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Rethinking Fashion's Supply Chain for a Sustainable Circular Bioeconomy: Materials, Models, and Market Transformation

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Abstract

The global fashion industry, traditionally reliant on a linear, fossil-based, and growth-oriented production model, confronts a sustainability reckoning that challenges its very structure [1]. This article offers a critically framed conceptual synthesis exploring the systemic transformation necessary to shift fashion toward a circular bioeconomy [1]. It constructs and applies an integrated theoretical framework that synthesizes systems change theory [2], degrowth economics [3,4], and emotional durability [5] to present a comprehensive model for reimagining fashion through renewable materials, closed-loop business models, and socially equitable value chains [1]. This model is analyzed through the lens of key United Nations Sustainable Development Goals (SDGs)—especially SDG 12 (Responsible Consumption and Production), SDG 13 (Climate Action), SDG 8 (Decent Work and Economic Growth), and SDG 9 (Industry, Innovation, and Infrastructure)—to examine how fashion's transition can become both regenerative and just [1]. Through an analysis of illustrative case studies—including pioneering brands like Eileen Fisher, Stella McCartney, and Patagonia, alongside policy innovations such as the EU's Digital Product Passport—this paper explores how sustainability is being operationalized at multiple scales [1]. Critically, it interrogates the pervasive issues of technological solutionism, systemic greenwashing, and waste colonialism that threaten to undermine genuine progress [1]. The article concludes by offering policy, industry, and academic recommendations designed to catalyze the deep, structural shifts required for a truly sustainable and equitable fashion future [1].

Keywords: circular bioeconomy; sustainable fashion; UN SDGs; degrowth; systems change; emotional durability; greenwashing; waste colonialism; ethical design; slow fashion

1. Introduction

The global fashion industry, a nearly three-trillion-dollar behemoth, is intrinsically linked to modern culture, identity, and economic development [1]. It functions as a powerful engine of globalization and a primary medium through which individual and collective identities are expressed [1]. However, its prevailing business model—fast fashion—has precipitated a multidimensional sustainability crisis of staggering proportions, casting a dark shadow over its creative and economic contributions [1]. This crisis is not a peripheral issue but a direct consequence of the industry's foundational logic, which prioritizes speed, volume, and disposability above all else [1].

The environmental footprint of this model is immense and well-documented [1]. The sector is responsible for up to 10% of global carbon emissions, a figure that starkly exceeds the combined emissions of all international flights and maritime shipping, underscoring its significant contribution to the climate crisis [1]. Its thirst for resources is equally alarming: the industry consumes around 93 billion cubic meters of water annually, placing extreme stress on water-scarce regions where textile production is often concentrated [1]. Furthermore, it contributes approximately 20% of the world's industrial wastewater, which is frequently laden with toxic dyes, finishing chemicals, and heavy

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metals that pollute local waterways and harm ecosystems [1]. The industry's deep reliance on synthetic fibers like polyester, derived from petrochemicals, creates another persistent environmental problem: it results in an estimated half a million tonnes of plastic microfibers entering the ocean each year, contaminating marine life and food chains [1]. Simultaneously, the land-use impacts of virgin material cultivation, particularly conventionally grown cotton, contribute directly to deforestation, acute soil degradation, and devastating biodiversity loss [1].

Beyond this extensive environmental footprint, the industry is fraught with profound and systemic social inequities [1]. The 2013 Rana Plaza factory collapse in Bangladesh, which killed over 1,100 garment workers and injured thousands more, cast a harsh, unforgettable light on the systemic exploitation embedded within global fashion supply chains [1]. This tragedy was not an isolated accident but a symptom of a system where the relentless pressure for low costs and fast turnarounds leads to dangerously unsafe working conditions [1]. Despite subsequent safety initiatives like the Bangladesh Accord, which brought about critical improvements, the underlying issues of poverty wages, excessive overtime, gender-based violence, and the active suppression of labor rights remain endemic throughout the industry [1]. Reports continue to highlight how major brands' purchasing practices squeeze manufacturers, which in turn leads to the violation of workers' rights, a dynamic that was exacerbated during the COVID-19 pandemic [1].

This complex web of ecological degradation and social injustice is the direct consequence of a linear "take-make-waste" system, supercharged by a culture of hyper-consumerism that encourages disposability [1]. Driven by micro-trends and artificially low prices, global clothing production has roughly doubled since 2000, yet the average garment is worn far fewer times before being discarded, fueling a mountain of textile waste that is overwhelming landfills and creating environmental justice crises in the Global South [1]. It is estimated that the global textile industry generates around 92 million tonnes of waste annually [1].

In response to this undeniable crisis, the concepts of a circular economy and, more specifically, a circular bioeconomy have emerged as dominant paradigms for reform [1]. A circular bioeconomy proposes an economic system that uses renewable biological resources sustainably to produce goods, while intentionally designing waste and pollution out of the system from the outset [1]. In the context of fashion, this translates to a vision of a closed-loop system where garments are made from safe, renewable, and recycled materials; are designed for longevity and repair; and at the end of their life, are systematically collected to be repaired, reused, or remanufactured into new products [1].

However, despite a surge in sustainability rhetoric from major brands and policymakers, progress remains dangerously slow and is deeply contested [1]. A central paradox clouds the industry's future: while consumer awareness and regulatory pressures intensify, many corporate actors demonstrate a profound reluctance to move beyond superficial changes, fearing that deep sustainability commitments will compromise the short-term profitability that their growth-oriented business models demand [1]. This fundamental tension gives rise to pervasive greenwashing, where minor eco-conscious collections or vague marketing claims are used to obscure the persistence of an unsustainable core business practice that continues to rely on volume and disposability [1].

This article argues that a genuine transformation of the fashion industry requires more than incremental improvements or technological fixes; it necessitates a paradigm shift [1]. To explore this, we develop a critically grounded conceptual framework that synthesizes three powerful theoretical lenses: systems change theory [2] (Meadows, 1999), degrowth economics [3,4] (Fletcher & Tham, 2019; Kallis, 2018), and emotional durability [5] (Chapman, 2009) [1]. This integrated framework moves beyond a purely technical understanding of circularity to foreground the interconnectedness of material flows, business models, power structures, social equity, and cultural mindsets [1]. By examining the fashion system through the United Nations Sustainable Development Goals (UN SDGs) [6] (United Nations, 2015), particularly SDG 12 (Responsible Consumption and Production), SDG 13 (Climate Action), SDG 8 (Decent Work and Economic Growth), and SDG 9 (Industry, Innovation, and Infrastructure), this article addresses a critical gap in the literature by providing a holistic, multi-scalar model for a just and regenerative fashion bioeconomy [1]. Furthermore,

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advancements in bio-based textiles, such as those discussed by Burnstine [29] (2020), offer crucial pathways for transitioning away from traditional fossil-based materials, playing a vital role in the circular bioeconomy [1].

The paper is structured as follows. First, we outline the conceptual synthesis methodology, justifying its suitability for this interdisciplinary inquiry [1]. Second, we detail the tripartite theoretical framework, explaining how each lens provides a unique and necessary perspective on the problem [1]. Third, we present an expanded literature review that maps the terrain of environmental, social, and cultural critiques of the current fashion system [1]. Fourth, we analyze the paradigm shift from linear to circular models in greater detail [1]. Fifth, we present illustrative case studies to ground the theoretical discussion in real-world practice, analyzing them through our integrated framework [1]. This section also includes a comparative matrix of brand claims versus practices [1]. Finally, we conclude with a synthesis of findings and propose robust recommendations for future research and action to catalyze meaningful, systems-level change [1].

2. Methodology

This research employs a conceptual synthesis methodology, an approach particularly suited for integrating and critiquing complex, multidisciplinary topics where knowledge is fragmented across various fields [1]. Following the guidelines articulated by Torraco [7,8] (2005, 2016), this method involves the systematic integration of existing theories, empirical findings, and conceptual frameworks from diverse bodies of literature to construct a new, more comprehensive theoretical model or perspective [1]. Unlike a traditional literature review, which primarily summarizes and organizes existing knowledge, a conceptual synthesis aims to create *new* knowledge by building novel connections, identifying underlying patterns, and developing a more holistic understanding of a phenomenon [1]. The primary contribution of this article is therefore theoretical and critical, aiming to advance understanding by creating novel linkages between established concepts and applying them to the pressing problem of sustainability in the fashion industry [1].

The research process involved several deliberate stages. First, a purposive sampling strategy was used to select literature from a wide range of fields, including sustainability science, environmental studies, sociology, design theory, economics, and business ethics [1]. The selection prioritized high-impact, peer-reviewed academic journals, seminal books, and globally recognized industry and policy reports (e.g., from the Ellen MacArthur Foundation, the United Nations, and McKinsey & Company) to ensure a robust and credible foundation [1]. Literature was identified through academic databases such as Scopus, Web of Science, and Google Scholar, using keywords like "sustainable fashion," "circular economy," "textile recycling," "degrowth," and "garment industry ethics" [1]. The timeframe for literature selection spans roughly from 2008 to 2025, a period chosen to encapsulate the maturation of the "slow fashion" discourse following the 2008 financial crisis, the post-Rana Plaza era of heightened supply chain scrutiny, and the recent surge in circular economy policy and corporate strategy [1].

Second, three core theoretical lenses—systems change theory, degrowth economics, and emotional durability—were selected for their unique and complementary insights into the fashion crisis [1]. This tripartite structure was chosen deliberately to enable a multi-scalar analysis that can capture the complexity of the problem from the global to the individual level [1]. Systems change theory provides the macro-level framework for identifying intervention points and understanding systemic lock-in [1]. Degrowth economics offers a critical economic perspective that challenges the dominant and often unquestioned paradigm of perpetual growth that underpins the fast fashion model [1]. Finally, emotional durability provides a micro-level, design-focused lens on the crucial consumer-product relationship, addressing the cultural drivers of disposability [1]. The synthesis of these theories allows for a holistic analysis that connects global economic structures to individual design choices and consumer behaviors, bridging a common gap in the literature [1].

Third, a set of illustrative case exemplars was chosen to ground the theoretical framework in practice and demonstrate its analytical utility [1]. These cases were not selected for exhaustive

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empirical analysis but as powerful illustrations of different strategies and leverage points for change [1]. The selection includes pioneers in sustainable luxury (Stella McCartney), brands built on circular design and take-back models (Eileen Fisher), companies leveraging corporate structure for activism (Patagonia), and avant-garde cultural influencers (Vivienne Westwood) [1]. Additionally, the inclusion of the EU's policy agenda provides an example of top-down regulatory intervention, while a comparative analysis with fast-fashion giants (H&M, Shein) serves to highlight the persistent and often widening gap between sustainability rhetoric and operational reality [1]. These cases collectively represent a spectrum of approaches, highlighting both best practices and the persistent challenges of market transformation [1].

By weaving these elements together, this conceptual synthesis aims to produce a rich, nuanced, and critically informed framework that is greater than the sum of its parts, offering valuable insights for academics, policymakers, and industry practitioners working to accelerate the transition to a sustainable fashion future [1].

3. Theoretical Framework

To deconstruct the complexities of the fashion industry and envision a path toward a circular bioeconomy, a multifaceted theoretical framework is required [1]. A singular lens is insufficient to capture the interplay of economic structures, design choices, consumer culture, and policy that defines the current system [1]. This study integrates three distinct yet complementary conceptual lenses: systems change theory, degrowth economics, and emotional durability [1].

3.1. Systems Change and Leverage Points

Thinking in systems is crucial for understanding why the fashion industry, despite widespread awareness of its myriad problems, is so resistant to fundamental change [1]. The industry is a classic complex adaptive system, characterized by numerous actors (designers, manufacturers, brands, consumers, regulators), powerful feedback loops (such as trends and pricing signals), and deeply entrenched structures that reinforce the status quo of high-volume, low-cost production [1]. Donella Meadows' [2] (1999) seminal work on leverage points provides a hierarchical framework for identifying places within a complex system where a small shift can produce significant, transformative change [1]. According to Meadows [2], interventions at higher leverage points are more powerful and capable of altering the system's fundamental behavior, goals, and paradigm [1]. Applying this hierarchy to fashion allows for a more strategic analysis of sustainability initiatives:

- **Low-Leverage Interventions (Parameters and Buffers):** These are the most common but least powerful interventions, involving adjustments to numbers and physical flows within the existing system [1]. Examples include increasing the percentage of recycled content in a polyester fabric or improving the energy efficiency of a dyeing machine [1]. While beneficial and necessary, these are "tweaks" that do not challenge the underlying linear logic of the system [1]. They make an unsustainable model slightly less bad but do not transform it [1].
- **Medium-Leverage Interventions (Feedback Loops and Information Flows):** These interventions are more powerful as they involve changing the information that actors in the system receive, which can alter behavior [1]. This can involve strengthening negative feedback loops that stabilize the system or introducing missing positive feedback loops [1]. For example, a robust take-back program provides a brand with direct physical feedback on its products' durability and failure points, creating an incentive to design better products [1]. The development of Digital Product Passports, as envisioned by the EU, is a powerful intervention at this level, as it alters information flows and enhances accountability for consumers, brands, and recyclers by making a garment's lifecycle transparent [1].
- **High-Leverage Interventions (Rules, Goals, and Paradigm):** These are the most transformative interventions, capable of altering the entire system's trajectory [1].

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- **Changing the Rules:** This involves implementing strong regulations or new business rules that change the incentives and constraints for all actors [1]. A prime example is Extended Producer Responsibility (EPR) policy, which makes producers financially and operationally responsible for the end-of-life management of their products [1]. This fundamentally changes the rules of the game, creating a powerful financial incentive to design for durability, repairability, and recyclability [1].
- **Changing the Goals of the System:** This is one of the highest leverage points [1]. The current goal of the dominant fashion system is to maximize profit and growth [1]. Shifting this primary goal to optimizing human and ecological well-being would fundamentally reorient all activities within it [1]. Patagonia's recent ownership restructuring, where the company's profits are dedicated to environmental protection and its values are legally protected by a trust, is a real-world attempt at such a goal change, moving beyond the shareholder primacy model [1].
- **Changing the Paradigm:** The highest leverage point is shifting the shared mindset or paradigm out of which the system arises—its deepest-held beliefs [1]. In fashion, this means transcending the deeply ingrained cultural belief of "fashion as disposable consumption" and replacing it with a new paradigm of "fashion as durable expression, service, and connection" [1].

By using this framework, we can analyze sustainability initiatives not just by their immediate impact, but by their potential to catalyze deeper, systemic transformation [1].

3.2. Degrowth and Post-Growth Economics

The concept of the circular economy is often co-opted by incumbent firms and policymakers to fit neatly within the existing paradigm of perpetual economic growth [1]. This "green growth" narrative suggests that through technological innovation and efficiency improvements, we can successfully decouple resource use and environmental impact from economic output indefinitely [1]. However, degrowth economics offers a powerful and necessary critique of this position [4] (Kallis, 2018) [1]. Degrowth scholars argue that in a world with finite planetary boundaries, the pursuit of endless GDP growth is a physical impossibility and a socially destructive goal [1].

In the context of fashion, this critique is particularly salient [1]. The industry is a textbook example of the Jevons paradox (where increased efficiency leads to increased consumption) or rebound effects: as production becomes cheaper and more efficient (e.g., through using recycled polyester or automating manufacturing), prices fall, which in turn stimulates even greater overall consumption, thereby negating any efficiency gains [1]. The global apparel market is a stark example of this, having roughly doubled production from 2000 to 2015 while the average number of times a garment is worn before being discarded has significantly declined [1]. This dynamic clearly demonstrates that a circular economy focused solely on recycling and material efficiency, without addressing the underlying driver of overconsumption, will fail to reduce the industry's overall environmental impact [1].

Degrowth should not be confused with austerity or recession; it is a call for a *planned* and *equitable* downscaling of production and consumption, particularly in wealthy nations, to bring society back within planetary boundaries [1]. It proposes replacing the GDP-growth imperative with goals centered on well-being, ecological health, and social equity [9] (Hickel, 2020) [1]. Applied to fashion, degrowth implies a radical shift toward sufficiency [3] (Fletcher & Tham, 2019) [1]. This could manifest in several ways:

- Radically smaller, seasonless collections and dramatically extended product lifetimes, moving away from the trend-driven cycle [1].
- The proliferation of business models that prioritize services like repair, rental, tailoring, and restyling over the sale of new units, thereby deriving revenue from value and durability rather than sheer volume [1].
- The implementation of transformative policies that limit resource throughput, such as caps on virgin material extraction, taxes on overproduction, advertising restrictions, or outright bans on the destruction of unsold goods [1].

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Degrowth theory forces a direct confrontation with fashion's core logic of endless expansion, arguing that true sustainability is unattainable without addressing the ideology that fuels the fast fashion model [1].

3.3. Emotional Durability and Slow Consumption

While systems thinking and degrowth provide macro-level critiques of the industry's structure and economics, emotional durability offers a crucial micro-level perspective focused on the relationship between the user and the product [1]. Coined by design theorist Jonathan Chapman [5] (2009), emotional durability refers to the design of objects that foster deep, meaningful, and lasting emotional connections with their users, thereby actively discouraging disposability [1]. In a world saturated with fleeting trends and driven by social media, emotionally durable design seeks to counteract the psychological obsolescence that is the primary engine of fast fashion's consumption cycle [1]. This concept aligns perfectly with the broader slow fashion movement, which champions quality, longevity, craftsmanship, and classic design over speed and volume [10,11] (Clark, 2008; Fletcher, 2010) [1]. It advances the simple but powerful idea that the most sustainable product is the one that is kept, cared for, and cherished for a long time, regardless of the materials it is made from [1].

Strategies to enhance the emotional durability of garments are tangible and can be integrated into the design process:

- **Design for Narrative:** Creating products with rich stories about their materials, their makers, their cultural heritage, or the place they were made [1]. This transforms the garment from a mere commodity into a vessel of meaning and connection [1].
- **Design for Agency:** Allowing for personalization, co-creation, or modularity, which enables the garment to evolve with the user over time [1]. Examples include a jacket with removable sleeves, customizable patches, or a design that can be altered easily [1].
- **Timeless Aesthetics and Superior Quality:** Crafting garments with high-quality materials and superior construction that are built to last physically and are designed to transcend fleeting trends stylistically, ensuring they remain relevant and wearable for years [1].
- **Fostering Care and Repair:** Designing products that are easy to repair and providing services, information (e.g., QR codes linking to care guides), or tools that empower users to maintain their clothing, thereby building a sense of stewardship and co-ownership [1].

Emotional durability offers a powerful antidote to the throwaway culture that defines modern fashion [1]. However, it is critical to avoid "green-shifting"—the tendency to place the full burden of sustainable consumption on individuals while producers continue to churn out low-quality, trend-driven items that are difficult to cherish or maintain [1]. Producers and designers have a primary responsibility to create products that are *worthy* of being cherished in the first place [1]. When integrated with the systemic and economic shifts proposed by systems theory and degrowth, fostering emotional durability can help cultivate a new cultural mindset where the most valued garments are not the newest, but those rich with memory, history, and personal significance [1].

4. Literature Review Summary

The scholarly and industry literature provides extensive documentation of the fashion industry's profound unsustainability, forming the foundation for this paper's synthesis [1]. Environmental critiques are well-established. Niinimäki et al. [12] offer a comprehensive, evidence-based account of the sector's severe climate impacts, extensive water pollution, and heavy chemical load, concluding that current practices are fundamentally incompatible with a sustainable future [1]. This alarm is echoed by industry-focused reports, such as one from the Bio-based Industries Consortium [13] (2021), which explicitly calls for a circular bioeconomy approach to transform the fashion and textiles sector into a sustainable system [1].

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The sheer scale of the waste problem is staggering, with the global industry generating an estimated 92 million tonnes of textile waste annually [14] (European Commission, 2023), the vast majority of which ends up in landfills or incinerated [1]. Critically, only a tiny fraction of this material is recycled back into new clothing, highlighting the failure of current recycling infrastructure [1]. This has led to the rise of waste colonialism, an environmental justice issue where textile waste from the Global North is exported to the Global South, creating significant environmental and social burdens [15,16] (Brooks, 2015; Kassaye et al., 2022) [1].

Alongside these material critiques, scholars have added crucial cultural dimensions [1]. Clark [10] (2008) and Fletcher [11] (2010) were instrumental in introducing the concept of slow fashion as an alternative ethos that values quality, longevity, and timelessness over the speed and disposability of the dominant model [1]. In response to this growing body of evidence and critique, policy documents have begun to emerge [1]. The European Union's Strategy for Sustainable and Circular Textiles [14] (European Commission, 2023) represents a landmark effort, calling for robust measures like Extended Producer Responsibility (EPR) and Digital Product Passports to improve transparency and accountability [1].

Despite this growing awareness, a significant implementation gap remains between sustainability rhetoric and corporate reality [1]. Many corporate sustainability initiatives lack transparency and accountability, often amounting to "greenwashing," where marketing claims are used to obscure unsustainable core business models [17] (Delmas & Burbano, 2011) [1]. For instance, major fast fashion retailers have launched "conscious" or "eco" collections that represent only a minuscule portion of their overall output and sometimes employ misleading or unsubstantiated claims about their environmental impact [1]. Joy et al. [18] note that even luxury brands have attempted to leverage ethical appeals for market distinction, yet genuine systemic change requires a fundamental rethinking of the business model, not just a marketing strategy [1].

The social dimension remains equally critical and unresolved [1]. Labor rights violations and deep-seated inequities persist throughout fashion's global supply chains, more than a decade after the Rana Plaza disaster highlighted the deadly cost of inaction [19] (Anner, 2019) [1]. Furthermore, the phenomenon of waste colonialism, where wealthy countries ship used clothing to developing regions under the guise of charitable donation, has only recently gained significant scholarly attention as a key ethical failure of the linear system [16] (Kassaye et al., 2022) [1]. This article seeks to address these interconnected issues by uniting critical theory, global sustainability goals, and case-driven analysis to envision a more just, equitable, and truly circular fashion system [1].

5. From Linear to Circular: A Paradigm Shift in Fashion Systems

The transition from a linear to a circular bioeconomy represents nothing less than a fundamental paradigm shift for the fashion industry [1]. It requires moving beyond the simple, destructive "take-make-waste" trajectory to a model that is regenerative and restorative by design [1]. The core objective of this shift is to decouple economic activity from the consumption of finite resources and to completely eliminate waste from the system by treating it as a design flaw [1]. This shift transforms every aspect of the industry, from material choice and design philosophy to business logic and the role of the consumer [1]. The key differences between these two paradigms are stark, as outlined in Table 1 [1].

Table 1. Comparison of the Linear Fashion Model and a Circular Bioeconomy Model [1].

Aspect	Linear Fashion Model	Circular Bioeconomy Model
Business Logic	Fast, trend-driven production; profit from volume	Regenerative, long-term value creation; profit from services & longevity
Materials	Virgin, fossil-based synthetics; resource-intensive cotton	Bio-based, renewable, recycled, and non-toxic fibers
Design Philosophy	Design for obsolescence; low cost and disposability	Design for durability, repair, disassembly, and recyclability

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Labor & Supply Chain	Opaque, outsourced production; focus on cost minimization	Transparent, ethical supply chains; investment in worker well-being
Consumer Role	Passive consumption; "buy and discard" mentality	Active co-creation; mindful use, care, repair, and return
End-of-Life	Disposal via landfill or incineration	Systematic collection for reuse, remanufacturing, or recycling

Export to Sheets *Note:* This table compares the fundamental characteristics of the dominant linear fashion model with an idealized circular bioeconomy model. The linear model prioritizes volume and speed at the expense of sustainability, whereas a circular bioeconomy emphasizes regeneration, transparency, and longevity [1].

This circular approach is predicated on three core principles, adapted from the work of the Ellen MacArthur Foundation [20] (2017) [1]:

- **Design Out Waste and Pollution:** This is a proactive, preventative approach that stands in stark contrast to the reactive waste management of the linear system [1]. It means designing garments from the very outset to be durable, easily repairable, and eventually, fully recyclable or compostable [1]. This involves critical choices at the design stage, such as selecting mono-materials (e.g., 100% cotton or 100% polyester) that are far easier to recycle than blended fibers [1]. It also requires the complete avoidance of hazardous chemicals in dyeing and finishing processes, which not only protects ecosystems but also ensures that materials are safe to be returned to the biosphere or technosphere at their end of life [21] (Kant, 2012) [1]. This principle fundamentally shifts responsibility for waste from the consumer or municipality to the designer and producer [1].
- **Keep Products and Materials in Use:** This principle emphasizes strategies that extend the life of products and materials at their highest possible value for as long as possible [1]. This creates a clear hierarchy of circular strategies: direct reuse (resale) is preferable to repair, which is preferable to remanufacturing, which is preferable to recycling, because each step down the hierarchy results in a greater loss of the product's embedded energy, labor, and economic value [1]. This principle gives rise to innovative business models like clothing rental platforms, brand-operated resale channels (such as Patagonia's Worn Wear), and the provision of robust repair services offered by brands to foster longevity and customer loyalty [1].
- **Regenerate Natural Systems:** This is where the "bio" in bioeconomy becomes crucial, connecting the industrial system back to the ecological one [1]. For fibers that come from agriculture (like cotton, linen, hemp, and jute), this means moving beyond merely "sustainable" farming to adopting regenerative agricultural practices that actively restore soil health, enhance biodiversity, improve water cycles, and sequester carbon from the atmosphere, turning farms into carbon sinks [1]. For technical materials like polyester or nylon, it means creating closed technical loops where they can be perpetually recycled back into high-quality fibers without significant degradation, thus reducing the reliance on virgin fossil fuels [1].

This paradigm shift fundamentally moves the source of value away from simply selling more new products [1]. Instead, value is created by providing durable, high-quality goods, offering valuable services that extend product life, and building long-term, service-based customer relationships [1]. In doing so, it transforms the role of the consumer from a passive buyer into an active participant and co-creator in a circular system [1]. This profound shift aligns directly with the highest leverage points for systems intervention identified by Meadows [2] (1999) [1].

6. Case Studies and Models of Circularity in Practice

To move from abstract theory to concrete practice, this section examines how various actors in the fashion ecosystem are attempting to implement circular bioeconomy principles [1]. These cases are chosen to illustrate different strategies, scales of operation, and leverage points for intervention, highlighting both the potential for transformation and the persistent challenges that remain [1].

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6.1. Eileen Fisher: Pioneering Circular Design and Take-Back

American fashion brand Eileen Fisher has long been a vocal advocate for sustainability, building its brand identity on timeless design, high-quality materials, and a commitment to ethical production [1]. A cornerstone of its circular strategy is the Renew program, first launched in 2009 as one of the earliest take-back initiatives in the industry [1]. This initiative functions as a robust and well-established take-back and resale system: customers can return any worn Eileen Fisher garment, at any time and in any condition, to any of the brand's retail stores in exchange for a small store credit [1]. This simple mechanic has proven remarkably effective; as of the early 2020s, the company had taken back over 1.5 million garments, diverting them from landfills [1]. The returned items are sent to a dedicated facility where they are sorted, cleaned, and either resold as-is, expertly repaired for resale, or—if unsellable as garments—used as raw material for the company's "Waste No More" upcycling initiative, which transforms damaged textiles into unique wall hangings, pillows, and other art objects [1].

This model exemplifies several core circular principles in action: it demonstrates profound producer responsibility for products at their end-of-life, it extends the life of garments through repair and resale, and it creates new value from materials that would otherwise be considered waste [1]. From a systems perspective, the Renew program represents a high-leverage intervention by changing information flows—the company gains invaluable data on product longevity, common failure points, and material performance—and altering the rules of its own business model to one that profits from durability and long-term customer relationships [1].

6.2. Stella McCartney: Leadership in Sustainable Luxury and Material Innovation

Stella McCartney has built her luxury fashion house on an uncompromising ethical foundation since its inception in 2001, proving that high fashion and sustainability are not mutually exclusive [1]. A lifelong vegetarian, McCartney has famously and steadfastly refused to use leather, fur, feathers, or animal-based glues in any of her collections, a radical stance in the luxury sector [1]. This deep-seated ethical commitment has driven the brand to become a global leader in material innovation [1]. McCartney has consistently championed the use and development of sustainable alternatives, including organic cotton, recycled polyester and nylon, and, most notably, cutting-edge bio-fabricated materials [1]. The brand has been a key partner in the development and commercialization of materials like Mylo™, a "mushroom leather" grown from mycelium, the root structure of mushrooms, which offers a viable, high-performance alternative to animal leather [1].

This intense focus on the "Materials" component of circularity is a crucial intervention at the very input stage of the fashion system [1]. By leveraging the significant cultural capital and influence of a luxury brand, Stella McCartney not only reduces her own company's environmental footprint but also helps to normalize, popularize, and de-risk sustainable materials for the wider industry [1]. Her work challenges the deeply entrenched paradigm that luxury requires extractive and often cruel materials, demonstrating that innovation and ethics can be sources of desirability and brand value [1].

6.3. Vivienne Westwood: Fashion as Cultural Activism and Protest

The late Dame Vivienne Westwood used her global platform as a world-renowned and revered designer to wage a relentless campaign of cultural and political activism [1]. Emerging from the anarchic punk scene of the 1970s, Westwood's work was always infused with a rebellious, anti-establishment spirit that she carried throughout her career [1]. Her iconic slogan, "Buy Less, Choose Well, Make It Last," became a powerful and concise mantra for the slow fashion movement and served as a direct and unambiguous challenge to the consumerist ethos of the mainstream industry [22] (Westwood, 2014) [1].

Westwood's primary contribution to the circular economy was not in material science or business models, but at the level of mindset and paradigm shift—the highest and most powerful

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leverage point in Meadows' [2] (1999) framework [1]. Through her provocative runway shows, which often featured models carrying protest signs about climate change and political corruption, her advertising campaigns, and her frequent public protests, she relentlessly communicated the urgency of the climate crisis and the fashion industry's complicity in it [1]. Her work was a direct application of degrowth politics, questioning the very desire for novelty and constant consumption that fuels the industry [1]. She famously advised people to wear their clothes repeatedly and to not follow fashion trends, an act of commercial heresy that solidified her role as a cultural provocateur [1].

6.4. Patagonia: Regenerative Business and Corporate Governance

Patagonia has long been an exemplar of corporate responsibility, building its brand on product durability and environmental activism [1]. Its Worn Wear program is a multi-faceted initiative that encourages repair through DIY guides and repair services, facilitates trade-ins of used gear for store credit, and operates a thriving resale market for pre-owned Patagonia products [1]. The company has also been a leader in material innovation for decades, from its early adoption of organic cotton and recycled polyester in the 1990s to its development of Yulex®, a plant-based, renewable alternative to petroleum-based neoprene for wetsuits [1].

However, Patagonia's most radical and system-changing intervention occurred in 2022 when its founder, Yvon Chouinard, and his family transferred 100% of the company's ownership to two new entities: the Patagonia Purpose Trust and the Holdfast Collective [1]. The Trust holds all voting stock (2% of the total), with the legal mandate to protect the company's core values and mission indefinitely [1]. All non-voting stock (98% of the total) was transferred to the Holdfast Collective, a non-profit organization dedicated to fighting the environmental crisis [1]. This groundbreaking structure means that all of Patagonia's profits that are not reinvested back into the business are distributed as a dividend to fund environmental protection and advocacy work around the world [1]. This represents the highest level of systems intervention: changing the goal of the corporation from maximizing shareholder profit to maximizing environmental benefit [1]. In Chouinard's words, "Earth is now our only shareholder" [23] (Patagonia, 2022) [1].

6.5. EU Policy Innovation: Creating a Regulatory Framework for Circularity

While brand-led initiatives are crucial, top-down regulatory intervention is a vital lever for driving industry-wide change and creating a level playing field [1]. The EU Strategy for Sustainable and Circular Textiles [14], adopted in 2022, is arguably the most ambitious and comprehensive policy package of its kind globally, signaling a major shift in how the fashion industry will be regulated (European Commission, 2023) [1]. Key measures proposed in the strategy include:

- **Eco-design Requirements:** Mandating that textiles sold in the EU meet specific criteria for durability, repairability, recyclability, and minimum recycled fiber content, effectively banning the most disposable products from the market [1].
- **A Digital Product Passport (DPP):** A digital record attached to a garment that provides transparent and standardized information about its materials, origin, manufacturing processes, and recyclability, enhancing transparency for consumers, businesses, and recyclers [1].
- **Extended Producer Responsibility (EPR):** Legally and financially mandating that producers are responsible for the collection and management of textile waste, creating a powerful incentive to design products that are easier and cheaper to recycle [1].
- **Tackling Greenwashing:** Implementing stricter, legally binding rules on the use of environmental claims to ensure they are clear, specific, and verifiable, thereby protecting consumers from misleading marketing [1].

These regulations, once fully implemented, aim to change the rules of the entire market, forcing all companies operating in the EU to raise their sustainability baseline and move away from a linear model [1].

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6.6. Content Analysis Matrix: Sustainability Claims vs. Practices

There is often a significant and telling disconnect between the sustainability claims made in corporate marketing materials and the reality of a company's core business model [1]. Table 2 provides a comparative analysis of two prominent fast-fashion brands against two brands that have built their identities on sustainability principles, illustrating the difference between superficial and systemic approaches [1].

Table 2. Comparative Analysis of Sustainability Claims and Practices in Select Fashion Brands [1].

Brand	Sustainability Claim	Actual Practice & Business Model	Alignment with SDGs & Circular Principles
Shein	"EvoluSHEIN" eco-conscious collection; claims of using recycled materials.	Ultra-fast fashion model with thousands of new styles daily; extreme production volumes; lack of supply chain transparency; business model is fundamentally linear and disposable.	**Weak/Contradictory:** Claims align with SDG 12, but the core business model directly undermines it by promoting hyper-consumption and waste.
H&M	"Conscious Choice" line; garment collection program; goal to use 100% recycled or sustainable materials.	"Conscious" line is a small fraction of total output; core business remains fast fashion; garment collection has low recycling rates into new clothes; accused of destroying unsold stock.	**Partial/Incremental:** Shows some alignment with SDG 12.5 (waste reduction), but impact is limited by the persistence of a linear, high-volume business model. A low-leverage intervention.
Eileen Fisher	"Circular by Design"; "Waste No More"; commitment to organic and sustainable fibers.	Robust take-back program (Renew) for resale and upcycling; focus on timeless design and quality; significant investment in organic fibers and fair labor.	**Strong:** Deep alignment with SDG 12 (sustainable production), SDG 13 (climate action), and SDG 8 (decent work). The model is circular in practice, not just in marketing.
Patagonia	"Built to Last"; "We're in business to save our home planet".	Lifetime repair guarantee; Worn Wear resale platform; use of recycled/regenerative materials; corporate ownership structure dedicates all profits to environmental causes.	**Very Strong/Transformative:** Aligns with SDG 12, SDG 13, SDG 8, and SDG 9 (innovation). The corporate governance change represents a shift in the system's goal, the highest leverage point.

Note: This table illustrates the stark difference between incremental, superficial sustainability efforts and deep, systemic commitment. Fast-fashion retailers deploy sustainability as a marketing tool for specific product lines, while their core business model continues to drive overconsumption. In contrast, brands like Eileen Fisher and Patagonia have integrated circular and ethical principles into their core operations, strategy, and governance [1].

7. Conclusions: Towards a Regenerative and Just Fashion Future

The transition to a circular bioeconomy in fashion is not merely a technical challenge of material substitution or waste management; it is a profound project of systemic and cultural transformation [1]. This article has synthesized theoretical perspectives from systems change [2] (Meadows, 1999), degrowth economics [4] (Kallis, 2018), and emotional durability [5] (Chapman, 2009) to argue that a genuinely sustainable future for fashion requires simultaneous, interconnected shifts across materials, business models, policy, and cultural mindsets [1]. The evidence and analysis presented confirm that simply tweaking the existing linear, growth-obsessed system is insufficient and will not deliver the necessary change; a full paradigm shift is necessary [1].

Our analysis confirms that while technological innovations in materials and recycling are vital components of a future solution, they are not a panacea [1]. Without a corresponding shift in business models away from a relentless focus on volume, and without addressing consumption levels, any efficiency gains are likely to be consumed by rebound effects, potentially worsening the overall impact [12] (Niinimäki et al., 2020) [1]. The case studies of Eileen Fisher and Patagonia demonstrate that alternative models—predicated on take-back, repair, resale, and a deep commitment to longevity—are not only viable but can build profound and lasting customer loyalty [1]. Furthermore, the critique from degrowth economics is essential for tempering a naive optimism around "green growth" in a resource-intensive industry like fashion [1]. The industry simply cannot become sustainable while it continues to expand its material throughput exponentially [1]. This requires a

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courageous and politically difficult conversation about sufficiency, particularly in the over-consuming markets of the Global North, which drive the majority of the industry's negative impacts [9] (Hickel, 2020) [1].

A crucial and emerging catalyst in this transition is the shifting geopolitical and economic landscape, which may be forcing change upon the industry from the outside [1]. Recent protectionist trade policies, such as the significant tariffs imposed by the United States on apparel imported from China, Vietnam, and Bangladesh, are beginning to disrupt the fast fashion business model at its core [24] (Forest Shipping, 2025) [1]. The closure of tariff loopholes like the *de minimis* exemption, which ultra-fast fashion platforms like Shein and Temu relied on heavily to ship cheap, individual packages directly to consumers tax-free, is expected to increase the consumer price of disposable garments [25] (Kayata, 2025) [1]. This external shock acts as a powerful, if unintentional, intervention in the fashion system [1]. By eroding the artificially low-price advantage of linear fast fashion, these tariffs may inadvertently narrow the price gap between disposable clothing and more durable, sustainably made alternatives [26] (Raes, 2025) [1]. This economic pressure could serve as a "silver lining," forcing a reckoning with the true costs of production and potentially nudging consumers toward more considered purchasing habits, including quality-focused slow fashion and the second-hand market [27] (WHYY, 2025) [1].

However, this development is not without its own complexities and risks [1]. The same tariffs can harm small, ethical brands that rely on international sourcing for specialized sustainable materials, and there is a significant risk that production will simply shift to other low-cost regions not yet affected by tariffs, potentially exacerbating labor exploitation elsewhere as brands search for the next frontier of cheap labor [28] (NDTV, 2025) [1]. This underscores a central thesis of this paper: sustainable transformation cannot be left to market shocks or isolated interventions [1]. It requires intentional, holistic, and just design [1].

Crucially, justice and equity must remain non-negotiable pillars of the circular bioeconomy [1]. A circular system that merely cycles materials more efficiently while continuing to exploit labor in its supply chains [19] (Anner, 2019) or offload its waste burden onto marginalized communities in the form of waste colonialism [16] (Kassaye et al., 2022) is not a sustainable system; it is merely a greenwashed version of the old one [1]. True circularity must be inclusive, ensuring living wages, respecting indigenous knowledge, and eliminating the neocolonial dumping of waste [1].

Ultimately, policy and culture are the highest-leverage points for driving deep and lasting change [1]. The EU's ambitious regulatory strategy shows the potential for top-down intervention to level the playing field and raise the bar for the entire industry [1]. Simultaneously, the work of cultural influencers and designers like Vivienne Westwood highlights the critical importance of shifting mindsets and challenging the deep-seated cultural narratives that equate happiness with novelty and consumption [1]. The path ahead is fraught with challenges, from the entrenched financial interests of the fast fashion model to the persistent threat of sophisticated greenwashing [17] (Delmas & Burbano, 2011) [1]. Yet, the seeds of a new, regenerative fashion system are visible across design studios, innovative businesses, policy chambers, and activist communities [1]. Nurturing them will require unprecedented collaboration, courage, and a shared commitment to building a fashion industry that is not only circular and bio-based, but also equitable, just, and beautiful in the truest sense of the word [1].

8. Future Research

This conceptual synthesis opens several crucial avenues for future empirical and theoretical inquiry [1]. Advancing the transition to a just and circular bioeconomy in fashion requires a research agenda that is as multi-scalar and interdisciplinary as the problem itself [1]. We propose the following priority areas for future scholarship:

- **Centering Global South Leadership and Indigenous Knowledge:** The dominant discourse on the circular economy is often Eurocentric, focusing on high-tech solutions and business models developed in the Global North [1]. Future research must actively investigate and amplify circular

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fashion models, indigenous material knowledge, and sustainable textile practices that are already being led by entrepreneurs, designers, and communities in the Global South, because these perspectives are often marginalized in current discourse despite offering centuries of sustainable practice [1]. This includes studying traditional textile systems that have operated sustainably for centuries and understanding how they can inform a modern circular bioeconomy [1].

- **The Political Economy of Degrowth in Fashion:** While degrowth offers a powerful theoretical critique, more empirical research is needed to model the economic and social implications of a planned downscaling of the fashion industry in high-income countries [1]. This includes researching transition pathways for workers, exploring alternative metrics of economic health beyond GDP for the sector, and analyzing the political feasibility of implementing degrowth-aligned policies like production caps or consumption taxes [1].
- **Measuring and Governing Emotional Durability:** Emotional durability is a powerful concept, but it remains difficult to measure and operationalize at scale [1]. Future research could develop and validate metrics to assess the emotional longevity of garments, moving beyond purely physical durability testing [1]. This could involve longitudinal studies of wardrobe use, qualitative analysis of consumer-garment relationships, and exploring how policies or business models (like repair services) can be designed to actively foster it [1].
- **Critical Assessment of Circular Technologies and Infrastructure:** As new technologies for chemical recycling and automated textile sorting become available, critical and independent assessments are needed to evaluate their true environmental benefits, economic viability, and scalability [1]. Research should investigate the energy inputs, chemical outputs, and actual recovery rates of these technologies to avoid investing in solutions that may have unintended negative consequences or that fail to deliver on their promises [1].

By pursuing these research directions, the academic community can play a vital role in navigating the complexities of fashion's transformation, holding the industry accountable, and helping to build the evidence base for a system that is environmentally regenerative, socially just, and culturally enriching [1].

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