactions transparent, traceable and secure. It says that blockchain technology has some good points. These include the fact that it is spread across many computers, is permanent, anonymous and can be checked.

Fallahi et al. (2022) highlights Artificial Intelligence (AI) can be merged into financial risk assessment through predictive analytics. It also discusses the importance of different forms of data in future business ecosystems and the nature of collaborations which is required between product companies and financial actors in these ecosystems to improve financing CBMs. These aspects are shown to reduce uncertainties and risks which are related to the circular economic practices.

4.4 Stakeholder Engagement and the Quadruple Helix

Stakeholder involvement emerges as a critical dimension across nearly all studies analyzed. Financing CE initiatives require participation and alignment across a diverse range of actors that include governments, private firms, financial institutions, civil society, and end-users. Austin and Rahman (2022) frame financing gaps in the CE as stemming from overlapping market, policy, and institutional failures. They argue that effective financing requires public–private collaboration, where governments de-risk investments while private actors innovate and deliver solutions. Similarly, Sani et al. (2021) emphasizes the need for regional and municipal coordination in designing regulatory and financial ecosystems supportive of CE transition.

Leone et al. (2022) supports the reward-based crowdfunding is a source of funds for innovative start-ups. It emphasizes that funders are often treated as “early customers” and that funding decisions are often akin to “customers ‘buying’ an innovative product or service as a reward”. The study highlights that backers and stakeholders on these platforms provide “monetary and non-monetary resources”. This clearly aligns with the idea of consumers and community investors funding circular start-ups through reward-based crowdfunding.

4.5 Regulatory and Institutional Aspects

Regulatory and institutional environments play a pivotal role in enabling or constraining the scalability of financing mechanisms for CE initiatives. Several papers in the review highlight that beyond technical and financial innovation, systemic institutional alignment is essential for circular finance to be effective.

Austin and Rahman (2022) identify significant challenges related to the financing of the CE in European SMEs, including traditional barriers to accessing finance like private costs, industry standards, lack of human and technological capital, limited information, and low market demand. They also highlight a "triple helix of market failures" encompassing environmental externality, knowledge spillovers, and financial risk, which collectively make a strong case for private and public sector contributions. The study emphasizes existing regional differences and hesitancy among EU SMEs in adopting CE practices and notes that unsuitable institutions pose challenges to CE objectives.

5. Discussions

The qualitative meta-synthesis conducted in this study reveals that innovative financing mechanisms, particularly DeFi and crowdfunding, offer substantial opportunities for scaling CBMs, but their effectiveness is shaped by sectoral, institutional, and technological contexts (Austin & Rahman, 2022; Leone et al., 2022; Zhu et al., 2020). Across the cases analyzed, these mechanisms emerged as more than just funding tools; they act as platforms for trust-building, community engagement, and stakeholder collaboration which are features that align with the systemic approach advocated by the Quadruple Helix model. By fostering collaboration between government, industry, academia, and civil society, this model creates an enabling environment for CE financing where policy incentives, technological platforms, and social participation reinforce each other (Panori, 2024; Mehrotra & Jaladi, 2022). This chapter, reflects on the findings from three different perspectives, such as managerial, business, and banking/governance, and discusses the limitations of the study along with suggestions for future research.

5.1 Managerial Perspective

For managers of circular businesses, navigating this new financing landscape comes with both opportunities and challenges. One clear takeaway is that today's circular business leaders need to wear many hats. It is no longer just about running efficient operations; it is also about

building community trust, understanding emerging technologies, and being able to tell a compelling story. For example, crowdfunding platforms not only provide money but also they rely on the ability of founders to engage with early supporters and build social proof. DeFi mechanisms require an understanding of blockchain tools and how to present a transparent, trustworthy project. DeFi-based smart contracts and tokenized systems provide managers with programmable, transparent financing options, while crowdfunding platforms allow them to mobilize early adopters as both funders and advocates (Leone et al., 2022; Zhu et al., 2020).

5.2 Business Perspective

At the business level, the application of DeFi and crowdfunding often reshapes the core operations of CBMs. Reward-based crowdfunding, as seen in Leone et al. (2022), validates demand while generating social proof, and DeFi enables capital access in contexts where traditional banking is risk-averse (Mehrotra & Jaladi, 2022). The findings suggest that businesses using these mechanisms benefit from enhanced brand legitimacy and stronger stakeholder networks that outcomes are amplified when integrated into multi-actor innovation systems like the Quadruple Helix (Panori, 2024).

Crowd funding is not just a funding tool; it is a signal to the market and a test of customer interest. DeFi platforms remove traditional financial gatekeepers and make funding more accessible to startups, especially in contexts where banks are risk-averse or uninterested in circular models. But these benefits come with expectations: businesses must now offer more transparency, engage in continuous dialogue with supporters, and build operations around long-term impact rather than short-term profits. This means that financing strategy and business model design need to go hand-in-hand.

5.3 Banking and Governance Perspective

The role of institutional actors is critical. Banks remain cautious due to unconventional asset structures and long payback periods, but emerging practices in environmental accounting and green credit assessment are promising (Marco-Fondevila et al., 2023; Zahid et al., 2024). Governance frameworks that integrate blockchain regulation, climate finance, and CE policy, such as the Carbon Border Adjustment Mechanism (Teixeira & Lefèvre, 2025), can lower market barriers and encourage blended financing models. Here, the Quadruple Helix lens again proves useful, highlighting the need for coordination between policymakers, financiers, researchers, and citizens to accelerate adoption.

Many traditional financial institutions are still hesitant to support circular models because they do not fit neatly into existing credit or risk frameworks. Yet, there are encouraging signs; some banks are beginning to adopt environmental accounting and explore circular performance indicators. In developing regions, however, the gap is still wide.

Regulation often lags behind technological innovation, especially when it comes to blockchain-based finance. For financing to be truly inclusive and scalable, banks, governments, and international institutions need to work together to create enabling environments through better risk-sharing mechanisms, regulatory clarity, and more education on the value of circular investments.

5.4 Key Dimensions in CE Business Models

The radar chart below illustrates the relative emphasis placed on five key dimensions in the context of circular economy business models. Among these, Stakeholder Involvement and Collaboration stands out with the highest score (12) which indicate its critical importance in platform development and success. Contexts and Application Areas (10) and Financing Models and Instruments (9) also show strong relevance that are suggesting practical use cases and funding strategies are essential considerations. In contrast, Platform Characteristics and Technological Features scored lowest (6) implying that while technology matters, it may be perceived as less influential than social and strategic factors. This distribution highlights a system where collaboration, context, and financial support drive impact more than technical capabilities alone.

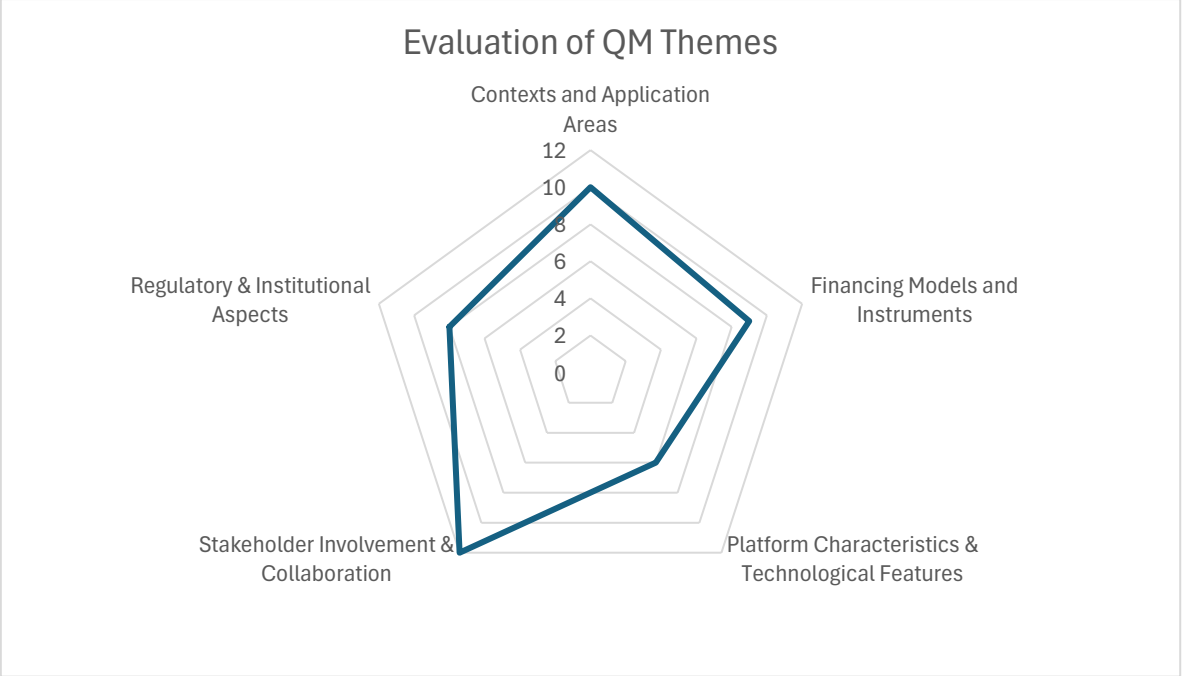

Figure 3 Evaluation of QM Themes

(Source: Author)

5.5 Causal Loop Diagram of CE Financing Mechanisms

The Causal Loop Diagram (CLD) is a way to show how different things like technology, money, society and organizations work together to affect the growth of CBMs. Blockchain, artificial intelligence, and trust in blockchain are needed to make new financial systems work. DeFi, Crowdfunding, and Financial Accessibility are ways to get money for CBMs. Risk perception, investor confidence and public trust are related to how people and institutions view risks and trust. Public Awareness and Stakeholder Engagement are about how people, institutions and platforms work alongside.

Blockchain and Artificial Intelligence (AI) are technologies that are improving new ways of financing. Blockchain helps to use features like smart contracts (agreements that automatically happen when conditions are met) and tokenization (turning assets into digital tokens), which make financial processes more transparent (Zhu et al., 2020). Meanwhile, AI assists by providing predictive analytics, helping to assess risks, and estimate the future value of products in CBMs (Fallahi et al., 2022). Trust in blockchain is a key factor that decrease the unpredictability in decision and making both investors and users more willing to participate in financing based on DeFi (Zhu et al., 2020; Mehrotra & Jaladi, 2022).

DeFi and crowdfunding are important ways for businesses to get money specifically when traditional banks do not support them (Leone et al., 2022; Mehrotra & Jaladi, 2022). These methods make it easier for more people to join and help by lowering the amount of money needed to start their businesses (Austin & Rahman, 2022; Zahid et al., 2024). Crowdfunding also helps build trust with the public and involves early supporters and it fits with financing models that focus on local communities (Leone et al., 2022; Panori, 2024).

The diagram also shows how important investor confidence is in CBMs financing which comes from both clear technology and rules. When the government supports regulations like blockchain, climate finance, and green policies, it makes risks seem lower and encourages more people to join (Sani et al., 2021; Teixeira & Lefèvre, 2025; Rossetto, 2023). Additionally, public awareness helps build trust and gets people involved and creating positive effects that help CBMs scale up.

At the center of this system is the growth of CBMs, which is affected by different positive and balancing forces. This fits with the Quadruple Helix model, where government, industry, universities, and society work together for the same goal. Their cooperation helps technology, money, and rules come together to speed up the move toward circular economy businesses (Panori, 2024; Mehrotra & Jaladi, 2022).

Figure 4 Causal Loop Diagram

(Source: Author)

The findings of this study fit well with the Quadruple Helix model, which highlights the importance of collaboration between government, industry, academia, and civil society to drive innovation (RiConfigure, 2021). In the world of circular economy finance, this model helps explain why DeFi and crowdfunding are becoming popular. They are not just financial tools but also ways to involve many different groups working together. Successful cases highlight CBMs scale up better when public policy, community involvement, technology, and academic knowledge are working together.

The application of DeFi and crowdfunding was illustrated through real-world examples where these tools provided trust, flexibility, and validation mechanisms for circular ventures. Lastly, the key challenges in financing circular models, such as long payback periods, risk perceptions, and limited access to traditional finance, were explored, particularly in the banking and governance context and the impact of these mechanisms on stakeholder and community participation was highlighted through the emphasis on co-creation, reward-based engagement, and platform-driven collaboration which are critical in driving scalable circular economy initiatives.

5.6 Limitations and Future Research

This study draws on a limited sample of 14 peer-reviewed cases, potentially overlooking case studies or emerging informal financing models. While the meta-synthesis provides thematic depth, it does not quantify impact metrics such as funding success rates or Return on investment rate.

There is a lot more to explore in this space. Future research can take a closer look at specific sectors or regions to understand how DeFi and crowdfunding work over time. It would also be valuable to combine qualitative and quantitative approaches that look not just at what works, but how well it works in terms of funding raised, project sustainability, or impact. Research into how different digital platforms shape user behavior and trust could also help improve platform design. And finally, more work is needed to understand how regulation and public awareness influence the adoption of innovative financing tools, especially in countries where financial ecosystems are still evolving.

Additionally, further investigation into platform design, trust-building mechanisms, and cross-sector policy coordination would also deepen understanding of how innovative finance can enable a systemic CE transition. Lastly, future work could explore longitudinal effects of DeFi and crowdfunding on CBM scalability, compare regional adoption patterns, and examine how Quadruple Helix dynamics influence financing performance in CE ventures.

6. Conclusions and Recommendations

The findings of this study illustrate that innovative financing methodologies, such as DeFi and crowdfunding, provide opportunities to help CBMs scaling up. However, their success depends on understanding the different roles that people has and the specific context. From a managerial

point of view, nowadays leaders in circular businesses face more complex financial environment. Today's businesses need to do more than just managing a efficient operations. They also have to build trust with communities, engage a wide range of stakeholders, and be familiar with new technologies such as blockchain. For example, crowdfunding is about raising money and sharing a compelling story that attracts early supporters and builds social proof.

This means managers should be adaptable, open to collaboration, and willing to explore these new tools in the ways that align with local situations and social principles. These new financing options are changing businesses' function and improvement. Crowdfunding helps achieving money, test the market, and build loyal customers for sustainable projects. DeFi has an important role because it breaks traditional funding methods barriers which is essential in situations that banks are not sure about invest in business models that focus on sustainable impact rather than earning money.

Businesses need to be transparent about their practices, maintain strong relationships with supporters, and focus on long-term benefits instead of just short-term gains to be successful. They should make sure their financing strategies is align with their business models. Additionally, it is better for them to and combine traditional funding with these new methods in order to balance risk and support their growth. From the perspective of banking and governance, the situation the situation needs to consider carefully. Many traditional banks are still unsure about how to manage projects that follow the circular economy model because most of the CBMs are in the early stage.

This is because the usual ways of assessing credit and risk do not work well with CBMs. This is because CBMs often have longer timelines and unique challenges. Although, some banks have begun exploring new tools like environmental accounting but progress is slow and regulations have yet to catch up, especially when it comes to blockchain and DeFi. To unlock the full potential of circular financing, it is clear that banks, governments, and international organizations need to work together more closely. They must clarify rules, improve ways to share risk, and invest in education to help all parties understand these new financial tools. At the same time, creating standardized methods for transparency and impact reporting will help build the trust that is so crucial for this ecosystem to improve. Without adaptive policies and governance, innovative financial technologies will struggle to reach their potential in supporting sustainable change.

Moving CBMs forward with innovative financing will require effort on several fronts. Managers must develop new skills and foster meaningful relationships, businesses need to rethink how they combine finance and strategy, and banks and regulators must evolve to support these changes thoughtfully. When these pieces come together, they create a strong, inclusive, and innovative financial ecosystem that can truly accelerate the shift toward a sustainable circular economy and scaling CBMs.

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