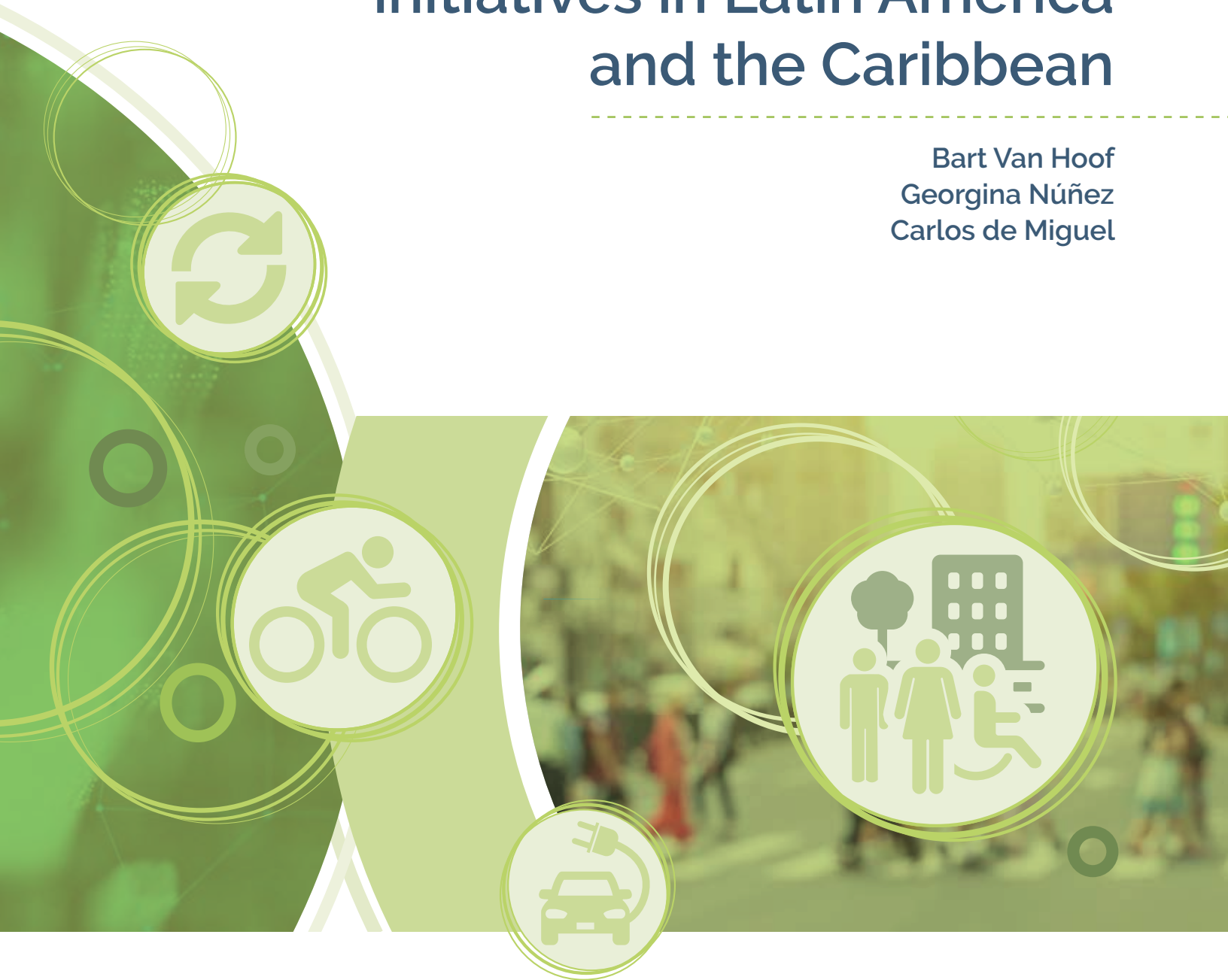


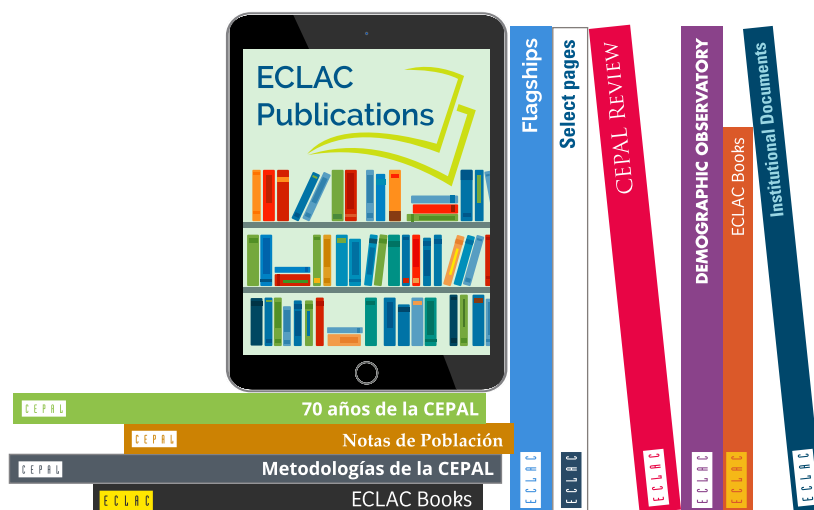
Inclusive and sustainable smart cities (CISI)

Scaling up circular economy initiatives in Latin America and the Caribbean

Bart Van Hoof
Georgina Núñez
Carlos de Miguel



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Scaling up circular economy initiatives in Latin America and the Caribbean

Bart Van Hoof
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This document was prepared by Bart Van Hoof, a consultant at the Division of Production, Productivity and Management of the Economic Commission for Latin America and the Caribbean (ECLAC), under the coordination of Georgina Núñez, Economic Affairs Officer at the same Division, and Carlos de Miguel, Chief of the Sustainable Development Policy Unit at the Sustainable Development and Human Settlements Division of ECLAC. It was prepared as part of the project "Inclusive, sustainable and smart cities in the framework of the 2030 Agenda for Sustainable Development in Latin America and the Caribbean", implemented by ECLAC together with Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) and financed by the Federal Ministry of Economic Cooperation and Development (BMZ) of Germany.

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Introduction

This document evaluates opportunities for scaling up circular economy (CE) initiatives in Latin America and the Caribbean (LAC) through environment, social and governance (ESG) business strategies. It reviews four circular economy business cases, following priorities and representativeness for the LAC region, and analyses financial mechanisms and ESG schemes applied in the region. The document serves as a valuable resource for entrepreneurs, firm managers, and financial professionals interested in financing circular economy initiative. It provides a comprehensive perspective for evaluating the scaling potential of circular economy initiatives in LAC.

Recognizing the advances of ECLAC on circular economy studies in the region over the past five years, including: work on priorities for public policy developments in CE (ECLAC, 2020); the Latin America and the Caribbean economic outlook report (LEO, 2022) "Towards a Green and Just Transition", launched during the 27th Conference of the Parties (COP27)" (OECD, 2022); and the document of ECLAC 2022 session period "Towards transformation of the development model in Latin America and the Caribbean: production, inclusion and sustainability" (ECLAC, 2022) both reinforcing CE benefits toward more inclusive and sustainable societies; a "Methodology proposal for a value chain perspective of circular economy in LAC" (Van Hoof et al. 2022); the document "Corporate governance in Latin America and the Caribbean: using ESG debt instruments to finance sustainable investment projects" (Núñez, et al., 2022), emphasizing corporate sustainable finance and strategies; "Contribution of international trade to the circular economy in Latin America and the Caribbean" (Mulder et al., 2022); and "Presentation an overview of circular economy roadmaps in Latin America and the Caribbean" (Samaniego et al., 2022).

The CE proposes a model for transitioning from a resource-intensive economy to a more resource efficient and effective production and consumption system. The main principles guiding the current circular thinking are: (i) eliminating waste and pollution through design, (ii) maintaining materials and products in use, (iii) regenerating natural systems (Ellen McArthur, 2018). The new circular thinking results in resource efficiency when re-using materials and or products, elimination and prevention of waste streams and emissions through design alternatives, and conservation of resources by restoring and conservation of ecosystem services (Kapsalis et al., 2018). The benefits of the CE include financial

returns, resource conservation, social behavioral changes, and employment generation. As such, the CE perspective is an important vehicle to meet de-carbonization targets (Schroeder et al., 2020; Ellen McArthur Foundation, 2019), and to advance on the Sustainable Development Goals (SDG) as part of the global agenda towards 2030-2050. CE models also connect to the bioeconomy contributing to the regeneration of biodiversity, in addition to human health by reusing biomass and prevention of chemicals (Robertson-Fall, 2021).

CE covers a variety of strategies for resource efficiency including frameworks such as the 9R's, proposed by Potting (2019) emphasizing smarter product use and manufacturing, extension of life span and its parts and useful applications of materials. Other models, compatible with the forgoing categorization of the Organization for Economic Cooperation and Development (OECD, 2018), consider five complementary circular innovation models based on; (i) circular supply models replacing traditional material inputs derived from virgin resources, (ii) resource recovery models recycling waste into secondary raw materials, (iii) product life extension models extending the use period of products, (iv) sharing models of underutilized products, and (v) product service system models, where services rather than products are marketed. This categorization system of the Organization for Economic Co-operation and Development (OECD) is used most of the public policy development in Latin American countries (Van Hoof et al., 2022).

Implementation and scaling of CE models requires transformation in the operations and strategies of organizations and systems, involving decision-making on investments in new technology, partnerships, and business models (Scipioni et al., 2021). For understanding of these management decisions of scaling potential includes understanding of information on organizational capacities, value chain collaborations, and market potential, including financial instruments and indicators.

This study proposes a comprehensive structure that provides information for evaluating the scaling potential of the initiatives, based on complementary dimensions such as: (i) the business model of the circularity initiative, including the geographic and temporary contexts, and description of firm characteristics, (ii) application of CE indicators related to ESG frameworks, for evaluating environmental, social and governance contributions, (iii) risk assessment for scaling the initiative. Four case analysis provide reference for understanding concepts like the CE and offer insights into the nuances of reality, which are important to consider when making recommendations for public policy. For this study, cases were selected based on priorities proposed by earlier studies of ECLAC (Van Hoof et al., 2022) and consider CE initiatives in four sectors such as construction, agro-food, mining and automotive industry. Within these sectors, four CE initiatives of diverse Latin American countries are identified as representative examples. Sources for information for case analysis include interviews with managers, and professionals involved in the initiative, secondary information sources as other case documentations, articles and web-sides. Canvas model¹ is used as a tool to synthesize the business model of each case.

This document is organized as follow: besides this introduction, chapter one look at risks involved with scaling up CE initiatives in LAC, at the organization level (micro-level) in value chains (meso-level) associated with policy and regulatory environment (macro-level). The next chapter describes the existing sustainable financial instruments available for scaling up CE initiatives. Access to financing increases the demand to establish evaluation mechanisms for CE initiatives. In chapter three, we look at existing standards for assessing ESG disclosures and propose indicators for evaluation of CE initiatives from an ESG perspective. In chapter four, was developed four case-analysis; and finally, a conclusions and recommendations section.

¹ Canvas Model is visual tool that allows to outline a business model in a simple diagram. It is made up of nine elements: value proposition, customer segment, channels, customers relationship, revenue streams, key resources, key activities, key partnerships, and cost structure.

I. Dimensions involved in scaling up circular economy (CE) initiatives in Latin America and the Caribbean (LAC)

CE models occur at different levels of the business model. On a micro level, factors relate to a firms' organizational ability to learn and adapt, the quality of managerial leadership, and access to technology as critical resources for innovation; a second level (meso) involves assessment of commercial and social factors such as collaborations among various stakeholders of the value chains, including suppliers, channels, and clients; a third level of assessment (macro) considers factors included in the business environment such as public policies, incentives, and available financial mechanisms, that can influence the adoption and scaling up CE practices. Based on the multilevel analysis of comprehensive business assessment, this section develops a perspective for documenting cases as references for scaling up CE initiatives in LAC.

A. Dimensions influencing the potential for scaling up circular economy (CE) initiatives

The subsequent sections of this chapter present a framework to identify the scaling potential for the CE in LAC. The framework is based on information from ECLAC studies (ECLAC, 2021; LEO, 2022; Van Hoof et al. 2022) and review of literature and consider diverse complementary levels of analysis, such as the micro level of the firm, the value chain, and the business context. The dimensions are systemic, as they operate at multiple levels and can reinforce one another. Hence, a comprehensive analysis provides insight into the viability associated with scaling CE alternatives. Different mechanisms influence the decision-making of business managers and entrepreneurs regarding investment in circular economy initiatives, creating a favorable context for the transition to a circular economy. Table 1 summarizes the systemic levels of dimensions influencing scaling potential. The framework guides the case documentation presented in chapter V of this study.

Table 1
Comprehensive analysis of dimensions influencing scaling up of CE initiative

Level	Institutions	Factors	Mechanisms
Micro	Management Human resources Research and development Finance Operations	Learning Vision Capacity	Strategy development Capacity building Innovation Accounting Implementation
Meso	Supply chains Regional networks Business Associations	Market demand Symbiosis Information	Collaboration Information systems Dissemination Certification
Macro	Public institutions Academia Financial system	Societal need/ culture Incentives Compliance Standards Infrastructure	Public policy Innovation of regulation Training and research Financial mechanisms Resource management systems

Source: Authors.

The following sections describe and analyses the dimensions influencing scaling up of CE initiatives.

B. Factors at the organization level (micro-level)

Circular solutions require companies' and entrepreneurs' transformative learning for acquiring a strategic vision, as well as operational capacity to design and implement circular practices. The learning involves the integration of physical and social criteria into project and business model design: organizational learning is a dynamic process introduction changes on diverse dimensions in an organization (Argyris and Schon, 1997; Senge et al. 1999).

The first dimension of learning involves an individual organization member acquiring knowledge and skills related to design and implementation of sustainability alternatives such as CE business models. The integration of sustainability criteria into the management decision-making process adds a second dimension, which transforms individual capacity into organizational structure. Resources are allocated to develop and implement sustainability-related business alternatives including CE projects. The third dimension of learning focuses on organizations acting as multipliers of sustainability management throughout their supply chain, by involving suppliers, clients, and other stakeholders. In literature, these dimensions of learning are recognized as single, double, and triple-loop learning (Scipioni et al., 2021; Van Hoof, 2014). Each dimension describes a gradual approach, understanding single-loop learning most simple, and triple-loop learning as the most advanced stage affecting multiple stakeholders.

Risk assessment in scaling up CE initiatives requires evaluating the organization's capacity and experience in the field. Experience encompasses both business administration and expertise in sustainability, necessary for the effective execution of CE initiatives that integrate resource efficiency into the business strategy as a value-adding factor. The analysis of CE business risks involves examining three dimensions in a hierarchical order that considers organizational learning:

- (i) **Resource accounting:** Identifies and quantifies the physical materials, energy, and water used and released throughout the life cycle value chain, from raw material extraction to processing, transformation, transport, consumption, and end of life. It enables the identification of waste generation priorities and opportunities for efficiency improvement and is the first step in the CE analysis as it helps to improve resource use efficiency.

- (ii) Technological innovation: is necessary to enhance the resource efficiency of production and consumption systems. This can take various forms such as implementing best practices, clean technology, eco-design of products and services, and utilizing big data and information technology (IT). Every CE initiative involves a technological innovation aspect to enhance resource efficiency.
- (iii) Collaboration and alliances: drive systematic changes, as the CE aims to advance transformation beyond improvements of individual firms. By forming symbiotic relationships with suppliers, neighboring businesses, and new entities, the value chain can be expanded. Institutions such as authorities, brokers, universities, chambers of commerce, and financial mechanisms are a crucial part of the innovation system, helping to integrate the CE through regulation innovation, information supply, and technical assistance.

The capacity for organizational learning and technological innovation are key resources for implementation of a CE model. Firms with experience in implementing circularity strategies have a more favorable scaling profile when seeking financing mechanisms.

C. Factors influencing value chains (meso-level)

Circular economy implies transformation of production and consumption systems, also known as value chains (Rovanto and Bask, 2021). World-class supply chains lead to "flawless delivery to customers yields higher revenues, more efficient operations that reduce costs, lower inventories that lower capital requirements, and streamlined physical networks that reduce working capital" (Slone et al., 2010). Value chains connect resource flows with product life cycles through relationships among companies and individual consumers in the supply chain. They also link diverse complementary business models, ranging from companies that design and supply raw materials to businesses that add value through transformation, distribution, and service supply (Bolwig et al., 2010). The integration of these business models makes it possible to use a product and service throughout its lifetime. Some value chains consist of several complementary business models, while others incorporate them through vertical integration. A well-developed value chain, count with suppliers, distribution channels and market demand. Alignment of value-chain partners, condition scaling up potential for CE initiatives, and reduce risk for business decision-making.

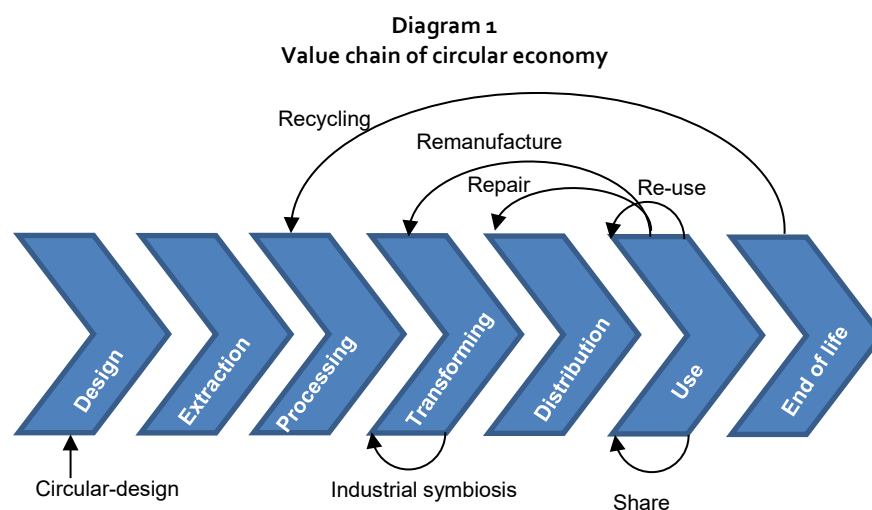
Value chains may cover diverse geographical scales. Global value chains involve extracting materials in one country, processing and transforming raw materials in other countries, consuming in other places, and disposing of or treating waste in separate locations (Hofstetter et al., 2021). The dispersal of diverse business models along the same value chain is due to the advantages and asymmetries of different business contexts, availability of resources such as raw materials, energy, and social resources including labor, knowledge, and the economic resources that result from market demands. For example, the electronics and automotive industries are examples of global markets where raw materials extraction and preparation, transformation, production of parts, assembly, distribution, use, and disposal occur in various countries worldwide (Rentizelas and Trivyza, 2022). In contrast, food and construction-related value chains are typically more geographically concentrated.

Sustainable value chains take into consideration, the environmental and social impacts on all stakeholders, including suppliers of raw materials, products and services, consumers, governments, and NGOs (Suering and Muller, 2008). Impacts involve both direct operation such as waste generation, fair wages, and labor conditions as well as broader local societal issues such as access to infrastructure, resource conservation, and public services, and the effectiveness of collaborative governance, which vary depending on the specific geographic location (Vermuelen and Suering, 2017). The implementation of a CE at meso level as part of sustainable value chains considers the dissemination of internal company

operations to suppliers, collaboration with other firms, and engagement with stakeholders, as well as implementation in areas beyond just the immediate stakeholders (Rovanto and Bask, 2021).

The diverse circularity models connect to specific stages and business models in the value chain. Design solutions are concentrated often in anchor companies leading power relations among suppliers with interconnected business models in the value chain. Reuse and recycling involve both suppliers of raw materials and clients who participate in takeback solutions. Efficiency improvements such as re-manufacturing, and recycling, apply to most of the business models along the chain, while reuse and sharing circularity models apply to the user's stage (Bocken et al., 2014).

Diagram 1 presents the value chain approach including the diverse CE models. Innovations bring about changes for various supply chain participants that need to be both technically feasible and socially acceptable (Boons, 2002). Innovative circular value chains often require the creation of new collaborative relationships among stakeholders to replace traditional linear value chain relationships. Collaboration demands information sharing, cost/benefit negotiation, and flexibility to accommodate changes and integrate values among stakeholders and new partners (Van Hoof and Thiell, 2014). For example, waste recovery models require information on the quality and volume of waste streams, recycled materials, supply procedures, cost-benefit negotiations, and alignment of new supply relationships.



Source: Adapted for OECD, 2018.

Boons (2002) introduced a framework based on the value chain perspective for examining the effects of CE strategies on various interconnected business models. He illustrates how, for instance, resource efficiency in one business model influences material supply in another business model. Replacing materials can lead to the elimination of some business models in the value chain, while recycling and waste recovery can create new business models. The value chain partners play a key role in establishing collaborations for implementing the CE. Innovations in the CE can also impact existing relationships in the value chain and affect the financing of scaling up these strategies.

In all circular innovation models, suppliers of virgin materials might reduce sales and diversify their product portfolio by including recovered materials and even become involved in the recycling process based on their expertise. The impact on producers varies depending on the circular model. Often the use of recycled materials requires minor innovations regarding process adjustments, while resources reuse often imply technological innovations. Other models such as lifetime extension, sharing models and service products, change the whole production structure. Circular business models often

carry risks as they can disrupt traditional revenue streams, leading to resistance. An inclusive transition process is crucial to avoid dissent among stakeholders.

Distributors are impacted by the opportunity of expanding their services in waste recovery through recycling and reuse innovations. Other CE models like lifetime extension, sharing models, and service as products require completely new distribution services. Circular economy models depend on consumer involvement and acceptance of sustainable practices such as recycling, reusing, extending product life, using shared models, and purchasing service-based products. Market acceptance is crucial for ensuring social legitimacy of these practices. Marketing campaigns, jointly with awareness actions, and behavioral experiments are main instruments for transformative learning. Recyclers are integrated only in one of the circularity innovation models, and the goal is for disposal services to eventually become obsolete in accordance with the principles of the CE. While mature value chains, counting with experience of collaboration among suppliers, processors and client, alignment of vision and innovation, favor scaling potential of CE initiatives.

D. Factors associated with policy and regulatory environment (macro-level)

Public policies are important mechanisms for guiding and scaling systematic changes including paradigm shifts needed for the development of a CE (Gawer and Cusumano, 2014; Jannicke, 2002). These public policies address societal needs by establishing priorities, goals, and incentives to shape stakeholders' behavior. Moreover, public policies set a course on mid and long term by bringing together multiple actors to drive systemic changes in the society (Shove, 2010). International organizations such as the Ellen MacArthur Foundation and the OECD publish guides, toolkits, and recommendations for innovative regulation to improve public policy development in the CE field (McArthur Foundation, 2015a; OECD, 2020). Regulatory frameworks resulting from public policies impact ESG standards (Sipiczki, 2022) and provide stability for the implementation of a CE model.

Several national and regional governments in LAC have adopted policies that prioritize and set goals for the transition to a CE (ECLAC, 2020). One of the public policy approaches to scale CE in the region has been the adoption of Extending Producer Responsibility Regulation (EPR) as a type of regulation appointing producers a significant responsibility —financial and/or physical— for the treatment or disposal of post-consumer products. Argentina, Bolivia, Chile, Colombia, Costa Rica, Ecuador, and Honduras have adopted EPR regulations setting targets with industry to reduce waste streams related to electronic waste, tire waste, batteries, light bulbs, packaging waste, pharmaceutical packaging, and agricultural packaging (ECLAC, 2021).

The study, "Circular Economy in Latin America and the Caribbean: Opportunities for recovering and transformation" (ECLAC, 2021) identified regional priorities for CE. The recommendations include reform of current municipal waste management systems, adjustment of waste stream regulations and promotion of value chain networks within industrial sectors. To do so, governance of waste management systems, capacity building, increase of recollection rates, recycling and reuse, support innovation and eco-design, and develop financial mechanisms, are required to be enhanced (ECLAC, 2021).

Existence of public policy and mechanisms such as EPR regulation, financial incentives, capacity building programs, information systems, and consumer awareness campaigns, favor emergence of circular economy initiatives and benefit risk profiles for finance in a positive way, as they assure market developments for circular economy developments. Taking into consideration the business context for circular economy, table 2 summarizes diverse factors of the business context favoring development of circular economy initiatives.

Table 2
Factors of the business context favoring CE transitions

Factors	Objective	Example	Stakeholders
Public policy	<ul style="list-style-type: none"> – Establishing priorities. – Orienting strategies for implementation. – Reaching out to stakeholders. 	<ul style="list-style-type: none"> – National Strategy for Circular Economy of Colombia. – Roadmap for circular economy in Peru. 	<ul style="list-style-type: none"> – National public institutions such as Ministries. – Presidential office.
Innovation in regulation	<ul style="list-style-type: none"> – Adjusting existing regulation. – Developing new regulation. – Sectoral guides. 	<ul style="list-style-type: none"> – Extended producer responsibility. – Regulation for reuse of treated sewages. – Innovation of public service tariffs. 	<ul style="list-style-type: none"> – Environmental authority. – Commerce authority. – Public service authority.
Incentives	<ul style="list-style-type: none"> – Providing financial resources for circular economy innovation. – Public disclosure of circular economy advances. 	<ul style="list-style-type: none"> – Credits, equity investment blended finance. – Grants. – Certifications. 	<ul style="list-style-type: none"> – Development Banks. – Banks. – Municipalities. – Chamber of commerce. – Business association.
Capacity building and research	<ul style="list-style-type: none"> – Strengthening capacity for circular business model. – Information dissemination. – Legitimacy of circular business models. 	<ul style="list-style-type: none"> – Circular economy courses. – Executive programs for circular economy. – Research programs on circular economy. 	<ul style="list-style-type: none"> – Universities. – Research centers. – Consultancies. – Technical education.
Information system	<ul style="list-style-type: none"> – Information on resources flows for decision making. – Material Flow analysis (MFA). – Life Cycle Analysis (LCA). 	<ul style="list-style-type: none"> – Circularity gap—report PACE. – Resource outlook. 	<ul style="list-style-type: none"> – Research centers. – Statistical institution. – International cooperation. – Universities.
Consumer behavior	<ul style="list-style-type: none"> – Paradigmatic change towards circularity. – Sustainable consumption. 	<ul style="list-style-type: none"> – Publicity campaign. – certification (such as the forthcoming ISO TC 323 Circular Economy). 	<ul style="list-style-type: none"> – Certification organization. – Authorities. – Consumer organizations.
International cooperation	<ul style="list-style-type: none"> – Alignment of global trends. – Experience exchange. – Visibility of CE. – Blended finance. 	<ul style="list-style-type: none"> – Latin American alliance for circular economy. 	<ul style="list-style-type: none"> – Ministries. – Cooperation agencies. – Development banks. – International institutions.

Source: Authors.

The business context influences the scaling up potential of CE opportunities by signaling societal needs. Therefore, firms participating in stakeholders-network including public institutions, universities, business associations, consultancy firms, favor scaling opportunity through finance. New trends in the business context and innovations in the regulatory framework provide inputs for ongoing goal orientation. The existence of public policy initiatives provides long-term signals for scaling up CE initiatives.

II. Finance mechanisms for scaling up circular economy (CE) initiatives

Companies adopting the circular economy generally face barriers, including a lack of financial assets for initial investment costs and increased exposure to risk. Access to finance, as a crucial aspect of the business context, is critical for unlocking innovation opportunities and integrating stakeholders across the supply chain. This chapter reviews emerging financial mechanisms for scaling sustainability initiatives that are relevant for CE initiatives.

A. Circular economy (CE) contributing to Sustainable Development Goals (SDG)

The financing of scaling CE initiatives is an emerging field, in which mechanisms and instruments, such as taxonomies, risk assessment indicators, and valuation schemes, are under development. So far, advances of circularity finance, connect to broader fields such as sustainability finance and climate finance (Circle Economy, 2022).

Sustainability is an ample field that covers 17 Sustainable Development Goals (SDGs), including social, environmental, economic, and interrelated needs for development (UN, 2022). The CE model contributes to these SDGs by addressing physical resource flows, such as SDGs 6, 9, 12, 13, and 16 (Schroeder et al., 2019). As part of its contributions to SDG 13 on action for climate, CE alternatives are estimated to support approximately 50% of greenhouse gas reductions as part of international agreements for 2050 (Ellen MacArthur, 2019).

The CE emphasizes resource efficiency and has a strong focus on environmental benefits, such as reducing resource extraction, promoting ecosystem recovery, and eliminating waste. As CE business models scale, their contributions to job creation also increase. However, the CE does not address all the SDGs, such

as poverty alleviation, hunger, accessibility, governance, and transparency. Additionally, the CE does not emphasize reforestation and climate change mitigation beyond production and consumption systems.

The emerging field of financing for scaling sustainability encompasses the CE agenda and more. Sustainable finance mechanisms, such as debt, equity, blended finance, and non-reimbursable, that have emerged in the LAC region as precursors to CE finance are analyzed.

B. Revision of sustainable financial mechanisms including circular economy (CE)

In recent decades, sustainable financial mechanisms have gained prominence in the LAC region. Sustainable financial instruments are issued and traded in financial markets in the same way as conventional financial instruments, but the funds are directed towards green or sustainable purposes (UNEP, 2020). Some of these instruments are directly or indirectly linked to CE initiatives as they support a sustainable use of resources and therefore contribute to climate change mitigation and adaptation. Globally, the total value of private financing in circular investment until May 2021 was around \$45.5 billion (Schroeder and Raes, 2021), indicating interest of the financial sector in promoting CE projects (BASE et al., 2022). The most significant mechanisms for financing sustainability and examines how CE initiatives fit within their parameters. The mechanisms vary in terms of the objects of financing, risk profiles, and level of property involvement.

The debt mechanisms consist of various fixed-income instruments that generate funds for projects that further economic, environmental, and social goals (Nunez et al., 2022; CEPAL et al., 2022). They provide financial resources in the form of loans, in exchange for interest payments. The recipient of the loan retains full ownership of the project (UNEP, 2016). Objects of debt mechanisms among CE initiatives include investments in equipment, project development, working capital, acquisitions, and others.

Examples of debt instruments that may offer financing for CE initiatives include loans, sustainability-linked bonds, and SWAPS. Sustainability-linked bonds are growing in popularity in the LAC region. Despite the impact of COVID-19, climate-focused development finance in LAC reached USD 17 billion in 2020 from sources such as bilateral organizations, multilateral organizations, and private donors (OECD, 2022). By offering bank credits, financial actors can partner with key clients involved in CE initiatives and expand their influence across supply chains (Latin America and Caribbean Circular Economy Coalition, 2022).

Unlike traditional debt instruments, sustainable debt finance operations and projects consider ESG indicators as complementary evaluation criteria along with financial risk profiles (IFAC, 2022). Typically, sustainable debt instruments offer favorable interest rates, such as flexibility, prepayment benefits, and the lowest rate, when meeting ESG targets. There is increasing pressure from responsible investors for transparency and the use of key performance indicators (KPIs) that align with CE principles, such as the number of tons of material recovered and the percentage of secondary materials used (Schroeder and Raes, 2021).

Likewise, bonds and loans related to sustainability initiatives include green bonds for financing projects with environmental benefits, and social bonds for financing projects with social benefits (Núñez et al., 2022). The CE is addressed through these instruments by financing projects focused on energy efficiency, waste management, efficient use of natural resources, logistics, and technology (UNEP, 2020).

In Latin America, the issuance of green bonds has more than doubled in less than two years since 2019, and sustainability bonds have shown notable growth since their inception in 2016 (CBI, 2021). The International Capital Market Association (ICMA) has developed and regularly updates principles for each type of bond to serve as application guidelines (BMZ, 2022). For example, FEMSA, a beverage company from

Mexico, issued two sustainability-linked bonds in 2021, valued at 700 million euros and 500 million euros, aimed at reducing waste sent to landfills and increasing the use of renewable energy (Nuñez et al., 2022).

Complementary, transition bonds are financial instruments that facilitate companies in high-impact sectors to access funding for the implementation of specific technologies. These bonds are linked to the CE and finance the transition to circularity (UNEP, 2022). For example, in 2020, the Brazilian energy company Eneva launched a transition bond worth USD 178 million to fund the expansion of a gas-fired power generation plant using geothermal energy and the construction of a natural gas-based thermoelectric plant to replace a diesel-fueled plant (CBI, 2021).

Debt-for-nature swaps are also a type of debt financial mechanism that involve a voluntary transaction where a developing country's² government debt is cancelled or reduced by a creditor in exchange for financial commitments to conservation (Mengdi and Nedopil Wang, 2021). This mechanism aligns with the CE when incorporated into institutional strategies for environmental protection. ECOFONDO,³ a conservation trust fund, is an example of a debt-for-nature swap, that finances community conservation projects in Colombia, the United States, and Canada, which incorporate principles of the CE, such as sustainable agriculture systems (FAO, 1997).

Efforts to develop taxonomies and schemes for the scaling up debt instruments remain applicable on a voluntary basis, including the ICMA Principles⁴ or the LMA Principles.⁵ As the development of debt mechanisms evolves, there is increasing concern about maintaining market integrity through greater rigor and transparency. Moreover, the lack of sufficient assets that meet the criteria for inclusion in sustainable, green, or social bonds, has led to barriers for the entry of smaller companies and industries. Additionally, there are costs associated with sustainable debt instruments, such as increased disclosure and tracking requirements to avoid greenwashing practices that could harm the issuer's reputation, and the risk of crowding out conventional debt mechanisms, resulting in reduced liquidity and higher funding costs for both segments (Roch et al., 2022; Doronzo et al., 2021).

Equity mechanisms, in which representatives of the equity participate in the governance structure of the investment project (BMZ, 2022) and benefit from financial returns as a shareholder (UNEP, 2016) can be another source of financing. Usually, a specific period of participation is agreed upon, and these shares are often traded on a stock exchange. Equity mechanisms utilize both venture capital (institutional owners) and private equity (individual owners) as investment instruments for growing business models or supporting entrepreneurial initiatives. This mechanism focuses on innovative projects and companies at an early stage of development, such as those related to the CE (BMZ, 2022).

Examples of equity funds in the LAC region include private equity investors like Rise Ventures, which focus on high-growth potential initiatives with financial returns and positive socio-environmental transformations. Another fund, Kapin Capital, invests in natural resource-related initiatives, including circular business models. The Inter-American Development Bank Group, through its innovation laboratory IDB Lab, mobilizes financing as an equity fund to co-create economic, social, or environmental solutions. Since 1993, IDB Lab has approved more than \$2 billion in projects developed in 26 LAC countries, including

² Countries in LAC region classified as developing countries (World Bank, 2022): Argentina, Bolivia, Brazil, Colombia, Cuba, Dominican Republic, Ecuador, Salvador, Guatemala, Guyana, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Paraguay, Peru, Suriname, Venezuela.

³ ECOFONDO is an organization that brings together non-profit environmental organizations, non-governmental, community, indigenous and Afro-descendant organizations. Its purpose is to co-finance environmental projects among other actions in relation to environmental problems and the strengthening of organizations and social movements (ECOFONDO, 2022).

⁴ ICMA serves as Secretariat to the Green Bond Principles (GBP), the Social Bond Principles (SBP), the Sustainability Bond Guidelines (SBG) and the Sustainability-Linked Bond Principles (SLBP), providing support while advising on governance and other issues. The principles are backed by a global market initiative bringing together all market participants and stakeholders from the private and official sectors.

⁵ The Loan Market Association (LMA publishes updated Green, Social and Sustainability-Linked Loan Principles and accompanying guidance. Its initial aim was to assist in the development of the secondary loan market in Europe. Its intention was to develop industry best practice and standard documentation. The LMA is active in the primary market as well as the secondary market.

investments in over 90 venture capital funds (IDB, 2021). The Finep fund finances entrepreneurs of innovative business models, including circular business models, through a wide range of instruments, including capital injections via venture capital, among others (Zhongming et al., 2022).

Barriers hinder sustainable private equity and venture capital investment activity, including higher costs and potential lower short-term returns, a brief track record leading to perceptions of illiquidity, lack of harmonized standards for measuring environmental impact, mismatch with traditional fund structures, and lack of knowledge about sustainable investing norms and ESG risk management standards (Ahmad et al., 2018).

Hybrid mechanisms or blended finance involves the combination of public and private resources for financing projects where property rights are shared as part of the financial agreement (OECD, 2017). This type of finance is typically applied to larger infrastructure projects such as those for water and sanitation and clean energy (Schröder and Raes, 2021). Blended finance transactions often have three key features: (i) they tend to contribute to achieving the Sustainable Development Goals, (ii) the transaction is expected to yield a positive financial return, and (iii) public and/or philanthropic parties act as catalytic institutions (Schröder and Raes, 2021).

Latitud R is a blended financing initiative (Latin America and Caribbean Circular Economy Coalition, 2022). As a multisectoral regional platform, it connects actions, resources, and knowledge from the public, private, entrepreneurial, academic, and civil society sectors. The platform aims to contribute to the development of inclusive recycling systems with economic, social, and environmental sustainability. This is done by supporting the formalization and improvement of conditions for basic recyclers and promoting the growth of the circular economy. With its efforts, LatitudR has been able to develop around 30 initiatives, activities, and strategic projects that benefit over 15,000 recyclers across 17 countries in the Latin America and Caribbean region.

Non-reimbursable mechanisms, mainly in the form of grants, are used to finance projects with specific ESG objectives of interest to the donor (Schröder et al., 2020). These mechanisms do not require repayment of the invested capital and are especially useful for non-government organizations, community-based organizations, and grassroots organizations that require funds to pilot circularity initiatives. The objective of the project should be closely aligned with the values and goals of the investing entity.

Examples of non-reimbursable financing mechanisms in Latin America include Innovate Peru, PROPME Fund, and CORFO (Production Development Corporation) programs, which are promoted by governmental organizations and provide resources to support the growth of circular initiatives (Latin America and Caribbean Circular Economy Coalition, 2022). Policy-based loans provide the member countries of development banks with funding to support policy reforms and/or institutional changes (IADB, 2018). In Colombia this type of funding has been used to finance regulatory innovation as part of the National Strategy on Circular Economy. Additionally, the Global Environment Facility's Small Grants Program has funded numerous projects aimed at managing plastic waste in the LAC region through a circular economy approach (Schröder et al., 2020).

Table 3 includes information on the different financing mechanisms, their application instruments, some key characteristics, and examples in the ALC region.

Financial mechanisms that are compatible with the CE, although not necessarily explicitly referencing it, can finance circular initiatives. The appropriate mechanism depends on factors such as the fit with the funding organization and initiative owner, impact, stage of development, stakeholders, governance, and management.

Table 3
Financing mechanisms used for scaling Circular Economy in Latin America

Mechanism	Instruments	Characteristics	Types of ESG indicators	Examples
Debt	<ul style="list-style-type: none"> - Banking credit (long and short term) - Bonds issue 	<ul style="list-style-type: none"> - Purpose of the investment aligned with a specific objective - Benefactors maintain full ownership of the project - Periodic evaluation - Involve business model assessment 	<ul style="list-style-type: none"> - Impact category - Sector specific - Qualitative approach 	<ul style="list-style-type: none"> - Bancolombia and Banco Estado de Chile - Bancoldex, BNDES, CORFO, and IDB/IDB Invest - FEMSA - TES verdes
	<ul style="list-style-type: none"> - SWAP 	<ul style="list-style-type: none"> - Amount of debt owed by a developing country in the region is cancelled or reduced - Exchange for the debtor making financial commitments to conservation - Can result in win-win situations 	<ul style="list-style-type: none"> - Impact category - Sector specific - Qualitative approach 	<ul style="list-style-type: none"> - ECOFONDO - Amazon Fund
Equity	<ul style="list-style-type: none"> - Private Equity - Venture Capital 	<ul style="list-style-type: none"> - Focused on early-stage alternatives/projects/startups - Attention to innovation strategies - Purpose related to scalability of projects 	<ul style="list-style-type: none"> - Sector specific - Impact category - Qualitative approach 	<ul style="list-style-type: none"> - FINEP - Kapin Capital - Rise Ventures - IDB Lab
Hybrid	<ul style="list-style-type: none"> - Blended finance schemes 	<ul style="list-style-type: none"> - Anchor to a sustainable development rationale (SDG) - Design to increase the mobilization of commercial finance - Focus on effective partnering 	<ul style="list-style-type: none"> - Impact category - Sector specific - Qualitative approach 	<ul style="list-style-type: none"> - LatitudR
Non-reimbursable	<ul style="list-style-type: none"> - Non-reimbursable funds - Grants - Policy based loans 	<ul style="list-style-type: none"> - Focused on Small and medium-sized enterprises (SMEs) - Focused on non-government organization, community-based organization, grassroots organization - Purpose of the investment aligned with a specific objective - Purpose related to the scalability of the project - Connected to policy commitments of public agencies 	<ul style="list-style-type: none"> - Impact category - Qualitative approach - Innovation in regulation 	<ul style="list-style-type: none"> - "Innovate Peru" - The PROPME Fund, CORFO (Production Development Corporation) - Small Grants Program - Policy Based Loans offered by development Banks

Source: Authors.

III. ESG frameworks and circular economy (CE)

Access to financing enhances the demand to establish evaluation mechanisms for circular initiatives. Determining indicators for CE projects assessment allows funders to monitor compliance with the goals established by the projects, as well as report achievements in meeting the established goals. ESG rating systems and schemes offer a methodological guide for the evaluation of sustainable and circular initiatives. Integration of a common framework and increased transparency play a transformative role in promoting sustainable financing. This section reviews the key standard frameworks used by banks and financial institutions to evaluate financial mechanisms related to sustainability and develops a framework of indicators for financial institutions to consider when assessing circular initiatives.

A. The relationship between CE initiatives, ESG disclosure, corporate reputation and cost of debt

ESG disclosure refers to a company's public reporting of its performance and practices in relation to environmental, social, and governance (ESG) factors. These disclosures can communicate important signals to stakeholders and the broader market, which can generate benefits beyond meeting established ESG metrics. CE is included in ESG frameworks, for its contribution to sustainable use of resources with positive environmental impacts, and social contributions to business model development and employment generation.

In order to map the different approaches and gaps within the sustainability-related disclosure requirements and regulations within LAC, ECLAC developed a survey that could document the current state of regulation on ESG factors in seven countries (Argentina, Barbados, Chile, Colombia, México, Perú and Uruguay).⁶ This study develops a catalogue to compare and navigate the regulatory landscape for issuers, investors, and the financial sector, covering a list of 92 ESG items of possible disclosure divided into:

⁶ The results of the survey which have not yet been published, will be discuss in detail under Sustainability-related disclosures in Latin America and the Caribbean section in a forthcoming ECLAC paper.

- **Environment:** Biodiversity Ecosystem Services; Climate Change; Land Use; Energy; Resources; Waste; Water; Oceans, and Emissions/Pollution. Regarding the disclosure of the environmental information, the responding jurisdictions choose different approaches. Some consider the information must be included in the mainstream report, while in other country it must be included in an integrated report.
- **Social:** Human Rights; Employment Conditions, Policies and Practices; Product and Service Responsibility; Social Impacts/Value Creation; Market presence, and Supply Chain. The disclosure of social information is clearly in favor of a comply-or-explain approach over a mandatory model.
- **Governance:** Leadership; Effectiveness; Accountability; Remuneration, and Relations with Stakeholders. The disclosure of the governance information, in terms of the way regulators foresee the reporting is slightly in favor of a mandatory over a comply-or-explain approach.

One of the items the survey asked for was the use of materiality to determine if disclosure is needed and if there was a definition for it. Three of the countries have both the requirement for materiality and provide a definition. One has the requirement, but no definition. And only one does not use materiality to determine when or what to disclose.

The literature sustains that ESG disclosure has a strong relationship with companies' borrowing costs. Generally, companies with strong ESG performance and practices are perceived as less risky and more likely to achieve long-term sustainability, which may lead to lower borrowing costs.⁷ Conversely, companies with poor ESG performance and practices may be viewed as riskier and face higher costs of debt. With respect to this, ESG investing and disclosing benefits go beyond the well-known benefit of attracting green investors and contributing to the SDGs or the Paris agreement, some authors argue that this whole process could lead to lower costs of financing (Maaloul et al., 2021). But what is not so straightforward when studying the relationship between ESG disclosure and the cost of financing is that the effect of ESG investing on the cost of debt of corporates is mediated by another component, reputation.

The benefits of ESG investment on companies' cost of debt deem from improvements in corporate reputation (Maaloul et al., 2021). As companies start reporting more efficiently by adopting voluntary standards such as ICMA's or TCFD's, investors and risk rating agencies receive relevant inputs that influence how they perceive a company's reputation. This behavior positively changes stakeholders' perception of the risks associated with investing in certain companies by improving their reputation. The opposite happens when environmental irresponsibility takes place (Chen et al., 2020).

Reputation also shields corporates. Companies with good reputations are perceived to enjoy the benefit of the doubt with stakeholders. In other words, negative circumstances or media-related scandals may stop on a reputation wall (Marcelis-Warin and Teodoresco, 2012). In this regard, the idea that "the higher we go the huge the fall" is not so white and black when it comes to reputational risks. Although stakeholders certainly expect more of companies with a good reputation, build up through investments in ESG or Corporate Social Responsibility (CSR), they also recognize that this provides companies with more solid protection in an event of a negative circumstance. Scandizzo (2011) argues that a solid reputation acts like a capital buffer, softening the impact of adverse events.⁸

⁷ However, the extent to which ESG disclosure affects the cost of debt depends on various factors. Different industries may value differently ESG aspects, level of transparency and disclosure may differ, and size and maturity of companies are also a determinant of borrowing costs. Moreover, investors' appraisal of ESG factors can vary.

⁸ By resembling a capital buffer, reputational losses, increase the risk of future damages, whether reputational or of another kind, by representing less of a cushion against adverse events. This lack of preparedness could lead to what Scandizzo (2011) calls a reputational bankruptcy.

Corporate reputation offers more benefits than those already discussed. It can help differentiate a product, enhance brand value, attract talented employees, consumers, and investors, and assist in crisis management. Furthermore, and this is the main objective of this section, corporate reputation can lower corporates' cost of debt by transmitting to the most diverse stakeholders, companies' capacity to endure crisis, and commitment to long-term financial, sustainable, and social goals. Therefore, by granting companies reputational gains, investments in ESG can be a valuable tool to improve corporate transparency and reduce the cost of debt. In this sense, financial mechanisms can play a dual role in the corporate world by funding the transition to a greener economy and improving corporate reputation.

Whether by self-commitment to sustainable goals or ESG bond issuances, investing and reporting ESG can lead to higher transparency once companies are obliged to report on information that otherwise they would not report on. In the first case, to make contributions to a greener future companies integrate their commitment to sustainability into the overall business plan which signals to a broad range of stakeholders the company's dedication to creating positive environmental, social, and economic impacts while minimizing negative effects. We argue that an even stronger signal is sent when reporting on ESG metrics after issuing a sustainable bond. In other words, by publicly reporting on the Key Performance Indicators (KPIs) of ESG projects, companies, and governments are demonstrating their commitment to broader goals and providing a level of accountability to stakeholders.

One of the critical aspects of financial mechanisms is the obligation to report on KPIs. KPIs are specific measures that are used to track and report on the performance of a project or initiative. The KPIs for sustainable-linked bonds are designed to measure the positive environmental, social, or governance impact of the projects being funded by the bonds. Reporting on KPIs provides transparency to investors and other stakeholders which builds trust and ensures accountability.⁹ By providing transparency, monitoring, and evaluating project effectiveness, and demonstrating a commitment to broader ESG goals, these issuances can effectively improve a company's reputation which we argue can lead to overall lower borrowing costs.

In addition to the potential reputational gains, financing ESG and circular projects through borrowing can also offer more benefits. It can be less expensive than raising capital through equity, does not require giving up ownership as in the case of equity, good payers have their credit rating enhanced, and can be less expensive when interest rates are low, among others. Reporting ESG metrics can also be part of the risk —reputational or not— mitigation strategy of companies.¹⁰ As mentioned before, companies with strong ESG performance and practices are perceived as less risky. Companies and investors are becoming aware of the risks of reputation-linked losses to business continuity by day, which is been driving academic production and stakeholders' attention to the subject. Therefore, ESG disclosing can lead to consistent reputational gains by signaling to stakeholders what the company has been doing or planning to do regarding climate risks, which directly and indirectly mitigates reputational risks.

The idea that only hard information,¹¹ i. e., a company's payment track record or its credit rating, would influence corporate reputation has changed in the past twenty years as new evidence came out showing that soft information¹² (for example, ESG information) can also impact companies' reputation (Maaloul et al., 2021). As lenders are increasingly valuating non-financial information when electing borrowers, soft information such as firms' innovativeness, quality of management, workforce talent, etc. starts gaining more relevance.

⁹ Reporting on KPIs also enables companies and governments to monitor and evaluate the effectiveness of the ESG projects being funded.

¹⁰ Roehrich, Grosvold, and Hoejmose (2014) argue that reputational risks are the main drive for implementing sustainability practices into companies' management strategies.

¹¹ Hard information is quantitative and objective data that can be easily measured, verified, and quantified. Examples of hard financial information include financial statements, revenue figures, earnings reports, and other financial metrics that can be expressed numerically.

¹² Soft information is qualitative and subjective data. Usually, soft information is used to complement hard information and provide a more complete understanding of a company's financial health. Examples of soft financial information include customer feedback, industry trends, management quality, etc.

More often financial analysts are using a combination of hard and soft information to base their financial analysis and decisions. In this sense, reporting on ESG can also play a valuable role in screening loan applicants and determining borrowing costs. To put it differently, corporate reputation may represent soft information not captured by financial statements, which is nonetheless valuable to lenders (Anginer et al., 2019). According to De Castro, López, and Sáez (2006), corporate reputation is configured by the following elements: (i) managerial quality; (ii) financial strength; (iii) product and service quality; (iv) innovation; (v) use of corporate assets/efficiency; (vi) capability to gather, develop, and retain talented people; (vii) social responsibility among the community; and (viii) value of long-term investments. These categories of corporate reputation as part of ESG assessment, connect to CE scaling up potential.

B. ESG assessment and circular economy (CE) indicators

Complementary to financial mechanisms, rating systems have emerged in the financial sector as a tool for evaluating investments related ESG issues (ECLAC et al., 2022). ESG ratings measure a company's exposure to long-term ESG-related financial risks and are used by organizations to communicate standard impact performance language. These ratings also enhance data operability among different actors by recommending metrics, formats, and reporting frequencies (OECD, 2020).

Several assessment initiatives share common indicator frameworks, even though they employ different methodologies for managing data. Organizations such as the Climate Disclosure Standards Board (CDSB), the Global Reporting Initiative (GRI), the International Integrated Reporting Council (IIRC), the Sustainability Accounting Standards Board (SASB), and the Task Force on Climate-related Financial Disclosures (TCFD) are collaborating towards a unified vision of comprehensive corporate sustainability reporting.

In fact, during 2022 some sustainable performance reporting standards merged. The main goal is to align the standards towards greater integration. In 2021, the Sustainability Accounting Standards Board (SASB) merged with the Integrated Reporting (IR) to create the Value Reporting Foundation, which in turn merged with the Climate Disclosure Standards Board (CDSB) into the International Financial Reporting Standards Foundation (IFRS), a nonprofit, public interest organization established to develop high-quality, understandable, enforceable, and globally accepted accounting and sustainability disclosure standards. IFRS has two areas: accounting, which evaluates financial statements and their notes, particularly financial position, results, and changes in stockholders' equity and cash flows; and sustainability, which includes integrating reporting and SASB Standards. The two areas cover certain basic information needs of users, investors, creditors, and regulators, among others. The SASB standards will be an integral part of the future International Financial Reporting Standards on Sustainability (IFRS) developed by the International Sustainability Standards Board (ISSB).

The SABS Standard indicators, founded by the International Financial Reporting Standards Foundation, provide comparable information on the sustainability factors relevant to financial performance and enterprise value. They help investors identify key sustainability-related drivers of risk and return within a specific industry. SASB offers tailored indicators for 77 industry standards that identify a subset of ESG issues most relevant to financial performance in each industry (IFRS, 2022).

The IRIS+ standards, created by the Global Impact Investing Network (GIIN), provide a framework to measure and manage the social and environmental impact of companies, initiatives, or projects (IRIS+, 2019). The framework's indicators have three characteristics: (i) they provide a core set of metrics for investment decision-making based on best practices, standardized to enable data comparison; (ii) they organize a thematic taxonomy based on generally accepted impact categories and themes; and (iii) they align with the SDGs targets and other major frameworks and conventions.

Recommendations of the Task Force on Climate-related Financial Disclosures (TCFD)¹³ were prepared at the request of the Financial Stability Board (FSB) to provide guidance for more effective climate-related management and disclosure, which could promote more informed investment, credit, and insurance underwriting decisions. The recommendations span four different areas: governance, strategy, risk management, and metrics and targets that companies should disclose to support investors, lenders, and insurance underwriters in appropriately assessing and pricing risks related to climate change (TCFD, 2022). The TCFD suggests clear, comprehensive, high-quality information, including the risks and opportunities presented by rising temperatures, climate-related policies, and emerging technologies in a changing world. Complementary, the FTSE4Good index series, launched in 2001 by FTSE Russell, a global provider of benchmarks, analytics, and data solutions, provides metrics ESG performance. This tool for investors identifies companies that demonstrate good sustainability practices (FTSE Russell, 2021).

The ESG assessment process and criteria have evolved to align with industry trends and investor needs. The ESG evaluation criteria are based on global standards and aim to support the drive towards harmonizing sustainable investment methodologies. They draw from sources such as the GRI, TCFD, the OECD Guidelines, the GHG Protocol, and Transparency International's Business Principles for Countering Bribery and align with the UN SDGs. Table 4 displays the key characteristics of the rated systems and their indicator frameworks.

Table 4
ESG ratings characteristics

Rating system	Objective	Developer	Indicators characteristics	Source
SASB Standard	Provide industry-based sustainability disclosures about risks and opportunities that affect enterprise value.	IFRS Foundation: not-for-profit organization established to develop globally accepted accounting and sustainability disclosure standards.	77 industries standards that identify a subset of environmental, social, and governance issues most relevant to financial performance.	IFRS, 2022
IRIS+ System	Provide investors information on the impact performance of their investments on the people and the planet.	The Global Impact Investing Network (GIIN): network of investors and leaders focused on reducing barriers so more investors can allocate capital to fund solutions to the world's most intractable challenges.	Core Metric Sets based on best practices and standardized to enable comparison of data. Taxonomy based on generally accepted Impact Categories and Impact Themes.	IRIS+, 2019
TCFD Task force on climate related financial disclosures	Encourages companies to disclose climate-related risks and opportunities.	Financial Stability Board (FSB): international organization that pursues efficiency and stability of the international financial system.	Recommendations on information companies should disclose. Structured around four thematic areas: governance, strategy, risk management, and metrics and targets.	TCFD, 2022
FTSE4Good	Tool for investors seeking to invest in companies that demonstrate good sustainability practices.	FTSE Russell: global provider of benchmarks, analytics, and data solutions.	Measures the overall quality of a company's management of ESG issues. Scores for each of the three ESG pillars. More than 300 ESG indicators, with an average of 125 indicators applied to each company.	FTSE Russell, 2021

Source: Authors.

¹³ See <https://www.fsb-tcfd.org>.

Different indicator guidelines are complementary and can be used together to provide investors with an understanding of the drivers of risk and return of investments that have positive social and environmental effects. By combining the different assessment methodologies, investors can make informed investment decisions for CE initiatives. Moreover, evidence suggests that actual disclosed sustainability performance has a positive association with business reputation (Alon and Vidovic, 2015). Corporate reputation is recognized as an important asset, and research indicates that a positive reputation is crucial for stakeholders and financial performance (Tischer and Hildebrandt, 2014; Baalbaki and Guzmán, 2016).

Within the last two years, however, we observe a trend of harmonization of disclosure frameworks and standards. One of the highlights was the announcement, on November 2021 at COP26, in Glasgow, that the International Financial Reporting Standards Foundation (IFRS)¹⁴ would create the International Sustainability Standards Board (ISSB). The ISSB was created to provide a comprehensive global baseline of sustainability-related disclosure standards that offers investors and other capital market participants with information about companies' sustainability-related risks and opportunities to help them make informed decisions.¹⁵

C. Different approaches for sustainability-related disclosure requirements

Scaling CE initiatives requires measurable results in terms of value added, promoting the use of circularity indicators and metrics (UNEP, 2020). Currently, there is no unified measure for CE progress, and existing indicators are not always comparable (Van Hoof et al., 2022). A compilation of available indicators is presented based on the analysis of ESG instruments applied in a financial setting. This section presents a compilation of the available indicators integrating ESG performance assessment, including business risks and opportunities and evaluation of advances in circularity in the productive sectors in LAC.

In the past decade, even though it is voluntary, ESG measurement has become the standard for sustainability reporting by companies and risk evaluation for financing sustainability projects. Large investors are adopting sustainability parameters, reflecting the global trend towards responsible investment, and addressing the climate emergency by transitioning to a net-zero economy (FTSE Russell, 2021).

The proposed framework for evaluating the risk of CE initiatives used in the next section, emphasis on the governance and environmental dimensions of existing ESG frameworks. Each dimension includes a series of categories related to the circular economy, in which the KPIs are grouped. The social dimension, which is a part of ESG frameworks, is not considered due to the scarcity of CE impact indicators beyond direct job creation (Padilla-Rivera et al., 2021).

Governance dimension evaluates the relationship of circular initiatives with the internal and external environment of the business model. This dimension includes four categories of CE: (i) general information, (ii) circular model, (iii) regulations and incentives, and (iv) collaboration and alliances. The indicators collected in these categories aim to provide insight into the business factors that impact the development of a circular initiative and to provide a deeper understanding of the nature and management model of the initiative.

Financial institutions are prioritizing financing for climate change mitigation and adaptation initiatives in alignment with global commitments. Profitable business models consider the added value of efficient resource use. The environmental dimension assesses the impact that circular activities have on the environment, both directly and indirectly. This dimension considers five categories for environmental evaluation: (i) environmental management, (ii) resource flow, (iii) circularity gap, (iv) natural resource management and (v) sensitivity and resilience.

¹⁴ The IFRS was developed by the International Accounting Standards Board (IASB). The standards, methodology, and infrastructure behind their accounting standards have ensured a robust set of reporting standards that are used in more than 140 jurisdictions.

¹⁵ See <https://www.ifrs.org/groups/international-sustainability-standards-board/>.

The environmental management category evaluates sustainability management plans and certifications that impact circular initiatives, while the resource flow category looks at material use efficiency. The circularity gap category evaluates the reuse and recycling of materials. The natural resource management, and sensitivity and resilience categories gather indicators about measures or activities that aim to reduce the vulnerability of natural systems. Table 5 summarizes the indicator framework for evaluating of circular economy initiatives from a financial perspective in Latin America and the Caribbean.

Table 5
Indicators framework for the evaluation of circular economy initiatives

ESG Dimension	CE Categories	Indicators	Measurement
Governance	General information	Size of economic units: micro, small and medium-sized companies	Qualitative
		Location of operation: urban and rural	Qualitative
		Years of operation: (i) recently created, (ii) consolidation process, (iii) consolidated	Qualitative
		Sector: agriculture, industry, commerce, and services	Qualitative
		Productive activity within each economic sector	Qualitative
	Circular model	Circular supply, Recovery of resources, Extension of product life, Sharing products or resources, Product systems as a service	Qualitative
	Regulations and Incentives	Policy process for new circular laws and regulations	Qualitative
		Existence of mechanisms for (a) public procurement, (b) training programs, (c) technical assistance in CE, (d) financial instruments	Qualitative
	Collaboration and alliances	Collaborations between companies, public institutions and/or universities	Qualitative
Environment	Environmental management	Environmental impact analysis	Qualitative
		Organization of environmental management activities	Qualitative
		Number of sustainability related certifications	Quantitative
		Use of low-emission engines or fuels	Quantitative
		Efficient logistics systems	Quantitative
	Resource flow	Use of electric power generation mechanisms from renewable sources	Quantitative
		Use of renewable energy for various purposes	Quantitative
		Substitution of polluting inputs or raw materials	Quantitative
		Energy efficiency	Quantitative
		Polluting gas emissions	Quantitative
		Inputs and outputs of key resources (raw materials, water, energy)	Quantitative
	Circularity gap	Effluent and waste management	Quantitative
		Development of recycling activities	Quantitative
	Natural resource management	Restoration of damaged ecosystems	Quantitative
		Conservation of agrobiodiversity	Quantitative
	Sensitivity and resilience	Warning and risk management systems for extreme weather events	Qualitative
		Action protocols for climatic emergency situations	Qualitative

Source: Authors.

The framework consists of indicators to be considered for evaluation of CE initiatives. However, these indicators should be adjusted to a more specific context, taking into consideration the business model of the circular initiative, including alignment with value chain partners, and the policy and regulatory environment. Considering case specific indicators provide a detailed evaluation of business risks for decision-making processes.

For instance, the construction and automobile manufacturing sectors emphasize indicators related to the use, reuse, and recycling of specific materials, such as the percentage of steel recovered for reuse and recycling. In contrast, sectors like agriculture and mining highlight indicators related to land management and water use, such as the deforested area. Furthermore, the business model (manufacturer, distributor, retailer) and the value chain (local or global) also play a role in determining the specificity of the indicators to be used.

The customization of the evaluation process enables an understanding of the unique characteristics of each circular initiative and provides a basis for comparison with other similar initiatives in the same industry. In the following section, the general framework of indicators is applied and adjusted for each of the case studies, providing a practical validation of the indicators. This evaluation process also assesses the effectiveness of the indicators and identifies information gaps in the evaluation for financing circular economy initiatives.

IV. Case studies on scaling up circular economy (CE) initiatives

Scaling up CE initiatives in Latin America is illustrated through case analysis. Case analysis helps to understand the application of the framework for risk analysis of scaling potential, discussed in chapter II, including financial mechanisms applied following the revision in chapter III, revision CE indicators as part of ESG frameworks presented in chapter IV. Cases provide a reference for understanding complex concepts like the CE and offer insights into the nuances of reality, which are important to consider when making recommendations for public policy.

A. Selection of cases

The research methodology for developing guidelines for scaling the CE initiatives uses a case study approach. The cases were selected based on priorities identified in previous studies by the ECLAC (Van Hoof et al., 2022) and cover CE initiatives in four economic sectors.

- (i) **Construction:** Construction of housing and infrastructure is a major contributor to resource extraction in most countries in Latin America. The majority of resource-intensive activities in the value chain, from raw material extraction to energy generation, transformation, use, and disposal, take place within the national borders. Additionally, resources used in building housing and infrastructure have a long lifespan.
- (ii) **Agro-food:** Agro-food value chain consumes large amounts of resources such as water, fertilizers, and pesticides, and uses a significant amount of energy in food processing. It also results in high volumes of single-use packaging waste due to mass consumption of processed foods. The value chain also generates significant amounts of organic waste, presenting a high potential for organic waste recovery. Most resource-intensive activities within the value chain, such as cultivation, processing, consumption, and packaging waste generation, occur within the national territory.

- (iii) Automotive industry: The automotive industry's global value chain is comprised of a complex network of suppliers of auto parts that are manufactured in various countries worldwide. The industry consumes a high number of resources and represents a significant aggregated value. In Latin America, various stages of the value chain take place, both for national consumption and for export to global markets.
- (iv) Mining: The mining value chain is a complex, global network that involves the extraction and use of minerals for various applications. In Latin America, several countries extract significant volumes of minerals as part of their national resources, with large-scale extraction processes requiring large amounts of resources such as water.

Four representative examples of CE initiatives were selected for the study from different Latin American countries within these economic sectors.

B. Circular economy case analysis

1. Case 1: Circular Real-Estate (Bogota, Colombia)

General characteristics

Circular Real-Estate promotes the acquisition of refurbished apartments that include circular economy technology and offer certified resource efficiency benefits and lower loan rates. The used properties are remodeled according to certified circularity standards adapted from LEED and EDGE certification models. This circular initiative was launched in Bogota, Colombia in 2021 through a partnership between HABI, a technology-based real estate start-up; Green Factory, a sustainability consulting company specializing in construction and certifications; and Banco de Bogota, a financial institution that provides loans for housing acquisition. The initiative has so far generated profits of approximately \$100,000 USD through a pilot project of 12 sustainable refurbished apartments.

The business model adopts a circular approach that incorporates social and environmental considerations within a technology-focused real estate venture. Circular Real-Estate targets the segment of used properties with commercial value ranging from \$50,000 to \$100,000 and less than 30 years old. In Bogota, these properties cater to the lower-middle class segment or typically first-time home buyers, which make up about 40% of the used housing market. Expertise in standards and best available technology for circular construction is a key resource. The added value of the circular innovation model includes resource efficiency in energy and water consumption, reduced waste disposal, lower monthly energy and water costs, and an increase in the value of the refurbished real estate.

Circular Real-Estate integrates several circular innovation models, including (i) resource conservation using cleaner technology to reduce energy and water consumption, (ii) material reuse and recycling, (iii) recycling of household waste streams, and (iv) extending the lifespan and value of existing buildings. The sustainable refurbishment is expected to result in an estimated 20% reduction in water use and 20% reduction in energy consumption, equating to a yearly saving of 398.4 kg of CO₂ per apartment.

The launch of Circular Real Estate combines various financing methods, including a green bond issued by Banco de Bogota, which is utilized by Circular Real Estate to offer discounts on interest rates for clients acquiring refurbished apartments equipped with resource-efficient technology. The installation of such technology was financed through the operational internal budgets of HABI as part of its real estate business model. Image 1 displays the circular real estate business model.

Image 1
CANVAS model of Circular Real Estate

<div>Suppliers</div> <ul style="list-style-type: none">Construction companyTechnology for energy, water, efficiency and waste management	<div>Key activity</div> <ul style="list-style-type: none">Acquisition of used apartmentsRefurbishingCertification of green apartmentsClosing real state transaction	<div>Value proposition</div> <div>Resource efficient refurbished apartments</div>	<div>Relations</div> <div>Alliance among HABI, Green Factory and Banco de Bogota</div>	<div>Clients</div> <div>Private people looking for apartments in Bogota in the price range of USD 50M - 100M</div>
	<div>Key resource</div> <ul style="list-style-type: none">Knowledge of real state marketKnowledge on refurbishing technologyKnowledge on certification of circular housing		<div>Channels</div> <div>HABI app</div>	
<div>Cost structure</div> <ul style="list-style-type: none">Acquisition of used real stateInvestment in refurbish technology			<div>Finance source</div> <ul style="list-style-type: none">Investors in real state business modelLoans for housing	

Source: Authors.

Scaling perspective

The Circular Real Estate initiative aims to optimize resource flows and increase value in the used housing market. The initiative results in quantifiable savings for water and energy consumption, promoting circular efficiency in domestic resource use. In 2021, HABI sold 5,000 apartments with an estimated energy saving potential of 160 KWh/month, leading to a potential cost savings of 20,000 USD per month in accumulated energy bills. The scaling of Circular Real Estate also has significant environmental impacts, with a projected reduction of 2,000 tons of CO₂ per year through modest and cost-effective adjustments. Approximately 80% of the resources and materials in good conditions are reused and recycled in the refurbishment process.

The scalability of Circular Real Estate is linked to several factors such as organizational capability, shared value creation, and the demonstration of tangible benefits to stakeholders. In the first phase, a pilot project was carried out to showcase the benefits of the circular economy initiative to the business, its customers, and the environment. However, the full integration of the circular initiative into HABI's traditional business model will depend on the sales potential of circular apartments. Consumer education and training on shared value and sustainable living is crucial to realizing the maximum potential of the circular initiative. It is estimated that to sell 10,000 circular refurbished apartments next year, an investment of 30 million USD in cleaner technology and waste management infrastructure, is needed as part of the refurbishing intervention (3,000 USD per apartment). To meet the commercial target, an additional investment of 150,000 USD in marketing and educational programs is estimated. Savings in energy and water bills, sum on average 144 USD¹⁶ per apartment per year, which counts for total yearly savings for the 10,000 apartments target in 1,44 Million USD per year.

¹⁶ Average bills for the target group sum 240 USD per year for energy and 480 USD per year for water (family of 4 persons, socio-economic tax segment 3 – 4). Efficiency is estimated in 20% of the resource use.

- Organizational capacity:
 - The co-founders of HABI, Sebastian Noguera¹⁷ and Brynne McNulty,¹⁸ bring a diverse set of skills to the Circular Real-Estate initiative. Based on their combined expertise, they aim to revolutionize the real-estate sector by using data intelligence to make housing transactions faster and more accessible through easier access to banking credits.
 - Other partner of Circular Real-Estate, Green Factory, was founded by Diego Prada.¹⁹ With a family background in the construction industry, Green Factory initially started as a project within the family business and has since become recognized as the most sustainable benchmark in sustainable construction in Colombia. Green Factory has vast experience in sustainable construction standards and methodologies and has been incorporating a circular construction approach since its establishment.
- Value chain collaboration:
 - Circular Real-Estate initiative was facilitated by the personal and professional relationships among the partners. The managers of HABI and Green Factory have been connected for years, which led them to investigate opportunities for creating shared value in the apartment refurbishment business through the integration of technology. Green Factory's background in implementing circular construction strategies was instrumental in developing appropriate circular methods and schemes for the renovations. Their prior knowledge of circular construction was crucial in adapting the renovations to specific contexts. Furthermore, their expertise in international and national sustainable construction standards and certifications enabled the creation of a sustainable self-certification system that has encouraged financial institutions to participate in the circular initiative.
 - The prior employment relationship of HABI's manager with Banco de Bogota played a crucial role in the bank's involvement in the Circular Real-Estate initiative. Banco de Bogota has extensive experience in housing finance, serving 82% of the national territory. Their participation in the project brings credibility and enhances the initiative's financial benefits for clients. Additionally, the financial institution benefits from the initiative, as it aligns with the objectives of the green bonds issued by the bank in 2021.
- Facilitating mechanisms in the business context:
 - Regulations and incentives play a crucial role in guiding institutions towards circular goals. In Colombia, incentives for sustainable construction mainly focus on new buildings. Resolution 0549 of 2015 provides parameters and guidelines for new constructions to achieve minimum standards in terms of water and energy consumption. Additionally, Resolution 196 of 2020 outlines requirements and procedures for accessing tax benefits related to energy efficiency management projects. With a recognized environmental certification, the regulation allows for a tax discount of up to 50% on expenses, making it more affordable to build with energy-saving strategies.

¹⁷ HABI CEO has a background in industrial engineering and economics and started his career as the founder of the largest online grocery platform in Colombia. He later became the Chief Digital Officer at Banco de Bogota, where he gained knowledge of housing financing schemes in the country.

¹⁸ HABI CEO has a background in finance and real estate, she studied at the Wharton School and completed an MBA at Harvard Business School.

¹⁹ Green Factory CEO studied Biology and holds a master's degree in Environmental Management. From a young age, he developed a passion for environmental issues. After completing his Master's, he founded Green Factory.

- Regulations and incentives constitute the use of rewards and penalties to guarantee that institutions move towards the desired goals. Incentives towards sustainable construction in Colombia are mainly focused on new buildings. The Resolution 0549 of 2015 defines parameters and guidelines for new sustainable constructions to achieve minimum goals associated with water and energy consumption. Likewise, in terms of energy efficiency, the Resolution 196 of 2020 establishes requirements and procedures to access tax benefits related to energy efficiency management projects. Through a recognized environmental certification, the regulation enables access to tax discount that can represent a deduction up to 50% in expenses. This incentive currently creates a cost-effective environment for constructing with energy-saving strategies, and construction leaders are starting to take advantage of it.
- In Colombia, several financial institutions are promoting sustainable construction through loans and benefits in interest rates. According to Asobancaria, one of the most notable efforts in Colombia is the issuance of green bonds and climate bonds to help finance projects with energy and water savings in various industries, including real-estate. However, this project became a pioneer in terms of certification and financial schemes designed for sustainable renovation in the country. The main recognized sustainable construction certifications (LEED, EDGE, CASA) overlook sustainable renovations within their standards, for which Circular Real-Estate created its own certification to strengthen the recognition of the project. The certification resulted from the adoption of international standards placed in a refurbishment context and was key to guarantee the commitment of the financial institution.

Circular economy Indicators

In 2019, HABI set out to become a leader in the use of technology for real estate transactions, promising a 10-day turnaround for sales. After three years of operations, the company was valued at \$1,000 million, attracting investments from companies such as Softbank, Homebrew, Inspired Capital, and Tiger Global, making it the second unicorn company in Colombia. The Circular Housing Renovation initiative was launched to diversify HABI's market, cater to clients interested in sustainable housing, and enhance the company's reputation, both to attract investors and promote sustainable living.

To determine the feasibility of the project, three key indicators were considered: (i) renovation time, (ii) additional costs, and (iii) market demand. These indicators align with HABI's business model and focus on maximizing material reuse and implementing low-cost, high-impact adjustments related to water and energy consumption. The renovation decisions for each apartment were based on technical specifications for the materials and installations in each unit.

The pilot project of the Circular Housing Renovation initiative successfully met the same refurbishing times as conventional apartments while staying within budget. Additionally, these apartments are anticipated to have a higher turnover rate due to greater market interest in sustainable housing, lower costs from reduced water and energy consumption, and improved interest rates. However, the Colombian real estate market has experienced a slowdown due to uncertainty surrounding the recent election of the new government, leading to a 37% decrease in disbursements for used housing purchases in the third quarter of 2022 (DANE, 2022).

This decline in property turnover presents a risk to the business model and affects investors' confidence, which is why the Circular Housing Renovation project remains a pilot for now. Nevertheless, it is hoped that this initiative will be the first step towards HABI's new circular business model. Table 6 presents a comprehensive overview of the Circular Real State initiative.

Table 6
Circular economy indicators of circular Real-Estate

ESG Dimension	CE Categories	Indicators	Measures
Governance	General information	Size of economic units	Small
		Location of operation: urban and rural	Urban
		Years of operation	Recently created
		Sector	Industrial
		Productive activity within economic sector	Construction
	Circular model	Circular models included	Recourse use prevention (cleaner technology) Reuse and recycled of materials. Recycling of household waste streams Extension of lifetime
	Regulations and Incentives	Financial instruments	1% interest rate benefits
	Collaboration and alliances	Collaborations between companies, public institutions and/or universities	HABI Banco de Bogotá Green Factory Contractors
Environment	Environmental management	Number of sustainability related certifications	12 apartments
		Water and Energy consumption reduction	20%
		Reduced CO ₂ emissions	398.4 kg of CO ₂ /year per apartment
		Materials reused and recycled	80%
Social	Education of circular use of public services	Number of families educated	12

Source: Authors.

Risk assessment

The circular business model faces financial risks associated with the real-estate market. Economic inflation in Colombia has led to a decrease in demand for real-estate, resulting in an average decrease of -0.6% in housing prices in 2022 and an increase in interest rates, as reported by real estate studies (Global Property Guide, 2022). Physical risks involved in the circular real-estate favor its development, as tariffs of energy supply, and public services for water supply and waste collection, tend to rise in the coming future.

Risk mitigation characteristics consider the capacities of the entrepreneurs and widely available technology, reducing the risk profile of the initiative: The use of existing technology has opened the path to improve resource efficiency even in aged properties that initially did not fulfill the current construction sustainable schemes. Likewise, managers solid experience in financing schemes, sustainable construction certifications, and refurbishing process is an asset for the initiative potential scalability. The used property market manages different financing mechanisms and benefits, and the market has been adopting sustainable certification construction systems. The initiatives' potential is encouraged through the adaptation of existing mechanisms to its own business model.

2. Case 2: Eco-fertilizer (Guamal, Meta, Colombia)

General characteristics

Eco-fertilizer business model uses organic residues such as cacao crops, plantain stems, cow manure and microorganisms to produce quality organic fertilizers. This reduces the use of chemical fertilizers, manages biomass waste effectively and offers a cost-effective alternative for supplying nutrients to agricultural crops. The model was launched in 2018 by Larry Smith, owner of a 10-hectare cacao farm in Guamal, Meta, Colombia.

The circular business model employs vermiculture technology to convert organic residues into certified liquid and solid fertilizers. 20% of the fertilizer is used on the cocoa farm, while the remaining 80% is sold to other farms in the area. The target market is small and medium-sized producers interested in improving soil structure, texture, and nutrient-holding capacity. Clients typically purchase the fertilizer directly from the vermiculture plant or through a partnership with Biocampo, a leading supplier of agricultural bioproducts in the region.

The total investment in the eco-fertilizer initiative, including infrastructure upgrades, operational costs for the vermiculture process, and the hiring of three full-time employees and two part-time experts for product quality and process oversight, amounted to USD 34,000. The production capacity is 60,000 liters per year of liquid fertilizer. Of the annual production, 20%, or 10,000 liters, is used on Larry's cacao farm, resulting in a 45% annual savings on chemical fertilizer costs, which amounts to USD 6,000. Eco-fertilizer sells an average of 50,000 liters per year, generating potential extra income of USD 180,000.

The circular initiative provides local producers with access to high-quality and affordable fertilizer. Eco-fertilizer has a complete mineral profile and is priced at approximately 3.8 USD per liter less than comparable chemical fertilizers. The use of liquid organic fertilizer, combined with proper technical support, increases crop yields by 30% compared to chemical fertilizers. Additionally, using organic fertilizer provides long-term benefits such as improved soil health, reduced risk of pests and diseases, soil erosion, surface and groundwater contamination, and biodiversity loss.

Eco-fertilizer combines several circular innovation models, including: (i) recycling of biomass residues into a nutrient-rich material for agricultural crops, (ii) preventing soil degradation caused by the extensive use of chemical fertilizers in agriculture, and (iii) preventing water contamination and pest propagation due to poor management of biomass residues. The main environmental benefit of eco-fertilizer is a reduction of approximately 2.3 tons of CO₂ per year for 10 hectares of cacao crops, representing a 48% decrease in emissions per hectare. This initiative also provides socio-economic benefits for small-scale farmers, including maintaining productivity using effective organic fertilizers and a product less likely to be affected by inflation dynamics in local and global markets.

The financing of the circular initiative, Ecofertilizer, was entirely dependent on the internal budget of the cacao farm. Some of the infrastructure construction and roofing for the composting installations was already available on the farm, while other infrastructure adjustments and the acquisition of compost technology were funded through the cacao farm's cash flow, including savings from reduced fertilizer expenses. Image 2 shows the eco-fertilizer business model.

Image 2
CANVAS model of Eco-fertilizer

Suppliers	Key activity	Value proposition	Relations	Clients
<ul style="list-style-type: none">• Cacao farm (internal supply)• Certified dairy farms not using penicillin)• Nutrient complement supplies• Packaging• Vermiculture technology	<ul style="list-style-type: none">• Reception and preparation of biomass residuals• Quality control of liquid fertilizers• Distribution to regional stores	Certified organic liquid fertilizer for productivity assurance in agriculture	Colombian Agricultural Institute (ICA) for certification	Internal use in the cacao farm + agro producers in the region (pasture, cacao, rice, orange and lemon)
	Key resource <ul style="list-style-type: none">• Vermiculture technology• Homogeneous material flows• Quality control		Channels Direct sales in the production plant + regional agro-supplies stores	
Cost structure <ul style="list-style-type: none">• Investment in vermiculture infrastructure• Opportunity cost of reconversion from traditional chemical based fertilization technology to organic technology• Supplies (packaging and nutrient complements)			Finance source <ul style="list-style-type: none">• Owner resources• Farm income	

Source: Authors.

Scaling perspective

The scalability of the eco-fertilizer business model depends on local demand for liquid organic fertilizer and its expansion to regions and crops with similar characteristics. Other factors contributing to scalability include organizational capacity, shared value strategies, and tangible benefits for stakeholders.

- Organizational capacity

Larry Smith's farm counted with both administrative and technical capacity to advance the Ecofertilizer initiative. Eight years after acquiring the cacao farm, Larry Smith,²⁰ farmer and owner of Eco-fertilizers, noticed that costs exceeded sales and that he needed to find a more cost-effective solution to maintain production yields. He reached out to Nancy Acosta, an agronomic engineer with over 15 years of experience in ecological soil management and a part-time professor at the regional University of Los Llanos. Nancy is also the founder of Biocampo, a leading supplier of agricultural bioproducts in the region. With her guidance, Larry started the Eco-fertilizer project. As a self-taught entrepreneur in cacao farming, he quickly realized that liquid fertilizer could help improve soil health and serve as a complementary source of income.

- Value chain collaboration

- Eco-fertilizer emerged in the Meta department, a region that over the past 50 years has relied on agriculture and oil exploitation as its primary productive activities. With its favorable climate and soil conditions, the region is conducive to growing a diverse range of crops and is a leading producer of agro-industrial crops such as palm oil, corn, soybean, and rice. However, many producers in the area, close to 80%, own less than five hectares and their production focuses on other crops such as oranges, lemons, plantains, cacao, and coffee grown in the mountain ranges bordering the region.
- The Meta department, including the Acacias municipality, is characterized by a local agriculture-based economy. For instance, each municipality in the region has expert technicians providing technical assistance to farmers and agricultural supply stores. Farmers have also organized themselves into associations based on their crops and interests. In Acacias, the municipality where Eco-fertilizer is located, there are four cacao associations that represent the interests of nearly 150 farmers who own 110 hectares of cacao crops.
- In the region, organic farming has become increasingly popular among medium and small progressive farmers, making up between 15% and 20% of total production in the region. This has created a thriving market for certified liquid organic fertilizers. Additionally, prices for traditional chemical fertilizers have risen by 40% in 2022, due to global market trends, making eco-fertilizer an appealing alternative for local producers seeking a cost-efficient source of nutrients for their crops.
- This circular initiative leverages its environment by sourcing local suppliers who are willing to sell biomass residues, such as cow manure and plantain stems, at low prices. This not only provides local farmers with additional income, but also helps manage biomass waste effectively. Quality control of the fertilizer is maintained by sourcing manure from farms that do not use penicillin for disease control in cattle, as the chemical impacts the worms in the vermiculture process. The cocoa pod husk is

²⁰ Larry is a retired businessman who in 2010 decided to switch to cacao farming. After a thirty-year career as a manager and CEO in the information technology industry, Larry, coming from a farming family in the US, purchased a 10-hectare farm in Acacias Meta with his American wife started his agribusiness together. With no prior experience, Larry and his wife chose to cultivate cacao, a promising crop grown by local farmers.

collected directly from Larry's farm, while high-quality mineral supplements are sourced from traditional agrochemical supply chains. The necessary infrastructure, such as storage barrels and construction materials, is readily available in the region, as is the technical knowledge of vermiculture technology.

- Facilitating mechanisms in the business context:
 - The quality criteria and registration of organic fertilizers are regulated by the Colombian Agricultural Institute (ICA in Spanish), an institute affiliated with the Ministry of Agriculture, through Resolution 00375. In 2017, the ICA published a guide on vermiculture production to spread knowledge on the technology and quality standards. Vermiculture production with a capacity of less than 20,000 tons per year does not require additional licensing.
 - Aside the specific national certification for bio-based fertilizer, the growing global market for organic agri-food products includes a wide range of existing certification schemes for agri-food products such as the EU organic, the German Bio-Siegel and Naturland, the French AB mark, Soil Association (UK), and Bio Suisse (Switzerland) (Germany). Examples of these labels are Demeter, focused on biodynamic agriculture, and Regenerative Organic Certified. These trends in the global food market favor businesses like Eco-fertilizer by stimulating the market demand for certified organic fertilizer.
 - Alongside existing norms and certification schemes, the Acacias region also has technical assistance programs for agriculture, offering training, technical assistance, and dissemination of best agriculture practices among associations of farmers. These programs, as part of compensation strategies impulse by oil company Eco-petrol, represent an incentive for producers and companies such as Eco-fertilizer to enhance their knowledge on production and administrative capacities, to strengthen governance of associations and value chain relationships, and to measure and document practices, facilitating dissemination.

Circular Economy indicators

Optimized cacao production systems require a yearly application of approximately two tons of organic material for improving soil structure, texture, and nutrient holding capacity (in comparison to 1.1 ton per hectare chemical fertilizer in traditional not organic crops). Another significant resource for cacao production is water (52 m³ per hectare/year),²¹ which is mainly consumed in the irrigation process during production and in the post-harvest when the cacao beans are washed as part of the fermentation process. For each kilogram of cacao beans, 7.4 kg of biomass residues are produced. These byproducts include the cocoa pod husk (6.7 kilogram), mucilage (0.4 kilogram), and placenta (0.3 kilogram). After the fermentation process, every kilogram of dry cacao beans contains 0.12 kilograms of shell.

Circularity indicators of Eco-Fertilizer focuses mainly on biomass reuse and productivity. For instance, the Eco-fertilizer initiative optimizes biomass residual by 1.2 tons per hectare, representing 42% of composting material (which requires complementary materials such as manure, among others). On the other hand, vermiculture reduces costs by replacing the use of chemical fertilizers and represents an additional income of sales of Eco-fertilizer. The biomass-based fertilizer also adds value by potentially incrementing yields by 30%. Other relevant resource flow indicators include a reduction of CO₂ emissions by 48% compared to traditional crop production practices.

²¹ The indicators show the reduction of impacts. The 52 m³ per hectare/year means the water use and not the water reduction. Ecofertilizer doesn't impact reduction of water-use and therefore water reduction isn't included as a circular economy indicator.

Eco-fertilizer circularity model encompasses biomass reuse, regeneration of soil and prevention of agrochemical use by providing a fertilization solution manufactured under a national quality assurance certification granted by the Colombian Agricultural Institute (ICA in Spanish). The operation also involves the collaboration between a diverse group of stakeholders. Local farmers play a dual role both as potential customers and suppliers: they are the end users of Eco-fertilizer and provide the diverse biomass required for the manufacturing process (from cacao and other related crops like plantain). A network of agricultural professionals, technicians and agricultural supply stores (e.g. Nancy Acosta's Biocampo) proves to be an effective retail channel that actively increases sales and boost product development by providing in-situ technical support to new and current customers.

Eco-Fertilizer optimizes resource flows in the cacao agri-food chain by re-using biomass, preventing use of agrochemicals and regenerating ecosystems by improving soil quality (physical, biological, and chemical properties). Circularity indicators quantify CO₂ reductions of 2.3 ton/hectare/year for 10 has, economic benefits resulting from costs savings and yield increases of 2,200 USD/hectare/year, and additional income from the commercialization of certified fertilizer surplus of 180,000 USD/year. Investments include costs involved in reconversion of traditional production techniques based on agrochemicals, towards organic farming, and investments in infrastructure and technology for vermiculture. Table 7 presents a comprehensive overview of the circular economy indicators of Eco-fertilizer initiative.

Table 7
Circular Economy Indicators of Eco-fertilizer

ESG Dimension	CE Categories	Indicators	Measurement
Governance	Circular model	Innovation models for circularity (Circular supply, Recovery of resources, Extension of product life, Sharing products or resources, Product systems as a service)	(3) Biomass reuse + regeneration of soil + prevention of agrochemical use
		Circular business Project cost-benefit ratio	6.8
	Regulations and Incentives	Local quality assurance certifications for biofertilizers	1
	Collaboration and alliances	Incentives through retail margin	30%
Environment	Resource flow	Prevention of agrochemical use	1.1 Ton / Ha / year
		Reduced CO ₂ emissions	2.3 kg of CO ₂ /year
	Circularity gap	Materials reused and recycled (biomass residues from cocoa production)	42%

Source: Authors.

Risk assessment

The financial risks associated with the circular business model of Eco-Fertilizer are typical for small-scale farming, such as market volatility of agro-products, climate-related risks, and quality control in operations, especially ensuring the consistency of biomass supplies without harmful agrochemicals or penicillin. The prices of cacao for small-scale farmers have fluctuated between 1.43 and 2.13 USD/kg of dry beans (45%) in the period from 2020 to 2022. Physical risks include climate change risks affecting productivity of biomass in the cacao-crop, as main raw material for producing Ecofertilizer.

The risk mitigation strategies for the successful business model of Eco-fertilizer include marketing towards the growing organic farming trend, which requires bio-based fertilizers. Hiring and training vermiculture facility operators, as well as the owner's solid business experience and the availability of abundant supplies and potential clients in the Meta region, are additional factors that favor the circular business model of Eco-fertilizer. Furthermore, the increasing prices in the market for chemical fertilizers (a 40% price increase in 2022) further bolster its viability.

3. Case 3: Sewage for copper Mining (Sonora, Mexico)

General characteristics

Sewage for copper mining is a circular initiative of Grupo México Corporation. Sewage for mining initiative, started more than 10 years ago in the metallurgical refining plant is in San Luis de Potosi Mexico and also applies to the copper mine operation of Buenavista copper mine, located part of the in Sonora, in northern Mexico.

Buenavista copper mine is part of Grupo Mexico, a large Mexican corporation with operations in mining, transport, and infrastructure. The corporation operates copper mines in Mexico, Peru, and Spain, and is classified as the fourth copper producer worldwide. Since 1966 the company is listed in the Mexican stock exchange, counting with 49% public traded shareholders. The corporate vision highlights commitment with the sustainable development goals and climate change, generating shared value with communities in areas in influence of operations, continuous improvement of resource use and environmental performance, and operation with transparency. Long term, preventive approach, and continuous improvement guide operationalization of these ESG dimensions. Since 2017, Grupo de Mexico is listed in the Dow Jones Sustainability Index and makes part of FTSE4Good Index for sustainable finance.

The sewage for copper mining initiative, starting operation in 2019, reflects the sustainability strategy of the company by improving resource efficiency, including prevention of water extraction and savings of resources used in sewage treatment. Moreover, this circularity initiative, generates shared value for the Cananea community by taking care of municipality sewage treatment, and contributes to productivity by assuring water availability critical for the concentration process.

The implementation of the circularity initiative involves the design and construction of an infrastructure that connects the municipality sewage system, to the concentration facility in the Buenavista mine. Additionally, technology innovation includes adjustment of concentration process parameters for the use of sewage as process water, adjustments technology of concentration process, and operational update of the sewage and pumping systems, as well as update of environmental licensing. Development of the project involves agreements with community for use of municipality sewage, and environmental licensing for the infrastructure and adjustments to the concentration process infrastructure, including sewage treatment facilities.

The financing of the circularity initiative sewage for copper mining was entirely sourced from the internal budget of the corporate organization Buenavista Copper Mine. The allocation of funds was justified as a social responsibility investment with an estimated return on investment of 15 years. Image 3 summarizes the business model of the sewage for copper mining initiative.

Image 3
CANVAS model of Sewage for copper mining

<div>Suppliers</div> <ul style="list-style-type: none">Engineering services for installation and maintenance of water-reuse systemEngineering services	<div>Key activity</div> <ul style="list-style-type: none">Pumping municipality sewageQuality control of concentration <div>Key resource</div> <ul style="list-style-type: none">Infrastructure for municipality sewage reuseLicensing for operating sewage reuseControl of concentration process	<div>Value proposition</div> <div>Availability of critical water resources and community shared value</div>	<div>Relations</div> <div>Municipality of Canacea Semarnat, Conagua</div> <div>Channels</div> <div>Direct contact through corporate department of Grupo de Mexico</div>	<div>Clients</div> <div>Canacea municipality, Buenavistamining operation</div>
<div>Cost structure</div> <ul style="list-style-type: none">Investment of infrastructure for municipality sewage reuseOperation of sewage reuse systemPayment for sewage water concessionInvestment in concentration process adjustments and control			<div>Finance source</div> <ul style="list-style-type: none">Corporate resources	

Source: Authors.

Scaling perspective

The scaling of the circular initiative for reusing municipality sewage in copper mining has high potential. Currently, 77% of the water used in the copper extraction process is reused, while 23% requires freshwater extraction. The goal to design a project is to reach 85% water reuse, which represents over 30 times the current initiative at the Buenavista mine. In 2024, the mine aims to include 19,000 m³ of sewage from the Agua Prieta municipality (30% of current freshwater extraction for the leaching process), a city of 80,000 inhabitants, into the leaching process. This requires an investment of around USD 100 million, in 95 km of pipelines and pumping stations.

Additional scaling includes reuse of sewages of neighboring municipalities of Naco (Mexico), and Douglas (port of entry US), together counting for 7,000 inhabitants, providing 70 thousand m³ of sewage per year to the copper mine. Scaling of pilot contributes to replace freshwater extraction required for expansion of resource uses when increasing copper extraction capacity of the Buenavista mine.

The circular use of sewage in copper mining presents scaling perspectives beyond the Buenavista copper mine. Similar initiatives are under development in mines of Grupo de Mexico in Peru. Moreover, the whole mining industry in Latin America represents the scaling potential of this circularity practice.

- Organizational capacity:
 - The initiative to use municipality sewage as process water in copper mining was proposed by the water management department of Grupo de Mexico corporation. This department has extensive experience in optimizing water usage and exploring diverse water sources for the company's mining operations. The corporate office of environmental affairs was involved to ensure proper environmental licensing and compliance with environmental standards during infrastructure construction. The construction and engineering division of Grupo de Mexico was responsible for the design and supervision of the infrastructure, while the operational departments and senior management of the Buenavista mining operation oversaw process adjustments.
 - The pilot for municipality sewage reuse, counted with support and approval of corporate directives of Grupo de Mexico. The scaling of the initiative including sewage from the Municipality of Agua Prieta, is in a mature project design stage, for directive approval.
- Value chain collaboration:
 - The main collaboration in the sewage for mining initiative's value chain is between the Cananea municipality's office and the mining operation, with the municipality granting the mining operation the right to use its wastewater in exchange for a fee.
 - The collaboration between the Cananea municipality and the Buenavista mine is based on a long-standing relationship that dates back to the 18th century. The town of Cananea is a mining village where a large portion of the population either works at the mine or provides services to it. The agreement to reuse the municipality's sewage takes advantage of the existing social ties between representatives of the municipality and employees of the Buenavista mine.
 - The value chain of the sewage for mining initiative also involves collaboration with local firms for the construction of the required infrastructure, such as pipelines and pumping stations. Project design was executed by the construction and engineering department within Grupo Mexico, while the construction was subcontracted to local firms in accordance with Grupo Mexico's policy of promoting local hiring.
- Facilitating mechanisms in the business context

- Facilitating mechanisms include required licensing for operation the municipality sewage reuse, including environmental licensing for the construction of the infrastructure such as the pipelines and pumping stations. These types of licensing are filed for by environmental authorities representing the national environmental authority, supervising all mining operations in Mexico. Complementary licensing involves the water concession to be approved by the national water authority. Both licensing's require technical studies measuring environmental impacts and water quality, and periodically reporting of water quality parameter as part of operation of the sewage reuse system. Scaling of the sewage for copper mining initiative requires renewal of licensing procedures. Future scaling of this type of swage for mining initiatives align with national policy developments on circular economy strategies, currently under development by Mexican government.

Table 8
Circular Economy Indicators of sewage for copper mining

ESG Dimension	CE Categories	Indicators	Measurements
Governance	General information	Size of economic units	Multinational
		Location of operation: urban and rural.	Rural
		Years of operation	Consolidated
		Sector:	Mining
		Productive activity within economic sector	Copper mining
	Circular model	Circular models included	Closure of water cycles Efficient use of resources
	Collaboration and alliances	Collaborations between companies, public institutions and/or universities	Municipality of Cananea
Environment	Transparent communication	Communication mechanisms with benefitting communities in place	3
	Environmental management	Environmental impact analysis	Yes
		Water reuse	7,200,000 m ³ / year (equivalent to use of 12,600 families)
Social	Circularity gap	79% (77% internal reuse + 2 use of municipality sewage)	Water
	Contribution to support public services	Number of households' beneficiaries of public services of sewage treatment	8,000
		Financial contribution to public service	Between USD 1 million – USD 1,5 million

Source: Authors.

Circular Economy indicators

Circular economy indicators of sewage for copper mining initiative present promising accumulated contributions to resource efficiency and effectiveness. Circular sewage reuse sums 7,2 million m³ per year, equivalent to the annual use of about 12,600 families and 30% of the total process water used by the Buenavista copper mine. Moreover, the initiative reduces sewage treatment cost of the municipality (8,000 families) and generates additional income though of royalties paid to the municipality office.

Implementation of the pilot project sums 1,500,000 USD, for construction of the infrastructure. Additional costs include payment of yearly royalties and operation costs of the sewage reuse system. Most important, the initiative assures water availability, as a critical resource for copper mining.

Social indicators include number of beneficiaries of free public services for sewage treatment and investment in in sewage public sewage treatment systems. Moreover, communication mechanisms in place on advances and development of the initiative indicate transparent corporate governance practices.

Risk Assessment

The main financial risks in the circular business model of using municipality sewage for copper mining include obtaining a social license to operate and increasing the production capacity of the Buenavista Copper Mine, which depends on having a secure supply of water, a critical resource. The Sonora region is particularly prone to water scarcity, making water availability a significant concern. The reuse of municipality sewage in the copper extraction process contributes to the mine's social license to operate by mitigating water scarcity concerns.

Additional risks include obtention of licensing's for operating and scaling the initiative. The bureaucratic process for licensing expedition might be time consuming pending on the institutional capacity of the public authority offices involved. No mayor operational risks are involved due to the proven technical viability to reuse sewage in the concentration process in copper mining.

Risk mitigation strategies involve permanent relationship management and transparent communication with the communities located in the area of influence of the Buenavista copper mine, including environmental and water authorities.

4. Case 4: HARMAN's circular supply (Queretaro-Mexico)

General characteristics

The initiative furthered HARMAN's circular supply engagement of local suppliers in the circular economy initiatives contributing to energy reduction projects and waste minimization targets. The innovation process of this initiative includes capacity building process of suppliers in the formulation and development of circularity projects aiming at efficient use of resources, closure of material cycles, and industrial symbiosis. Since 2021, Harman's manufacturing plant in Queretaro has involved 12 local suppliers formulating 10 initiatives contributing to corporate goals in waste reduction of 152.6 metric tons/year and 847,791 kWh in annual energy savings.

HARMAN International is a subsidiary of the global Korean corporation of Samsung Electronics. The company designs, and engineers connected car systems, audio and visual products, enterprise automation solutions, and services supporting the Internet of Things (HARMAN, 2021). HARMAN International is a global leader in car technology, supplying electronic systems to over 50 million cars. The global corporate sustainability vision of the multinational, reaffirms commitment to sustainability, based on three pillars: people, communities, and the environment. By placing social and environmental responsibility at the heart of its strategy, HARMAN has declared its commitment to ensure a responsible, sustainable, and equitable growth.

HARMAN is taking systematic action to measure and monitor impacts across all dimensions of Environment Social and Governance (ESG). Understanding climate change is one of the most critical challenges of our time, HARMAN leadership has made a concerted effort to integrate climate priorities into strategic decision-making. The decarbonization roadmap proposed by the multinational focuses first on improvements in operational efficiency, including waste reduction initiatives and increasing procurement of renewable electricity. The company has taken actions to drive impact throughout their business, from redesigning products to reduce environmental impact, to support local communities through strategic partnerships.

Corporate materiality shows in energy use and waste production, counting with corporate goals of 40% reduction of greenhouse gasses in the whole value chain up to 2025, by changing energy sources

and improving energy efficiency (15%). Waste reduction targets include 90% in 2022. To meet these targets, Harman advances circularity initiatives in its own operations and involves suppliers' part of the value chain, to contribute to reduction targets through circularity initiatives as a collaborative commitment. To advance sustainable supply for circularity, Harman's facility in Queretaro, joined in 2021 the Circular Economy System Queretaro (CESQ), a public-private program led by Queretaro's Sustainable Development Secretary (SEDESU) and the Automotive Cluster, to promote circular economy capacity and initiatives in a critical mass of firms, public institutions, and universities in Queretaro state. Harman participates in this program as one of the pioneering anchor companies.

As SEDESU provides financing for the operational mechanisms of capacity building and project formulation for the firms participating in Harman's circular supply initiative, the financing for the first pilot of this initiative fits the characteristics of blended finance.

The circular business model of sustainable supply initiative of Harman is presented in image 4.

Image 4
CANVAS model of Harman's Sustainable Supply initiative

Supplier	Key activity	Value proposition	Relation	Client
<ul style="list-style-type: none">Services provides of CESQ such as local universities and consultantsSuppliers of technologies required for CE projects formulated by suppliers	<ul style="list-style-type: none">Accompany circular economy project formulationDevelopment of symbiotic resource efficiency projects	Supplier firms contributing to resource efficiency and climate change reduction in the electronics value chain	Secretary of Sustainable Development of Queretaro State (SEDESU)	Firms part of the supply chain of Harman Electronics with operations in Queretaro State
	Key resource <ul style="list-style-type: none">Information on critical resources flowsCapacity on circular economy project formulationTrust for collaboration and symbiosis with supplier firms		Channel Direct contact through supply chain department of Harman	
Cost structure <ul style="list-style-type: none">Time of professionals dedicated to the CESQInvestment in project implementation			Finance source <ul style="list-style-type: none">Owner resourcesPublic funds	

Source: Authors.

Scaling perspective

The scaling perspective of Harman's circular sustainable supply initiative encompasses several scopes. The first scope involves the expansion of the initiative among local suppliers in the Queretaro State, numbering between 150 to 200 firms, mostly classified as SMEs. The second scope involves suppliers within the HARMAN value chain in Mexico, which totals 3,000. The third scope encompasses the global corporate organization of HARMAN, with operations in the USA, India, Japan, China, Brazil, and Hungary, and includes over 15,000 suppliers globally (including first, second, and third-tier suppliers). Extrapolating the impact of the first pilot group of suppliers participating in the circular supply chain initiative, an estimated 20,000 metric tons of waste reduction per year and 530,000 kWh in annual energy savings could be achieved if 50% of all global suppliers participated in the circular supply initiative. Scalability of Harman's circular supply initiative depends on managerial commitment, organizational capacity, shared value strategies, and tangible benefits for all stakeholders.

- Organizational capacity:

The initiative of HARMAN's circular supply, started as a pilot initiative of the department of sustainability by signing up as an anchor company to participate in the Circular Economy System Queretaro. The commitment involved the identification and follow-up to a group of suppliers with operations in Queretaro State to participate in capacity building and in the design of circular initiatives. The commitment fitted within the scope of the sustainability department.

Once under development, a team of managers of diverse departments of the Queretaro manufacturing plant such as maintenance, EHS, and supply connected to the initiative. This led to a change in leadership from the manager of the sustainability department in the first phase of the circular supply pilot, as part of the Circular Economy System Queretaro, to leadership of the maintenance department, in the second phase of the pilot. The supply department supported identification of participating supply firms in both phases of the pilot.

So far, HARMAN's circular supply initiative is still in its pilot development, and hasn't scaled yet within the corporate structure. Only for the sustainability report 2023, the circular supply initiative will be included as a show case. Dissemination of the initiative toward a national level, and or to the global scope of HARMAN corporation hasn't occurred. Continuous participation in the Queretaro's Circular Economy System and dissemination of accumulated results of the pilot, are key mechanisms for scaling managerial commitment.

- Value chain collaboration:

Harman's circular supply initiative, as part of the Circular Economy System Queretaro (CESQ), is based on collaboration among supply chain partners withstanding commercial relationships. Harman as an anchor company, and important client, invites suppliers to participate in a collective capacity building program offered by the CESQ. The capacity program includes workshops in which companies are encouraged to exchange information and formulate collaborative circularity projects. Collaborative activity among suppliers and Harman, shows in exchange of information and experiences among firms, generating trust for collaboration among representatives of firms, and in some of the cases, formulation of symbiotic circularity projects where waste flows of one firm is used by another firm as raw materials, or projects where collaborative planning of transformation processes, result of resource efficiency and effectiveness.

In the period from March 2021 till September 2022, Harman advanced two circular supply groups with a total of 17 suppliers, among suppliers of raw materials, packaging and services such as waste collection, engineering, protection and health services, logistics. The suppliers formulated 17 circularity projects of which 5 included symbiotic activities among two or more suppliers. 4 manufacturing plants of Harman's operations in Queretaro, also formulated project to optimize resource efficiency in their plants such as installation of solar panels, energy savings, water reuse, and waste recycling. As part of the CESQ, follow-up of implementation of formulated projects is offered by the facilitation mechanisms.

Harman's circular supply initiative also involved collaboration with stakeholders such as the Automotive Cluster of Queretaro and the Secretary for Sustainable Development public office, who initiative and led the CESQ. Collaboration with these entities triggered Harman's circular supply initiative as one of the anchor firms signing in for participation in the CESQ.

- Facilitating mechanisms in the business context:

The Circular Economy System of Queretaro is a triple helix initiative designed to build capacity for circular economy practices in Queretaro State, Mexico. The initiative, started in September 2020 by the Secretary for Sustainable Development of the State (SEDESU), and the Automotive Cluster Queretaro, has scaled up in its first two years of operations towards a

network of organizations, including 150 companies' part of the automotive value chain, four regional universities, three public offices and five NGOs. Outcomes so far, include actions such as the design of 100 circular economy projects, the design of ten institutional mechanisms in innovation in regulation, incentives and circular economy information systems, and the training of 15 consultants as multipliers of capacity building mechanisms. Herman as a leading company in the region, started to cooperate in SECQ from its start in 2021.

Other facilitating mechanisms for the circular supply initiative include upcoming tax incentives related to: (i) CO₂ emissions, (ii) waste disposal and storage, and (iii) compensation tax for raw material extraction. These tax related regulations are grounded in the Mexican law for public income for the year 2023, and represent incentives for companies to reduce CO₂ emissions, waste generation and substitute raw material extraction and resource conservation.

Circular economy indicators

Circular economy indicators of Harman's circular supply initiative present promising accumulated contributions to resource efficiency and effectiveness. The 17 projects formulated by 17 suppliers and 4 manufacturing plants of Harman, accumulate reductions in waste generation of 30,000 tons/year, reduction of greenhouse gases resulting from energy savings and renewable energy installations accumulate 1.415ton CO₂ equivalents, and water reuse of 600m³. The foregoing savings consider that every circular economy project last about five years.

Implementation of the 17 projects sum 900,000 USD, and accumulated economic benefits sum net present value of 40 million USD. Returns on investments of the circularity projects vary from < than a year, toward > 10 years. Outcomes of follow-up activities for evaluation of implementation, evidenced implementation rates of 80% for the first group of seven suppliers who designed their initiatives during 2021. Table 9 summarizes CE indicators for Harman's case.

Table 9
Circular Economy Indicators of Harman's circular supply

ESG Dimension	CE Categories	Indicators	Measurements
Governance	General information	Size of economic units	Multinational
		Location of operation: urban and rural	Urban and rural
		Years of operation	Consolidated
		Sector	Industry
		Productive activity within economic sector	Automotive
	Circular model	Circular models included	Efficient use of resources Closure of material cycles
	Regulations and Incentives	Existence of mechanisms for (b) training programs	Yes
Environment	Environmental management	Collaborations between companies, public institutions and/or universities	Queretaro's Sustainable Development Secretariat (SEDESU)
		Environmental impact analysis	Yes
		Efficient logistics systems	Quantitative
		Energy savings	64 MWh/year
		Avoided polluting gas emissions	1.415 Ton CO ₂ eq/year
		Materials and waste	405 tons/year
		Water use	600 m ³ /year
Social	Circularity gap	Reuse waste	30,000 tons/year
	Value added	Value added to SME suppliers	40 million USD

Source: Authors.

Risk Assessment

Business risks of Harman's circular supply, show on diverse dimensions; In the first place, Harman's sustainable supply depends on the availability of the subsidy provided by public agency SEDESU, through circular economy training mechanisms offered through the CESQ. The training mechanisms assures training and circular project formulation of suppliers led by anchor companies, as the operational approach of Harman's circular supply initiative. Risk of continuity of the CESQ, and consequently Harman's circular supply initiative, depends on yearly renewable of SEDESU political choice.

Additional risk for scaling of Harman's circular supply initiative relates to evolvement of management commitment in Harman's regional and corporate administration. The circular supply initiative started off as a bottom-up local initiative of the sustainability manager of Harman's production plant located in Queretaro State. Along the development of the initiative, other departments such as maintenance, supply, operation, and general management on the Queretaro's production plants got involved. Scaling of the initiative within Harman's national and global corporation, depends on organizational capacity to communicate and scale commitment within the corporate organizational structure of Harman.

Another risk of Harman's circular supply initiative relates to the implementation of the circular economy projects formulated by suppliers and production plants of Harman. Implementations often require investments in new technology, adaptation of existing operational structure or development of new once. Availability of funding is a key driver for implementation of circularity. Physical risk relates to scarcity of resources such as water, energy and raw materials. Especially energy shortages such as gas and water scarcity are common in the Queretaro region.

Risk mitigation strategies for scaling Harman's circular supply connect to corporate managerial commitment to the initiative and assignment of strategic budget beyond the temporal subsidy of the CESQ by SEDESU. This commitment allows scaling to supplier on a national scope in Mexico and on a global scope, in other countries with operations of Harman. Complementary mitigation strategy proposes the development, through alliances with financial institutions, of funding for implementation of circular economy projects.

V. Recommendations for scaling circular economy (CE) initiatives in LAC

The scaling of circular economy initiatives in LAC requires the development of tools and strategies for understanding circular business models, availability of financial mechanisms, and management of associated financial risks. The case studies analyzed earlier provide insights into the application of the scaling perspective in different contexts. This chapter provides recommendations for scaling up of the CE, based on a comparative analysis of the four cases, aimed at advancing the tools and strategies needed for a successful transition to a circular economy.

A. Comparative analysis of cases

The foregoing chapter examines four critical sectors in Latin America: construction, agro-food, mining, and automotive. The first three sectors primarily have local or regional value chains and consume substantial amounts of locally sourced resources, whereas the automotive sector is part of a global value chain. The case descriptions in this chapter are structured systematically to analyze both scaling potential and business risks.

The comparative analysis of the four cases illustrates the diverse implementation of the CE transition, including start-ups, small enterprises, and large multinational corporations. These initiatives are recent and in their pilot phase of development, with the explicit goal of advancing the CE transition. The circularity mode of each case add value to traditional business models by creating alternative opportunities for market differentiation, cost reduction, and reputation enhancement. These business models contribute to resource efficiency and effectiveness, require investment in technology, facilitate new value chain alliances, and present economically viable solutions.

The financing mechanisms behind the initiation and early stages of the four circularity initiatives are varied. In the case of Ecofertilizer and sewage treatment for copper mining, the owners' resources were the primary source of funding, while in Circular Real Estate and Harman's circular supply initiative, complementary mechanisms such as green bonds to finance favorable loan interest rates and blended finance through public subsidies for capacity building and technical assistance were employed.

Scaling potential of the four cases is diverse. One scope considers the potential for growth within the same organizations. This potential is directly related to the business models and capacities of the leaders involved in the initiative. Generally, circular models within large corporate structures have a higher direct scaling potential compared to small enterprises and startups. Another scope of scaling potential is demonstrated in the possibility of spreading the circular models across the sector, leading to their adoption as standard practices.

All the cases within CE initiatives were supported by experienced leaders with both managerial and technical expertise. The managerial expertise includes an understanding of the market and the value added by the circular business model, the ability to establish new partnerships for creating new value chains, and problem-solving and adaptability skills required for pilot initiatives. The technical expertise encompasses knowledge of technological solutions and the development of metrics to communicate value.

All cases benefit from facilitating mechanisms that support their circular innovations. Normative requirements, such as tax incentives for energy savings, drive market developments (Circular Real-Estate). Other normative requirements offer legal security through licensing (Sewage for Copper Mining). In some cases, public instruments such as the CESQ provide explicit incentives such as training to pilot the initiative (Harman's Circular Supply), while the presence of quality standards (Ecofertilizer) or access to finance mechanisms such as green bonds (Circular Real-Estate) also provide benefits.

Circular economy indicators do not show uniform standards for evaluation. They focus on resource savings or replacements on a yearly basis and are expressed numerically, not necessarily relative to circularity metrics like those proposed by the Ellen MacArthur Foundation (Valls-Val et. al., 2022). Social and governance indicators, which are part of ESG schemes, are qualitative and underdeveloped, while financial indicators such return on investments and payback periods are not yet included in CE indicator frameworks in the documentation of the cases.

Risk assessment of cases, show how sector specific risks are considered main business risks for CE scaling up potential. Especially the cases of the small firms such as, circular real-estate and Ecofertilizer, market volatility is the mayor risk for scaling of CE initiatives. Other risks consider continuity of public policy (Harman's circular supply), and legitimacy (Sewage for copper mining). Risk mitigation strategies for scaling up CE potential through finance, involve top management commitment within the organizations leading the initiatives, and communication of showcases of profitable circularity solutions, for converting pilot initiatives, into established and recognized practices. Table 10 summarizes comparative analysis of the cases on the four dimensions of analysis.

Table 10
Comparative analysis of circular economy cases and their scaling potential

Dimension/ Case	Circular real estate	Eco-fertilizer	Harman's circular supply	Sewage for copper mining
General characteristics	<ul style="list-style-type: none"> • Start up • New circular business model • Alliance among three business partners • Recent initiative (< 3 years) • Finance through green bond and owners' budget • Value: market differentiation 	<ul style="list-style-type: none"> • Small firm • Improvement of existing operation • Additional value-added product of existing business • Recent initiative (< 3 years) • Finance with own resources • Value: Cost reduction + additional income 	<ul style="list-style-type: none"> • Large global corporation • Public private partnership • Innovation of existing supply strategy • Recent initiative (< 3 years) • Finance through public subsidy (blended finance) • Value: stakeholder management 	<ul style="list-style-type: none"> • Large global corporation • Public private partnership • Diversification of water supply • Recent initiative (< 3 years) • Finance with own resources • Value: Social license + cost reduction
Scaling up potential	<ul style="list-style-type: none"> • Experienced business partners • Value added in existing traditional market • Financial instruments critical for scaling • Favoring facilitating mechanisms (regulation + finance) 	<ul style="list-style-type: none"> • Experienced business owner • Existing market • Favoring conditions (high prices chemical fertilizers) • Financial instruments critical for scaling • Favoring facilitating mechanisms (quality standards) 	<ul style="list-style-type: none"> • Managers on plant level • Large global corporation • Public private partnership • Innovation of existing supply strategy • Favoring facilitating mechanisms (training) 	<ul style="list-style-type: none"> • Managers on plant level • Large global corporation • Public private partnership • Innovation of existing supply strategy • Facilitating mechanisms (licensing)
Circular economy indicators	<ul style="list-style-type: none"> • Multiple resources (energy, water, waste) 	<ul style="list-style-type: none"> • Single resource (biomass) 	<ul style="list-style-type: none"> • Multiple resources (energy, water, waste) • Social impact (training) 	<ul style="list-style-type: none"> • Single resource (water) • Social impact (private support for public services)
Risk	<ul style="list-style-type: none"> • Risks related to traditional market dynamic of real state • Profitability of business model to be established 	<ul style="list-style-type: none"> • Risks related to traditional market dynamic of agro-business • Established profitability of business model 	<ul style="list-style-type: none"> • Risks related to continuity of public policy • Profitability of business model to be established 	<ul style="list-style-type: none"> • Risks related to traditional social legitimacy of mining activity • Established profitability and strategic importance of business model

Source: Authors.

B. Recommendations for scaling up CE initiative in LAC

Circular economy finance emerges as an opportunity embedded in broader societal needs expressed by the Sustainable Development Goals (SDGs), and global climate change agreements. In fact, CE is an innovation strategy for companies and entrepreneurs, to contribute to SDG and or climate change targets. Circularity initiatives cover a broad range of diverse and complementary innovation models, for optimizing resource efficiency, conserve natural capital and eliminate waste.

Scaling up circularity initiatives through finance offers opportunity to both the financial markets as for those organizations advancing high potential circular economy initiatives. For the financial markets the opportunity consists in developing new financial products and services, and to integrate circularity principals in existing mechanisms. For companies and entrepreneurs circular finance mechanisms facilitate scaling of profitable circular business models generating societal value.

Based on the case analysis, the following recommendations for public policy and sectorial effects for scaling up circular economy potential through finance are proposed:

- (i) Comprehensive analysis of CE initiatives: Circular economy is a broad strategy covering diverse innovation models and market configurations. Even when definitions, taxonomies, classification systems are under development, so far, a unified interpretation of circular

economy initiatives doesn't exist. The diverse circularity models share common principals, and consider diverse scales of analysis, used in the case documentation, covering organizational characteristics, value chain characteristics and business context characteristics. Diverse circular economy models are also embedded in business models, operating existing or diversified markets. Therefore, analysis of circularity initiatives includes risks related to traditional business model evaluation. Only considering multiple scales, and sectorial risks offer a comprehensive perspective for evaluation. The cases analyzed in this document provide a reference for comprehensive analysis of scaling potential of circular economy initiatives through finance.

- (ii) Connect complementary finance mechanisms: Circular economy initiatives might benefit from diverse financial mechanisms, such as debt instruments, green bonds, blended finance and equity funds. The traditional differentiated finance targets of these mechanisms apply the diversity of circularity initiatives. Startups like Circular real state might both benefit from equity funds, as source for investment capital, and from investments of green bonds as opportunity to offer value added financial products to finance circular real estate transactions. Initiatives such as Harman's circular supply, connect to mixed finance mechanisms where subsidies stimulate the pilot phase of the initiative. Cases such as Eco-fertilizer, provide an established proven low risk business opportunity for scaling finance in a specific sector, related to a specific circular technology.
- (iii) Develop standard tools for identification and evaluation: Circular economy scaling through finance lacks standard tools for identifying, evaluating and comparing scaling potential and risk assessment. Existing ESG certification systems, even when providing useful frameworks, don't offer classification systems for identification of circular economy initiatives, neither indicator useful for comparative analysis among circularity alternatives. Development of these tools, and the adaptation of standards, represents a priority for policies oriented towards development of financial mechanisms for scaling circular economy potential.
- (iv) Capacity building in both the financial sector and among business leaders: Circular economy is an emerging language which is disseminating among firms and institutions in Latin America and the Caribbean due to global trends and local public policy developments and entrepreneurial efforts. The four cases illustrated portrayed initiatives, led by experienced leaders with managerial and technical capacities for circular economy knowledge. Scaling circular economy through finance, requires personnel of financial institutions, and professionals of firms, share a common language, develop capacities for resource accounting, tools for categorization, evaluation, and comprehensive risk assessment.
- (v) Collaborative sectoral approach: Scaling circular economy opportunity through finance requires a collective approach among public and private institutions involved in the financial sector, and circular economy policy developments, such as illustrated in the cases analysis. The transformative and comprehensive implications of circular economy, require acquisition of new capacities, beyond traditional logic of linear production and consumption and finance opportunities of these systems. Development of new standards and tools, benefit from collaborative efforts, aiming at legitimacy and recognition of a common vision and language. Stakeholders for collaboration include, associations of financial institutions, multilateral development banks, financial control agencies, banks, financial consultancies, universities, among others.

VI. Conclusions

Circular economy is an emerging label that aims to transform current production and consumption systems into a circular use of resources, promoting innovative business models. The implementation and scaling up of CE initiatives require a significant transformation in organizational operations and strategies. The scope of circular economy encompasses complex decision-making regarding investments in new technology, partnerships, and business models, considering organizational capacities, value chain collaboration, and market potential. This decision-making process typically follows management and business considerations and involves the use of financial instruments and indicators to evaluate the risk and added value of each circular economy model.

The diversity of circular innovation models and their varied emergence patterns are exemplified by the circular economy cases discussed in this study. The initiatives take various approaches to achieve circularity, such as efficient technology use for public services, reuse of biomass as fertilizer, reuse of sewage, and efficiency improvements and material reuse resulting from sustainable supply and/or industrial symbiosis among firms. The document also illustrates how circular economy initiatives can emerge in various ways. The cases discussed identified initiatives that resulted from new entrepreneurial activity, improvement of existing operations and the need to reduce costs, the need for a license to operate and to reduce physical risks of resource scarcity, and the utilization of public policy instruments, such as the CE system in Queretaro.

The diversity of circular innovation models and their varied emergence patterns also results in distinct and gradual pathways for scaling up potential. Large corporations provide perspectives on how to convert pilot projects into corporate strategies with a significant potential impact on resource efficiency. The visibility of such firms exemplifies the institutionalization of circular practices within their industries. On the other hand, small-scale entrepreneurial initiatives showed that they require facilitation mechanisms, such as financial instruments or training and information dissemination mechanisms, to enable scalability.

The risks involved in scaling up circular initiatives are diverse and contingent upon the business type and sector, as well as its organizational capacity and the availability of facilitating mechanisms in the business context. However, circular economy initiatives often present favorable risk profiles, as they reduce risks related to the dependence on physical resources and strengthen business networks through collaborations.

Circular economy initiatives present attractive prospects for finance, and diverse mechanisms are available including debt instruments and existing sustainable and climate finance initiatives that are connected to the circular economy, offering scaling up opportunities. Enhanced standards and harmonized sector-specific circularity indicators are necessary for risk analysis and alignment with ESG frameworks. These sector-specific frameworks for scaling circular economy potential in LAC recognize the value chains of agro-food systems, construction, and mining as the most significant economic sectors in the region. Only a few industries, such as the automotive industry in Mexico, have significant participation in global value chains.

The proposed approach integrates multiple dimensions and scales in the analysis of circular business model opportunities and financial risks. The indicator framework encompasses resource impacts, scaling potential, and business risk considerations and is applied to four case studies in the construction, agro-food, automotive, and mining value chains. The public policy implications suggest a path for scaling circular economy initiatives through financial mechanisms as part of the transition of productive sectors in LAC.

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Annex

Table A1
Questions guiding qualitative risk analysis for scaling circular economy opportunities

Level of analysis	Questions for analysis
Firm organization (micro)	<ul style="list-style-type: none"> - What resources are effected by the initiative? - What innovation is proposed? - What value chain stakeholders are involved in the development of the initiative? - What is the value added of the circular initiative? - What is the predominant circular economy innovation model represented in the business model? - Which structural changes in the operation and organization will imply the adoption of the circularity practice? - Does the firm has previous experience with prevention oriented innovations? (cleaner production, industrial symbiosis, eco-design) What was the last innovation implemented in the firm? (date) - Who(m) are involved in the decision making on the implementation of the circularity initiative? - Who in the firm is responsible for the implementation of the circularity initiative? Who else is involved in the implementation?
Value chain (micro)	<ul style="list-style-type: none"> - How will the circularity initiative impact your current clients? What new clients will be attracted? What clients will refuse the circularity alternative? - Who will supply the resources (technology and training), required to implement the circular economy initiative? - How will the circularity initiative affect the current suppliers? Who will increase participation, who will reduce participation? - Which value chain actors are collaborating in the development and implementation of the circular economy initiative? - Who has implemented a similar circularity innovation? Who will be interested in copying the circularity initiative?
Business context (marco)	<ul style="list-style-type: none"> - Does the country the case is located in have a national policy on circular economy? Since when? - What specific regulatory mechanisms are in place, affecting goal setting for firms in the sector? Since when? - What specific incentives are available to stimulate circular economy advances for firms in the sector? Since when? - What programs in the business context are specifically relevant for the firm? In what manner? - Which standards (certifications or technical standards) apply to the circularity initiative?

Source: Authors.



This document analyses the possibility of scaling up the potential of the circular economy through financial instruments in Latin America and the Caribbean. It reviews progress in the circular economy in four business cases, selected based on priorities and representativeness for the Latin American and Caribbean region, and assesses the prospect of scaling them up using financial mechanisms and environmental, social and governance (ESG) schemes. The findings show that investment in circular economy business models has multiple benefits for companies, such as profitable operating margins and improved corporate reputation, thereby lowering the cost of debt and of financing circular economy projects. Various financial mechanisms are applied to scale up circular economy initiatives and circular economy indicators are aligned with broader ESG frameworks. To unlock the full potential of the circular economy in the region, new —and cheaper— financing alternatives should be considered. ESG funding has proven to be a reliable source of funding, even for circular economy projects, and has attracted the attention of investors the world over.