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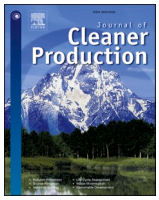

Business model development in the circular bioeconomy: A focus on the fashion-textile industry

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ABSTRACT

In recent years, exploring business models (BMs) within the circular bioeconomy (CBE) framework has gained increasing prominence in academic discussions, driving transformation across various industries. This research focuses on the textile-fashion (T-F) industry, a sector with significant environmental impact, to examine how innovative BMs can enhance sustainability. By aligning with circular economy (CE) principles - emphasizing resource efficiency, waste reduction, and sustainable development - and leveraging the pathways of CBE, pathways that prioritize renewable biological resources such as plants, animals, and microorganisms, the study explores the potential of green circular business models (GCBMs). Using a qualitative research approach, we review key studies on BMs to assess their alignment with the CBE vision and identify models suitable for implementation. Additionally, we propose and refine a conceptual managerial model through case study analysis within the T-F industry, offering actionable insights for industry stakeholders. This study contributes to BMs research highlighting a significant role for innovative BMs in driving sustainable practices, particularly through the adoption of green circular business models (GCBMs) that align with the green and circular principles. The findings underscore the role of CBE-aligned BMs in fostering competitive advantage, promoting responsible industry practices, and advancing global sustainability goals. This research provides a practical guide for managers and industry leaders seeking to embed circularity and sustainability into their strategies within the CBE framework.

1. Introduction

The circular economy (CE) is a central component of the 2022 European Green Deal, aimed at promoting sustainability throughout the entire product lifecycle. By focusing on sustainable consumption, the CE seeks to minimize resource use, extend the lifecycle of products, and transform waste into resources. In parallel, the bioeconomy emphasizes the sustainable use of renewable biological resources, integrating the principles of circularity with biotechnology advancements to create biobased products. The intersection of these two concepts, known as the circular bioeconomy (CBE), presents a significant opportunity to enhance sustainable development by combining waste reduction and resource efficiency with renewable biological materials. Despite the synergies between CE and bioeconomy, the literature lacks a unified approach that fully integrates these concepts. Carus and Dammer (2018) argue that while CE and CBE share similar goals, they remain distinct fields that have yet to be fully incorporated into each other. Therefore, CBE emerges as a promising framework that connects the circularity of CE with the innovative potential of the bioeconomy, providing a comprehensive approach to sustainable resource utilization. Business models (BMs) play a critical role in facilitating the transition to a CBE. Through business model innovation (BMI), companies can address economic, social, and environmental challenges, enhancing their competitiveness by creating new value through sustainable practices. However, the process of redesigning BMs into green business models (GBMs) is complex and resource-intensive. The growing literature offers some interesting insights into making the change towards GCBM happen, such as in terms of capabilities that enable a successful change or suggesting a roadmap towards circularity for incumbent firms (Santa-Maria et al., 2022; Guo et al., 2022). Despite the urgency and

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importance of transforming BMs into the T-F industry (see *e.g.*, Coscieme et al., 2022; Ellen Mac Arthur Foundation, 2023), the factors that make the adoption of GCBMs successful in practice in T-F companies are still largely unknown. The literature reveals a lack of consensus on the definitions of both "green business model" and "business model" which complicates their classification and assessment in terms of economic viability and environmental impact (Trapp and Kanbach, 2021). Moreover, according to Salvador et al. (2023), studies on archetypes for BMs for a CBE context are lacking. Therefore, there is a need for a deeper understanding of what and how CBMs can be practically applied in a CBE framework. This study was guided by the following research questions: *"What business models identified in the literature are suitable for advancing the goals of the Circular Bioeconomy (CBE) framework?"* and *"How can an innovative managerial model be effectively integrated into the textile and fashion industry to promote sustainability and align with circular economy principles"?*

This study aims to address these gaps by exploring the development of BMs within the context of a CBE. The research focuses on the T-F industry, a sector facing significant environmental challenges, to explore how CBE and GBMs can provide sustainable solutions. This study makes a valuable contribution to the research on BMs by emphasizing the critical role of innovative models in advancing sustainable practices. It particularly focuses on the potential of GCBMs to integrate CE principles such as improving resource efficiency, minimizing waste, and promoting sustainable development. The research highlights how businesses can adopt CBE-aligned models not only to gain a competitive edge but also to cultivate a more responsible industry that actively contributes to global sustainability efforts. By demonstrating practical applications, this study serves as a strategic resource for managers and industry leaders aiming to integrate circularity and sustainability into their BMs, especially within the CBE framework. The study also provides several important theoretical contributions. It addresses the ambiguity surrounding the definitions of "green business model" and "business model," offering a refined conceptualization that facilitates better classification and assessment of GBMs, particularly in terms of their economic viability and environmental impact.

A comprehensive review of relevant academic literature was conducted, from the Web of Science (WOS) according to our SLR PRISMA protocol (Mishra and Mishra, 2023). This approach ensured the consideration of only high-quality and pertinent evidence. Additionally, the study develops a theoretical framework that integrates BMI with the principles of the CBE, providing a structured approach for understanding how businesses, especially those facing significant environmental challenges, can transition towards sustainable models. Moreover, the study identifies key factors that enable the successful adoption of GCBMs in practice, enriching the theoretical understanding of the drivers and barriers involved in implementing these models in industries like the T-F. It also builds on existing research by proposing a more tailored roadmap for achieving circularity in the T-F industry, which could serve as a model for other industries pursuing similar transformations. In doing so, the research advances the theoretical understanding of how sustainability can be embedded into BM design, offering insights into the balancing of economic goals with environmental and social considerations. Furthermore, the study emphasizes the role of innovative management practices in advancing CE objectives, contributing to theories on leadership and change management within sustainable business transformation. These contributions deepen the understanding of how BMs can be designed and adapted to support sustainability and circularity, providing a foundation for both future research and practical implementation in industries aiming for a greener future. The paper is structured as follows: Section 2 provides an overview of the CBE context and emerging GBMs; Section 3 outlines the research framework and methodology; Section 4 presents the results of the analysis; Section 5 discusses the managerial tool (GCBMs); Section 6 addresses the managerial implications; Section 7 explores the political-industrial implications; Section 8 focuses the ethical and social implications and Section 9 concludes with limitations and recommendations for future research.

2. Literature and theoretical framework

2.1. Circular bioeconomy (CBE)

As part of the European Green Deal, the new Action Plan for the CE (COM/2020/98) and the European Industrial Strategy (COM/2021/350) are designed to accelerate industrial transformation towards ecological sustainability. These initiatives emphasize the shift from the current economic model to a CE, which is crucial for achieving the 2050 decarbonization goals. The Circularity Gap Report 2023 reveals that the global economy is only 7.2% circular, a figure that is declining due to increased material extraction and usage (Fraser et al., 2023). Transitioning to renewable energy sources, as proposed by the CE (Ellen Mac Arthur Foundation, 2023), offers a pathway to reducing reliance on fossil fuels and nuclear energy (Sovacool, 2016, 2021). This shift towards a regenerative growth model aims to restore more to the planet than what is extracted, reduce consumption footprints, and double the use of circular materials over the next decade. A self-regenerating production system is essential, where biological materials are returned to the biosphere, and other materials are designed for reuse and recycling, aiming to minimize waste production, ideally to zero. This model impacts various industries, from those at the start of the production chain (agriculture, forestry, fishing, wood, paper, chemical, and rubber-plastic industries) to those at the end (food, clothing, furniture, pharmaceuticals), including bioenergy, biofuels, and water cycle management. Closing the circle not only involves recycling and waste treatment but also valorizing production byproducts to maximize economic value (Haque et al., 2023). This includes developing zero-waste biorefineries, redesigning production systems, and implementing radical process and product innovations while considering the regeneration of key industrial crisis areas as recovery opportunities. The bioeconomy, which uses biological resources, including waste, to produce goods and energy, plays a critical role. It is closely linked to local territories and capable of creating integrated multidisciplinary supply chains (Wohlfahrt et al., 2019). Through a circular approach, it can return vital nutrients to the soil, making it a cornerstone of the sustainable transition. Studies on BMs within the bioeconomy, especially those incorporating biobased technology, are strategic yet limited in the literature (Bröring and Vanacker, 2022). Donner and de Vries (2021) argue that effective CBE models require radical organizational and technological innovations to efficiently utilize agricultural waste and byproducts. The CBE encompasses key areas such as transformation processes, raw materials, products, and industry. Promoting a CBE involves creating synergies among various policy domains-circular economy, climate, agriculture, energy, and industrial policy—and adopting integrative perspectives. This holistic approach is essential for fostering the CBE and achieving sustainable development goals.

2.2. Agro and biowaste in the textile-fashion industry

Agro and biowaste offer sustainable alternatives in the T-F industry, reducing reliance on non-renewable resources and minimizing waste and pollution. By integrating these materials, the industry can adopt more environmentally friendly practices. This can involve utilizing agro-waste for natural fiber production, extracting biobased dyes from vegetable and fruit peels, creating biobased fabrics from waste materials, developing sustainable packaging solutions, recycling production waste, and embracing CE initiatives. Implementing these practices requires collaboration among stakeholders and shifts in consumer behaviour to support sustainability. The textile industry, which produces yarn, fibers, fabrics, and apparel, significantly impacts the environment (You et al., 2009). Rethinking business strategies to align with CE principles is essential for the industry (Tura and Laukkanen, 2024). Governments, responsible organizations, and multinational

corporations are advocating for a shift from a linear to a CE model. The traditional linear model imposes disproportionate environmental and social burdens associated with energy and resource use (Ashton et al., 2022; Hickel and Slamersak, 2022), including challenges like energy poverty. The CE offers new avenues for technical, social, and organizational innovations (Leipold and Petit-Boix, 2018). To reduce environmental impacts and foster a sustainable fashion business, the industry is transforming consumption patterns (Niinimäki and Hassi, 2011; Pandit et al., 2020a,b). Recent initiatives include recycling unsold products, upcycling existing stocks, and exploring alternative materials. Over the past decade, the industry has increasingly adopted eco-friendly practices throughout the apparel manufacturing process, from raw material selection to the final product. Worldwide efforts are enhancing awareness of natural waste resource utilization and promoting the consumption of eco-friendly products (Jose et al., 2020). Growing global awareness of environmental issues and competitive pressures for sustainability are driving eco-friendly production practices in the textile industry. Investments in these areas indicate that eco-friendly textile materials have become a fundamental aspect of BMs, rather than an optional feature (Lee et al., 2012). Cellulosic fibers, derived from organic plant sources, have smaller ecological footprints compared to other fibers. Protein fibers, sourced from animal hairs and insects, are produced by responsible farming practices. Mineral fibers like asbestos, valued for their flame retardancy, are used in industries where fire-resistant materials are necessary. Regenerated fibers come from plant cellulose, grains, and milk protein, while recycled fibers utilize used textiles and plastic bottles (Pandey et al., 2020). Fig. 1 outlines major eco-friendly textile materials and designers in the T-F industry. Recently, there has been a trend towards greentech solutions that create strong, recyclable biobased materials from coproducts and byproducts, offering alternatives to petrochemical-derived materials (Bradu et al., 2022). Biobased polyester and polyamide represent just 0.03% and 0.4% of those materials' total market share, while recycled manmade cellulosic fibres account for 0.5% of the Man-Made Cellulosic Fibres market (Costa et al., 2022).

Therefore, the integration of agro and biowaste into the T-F industry aligns with the goals of the research on CBE business model development by promoting resource efficiency, waste valorization, and sustainable innovation. Agro-waste, such as crop residues, can be repurposed into fibers and materials, supporting the CE by reducing reliance on virgin resources. This approach drives innovation in sustainable materials, creates value from waste, meets growing consumer demand for eco-friendly products, and encourages collaboration with agricultural sectors.

2.3. Circular business model (CBM) and green business model (GBM)

A BM can be made greener when a business changes elements of its BM to create and capture a business opportunity or a proposition that provides environmental and social improvement coupled with economic benefits. Linder and Williander (2017, p. 2) define it as "*a business model in which the conceptual logic for value creation is based on utilizing the economic value retained in products after use in the production of new offerings*", thus highlighting the return flow from the user to the producer. Sustainable and circular BMs are closely related and can be considered a subcategory of BMs (Antikainen and Valkokari, 2016). However, CBMs offer new perspectives by developing strategies to close, slow, intensify, dematerialize or narrow resource loops (Bocken et al., 2016; Ünal et al., 2019). Toth-Peter et al. (2023) stated that incorporating product lifecycle management influences all aspects of CBMs and highlights the CE's emphasis on the entire product lifecycle, from its inception to its use and eventual end-of-life. Adopting a CBMs demands a range of general, sustainable, and circular skills. Therefore, using circular narratives as a framework for skill development can support the wider adoption of the CE (Straub et al., 2023). The taxonomy of eco-friendly textile materials provides a practical guide for harnessing talent to speed up the transition to a CE. By utilizing this taxonomy, companies can effectively identify and prioritize environmentally sustainable materials, thus facilitating the development of BMs that reduce waste, extend product lifecycles, and promote resource efficiency. A GBMs has a dual focus both on green value creation and capturing and delivering value from customers. In this regard, Table 1 (see appendix) collects the main academic contributions of GBM. Innovation, flexibility, and sustainability constitute basic enablers of GBMs (Nair and Paulose, 2014). According to Abuzeinab and Arif (2014), a GBM consists of five key elements: 1) Green Value Proposition (GVP), green products and services that can be appealing to clients; 2) Target Groups (TG), the segment of clients to whom an organization wants to offer value; 3) Key Activities (KA), the most important activities that need to be performed to create value for clients; 4) Key Resources (KR), the assets, which can be tangible, intangible, or human, that are needed to offer and deliver value to clients; and 5) Financial logic (FL), the financial assessment of all the

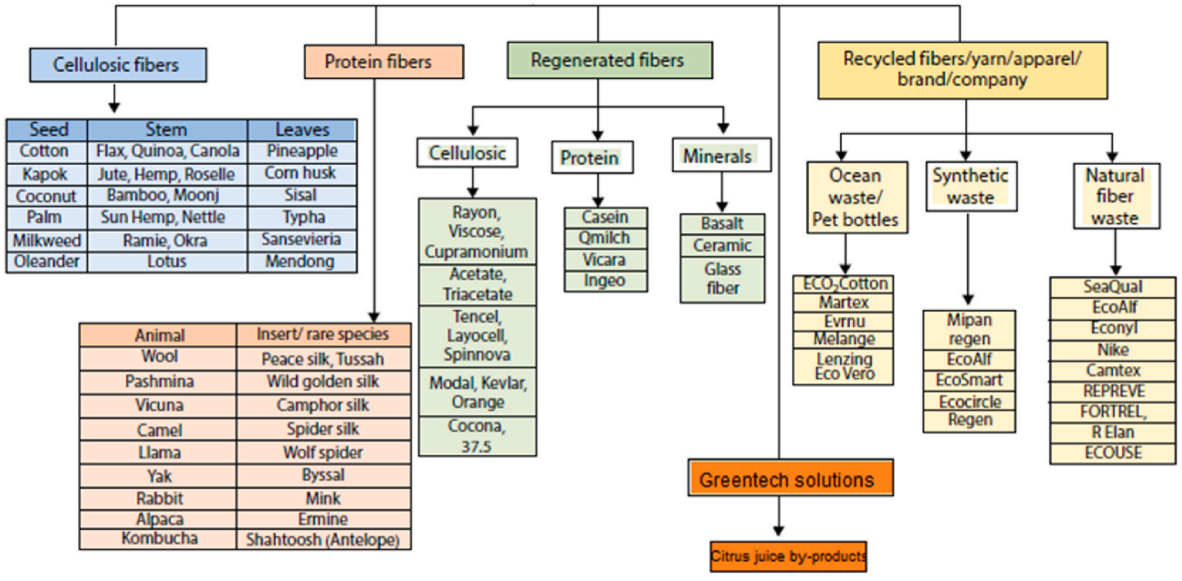

Fig. 1. Eco-friendly textile materials.
Source: adapted from Pandey et al. (2020).

means employed in the BM. GBMs could have the potential to deliver much better products compared to conventional BMs. The contribution of renewable raw materials (*e.g.*, citrus fruit byproducts) is one of the key elements to help facilitate the increased uptake of GBMs and create value for customers. Moreover, companies are increasingly greening their value chains by improving resource productivity due to the contributions of new green technologies (Jorzik et al., 2024). Henriksen et al. (2012) identified two primary categories within companies' BMs for greening businesses: incentive models and life-cycle models. Incentive models involve creating incentives for customers and companies to enhance resource efficiency. The authors use an SLR to organize and synthesize existing literature. This approach allows for a rigorous and structured examination of relevant contributions on a specific topic. By identifying, evaluating, and interpreting all available evidence on a particular research question, the SLR approach enhances the transparency and replicability of the study. Specifically, the tool proposed by Salvador et al. (2021) (shown in Fig. 2) was selected for its specific relevance and adaptability in analyzing BMs within the context of CBE (see Fig. 3).

This tool stands out for its ability to adapt to the unique characteristics of the CBE context, making it particularly effective for studying how BMs can support sustainability and circularity strategies in businesses.

The GBM is crucial as a strategic framework for the development and implementation of sustainable business practices. Several studies underscore the importance of circular and green economies, given the significant environmental and social challenges faced by industries like textile manufacturing. These challenges include non-recoverable materials and blends, excessive water usage, reliance on harmful chemicals, and poor human rights records (Franco, 2017). The manufacturing process consumes substantial natural resources, fuel, and chemicals, leading to environmental pollution. Achieving sustainability through cleaner production is a primary concern to mitigate these problems (Parisi et al., 2015; de Oliveira Neto et al., 2019). The implementation of circularity solutions, supported by the GBM, is essential to address these challenges. This includes reducing resource consumption, preserving natural resources, avoiding waste generation, and fostering inter-organizational efforts, innovation, collaborations with stakeholders, and consumer education for a more sustainable future (Provin and de Aguiar Dutra, 2021; da Costa Fernandes et al., 2020; Allen et al., 2021). Technological opportunities are critical for achieving the outlined goals of a CE, and adopting BMs supported by relevant technologies can lead to more efficient and eco-friendly processes (Riba et al., 2020; Casciani et al., 2022). Technology serves as both an enabler and a driver of innovation, particularly for green technology and clean technology companies. Trapp and Kanbach (2021) provide a variety of green technology solutions identified through a systematic review of literature on the subject. The proposed framework of Greentech BM archetypes in green entrepreneurship covers two dimensions: "green business models" and "technological opportunities." Bocken et al. (2014) distinguish these dimensions to maximize energy and material efficiency, ultimately focusing on the renewal or substitution of natural processes. Trapp and Kanbach (2021) suggest that this framework is useful for future research on policy-making related to cleaner production, helping firms innovate with CBMs. Salvador et al. (2023) identified seven archetypes for BMs in a CBE, including

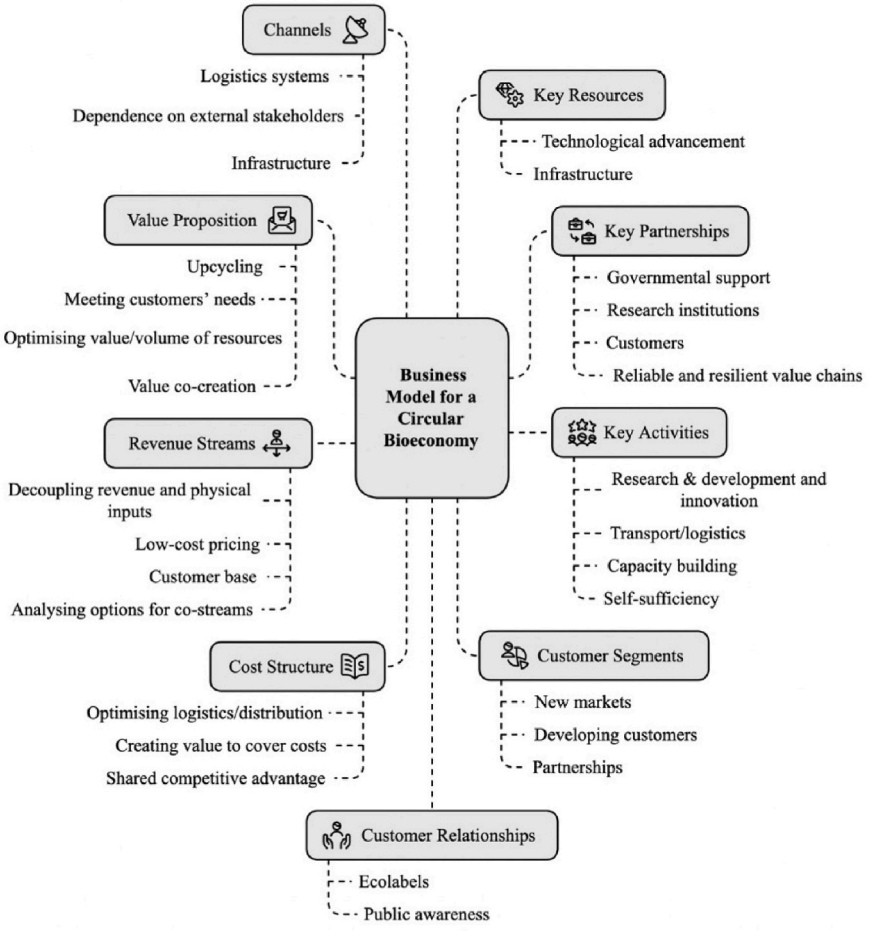

Fig. 2. business models for a circular bioeconomy.
Source: adapted from Salvador et al. (2021).

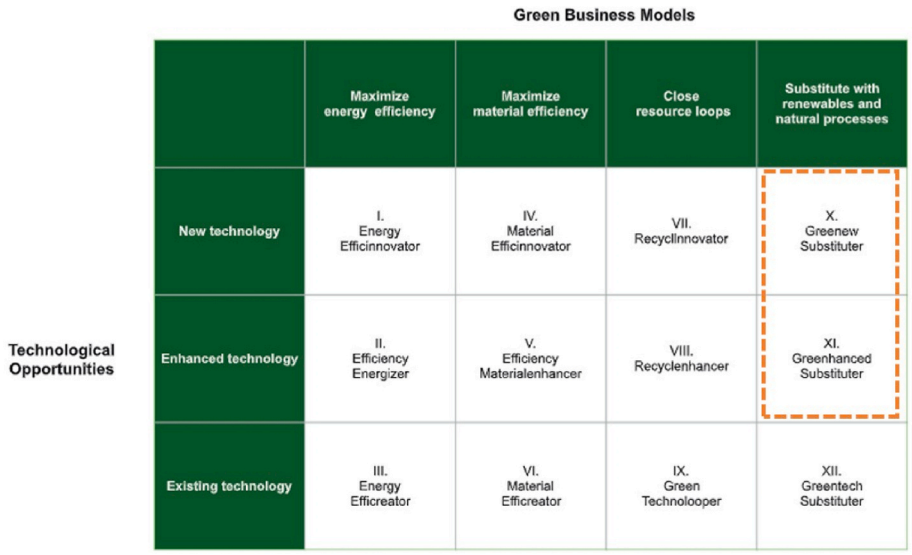

Fig. 3. Greentech business model archetypes in green entrepreneurship. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)
Source: adapted from Trapp and Kanbach (2021).

optimizing resource efficiency, establishing biorefineries, value recovery from waste, resource exchange, innovation towards bio- and renewable resources, valuing the local economy, and service-oriented value offers. These archetypes enhance interest in future research on GCBM and support managers in identifying opportunities and engaging with CBE.

2.4. The evolution of BM towards circular bio-economy (CBE)

Become crucial to clarify the line of reasoning also present in the literature that led to the evolution of traditional business models (TBM) to those used in the bioeconomy with characterizing innovations. Table 2 below summarizes the different business models, showing the main information of each of them, in particular the main components and levers that compose them. TBMs focus on profit through linear "take-make-dispose" processes, prioritizing cost-efficiency with little regard for resource depletion or environmental impacts (Remane et al., 2017). CBMs shift away from this linearity, emphasizing waste reduction and resource efficiency through closed-loop systems, recycling, and durability, but they don't entirely center on renewable resources

Table 1
Comparison of business model typologies in value creation, delivery, and sustainability.

MAIN COMPONENTS/ BUSINESS MODEL	TRADITIONAL BUSINESS MODELS (Remane et al., 2017)	CIRCULAR BUSINESS MODELS (Coscieme et al., 2022)	GREEN BUSINESS MODELS (Lamptey et al., 2021)	BUSINESS MODELS FOR CIRCULAR BIOECONOMY (Salvador et al., 2021)
Value Proposition	*Products and services that fulfil customer needs or solve problems.*	*Products designed for durability, repairability, and recyclability.*	*Products and services are designed with sustainability and environmental responsibility.*	*Bio-based products from renewable resources, designed for circular use (e.g., bioplastics, biofuels).*
Customer Segments	*Specific groups of consumers targeted by the business.*	*Often focuses on environmentally conscious consumers.*	*Consumers who value eco-friendly products and transparency.*	*Eco-conscious consumers, industries needing sustainable materials, and those focused on biodegradability.*
Revenue Streams	*Sales, subscriptions, licensing.*	*Subscription models, pay-per-use, leasing, selling refurbished goods.*	*Green premium pricing for sustainable products or services.*	*Sale of bio-based products, licensing of bio-based technologies, waste-to-product innovations.*
Cost Structure	*Fixed and variable costs associated with operations.*	*Costs related to reverse logistics, refurbishing, and waste reduction.*	*Investments in renewable energy, eco-friendly materials, and sustainable operations.*	*Research and development of bio-based products, reverse logistics for organic waste, and investment in bio-refineries.*
Key Resources	*Physical, human, financial, and intellectual resources required to operate.*	*Circular resources like recycled materials, and extended product life cycles.*	*Renewable resources, eco-certified materials, and technologies reducing carbon footprints.*	*Biomass, organic waste, bio-based materials, advanced biotechnology.*
Key Activities	*Core processes like production, marketing, sales, and R&D.*	*Collection and recovery of used products, remanufacturing, and resource optimization.*	*Sustainable sourcing, eco-friendly manufacturing, waste reduction, and carbon offsetting.*	*Bio-based manufacturing, upcycling of organic waste, and recycling of biological materials.*
Channels	*Methods of delivering the product or service (e.g., physical stores, online).*	*Selling refurbished or recycled products, rental or sharing platforms.*	*Often sold through digital platforms, eco-friendly retail outlets, or direct-to-consumer models.*	*Selling bio-based products through direct channels, and partnerships with industries (e.g., packaging, food, energy).*
Customer Relationships	*How the business engages with and retains customers.*	*Focus on long-term engagement, repair, and maintenance services.*	*Transparent communication about sustainability initiatives, green certifications, and eco-education.*	*Emphasizes innovation in sustainability and promoting circular use of biological resources.*
Key Partners	*Suppliers, distributors, or other businesses that contribute to the value chain.*	*Recycling companies, suppliers of sustainable materials, and refurbishing partners.*	*Green suppliers, renewable energy providers, and certifying organizations for sustainability.*	*Agricultural sectors, waste management companies, bio-refineries, and research institutions.*
Strategic Levers	*Economies of scale, market penetration, product differentiation, cost leadership.*	*Product as a Service (PaaS), designed for longevity, closed-loop systems, and collaboration.*	*Sustainable innovation, regulatory compliance, green marketing, energy efficiency.*	*Biotechnology innovation, waste-to-resource, sustainable sourcing, cross-industry collaboration.*

Source: Authors' elaboration.

Table 2
Overview of business models.

TYPOLOGIES OF BUSINESS MODELS	MAIN COMPONENTS	STRATEGIC LEVERS
Traditional Business Model	- *Value proposition: product/ service* - *Customer segments* - *Revenue streams* - *Cost structure* - *Key resources* - *Key activities* - *Channels* - *Customer relationships* - *Key partners*	- *Economies of scale* - *Market penetration* - *Product differentiation* - *Cost leadership*
Circular Business Models	- *Value proposition: durable, repairable, recyclable products* - *Customer segments* - *Revenue from subscription, leasing, refurbished goods* - *Cost of reverse logistics* - *Circular resources* - *Key activities: recovery, remanufacturing* - *Channels: sharing, rental* - *Customer relationships: repair, maintenance* - *Key partners: recyclers, refurbishers*	- *Product as a Service (PaaS)* - *Design for longevity* - *Closed-loop systems* - *Collaboration*
Green Business Models	- *Value proposition: eco-friendly, sustainable products* - *Customer segments* - *Revenue: green premium* - *Cost structure: renewable energy, eco-materials* - *Key resources: renewable resources* - *Key activities: sustainable sourcing, waste reduction* - *Channels: eco-retail, digital* - *Customer relationships: transparency, education* - *Key partners: green suppliers*	- *Sustainable innovation* - *Regulatory compliance* - *Green marketing* - *Energy efficiency*
Business Models for Circular Bioeconomy	- *Value proposition: bio-based products (bioplastics, biofuels)* - *Customer segments* - *Revenue: bio-products, licensing* - *Cost structure: bio-refineries, R&D* - *Key resources: biomass, bio-materials* - *Key activities: bio-manufacturing, waste upcycling* - *Channels: bio-based sales, industry partnerships* - *Customer relationships: circular use, innovation* - *Key partners: agriculture, bio-refineries*	- *Biotechnology innovation* - *Waste-to-resource transformation* - *Sustainable sourcing* - *Cross-industry collaboration*

Source: Authors' elaboration.

(Coscieme et al., 2022). GBMs embed eco-friendly practices, focusing on reducing environmental impacts, especially carbon emissions, though often without full circularity (Lamptey et al., 2021). Finally, BMCBEs focus on renewable biological resources, regenerating natural systems, and closing loops within biological cycles, particularly for agriculture and bioplastics, achieving complete circularity through biogenic resources (Salvador et al., 2021). That is, it is necessary to understand the differences between traditional BMs, CBMs, GBMs and BMCBEs. This table is necessary for the development of the methods section and to better understand which research variables will be adopted for the development of empirical research.

In summary, while BMs focus on linear value creation with a profit-driven mindset, circular, green, and bioeconomy models emphasize sustainability, resource efficiency, and long-term environmental impact as strategic priorities. The key to differentiation lies in leveraging design, customer engagement, partnerships, and innovation to align with circular and green principles. Both CBE and GBMs leverage agro- and biowaste to produce sustainable, low-impact products. They share goals of reducing resource consumption, minimizing waste, and cutting carbon emissions while emphasizing innovation, eco-design, and collaboration. The CBE focuses on biotechnology and closed-loop systems using renewable biological inputs, while GBMs prioritize reducing overall environmental impact and promoting ethical and sustainable production practices. Both contribute significantly to creating a more sustainable and regenerative economy. In this context, integrating GBMs with technological advancements offers promising solutions for sustainability challenges. GBMs provide a strategic framework for embedding CE principles into business practices, thereby addressing environmental and social concerns. By leveraging technology-supported BMs, such as biofabrication techniques like bacterial cellulose production, industries can achieve more efficient and eco-friendly processes. This approach not only promotes resource efficiency and waste reduction but also fosters innovation and collaboration across the value chain. Additionally, consumer education and stakeholder engagement are crucial components of GBMs, facilitating the transition towards a more sustainable and responsible future. Coscieme et al. (2022) introduce a framework to map and drive the implementation of CBMs. They examine four distinct CBM approaches: models centered on product durability, access models revolving around renting, leasing, and sharing, garment collection and resale models, and recycling and reuse of materials. For each BM, the authors explore the enablers driven by technical and social innovations, policy interventions, behavioral shifts, and educational initiatives. Table 3 provides a breakdown of the main components and strategic levers associated with each BM typology.

The evolution from Traditional to circular, green, and circular bioeconomy business models reflects an increasing focus on sustainability, each stage aligned with specific academic theories: 1) Traditional Business Models focus on efficiency and profitability through economies of scale, informed by Porter's competitive advantage and Resource-Based View (RBV), aiming for cost leadership and market dominance (Spanos and Lioukas, 2001).; 2) Circular Business Models introduce durable and recyclable products, emphasizing closed-loop systems and Product-as-a-Service (PaaS), aligned with Industrial Ecology and systems thinking theories (Williams et al., 2017). Collaboration with recyclers and refurbishers enhances resource longevity and waste reduction; 3) Green Business Models prioritize eco-friendly products, sustainable sourcing, and transparency (Hossen et al., 2024). Grounded in Stakeholder Theory and the Triple Bottom Line (TBL), they emphasize accountability to both society and the environment, often motivated by regulatory pressures and CSR commitments; 4) Circular Bioeconomy Models extend circular principles to bio-based resources, supported by theories of Industrial Symbiosis and Biocapitalism (Neves et al., 2020). These models rely on biotechnology and cross-industry collaborations to innovate and repurpose waste, promoting a fully integrated sustainable approach. Each stage reflects a deeper integration of sustainability principles, with models evolving to balance economic, social, and environmental value creation.

3. Research method

3.1. Approach and framework

The research methodology employed a systematic and multifaceted approach to thoroughly investigate emerging GBMs within the CBE framework. The CBE represents an innovative and sustainable approach aimed at reducing waste and optimizing resource use through closed production cycles and material reuse. Understanding how various BMs can support industrial sustainability and promote more ecological and circular practices is essential in this context. A Systematic Literature Review (SLR) – PRISMA protocol locates, assesses, and interprets all

existing research pertinent to a specific research question or area of interest. SLRs are effective for organizing and synthesizing literature to enhance knowledge within the field (Petticrew and Roberts, 2008). Starting with 136 records identified using the keywords "business model circular bioeconomy" in the title field of the Web of Science (WoS) database. The rationale behind this specific choice is now explained in the revised text to ensure readers understand how the search terms align with the research objectives. The results were refined by focusing on publications from the last five years (2020–2024) and limiting the search to specific Web of Science categories: Environmental Sciences, Environmental Studies, Green Sustainable Science Technology, Business, or Management. This refinement reduced the records to 41. Further refinement was applied by selecting only articles or review articles, which brought the dataset down to 33 records. During the second screening stage, additional records were excluded, including proceedings papers, early access articles, retracted papers, book chapters, and similar types. Only studies published in English and indexed in the Social Sciences Citation Index (SSCI) or the Science Citation Index Expanded (SCI-EXPANDED) were retained, keeping the dataset at 33 records. A subsequent full-text review resulted in the inclusion of 7 articles. This systematic process refined a broad initial dataset into a highly focused set of studies, providing a solid foundation for research on GBMs. Examples of studies that were excluded include those that focused solely on technological innovations without addressing BMs or those unrelated to the CBE. During the full-text review, we analyzed the selected papers to extract key elements, including theoretical frameworks, methodologies, findings, and implications for GBMs. See Fig. 4 for a visual representation of the selection process.

From SLR also emerged a BM tool, which is detailed and structured in Fig. 2. This tool highlights the key aspects of sustainability and innovation within the CBE framework. Various are the links between BMs for the CBE and GBMs in the T-F industry - especially concerning agro - and biowaste - due to their shared focus on sustainability, resource efficiency, and waste reduction. Below is Table 3, summarizing the connections between the two BMs:

The research follows a deductive approach to test and refine the theoretical framework proposed by Salvador et al. (2021), which focuses on integrating CBE principles into BM design. The framework, initially developed through a literature review, is applied in a case study context to assess its applicability and make necessary refinements based on real-world data. The framework used for analysis is based on Salvador et al. (2021), which outlines essential elements for implementing and managing CBE business models. This framework includes predefined categories such as value creation, which refers to how businesses create value in a CBE context; value capture, which focuses on the mechanisms by which businesses capture value within a CE; value delivery, which describes the systems used to deliver value to customers in a sustainable and circular manner; governance and stakeholders, which examines the roles and relationships among stakeholders involved in the BM; and sustainability integration, which addresses how sustainability principles

Table 3
Comparison of circular bioeconomy models and green business models in the textile-fashion industry.

ELEMENT/ BUSINESS MODEL	BUSINESS MODELS FOR CIRCULAR BIOECONOMY (Salvador et al., 2021)	GREEN BUSINESS MODELS (Henriksen et al., 2012)
1. Sustainable Resource Use (Agro- and Biowaste)	- *Use of agro- and biowaste (e.g., crop residues, plant fibers) as raw materials (banana, Piñatex, hemp)* - *Biotechnological processes convert organic waste into textiles, reducing fossil-based resources*	- *Focus on natural, renewable resources and low-impact materials (organic fibers, recycled agricultural waste)* - *Minimize environmental footprint*
2. Waste Reduction and Circularity	- *Aim for zero waste, utilizing agro-industrial by-products and organic waste in a closed-loop system* - *Promote bio-based, biodegradable materials for eco-friendly disposal*	- *Incorporate recycling and upcycling of textile waste* - *Support eco-friendly production processes with lower chemical, water, and energy use*
3. Innovation and Sustainable Design	- *Foster biotechnology innovations (fermentation, bio-refining) to create high-performance textiles - Design products for circularity (compostable or recyclable)*	- *Focus on eco-design (biodegradable materials, eco-friendly dyeing)* - *Ensure life cycle assessments (LCA) for sustainability throughout the product life cycle*
4. Energy Efficiency and Carbon Reduction	- *Reduce carbon emissions by avoiding synthetic fiber production and utilizing local agro-waste to cut transportation emissions* - *Support decentralized supply chains*	- *Encourage renewable energy use in production* - *Minimize carbon footprint through sustainable materials and energy-efficient processes*
5. Collaboration and Partnerships	- *Rely on partnerships with agricultural sectors, bio-refineries, and waste management companies to scale bio-based textile production* - *Cross-industry collaboration to integrate agricultural waste into textile production*	- *Collaborate with suppliers and certification organizations to ensure eco-friendly practices* - *Partner with stakeholders to guarantee sustainability from farming to finished garments*

Source: Authors' elaboration.

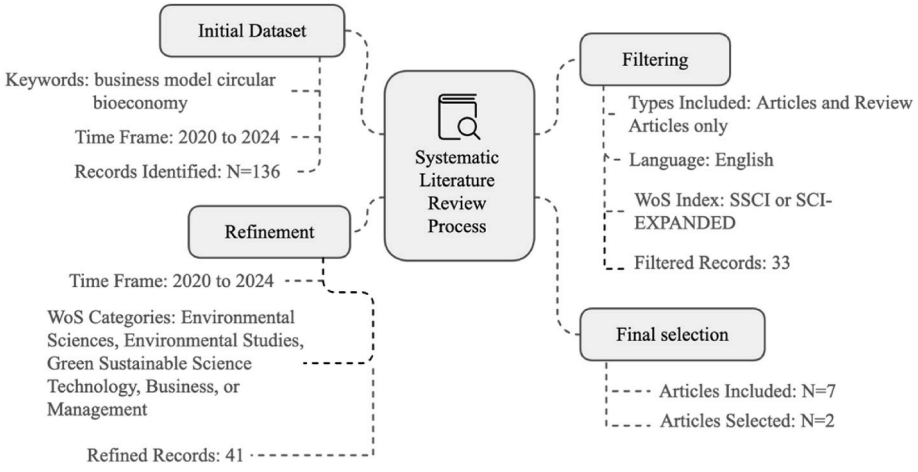

Fig. 4. Systematic Literature Review (SLR) – PRISMA protocol.
Source: Authors' elaboration.

are embedded into business processes. These elements were initially developed based on existing literature on CBE and BMs.

3.2. Case selection

An increasing number of T-F companies are focusing on material innovations and biobased smart materials to produce fibers, textiles, and finishes at scale. Many companies have incorporated sustainability initiatives into their corporate agendas. For example, Kering has developed the Environmental Profit & Loss (EP&L) methodology to assess environmental impact beyond traditional reporting, while LVMH has launched the LIFE 360 plan, which targets biodiversity protection, climate action, CE practices, and transparency, with deadlines set for 2023, 2026, and 2030. Fast fashion brands like ZARA, H&M, Primark, and Uniqlo are also promoting sustainability through conscious choices, take-back and recycling programs, and eco-friendly material selection for their production processes. The industry is increasingly creating products with lower environmental impacts, exploring new materials, adopting greener supply chains, and aligning global eco-friendly policies. Our qualitative and descriptive case study approach was employed to refine the tool, following Kahlke's (2014) guidelines. The case study focused on Orange Fiber, an innovative Italian company chosen due to its involvement in sustainable practices and its potential for applying CBE principles to its BM. The case study serves as the primary source of real-world data for testing the theoretical framework. This choice offered valuable insights into the practical application of GBMs (Salvador et al., 2021) and relevant archetypes from Trapp and Kanbach's (2021) model: X. Greenew Substituer and XI. Greenhanced Substituer, which relates to "substituting with renewables and natural processes" and utilizing "new and/or enhanced technology." Founded in Catania in 2014, Orange Fiber specializes in creating sustainable fabrics from citrus byproducts. Known for its transparent supply chain and innovative circular practices, the company recycles these byproducts into high-quality cellulose fibers used in luxury T-F. This approach addresses both environmental and cost issues associated with byproduct disposal. Orange Fiber's patented technology has been implemented in major citrus juice-producing countries and is promoted through a registered trademark and transparent labelling. With over 1 million euros in funding from angel investors, public funds, and grants, Orange Fiber completed a successful equity crowdfunding campaign in 2019 to expand production. The company collaborates with various stakeholders to foster growth and sustainably drive innovation.

3.3. Data collection and analysis

Data collection was conducted through focus group discussions and semi-structured interviews with key stakeholders from the selected firm. These instruments were designed to capture both predefined categories from the theoretical framework and emergent themes related to CBMs. The focus group was held in January 2023 and included managers chosen for their experience in the T-F industry and their expertise in environmental sustainability. The primary objective of the focus group was to explore key circular business practices adopted in the T-F industry and evaluate the applicability of the emerging GBMs framework within the CBE context. Special emphasis was placed on understanding the role of social awareness in textile companies. This session was essential for determining whether the framework could be adapted to the case study. Insights gathered during the focus group were later used to test the model in the case study context. By effectively employing focus groups, researchers were able to gain valuable insights into the practical application of emerging BMs for CBE. This contributed to a deeper understanding and more effective strategies for implementation. The session was conducted online and moderated by both authors, who used a combination of structured and open-ended questions to encourage participation and extract meaningful insights. Participants were actively encouraged to share feedback and personal reflections, ensuring a dynamic and inclusive discussion. Following the focus group, a series of in-depth interviews were conducted with key executives at Orange Fiber, including Dr. Enrica Arena (CEO and co-founder), Dr. Andrea Bonina (CTO), and Dr. Giuseppe Venezia (CFO). These interviews, conducted between January and March 2023, were critical for exploring the elements of GBMs and testing the model within the case study context. Each interview followed a structured framework, consisting of nine questions per managerial tool block, with particular focus on challenges and changes related to BMs. Special attention was also given to understanding the role of social awareness in textile companies. To enhance the validity of the study, several measures were implemented at different stages, following Yin's (2014) recommendations. Triangulation was employed by cross-referencing evidence from multiple sources, including secondary data from the company's presentations, website, and informal discussions with company representatives. This triangulation process helped strengthen the robustness and reliability of the findings.

In both the focus group and interviews, several key variables were explored to understand the company's implementation of GBMs within the CBE context. These included: 1) Environmental sustainability practices: the firm's initiatives and practices related to environmental sustainability; 2) Innovation and adoption of GBMs: how the firm innovates and integrates green business practices into its operations; 3) Economic viability: the firm's ability to maintain profitability while incorporating CBE principles; 4) Stakeholder engagement: how the firm engages with various stakeholders in implementing CBMs; 5) Technological integration: the role of technology in enabling sustainable business practices; 6) Supply chain rransparency: how transparent the company is regarding its supply chain and the sustainability of its operations; 7) Challenges in implementing GBMs: the difficulties the firm faces in adopting and scaling GBMs.

Thematic analysis was conducted in a structured manner to ensure reliability and validity. Initially, categories for analysis were derived from the theoretical framework established through the literature review, focusing on the key elements of GBMs within the CBE context, as proposed by Salvador et al. (2021). These pre-identified categories included: environmental sustainability practices, innovation in GBMs, economic viability, stakeholder engagement, technological integration, supply chain transparency and challenges in implementation. During the focus group session, additional themes emerged organically from the expert discussions. These emergent categories were documented and compared for alignment or divergence with the existing theoretical framework, such as scalability challenges in the T-F industry and specific stakeholder dynamics within the case company. An iterative process of reading, coding, and re-coding the focus group transcripts was employed to refine the themes and ensure all relevant aspects of GBMs in the CBE context were comprehensively captured. The identified themes were cross-checked by the research team to ensure consensus and minimize subjective bias, contributing to the robustness and reliability of the analysis. The transcription and coding of interview data followed a systematic process designed to extract insights that could be triangulated with the focus group findings. Initial coding was based on categories identified during the literature review, such as environmental sustainability, economic viability, and stakeholder engagement. However, new categories emerged from the interview data, including practices and challenges related to supply chain transparency and technological integration, which were critical to the case company's context. A structured coding protocol was used, with transcripts independently coded by two researchers to enhance consistency and reduce potential bias. Discrepancies in coding were resolved through discussion and consensus. The coded themes from interviews were compared with those from the focus group to ensure alignment and identify unique insights provided by the different data sources. These processes ensured that the thematic analysis and coding were rigorous and reflective of the empirical evidence, contributing to a deeper understanding of GBMs within the CBE context. Table 4 provides a detailed overview of the

Table 4
overview of the data collection process.

PHASE	METHOD	PURPOSE	PARTICIPANTS	DETAILS
1. Literature Review	*Systematic Review*	*To establish a theoretical foundation and identify relevant frameworks.*	*Researchers*	*Involved in a comprehensive review of academic papers, industry reports, and existing frameworks.*
2. Focus Group Preparation	*Selection of Participants*	*Identify key experts and practitioners with expertise in T-F and sustainability.*	*Experts and practitioners*	*Participants selected based on roles, experience, and expertise in circular business practices.*
3. Focus Group Session	*Online Focus Group*	*Explore circular business practices and assess GBM framework applicability.*	*Experts and practitioners*	*Conducted in January 2023, moderated by both authors.*
4. Data from Focus Group	*Thematic Analysis*	*Identify key themes and insights for case study analysis.*	*Researchers*	*Thematic analysis applied to focus group discussions; findings used to test the selected model.*
5. In-depth Interviews	*Structured Protocol Interviews*	*Gather detailed information on specific elements of GBMs in Orange Fiber.*	*Key executives*	*Conducted between January and March 2023, interviews followed a structured framework.*
6. Data from Interviews	*Transcription and Coding*	*Ensure accuracy and identify common themes for triangulation with focus group data.*	*Researchers*	*Interviews were transcribed and key themes coded for analysis.*
7. Secondary Data Collection	*Review of Internal Documents*	*Gain a deeper understanding of company processes and context.*	*Provided by company*	*Internal documents, including company reports and strategic plans, were reviewed before interviews.*
8. Triangulation	*Cross-referencing Data Sources*	*Enhance robustness by cross-referencing focus groups, interviews, and secondary data.*	*Researchers*	*Triangulation ensured consistency and reliability across different data sources.*
9. Analysis	*Comprehensive Analysis*	*Develop a holistic understanding of evolving BMs in the CBE context.*	*Researchers*	*The final analysis integrated insights from all data sources to form conclusions and recommendations.*

Source: Authors' elaboration.

various stages and methods used to achieve the research objectives.

The final analysis integrated all the insights gained from the different data sources and applied the refined theoretical framework to assess its applicability in the case study context. Through the analysis process, the researchers were able to: identify patterns and relationships between key themes; understand the challenges and opportunities companies face when implementing GBMs and refine the theoretical framework based on the real-world data. This comprehensive and iterative process enabled the researchers to gain a deeper understanding of how CBMs can be successfully implemented in the T-F industry and provided valuable insights into the evolving BMs within the CBE.

4. Results

The primary contribution of this research lies in the application and refinement of the GCBM framework, originally proposed by Salvador et al. (2021). The GCBM framework serves as the central conceptual tool for this study, offering a structured method to analyze and integrate sustainability and CE principles into BMs. While the initial framework was grounded in theoretical assumptions and best practices, this research adapts it to the specific context of a real-world case within the T-F industry. The case study focuses on Orange Fiber, an innovative company that exemplifies sustainable practices and offers a unique opportunity to test and refine the GCBM framework. Orange Fiber is committed to ethical sourcing, using citrus byproducts sourced from the local economy in Sicily. This not only supports regional economic development but also fosters fair labor practices, ensuring that the benefits of production are equitably distributed. The company's approach emphasizes community empowerment and poverty reduction. Social justice plays a pivotal role in the company's operations, reflected in its transparency, fair trade practices, and gender equality across its supply chain. Orange Fiber ensures that stakeholders, from agricultural workers to textile producers, receive fair compensation and work under ethical conditions that respect their rights and well-being. Furthermore, the company selects partners who share these values, creating a network that upholds human dignity and environmental stewardship. Incorporating CBE principles, Orange Fiber transforms agricultural waste, specifically citrus byproducts, into high-value textiles. This process not only reduces waste but also promotes the sustainable use of natural resources, aligning with global efforts to combat climate change and protect biodiversity (Mondal et al., 2022). The company's circular approach fosters the creation of a closed-loop system within the T-F industry, where materials are continuously repurposed, thus reducing the reliance on virgin resources. Orange Fiber's model serves as an example of how businesses can operate sustainably, advance social justice, and contribute to the CBE, all while maintaining profitability. By focusing on ethical production, environmental sustainability, and social equity, Orange Fiber sets a powerful example for the T-F industry on how to evolve in response to the demands of a more conscious and responsible global market. Table 5 provides a comprehensive overview of Orange Fiber's BM blocks, including Customer Segments (CS), Value Proposition (VP), Channels (CH), Customer Relationships (CR), Revenue Streams (RS), Key Resources (KR), Key Activities (KA), Key Partnerships (KP), and Cost Structure (CS). This table illustrates how each of the nine building blocks of the BM is integrated with the company's strategic objectives. Orange Fiber's BM uniquely blends sustainability, innovation, and economic development, demonstrating how a company can achieve both profitability and social impact. Each component of the BM plays a critical role in ensuring the company's success. The customer segments, for example, target luxury fashion brands and environmentally conscious designers, positioning Orange Fiber's offerings as premium, sustainable alternatives in the market. The value proposition highlights the company's innovative textile production process and the positive environmental impact of upcycling citrus byproducts, offering differentiation from traditional textile manufacturers. Through its distribution channels and strong customer relationships, Orange Fiber builds trust and credibility with its stakeholders, reinforcing its commitment to sustainability through ecolabels, certifications, and co-branded campaigns with luxury partners. The revenue streams, supported by high-margin product sales, strategic collaborations, and R&D grants, ensure the company's financial sustainability, while the key resources, such as patented technology and sustainable raw materials, provide a foundation for long-term growth and innovation. Key activities—such as research and development, market development, and efficient production processes—enable the company to continuously innovate and expand into new markets. Partnerships with luxury fashion brands and research institutions further strengthen the company's position in the market, driving both innovation and sustainability. The cost structure emphasizes efficient logistics, compliance with sustainability standards, and ongoing investment in R&D to maintain a competitive edge. In combination, these elements contribute to Orange Fiber's overarching goal of integrating CE principles with ethical business practices, thereby creating value for both the company and society.

Orange Fiber's BM (Fig. 5) exemplifies how businesses in the T-F industry can embrace sustainability, innovation, and social equity. Through its focus on circularity, upcycling, and the promotion of local economic development, the company not only addresses environmental challenges but also supports social justice initiatives. By refining and applying the GCBM framework, this research demonstrates how the integration of sustainability and CE principles into BM can drive both

Table 5
Overview of Orange Fiber's business model and its strategic outcomes.

BUSINESS MODEL BLOCKS	BLOCKS DESCRIPTION	STRATEGIC OUTCOMES
CUSTOMER SEGMENTS (CS)		
Primary Customers	*Luxury fashion brands and high-end designers focused on sustainability and exclusivity.*	Unique, sustainable, and high-quality fabrics.
Secondary Customers	*The broader textile industry, including mid-range apparel, home textiles, and lifestyle products incorporates sustainable materials.*	Scalable, eco-friendly material options.
Niche Markets	*Environmentally conscious start-ups and small-scale designers focused on circular economy and zero-waste principles.*	Partnerships aligned with sustainability missions.
VALUE PROPOSITION (VP)		
Upcycling & Sustainability	*Citrus byproducts are converted into premium textiles, reducing waste and environmental impact.*	Appeals to eco-conscious brands and consumers.
Innovative Process	*Unique, soft, and lightweight fabric ideal for luxury garments, easily dyed and printed.*	Offers differentiation through texture and versatility.
Environmental & Social Impact	*Reduced carbon footprint, supports local economy, and less reliance on conventional textiles.*	Strengthens brand as a sustainable industry leader.
Circular Economy Alignment	*The entire model is based on minimizing waste and reusing resources.*	Aligns with consumer demand for transparency.
CHANNELS (CH)		
Local Economy & Supply Chain	*Integrated with Sicily's economy, using local citrus waste and supporting local farmers.*	Sustainability, quality control, and local support.
Supply Chain Transparency	*Fully traceable processes from sourcing to production.*	Builds customer trust and brand credibility.
Distribution Channels	*Direct sales to luxury brands, collaborations, and participation in trade shows.*	Increases market reach and brand visibility.
CUSTOMER RELATIONSHIPS (CR)		
Ecolabels & Certifications	*Certifications like GOTS and OEKO-TEX establish credibility in sustainability.*	Build trust and validate quality.
Public Awareness	*Campaigns and advocacy at events to educate on sustainable textiles.*	Position as a thought leader.
Collaborative Marketing	*Co-branded campaigns with luxury brands to highlight product uniqueness and sustainability.*	Enhance brand reach and customer alignment.
Long-Term Partnerships	*Consistent quality fosters loyalty and sustained collaborations with luxury brands.*	Mutual growth and trust.
REVENUE STREAMS (RS)		
Product Sales to Luxury Brands	*Primary revenue from selling textiles to high-end fashion houses.*	High-margin, luxury market position.
Innovation & R&D Grants	*Grants and subsidies support continuous technological development.*	Fund research and development.
Strategic Collaborations & Licensing	*Revenue from partnerships with brands on exclusive product lines or licensing technology.*	Enhances visibility and market presence.
Sales of Byproducts	*Selling byproducts like fertilizers or bio-based materials.*	Adds financial sustainability and reduces waste.
Custom Solutions	*High-margin bespoke textiles for premium brands.*	Increased revenue from specialized products.
KEY RESOURCES (KR)		
Patented Technology	*Proprietary extraction method for cellulose from citrus waste.*	Differentiation and scalability.
Sustainable Raw Materials	*Local citrus waste ensures supply consistency and reduces costs.*	Cost stability, local support, and sustainability.
Human Capital	*Expertise in textile engineering and sustainability, with academic partnerships.*	Innovation and high product standards.
Funding & Financial Resources	*Capital from investors and grants enables growth.*	Supports R&D and operational expansion.
KEY ACTIVITIES (KA)		
Extraction & Production	*Converting citrus waste into textiles.*	Core production and value creation.
R&D	*Continuous product and process improvement, with academic collaborations.*	Maintain innovation and competitiveness.
Market Development	*Expanding globally and into new textile sectors.*	Diversify customer base and increase reach.
KEY PARTNERSHIPS (KP)		
Luxury Fashion Collaborations	*Partnerships with brands like Salvatore Ferragamo and H&M validate quality and increase brand visibility.*	Access to luxury segments and brand strengthening.
Research Institutions	*Collaborations with universities for R&D.*	Drives innovation and maintains a competitive edge.
Sustainability Alliances	*Participation in initiatives like Fashion for Good.*	Access to shared resources and the latest industry practices.
COST STRUCTURE (CS)		
Logistics & Distribution	*Focus on optimized logistics to align with sustainability goals.*	Efficient transport, low emissions.
Research & Development	*Significant investment to maintain tech advancements and sustainability standards.*	Essential for competitive advantage.
Compliance & Certifications	*Obtaining and maintaining GOTS, OEKO-TEX, etc., for sustainability credibility.*	Builds brand trust and justifies premium pricing.

Source: Authors' elaboration.

profitability and positive social impact. The findings underscore the potential for businesses in the T-F industry to evolve and align with global sustainability goals, offering actionable insights for companies seeking to innovate in a responsible, CE framework. This research makes a significant contribution to the literature on GBMs and CE by refining and applying the conceptual framework initially proposed by Salvador et al. (2021). Through the case study of Orange Fiber, we have demonstrated how a theoretical framework can be tested and adapted to reflect the practical realities of a specific industry. The application of the GCBM framework to Orange Fiber's BM reveals how sustainability, circularity, and social justice principles can be integrated into a functional and scalable BM.

The iterative refinement process undertaken throughout this research highlights the dynamic and evolving nature of the GCBM framework. By incorporating empirical data and real-world insights from the case study, the framework was adjusted to more accurately reflect the challenges and opportunities facing companies operating in the CE. The refinements made to variables such as supply chain transparency, technological integration, scalability, and stakeholder engagement enhance the framework's applicability and relevance, making it a more effective tool for guiding sustainable business practices. One of the key insights from this study is the importance of localizing BM to align with both environmental and social objectives. Orange Fiber's success in integrating CE principles within the specific context of the Sicilian economy demonstrates the potential of localized circular models to create economic and social value. Furthermore, the company's focus on upcycling agricultural waste into high-value products highlights the role of innovation in driving sustainability and reducing environmental impact. The results also underscore the importance of a holistic approach to BM development. Successful GCBM are not just about environmental sustainability but also about creating social value and fostering strong, ethical relationships with stakeholders. As demonstrated by Orange Fiber, businesses can thrive by adopting circular and sustainable practices that address both economic

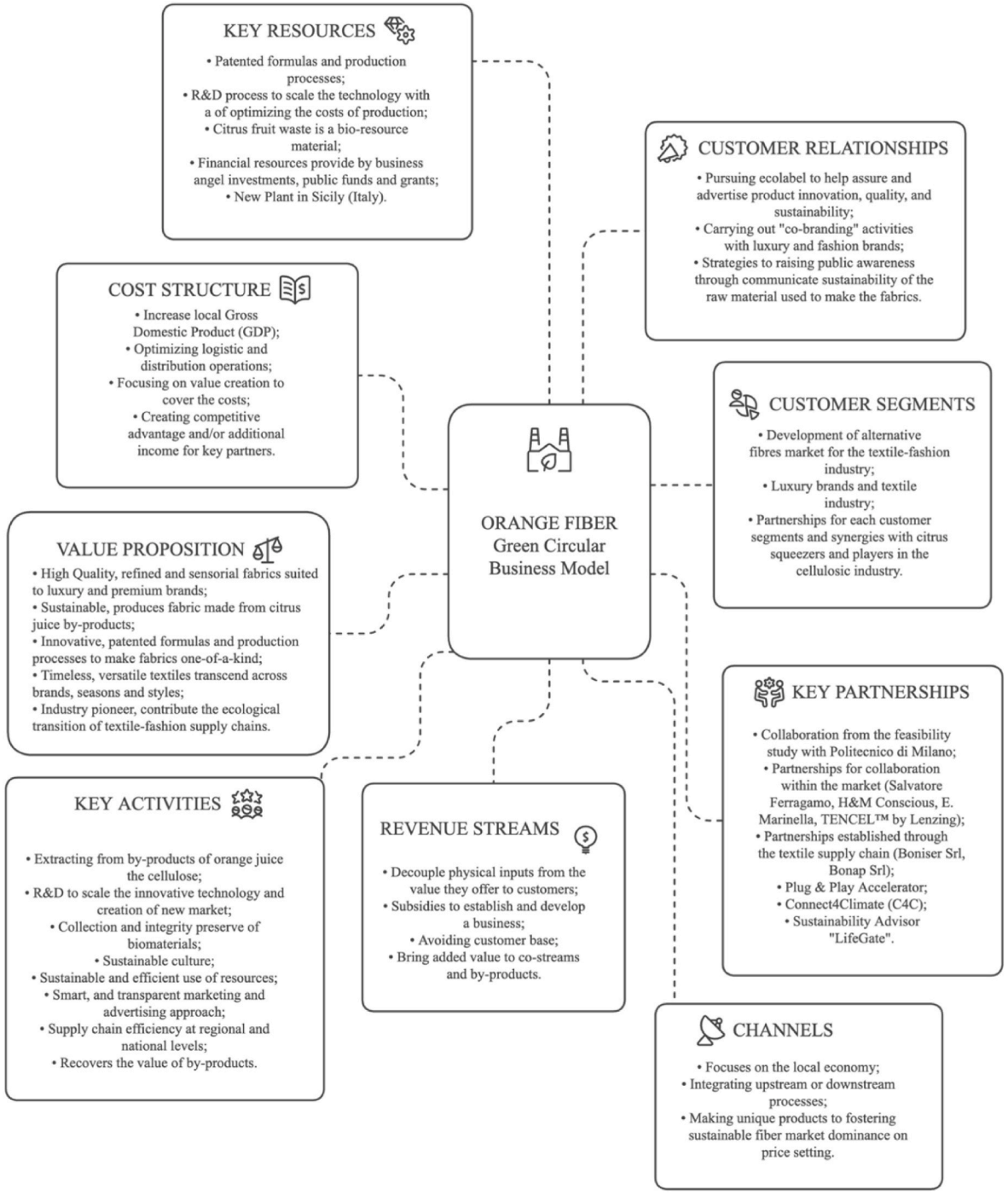

Fig. 5. Orange Fiber's business model.
Source: Authors' elaboration based on Salvador et al. (2021).

and social challenges.

In conclusion, the application and refinement of the GCBM framework through this case study offer valuable insights into the practical implementation of CE principles in the T-F industry. This research provides a valuable tool for other businesses looking to transition to more sustainable, circular, and socially responsible BMs. The findings contribute to the growing body of knowledge on CE and sustainable business practices, offering actionable insights for companies across various industries seeking to innovate in line with global sustainability goals.

5. Discussions

In recent years, the discourse surrounding BMs and the CBE has gained prominence within the scientific community, influencing a variety of industries. This study explores the potential of innovative BMs to enhance and derive value from the natural environment, aligning with the current focus of the literature (Bocken et al., 2019; Konietzko et al., 2023). Strategic decisions in BM design are increasingly aimed at maximizing environmental and social benefits, surpassing the efficiency of traditional models. Although tracing best practices in this emerging field remains challenging, it is anticipated that new BMs will eventually facilitate the evolution of consumption patterns and supply chains

Table 6
Explored variables in the GBM framework.

EXPLORED VARIABLE	DESCRIPTION	IMPACT	BUSINESS STRATEGIES
Environmental Sustainability Practices	Patented technologies repurpose byproducts or waste, transforming them into eco-friendly textiles, and reducing waste and pollution.	Closed-loop production reduces waste and emissions through local sourcing. This practice attracts eco-conscious consumers, enhancing brand appeal in the green market.	Local sourcing of waste materials, implementation of circular production processes, and focus on environmental stewardship to strengthen sustainable brand equity.
Innovation and Adoption of Green Business Models	Use of unique, patented processes to transform waste into resources, developing green business models that add value for eco-sensitive consumers.	Innovative technologies and materials respond to the growing demand for sustainable products, differentiating the company from competitors, improving competitiveness, and attracting luxury brands and strategic partners.	Use of patented technologies, development of strategic partnerships, collaborations with brands, and investments in R&D for eco-sustainable business models.
Economic Sustainability and Revenue Diversification	Diversified revenue streams, including access to R&D grants and collaborations with brands, to ensure financial stability and support ongoing innovation.	Financial resilience ensures the ability to invest in continuous innovation and maintain a strong market position, reducing reliance on single revenue sources and promoting long-term growth.	Seeking grants to fund technology R&D, collaborations with brands for tailored projects, and potential licensing of technology to eco-conscious manufacturers.
Stakeholder Engagement and Local Economic Impact	Collaboration with local stakeholders and regional sourcing of raw materials, supporting the local agricultural economy and reducing transportation emissions.	Regional partnerships and a traceable supply chain generate positive economic impact locally and promote environmental sustainability, enhancing the company's social responsibility.	Local sourcing strategy, and collaboration with regional suppliers to strengthen community ties, improve traceability, and enhance branding.
Technological Integration	Use of innovative, patented technology to transform waste into high-quality textiles, with continuous improvements through R&D investments.	High-quality and differentiated products attract luxury brands, strengthening the company's competitiveness and leadership in the sustainable fashion sector.	Continuous investment in R&D to refine technology, focus on quality to meet the requirements of the target market and consolidate market positioning.
Supply Chain Transparency	Prioritizes supply chain traceability through local sourcing, enhancing visibility and control over ethical sourcing practices to reassure consumers of transparency and sustainability.	Transparency in the supply chain strengthens the brand's ethical reputation and responds to the growing demand for traceable products, increasing consumer trust.	Implementation of traceable sourcing practices, focus on transparency and ethics to ensure supply chain sustainability and attract conscious consumers.
Challenges in Implementation and Scalability	Sustainable scaling involves high costs for obtaining environmental certifications, as well as logistical challenges in sourcing and processing waste sustainably.	Business growth must be balanced with sustainability values; this requires strategic planning to avoid compromising environmental principles and maintaining consumer trust and brand credibility.	Partnerships with sustainable logistics providers, resource management plans to optimize efficiency, and maintaining certifications to ensure compliance with standards.

Source: Authors' elaboration.

(Geissdoerfer et al., 2018). The transition towards a green economy underscores the need to design and reconfigure BMs to achieve global sustainability goals (Geissdoerfer et al., 2017; Lüdeke-Freund et al., 2019). Stakeholder expectations and societal pressures drive companies to develop GBMs, yet the competitive advantage of these models within the CBE framework remains underexplored in academic discourse (Bocken et al., 2014). This study employs qualitative research to investigate significant BM studies and proposes a conceptual and managerial model to support sustainable practices in the textile supply chain. The research highlights the importance of the CBE in shaping tailored BMs, particularly the GCBMs. By aligning operations with CE principles, GCBMs provide insights into addressing the challenges and opportunities of the CBE (Tura et al., 2019). Innovation, flexibility, and sustainability are fundamental enablers of GBMs, ensuring that businesses can not only create green value but also effectively capture and deliver it to customers, fostering a sustainable competitive advantage in the market (Antikainen and Valkokari, 2016). Table 6 below integrates the variables of the CBE framework with the strategic outcomes of the GBM and associates each analyzed variable with its description, impact, and specific business strategies. This approach connects each explored variable to specific aspects of a firm's operations, providing a comprehensive perspective on how a company can navigate its position in the sustainable T- F market.

Furthermore, the GCBM offers a novel framework for analyzing and conceptualizing the innovation of CBMs focused on sustainability (Pieroni et al., 2019). Companies increasingly need to develop models that create and deliver value, incorporating economic, environmental, and social dimensions (Joyce and Paquin, 2016). Economic dimensions include factors such as growth, profit, return on investment, financial resilience, and long-term sustainability and stability. Environmental dimensions focus on using resources at a renewable rate, ensuring emissions and waste are at levels that the environment can safely metabolize, protecting biodiversity, and generating positive environmental benefits to counteract past excesses (Basile et al., 2021). Social dimensions pertain to poverty reduction, social justice, equality, well-being, community development, long-term employment, meaningful livelihoods, labour standards, wages, career development, health and safety, and diversity (Boons and Lüdeke-Freund, 2013). Attention to social justice issues is increasingly crucial in the development and reconfiguration of BMs. These issues have implications for fair trade sourcing, support for marginalized communities, progressive policies, diversity and inclusion, and local community engagement, as well as climate mitigation and CO2 reduction goals. For shareholders and investors, justice and fairness involve prioritizing social and environmental impact alongside financial returns, recognizing businesses' roles in addressing systemic issues and supporting practices that promote diversity, inclusion, and ethical conduct (Konietzko et al., 2023). The transition to a CE must be in line with aspects of environmental and social justice (Schröder, 2020). Even in developing the GCBM, important environmental and social justice aspects must be considered. Creating value not only economically but also for a just and equitable society, where diversity, equal opportunities, and human rights are guaranteed, without leaving anyone behind regardless of their disability, ethnicity, gender, or age, and supporting fair resource allocation (Bhugra, 2016). According to (Jaeger-Erben et al., 2021) and (Moreau et al., 2017) the advancement of new BMs, especially within the context of CE, should be underpinned by emerging ethical principles and economic frameworks that prioritize human welfare and societal bonds over mere financial interests. This is particularly crucial when considering the interplay of economic activities with environmental sustainability and social equity in the GCBM. The GCBM Canvas serves as a strategic tool for companies, facilitating the systematic integration of sustainable practices such as resource management, waste reduction, and aspects related to social justice. These include policies to ensure fair wages and safe working conditions for employees throughout the entire supply chain, measures to promote diversity and inclusion in the workplace, as well as initiatives aimed at supporting marginalized communities and fostering local economic development. Integrating these practices into BMs is essential

to promote a fair, equitable, and inclusive work environment that respects human rights and contributes to reducing social inequalities. The T-F industry is progressively transitioning towards sustainability, with the increased consumption of sustainable fibers being propelled by companies' ability to implement innovative BMs (Botelho et al., 2021). This transition towards sustainability in the textile industry has implications for economic, environmental, and social issues. With the increasing awareness among brands and consumers, there is an opportunity to address social inequalities within the sector. The benefits of sustainability must extend beyond profit-driven motives and luxury brands. Accessible brands, which often employ workers in vulnerable conditions, should also be integrated into these sustainability efforts. The implementation of GCBM can play a crucial role in this context, ensuring fair wages, safe working conditions, and social protections for all workers involved in the supply chain. Collaborative ecosystems will play a critical role in scaling CBE practices. Partnerships between industries - such as textiles, agriculture, energy, and waste management - will be essential. Collaborations that integrate agro-waste as raw materials will drive cross-industry innovation, illustrating the growing recognition of network-based strategies in achieving sustainability goals (Donner et al., 2020; Pedersen et al., 2021). Additionally, the widespread phenomenon of greenwashing represents a social issue as well (Løkke et al., 2020). The phenomenon is very frequent in the T-F industry and can be considered a barrier to the development of a sustainable supply chain in the textile industry (Oelze, 2017; Glavas et al., 2023). For example, H & M Hennes & Mauritz AB have been criticized for assuring that they work for sustainability, but it is very difficult for customers to know if they genuinely care for the environment or if this is merely a marketing initiative to make more financial profit (Kaner, 2021). Misleading sustainability claims not only deceive consumers but also undermine efforts towards a more equitable and sustainable industry. This perpetuates a system where those who can afford luxury products are misled into believing they are making ethical choices, while workers at the bottom of the supply chain continue to face exploitation. Consequently, combating greenwashing becomes vital in the textile industry and for promoting genuine sustainability efforts. Indeed, aspects related to social justice will increasingly play a central role in the development and reconfiguration of BMs.

6. Theoretical and managerial implications

Our research advances theoretical understanding in several key areas. The research highlights the importance of incorporating social justice into BMs, focusing on fair wages, ethical production, and equitable value distribution (Moratis et al., 2018). Integrating GBMs and CBMs within the textile and T-F industry, particularly with a focus on agro - and biowaste, carries significant political and industrial implications. It incorporates CE and BE principles into a cohesive framework tailored for the T-F industry, using waste valorization (*e.g.*, agro and biowaste) to create high-value products (Salvador et al., 2022). These are closely tied to evolving policies, industrial innovations, and cross-sector collaborations designed to foster sustainability. By applying these concepts through a case study of Orange Fiber, the study demonstrates how CBE models can be scalable and adaptable in real-world industrial contexts. It also emphasizes interdisciplinary collaboration, suggesting that partnerships across sectors like agriculture and textiles can drive sustainability and innovation. Overall, the paper enhances the existing literature on CBMs by providing sector-specific applications and a strong focus on social and environmental justice. This study presents important managerial implications, contributing both to the theoretical and practical understanding of BMs in the T-F industry. It addresses significant gaps in the global understanding of BMs, particularly in the application of sustainable practices. By focusing on dimensions such as value propositions and customer relationships, the study offers essential insights into the effective execution of BMs. A key contribution is the introduction of the GCBM, specifically designed for the T-F sector. This model focuses on utilizing agro-industrial byproducts, such as those from the citrus industry, as raw materials for production. This practical framework offers a tangible solution for companies looking to integrate sustainable practices into their operations. In addition, the study enhances existing theoretical frameworks, particularly GCBM, by applying it in the context of the T-F industry. Through a detailed case study, the research not only validates the managerial tool but also refines and adapts it to meet sector-specific challenges. This enhances its relevance and applicability, making the findings useful for industry stakeholders. The study distinguishes itself by providing concrete, actionable guidance for industry managers and decision-makers. Rather than remaining theoretical, it offers a framework that managers can use to implement sustainable practices more effectively within their organizations, ensuring its practical utility in real-world scenarios. The exploration of GCBM further integrates CE principles, offering insights into resource management, waste reduction, and ethical practices. By examining real-world examples, the study provides valuable strategies for managers looking to embed sustainability into their BMs. Moreover, the study prioritizes solutions to the environmental and social challenges faced by the T-F industry. It emphasizes resource efficiency, waste reduction, and responsible production methods, presenting the GCBM as a tool to address these pressing issues. The proactive nature of this approach ensures that companies adopting the model can contribute positively to environmental and social sustainability. The research addresses key challenges in the T-F industry's move toward CE and sustainability by integrating social justice, cross-sector collaboration, and waste reduction into BMs. It proposes the GCBMs, tailored for the T-F industry, which uses agricultural byproducts as sustainable raw materials. This model not only minimizes resource dependency but also bridges sectors like agriculture and fashion, fostering innovation and resource efficiency. The study provides actionable frameworks for managers, enabling practical shifts from traditional to sustainable practices that emphasize fair wages, ethical production, and reduced waste. These models also enhance brand reputation and align with rising consumer demand for eco-friendly products, positioning companies for long-term competitiveness and social responsibility. Overall, the research offers a clear pathway for the industry to adopt sustainability, addressing both environmental and ethical concerns while contributing positively to global sustainability goals. Finally, the research highlights the broader implications of adopting sustainable business practices, particularly in enhancing a company's reputation and competitiveness. By aligning with eco-friendly principles and meeting growing consumer demand for sustainable products, businesses can strengthen their brand image and long-term success. In conclusion, the study provides both theoretical insights and practical recommendations for stakeholders in the T-F industry, offering a clear path toward embracing sustainability and fostering a more responsible and resilient sector.

7. Political-industrial implications

Recent research on BMs sheds light on these dynamics. Politically, governments are expected to increasingly promote the adoption of BMs through regulations and incentives that align with initiatives like the European Green Deal and the Circular Economy Action Plan. Such policies encourage using renewable biological materials and push for CBE practices in sectors like textiles. This political backing is not only necessary from a regulatory standpoint but also offers strategic advantages, as recent studies emphasize the critical role of policy frameworks in promoting sustainable industrial practices. Policies designed to minimize textile waste, reduce pollution, and cut carbon emissions further create a favourable environment for industries embracing circular principles. This corresponds with the broader theory of ecological modernization, which highlights how government policies can catalyze industrial transformations toward sustainability. A key element of political support will be the integration of multi-sectoral policies, particularly those connecting agriculture, climate, and industrial sectors.

Since the textile industry increasingly utilizes agro-waste, such as citrus byproducts, coherent policy frameworks across these sectors will be essential for optimizing resource efficiency and managing sustainable materials. Literature on BMs further stresses the necessity of this integration to accelerate the transition to CBMs. Globally, the adoption of GBMs and CBMs aligns with international environmental goals such as the UN Sustainable Development Goals (SDGs) and the 2050 Decarbonization Targets. Political actors will continue to push industries to align with these global sustainability frameworks, reinforcing the importance of linking business practices with international environmental objectives. Furthermore, the growing prominence of transparency in business practices, particularly through certifications and ecolabels such as GOTS and OEKO-TEX, underlines the importance of governmental support for sustainable labelling. Such certification systems serve to verify the sustainability of products and hold industries accountable while avoiding superficial greenwashing. The increased focus on transparency and ethical practices helps maintain consumer trust and promotes genuine sustainability, a growing concern in the current industrial landscape. On an industrial level, the textile sector will face a significant need for investment in biotechnology and waste valorization technologies. Using agricultural waste, such as citrus peels, for fabric production underscores the demand for advanced bioprocessing and circular manufacturing technologies. Such transformations will drive innovation, promoting bio-manufacturing systems and circular production processes. BMs research highlights these shifts as central to future industry transformations. Industries are expected to move from linear production systems to closed-loop models, where agro-waste and other materials are continuously reused. This transition not only reduces waste but also creates opportunities for developing biorefineries and zero-waste production facilities, aligning with the core principles of the CE. Additionally, fostering collaborative ecosystems across industries such as textiles, agriculture, energy, and waste management will be crucial. Cross-industry partnerships that utilize agro-waste as raw materials represent an innovative strategy for achieving sustainability goals. The economic benefits of adopting CBMs and GBMs are also evident. By harnessing local resources like agricultural byproducts, industries can stimulate local economies and create green jobs in sectors such as bio-manufacturing. This, in turn, offers significant opportunities for job creation and economic growth, making sustainable practices economically viable. However, businesses must tread carefully to avoid the pitfalls of greenwashing, where sustainability claims are exaggerated or false (Løkke et al., 2020). As consumer demand for sustainable products grows, companies that genuinely integrate GBMs and CBMs will enhance their reputation and gain a competitive edge. Transparency and ethical practices will be essential to maintaining consumer trust and securing long-term success in the market. Policymakers should use this research as a foundation to create policies, design incentives, and craft public strategies specifically suited to the types of businesses that can thrive in a circular business environment, thereby accelerating the shift towards a CE (Salvador et al., 2023). In conclusion, the political and industrial implications of integrating GBMs and CBMs suggest a future where policy support, technological advancement, and multi-sector collaboration drive the transformation of the T-F industry, embedding sustainability into the very core of business strategies.

8. Ethical and social implications

The ethical implications and the importance of the environment and social justice in the sustainability of BMs emphasize the need for inclusive and equitable practices, especially in industries like T-F, which have historically faced criticism for labour exploitation, environmental harm, and unequal resource distribution. Ethically, the sustainable use of resources and environmental stewardship are central to this transformation. The shift towards using agro- and biowaste as sustainable materials reflects a commitment to environmental ethics by reducing waste and decreasing reliance on non-renewable resources. However, this approach must also ensure that communities supplying these materials are fairly compensated, highlighting the necessity for ethical resource use that benefits all stakeholders, not just the environment. Fair labour practices are another critical aspect, particularly in the T-F industry, where exploitative labour conditions often exist, especially in developing countries. Implementing BMs for CBE requires businesses to ensure that workers across the supply chain-especially those in low-income regions-receive fair wages and work in safe conditions. Ethical sustainability demands a holistic approach that includes not only environmental concerns but also the well-being of all workers involved in the production process. Transparency is also crucial in avoiding the ethical risks associated with greenwashing, where companies falsely claim sustainability to attract eco-conscious consumers. This practice undermines real sustainability efforts and erodes consumer trust. To maintain ethical integrity, companies must commit to transparency, using certifications and ecolabels to validate their sustainability claims and build trust with consumers. In terms of biodiversity and ethical sourcing, using agro-waste and biological resources aligns with ethical principles by reducing environmental impact and protecting biodiversity. However, ethical sourcing must also address social justice by ensuring that local communities providing these materials benefit from fair trade and are not exploited. This balance between environmental and social considerations is essential for true sustainability. Social justice plays a vital role in ensuring the equitable distribution of resources. For the T-F industry, which often relies on labour and resources from developing countries, the benefits of adopting new BMs rooted in CBE principles must be shared fairly. This involves empowering local communities, fostering economic development, and reducing inequalities. Supporting fair trade and ensuring that the economic gains from sustainable practices are shared with marginalized producers and workers is essential for achieving environmental and social justice. Inclusivity is another key component of social justice, ensuring that marginalized communities - such as women and low-income workers - are not excluded from the transition to sustainability of BMs. BMs must go beyond profitability and environmental goals to provide all workers, especially those at the lower end of the supply chain, with fair wages, safe working conditions, and opportunities for growth and development. Addressing the inequities in fast fashion is particularly important. The industry has long been criticized for contributing to labour exploitation and environmental degradation, especially in developing countries. The shift to GBMs and CBMs provides an opportunity to correct these injustices by ensuring that supply chains are ethical, that workers' rights are upheld, and that communities contributing raw materials or labour are compensated.

9. Limitations and future research

The limitations of our research concern two aspects. Firstly, a SLR that are used to access the main contributions of the literature and conceptual model. For example, the publication bias, since SLRs often focus on published studies. This bias results from the tendency to publish positive or significant findings, potentially overlooking relevant studies with null or negative results. Moreover, the SLRs are typically suited to quantitative data; applying them to qualitative studies can be challenging and may require adaptations, as they may not capture nuanced insights or themes effectively. The other limitations relate to the theoretical framework used for managerial tool selection and mainly the qualitative approach adopted in the case study. It heavily relies on the case study method, as outlined by Eisenhardt (1989) and Feagin et al. (1991), using qualitative methods during the initial exploratory phase, including in-depth interviews (Tiu Wright, 1996). Case studies are particularly well-suited for detailed exploration of research questions (Yin, 2011) and often employ data triangulation to enhance validity. However, focusing on a single case limits the generalizability of the findings. Yin (2013) suggests that using multiple case studies could provide a more comprehensive understanding, but in this research, the

focus on a single case aims to gain an in-depth understanding of the GCBMs. The emphasis on a single case study, specifically on Orange Fiber within the T-F industry, restricts the generalizability of the results. While valuable insights are provided, a more robust analysis would require multiple case studies across different industries and geographical regions to validate the framework's applicability in various contexts. Focusing on a single company also risks presenting results that may not apply to other sectors or regions. The exploratory nature of this research offers only initial insights without making definitive claims about relationships or causality. Further empirical research is required to examine the impact of the GCBM on specific sectors or industries. While the GCBMs, framework offers an innovative approach to analyzing sustainability-oriented CBMs, several limitations remain. The GCBMs, is a tool for analysis and does not replace the need to explore and evaluate potential innovations. The qualitative approach adopted, based on focus groups and in-depth interviews, while useful for exploring new areas, also faces limitations. The small sample size—composed of two focus groups and three interviews—further limits the external validity of the findings. The experiences and perspectives gathered may not represent the broader T-F industry or other sectors. Expanding the sample size or including a wider range of stakeholders, such as policymakers, customers, and supply chain partners, would enhance the study's comprehensiveness. The absence of quantitative data or a mixed-method approach makes it difficult to empirically measure the financial and environmental impacts of the GCBMs, reducing the ability to demonstrate causal relationships between the GCBMs, implementation and specific business outcomes. Moreover, integrating aspects of the environment and social justice into the study of BMs is essential to ensure a comprehensive analysis and effective application in sustainable practices. The study applies an existing framework (Salvador et al., 2021) to evaluate GBMs within the CBE. Although adapted to the T-F industry, this framework may not fully capture the dynamic nature of CE practices in other sectors. The GCBMs, functions as an analytical tool rather than an innovation generator, which may limit its practical implementation and adaptability to new technologies and market conditions. A more flexible, iterative approach may be necessary to account for evolving practices. The study lacks longitudinal data to assess the long-term impact of the proposed BM. Without such data, it is difficult to observe how BMs evolve, especially in response to changes in market conditions, regulations, and consumer preferences. Future research should include longitudinal studies to monitor the development and performance of companies adopting the GCBMs. While the study strongly emphasizes environmental sustainability, it pays less attention to the dimensions of the environment and social justice and economic factors. These aspects are increasingly interconnected, particularly in the T-F industry, where labour issues and supply chain ethics are critical concerns. A more holistic approach that balances social, economic, and environmental considerations would add significant value to the GCBMs framework. Future research could extend the application of the GCBMs beyond the T-F industry to sectors such as agriculture, automotive, or electronics, to test its versatility. Combining qualitative insights with quantitative analysis would provide a deeper understanding of the impacts of green and circular BMs, such as reductions in carbon footprint, waste, or operational costs. Investigating how regional differences in policy, culture, and market dynamics affect the implementation of GCBMs would provide a global perspective. Further exploration of the environment and social justice implications of these models is essential to ensure that economic benefits and social equity are integrated into the sustainability framework. Longitudinal studies would also provide insights into how these BMs adapt and perform in response to market shifts, technological advancements, and regulatory changes. The limitations of this study impact the generalizability and depth of its findings on GCBMs in the F-T industry. To address these, future research could broaden the scope by incorporating unpublished studies to reduce publication bias, applying multiple case studies across diverse industries and regions, and increasing sample size to represent a wider range of stakeholder perspectives. A mixed-method approach, including quantitative analysis, would offer empirical insights into the environmental and financial impacts of GCBMs, improving validity. Additionally, exploring social and economic dimensions alongside environmental sustainability could create a more holistic framework, especially important for labour and ethical issues. Longitudinal studies would reveal the long-term adaptability of GCBMs, while cross-regional research would address differences in policy, culture, and market dynamics. Expanding in these areas would enhance the relevance and practical application of GCBMs across industries and global contexts. In conclusion, while this research offers significant contributions to the literature on CBE and GBMs, its methodological limitations and narrow scope present opportunities for future studies to broaden the understanding and practical application of sustainable business practices.

CRediT authorship contribution statement

Vincenzo Basile: Writing - review & editing, Writing - original draft, Methodology, Conceptualization, Visualization. **Nunzia Capobianco:** Writing - original draft, Writing - review & editing, Methodology, Investigation, Data curation. **Roberto Vona:** Validation, Supervision, Resources.

Declarations

Conflict of interest The Authors have no conflicts of interest to disclose.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper. None. There are no interests to declare.

Appendix

Table 1
Core academic contributions of green business models (GBMs)

AUTHORS	FOCUS	MAIN FINDINGS	KEY SECTOR ASPECTS
Løkke et al. (2020)	How Sustainable Are Supported 'Green' Business Models? Advocating for the Integration of a Life Cycle Approach in Public Support Programs	*Green business models have garnered substantial political and financial support, which the public often interprets as validation of their sustainability. However, their actual sustainability performance is frequently called into question. This paper aims to evaluate the effectiveness of a specific public support program for green business models.*	Sustainable business models, Life cycle assessment, Greenwashing, Public support programmes

(*continued on next page*)

Table 1 (*continued*)

AUTHORS	FOCUS	MAIN FINDINGS	KEY SECTOR ASPECTS
Zhang et al. (2020)	Enhancing Green Dynamic Capabilities in Construction Enterprises: The Influence of Business Models and Sustainable Production Practices	*Presents a theoretical framework that integrates the concept of a green business model and sustainable production practices to explore how enterprises can develop and strengthen their green dynamic capabilities. This approach emphasizes the pivotal role of adopting environmentally conscious business strategies to drive sustainability and innovation.*	Business model, green dynamic capability, green production
Salvador et al. (2021)	Key aspects for designing business models for a circular bioeconomy	*Essential elements for implementing and managing business models were identified using the Business Model Canvas framework. These elements emphasize the importance of innovation and exploring new markets, integrating customer perspectives in value creation, maintaining strong customer relationships, effectively managing logistics and feedstock collection, understanding various methods for biomass utilization, pursuing technological advancements, establishing resilient value chains, and prioritizing value creation to ensure cost coverage.*	Circular economy, circular business model, bioresource
Trapp and Kanbach (2021)	Green technology business model archetypes	*Develops a typology of green technology business models through the identification of twelve distinct archetypes. This categorization integrates sustainable business model archetypes with technological entrepreneurship activities.*	Green technology, entrepreneurship activities
Mondal et al. (2022)	A Meta-Analysis of Green and Sustainable Business Models: An Integrated and Holistic Approach	*Explores the relationship between green entrepreneurship and the sustainable development and growth of environmentally conscious enterprises. It provides insights into the critical role played by green and sustainable entrepreneurs in driving sustainable development. Additionally, the findings highlight the importance of policymakers in fostering green and eco-friendly entrepreneurship, emphasizing their role in promoting the adoption of green business models and encouraging sustainable practices.*	Green entrepreneurship, Strategic sustainable development, Sustainable entrepreneurship
Salvador et al. (2023)	Business models for a circular bioeconomy	*Proposes archetypes for Business Models for a Circular Bioeconomy, essential for successful circular bioeconomy strategies. Focuses on resource efficiency, bio-refineries, value recovery from waste, resource exchange, and the use of bio- and renewable resources.*	Resource efficiency, bio-refineries, waste recovery, bio-resources
Kim et al. (2024)	Green Business Models and Media Coverage: Key Drivers for Successful Initial Public Offerings	*Firms with green business models (GBMs) are more attractive to investors by providing positive signals of future growth potential and sustainability. To reveal this, the study investigates the relationship between GBMs and IPO success by Ordinary Least Squares (OLS) regression analysis.*	Initial Public Offerings, green industries, green business models, green media coverage, green signal
Lee et al. (2024)	Does Institutional Pressure Drive Green Business Model Innovation in SMEs? Exploring the Mediating and Moderating Roles of Regional Innovation Intermediaries	*Identify the mechanisms through which small and medium-sized enterprises (SMEs) enhance their green business model innovation (GBMI), arguing that regional innovation intermediaries (RIIs) multifaceted response to institutional pressures can act as both a mediator and a moderator.*	Regulatory pressure, Regional innovation intermediaries, Green business model, Small-and-medium-sized enterprises
Jorzik et al. (2024)	Planting the Seeds of Sustainability: A Business Model Innovation Approach to Artificial Intelligence in Green Technology Startups	*Examines how green technology startups leverage artificial intelligence to drive business model innovation, advancing the development and implementation of green business models for environmental sustainability*	Business model innovation, Artificial intelligence, Green technology startups, Sustainability, Entrepreneurship & Startups

Source: Authors' elaboration.

Data availability

Data will be made available on request.

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