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Transforming Fashion's Footprint: Business Models and Innovation for Circularity and Clean Energy

By **Sally Qiu**

Top discussion points

- The fashion industry accounts for about 2–8 percent of global greenhouse gas emissions, making it a key sector in the clean energy transition.
- Design choices determine most of a garment's footprint, shaping emissions, product life, and circular potential. Scaling low-carbon materials and technologies requires coordinated finance, long-term procurement, and stable regulation.
- Supply-chain decarbonization depends on supplier innovation, transparent data, and financing that lowers the cost of clean technology.
- Standardized labeling and carbon reporting are essential for tracking progress and aligning business practices with climate goals.

The fashion industry sits at the intersection of climate, energy, and consumption, facing growing pressure to cut emissions, transition to clean energy, and build circular systems across global supply chains. The fashion system is responsible for an estimated 2 to 8 percent of global greenhouse gas emissions and 20 percent of industrial wastewater pollution worldwide.[2] The event "Transforming Fashion's Footprint: Innovation and Business" was held on September 22 during Climate Week NYC to discuss such industry challenges as well as opportunities.

This event summary reflects the author's understanding of key points made in the course of the discussion. It does not necessarily represent the views of the Center on Global Energy Policy. The summary may be subject to further revision.

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The half-day event, cohosted by the Center on Global Energy Policy at Columbia University SIPA; the Fashion, Energy, and Climate Network at the Columbia Climate School; and the Energy, Climate Justice, and Sustainability Lab at New York University, convened industry leaders, academics, investors, and policymakers to discuss how material innovation and business transformation can advance decarbonization and circularity in the global fashion system. To follow is a summary of the discussion and key insights that resulted from this event.

Circularity in Fashion Design

In the opening fireside chat, Sandra Goldmark, associate dean in the Office of Engagement and Impact at the Columbia Climate School, and Indré Rockefeller, founder of The Circularity Project, which aims to equip designers with the tools and community for a circular practice, explored how design and storytelling can drive circularity in fashion.

Goldmark described circularity as both a system model and a creative practice inspired by natural cycles where waste becomes input. Drawing on her background in theater design, she said that creative constraints, such as limits on materials, waste, or energy use, can spark creative solutions. She encouraged designers to treat these environmental parameters as part of the design problem to be solved and build garments that are easier to repair, recycle, and produce responsibly.

Rockefeller said 80 to 90 percent of a garment's environmental impact is determined during the design stage, and therefore designers have a disproportionate influence on products' longevity, repairability, and recyclability. She encouraged integrating design and sustainability teams to dismantle silos that hinder innovation. She described how collaborative and shared case studies among designers allow them to learn directly from each other's practical experiences, helping them overcome the fear of imperfection and challenge the outdated ideas about "eco-fashion." She also emphasized the economic dimension of circularity related to labor, fair wages, quality, and longevity, and called for stronger policy incentives, such as extended producer responsibility and fair competition standards, to reward companies investing in sustainable design.

Both speakers highlighted how small, intentional design choices can drive meaningful outcomes. Rockefeller cited ELV Denim as an example; the company adds extra seam allowances that make jeans alterable, which helps extend the garment's life and enables business models like repair and resale. Goldmark noted that such design choices help businesses generate steady revenue while reducing waste.

Both speakers emphasized storytelling's power to shift culture. Narratives around repair and heritage make sustainability tangible and desirable, while creative storytelling helps spread ideas

faster than policy alone. They framed circularity as both a design principle and a cultural link between creativity and systemic change.

Fashion Industry Sustainability

In the second fireside chat, Sally Qiu, co-director of the Fashion, Energy, and Climate Network at the Columbia Climate School, sat down with Sarah Kent, chief sustainability correspondent at The Business of Fashion, to unpack how the global fashion industry's sustainability agenda has been shifting amid growing geopolitical uncertainty.

Kent observed that policy momentum of the past decade on climate action and corporate sustainability standards has begun to slow down. Regulatory ambition has eased both in the US and Europe, creating a sense of drift that makes long-term business planning difficult. With companies preoccupied by tariffs, trade disruptions, and rising costs, sustainability often slips down the priority list.

Ongoing US-China trade tensions have added to the strain. Kent noted that constant tariff changes drain management bandwidth and stall decarbonization projects. New duties on small-parcel imports could reshape the landscape of ultra-fast-fashion—low-cost brands producing thousands of new styles each week—though the consumer impact is still uncertain. For manufacturers, shrinking margins mean fewer resources to invest in cleaner production.

The conversation also turned to climate shocks already testing the industry's resilience. Kent noted that recent floods in Pakistan wiped out nearly a third of its cotton crop,[3] while heatwaves and wildfires in Europe and Asia disrupted both production and retail. Global sourcing offers temporary flexibility, Kent said, but a series of cascading disruptions could push supply chains past their limits of adaptability.

Kent observed that waste policy rather than emissions regulation is currently where most momentum lies. Europe generates 7.5 million tons of textile waste each year, much of which is unrecyclable due to blended fibers.[4] New extended producer responsibility (EPR) laws in California and Europe are pushing companies toward design for recyclability, fiber sorting infrastructure, and material circularity. Kent also mentioned pending EU legislation on environmental disclosures and supply-chain due diligence for the fashion sector now facing dilution amid political pushback.

Both speakers agreed that durable regulatory frameworks and transparent accountability across the fashion supply chain are essential to sustaining decarbonization investment and rebuilding confidence in the business and its investors.

Materials Innovation for Decarbonization

The first panel of the event, moderated by Kelley Kizzier, director of corporate action and markets at the Bezos Earth Fund, explored how material science, chemistry, and land-use policy intersect in fashion's path to net-zero greenhouse gas emissions.

Kizzier framed fashion as a mirror of the broader energy transition, one that hinges on innovation across bio-based materials, electrified manufacturing, and financing. She emphasized philanthropy's ability to de-risk early-stage R&D and called for blended finance models that combine philanthropic, venture, and public funding to move promising solutions from lab to market.

Jon Veldhouse, CEO of Qore, a joint venture between Cargill and HELM that produces bio-based chemical intermediates, described his company's $400 million facility producing QIRA, a renewable version of the chemical liquid 1,4-butanediol (BDO) used in spandex and foams, designed to replace coal-based inputs. More than half of global BDO production relies on coal in China, where fossil-based production is significantly cheaper than low-carbon alternatives, putting the latter at a price disadvantage. Veldhouse noted that corporate climate commitments often falter at the procurement stage, where managers prioritize cost savings. Long-term offtake agreements and a willingness among brands to absorb modest cost premiums, he said, are essential steps for attracting the capital needed for large-scale decarbonization.

Kevin Karl, co-director of the Fashion, Energy, and Climate Network, examined the issue through a land-use lens, pointing out that nearly half of US corn goes toward ethanol production, limiting feedstock for bio-based textiles. He called for a "policy-ready land-use blueprint" that integrates data on land use, crop yields, and industrial demand to inform future policies promoting regenerative agriculture and bio-based material production while supporting rural livelihoods.

Stwart Peña Feliz, co-founder and CEO of MacroCycle Technologies, a cleantech company developing chemical upcycling technologies for plastic and textile waste, described his company's work converting polyester waste into high-quality recycled fibers with lower energy inputs. He identified three persistent barriers: limited textile collection, energy-intensive processing, and unstable demand, and stressed that community-level collection systems and consumer participation are as important as technological breakthroughs in building circular supply chains.

Miguel Modestino, director of the Sustainable Engineering Initiative at NYU Tandon, discussed how re-engineering polymers for controlled disassembly can make recycling both efficient and scalable. He argued that sustainable materials must outperform conventional ones on function and cost to gain market traction before regulation catches up. Universities, he added, play a critical role in bridging research and commercialization through lifecycle analysis and hands-on practitioner training.

Across the discussion, one theme stood out: technology alone won't drive transformation. Scaling low-carbon materials will require supportive policies; smarter procurement that values carbon impact; and shared risk across brands, recyclers, and researchers. Stronger collection systems and consumer participation are also essential to keep materials in use.

New Paradigms for the Fashion Business

The final panel examined how fashion's business models can evolve to enable innovation, scale sustainability, and remain commercially viable. Moderator Sally Qiu framed the conversation as a shift from isolated breakthroughs to systems transformation, embedding accountability, transparency, and finance into the mechanics of how fashion operates.

Amy Jaffe, director of the Energy, Climate Justice, and Sustainability Lab at NYU, argued that standardized product labeling, similar to nutrition or energy-efficiency ratings, could help guide consumer choices and create a new basis for market differentiation. She suggested that labels disclose fossil-based origins, for example by naming virgin synthetics as "crude oil," and proposed using AI tools to enhance supply-chain traceability and circular design rather than drive overproduction.

Michelle Gabriel, lecturer at the Columbia School of Professional Studies, described fashion as an "ultra-free market," in which rapid competition on style and price often undermines innovation. She pointed to the Fashion Act, which would require major brands doing business in New York to map their supply chains and disclose their social and environmental impacts, as a potential foundation for broader governance reform. She added that coordinated policies, linking trade, tax incentives, and innovation funding within and across markets, could help stabilize long-term investment and encourage companies to prioritize sustainability. Within companies, she urged decision-making that considers sustainability criteria equally with design, sourcing, and finance.

Inka Apter, senior director of materials and circularity at Eileen Fisher, a clothing retailer, shared the brand's long-term circular strategy centered on regenerative fibers, multi-life product pathways, and close supplier partnerships. She described pricing systems that spread the added costs of sustainable materials across the value chain, so that brands, not only consumers, share the expense. These systems would help maintain affordability while rewarding farmers and mills for regenerative practices. Apter highlighted 3D sampling and digital fittings, which allow garments to be prototyped virtually, as cost-effective tools to reduce waste and emissions and called for greater inclusion of artisanal and decentralized producers within decarbonization frameworks.

Christina Castle, senior manager of impact and product sustainability at DÔEN, a clothing retailer, discussed the brand's regenerative fiber sourcing and its resale platform *Hand Me DÔEN*, which

extends product life while remaining profitable. She emphasized that circularity can strengthen both brand value and customer loyalty when integrated into a company's core identity. Castle also described pilot projects using AI to automate certification requests, such as those verifying organic or regenerative fibers, to improve supplier efficiency.

Lewis Perkins, president and CEO of the Apparel Impact Institute, presented the institute's supplier-centered approach to decarbonization, focusing on Tier 2 wet processing, the industry's largest source of emissions. He outlined financial mechanisms such as loan guarantees and performance-based rebates that lower capital costs for clean technologies like industrial heat pumps. Perkins emphasized the importance of benchmarking supplier energy use and emissions performance to link verified progress with procurement incentives and encourage brands to coordinate sourcing around shared, low-carbon facilities.

The panel concluded that real progress depends on linking sustainability directly to how business is run. Procurement should reward verified emissions cuts through long-term commitments, financing must share risk and support clean technology, and transparency tools like labeling and traceability need to make accountability tangible. Circularity should be integrated into core business strategy, from resale and repair to regenerative sourcing, so that sustainability becomes a driver of profitability and long-term competitiveness, not a side project.

Cross-Cutting Insights and Outlook

Across all sessions, participants converged on a clear message: decarbonizing fashion requires aligning creativity, capital, and accountability. Design remains a powerful lever upstream, while material science and digital tools are unlocking new technical solutions to improve efficiency and reduce emissions in manufacturing. Yet scaling these innovations will require companies to embed sustainability into purchasing and supplier engagement and policymakers to create consistent frameworks that reward long-term decarbonization.

Speakers noted that fashion's transformation parallels the broader global energy transition, requiring a balance between innovation, cost, and long-term climate goals. By positioning fashion within this context, this event highlighted how a sector built on creativity can serve not only as a testing ground, but also an integral front in the systemic clean energy transition.

Notes

1. Geneva Environment Network, "Environmental Sustainability in the Fashion Industry," October 3, 2025, https://www.genevaenvironmentnetwork.org/resources/updates/sustainable-fashion.
2. Ibid.

3. Elian Peltier and Claire Brown, "Pakistan's Floods Are a Climate Change Warning," *New York Times*, September 11, 2025, https://www.nytimes.com/2025/09/11/climate/pakistans-floods-are-a-climate-change-warning.html.

4. Mireia Fernandez, "Textile Waste Recycling: Weaving a Sustainable Future," *International Fiber Journal*, October 22, 2025, https://www.fiberjournal.com/textile-waste-recycling-weaving-a-sustainable-future/.

About the Author

Sally Qiu is a senior research associate at the Center on Global Energy Policy (CGEP) at Columbia University. In this role, she supports the center's Inaugural Fellow David Sandalow, in work related to US-China energy and climate policy, as well as the AI-Energy Program. She is a co-author of the Guide to Chinese Climate Policy (2022) and a chapter contributor to the annual China Energy Transformation Outlook (CETO).

Sally founded and co-directs the Fashion, Energy, and Climate Network at the Columbia Climate School, a collaborative program that assesses and addresses the complex relationship between the fashion industry, energy transition, and climate change. The network brings together industry stakeholders, policymakers, and researchers to develop systematic, solution-oriented approaches to decarbonizing the fashion industry.

Previously, at Columbia's School of International and Public Affairs (SIPA), she supported former dean Merit Janow on research, case studies, and events related to U.S.-China trade relations, foreign direct investment, and digital innovation.

She also worked as an environmental statistics consultant at the United Nations Food and Agriculture Organization (FAO), where she contributed to FAOSTAT databases and publications on greenhouse gas emissions from global food systems. She provided research and analysis on global energy efficiency standards at the ClimateWorks Foundation and supported the clean energy transition projects in Asia-Pacific during her time at the UN Economic and Social Commission for Asia and the Pacific (UNESCAP) in Bangkok.

Sally's passion for sustainability began during her undergraduate years, when she volunteered in Fiji and Mexico, participating in local community development projects and sea turtle conservation. Beyond her professional work, she is currently pursuing a part-time degree in fashion design at Parsons School of Design, further integrating her interest in sustainability with design and innovation.

Sally holds a Master of Science in Public Policy and Management from Carnegie Mellon University, with a focus on energy policy and data analytics, and a Bachelor of Arts in History and Environmental Geoscience from DePauw University, where she was a Rector Scholar.

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