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Assessing the Sustainable Circular Fashion Supply Chain as a Model for Achieving Economic Growth in the Global Market

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Abstract

The global fashion industry faces a deepening sustainability crisis that threatens its structural integrity. This study explores the systemic transformation required to transition fashion toward a circular bioeconomy, emphasizing renewable materials, closed-loop business models, and socially equitable value chains. Using a conceptual synthesis approach, the research integrates systems change theory, degrowth economics, and emotional durability to develop a comprehensive model aligned with key United Nations Sustainable Development Goals, including responsible consumption, climate action, decent work, and innovation. Through illustrative case studies—such as Eileen Fisher, Stella McCartney, Patagonia, and policy initiatives like the EU's Digital Product Passport—the paper examines how sustainability is being operationalized across scales. It critically addresses challenges including technological solutionism, systemic greenwashing, and waste colonialism. The findings offer practical insights and strategic recommendations for policymakers, industry leaders, and academics to support a regenerative and just transition in fashion. The study highlights the complex interplay of material flows, business models, power structures, and cultural mindsets, presenting a multi-scaled framework for advancing cleaner production and circularity in one of the world's most resource-intensive sectors.

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

1. Introduction

The global fashion industry, a nearly three-trillion-dollar behemoth, is intrinsically linked to modern culture, identity, and economic development. It functions as a powerful engine of globalization and a primary medium through which individual and collective identities are expressed. 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. 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.

The environmental footprint of this model is immense and well-documented. 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 [29–32]. It emits approximately **1.2 billion tons of CO_2 annually**, and if current trends persist, it could account for **26% of global emissions by 2050 [31,32].** The **fast fashion model**, with its rapid production and consumption cycles, is a major driver of these emissions [29,31,32] underscoring its significant contribution to the climate crisis. Its thirst for resources is equally alarming: the industry consumes around 93 billion

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cubic meters of water annually, placing extreme stress on water-scarce regions in the global south, where textile production is often concentrated [29,30,32,33]. Furthermore, it contributes approximately 20% of the world's industrial wastewater, which is frequently laden with toxic dyes, finishing chemicals, and heavy metals such as **oil, phenol, dyes, pesticides**, and **heavy metals** (e.g., copper, mercury, chromium) that pollute local waterways where laws regulating water discharge do not exist or are not enforced [29,30,32,34]. 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 Tons of plastic microfibers entering the ocean each year, contaminating marine life and food chains [5]. Simultaneously, the land-use impacts of virgin material cultivation, particularly conventionally grown cotton, contribute directly to deforestation, acute soil degradation, and devastating biodiversity loss [30,32].

Beyond this extensive environmental footprint, the industry is fraught with profound and systemic social inequities. 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. 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 [6]. 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 [7]. Reports continue to highlight how major brands' procurement practices squeeze manufacturers, which in turn leads to the violation of workers' rights, a dynamic that was exacerbated during the COVID-19 pandemic [8].

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. 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 [9,10]. It is estimated that the global textile industry generates around 92 million tons of waste annually [11].

In response, the concepts of a circular economy and, more specifically, a circular bioeconomy have emerged as transformative frameworks aimed at solving these systemic challenges. A circular bioeconomy envisions an economic model that relies on renewable biological resources and designs waste and pollution out of the system from the outset. Within the fashion context, this translates into a closed-loop system where garments are produced from safe, renewable, and recycled materials; designed for durability, repair, and reuse; and manufactured under enforceable western labor and environmental standards through sourcing practices that require them and audits the manufacturing sites for them, being the most influential point of intervention [1]. At the end of their lifecycle, these garments are systematically collected and reintegrated into production through reuse, remanufacturing, or recycling. This approach directly addresses the core problem of waste accumulation by establishing clear objectives: reducing resource consumption, minimizing environmental harm, and creating socially equitable value chains. Innovations in bio-based textiles, such as those explored by Burnstine (2020), further support this transition by offering alternatives to fossil-based materials, thereby reinforcing the goals of a regenerative and sustainable fashion system [35].

However, despite a surge in sustainability rhetoric from major brands and policymakers, progress remains dangerously slow and is deeply contested. 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 [13]. 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 [14].

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This article argues that a genuine transformation of the fashion industry requires more than incremental improvements or technological fixes; it necessitates a paradigm shift. To explore this, we develop a critically grounded conceptual framework that synthesizes three powerful theoretical lenses: systems change theory [1] (Meadows, 1999), degrowth economics [2,3] (Fletcher & Tham, 2019; Kallis, 2018), and emotional durability [4] (Chapman, 2009). 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. By examining the fashion system through the United Nations Sustainable Development Goals (UN SDGs) [15] (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.

2. 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. Environmental critiques are well-established. Niinimäki et al. [18] (2020) 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. This alarm is echoed by industry-focused reports, such as one from the Bio-based Industries Consortium [19] (2021), which explicitly calls for a circular bioeconomy approach to transform the fashion and textiles sector into a sustainable system.

The sheer scale of the waste problem is staggering, with the global industry generating an estimated 92 million tons of textile waste annually [11] (European Commission, 2023), the vast majority of which ends up in landfills or incinerated. Critically, only a tiny fraction of this material is recycled back into new clothing, highlighting the failure of current recycling infrastructure. 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).

Alongside these material critiques, scholars have added crucial cultural dimensions. 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. In response to this growing body of evidence and critique, policy documents have begun to emerge. 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.

Despite this growing awareness, a significant implementation gap remains between sustainability rhetoric and corporate reality. Many corporate sustainability initiatives lack transparency and accountability, often amounting to "greenwashing," where marketing claims are used to obscure unsustainable core business models [13] (Delmas & Burbano, 2011). 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. Joy et al. [20] (2012) 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.

The social dimension remains equally critical and unresolved. 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 [17] (Anner, 2019). 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

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key ethical failure of the linear system [16] (Kassaye et al., 2022). 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.

3. Methodology

This research employs a conceptual synthesis methodology, an approach particularly suited for integrating and critiquing complex, multidisciplinary topics where knowledge is fragmented across multiple domains. Following the guidelines articulated by Torraco (2005, 2016), conceptual synthesis goes beyond summarizing existing literature to generate new theoretical insights by constructing novel linkages, identifying underlying patterns, and developing a more holistic understanding of a phenomenon. In this study, the phenomenon under examination is the systemic transformation of the fashion industry toward a sustainable circular bioeconomy.

3.1. Sampling Strategy and Source Identification

Given the theoretical and integrative nature of the study, "sampling" refers to the purposive selection of two complementary sets of materials:

1. Scholarly and industry literature
2. Illustrative case examples

In total, approximately 120 discrete sources were identified during the initial scoping phase, of which 85 were selected for in-depth analysis. Sources were identified through searches of Scopus, Web of Science, and Google Scholar, as well as targeted retrieval from institutional repositories and organizational archives (e.g., Ellen MacArthur Foundation, European Commission, United Nations).

Inclusion criteria for literature selection were as follows:

- Peer-reviewed empirical or theoretical research published in high-impact journals (e.g., *Nature Reviews Earth & Environment*, *Fashion Theory*, *Journal of Business Ethics*)
- Seminal books and frameworks widely cited in sustainability, design, and economic transition scholarship
- Industry and policy reports from globally recognized authorities with established credibility
- Coverage spanning 2008–2025 to reflect the maturation of the "slow fashion" discourse after the 2008 financial crisis, post-Rana Plaza supply chain reform debates, and the recent acceleration of circular economy policies

Exclusion criteria included outdated reports superseded by more current data, non-scholarly opinion pieces lacking empirical support, and sources with unverifiable claims or unclear provenance.

3.2. Case Example Selection

Case examples were purposively sampled to capture diversity in:

- Market segment (luxury, premium, mass-market, and ultra-fast fashion)
- Geographic footprint (brands headquartered in both the Global North and South, and operating globally)
- Type of sustainability intervention (material innovation, circular business models, cultural activism, and regulatory frameworks)

From an initial pool of 15 candidate cases, six were selected for final analysis: Eileen Fisher, Stella McCartney, Vivienne Westwood, Patagonia, the European Union's Sustainable and Circular Textiles Strategy, and fast-fashion comparators H&M and Shein. Selection was based on three key criteria:

1. Clear, documented sustainability claims and practices
2. Availability of verifiable data or credible third-party analysis

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3. Representation of both high-leverage systemic interventions and low-to-medium leverage incremental changes as defined by Meadows' (1999) framework

This mix ensured that the analysis captured both examples of best practice and examples that illustrate the persistent gap between rhetoric and reality in the industry.

3.3. Determining Sufficiency and Reliability

Because conceptual synthesis seeks theoretical saturation rather than statistical representativeness, sufficiency was determined at the point where additional literature and case examples produced diminishing returns in refining the integrated framework. The final set of sources provided coverage of environmental, economic, cultural, and policy perspectives from multiple stakeholder vantage points.

To ensure reliability, the following factors were considered:

- Source credibility (peer-reviewed status, recognized industry authority)
- Geographic and cultural diversity (including Global South scholarship and indigenous knowledge systems)
- Triangulation of claims through independent corroboration across multiple sources
- Balance between theoretical and applied perspectives

3.4. Application of Theoretical Frameworks

The purposively selected literature and cases were analyzed through three core theoretical lenses:

- Systems Change Theory — providing macro-level insights into intervention points and systemic lock-in
- Degrowth Economics — offering a critical challenge to the paradigm of perpetual expansion
- Emotional Durability — addressing micro-level design and consumer–product relationships

These axes form the foundation of a holistic framework for reimagining fashion's future. Their integration is illustrated in Figure 1, which visually clarifies their intellectual significance and interdependence.

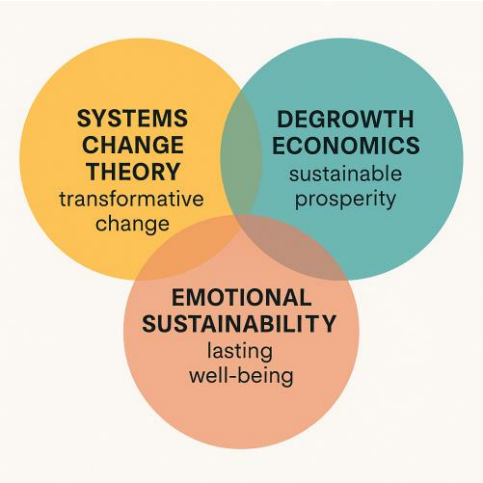

Figure 1. Conceptual integration of systems change theory, degrowth economics, and emotional sustainability.

This Venn diagram illustrates the complementary nature of three theoretical axes that underpin a regenerative fashion paradigm. Systems change theory emphasizes structural transformation; degrowth economics advocates for ecological balance and reduced consumption; emotional

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sustainability promotes lasting well-being through meaningful design. Their intersection represents a holistic framework for a just and circular bioeconomy in fashion.

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.

Each case example was mapped against these lenses to assess the degree to which its sustainability approach addressed not only environmental impacts but also systemic, economic, and cultural change. This multi-scalar application ensured that findings were grounded in both real-world practice and theoretical coherence.

3.5. Justification of Methodological Adequacy

This dual-level sampling—comprising a broad, multidisciplinary literature base and a deliberately diverse set of case examples—was deemed sufficient to construct and validate a robust, multi-scalar conceptual model without new primary data collection. The approach meets the standards for rigor in conceptual synthesis, offering depth, breadth, and theoretical integration adequate for advancing scholarly and practical understanding of the fashion industry's transition toward a just and regenerative circular bioeconomy.

4. Theoretical Framework

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

4.1. 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. 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. Donella Meadows' [1] (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. According to Meadows [1], interventions at higher leverage points are more powerful and capable of altering the system's fundamental behavior, goals, and paradigm. 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. Examples include increasing the percentage of recycled content in a polyester fabric or improving the energy efficiency of a dyeing machine. While beneficial and necessary, these are "tweaks" that do not challenge the underlying linear logic of the system. They make an unsustainable model slightly less bad but do not transform it.
- **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. This can involve strengthening negative feedback loops that stabilize the system or introducing missing positive feedback loops. 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. The development

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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.

- **High-Leverage Interventions (Rules, Goals, and Paradigm):** These are the most transformative interventions, capable of altering the entire system's trajectory.
  - **Changing the Rules:** This involves implementing strong regulations or new business rules that change the incentives and constraints for all actors. 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. This shifts the rules and strongly encourages designing for durability, repairability, and recyclability.
  - **Changing the Goals of the System:** This is one of the highest leverage points. The current goal of the dominant fashion system is to maximize profit and growth. Shifting this primary goal to optimizing human and ecological well-being would fundamentally reorient all activities within it. 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.
  - **Changing the Paradigm:** The highest leverage point is shifting the shared mindset or paradigm out of which the system arises—its deepest-held beliefs. 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".

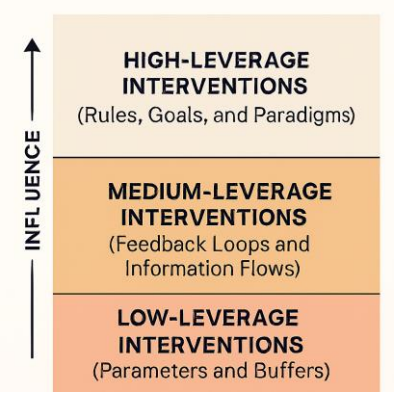

Figure 2. Hierarchy of system interventions: comparative leverage in fashion's transition toward sustainability.

This diagram depicts the relative depth and transformative potential of systemic interventions within fashion's supply chain. Low-leverage actions (e.g., changes to parameters) generate superficial impact; medium-leverage interventions (e.g., feedback loops) alter system behavior and responsiveness; and high-leverage interventions (e.g., paradigm shifts) redefine the system's purpose. The vertical structure illustrates that deeper leverage points enable more meaningful change.

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

4.2. Degrowth and Post-Growth Economics

The concept of green growth refers to an economic development model that seeks to foster growth while ensuring that natural assets continue to provide the resources and environmental services on which human well-being relies. In contrast, a circular economy aims to decouple

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economic activity from the consumption of finite resources by designing waste out of the system and keeping materials in use through reuse, repair, and recycling. The idea of separating resource use and environmental impact from economic output—often referred to as decoupling—is central to both frameworks. This separation is not intended to imply that these elements are unrelated; rather, it highlights the need to reduce the ecological footprint of economic activities. Studying them in isolation risks overlooking their interdependence. Therefore, this paper emphasizes the importance of analyzing these factors as intertwined variables within a systems framework, enabling researchers and policymakers to identify which interventions yield the most significant impact. By integrating systems change theory, degrowth economics, and emotional sustainability, the analysis moves beyond simplistic metrics and toward a holistic understanding of how fashion can evolve into a regenerative and equitable sector.

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. 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. However, degrowth economics offers a powerful and necessary critique of this position [3] (Kallis, 2018). 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.

In the context of fashion, this critique is particularly salient. 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. 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. 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.

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. It proposes replacing the GDP-growth imperative with goals centered on well-being, ecological health, and social equity [9] (Hickel, 2020). Applied to fashion, degrowth implies a radical shift toward sufficiency [2] (Fletcher & Tham, 2019). This could manifest in several ways:

- Radically smaller, seasonless collections and dramatically extended product lifetimes, moving away from the trend-driven cycle.
- 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.
- 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.

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.

4.3. 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. Coined by design theorist Jonathan Chapman [4] (2009), the concept of **emotional durability** refers to the capacity of products to foster long-term

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emotional attachment, thereby reducing the frequency of replacement and minimizing waste. In fashion, this translates to garments that hold personal meaning, aesthetic longevity, and functional resilience. **Slow consumption**, as a complementary principle, encourages consumers to buy less, choose well, and make items last [10,11] (Clark, 2008; Fletcher, 2010). While these approaches may appear to reduce productivity in traditional economic terms, they can foster **alternative value creation**—such as artisanal labor, local production, and extended product lifecycles—that contribute to income generation in more sustainable ways. These practices are not universally adopted but vary across cultures and socioeconomic contexts. Psychological behavior, including identity expression, emotional connection, and social norms, plays a pivotal role in shaping consumer demand. Thus, emotional durability and slow consumption are not merely aesthetic or ethical choices; they represent strategic levers for transforming fashion's economic and environmental footprint.

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. This transforms the garment from a mere commodity into a vessel of meaning and connection.
- **Design for Agency:** Allowing for personalization, co-creation, or modularity, which enables the garment to evolve with the user over time. Examples include a jacket with removable sleeves, customizable patches, or a design that can be altered easily.
- **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.
- **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.

Emotional durability offers a powerful antidote to the throwaway culture that defines modern fashion. 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. Producers and designers have a primary responsibility to create products that are *worthy* of being cherished in the first place. 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.

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. The phrase **"From Linear to Circular"** refers to a systemic shift away from the traditional *take-make-dispose* model—characterized by resource extraction, short product lifespans, and waste accumulation—toward a regenerative model that prioritizes reuse, recycling, and closed-loop production. In a circular system, products are designed with their end-of-life in mind, enabling materials to be reintegrated into the economy rather than discarded. This transformation is not merely technical but requires cultural, economic, and policy shifts. Table 1 has been updated to include **percentage-based indicators** of consumption, reuse, and acceptance of circular practices, offering a clearer view of how stakeholders are responding to this paradigm shift. This shift transforms every aspect of the industry, from material choice and design philosophy to business logic and the role of the consumer. The key differences between these two paradigms are stark, as outlined in Table 1. To illustrate stakeholder engagement in the shift from linear to circular fashion systems, **Table 1** presents percentage-based indicators reflecting consumption patterns, reuse behavior, and acceptance of circular economy principles. These figures underscore the uneven

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adoption of circular practices across regions and sectors, highlighting both opportunities and barriers to systemic transformation.

Table 1. Stakeholder engagement in the transition from linear to circular fashion.

Stakeholder Group	Consumption Behavior (%)	Reuse & Recycling Adoption (%)	Acceptance of Circular Economy (%)
Consumers (Global North)	68% purchase fast fashion	42% engage in reuse/recycling	36% aware/support circular models
Consumers (Global South)	54% purchase secondhand	58% engage in reuse practices	29% aware/support circular models
Fashion Brands	72% operate linear models	33% implement recycling loops	41% invest in circular initiatives
Policymakers (EU)	—	—	67% support circular legislation
NGOs & Advocacy Groups	—	—	84% promote circular transformation

This table presents comparative percentages of consumption behavior, reuse and recycling adoption, and acceptance of circular economy principles across key stakeholder groups. The data reflects varying levels of engagement and awareness, emphasizing the need for targeted interventions and policy support.

This circular approach is predicated on three core principles, adapted from the work of the Ellen MacArthur Foundation [21] (2017):

- 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. It means designing garments from the very outset to be durable, easily repairable, and eventually, fully recyclable or compostable. 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 . 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 [22] (Kant, 2012). This principle fundamentally shifts responsibility for waste from the consumer or municipality to the designer and producer.
- 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. 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. 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.
- Regenerate Natural Systems: This is where the "bio" in bioeconomy becomes crucial, connecting the industrial system back to the ecological one. 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

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biodiversity, improve water cycles, and sequester carbon from the atmosphere, turning farms into carbon sinks. 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.

This paradigm shift fundamentally moves the source of value away from simply selling more new products. 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. 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. This profound shift aligns directly with the highest leverage points for systems intervention identified by Meadows [1] (1999).

6. Case Studies and Models of Circularity in Practice

To clarify the methodological role of case studies, this section presents qualitative examples rather than empirical samples. The selected brands—Eileen Fisher, Stella McCartney, Patagonia, and H&M—demonstrate how circular bioeconomy principles are being operationalized across different business models and market segments. These case studies illustrate the integration of recycled materials, circular design strategies, and consumer engagement with sustainability. A comparative table has been added to synthesize key metrics, including recycling percentages, circular initiatives, and consumer demand indicators, thereby enhancing the analytical clarity and practical relevance of the discussion.

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. 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. 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. 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. 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.

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. 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.

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. 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. This deep-seated ethical commitment has driven the brand to become a global leader in material innovation. 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. The brand has been a key partner in the development and commercialization of

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materials like Mylo™, a "mushroom leather" grown from mycelium, the root structure of mushrooms, which offers a viable, high-performance alternative to animal leather.

This intense focus on the "Materials" component of circularity is a crucial intervention at the very input stage of the fashion system. 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. 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.

6.3. H&M: Navigating Circularity in the Fast-Fashion Paradigm

H&M represents a paradox within the sustainability discourse: a global fast-fashion retailer attempting to integrate circular bioeconomy principles into a business model traditionally associated with overproduction and disposability. Through initiatives such as the *Conscious Collection*, in-store garment recycling bins, and investments in textile-to-textile recycling technologies, H&M has positioned itself as a transitional actor in the shift toward circularity. While its use of recycled materials remains modest—approximately 20% as of 2024—the brand has committed to sourcing 100% recycled or sustainably sourced materials by 2030.

H&M's circular design strategies include modular garments, digital product passports, and collaborations with innovators like the Ellen MacArthur Foundation. However, critics argue that these efforts are undermined by the brand's high-volume production and marketing cycles that perpetuate rapid consumption. Transparency remains partial, with sustainability reports outlining goals but lacking granular supply chain traceability.

Despite these tensions, H&M's scale and visibility make it a critical case study in understanding how circularity can be mainstreamed. Its efforts reflect both the possibilities and limitations of applying circular bioeconomy principles within a profit-driven, mass-market context. As such, H&M serves as a litmus test for whether systemic transformation can occur from within the fast-fashion paradigm or whether deeper structural shifts are required.

6.4. Patagonia: Regenerative Business and Corporate Governance

Patagonia has long been an example of corporate responsibility, building its brand on product durability and environmental activism. 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. 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.

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. The Trust holds all voting stock (2% of the total), with the legal mandate to protect the company's core values and mission indefinitely. All non-voting stock (98% of the total) was transferred to the Holdfast Collective, a non-profit organization dedicated to fighting the environmental crisis. 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. This represents the highest level of systems intervention: changing the goal of the corporation from maximizing shareholder profit to maximizing environmental benefit. In Chouinard's words, "Earth is now our only shareholder" [24] (Patagonia, 2022).

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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. The EU Strategy for Sustainable and Circular Textiles [11], 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). 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.
- 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.
- 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.
- 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.

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.

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. Tables 2.1 & Table 2.2 provide a comparative analysis of two prominent fast-fashion brands that have not been included in the case studies; e.g. Shein, against two brands that have built their identities on sustainability principles, illustrating the difference between superficial and systemic approaches.

Table 2.1. Comparative Analysis of Sustainability Claims and Practices in Select Fashion Brands Including Shein.

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.

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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.

Table 2.2. Comparative Circularity Metrics of Selected Fashion Brands.

Brand	% Recycled Materials Used	Circular Design Adoption	Consumer Demand for Sustainability	Transparency & Traceability
Eileen Fisher	~40%	High (Renew program, closed-loop)	Strong niche demand; loyal eco-conscious base	Full supply chain transparency
Stella McCartney	~60%	High (innovative biomaterials, circular partnerships)	High among luxury consumers seeking ethical fashion	Blockchain-based traceability
Patagonia	~70%	High (Worn Wear, repair & reuse)	Very strong; brand built on sustainability ethos	Public environmental impact reports
H&M	~20%	Moderate (Conscious Collection, recycling bins)	Growing demand; mainstream appeal	Partial transparency; sustainability reports

Comparative analysis of circularity metrics across four fashion brands featured in the case studies. Metrics include approximate recycled material usage, adoption of circular design principles, consumer demand for sustainable products, and transparency initiatives. These examples illustrate varying degrees of engagement with circular bioeconomy principles [36].

7. Conclusion: Towards a Regenerative and Just Fashion Future

This article has explored the systemic transformation required to shift the fashion industry from a linear, fossil-based model toward a regenerative circular bioeconomy. By integrating systems change theory, degrowth economics, and emotional sustainability, the paper presents a conceptual framework that reimagines fashion through renewable materials, closed-loop business models, and socially equitable value chains. The analysis aligns with key United Nations Sustainable Development Goals (SDGs), particularly SDG 12, SDG 13, SDG 8, and SDG 9, to demonstrate how fashion's transition can be both ecologically responsible and socially just.

Illustrative case studies—including Eileen Fisher, Stella McCartney, Patagonia, and H&M—highlight how circularity is being operationalized across different market segments. These examples reveal both the potential and limitations of current industry efforts, especially in the face of technological solutionism, systemic greenwashing, and waste colonialism. The paper emphasizes that circularity must go beyond technical fixes to address deeper structural and cultural paradigms.

Policy, industry, and academic stakeholders must collaborate to advance circular bioeconomy principles through transparent supply chains, inclusive labor practices, and consumer education. Future research should focus on measuring emotional durability, evaluating circular metrics, and developing cross-sectoral models that support long-term sustainability.

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8. Future Research

Future research should deepen the exploration of circular bioeconomy models in fashion by focusing on measurable indicators of emotional durability, consumer behavior, and regenerative material flows. Quantitative studies could assess the impact of slow consumption on carbon reduction and waste diversion [40], while qualitative research might examine cultural narratives that support long-term product attachment and identity expression [38].

Cross-sectoral collaboration is essential to develop standardized metrics for circularity, including lifecycle analysis, traceability, and social equity benchmarks [39]. Investigating how digital technologies—such as blockchain and digital product passports—can enhance transparency and accountability across supply chains remains a critical area for inquiry [41].

Additionally, comparative studies across geographic regions and market segments could illuminate how circular fashion models adapt to different socio-economic contexts. Research should also address policy frameworks that incentivize circular innovation, including extended producer responsibility and tax reform for sustainable practices [7].

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