



NEBRASKA
RECYCLING
COUNCIL

Textile Waste and Recycling

Nebraska's Role in the Future of
Fashion

prepared by:

Nebraska Recycling
Council

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Introduction

Someday in the future you might be able to throw your ripped jeans, threadbare shirts, and musty sweaters into your curbside recycling bin.

As the fashion industry comes under fire for its hefty environmental footprint, many are looking to textile recycling as one potential solution to the problem. As much as 95% of all textiles could be recycled in the current system, although the US only achieves a 15% recycling rate^{1,2}. When it comes to using recycled materials as feedstock for textile production, however, there are significant roadblocks to be overcome.

**“The state of Nebraska it’s really quite spectacular what’s happening,”
“Who would’ve thought the state of Nebraska would lead on textiles,”
Scott Kuhlman - ReCircled**

With thanks to those who contributed time and knowledge:

Dr. Jennifer Johnson Jorgensen - Associate Professor, University of Nebraska Lincoln

Dr. Yiqi Yang - Charles Bessey Professor, University of Nebraska Lincoln

Scott Kuhlman - CEO, ReCircled

Sami Hartong - Social Media and Marketing Director, Omaha Fashion Week/Swap Omaha

**“I think there’s an opportunity for Nebraska to be the leader in textile recycling and sustainability, we just have to claim it,”
Jennifer Johnson Jorgensen - UNL**

Less than 1% of recycled textiles are actually made back into clothing³. This is a significant barrier for the fashion industry to overcome in moving from a linear model to a circular model.

Here at home in Nebraska, innovations in textile to textile recycling position the state to be a leader in the future of the industry. Over the course of 2023, the Nebraska Recycling Council has worked to understand the complexities of textile recycling and reuse. We’ve spoken with experts across the state, hosted an Earth Day clothing swap, and presented on the issue at our annual conference. With this report we seek to summarize what we’ve learned and what a future textile recycling system might look like.

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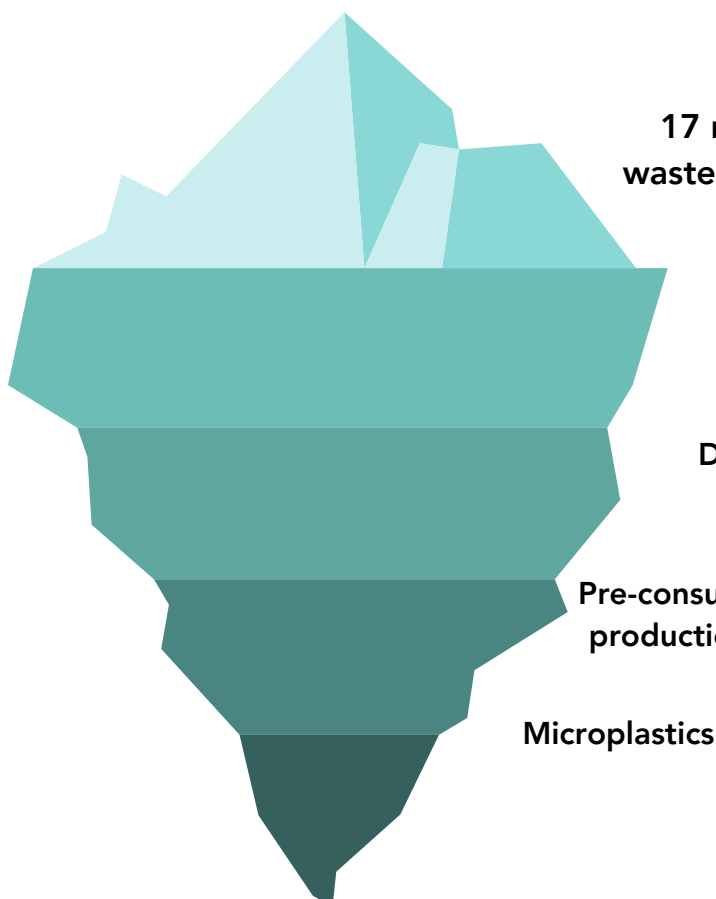
The Rising Cost of Consumption

Over the last 15 years clothing sales have doubled, meanwhile nearly three fifths of all clothing winds up in the landfill or incinerator within a year of production^{3,4}.

Often cited as the second most polluting industry, textile production results in roughly 10% of global greenhouse gas emissions, and 20% of global water pollution⁵. Of all the chemical compounds produced globally, 20-25% are used in the textile finishing process, ultimately winding up in our waterways⁴. Whether or not textile production actually deserves the title of second most polluting industry is up for debate, but it has been well established that textile production - and by extension the fashion industry - has an enormous environmental footprint.

While the fashion industry catches most of the criticism for this impact, it's not only clothing that contributes. Carpeting, upholstery, linens, curtains and more are all included in statistics around waste, and the impact of textile production. However, clothing accounts for over 60% of textiles produced, and much of the data and research around environmental impact focuses on clothing³. Of course, the potential benefits of textile recycling will impact the industry as a whole, and hopefully reduce the need for resource extraction for textile production.

Problems with Plastic - An estimated 35% of all microfibers in the oceans come from textiles. In a future textile system, it will be essential to replace petroleum fabrics with natural fibers⁶.



17 million tons a year in the US waste stream are only the tip of the iceberg¹

Water pollution
Carbon emissions

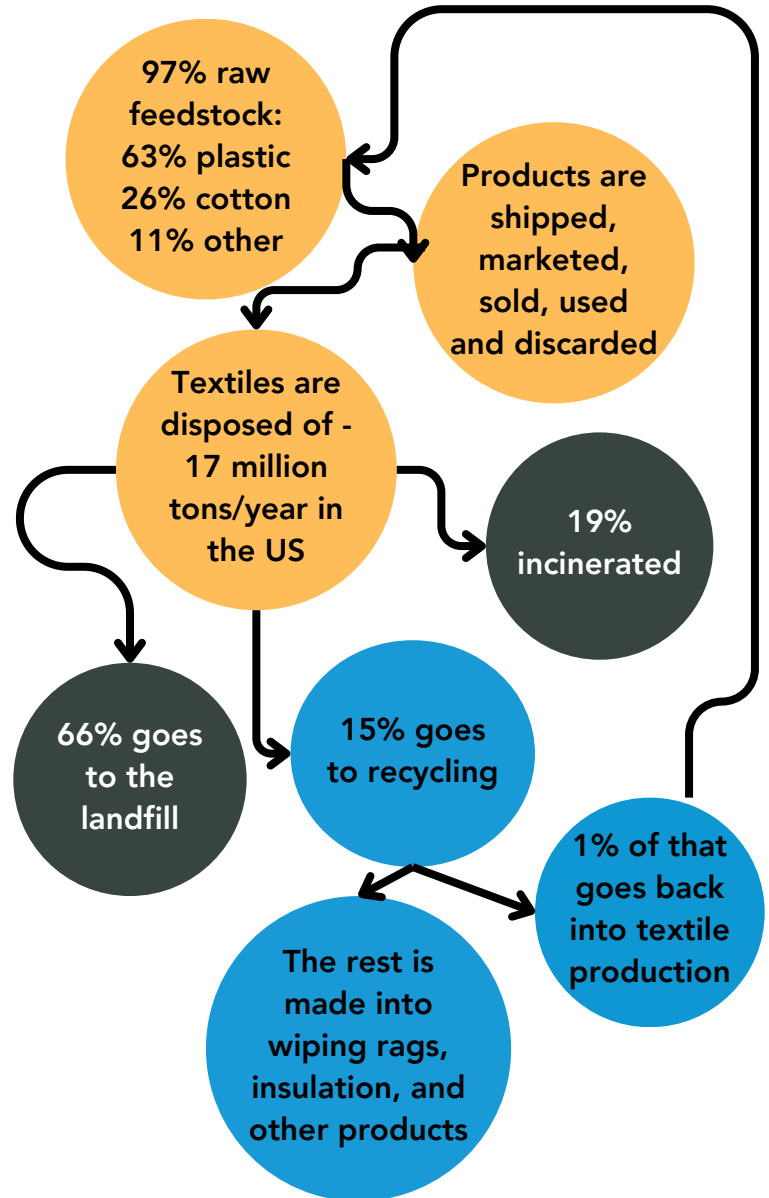
Dyes, finishes,
coatings

Pre-consumer waste in
production and retail

Microplastics

Take-Make-Waste: The Linear Model

The world of recycling is all about resource management. Products made with recycled materials typically have a much lower environmental footprint, as well as a positive economic impact. Yet, with a national recycling rate of 32%, valuable resources are still allowed to go to the landfill, instead of being converted back into feedstock for manufacturing¹. This is the linear model - where resources are extracted, consumed, and then discarded, only to be constantly replaced with more. Landfilling is a convenient solution to this linear system. As the impacts of resource extraction and consumption catch up with us in the form of greenhouse gasses, water pollution, and microplastics, we must look to our discards and ask, "Is that really waste? Or is it just wasting resources?"

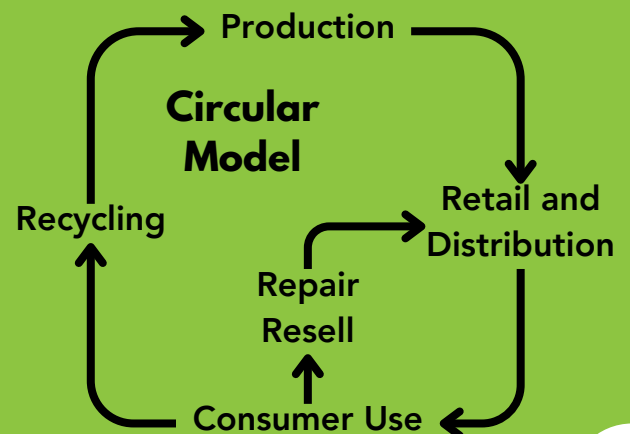


Sources - EPA, SMARTASN

Aiming for a Circular Future

In a circular model, materials would be kept in use for as long as possible. Reuse and repair would be an integral part of the system, and recycling would provide the majority of feedstock for manufacturing, instead of raw material extraction.

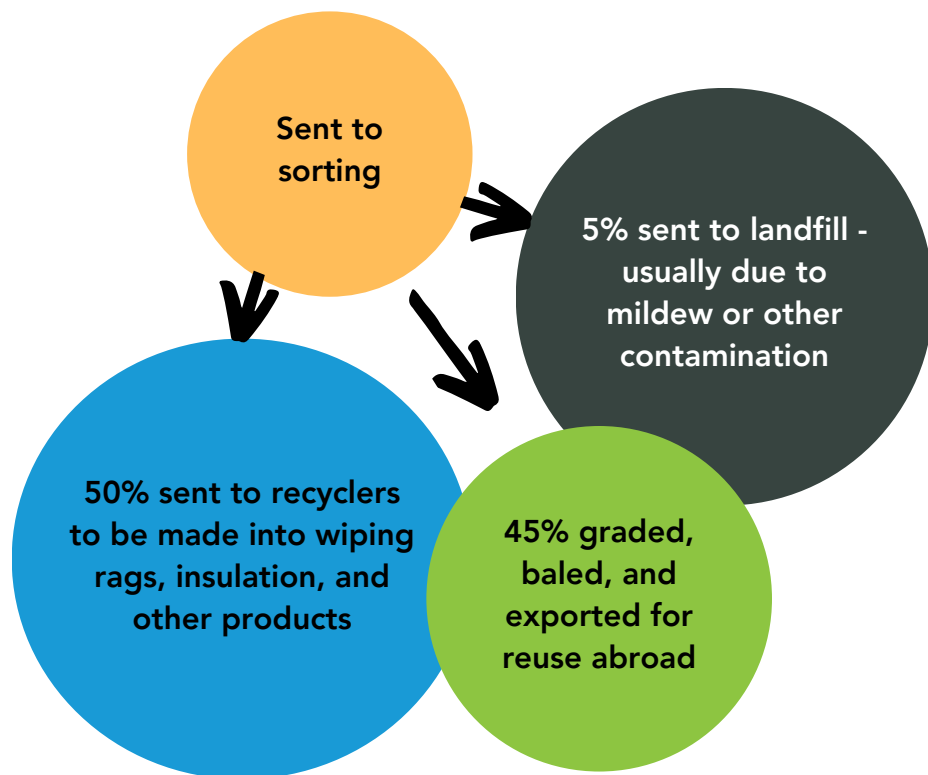
With less than 1% of textile recycling going back into textile production, significant strides need to be made with textile recycling to close the loop³.



The Linear Model

Issues in Diversion

Consumers have a strong desire to divert material from the landfill, but don't have many options for getting rid of textiles they no longer need. Donating to thrift stores and charities, or using drop off bins is one popular way people avoid the landfill. **However, thrift stores typically are only able to sell 20-30% of the material they receive**⁷. Depending on the organization, the remainder either goes to landfill, or to recycling brokers, who sort the material for reuse and recycling.



Source: SMARTASN

Recycling

Material too worn or damaged to be sold for reuse goes to recycling. **Most of the material is recycled into a new form, with less than 1% going back into making fabric and apparel**³.

SMARTASN (Secondary Materials and Recycled Textiles, the Association of Wiping Materials, Used Clothing and Fiber Industries) reports that among its members 45% gets sold for reuse and 50% is recycled. Of that 50% a little over half is cut into wiping rags or polishing cloths that are then used in commercial and industrial settings. The remaining 20% is re-processed into its basic fiber content to create furniture stuffing, upholstery, home insulation, carpet padding, building materials and more².

Using recycled feedstock for these products creates environmental and economic benefits, but does not contribute to closing the loop on textiles. With a goal of reducing impacts of resource extraction, there is a need to develop processes for fiber to fiber recycling for use in textile production.

The Linear Model

Issues in Diversion

Reuse Abroad

Garments still in useable condition are typically sorted, graded, baled, and exported overseas, though some brokers report they bale textiles directly from donation bins.

The US was the leading exporter in 2021, shipping out 700,000 tons of secondhand items⁸.

At the top of the waste hierarchy, reuse is the most preferred option for an item before recycling or landfilling. There are many positives to the global used clothing trade - providing income opportunities for local traders, and access to low cost high quality durable goods, as well as keeping these items in use for as long as possible.

Poor sorting practices, lack of transparency, and overwhelming volume of material has created a host of negative outcomes as well. **Importers report poor quality, dirty, and damaged material, with up to 50% of some bales going straight to disposal⁹.** High volumes plus high percentages of waste has resulted in significant littering, dumping, and burning of the waste material, resulting in growing negative human health and environmental outcomes. The used clothing trade also suppresses local textile markets, putting local artisans out of business and creating a dependency on further imports to meet the need for apparel.



A woman looks through clothes at a dumpsite in Chile's Atacama Desert

Source: [AlJazeera](#) [Martin Bernetti/AFP]



Clothing waste lines a stream in Ghana

Source: Kevin McElvaney / [Greenpeace](#)



The clothing dump in the Atacama Desert was photographed by SkyFi's satellites

Source: [TMX/SkyFi](#)

The Three R's

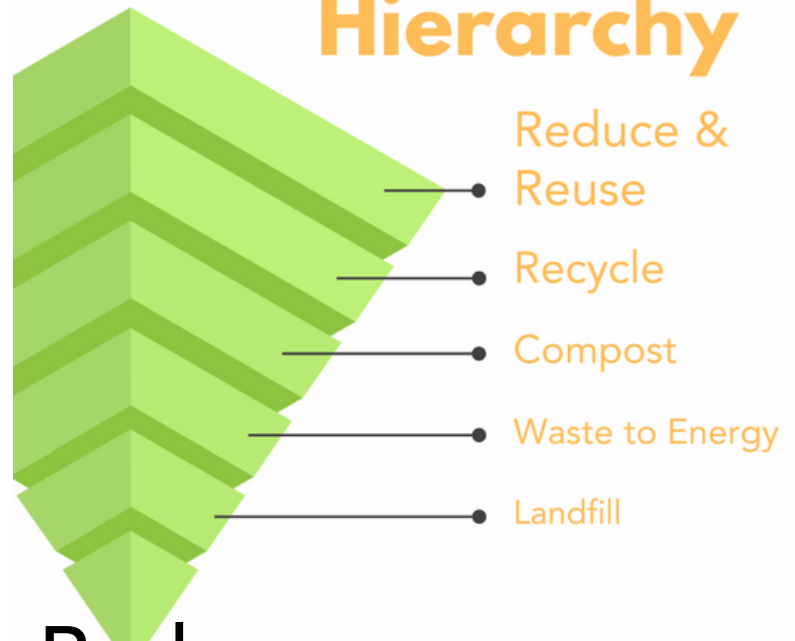
Reducing, Reusing, Recycling

Recycling alone cannot solve the problems of overconsumption. There are several steps that must be taken prior to recycling in order for the textile industry to reduce its impact and achieve sustainability.

All too often recycling becomes a deflection from accountability and a way to greenwash unsustainable practices. As we work to build a system for textile recycling, we must first acknowledge the importance of reducing consumption and extending the lifetime of use before we attempt to recycle.

Reducing consumption and increasing utilization have a far more substantial environmental benefit than the practice of recycling alone.

Waste Hierarchy



Reduce

Pre-consumer Waste Reduction

Generating far more waste than any individual consumer, lack of process efficiency in manufacturing results in waste across all industries. In the production of clothing, one major source of textile waste is inefficiencies in cutting garments from fabric. Textile waste and fabric leftovers produced in the manufacturing process comprises 25 to 40% of the total fabric used. One study found that 50 to 85% of this material could be upcycled into new garments¹¹.

At the retail stage, inventory is made quickly and readily available to the consumer through a practice of overproduction. **Up to 30% of items are expected to never be sold**¹². Pre-selling and made-to-order models have the potential to drastically reduce pre-consumer waste as well as reducing production costs for the retailers.

For some of that unsold merchandise, it will be destroyed before ever being used. Some high-end brands even have policies in place to destroy any unsold merchandise.

Coach Takes Strides Towards Sustainability

Coach is one of the brands partnered with ReCircled, a textile recycler operating in Sidney, Nebraska. Together they are working to develop a process for recycling poly bags into hardware for future Coach products.

.... and was also called out on bad behavior

In 2021 Coach made headlines after slashed bags were pulled out of a dumpster in NYC. After receiving public backlash they announced they were ending the policy of destroying damaged, defective items and in-store returns¹⁰.

Reduce

Eliminating Overconsumption With UNL and Omaha Fashion Week

Consumers hold the ultimate power when it comes to reducing consumption and the waste it generates. Culture, values, education, and income are all key factors when it comes to consumer choices around clothing. **“People used to be more sustainable than we are now. One of the reasons, I believe, is that they knew how to take care of their clothing.”** According to UNL professor Dr. Jennifer Johnson Jorgensen, cultural shifts around the maintenance, repair, and creation of clothing have contributed to an increasing perception of disposability.

Home economics programs have disappeared from schools around the country and fewer consumers know how to spot quality, repair simple issues, or properly maintain their clothes. “I do see a lot of people just throw away something because a button falls off. It’s such an easy fix!” says Jorgensen. Fast fashion practices contribute to these problems, producing cheap, low quality clothing that degrades quickly and is often not worth the effort of repairing.

Repairing, creating, or even purchasing clothing from small designers helps rebuild the perception of value. Jorgensen commented “Someone that has gone through the act of sewing something, they’ll understand how labor intensive it is and appreciate their items more, and so when they look at the \$10 pair of jeans in the discount store, they’ll look at that and say ‘I should be paying more for this.’”

“The biggest thing that people can do is to vote with your dollar. Every time you purchase something you’re making an environmental decision,” - Jennifer Johnson Jorgensen

In their 2023 report, ThredUp found that awareness and values are shifting in younger generations¹³.

- 61% of Gen Z and Millennials consider themselves eco-conscious or sustainability-focused
- 58% of Gen Z and Millennials say their closet contributes to climate change, compared to 43% of consumers overall
- Sustainability is a top 5 motivator in purchasing for Gen Z
- 47% of Gen Z refuse to purchase from non-sustainable apparel brands and retailers
- 2 in 5 items in Gen Z’s closet are secondhand
- 64% of Gen Z looks for an item secondhand before buying it new

Reduce

Eliminating Overconsumption With UNL and Omaha Fashion Week

Small scale design and slow fashion. As an art form, small scale design and production not only allows for techniques like upcycling and reuse, it also creates a better experience for the consumer. Items are unique, typically one of a kind, and usually something that cannot be reproduced on a mass scale. Small artists are able to utilize traditional techniques and natural materials. For some designers, using secondhand or upcycled materials is just more accessible, and for some it's passion and purpose.

Most of these designers are focused on creating items that are one of a kind, and often for a specific person. Special occasion garments, or staple wardrobe pieces become infused with meaning and connection for the wearer, because of the relationship to the maker. Items like these cannot be over consumed, because they are not mass produced. When clothing is made on a small scale, with intention and human connection, it is less likely to be underutilized.

Omaha Fashion Week -the biggest fashion show in the Midwest.

In Omaha, small scale design has a major foothold during the Omaha Fashion Week. Despite being the 4th largest fashion week in the country (after NYC, Miami, and LA) Omaha Fashion Week remains a free, accessible platform for small designers and other artists, like models and makeup artists, an aspect of the event that event staff consider to be an important component of sustainability too. The event creates opportunities for new artists to get involved in the fashion world and gain an audience. As the largest fashion week in the Midwest, they have designers from across the region participating.



Photos by Heather and Jameson Hooton. Designers Mayed by Rey, Reduce, Nuevintage

Recipe for a sustainable wardrobe:

Sami Hartong of Omaha Fashion Week offered this breakdown of wardrobe composition:

- 75% of clothes in a wardrobe should be WOFs - Without Fail. These are the staple pieces that work every time. Usually these items are pretty timeless, and they are items that you want to be durable.
- 20% can be statement pieces - these might not be good for every outfit, but offer the glitz and glam to add the wow factor to your daily outfits.
- 5% are fun pieces - These are the things you just had to have. These things might be lower quality, or part of a fast moving trend - items that won't last forever either durability or style wise.

Reuse

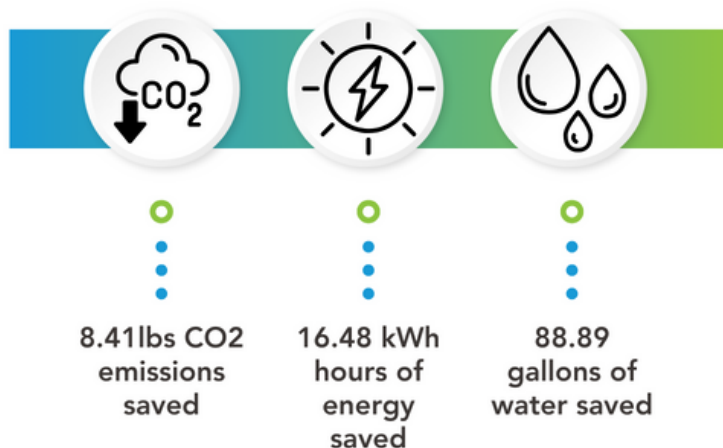
The Power of Secondhand

While clothing purchases continue to grow, clothing use has been on the decline. The Ellen MacArthur Foundation found that globally, **clothing utilization is down 36%**, meaning that consumers are discarding clothing faster than ever³. A system in which textile resources are diverted from the landfill will require that clothing is kept in use for as long as the quality of the garment allows.

Shopping secondhand keeps materials in use and creates access to high quality items at a lower cost. ThredUp, an online secondhand market, found in their annual report¹³

- Resale grew 5x more than retail in 2023
- Is expected to grow 9x faster than retail by 2027
- Will be the second largest market share of retail by 2027
- Online resale expected to grow 21% yearly for the next 5 years
- Branded resale programs skyrocketed, going from 36 brands with the program to 124

IMPACT OF Shopping Secondhand Over New



Source: ThredUp 2023 Resale Report

Clothing Swaps: an opportunity for community connection and landfill diversion

Swap Omaha got its start for Earth Day 2022, with an event that drew over 100 participants. Since then, they've successfully diverted more than 10,000 lbs of material from the landfill, sharing and swapping with community members for free. Typically $\frac{3}{4}$ of the items brought in are sent to a new home the same day. The remainder goes to local charities.

NRC hosted our own clothing swap for Earth Day 2023, with over 60 participants and 750 items swapped, achieving an almost 100% swap rate.

Reducing the harm caused by global reuse markets. With the goal being improved environmental and human health outcomes, the global secondhand clothing trade needs significant change in order to maximize the benefits and reduce the harm caused. Primarily, there needs to be improvement in sorting and overall reductions in the volume sent abroad for reuse. It is inherently unsustainable to rely on other countries to accept our waste as a waste management technique.

Strengthening the reuse and resale market domestically can make a big impact in reducing the volume of material shipped abroad.

Recycling

The Challenges and Potential in Textile Recycling

In an ideal system, the landfill would be reserved as a last resort for materials, and less than 5% of textiles would wind up there. There are many challenges with not only textile recycling but recycling systems in general to get to that point.

Currently more than 97% of textile feedstock is virgin material³. In order to achieve a system where recycled feedstock is easily utilized in textile production we must first overcome the technical difficulties in recycling the material. Currently there are no recyclers operating at scale that are capable of separating fiber blends. With polycotton blends accounting for more than half of all fabric in use, there is a need to find ways to separate these materials.

Recycling technology advancements elsewhere...

- Evrnu - Seattle based company creating a lyocell fiber from waste cotton textiles. This fiber can be recycled up to 5x, and is 20x stronger than traditional lyocell and polyester fibers¹⁴.
- Circ - US based company using a hydrothermal process to separate polycotton blends, recovering both polyester and cellulose pulp for lyocell¹⁶.
- Dr. Sonja Salmon's process - In a recent webinar from the EPA and Biomimicry Institute Dr. Sonja Salmon of North Carolina State University shared her process for recycling polycotton blends. Using an enzymatic digestion process, she is able to digest the cotton fibers into a sugar solution, leaving only the polyester fibers behind¹⁵.

Everyday while we work to develop new recycling technology, materials that are already highly recyclable go into the landfill.

Although we know that recycling typically results in better environmental outcomes, more jobs, and a boost to the economy, the national recycling rate is only at 32%¹. The Nebraska Recycling Council regularly works with communities struggling to maintain basic recycling programs. The most common challenge facing Nebraskan communities is lack of access due to the high cost of collection. A handful of other states are taking an old idea and applying it to the problem of packaging to solve the challenge of cost.

Extended producer responsibility legislation is not new, but so far only 4 states have passed bills in regards to packaging. The set up of the legislation varies, but ultimately seeks to put responsibility for the cost of collection back on the producer. Other benefits include:

- Steady supply of recycled materials
- Stabilizing recycling markets
- Incentivize producers to create recyclable products
- Job creation
- Improved relationship between public and recyclers by creating universal access, standardized recycling information, and rebuilding confidence in recycling systems

In our conversation with ReCircled, we learned how this legislation could be applied to the fashion industry in the future. With RFID tagging on every piece of clothing, we would be able to easily track not only the materials, but also the producers. Scott Kuhlman of ReCircled shared "It's around the corner. A lot of the brands know this is coming,"

Recycling

Nebraska's Role in the Future of Fashion

In Sidney Nebraska, textile recycler ReCircled is taking strides towards textile circularity. They work directly with brands on pre-consumer waste material, deconstructing items down into their useful parts and materials. "Whether it's a garment or whether it's a shoe we can get that item into its components. It may be as easy as a 100% cotton t-shirt we just need to remove the label, or it could be a construction boot where there's 39 different parts on it and we have to get it into 39 different parts." From footwear to ski helmets, clothing items, and even the poly mailer bags Coach is turning into hardware, ReCircled aims to find value in every component of material.

Some of the innovative recycling projects ReCircled is involved in:

- EVA foam in shoes - "very very valuable and we've discovered a way to recycle it, so the issue is we just have to get it off of the shoe, and if we can do that we're creating a very high level product,"
- Creating composite materials and using injection molding with Panaco "We know that there is always going to be 'junk' that is always going to be low value," "What do we turn this junk into that we can create a high value out of it?" "We're almost as excited about that as we are the really really good stuff that we can harvest out of this. We're really excited about the very low value stuff and how we can create value with it."
- Developing automation for their disassembly processes with American Robotics Manufacturing Institute (ARM)
- Piloting curbside collection in large scale apartment buildings in major cities with Waste Management

According to Kuhlman, their work goes far beyond processing material. **"We believe that the current process will evolve and change 100%,"** and ReCircled is hard at work figuring out what the new processes will look like. In order to capture the 85% of textiles currently going to the landfill or incinerator, developing a collection and sorting system is going to be key. Kuhlman emphasized the importance of process engineers to help determine the most efficient way forward.

On whether or not a future sorting system would be able to handle blended fabrics, Kuhlman was confident the infrared scanners in use today could handle 90-95% of the material. In the future, we can likely expect every piece of clothing to have RFID tagging embedded in it. This tagging will not only allow sorting systems to identify fiber blends, dyes, and coatings used on materials, it would also create an avenue for tracking which companies are creating recyclable products, and which companies are not. In a future where producers carry the burden of cost for recycling these materials, it would become relatively simple to incentivize producers to make recyclable products. ReCircled is even getting involved in making this technology a national standard.

Recycling

Nebraska's Role in the Future of Fashion

Even ReCircled doesn't have a solution for the challenge of recycling blended fiber fabrics, but said, "the really really cool news is that at the University of Nebraska, Dr. Yang has developed another system for separating blended fibers, and not only separating them, the most important part is removing dyes and we can then reuse the dyes with that."

At the University of Nebraska - Lincoln, award winning researcher Dr. Yiqi Yang has been hard at work developing processes to solve the challenging problem of fiber to fiber recycling. With the support of UNL and funding from Nebraska Environmental Trust, Dr. Yang has developed a process to not only recycle a wide range of fiber blends, but also remove and recycle the dyes in the fibers. Dyes are a critical component in the challenge of fiber recycling - in order to utilize recycled fibers in production, they need to have uniform quality and color. Without dye removal, uniform color is extremely difficult to attain. According to Dr. Yang, not only is the process cost-effective, it also succeeds in preserving fiber quality, two vital steps in closing the loop on textile recycling. On scalability, Dr. Yang stated "Within 5 years we could do large scale production easily," "but the issue is who wants to invest." With major brands looking to reduce their footprint, that investment may be just around the corner.

Nebraska Recycling Council is working on textile waste by:

- Promoting reduction and reuse through public education, hosting our own Earth Day clothing swap and serving as a resource for other organizations hosting their own textile waste diversion events.
- Serving as a resource for the upcoming statewide waste characterization study - which will provide valuable data on the volume of textiles in Nebraska's waste stream.
- Providing support for legislative resolution 163 - which proposes an interim study on opportunities to increase recycling in the state.
- Providing funding for drop off bins, balers, and other recycling equipment through our Recycling Equipment Grants program.
- Publishing this report, presenting these findings at our annual state conference, and creating a page on our website for ongoing information and updates.

Conclusion

With thanks to the Nebraska Department of Environment and Energy for the funding to create this report, and to our contributors for their time and knowledge. Nebraska is uniquely positioned as a leader in the future of textiles - from slow fashion at Omaha's Fashion Week, the groundbreaking research at UNL, and serving as a homebase for innovative recyclers like ReCircled. As our state moves forward with climate action planning and a statewide waste characterization study, emphasizing the power and importance of recycling in our state is more important than ever.

Resources

Further Reading:

The Conscious Closet - by Elizabeth Kline

Secondhand: Travels in the New Global Garage Sale - by Adam Minter

A New Textiles Economy: Redesigning fashion's future - Ellen MacArthur Foundation Report

The Nature of Fashion: Design for decomposition - Biomimicry Institute Report

To Watch:

The True Cost - Andrew Morgan Documentary

Trashion: The stealth export of waste plastic clothes to Kenya - Changing Markets Foundation Documentary

Mend With Me series - @SocorroSociety on TikTok

Recycling Options:

Star City Recycling - Lincoln

Catholic Social Services - Lincoln, Southern Nebraska

The Clothes Bin - Omaha

Global Green Clothing - Lincoln

Crossroads Mission Avenue - Hastings, Broken Bow, Holdrege, Lexington, Doniphan, Grand Island, Kearney

H&M - Omaha, Lincoln, Gretna

Online options:

For Days Take Back Bag

Retold Recycling



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