

# Opportunities and Challenges for Implementing Circularity in Textile Production

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## Abstract

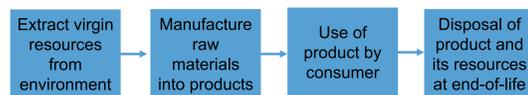
The textile industry produces substantial waste and environmental impacts in its production of textile goods. Waste management strategy is an issue in the textile industry as companies seek new ways to reduce environmental impacts of their production. The purpose of this research is to understand how textile companies are currently managing and reducing their waste and integrating sustainability into their production. Through an interview analysis of six textile producers, this study concludes that production optimization and internal resource reuse for waste reduction along with local recirculation systems provides opportunities for implementing circularity as a means to reduce waste in textile production. I also find that companies that were not founded with a sustainability-oriented mission struggle to create a culture surrounding sustainability. Further, developing technology and intentional product design for waste mitigation present challenges in textile production waste reduction goals.

## Introduction

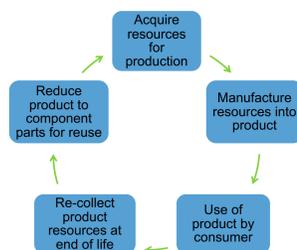
The 2021 Sixth Intergovernmental Panel on Climate Change (IPCC) Working Group I Report predicts global warming of 1.5 degrees Celsius above pre-industrial levels within 20 years if we follow our current economic and social trajectory. A rise beyond 1.5 degrees Celsius will likely lead to worsening flooding, drought, sea-level rise, heat waves, extreme storms, permafrost thaw, glacial melting, ocean acidification, and a myriad of other damaging environmental changes. These projections are coupled with an urgent call from the IPCC to improve our economic systems to avoid climate catastrophe.

The textile industry is the second most polluting industry in the global economy, producing 10% of global greenhouse gas emissions. One contributor to global greenhouse gas emissions is waste disposal. Disposing of solid wastes in landfills produces methane, a greenhouse gas with 25 times the warming potential of carbon dioxide. Alternatives to landfilling include waste incineration, which produces pollutants and emissions as well. Waste mitigation in the textile industry presents one avenue to reduce its greenhouse gas emissions and subsequent environmental impacts.

Our current economic systems of inefficient resource use follow that of the linear economy, depicted below:



The circular economy, depicted left, eliminates waste from the beginning of the product life cycle. The Ellen MacArthur foundation defines the three principles of the circular economy as “eliminate waste and pollution;” “recirculate materials at their highest value;” and “regenerate nature.” This framework and its micro-application of circularity offers one avenue for improving production environmental impacts.



## Methodology

I conducted a qualitative interview analysis of six textile companies with a stage of their production located in the United States. I recruited these companies through both “cold call” emails and personal connections. Institutional Review Board approval was not required due to the interview being focused on the company, not the initials. I de-identify interview data in reporting.

I asked each participant six standard questions over a 30-40 minute zoom, phone, or in person interview. These questions were:

1. What role does sustainability play in your company’s operations as a whole?
2. What role does sustainability play in your company’s textile production?
3. How might you estimate trends in your company’s waste generation over the past few years?
4. What have been your main challenges in improving resource reuse in production and/ or mitigating waste in your textile production process?
5. Have any strategies been particularly successful in reducing waste in your textile production processes?
6. What sort of business partnerships or relationships has your company explored to mitigate waste in your textile production process?

## Results

The chart below presents my findings from my interview procedure.

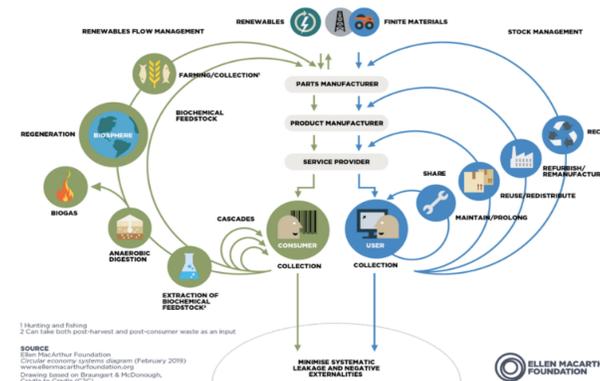
Key	
“SB1” Small Business 1	“MB1” Medium-sized Business 1
“SB2” Small Business 2	“LB1” Large-sized Business 1
“SB3” Small Business 3	“LB2” Large-sized Business 2

<b>Question 1: Role of sustainability in company</b>
Sustainability is the company mission SB2, MB1
Efficiency and cost reduction SB1, SB3, LB1
Image and customer perception SB2, MB1, LB2
Company culture or building a culture of sustainability SB1, SB2, MB1, LB1
<b>Question 2: Role of sustainability in textile production</b>
Drives resource input decisions SB2, MB1, LB1, LB2
Aim for low impact production SB1, SM2, SB3, MB1, LB1, LB2
Efficiency and cost savings SB1, SB3, LB1, LB2
<b>Question 3: Waste trends over time</b>
Seen improvements as business/sustainability acumen improves SB1, SB2, LB1, LB2
Challenges tracking waste over time SB3, MB1
Improved materials limiting degradation SB1, MB1
Research and development with efforts to loop waste materials directly back into production MB1, LB1, LB2
<b>Question 4: Challenges</b>
Time and cost SB1, SB2, SB3, LB2
Tracking waste impacts and progress LB2
Finding “homes” for waste materials MB1, LB1
Storage for items intended to be reused SB1, SB2, MB1
Return on investment in reuse infrastructure MB1, LB2
Technology surrounding reuse MB1, LB1
<b>Question 5: Successful strategies</b>
Technological/ research and development improvements allowing for material reuse: MB1, LB1, LB2
Remixing waste into new raw materials (fabrics, thread, etc.): SB3, MB1, LB1, LB2
Creating waste goals to track progress and promote accountability LB1
Outside the box/creative thinking: SB1, SB2, LB1
<b>Question 6: Partnerships/ relationships</b>
Local textile recycler connections: SB2, SB3, MB1
Partnerships with non-local or global circularity consultants LB1, LB2
Other hyper-local connections: SB1, SB3, MB1
Research and development partnerships: MB1, LB2

## Discussion

I analyzed my findings through the three principles of the circular economy as outlined by the Ellen MacArthur Foundation, the leading thinktank in circular economy research. These principles are illustrated in the butterfly diagram below created by the Ellen MacArthur Foundation of the elements of the circular economy.



### Eliminate Waste and Pollution

Intentional design in company mission impacted efficacy towards eliminating waste and pollution. Mission-driven companies with goals oriented towards themes in the triple bottom line see greater efficacy in their resource reuse. Company design allow for these groups to more deliberately use and reuse their resources to save money and conduct business more sustainably. Further, sustainable company design improves employee buy in towards waste reduction initiatives.

### Circulate Products and Materials at Their Highest Value

Companies I interviewed circulated materials through both upcycling/recirculation and downcycling. Businesses were able to recirculate fabric scraps back into their production processes to improve textile resource use. This maintained the integrity of the resource and its value for recirculation in line with the aim of this principle. On the other hand, many businesses practiced downcycling through conventional resource recycling. Recycling textile wastes into lesser value materials and sending plastics, cardboards, and papers to municipal recycling is a popular avenue for resource reuse amongst companies I interviewed. Despite this being a predominate waste management effort, these activities do not uphold the integrity of the resources and degrade the material with each reuse. Thus, while this is a useful waste management strategy in the short run, it is not an effective implementation of the circular economy and does not promote the integrity of resources in their recirculation.

### Regenerate nature

Efforts to regenerate nature are the rarest of practices I found employed by the companies I interviewed. Small Business 2 mentions this principle as a part of their business mission, and is the only entity that employs this principle. They do so through their product sourcing of hemp fibers as well as through a leg of their business that is effectively a sustainable farm/ regenerative space. While many companies do not see aspects of this principle in their business activities, this regenerating nature offers an opportunity to rebuild environmental systems damaged by unsustainable business practices.

## Conclusion

The circular economy opposes many economic systems currently at play in the United States. When discussing waste management with my interviewees, half the companies I interviewed mentioned the need for “outside the box thinking” to effectively reach zero waste or improved resource use. The circular economy and implementing circularity present one framework for such “outside the box thinking” to address environmental issues posed in the textile production process, and present the following opportunities and challenges for its implementation:

### Opportunities

- (1) Internal resource reuse efforts recirculating materials back into production
- (2) Local systems and business connections for reuse relationships

### Challenges

- (1) Intentional product design
- (2) Building intentional business culture oriented towards sustainability
- (3) Technology for resource deconstruction and recirculation

## Recommendations for Future Research

While the textile industry faces the rising need to address its environmental impacts, waste management and circularity provide an avenue to improve production sustainability. Due to the limited scope of this study, I determine that my findings are not “best practices” but rather “promising opportunities” for the textile industry. More widely applying the opportunities that yield success in the companies interviewed, while problem solving the challenges they face, may yield a promising avenue to improve textile production resource use. I recommend the following areas for future research to improve these practices based on my study:

- (1) Investigating the market opportunity posed in establishing intermediaries between waste producers and beginning of life users of waste resources. Entities could conduct a cost benefit analysis in improving geographic barriers through the market.
- (2) Waste tracking improvements and certifications. Creating systems that more easily allow companies to track the quantities and composition of their waste, as well as improving verification and certification processes for waste mitigation.
- (3) Product modularity and circular product design. Breaking down products into their component parts poses challenges for reuse, and improving these processes will allow for improved resource reutilization.

## Acknowledgements

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