



# RESEARCH AND MAPPING REPORT

FALL 2020



ACCELERATING®  
CIRCULARITY

# VISION

A world where textiles are in continuous use, the adoption of virgin materials are based on strategic limits and the industry has lowered GHG emissions.



# MISSION

To divert textiles from landfill and incineration for textile-to-textile recycling in circular supply networks.



# WHO WE ARE

An inclusive, task-oriented consortium with the single focus of proving the feasibility of textile-to-textile circular systems.

## FUNDING PROVIDED

GAP INC. • TARGET • VF CORPORATION • WALMART FOUNDATION

## FOUNDING MEMBERS

GAP INC. • GIOTEX • GR3N • LENZING • NIKE • REVOLVE WASTE • TARGET • UNIFI • VF CORPORATION

## COLLABORATING ORGANIZATIONS

AMERICAN APPAREL & FOOTWEAR ASSOCIATION  
UNITED STATES FASHION INDUSTRY ASSOCIATION  
APPAREL IMPACT INSTITUTE • THE RENEWAL WORKSHOP  
FASHION TAKES ACTION • SECONDARY MATERIALS & RECYCLED TEXTILES  
TEXTILE EXCHANGE • OUTDOOR INDUSTRY ASSOCIATION  
RETAIL LEADERS ASSOCIATION • CIRCLE ECONOMY



# WHAT WE WILL DELIVER

IMPACT!

OUTPUT

ACTION

PROBLEM?



The textile industry generates an enormous amount of waste: the United States' municipal solid waste stream alone contains 16.9 million tons of textiles annually.<sup>1</sup> Clothing under-utilization and lack of recycling are responsible for annual global economic losses of \$500 billion.<sup>2</sup> Less than 1% of used clothing is recycled into new materials.<sup>3</sup> The textile industry must become circular to eliminate waste and reduce the need for virgin raw materials, which will reduce planetary impacts in the critical areas of energy, chemicals, and water. Textile waste must become the industry's new raw material.

Accelerating Circularity will identify and assess processes in the conventional textile supply chain that lead to waste. This analysis will inform the development of new models that link all relevant processes, transactions, and actors in the system in order to close the loop by diverting material from landfill.

We will identify volumes of textile waste, where it sits, and what's in it. We will agree on standard specifications for sorting, hard part removal, right-sizing and sanitation of textile feedstocks. We will classify recycling technologies according to feedstock type, process, output, and commercialization stage. All of these outputs will be freely available to all interested parties.

Using these outputs, companies will be able to visualize recycling pathways critical to the development of circular supply chains, articulate the skills and identify the people needed to run them, and to drive new business models that transform materials currently destined for the landfill to feedstocks for the new textile supply chains. These new business models will be tested in pilots to demonstrate commercial viability.



**RESEARCH** existing systems for textile feedstock generation, collection, sorting, preprocessing, recycling, apparel & product development and brands and retailer businesses



**MAP** existing systems and identified gaps



**MODEL** new circular supply chain systems for textile-to-textile supply networks



**LINK** the newly identified supply chain systems



**PILOT** textile-to-textile supply networks



**REPORT** on all findings from research through piloting

We posit that our success will divert spent textiles from landfill. The Sustainable Development Goals (SDGs) address reductions in waste generation in Target 12.5: *By 2030, substantially reduce waste generation through prevention, reduction, **recycling**, and reuse* (emphasis ours). Accelerating Circularity will adopt Indicator 12.5.1: *National recycling rate, tons of material recycled* for in-scope materials (polyester, cotton, viscose and blends of those materials) to measure our progress.<sup>4</sup>

<sup>1</sup> U.S. Environmental Protection Agency. "Advancing Sustainable Materials Management: 2017 Fact Sheet". EPA website, 2017, [www.epa.gov/sites/production/files/2019-11/documents/2017\\_facts\\_and\\_figures\\_fact\\_sheet\\_final.pdf](http://www.epa.gov/sites/production/files/2019-11/documents/2017_facts_and_figures_fact_sheet_final.pdf). Accessed March 10, 2020.

<sup>2</sup> Ellen MacArthur Foundation, 2017, A New Textiles Economy: Redesigning Fashion's Future, [www.ellenmacarthurfoundation.org/assets/downloads/publications/A-New-Textiles-Economy-Full-Report-Updated-1-12-17.pdf](http://www.ellenmacarthurfoundation.org/assets/downloads/publications/A-New-Textiles-Economy-Full-Report-Updated-1-12-17.pdf). Accessed 2020.

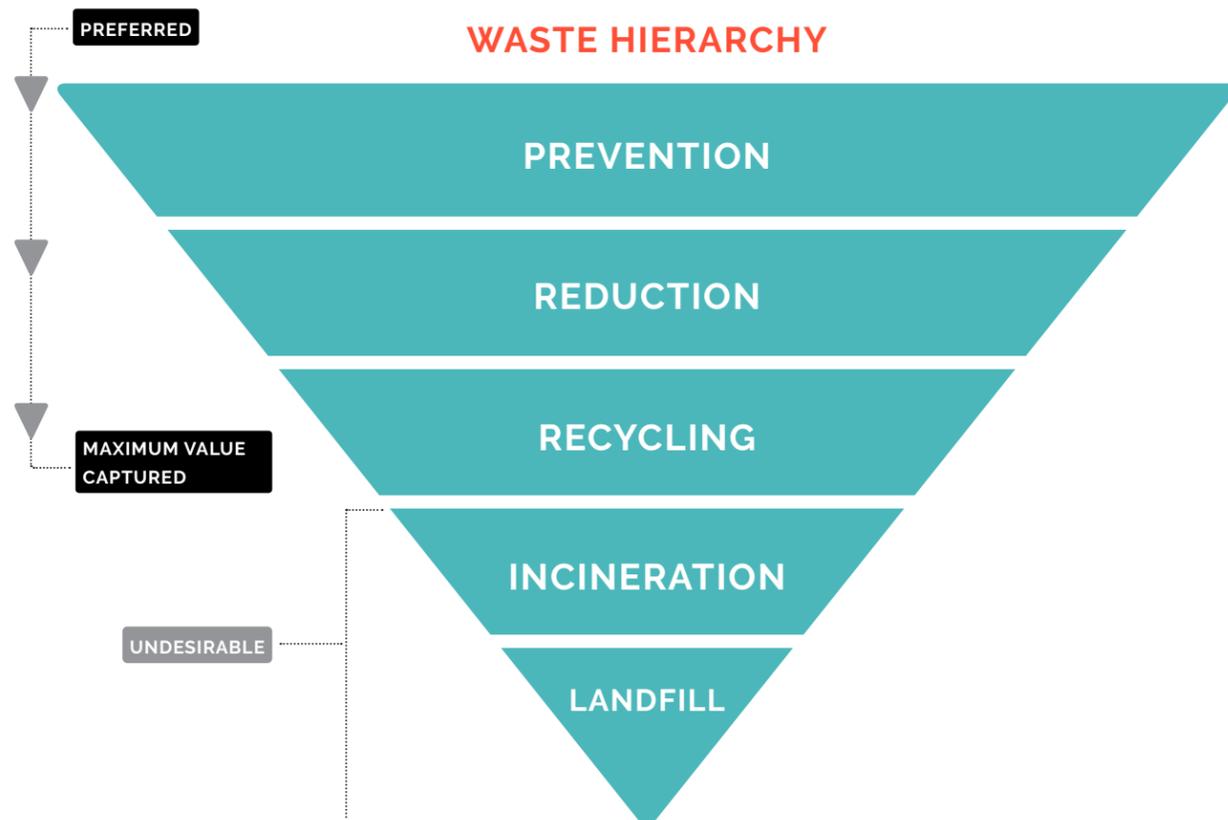
<sup>3</sup> Ibid.

<sup>4</sup> "Goal 12: Ensure Sustainable Consumption and Production Patterns." Sustainable Development Goals - 17 Goals to Transform Our World, 2020, [sdg.data.gov/responsible-consumption-and-production/](http://sdg.data.gov/responsible-consumption-and-production/).

# A LETTER

## FROM ACCELERATING CIRCULARITY

The Accelerating Circularity community believes it will take the cooperation of the entire industry to make meaningful change. Our initiative is unique in its focus on the systems required for textile-to-textile recycling, a critical step in the ability of the industry to become fully circular. We are unified around the goal to divert textiles from landfill and incineration. We support the importance of other circular business practices, such as reuse and repair, which are already being developed by other industry organizations.



Fiber Mfg.

Yarn Spinner

Fabric Makers Woven

Fabric Makers Knit

Dyers, Printers, Lamination Finishing

## PARTICIPANTS INCLUDE

- Working Group Members meet on a monthly basis to provide strategic direction and push progress on a regular basis, e.g. defining our technical scope to include both chemical and mechanical recycling; defining our geographic scope.
- Collaborating Organization participants meet on a quarterly basis for information exchanges and support on various circularity initiatives not within our daily strategic focus e.g. policy or reuse
- Industry experts participate through focused working sessions, e.g. we have convened a group that works together to outline potential sorting specifications.

We were excited about the opportunity to join a small group of first-mover brands and manufacturers with a shared goal to jump start circular solutions for apparel in North America. With the mix of partners in this group we can quickly check assumptions and test ideas to move solutions forward.

— ALICE HARTLEY, DIRECTOR GLOBAL SUSTAINABILITY, GAP INC. WORKING GROUP MEMBER

[It] provides exposure to other stakeholders to get their thinking. I find it helpful to hear what others in different sectors think about circularity.

—STEVEN USDAN CO-FOUNDER, GIOTEX WORKING GROUP MEMBER

I participate in ACP for three main reasons. First of all, circularity is a goal within the LENZING Sustainability strategy of Naturally Positive. I value the leadership of Karla Magruder and working with the companies involved in the group. Personally, after working on circularity developments with brands and communication to consumers, I see there are missing elements. I want to be part of the progress needed to move from linear to circular.

—TRICIA CAREY DIRECTOR GLOBAL BUSINESS DEVELOPMENT, DENIM AT LENZING WORKING GROUP MEMBER

I hope we are successful in advancing common language and shared standards, because these are badly needed in order to move circular apparel from pilot projects to solutions at scale. I think we will have succeeded when there are functioning marketplaces for post-consumer materials, that keep these materials in the region rather than exporting them overseas.

—ALICE HARTLEY, DIRECTOR  
GLOBAL SUSTAINABILITY, GAP INC.  
WORKING GROUP MEMBER

As an association and Collaborating Organization, we are excited to provide our members with education about circularity through collaborative webinars with AC, and at the same time learn from AC about circularity policy needs that we may be able to influence in our advocacy work. Accelerating Circularity, like USFIA, believes that taking action that makes change is what creates value for the entire industry.

—JULIE HUGHES, PRESIDENT  
USFIA  
COLLABORATING ORGANIZATION

The value of these meetings whereby the participants come from all aspects of the supply chain, truly provides us with the insights of how complex our supply chain can be. A manufacturer can help in solving certain processing issues downstream in the process that would take us closer to achieving our goals. The same goes for the manufacturer to understand the retail side of the business. Ultimately, as a supply chain network, we can provide the consumer the experience they desire. You can have both, great quality and optimal sustainable apparel that is affordable.

— DAVID SASSO, VP OF SALES AND MARKETING, BUHLER QUALITY YARNS

The Secondary Materials and Recycled Textiles Association (SMART) is proud to support such an innovative project with the potential to accelerate the textile industry's move from linear to circular. On behalf of our association, comprised of for-profit businesses in the textile reuse and recycling industry, it is exceptionally important for all stakeholders to be active participants in the conversation about circularity and we are eager to play our part in making a difference for our planet.

— JACKIE KING  
EXECUTIVE DIRECTOR, SMART  
COLLABORATING ORGANIZATION

Circularity is about shifting the whole system, from product design to business models to textile collection infrastructure. These types of systems challenges call for highly collaborative solutions, because no one company has all the answers or can move the needle itself.

—ALICE HARTLEY, DIRECTOR  
GLOBAL SUSTAINABILITY, GAP INC.  
WORKING GROUP MEMBER

This project would not be possible without the financial support from our sponsors, the expertise of the working group, the reach of the collaborating organizations and individuals who have given their time and expertise. Circularity is a team sport, no one company can create the new business models that will allow all the spent textiles to find new paths to closed loop systems.

—KARLA MAGRUDER, FOUNDER & PRESIDENT  
ACCELERATING CIRCULARITY

In the end, I hope from the outcome, we will be able to understand the pain points of circularity, especially related to value. Additionally I would like to understand where we need to put more effort in scaling and funding.

—TRICIA CAREY  
DIRECTOR GLOBAL BUSINESS DEVELOPMENT  
DENIM AT LENZING  
WORKING GROUP MEMBER

Unifi is proud to be part of an industry-wide initiative to help build a circular economy for textiles. Over the past 10 years we have run some pilot and commercial programs to recycle cut and sew fabrics from brand partners, and we are excited to be part of a border, more inclusive industry solution.

— CHAD BOLICK  
GLOBAL VP BRANDS SALES, UNIFI  
WORKING GROUP MEMBER

At The Renewal Workshop, our ability to divert waste from landfill by extending the life of products for resale relies on collaborating systems. Cycling products and information means we need to be in constant conversation with our brand and recycling partners. Collaboration is the only way we can do our work, the better we collaborate, the faster we can shift into a circular economy for apparel and textiles.

— THE RENEWAL WORKSHOP, COLLABORATING ORGANIZATION



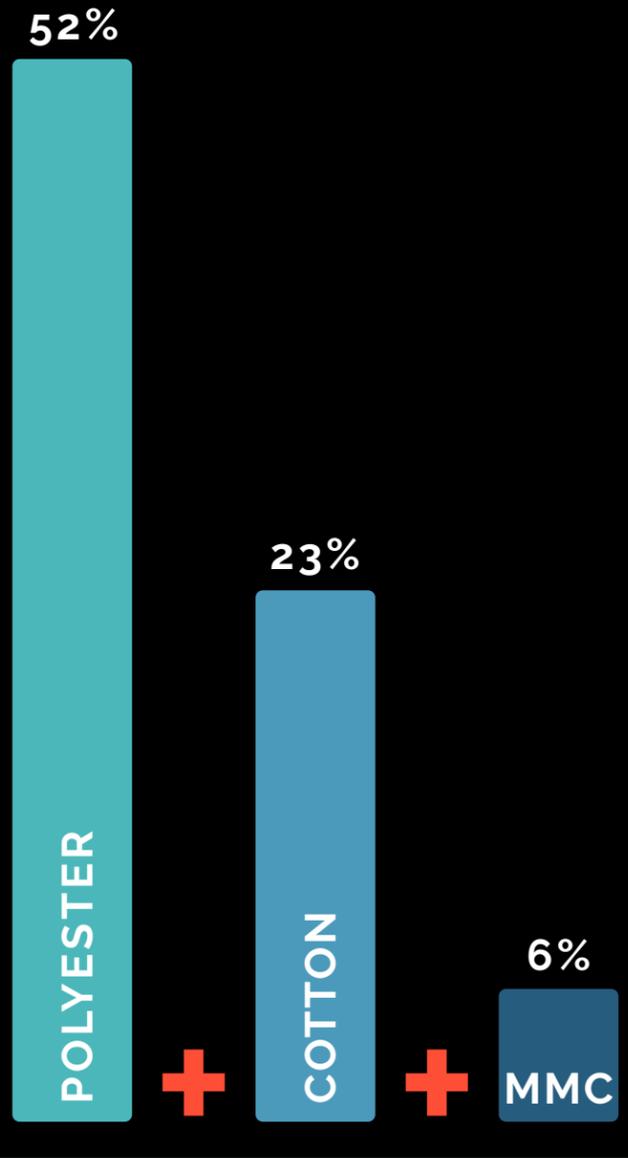
# OUR SCOPE

We focus on polyester, cotton and manmade cellulosics for textile-to-textile supply chains. These three fibers cover over 80% of the textile market. Bottles, other packaging and agricultural and food waste are excluded.

**Supply Networks** include the east coast of the U.S., Caribbean Basin, Mexico, and Central America for the best opportunity and to align with functioning textile supply networks used by U.S. Brands and Retailers.

**Brand & Retailers:** All U.S. based companies

**Recycling Technology** types include both mechanical and chemical recycling. Recycler research is global based on the ability of technologies to be licensed or their outputs used by fiber producers in any location. Technologies cover polyester, cottons and blended fibers.



**81%**  
of the textile fiber market



## GEOGRAPHIC SCOPE

Post-industrial and post-consumer generation and concentration includes the east coast of the United States, where there is a high population density and existing textile supply networks. It includes 20 states and Washington, D.C. with a closer look at 26 metro areas.

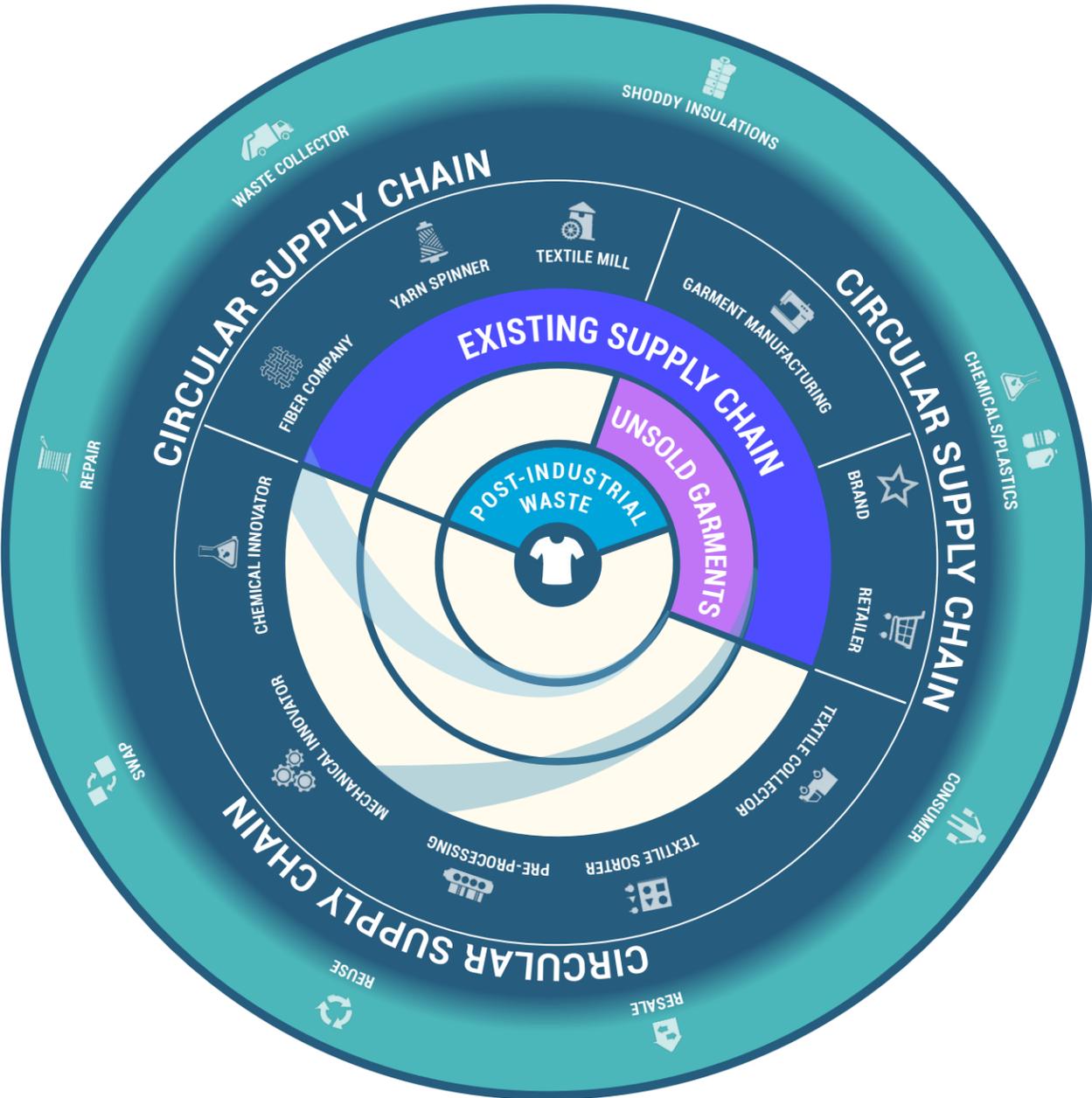
### STATES

- Alabama
- Connecticut
- Delaware
- Florida
- Georgia
- Kentucky
- Maine
- Maryland
- Massachusetts
- North Carolina
- New Hampshire
- New Jersey
- New York
- Ohio
- Pennsylvania
- Rhode Island
- South Carolina
- Tennessee
- Vermont
- Virginia
- West Virginia

### METRO AREAS

- New York, NY
- Washington, D.C.
- Miami, FL
- Philadelphia, PA
- Atlanta, GA
- Boston, MA
- Tampa, FL
- Baltimore, MD
- Orlando, FL
- Charlotte, NC
- Pittsburgh, PA
- Cincinnati, OH
- Columbus, OH
- Cleveland, OH
- Nashville, TN
- Virginia Beach, VA
- Providence, RI
- Jacksonville, FL
- Raleigh, NC
- Memphis, TN
- Richmond, VA
- Louisville, KY
- Hartford, CT
- Birmingham, AL
- Buffalo, NY
- Rochester, NY

# OUR AREAS OF WORK



In this view of a circular supply chain, some conventional supply chain steps are connected, and some are not. We believe by connecting the collection, sorting, pre-processing, and recycling nodes we will be able to integrate circularity directly into existing supply chains and scale quickly.



## Be the Knowledge Provider for Textile-to-Textile Circularity

Accelerating Circularity is focused on product recovery and recycling infrastructure. In order to achieve true circularity, we must also engage the systems that will connect recovery and recycling to conventional supply chains. Therefore, waste haulers, textile collectors, sorters, pre-processors, recyclers, fiber manufacturers, yarn spinners, fabric mills, garment makers, brands and retailers are all included in our research scope.

### THE BASICS

#### A COMMON LANGUAGE

We all understand the term *waste*, but we do not have a common value for it. Guided by the Waste Hierarchy, we recognize that what is waste for one system can be an input for another. When a textile has cycled through repair, re-use, resale, and/or re-make such that it retains no readily accessible value, the material is *spent*. Therefore, Accelerating Circularity calls the raw material for textile-to-textile recycling *spent* textiles. A full list of defined terms can be found in the **Glossary**.

#### BIG CIRCLES VS. LITTLE CIRCLES

Accelerating Circularity believes in going big! We define big, circular systems as those that take in spent materials from a variety of sources and produce materials that can be used in multiple product applications. Little circles are those where a single company takes back its own product and has it recycled into the same or similar product. While all circles are good, we propose that only big circles will lead to circular supply chains at scale.

#### CIRCULAR INS & OUTS

We're talking about systems. We need to know what is coming in and out of each node in a system. The flow of materials must create new business opportunities in order for circularity to become commercially viable.

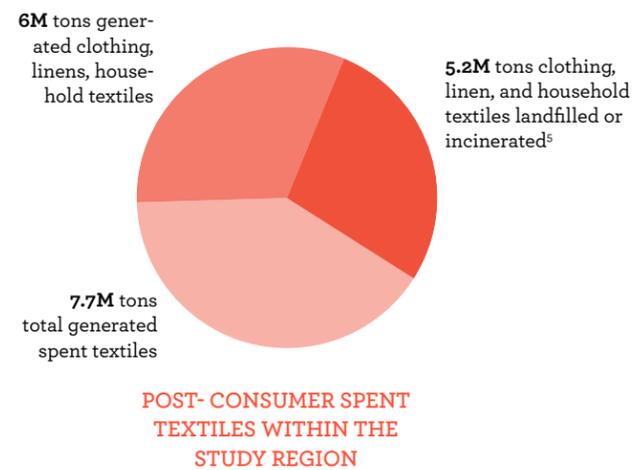
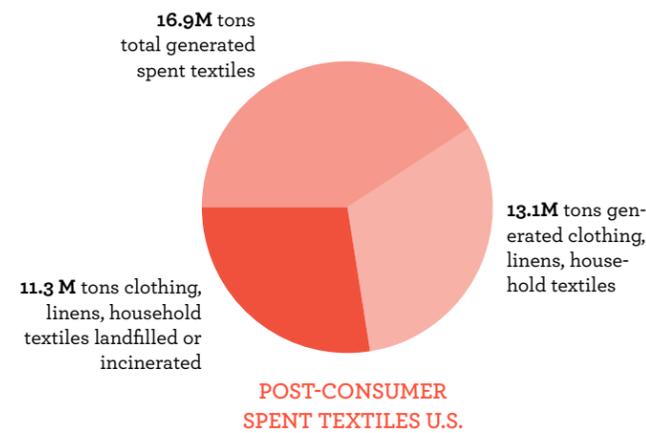
#### FORM AND ANSWER THE RIGHT QUESTIONS

Why do we need to recycle? What is there to be recycled? How can it be collected and prepared for recycling? Who can recycle it? How can it be recycled? What can they make? Who will buy it?

# Why Do We Need to Recycle?

**We are generating too much textile waste.** Our study region on the East Coast of the United States represents approximately 7.7 million of the 16.9 million tons of post-consumer spent textiles generated annually in the USA.<sup>5</sup>

There is little formal data for spent post-industrial textiles. A combination of U.S. Census data and our research shows that the U.S. is generating approximately 120,000 tons of post-industrial textile waste annually and 90,000 tons in our study region.<sup>6</sup>



By diverting these spent textiles from incineration and landfill in our study region, we can lower the textile industry's GHG emissions as well as reduce the use of virgin materials. The Sustainable Apparel Coalition HIGG MSI, an industry benchmark, highlights mechanical recycling as a lower carbon option than virgin materials. For example, compared with fossil-fuel based polyester, mechanically recycled polyester has a more than 70% lower GHG footprint. The same is true of recycled cotton compared to conventional cotton. As advanced recycling technologies become commercial, studies will need to be done to understand their environmental profiles as compared to virgin materials and confirm whether moving to these chemically recycled options provides a positive environmental benefit.<sup>7</sup>

Brands and retailers, driven to become more sustainable and reduce resource consumption, are making commitments to use recycled materials. Spent textiles become the logical industry feedstock since they have the potential to lower the use of virgin materials, water, energy, and chemicals and avoid competing with other industries for non-textile feedstocks.

<sup>5</sup> U.S. Environmental Protection Agency, Washington, D.C., 2019, p. 11, *Advancing Sustainable Materials Management: 2017 Fact Sheet*.

<sup>6</sup> Annex 3.

<sup>7</sup> "Higg Product Tools." *Sustainable Apparel Coalition*, Sustainable Apparel Coalition, [apparelcoalition.org/higg-product-tools/](https://apparelcoalition.org/higg-product-tools/).



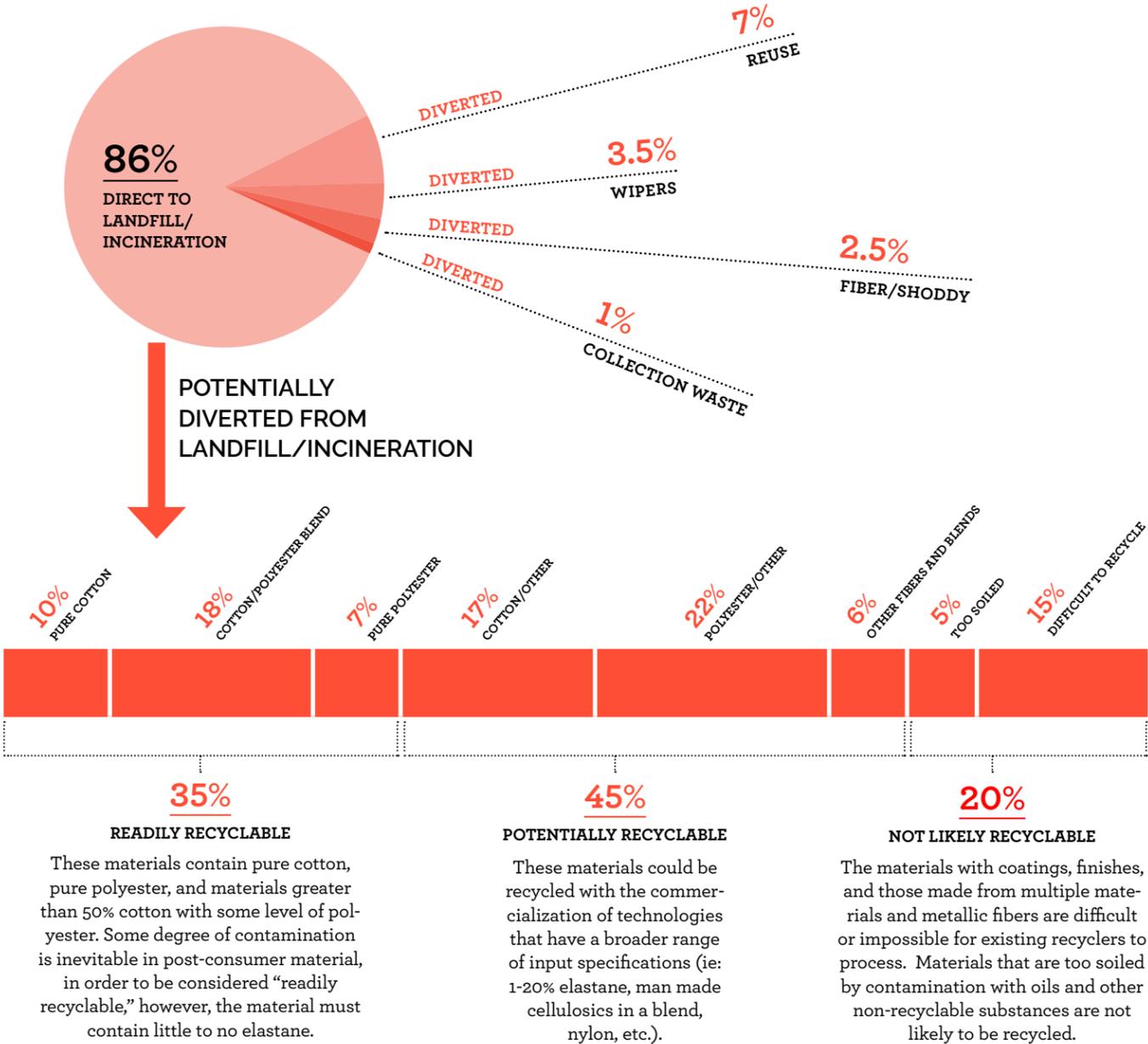


# What Is There to Be Recycled?

## POST-CONSUMER MATERIAL

Spent post-consumer textiles come from individual consumers and commercial users of textile products, such as hotels, hospitals, and industrial laundries. Comparing data and insights from (1) the secondhand industry, (2) import statistics from the U.S. Census Bureau, and (3) high level product details provided by brands and retailers and other industry actors, we estimate volumes of clothing, linens and other household textiles in municipal solid waste to be 13.1 million tons.

Six million tons, or 46% of these materials, is generated within the study region, with the New York City metro area accounting for more than a tenth and the Washington, D.C. to Boston corridor nearly a quarter.<sup>8</sup> Florida reports the highest per-state total material generated (746K tons landfilled or incinerated), which we attribute to low tipping fees and a lack of textile recycling programs.

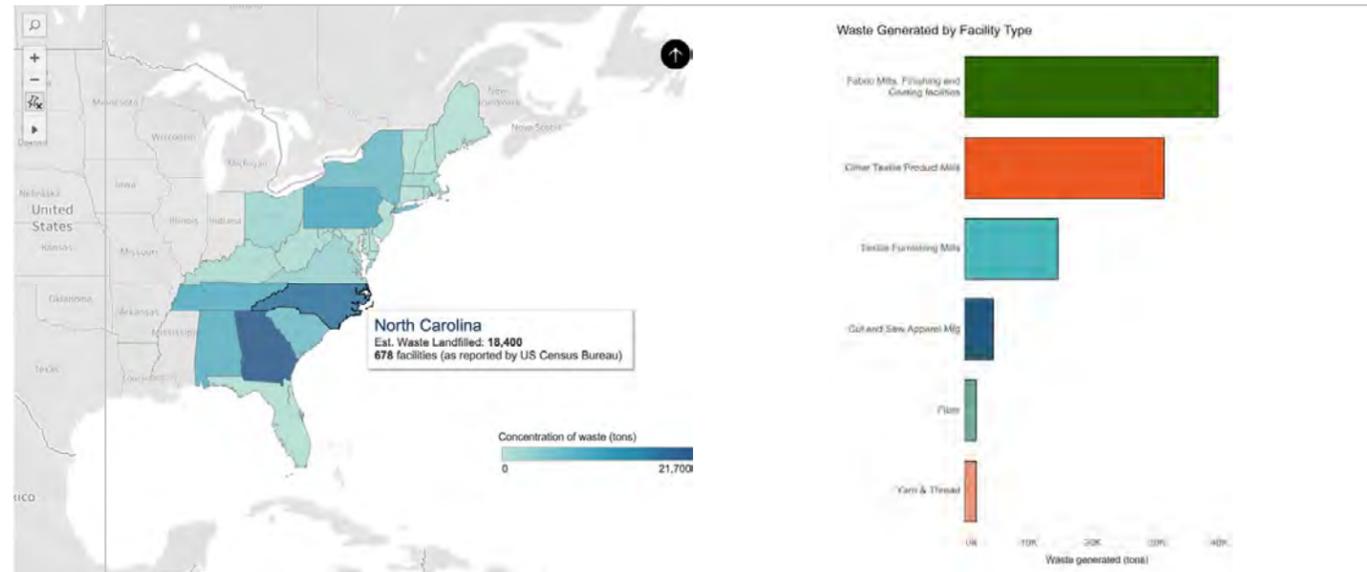


## POST-INDUSTRIAL MATERIAL

Spent post-industrial textiles come from textile industry manufacturing facilities, such as knitting or weaving mills, and cut and sew facilities. Because the fibers in this waste stream are easily identifiable, and because post-industrial suppliers are able to provide sorted, minimally processed material (eliminating the need for pre-processing steps such as hard part removal or sanitization), this valuable resource is already used widely in mechanical recycling. These attributes can also support the commercialization of chemical recycling.

Our post-industrial waste profile focuses on fabric mills, finishing and coating facilities, textile product mills, and apparel manufacturers. Synthetic fiber production and yarn spinning (NAICS Code 3131) is excluded from our estimates, because much of that working loss is reabsorbed by the generating facility or a third party (i.e., there is relatively little waste).

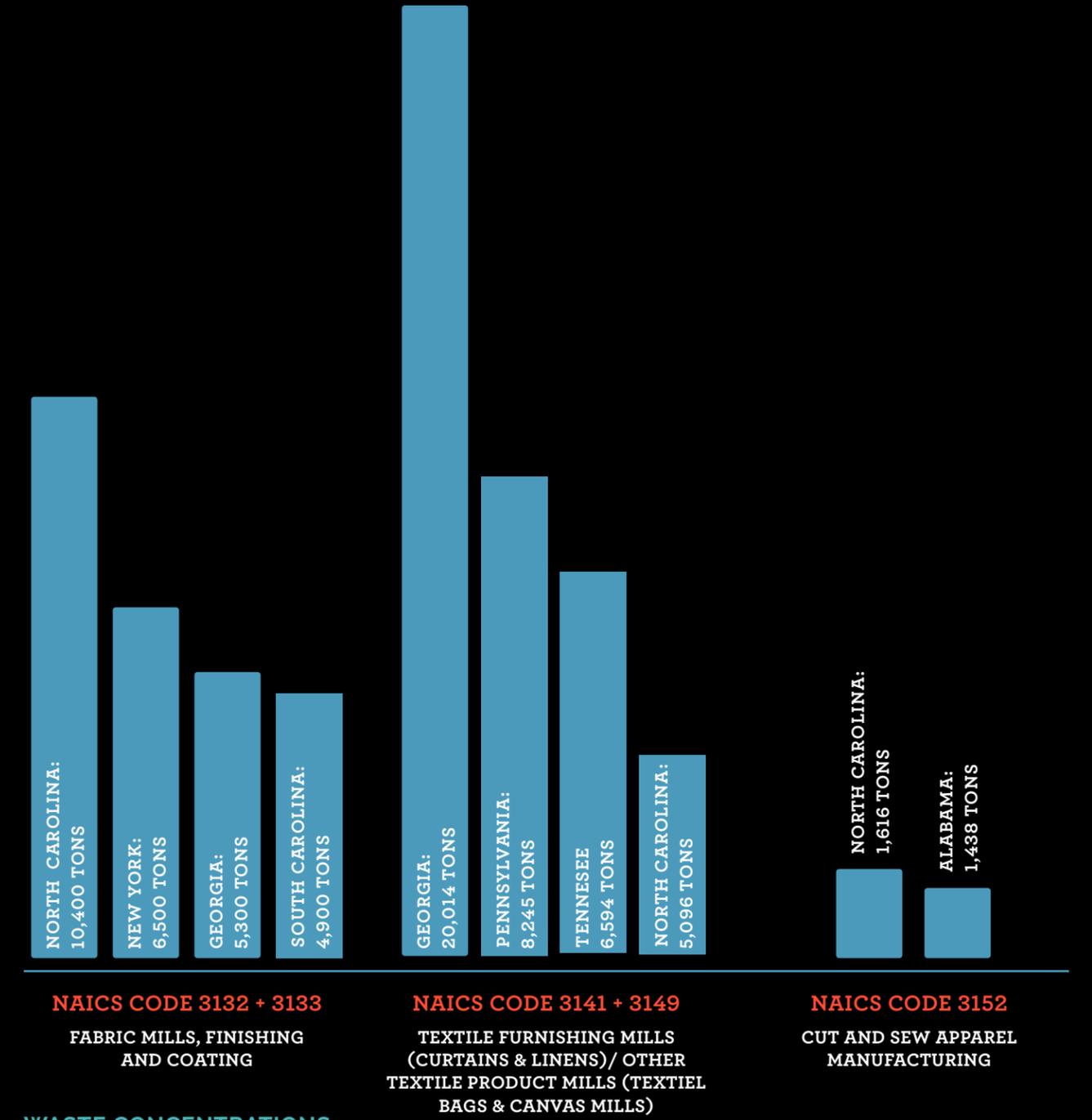
## POST-INDUSTRIAL WASTE



Go to our interactive mapping tool to see post-industrial waste volumes by state: [www.acceleratingcircularity.org/research](http://www.acceleratingcircularity.org/research)

NAICS Code	Tons of Spent Textile Materials to Landfill
<b>3132 + 3133</b> Fabric Mills, Finishing, and Coating	<b>39,500</b>
<b>3141</b> Textile Furnishing Mills (Curtans and Linens)	<b>14,750</b>
<b>3149</b> Other Textile Product Mills (Textile bags and Canvas Mills)	<b>31,250</b>
<b>3152</b> Cut and Sew Apparel Manufacturing	<b>4,500</b>
<b>TOTALS</b>	<b>90,000</b>

## TOP POST-INDUSTRIAL WASTE GENERATORS BY NAICS CODES, AMOUNT LANDFILLED



### WASTE CONCENTRATIONS

Cut and sew manufacturing waste is perceived to be the most readily recyclable post-industrial textile material, and Alabama and North Carolina are the largest producers of cut and sew waste in our study region. Georgia is home to a large number of textile furnishing and other product mills, driving it -- along with North Carolina -- to the top spot for total post-industrial waste generation.<sup>9</sup>

# How Can It Be Collected and Prepared for Recycling?

## COLLECTION

Materials must be collected, sorted and prepared for recycling. This step is most relevant to post-consumer textiles, since post-industrial materials are typically sorted at the generating facilities.

Provided there is downstream demand, material collection has the ability to scale quickly. The vast majority of post-consumer textiles are currently collected by the three largest thrift operators (Goodwill, Salvation Army, and Savers/Value Village), and collection bin operators.

### Other collection channels include:

- Curbside collection
- High-density apartment building collection
- Clothing drives
- Brand and retailer takeback programs
- Online thrift operations utilizing mail-in collection
- New business models and start-ups for collecting/sorting and preprocessing

Most spent textiles wind up in landfill through the municipal solid waste (MSW) stream. Because MSW collectors already handle so much of this material, they -- along with the municipalities and local governments they serve -- must play a role in diverting it from incineration and landfill into our new textile recycling pathways. The three largest solid waste and recycling collection companies in the U.S. (Waste Management, Republic, and Waste Connections) all operate in our study region and have a clear opportunity to engage in textile-to-textile recycling.

Twelve of the 26 municipalities or metro areas in the study region have a textile recycling initiative or provide specific textile recycling information to their residents. The New York Department of Sanitation and Massachusetts Department of

Environmental Protection are currently the most focused on textile waste. For example, New York City developed the Re-Clothe NYC Coalition, a group of recyclers, non-profits and government agencies working together to increase textile reuse in NY. Others have plans to address textiles in the future, have done pilots in recent years, and/or provide a list of textile recycling resources for residents.<sup>10</sup>

## SORTING

Sorting has challenges that demonstrate a potential gap. Today, spent textiles are manually sorted into fractions tailored for reuse markets. Non-reusable items are sorted into grades for shoddy, wipers and mechanical recycling. New sorting fractions are required to meet the needs of textile-to-textile recycling. Although sorting hubs still exist in Houston, Texas (and Toronto, Ontario), labor costs have driven several sorters to exit the US in recent years; only a few remain in our study region. Reduced sorting costs and increased accuracy of fiber detection are prerequisites to scaled circular supply chains. This requires commercialized, automated sorting solutions.

## AGGREGATION

The fiber content and volume of collected material varies by season and location. Fiber and volume requirements are typically tailored to individual recyclers' needs. This necessitates aggregation in order to build specific material bundles. Because this step is currently carried out in some form by various actors already collecting and sorting spent post-consumer textiles, aggregation has the ability to scale quickly.

## PREPROCESSING

Preprocessing, the transformation of spent textiles into recycling feedstocks, is a challenging area with several gaps.

## POST-CONSUMER TEXTILE RECYCLING ECOSYSTEM, EXCLUDING RECYCLERS



Go to our interactive mapping tool to see more detail: [www.acceleratingcircularity.org/research](http://www.acceleratingcircularity.org/research)

### Preprocessing may include:

- Hard part removal
- Print removal
- Sanitization/industrial laundering
- Right sizing

### Preprocessing activities are distributed across a number of industry actors:

- **Mechanical recyclers** are the only companies currently removing hard parts and prints and right sizing at scale, typically for use in their own recycling lines. Today, only five mechanical recyclers in the study region accept post-consumer textiles, and ever fewer are equipped to remove buttons, zippers, and/or hard parts.
- **Wiper suppliers** have the equipment for right sizing and skills to provide hard part removal, but adopting such a significant business model shift requires a convincing business case.
- **Industrial laundries** have the necessary scale and new technologies, such as ozone sanitation are being commercialized which will provide

additional capacities. The segment has the potential to provide some preprocessing or material aggregation services, but as with the wiper suppliers, this would require a significant shift in business models.

• **New businesses** aim to fill the gaps in today's collection, sorting, aggregation, and preprocessing infrastructure. Many are focused on brand-service models to fill these gaps.

Today's post-consumer textile market primarily serves reuse applications. This makes intuitive sense because of where reuse sits in the Waste Hierarchy. As we move to a circular economy, however, we must build infrastructure and business models that also accommodate recycling: eventually, an item's reuse value will be spent, and the material will need to be recycled.

In order to build a functioning circular textile supply network, all preprocessing activities must develop and scale. To do this, there must be demand for recycled outputs and a business case for each node in the supply network.

<sup>10</sup> Annex 2.

# Who Can Recycle It?

Mechanical recycling has been commercial for more than 200 years. This mature technology is used extensively with cotton and wool (which may also include some polyester), and we have identified 69 mechanical recyclers worldwide.

Chemical recycling is relatively new: Teijin claims to have developed the world's first chemical recycling of polyester in 2002. The sector is advancing quickly -- we found more than 56 chemical recyclers developing and/or commercializing these emerging technologies. For example:

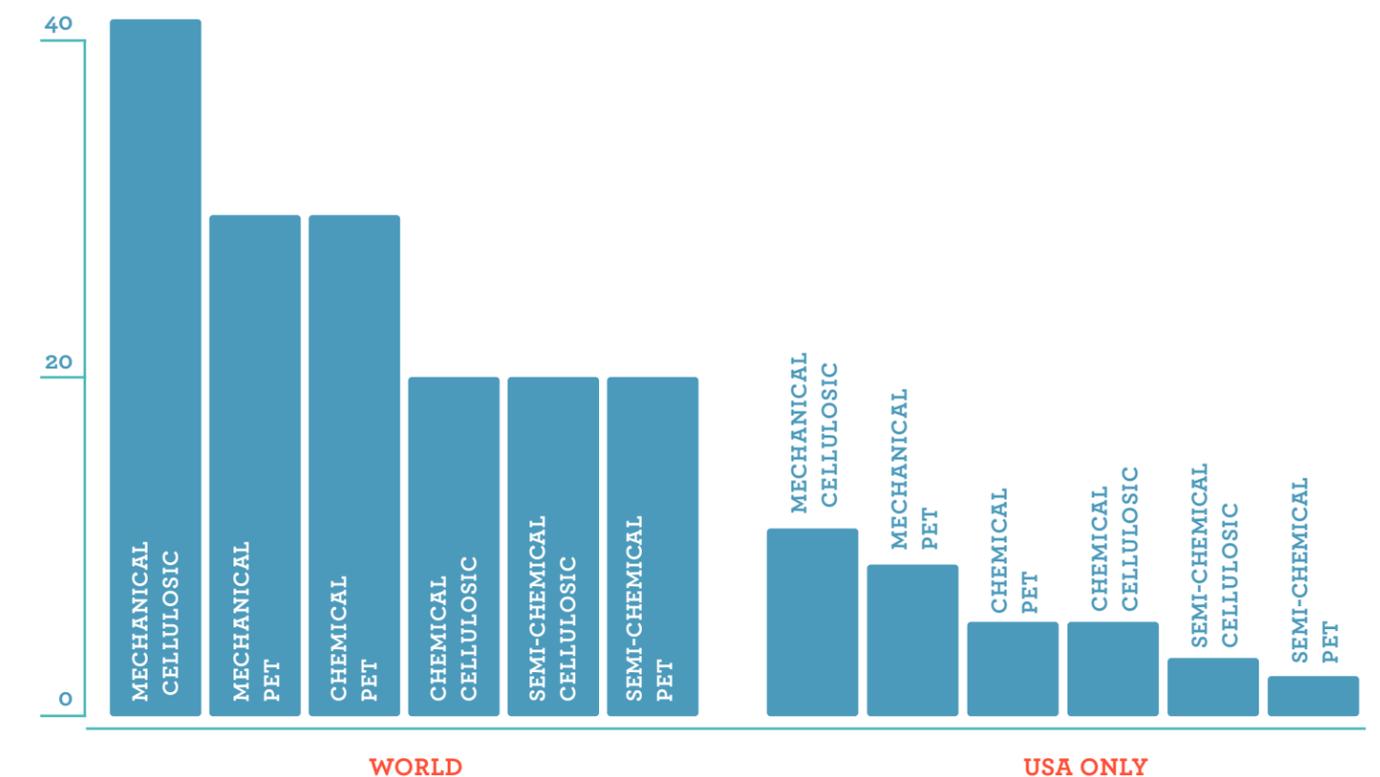
- Lenzing is one of the few commercial chemical cellulosic material suppliers who is able to use both post-industrial and post-consumer materials (albeit in blends with virgin wood pulp) as feedstocks in its Refibra product.
- Commercial-scale polyester recyclers Itochu and Far Eastern use primarily post-industrial feedstocks, though in some cases, purity targets even allow limited quantities of post-consumer feedstocks.
- Gr3n, an Accelerating Circularity Founding Member, is in the process of building a demonstration plant to process a variety of polyester blends (using 20-50% other fiber) into monomers, using a mass balance approach. The facility will have a nominal capacity of 1,000 tons/year by January 2021. Due to the volume of blended fibers in spent textiles, recyclers who can accept blends (like Gr3n) will be in high demand.

## POST-CONSUMER TEXTILE RECYCLING ECOSYSTEM, RECYCLERS ONLY



Go to our interactive mapping tool to see more detail: [www.acceleratingcircularity.org/research](http://www.acceleratingcircularity.org/research)

## NUMBER OF PROVIDERS BY TECHNOLOGY TYPE



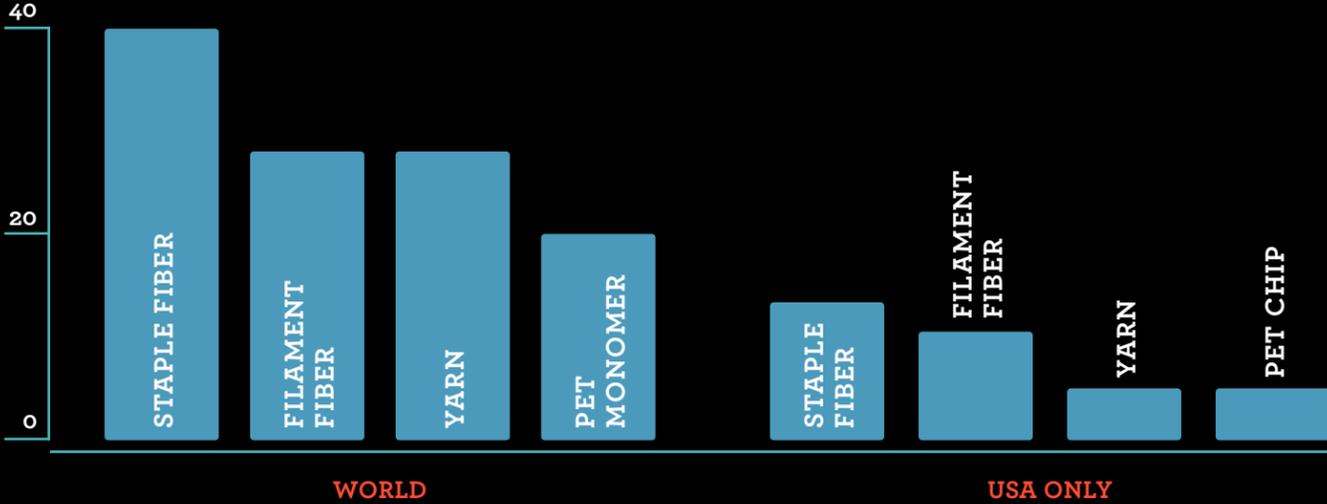
# How Can It Be Recycled?

Our scope includes mechanical and chemical recyclers, with a focus on post-industrial and post-consumer cotton, polyester and blended polyester/cotton feedstocks.

Given its ubiquity in finished goods, the ability to recycle materials containing polyurethane fibers like spandex and elastane will be in high demand.

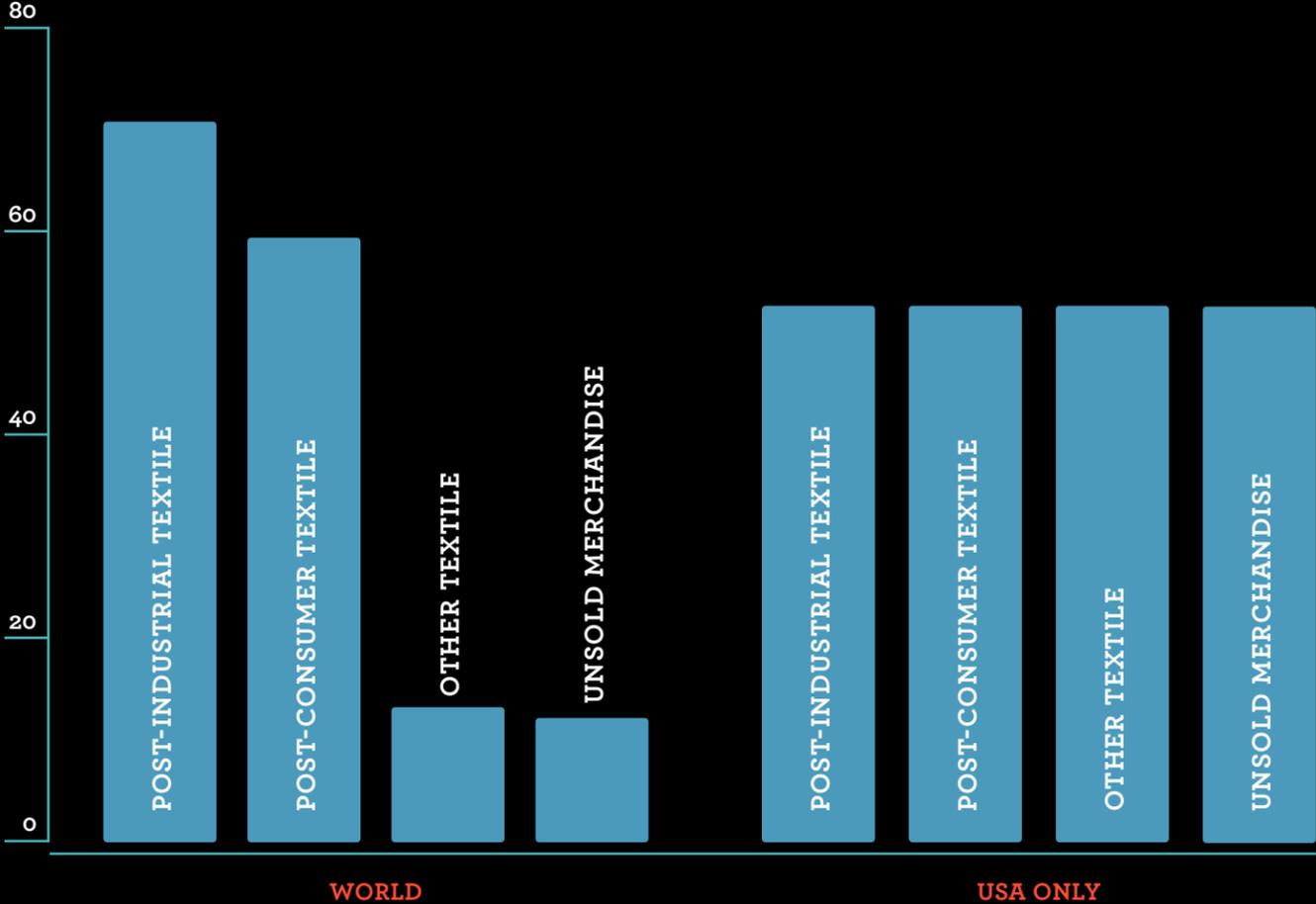
The biggest challenge to large-scale commercialization remains the ability to recycle blended materials, regardless of whether the source is post-industrial or post-consumer.

## NUMBER OF PROVIDERS BY OUTPUTS



Recycler outputs will have a direct impact on targeted markets and products for circular materials.

## NUMBER OF PROVIDERS BY FEEDSTOCK TYPE



The majority of recyclers use post-industrial textiles. Available fiber contents are known and preprocessing is usually not required. There's a push for the industry to use the vast quantities of available post-consumer textiles, which can be seen in the number of new U.S. recycling providers.

## NUMBER OF PROVIDERS BY RESTRICTIONS



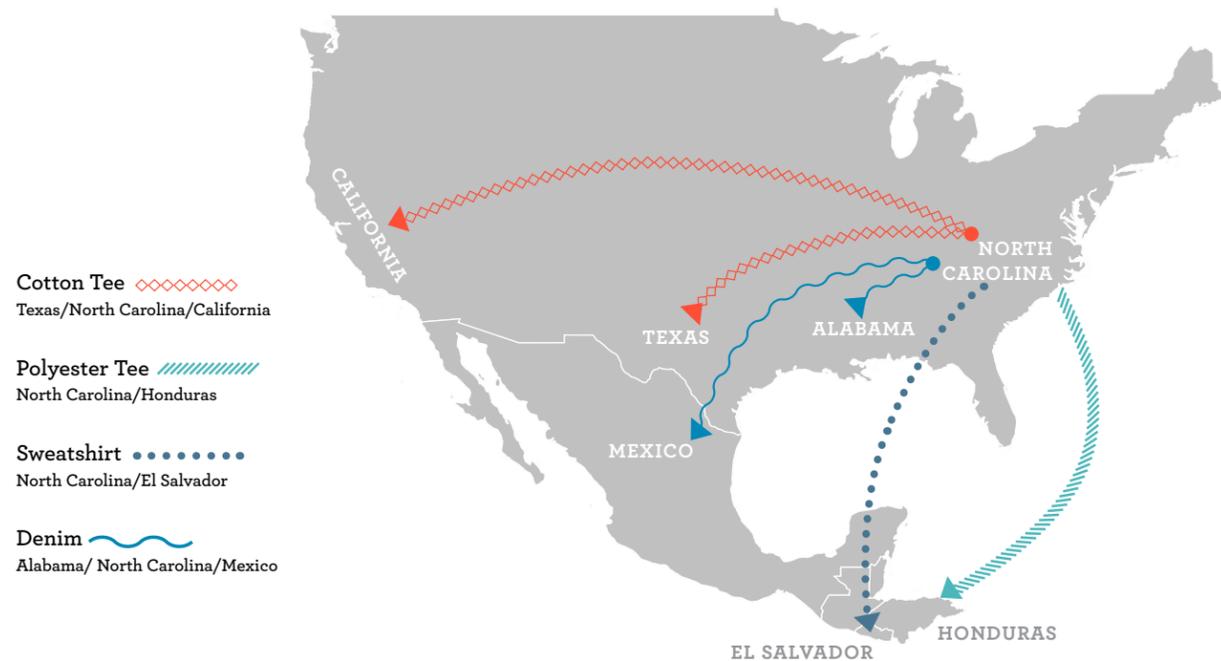
Elastane is cited as a restriction by more recyclers globally than any other fiber. This poses an enormous challenge because of its ubiquitous use in a wide variety of garments. Nylon and metals are also frequently restricted.

# What Can They Make?

## WESTERN HEMISPHERE CIRCULAR PRODUCTION FEASIBILITY

Commercial feasibility of recycled products depends on quality, quantity and cost; our goal is to define a cost-effective circular textile supply chain. To calibrate that potential, we examined existing linear supply chains through a geographic lens and conducted a survey to understand the current breakdown of how component costs (make, materials, etc.) contribute to the total cost of a product. Data collection focused primarily on the Western Hemisphere with some outliers included to accommodate existing gaps. This information will inform our model of future circular supply chains.

EXISTING WESTERN HEMISPHERE SUPPLY CHAINS



### COST RATIO DATA COLLECTION SCOPE:

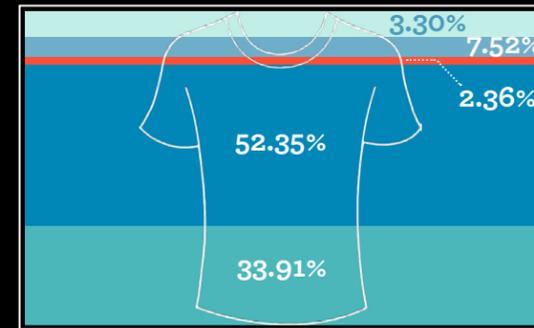
- We focused our data collection on three key products: t-shirts (cotton, blended and polyester), sweatshirts and a 5 pocket jean.
- We provided stakeholders with a specification to maintain a level of consistency.
- Data collection was centered on a fraction of the cost to total. For example, materials make up 52.35% of the cost of a 100% cotton, basic men's t-shirt.

### OUTPUTS:

We aggregated data from multiple industry participants into a single roll-up per product. We then further vetted the aggregated data through the stakeholder community to confirm the accuracy of our approach.

### OPPORTUNITY:

- How will the industry value circular materials and local cut-make-trim (CMT)?

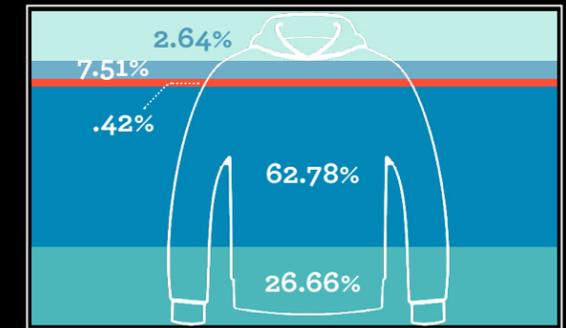


### BASIC MEN'S T-SHIRT

Medium

100% Cotton Jersey

180 GSM



### BASIC MEN'S SWEATSHIRT

Medium

60% Cotton/40% Polyester Fleece

280 GSM

### PACKAGING

### TRIMS

(Includes Wash/Finish)

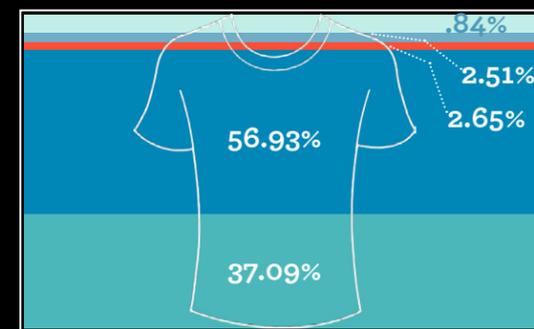
### RM CIF

(Carrier/Insurance/Freight)

### MATERIALS

### CMT

(Cut/Make/Trim)



### BASIC MEN'S T-SHIRT

Medium

100% Polyester Jersey

140 GSM



### FIVE POCKET JEAN

Men's 32" x 32"

98% Cotton/2% Elastane

Denim

360 GSM

# Who Will Buy It?

Brands & Retailers have made significant circularity commitments.

**The commitments include:**

- Developing more durable products
- Reuse and resale models
- The use of recycled materials

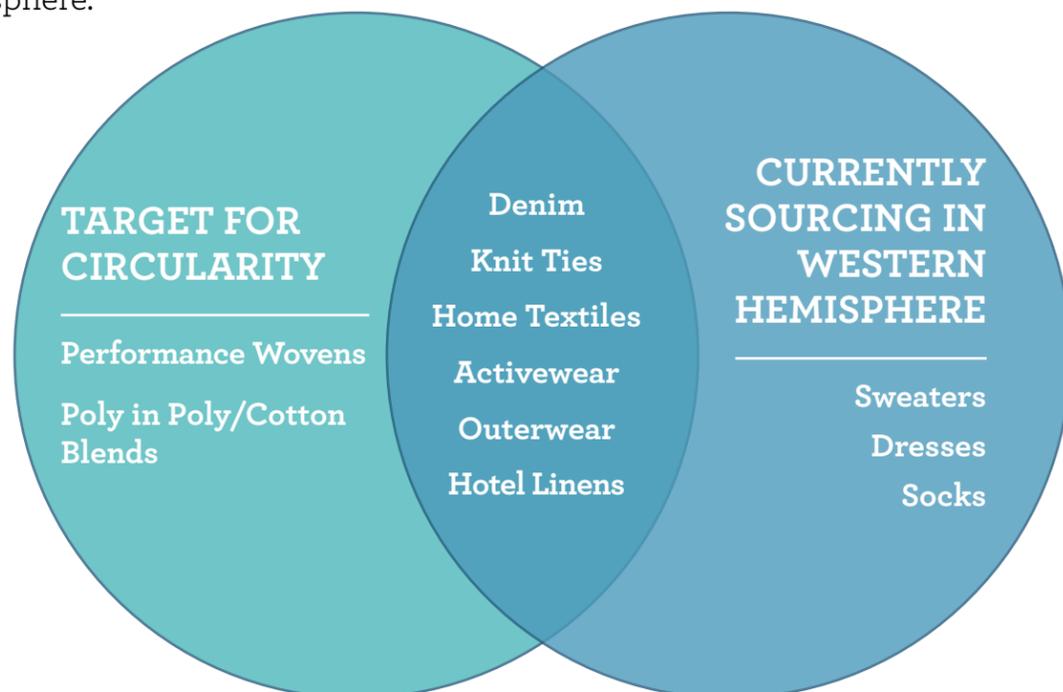
**RECYCLED FIBER COMMITMENTS SNAPSHOT**

**Who:** Dozens of brands, ranging from boutique sustainability leaders like Eileen Fisher to global powerhouses including Nike, VF Corporation, Gap Inc., Target, ASOS, PVH, and Inditex.<sup>11</sup>

**What:** From single-product content commitments to 100% recycled content requirements across entire lines. Many have also committed to invest in emerging recycling technology.

**Opportunity: \$350BN+**

Commitments to use recycled materials demonstrate demand for the recyclers' products, and Accelerating Circularity's Brand and Retailer survey responses indicate strong interest in and capacity for producing specific circular products in the Western Hemisphere.



<sup>11</sup> Pulse 2019, 2019, [globalfashionagenda.com/pulse-2019-update/](https://www.globalfashionagenda.com/pulse-2019-update/).





## Minding the Gap and Seeing Opportunities

Gaps and opportunities are often different sides of the same issue. For example, the volume of material available for recycling is an opportunity, however, data detailing specific fibers in that material is missing.

Luckily, we see some collaboration between industry, government and NGOs to solve for the gaps. We must be opportunistic to push the industry into action.

We have learned that existing collectors, sorters, pre-processors and recyclers on the East Coast of the U.S., with connections to traditional supply chains in the United States, Mexico, Central America and the Caribbean basin, have the capacity to bridge the gaps and take advantage of the opportunities.

### GAPS

#### Missing data

- Volumes of available waste by fiber type
- Recyclers' environmental credentials

#### Disincentives for becoming circular

- Policy
- High cost of new recycling technologies
- Lack of convenient system for consumers getting spent material to collectors
- Low price of virgin materials

#### Commercialization issues

- Scale and availability of circular supply chain steps (sorting, hard part removal, right-sizing and recycling)
- Downstream demand
- Aggregation of brand & retailer take back programs

#### Knowledge gaps

- Sorting specifications
- Recycler categorizations
- Consistent terminology for textile-to-textile circular systems. (Collectors reference is in kgs while the brands and retailers are talking about SKUs)
- Capabilities and commercialization status of collectors, sorters, preprocessors and recyclers

### OPPORTUNITIES

#### Vast quantities of materials for feedstocks

#### Technologies for:

- De-coloring materials
- Automated sorting
- Automated removing hard parts
- Chemically recycling blends

#### New circular business models

#### Job opportunities

#### Reduction of GHG emissions

#### Reduced use of water, chemicals and energy

#### Reduced use of virgin materials

#### Product innovation stories through new materials

#### Developing a common language

## Model Potential Supply Chain and Work on the Development of Links that will Realize Them

Accelerating Circularity will use the knowledge developed from our research to build model circular supply networks. These models will integrate currently available feedstocks, collecting, sorting and preprocessing infrastructure, and commercial recycling options as well as the products that brands and retailers have targeted for production and sourcing in the Western Hemisphere. We will then work on solving for the gaps and building the missing links to existing supply chains.

Knowing is not enough; we must apply. Willing is not enough; we must do.

—Johann Wolfgang von Goethe



# Call to Action

## 1. BRANDS & RETAILERS: Share the fiber content of your products with Accelerating Circularity.

Fiber content information is critical to this project. To divert textile waste from land-fill and incineration to collectors, sorters, and recyclers, we must know what is in it. Brands & Retailers sharing this information will facilitate effective and efficient collection, sorting, and preprocessing while also providing crucial information to recyclers about the availability of compatible feedstocks. Fiber content information is also important to traceability work, which impacts the credibility of any responsible textile production initiative. Make your contribution to the development of circular systems by disclosing your material content [HERE](#).

[https://docs.google.com/forms/d/e/1FAIpQLSfs8CcEbbKl2CNobADztEA2XxuzP-fu-wCZxB4bDD891osdfg/viewform?usp=sf\\_link](https://docs.google.com/forms/d/e/1FAIpQLSfs8CcEbbKl2CNobADztEA2XxuzP-fu-wCZxB4bDD891osdfg/viewform?usp=sf_link)

## 2. WASTE COLLECTORS, SORTERS, & PREPROCESSORS: Collaborate with us to set sorting and pre-processing specifications.

Universal specifications for sorting, hard part removal, right-sizing categories, and sanitation requirements will ensure the efficiency and interoperability of multiple nodes in a circular system. To help us capture the right requirements, please comment on and contribute to our draft specifications: for [COLLECTORS AND SORTERS](#); for [PREPROCESSORS](#).

[https://docs.google.com/forms/d/e/1FAIpQLScBhjDOegyjCihbEgmgyiiSYbNv4w0rOEvZCHy8BvjinMwJy4Q/viewform?usp=sf\\_link](https://docs.google.com/forms/d/e/1FAIpQLScBhjDOegyjCihbEgmgyiiSYbNv4w0rOEvZCHy8BvjinMwJy4Q/viewform?usp=sf_link)

[https://docs.google.com/forms/d/e/1FAIpQLScav64smD8dK2or-fZTLk2PB\\_otcJZyp1SsW-GGSWL449Eygw/viewform?usp=sf\\_link](https://docs.google.com/forms/d/e/1FAIpQLScav64smD8dK2or-fZTLk2PB_otcJZyp1SsW-GGSWL449Eygw/viewform?usp=sf_link)

## 3. RECYCLERS: Share the requirements and restrictions of your process with us.

We need an accurate picture of the recycling landscape in order to make the system work. Recycling categories will enable your suppliers to match their materials to your requirements, and at the same time potential customers will learn where they can purchase the products they need. Register your comments on the categories we have [OUTLINED TO DATE](#).

[https://docs.google.com/forms/d/e/1FAIpQLSeZt05egs4kZ3rqNHrTuAxAhYMT6Zzx1P9vtXEFYz\\_LVQw4hzA/viewform?usp=sf\\_link](https://docs.google.com/forms/d/e/1FAIpQLSeZt05egs4kZ3rqNHrTuAxAhYMT6Zzx1P9vtXEFYz_LVQw4hzA/viewform?usp=sf_link)

Participate! With the requested information the industry will be able to make positive steps toward achieving circular supply chains.



It always seems impossible until it's done.

—Nelson Mandela

# Glossary

**Advanced recycling:** see **chemical recycling**

**Chemical Recycling:** Chemical Recycling converts polymeric waste by changing its chemical structure to produce substances that are used as products or as raw materials for the manufacturing of products. Products exclude those used as fuels or means to generate energy. Sometimes called advanced recycling<sup>1</sup>.

**Contaminant:** A polluting or poisonous substance that makes something impure<sup>2</sup>.

**Cut-Make-Trim (CMT):** A three-stage production process wherein material is cut to a pattern (“cut”), sewn together (“make”), and finished (“trim”).

**Design for disassembly:** A concept that prioritizes design choices that will facilitate a product’s efficient disassembly at the end of its useful life so that components can be reused and/or recycled.

**Design for durability:** A concept that prioritizes design choices that will enhance product durability. Considerations include style, cut, fit, raw material selection, color, dye, and finish selection, and manufacturing specifications.

**Design for recycling:** Builds on the concept of *design for disassembly* to further specify the selection of materials that can be readily recycled. Strategies employed by this approach include designing single-fiber garments or selecting materials for which there are commercial recycling technologies available.

**Durability:** The ability of a material to remain serviceable for a long time without significant deterioration in quality or value<sup>3</sup>. Generally, durability is determined by fiber type, fabric and garment construction and can be tested through, for example, abrasion resistance, fabric pilling, fabric handle, fabric stiffness, colorfastness, dimensional stability and stretch recovery.

**Feedstock:** A raw material supplied to a machine or processing plant<sup>4</sup>.

**Incineration:** Destroys waste material through burning. When the incinerated material is used to fuel an electric generator, incineration is referred to as “energy recovery” or “resource recovery.”

**Landfill:** A site designated for the disposal of solid waste.

**Mass balance:** An accounting approach used to trace material through a value chain. This approach is often applied in the allocation of recycled content to different products with complex material properties.

**Mechanical Recycling:** Processes that use physical means such as shredding or melting to transform waste into feedstocks for new materials. For textiles, the output of mechanical recycling is a fiber or other material that can be used to make new yarn and fabric.

**Pre-consumer:** see **post-industrial**

**Preprocessing:** The manual or mechanical preparation of material for recycling. For textile recycling, this may include some or all of the following: aggregation, sorting, cleaning, disassembly, removal of hard parts, cutting material to size, shredding, and more.

**Post-consumer:** Describes material generated by households or by commercial, industrial, and institutional facilities in their role as end-users of the product that can no longer be used for its intended purpose. This includes returns of materials from the distribution chain<sup>5</sup>.

**Post-industrial:** Describes material diverted from the waste stream during the manufacturing process. Excluded is the reutilization of materials such as rework, regrind or scrap generated in a process and capable of being reclaimed within the same process that generated it. Also called **pre-consumer**<sup>6</sup>.

**Reclaimed material:** see **recovered material**

**Recovered material:** Material that would have otherwise been disposed of as waste or used for energy recovery, but has instead been collected and recovered as a material input, in lieu of new primary material, for a recycling or a manufacturing process. Also called **reclaimed material**<sup>7</sup>.

**Recyclable:** A characteristic of a product, packaging, or associated component that can be diverted from the waste stream through available processes and programs and can be collected, processed and returned to use in the form of raw materials or products<sup>8</sup>.

**Recycled content:** Proportion, by mass, of recycled material in goods or packaging. Only pre-consumer and post-consumer materials shall be considered as recycled content<sup>9</sup>.

**Recycled material:** Material that has been reprocessed from recovered material by means of a manufacturing process and made into a final product or into a component for incorporation into goods or services<sup>10</sup>.

**Reusable:** A characteristic of goods or packaging that has been conceived and designed to accomplish within its life cycle a certain number of trips, rotations or uses for the same purpose for which it was conceived<sup>11</sup>.

**Right sizing:** The process of transforming spent textiles into uniform pieces to prepare the material for recycling, often by cutting or shredding.

**Spent textiles:** Textiles that have cycled through the value chain through use, reuse, repair, and remaking such that all readily accessible value is spent. Spent textiles are the feedstock for recycling processes that generate new material.

**Takeback (program):** An initiative organized by a manufacturer, brand, or retailer to collect used products, components, or materials for refurbishment, re-manufacturing, recycling, resale, or other secondary purposes. For hazardous materials or those with no recoverable value, this includes safe disposal.

7 *ibid.*

8 “ISO 14021:2016.” Mar. 2016.

9 “ISO 14021:2016.” Mar. 2016.

10 *ibid.*

11 *ibid.*

12 BSR and United Nations Global Compact, 2014, *A Guide to Traceability: A Practical Approach to Advance Sustainability in Global Supply Chains*, [www.bsr.org/reports/BSR\\_UNGC\\_Guide\\_to\\_Traceability.pdf](http://www.bsr.org/reports/BSR_UNGC_Guide_to_Traceability.pdf).

13 ISEAL Alliance, 2016, *Chain of Custody Models and Definitions*, [www.isealalliance.org/sites/default/files/resource/2017-11/ISEAL\\_Chain\\_of\\_Custody\\_Models\\_Guidance\\_September\\_2016.pdf](http://www.isealalliance.org/sites/default/files/resource/2017-11/ISEAL_Chain_of_Custody_Models_Guidance_September_2016.pdf).

14 Verzijl, Diederik, et al. European Union, 2015, *Traceability across the Value Chain: Standards, Processes and Traceability*, [ec.europa.eu/docsroom/documents/13393/attachments/4/translations/en/renditions/native](http://ec.europa.eu/docsroom/documents/13393/attachments/4/translations/en/renditions/native).

15 “ISO 14021:2016.” Mar. 2016.

**Traceability:** The ability to identify and trace the history, distribution, location and application of products, parts and materials, to ensure the reliability of sustainability claims, in the areas of human rights, labor (including health and safety), the environment and anti-corruption<sup>12</sup>.

**Traceability system:** The system that records and follows the trail as products, parts, and materials come from suppliers and are processed and ultimately distributed as end products. Often when someone says ‘traceability system’ they mean an online traceability/tracking system, but this does not have to be the case. Systems used to ensure traceability vary widely and are designed to be fit for purpose (e.g. could be paper based or only go to a limited level of detail)<sup>13</sup>.

**Transparency:** Relates directly to relevant information been made available to all elements of the value chain in a standardized way, which allows common understanding, accessibility, clarity and comparison<sup>14</sup>.

**Virgin material:** Previously unused raw material such as wood, plant or animal fiber, metal ores, or petroleum.

**Waste:** Anything for which the generator or holder has no further use and which is discarded or is released to the environment<sup>15</sup>.

**Waste hierarchy:** A conceptual framework to guide decision making in waste management. The hierarchy prioritizes the efficient use of resources and the reduction of environmental harm. It is often represented as an inverted triangle with the most preferred waste-handling method(s) at the top and the least-preferred at the bottom.

**Waste collection:** The logistical process by which solid waste materials are transferred from the point of origin or use to a point of aggregation, storage, transfer, processing, sorting, treatment, incineration, and/or disposal.

**Working loss:** Material remaining after textile processing that cannot be manufactured into finished goods.

1 Ensuring That 10 Million Tonnes of Recycled Plastics Find Their Way into New European Products by 2025.” *Chemical Recycling - Just Another WordPress Site*, [www.coalition-chemical-recycling.eu/](http://www.coalition-chemical-recycling.eu/).

2 “Contaminant: Definition of Contaminant by Oxford Dictionary on Lexico.com Also Meaning of Contaminant.” *Lexico Dictionaries | English*, Lexico Dictionaries, [www.lexico.com/definition/contaminant](http://www.lexico.com/definition/contaminant).

3 “Durable.” *Merriam-Webster*, Merriam-Webster, 2020, [www.merriam-webster.com/dictionary/durable](http://www.merriam-webster.com/dictionary/durable).

4 “Feedstock.” *Merriam-Webster*, Merriam-Webster, 2020, [www.merriam-webster.com/dictionary/feedstock](http://www.merriam-webster.com/dictionary/feedstock).

5 “ISO 14021:2016.” Mar. 2016.

6 *ibid.*

# Annex 1

## Textile Quantification and Characterization Scope

The purpose of this work is to quantify post-industrial and post-consumer textiles within the study region and characterize post-consumer material. Limited data is available, and several estimates rely on qualitative assessments from a relatively small number of sources. These assessments were made based on close consultation with knowledgeable industry sources in addition to publicly available information.

All estimates require review and further comment from the industry and are presented here as indicators of scope and scale. We note underlying assumptions and unknowns wherever possible. These figures will be revised as new data becomes available.

### Study Region

Connecticut, Delaware, District of Columbia, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island and Vermont, Alabama, Florida, Georgia, Kentucky, North Carolina, Ohio, South Carolina, Tennessee, West Virginia

### Fibers

Cotton, polyester, man-made cellulose, and blends of these materials

### Post-Consumer Product and Item Types

This work focuses on clothing (excluding footwear), linens, and household textile items. These are defined by the EPA as “non-durable textiles,” which include products coming from residential sources, commercial businesses such as hotels and restaurants, as well as facilities such as hospitals and prisons.

Companies producing textiles and textile products are included in the post-industrial section of this work.

### Post-Industrial Company and Product Types

This work focuses on large sections of the textile industry. Production volume calculations include the following sectors: apparel, home goods, contract, residential, automotive, mattresses, nonwovens, industrial, technical, and finished product manufacturing. The figures have been adjusted to account for the exclusion of carpet, which falls out of this project’s scope. Another small adjustment accounts for nonwovens within these figures.

Waste quantification focuses on those production facilities most likely to use in-scope fibers: textile mills for apparel, home goods, contract, residential, automotive, mattresses, and industrial material; and cut and sew facilities. Companies that produce technical textiles and nonwovens as well as the items listed above are in scope. Companies focused solely on technical textiles, tire cord, carpet, and nonwovens are excluded.

# Annex 2

## Post-Consumer Calculation Methodology

### 2.1 Process Overview and Data

Four sources of information were used for post-consumer textile data and insights:

1. Primary data drawn from surveys
2. Existing data from a review of the literature
3. Industry stakeholder interviews
4. A review of confidential data sets provided by individual companies.

Surveys were sent to relevant stakeholders involved in the collection/sortation and buying/selling of post-consumer textile waste. Seven surveys contained at least one point of useful information. This primary data was supplemented by 21 interviews with industry stakeholders, additional data from government agencies, industry reports and publications, and other data provided by companies involved in the secondhand clothing industry.

Fiber utilization details from brands and retailers also informed materials characterization.

### 2.2 Quantify Post-Consumer Materials

The most consistent source of data for U.S. post-consumer textile generation is the U.S. Environmental Protection Agency (EPA). Their data are considered the standard for measuring post-consumer textiles in the U.S.. The figures used in this project’s calculations include post-consumer apparel and household textiles that enter the municipal solid waste stream to be recycled, landfilled, or incinerated. Footwear, carpet, furniture, leather, and rubber are excluded.

#### 2.2.1 Process Steps

1. Determine total post-consumer textile generation figure for in-scope materials
2. Estimate percentage of materials by diversion pathway
3. Calculate per-capita, state, and metro level textile figures
4. Characterize post-consumer textiles by fiber type

#### 2.2.2 Step 1: Determine generation figure for in-scope materials

*Data Set 1: EPA Advancing Sustainable Materials Management: Tables and Figures - 2017*<sup>1</sup>

This data covers the American municipal solid waste stream (MSW). It defines 2 groups of non-durable textiles which are in scope for this work (1) clothing and footwear and (2) towels, sheets, and pillowcases. This was the basis for quantification moving forward.

*Data Set 2: NYC Residential, School, and NYCHA Waste Characterization Study*<sup>2</sup>

*Data Set 3: Secondhand Industry Insights*<sup>3</sup>

The NYC study defines the percentage of shoes, rubber, and leather separately from other items in the

<sup>1</sup> U.S. Environmental Protection Agency. “Advancing Sustainable Materials Management: 2016-2017 Tables and Figures”. 2017, [www.epa.gov/sites/production/files/2019-11/documents/2016\\_and\\_2017\\_facts\\_and\\_figures\\_data\\_tables\\_0.pdf](http://www.epa.gov/sites/production/files/2019-11/documents/2016_and_2017_facts_and_figures_data_tables_0.pdf).

<sup>2</sup> NYC Department of Sanitation. “NYC Residential, School, and NYCHA Waste Characterization Study”. 2017, pp. 12, 15, 30. PDF file.

<sup>3</sup> Personal interviews, email correspondence, and survey responses, March 30 - July 25, 2020.

post-consumer stream. NYC figures were combined with information collected in interviews with second-hand industry companies to determine how much of the post-consumer textiles generated were footwear, and therefore out of scope.

Approximately 8% of all collected post-consumer textiles is footwear. This was subtracted from the EPA's non-durable textile figure for study estimates.

EPA MUNICIPAL SOLID WASTE DATA: NATIONWIDE FIGURES					
	Generated (tons)	Recycled (tons)	Combusted (tons)	Landfilled (tons)	Combusted & Lanfilled
Materials - All Textiles	16,890,000	2,570,000	3,170,000	11,150,000	14,320,000
Products - Nondurable goods Clothing and Footwear	12,800,000	1,740,000	2,160,000	8,900,000	11,060,000
Products - Nondurable goods Towels, Sheets, and Pillowcases	1,470,000	240,000	240,000	990,000	1,230,000
<b>TOTAL - All nondurable goods</b>	<b>14,270,000</b>	<b>1,980,000</b>	<b>2,400,000</b>	<b>9,890,000</b>	<b>12,290,000</b>
FOOTWEAR REMOVED					
	Generated (tons)	Recycled (tons)	Combusted (tons)	Landfilled (tons)	Combusted & Lanfilled
<b>TOTAL - Nondurable, no footwear</b>	<b>13,128,400</b>	<b>1,821,600</b>	<b>2,208,000</b>	<b>9,098,800</b>	<b>11,306,800</b>

Table 1: Non-durable post-consumer textile generation figures, totals and segments

### 2.2.3 Step 2: Estimate percentage of materials by diversion pathway

Data Set 4: SMART Materials Distribution<sup>4</sup>

Data Set 3: Secondhand Industry Insights

The association for Secondary Materials and Recycled Textiles (SMART) is an industry organization of for-profit companies who enable the reuse and recycling of post-consumer textiles into wiping materials, used clothing, and fiber. They estimate the materials their members handle are redistributed as follows:

%	Redistribution of Diverted Textiles - SMART
45%	Reused domestically and abroad
30%	Converted into polishing and wiping rags
20%	Processed into fiber to be manufactured into new products (mainly downcycling)
5%	Waste due to mildew or other contamination

Table 2: SMART estimates for how members' materials are used

Interviewees indicated thrift operators ("thrifters") are one of the two leading post-consumer collection channels. Two of the three largest thrift operators are non-profits, which means the textile items they sell are excluded from SMART's figures. Eighty percent of this material flows into the paths SMART has measured, but about 20% of the items a thrifter collects are sold directly to their customers. Although it is not currently possible to precisely determine how much of the total amount collected comes through non-profit thrifters, it is important to account for this additional reuse:

4 Secondary Materials and Recycled Textiles Association. "Frequently Asked Questions". [www.smartasn.org/resources/frequently-asked-questions/](http://www.smartasn.org/resources/frequently-asked-questions/). Accessed July 28, 2020.

We assume thrift and bin operators collect 90% of post-consumer textiles, divided equally (45% to thrift; 45% to bins). We know that two of the three biggest thrift operators are non-profit, and for the purposes of this estimate, we assume they take equal shares ( $\frac{2}{3} \times (45) = 30$ ). Twenty percent of that fraction is sold directly to nonprofit thrift customers ( $.2 \times (.3) = .06$ ), therefore, nonprofit thrift reuse attributable to direct sales =  $.2 \left( \frac{2}{3} \times \left( \frac{9}{2} \right) \right) = .06$ , rounded to 5% for simplicity.

Therefore, SMART's estimate of 45% for reuse was conservatively adjusted to 50%.

The remaining paths were also adjusted accordingly, and figures were rounded to the nearest whole percent.

%	Diverted Textiles Redistribution - Adjusted for Non-Profit Thrift
50%	Reused domestically and abroad
27%	Converted into polishing and wiping rags
18%	Processed into fiber to be manufactured into new products (mainly downcycling)
5%	Unusable due to mildew or other contamination

Table 3: SMART figures with reuse adjusted to 50% to account for items sold by non-profit thrift

This was then applied to the 14% of total post-consumer textiles diverted to illustrate the final destination of all post-consumer textiles generated in the U.S. Figures below were rounded to the nearest half percent.

%	Ultimate Destination for All Post-Consumer Textiles
86%	Landfill or incineration
7%	Reused domestically and abroad
3.5%	Converted into polishing and wiping rags
2.5%	Processed into fiber to be manufactured into new products (mainly downcycling)
1%	Unusable due to mildew or other contamination

Table 4: Diverted textiles redistribution, adjusted for reuse items sold by non-profit thrift

### 2.2.4 Step 3: Estimate the per-capita, state, and metro level figures

Data Set 5: U.S. Census Bureau 2019 Population Estimates by State<sup>5</sup>

Data Set 6: U.S. Census Bureau Population Data Tables - Metro Areas - 2010-2019<sup>6</sup>

U.S. Census bureau population data was used to estimate a figure for nationwide post-consumer textile generation per capita, and this was followed by estimates for states and metro areas in the study region.

5 U.S. Census Bureau. "United States, 2019 Population Estimates by State". U.S. Census Bureau website, Vintage 2019 Population Estimates. <https://www.census.gov/search-results.html?searchType=web&cssp=SERP&q=population%20by%20state>. Accessed March 10, 2020.

6 U.S. Census Bureau. "Annual Estimates of the Resident Population for Metropolitan Statistical Areas in the United States and Puerto Rico: April 1, 2010 to July 1, 2019". 2019. Microsoft Excel file.

PER CAPITA - US POPULATION IN 2017 325.7 MILLION					
	Generated (tons)	Recycled (tons)	Combusted (tons)	Landfilled (tons)	Combusted & Landfilled
Products – Nondurable goods – Clothing	0.036156	0.004915	0.006101	0.02514	0.031241
Products – Nondurable goods – Towels, Sheets and Pillowcases	0.004152	0.000678	0.000678	0.002796	0.003474
<b>TOTAL</b>	<b>0.040308</b>	<b>0.005593</b>	<b>0.006779</b>	<b>0.027936</b>	<b>0.034715</b>

**Table 5:** Per-capita post-consumer textile figures, excluding footwear

Six regional waste reports published by municipalities and states in the study region between 2015 and 2018 were reviewed to evaluate whether the per-capita figure should be adjusted by state.<sup>7 8 9 10 11 12</sup> Ultimately, the same figure was used for all initial estimates in this study, as attempting state level adjustments with limited and/or non-comparable data and before deeper analysis was thought to add more variability.

#### 2.2.5 Step 4: Characterize post-consumer textiles

Characterization data for post-consumer textiles is an estimate compiled from multiple sources and anchored in trade data. Several U.S. and European data sources, both publicly available and provided directly by individual companies, informed these figures. Some contributed directly to estimations while others acted as a comparative “guardrail” for reference. Secondhand industry interviews were also a guide. The most relevant are described below.

These are best guess estimates for an average within the study area and do not take into account variability between regions, seasons, and demographics. The data provided are intended as broad indicators and to establish a baseline for future measurement.

*Data Set 7: Company Data with Fiber Level Details*<sup>13</sup>

*Data Set 8: Fabscrap Annual Report*<sup>14</sup>

Information contributed by five companies provided a starting reference range for pure cotton, pure polyester, and cotton/poly blend calculations. Diverted textiles redistribution figures from SMART (previously cited) informed estimates for cotton rich blends, and a recent report from Fabscrap influenced pure cotton and pure poly estimates. Insights from yarn and textile manufacturing stakeholders contributed to the assumptions made about cotton and cotton blends present in post-consumer textiles.

7 Connecticut Department of Energy and Environmental Protection. “Statewide Waste Characterization Study”. 2015, pp 3-5 to 3-35. [www.portal.ct.gov/-/media/DEEP/waste\\_management\\_and\\_disposal/Solid\\_Waste\\_Management\\_Plan/CMMSSFinal2015MSWCharacterizationStudy.pdf?la=en](http://www.portal.ct.gov/-/media/DEEP/waste_management_and_disposal/Solid_Waste_Management_Plan/CMMSSFinal2015MSWCharacterizationStudy.pdf?la=en).

8 Delaware Solid Waste Authority. “Statewide Characterization Study”. 2016, pp. 10-11. <https://dswa.com/wp-content/uploads/2017/02/Final-Report-DSWA-Waste-Characterization-FY-2016-January-2017.pdf>.

9 Florida Department of Environmental Protection. “Total Tons: Other Paper, Food, Textiles, Misc.” 2018. [www.floridadep.gov/waste/waste-reduction/documents/2018-total-tons-other-paper-food-textiles-misc](http://www.floridadep.gov/waste/waste-reduction/documents/2018-total-tons-other-paper-food-textiles-misc).

10 NYC Department of Sanitation. “NYC Residential, School, and NYCHA Waste Characterization Study”. 2017, pp. 12, 15, 30. [www.dsnyc.cityofnewyork.us/wp-content/uploads/2018/04/2017-Waste-Characterization-Study.pdf](http://www.dsnyc.cityofnewyork.us/wp-content/uploads/2018/04/2017-Waste-Characterization-Study.pdf).

11 Rhode Island Resource Recovery Corporation. “Rhode Island Solid Waste Characterization Study”. 2015, pp. 13-18. [www.rirrc.org/sites/default/files/2017-02/Waste%20Characterization%20Study%202015.pdf](http://www.rirrc.org/sites/default/files/2017-02/Waste%20Characterization%20Study%202015.pdf).

12 Vermont Department of Environmental Conservation. “Vermont Waste Characterization”. 2018, pp. 12. [www.dec.vermont.gov/sites/dec/files/wmp/SolidWaste/Documents/2018-VT-Waste-Characterization.pdf](http://www.dec.vermont.gov/sites/dec/files/wmp/SolidWaste/Documents/2018-VT-Waste-Characterization.pdf).

13 Data sets and questionnaires from brands, retailers, and second hand companies, March 30 - September 14, 2020.

14 Fabscrap. “The Fabscrap Annual Report”. 2018, pp. 9. PDF file.

Key Fractions	Reported % of Total PCT	% for Recycling	Recycling Fraction
Pure Cotton	8-12%	10%	Readily Recyclable
≥50 Cotton / Poly	12-18%	18%	Readily Recyclable
Pure Poly	5-9%	7%	Readily Recyclable
Not Recyclable - SMART	5%	5%	Not Recyclable
<b>Sub Total</b>		<b>40%</b>	

**Table 6:** Range reported by outside sources for key fractions and % for project estimates

*Data Set 9: UN Trade Data*<sup>15</sup>

*Data Set 10: IDS Specialized Country Report - U.S. General Imports*<sup>16</sup>

UN trade data includes imports by weight for finished textile products according to their majority fiber under HTS codes 61, 62, and 63. This was used as the basis for estimating the other fiber fractions included in this report. A data set from International Development Systems (IDS) outlining the fiber content of apparel imports was also used as a cross reference. This was reported by number of units (individual items), not by total weight, however, the percentage of products imported under cotton and man-made fibers was similar. USDA Raw Fiber Equivalent data was also reviewed but not comparable enough to inform estimates.

UN Trade Data	Calculated	Rounded	Notes / Assumptions
Cotton	42%	45%	
Synthetic	28%	29%	
Not Specified	17%	6%	Some of this 17% fits into other categories
Not Recyclable	13%	20%	Added SMART waste figure
<b>Total</b>	<b>100%</b>	<b>100%</b>	

**Table 7:** Total of each majority fiber segment calculated from trade data and adjusted to reduce the “NES” or unspecified items listed in the trade data

In the case of pure cotton and pure poly, the percentage set for recycling was subtracted from the rounded figure in Table 7, and then the blend calculations were made as defined in Tables 8 and 9.

Items included in the “not recyclable” fraction are multi-material products such as overcoats, anoraks, blazers, and suits (excluding wool), items known for having high percentages of elastane, foam, and metal contaminants such as girdles and bras, and other problematic items such as life preservers, impregnated textiles, etc.

Cotton Breakdown		Notes / Assumptions
Pure Cotton	10%	
≥50 Cotton / Poly	18%	After removing pure cotton, about half is cotton / poly w/o elastane, and half is cotton rich
Cotton Rich	17%	
<b>Total Cotton</b>	<b>45%</b>	

**Table 8:** Estimating how cotton figures break down; assumptions should be validated

15 United Nations Statistics Division. “Commodity Trade Statistics Database”. UN Data A World of Information, 2018, [www.data.un.org/Explorer.aspx?d=ComTrade](http://www.data.un.org/Explorer.aspx?d=ComTrade).

16 International Development Systems. “Specialized Country Report for World - U.S. General Imports”, 2020. PDF file.

Polyester Breakdown		Notes / Assumptions
Pure Poly	7%	The vast majority of imported synthetic items are made from polyester, and a small amount of the unspecified items are also polyester
Poly Rich	22%	
<b>Total Synthetic</b>	<b>29%</b>	

**Table 9:** Estimating how synthetic figures break down; assumptions should be validated

35% Readily Recyclable		
10%	Pure Cotton	Highest compatibility with commercializing techs recycling cotton, poly, and cotton / poly blends
18%	≥50% Cotton in Cotton / Poly Blend	
7%	Pure Polyester	
	Elastane is a restricted fiber for more than 50% of the recycling technologies surveyed, including some in commercialization stages. Some degree of contamination is inevitable in post-consumer material, but in order to be considered “readily recyclable,” the material must contain little to no elastane.	
45% Potentially Recyclable		
17%	≥50% Cotton in Cotton / Other Blend	Low to medium level compatibility with current recycling techs, May be blended with readily recyclable materials for higher compatibility
22%	≥50% Poly in Poly / Other Blend	
6%	Other Fibers and Blends	
	These materials could be recycled if input specs on recycling technologies allow a broader range of fibers (ie: 1-20% elastane, manmade cellulosics in a blend, nylon, etc). “Other fibers and blends” include manmade cellulosics, wool and wool blends, and other fibers that are not quantifiable with available information.	
20% Not Likely Recyclable		
5%	Too Soiled	Not compatible with any recycling technology available or in development
15%	Difficult to Recycle	
	12-13% of imported apparel and household items are difficult to recycle, due to coatings and finishes or a multi-material construction too challenging for any recycler to manage. SMART states 5% of all materials collected are too soiled for recycling. These figures were combined and rounded up to 20% to include other potentially challenging materials.	

**Table 10:** Details on the groups of each fraction as it relates to recyclability

## 2.3 Assumptions and Unknowns

It should be emphasized that the unknowns and assumptions in these data are significant

### 2.3.1 Step 2: Diverted Textiles Redistribution - Non-Profit Thrift Adjustment

Interviewees agreed the vast majority of textiles are collected by thrifters and collection bin operators, however there was a wide range of qualitative estimates for what percentage of the total each collects. Both were said to collect the majority, and so these estimates assume they collect equal shares.

### 2.3.2 Step 3: Estimate the per-capita, state, and metro level figures

A single per-capita figure used across a large geography smooths out nuances in the actual quantity of post-consumer textiles present in specific cities and states. This data assumes estimates made with this single per-capita figure are reasonably representative of the study region. States and municipalities should conduct regular studies for more specific figures.

### 2.3.3 Step 3: Characterize post-consumer textiles

Fiber utilization data provided by individual companies and included in publicly available reports are inherently skewed and typically not comparable across the board. Figures in this report assume the available data can be combined to roughly estimate fiber usage and the recyclability of individual items. It is important to continue to adjust these figures over time as more data is available and fiber usage trends change.

The bold assumption has also been made that the UN’s trade data and HTS codes are accurate reflections of the fiber make up of textile products being imported and sold in the U.S.

# Annex 3

## Post-Industrial Calculation Methodology

### 3.1 Process Overview and Data

Three sources of information were used for post-industrial textile data and insights:

1. Primary data drawn from surveys
2. Existing data from a review of the literature
3. Industry stakeholder interviews.

Two surveys were created to collect data from textile product manufacturers: 1) fiber and yarn producers and 2) fabric mills and finishing and printing operations. The surveys were designed to capture key information about the flows of polyester, cotton, and man-made cellulosic textile waste from these industry sectors to characterize a range of attributes.

Two significant barriers to data collection through the survey method were identified:

1. Manufacturer’s reluctance to provide information deemed sensitive and proprietary
2. The survey was released at the height of the Covid-19 crisis, and most of the prospective respondents had significantly reduced or ceased operations

Because of these challenges, primary survey data was supplemented with data from academia, government

agencies and industry reports and publications. This data is also limited.

Interviews were conducted with 30 companies who represent the predominant types of post-industrial waste generators in scope for this study and other industry experts to identify trends, estimate figures for key data points, collect insights, and validate initial assumptions.

More details about data and calculations are included below.

## 3.2 Quantify Post-Industrial Materials

### 3.2.1 - Process Steps

1. Define supply chain segments and facility / product types
2. Estimate production volumes
3. Estimate working loss and waste to landfill

### 3.2.2 - Step 1: Define Supply Chain Segments and Key Product Types

The research team created a list of company and product types and used this to classify and analyze supply chain actors.

### 3.2.3 - Step 2: Estimate Production Volumes

Two data sets from the U.S. Census Bureau provide enough information to attempt to quantify production volumes of textile products.

#### Data Set 1: U.S. Census Bureau Commodity Flow Survey (CFS) - 2012<sup>17</sup>

The 2012 data set includes the shipment weight from textile facilities at a state level, broken down by 3-digit NAICS code.<sup>18</sup> This is the only available representation of total production weight for facilities within the study region, and it includes the following 3-digit NAICS codes:

- 313 textile mills (fiber, yarn, and textile production)
- 314 textile product mills (canvas, upholstery, linens, towels, carpet)
- 315 apparel manufacturing (cut and sew, knit apparel, accessories)

This data does not provide the level of detail on shipment weight needed for this study (ie: CFS shipment data combines fiber, thread, and yarn into one category). Additional estimates were made to distribute shipment weight more finely across the value chain using Data Set 3.

#### Data Set 2: U.S. Census Bureau Commodity Flow Survey (CFS) - 2017<sup>19</sup>

A limited amount of 2017 CFS data detailing total shipment weight from all U.S. facilities at the 3-digit NAICS code level became available in July 2020. The 2017 state-by-state breakdown was not available, so 2012 data was used to calculate each state's % of the U.S. total:

$$\text{State Total 313} \div \text{U.S. Total 313} = \text{State \% 313}$$

2017 total shipment weight was applied to the 2012 state percentages at the 3-digit NAICS level. It should be noted that the 2012 U.S. shipment weight totals reported in the 2017 data set varied from the 2012 data avail-

able for the initial state-level estimates. 2017 state-level estimates should be recalculated using the full 2017 CFS data set.

Specific attention should be paid to code 315, as the 2012 state level distribution appears to over-represent Alabama and North Carolina and under-represent New York. More information is available in Assumptions and Unknowns, section 3.3.1, data set 2.

2017 - Tons	313 Shipment Weight (tons)	313 Shipment % of US Total	314 Shipment Weight (tons)	314 Shipment % of US Total	315 Shipment Weight (tons)	315 Shipment % of US Total
US TOTAL	6,415,000		5,251,000		475,000	
Alabama	452,499.15	7.05%	307,132.66	5.85%	119,692.01	25.20%
Connecticut	17,693.80	0.28%	3,421.13	0.07%	3.42	0.00%
Delaware	8,600.19	0.13%	876.01	0.02%	234.47	0.05%
District of Columbia	0.25	0.00%	-	0.00%	-	0.00%
Florida	16,747.63	0.26%	9,932.02	0.19%	9,861.25	2.08%
Georgia	833,907.44	13.00%	2,031,141.76	38.68%	13,045.36	2.75%
Kentucky	110,936.19	1.73%	6,892.07	0.13%	5,602.30	1.18%
Maine	21,251.44	0.33%	4,037.35	0.08%	-	0.00%
Maryland	5,886.75	0.09%	603.92	0.01%	479.92	0.10%
Massachusetts	43,386.51	0.68%	72,268.20	1.38%	2,994.17	0.63%
New Hampshire	16,606.95	0.26%	931.19	0.02%	373.23	0.08%
New Jersey	31,843.37	0.50%	16,961.71	0.32%	1,595.30	0.34%
New York	753,166.28	11.74%	25,534.71	0.49%	7,133.26	1.50%
North Carolina	1,474,424.32	22.98%	388,790.44	7.40%	175,374.94	36.92%
Ohio	100,718.99	1.57%	106,839.85	2.03%	391.80	0.08%
Pennsylvania	178,673.61	2.79%	634,706.80	12.09%	18,831.85	3.96%
Rhode Island	64,053.36	1.00%	1,927.95	0.04%	3.24	0.00%
South Carolina	644,427.13	10.05%	105,539.94	2.01%	1,713.71	0.36%
Tennessee	337,665.61	5.26%	503,053.92	9.58%	11,445.19	2.41%
Vermont	17,342.17	0.27%	156.22	0.00%	135.53	0.03%
Virginia	226,727.08	3.53%	75,850.60	1.44%	2,348.08	0.49%
West Virginia	5,495.68	0.09%	65,320.17	1.24%	215.18	0.05%
<b>EAST COAST TOTAL</b>	<b>5,362,053.90</b>	<b>83.59%</b>	<b>4,361,918.61</b>	<b>83.07%</b>	<b>371,474.22</b>	<b>78.21%</b>

**Table 1:** 2017 data showing shipment weight by 3 digit NAICS code and state, with % of U.S. total

#### Data Set 3: U.S. Census Bureau Statistics of U.S. Businesses Annual Survey (SUSB) - 2017<sup>20</sup>

The 2017 SUSB Annual data released by the U.S. Census Bureau includes information on company types and number of establishments at the 4-digit NAICS code level. In order to estimate how much of the shipment weight in the CFS data set should be allocated to each step in the value chain, the shipment weight was distributed evenly across the number of establishments described in 4-digit NAICS codes at the state level.<sup>21</sup> NAICS codes in parenthesis were used for Step 2 but out of scope for Step 3.

- 3131 Fiber, yarn and thread mills
- 3132 Fabric mills
- 3133 Textile and fabric finishing and fabric coating mills
- 3141 Textile furnishing mills
- 3149 Other textile product mills
- (3151 Apparel knitting mills)
- 3152 Cut and sew apparel manufacturing
- (3159 Apparel accessories and other apparel manufacturing)

Table 2 shows the total number of establishments for each 3 and 4 digit NAICS code reported in the SUSB data. The 4 digit % of total establishments was estimated:

<sup>17</sup> U.S. Census Bureau. "Commodity Flow Survey". U.S. Census Bureau website, Datasets, 2012, [www.census.gov/programs-surveys/cfs/data/datasets.2012.html](http://www.census.gov/programs-surveys/cfs/data/datasets.2012.html), Accessed May 19, 2020.

<sup>18</sup> See NAICS Code Descriptions in Annex 4

<sup>19</sup> U.S. Census Bureau. "Commodity Flow Survey". Surveys and Programs, 2017, sent via email before publication, Microsoft Excel file.

<sup>20</sup> U.S. Census Bureau. "Statistics of U.S. Businesses Annual Survey". U.S. Census Bureau website, Datasets, 2017, [www.census.gov/data/datasets/2017/econ/susb/2017-susb.html](http://www.census.gov/data/datasets/2017/econ/susb/2017-susb.html), Accessed May 19, 2020.

<sup>21</sup> See Assumptions and Unknowns section for more information.

AL 3131 Estab. ÷ AL 313 Estab. = AL 3131 % of Total Estab.

State of Origin	313 Establishments						314 Establishments						315 Establishments						
	313 Total	# 3131	% of total	# 3132	% of total	# 3133	% of total	314 Total	# 3141	% of total	# 3149	% of total	315 Total	# 3151	% of total	# 3152	% of total	# 3159	% of total
Alabama	33	8	24%	15	45%	10	30%	108	37	34%	71	65%	47	21	45%	24	51%	2	4%
Connecticut	30	3	10%	14	47%	13	43%	90	34	38%	56	62%	21	1	5%	11	52%	9	43%
Delaware	3	0	0%	1	33%	2	67%	16	6	38%	10	63%	6	1	17%	2	33%	3	50%
District of Columbia	1	0	0%	0	0%	1	100%	2	1	50%	1	50%	2	0	0%	2	100%	0	0%
Florida	82	4	5%	36	44%	42	51%	433	147	34%	286	66%	210	6	3%	169	80%	35	17%
Georgia	155	48	31%	51	33%	56	36%	357	211	59%	146	41%	74	2	3%	61	82%	11	15%
Kentucky	13	0	0%	6	46%	7	54%	57	22	39%	35	61%	26	1	4%	19	73%	6	23%
Maine	23	5	22%	14	61%	4	17%	70	14	20%	56	80%	6	0	0%	5	83%	1	17%
Maryland	26	3	12%	12	46%	11	42%	96	21	22%	75	78%	30	0	0%	28	93%	2	7%
Massachusetts	78	6	8%	31	40%	41	53%	118	47	40%	71	60%	67	2	3%	57	85%	8	12%
New Hampshire	18	4	22%	10	56%	4	22%	41	10	24%	31	76%	13	0	0%	12	92%	1	8%
New Jersey	86	5	6%	39	45%	42	49%	166	62	37%	104	63%	143	8	6%	116	81%	19	13%
New York	175	10	6%	69	39%	96	55%	315	102	32%	213	68%	1128	34	3%	1,005	89%	89	8%
North Carolina	334	76	23%	134	40%	124	37%	268	116	43%	152	57%	194	97	50%	76	39%	21	11%
Ohio	51	6	12%	20	39%	23	45%	196	42	21%	154	79%	67	0	0%	48	72%	19	28%
Pennsylvania	116	19	16%	64	55%	33	28%	225	72	32%	151	67%	184	14	8%	147	80%	23	13%
Rhode Island	49	8	16%	29	59%	12	24%	45	14	31%	31	69%	11	0	0%	8	73%	3	27%
South Carolina	153	27	18%	78	51%	48	31%	128	40	31%	88	69%	30	2	7%	26	87%	2	7%
Tennessee	51	11	22%	17	33%	23	45%	135	41	30%	84	70%	95	10	11%	76	80%	9	9%
Vermont	7	3	43%	1	14%	3	43%	12	3	25%	9	75%	14	1	7%	10	71%	3	21%
Virginia	50	12	24%	26	52%	12	24%	154	58	38%	96	62%	61	3	5%	47	77%	11	18%
West Virginia	7	1	14%	2	29%	4	57%	13	2	15%	11	85%	7	0	0%	7	100%	0	0%
<b>EAST COAST TOTAL</b>	<b>1541</b>	<b>259</b>	<b>17%</b>	<b>689</b>	<b>43%</b>	<b>611</b>	<b>40%</b>	<b>3045</b>	<b>1102</b>	<b>36%</b>	<b>1941</b>	<b>64%</b>	<b>2436</b>	<b>203</b>	<b>8%</b>	<b>1956</b>	<b>80%</b>	<b>277</b>	<b>11%</b>

Table 2: 2017 SUBS data with number of establishments by state and % of total establishments

Table 3 shows the shipment weight per 4 digit code for each state with 2017 CFS data. 4 digit shipment weight estimates have a slight variation (<1%) from 3 digit totals. The shipment weight by 4 digit code per state was estimated:

AL 313 Total Ship. Weight x AL 3131 % Total Estab. = AL 3131 Ship. Weight

State of Origin	313 Shipments (tons)						314 Shipments (tons)						315 Shipments (tons)						
	313 Total	3131	% of total	3132	% of total	3133	% of total	314 Total	3141	% of total	3149	% of total	315 Total	3151	% of total	3152	% of total	3159	% of total
Alabama	452,499	109,697	24%	205,681	45%	137,121	30.30%	307,133	105,221	34%	201,911	66%	119,692	53,479	45%	61,119	51.06%	5,093	4.26%
Connecticut	17,694	1,769	10%	8,257	47%	7,667	43.33%	3,421	1,292	38%	2,129	62%	3	0	0%	2	52.38%	1	42.86%
Delaware	3,600	0	0%	2,867	33%	5,733	66.67%	876	329	38%	548	63%	234	39	17%	78	33.33%	117	50.00%
District of Columbia	0	0	0%	0	0%	0	100.00%	0	0	50%	0	50%	0	0	0%	0	100.00%	0	0.00%
Florida	16,748	817	5%	7,353	44%	8,578	51.22%	9,932	3,372	34%	6,560	66%	9,881	282	3%	7,936	80.48%	1,644	16.67%
Georgia	833,607	258,242	31%	274,382	33%	301,283	36.13%	2,031,142	336,113	16%	830,663	41%	13,045	353	3%	10,754	82.43%	1,939	14.86%
Kentucky	110,506	0	0%	51,201	46%	59,735	53.85%	6,892	2,650	39%	4,232	61%	5,602	215	4%	4,094	73.08%	1,293	23.08%
Maine	21,251	4,620	22%	12,936	61%	3,696	17.39%	4,037	807	20%	3,230	80%	0	0	0%	0	83.33%	0	16.67%
Maryland	5,887	679	12%	2,717	46%	2,491	42.31%	804	132	22%	472	78%	480	0	0%	448	93.33%	32	6.67%
Massachusetts	43,387	3,337	8%	17,243	40%	22,806	52.58%	72,268	28,785	40%	43,483	60%	2,994	89	3%	2,547	85.07%	358	11.94%
New Hampshire	16,607	3,690	22%	9,226	56%	3,690	22.22%	931	227	24%	704	76%	373	0	0%	345	92.31%	29	7.69%
New Jersey	31,843	1,851	6%	14,441	45%	16,551	48.84%	16,962	6,335	37%	10,627	63%	1,595	89	6%	1,294	81.12%	212	13.29%
New York	753,166	43,036	6%	296,963	39%	413,166	54.86%	25,535	8,266	32%	17,266	68%	7,133	215	3%	6,355	99.10%	563	7.89%
North Carolina	1,474,424	335,408	23%	591,536	40%	647,391	37.13%	388,790	168,282	43%	220,508	57%	175,378	87,887	50%	68,704	39.16%	18,984	10.82%
Ohio	100,719	11,849	12%	39,498	39%	45,422	45.10%	106,840	22,894	21%	83,946	79%	392	0	0%	281	71.64%	111	28.36%
Pennsylvania	178,674	29,266	16%	98,579	55%	50,830	28.46%	634,707	203,106	32%	428,959	67%	18,832	1,433	8%	15,045	79.89%	2,364	12.50%
Rhode Island	64,053	10,458	16%	37,909	59%	15,687	24.49%	1,928	600	31%	1,328	69%	3	0	0%	2	72.73%	1	27.27%
South Carolina	644,427	113,722	18%	328,531	51%	202,173	31.37%	105,540	32,981	31%	72,559	69%	1,714	114	7%	1,485	86.67%	114	6.67%
Tennessee	337,666	72,830	22%	112,555	33%	152,281	45.10%	503,054	152,779	30%	350,275	70%	11,445	1,205	11%	9,156	80.00%	1,084	9.47%
Vermont	17,342	7,432	43%	2,477	14%	7,432	42.86%	166	39	25%	117	75%	10	7	7%	97	71.43%	29	21.43%
Virginia	226,727	54,415	24%	117,898	52%	54,414	24.00%	76,851	28,567	38%	47,283	62%	2,348	115	5%	1,809	77.05%	423	18.03%
West Virginia	5,496	765	14%	1,570	29%	3,140	57.14%	65,320	10,049	15%	55,271	85%	215	0	0%	215	100.00%	0	0.00%
<b>EAST COAST TOTAL</b>	<b>5,362,054</b>	<b>1,063,995</b>		<b>2,233,829</b>		<b>2,060,288</b>		<b>4,361,919</b>	<b>1,112,841</b>		<b>2,379,070</b>		<b>371,474</b>	<b>145,327</b>		<b>191,766</b>		<b>34,381</b>	
								<b>3,491,911</b>	Adjusted for carpet										

Table 3: 2017 SUBS + CFS data showing shipment weights by 3 and 4 digit NAICS codes at the state level

3.2.4 - Step 3: Estimate Working Loss and Waste to Landfill

Data Set 4: Industry Expert Interviews for Waste Calculations and Characterization<sup>22</sup>

Due to the shortcomings of the data sets listed above, fiber characterization, working loss, and waste data were collected through interviews. Questions posed over email and through individual calls helped to esti-

22 Personal interviews, email correspondence, and survey responses, March 30 - September 14, 2020.

mate how much working loss was incurred at each step of the value chain and how much of this working loss went to landfill.

Manufacturers that fall under key NAICS codes and industry experts with extensive experience provided figures for working loss and waste to landfill produced at each step in the value chain. The average was confirmed with feedback from industry experts.

4 Digit NAICS	% Average Working Loss (From Production)	% Average Waste Sent to Landfill (as % of Working Loss)
3131	6.5	5
3132	5	17.5
3133	5	17.5
3141	7	17.5
3149	7	17.5
3152	12	17.5

Table 4: Average % of working loss and waste to landfill amounts based on industry feedback

Working loss and waste figures were then calculated for each 4 digit NAICS code per state.

State of Origin	313 Working Loss + Landfill (tons)				314 Working Loss + Landfill (tons)				315 Working Loss + Landfill (tons)			
	3131 Working Loss	3131 Waste to Landfill	3132+3133 Working Loss	3132+3133 Waste to Landfill	3141 Working Loss	3141 Waste to Landfill	3149 Working Loss	3149 Waste to Landfill	3152 Working Loss	3152 Waste to Landfill		
Alabama	7,594	380	17,997	3,150	7,881	1,379	15,123	2,647	8,214	1,438		
Connecticut	122	6	836	146	97	17	159	28	0	0		
Delaware	0	0	452	79	25	4	41	7	11	2		
District of Columbia	0	0	0	0	0	0	0	0	0	0		
Florida	57	3	836	146	253	44	491	86	1,067	187		
Georgia	17,877	894	30,222	5,289	25,175	4,406	62,217	10,888	1,445	253		
Kentucky	0	0	5,824	1,019	199	35	317	55	550	96		
Maine	320	16	873	153	60	11	242	42	0	0		
Maryland	47	2	273	48	10	2	35	6	60	11		
Massachusetts	231	12	2,103	368	2,156	377	3,257	570	342	60		
New Hampshire	255	13	678	119	17	3	53	9	46	8		
New Jersey	128	6	1,575	276	475	83	796	139	174	30		
New York	2,979	149	37,282	6,524	619	108	1,293	226	854	149		
North Carolina	23,225	1,161	59,794	10,464	12,604	2,206	16,516	2,890	9,234	1,616		
Ohio	820	41	4,458	780	1,715	300	6,288	1,100	38	7		
Pennsylvania	2,026	101	7,844	1,373	15,213	2,662	31,904	5,583				

**313**

- 3131 is included in the reporting, however, it is not a focus area for the project moving forward.
- 3132 and 3133 are reported together based on feedback from interviews that provided a combined working loss and waste figure of 5-8%.
- It was not possible within the project constraints to remove nonwovens from the total shipment weight for 313. Because nonwovens have almost no waste to landfill, the low end of the working loss for the combined 3132 and 3133 group was used as a rough adjustment for this.

**314**

- Shipment weight for 3141 GA was decreased by 72% to account for carpet, which is out of scope for this project. Carpet manufacturers make up 72% of 3141 NAICS code revenue.<sup>23</sup> While revenues were avoided for other calculations in this study, it was the best available quantification of carpet vs. other production in 3141.

**315**

- 3151 and 3159 were determined to be out of scope and were therefore removed from final data tables and reporting.

**3.3 Assumptions and Unknowns**

It should be emphasized that the unknowns and assumptions in these data are significant.

**3.3.1 - Step 2: Estimate Production Volumes**

*Data Set 2: Estimated shipment weight using 2017 CFS U.S. totals and 2012 state-level data*

The 2017 CFS data set including total shipment weight for the U.S. at the 3 digit NAICS level was provided to the project without the state-level details. It included the 2012 U.S. shipment weight totals, which varied from the data available for the initial state-level estimates. This lack of alignment and the 5-year gap between data sets adds uncertainty to these estimates.

For example, the largest variation is in code 315. Our estimates show heavy production in NC and AL with very little in NY, however details in the SUSB data indicate our estimates are likely over representing NC and AL and under representing NY. 2017 figures should be used to recalculate state level estimates.

*Data Set 3: Estimating shipment weight using 3 and 4 digit NAICS codes*

Our method of distributing 3 digit shipment weight across 4 digit establishments assumes that each state has a similar ratio of big to small producers of the same types of product. It also assumes different types of establishments within the same 3 digit NAICS code in the same state produce similar weights of materials. The assumption is that estimates based on number of establishments is less variable for the purposes of this study than using other available data.

*All Data in Step 2*

The U.S. Census Bureau produces both key data sets used for these calculations. CFS data comes from company surveys and SUSB data incorporates census bureau survey responses such as those collected for CFS into the data set. Using both data sets to make these calculations assumes they are reasonably comparable.

<sup>23</sup> U.S. Census Bureau. "Annual Survey of Manufacturers". U.S. Census Bureau website, Annual Economic Surveys, 2018, [www2.census.gov/programs-surveys/asm/data/2018/AM1831BASICO1.zip](http://www2.census.gov/programs-surveys/asm/data/2018/AM1831BASICO1.zip).

**3.3.2 - Step 3: Estimate Working Loss and Waste to Landfill**

By combining 3132 and 3133 in our reporting, it is assumed production through vertically integrated manufacturers and multiple stand-alone facilities will incur similar working loss during textile construction, finishing, coating, and printing.

The amount of nonwoven production as a percentage of all 313 establishments is unknown. As a rough correction for this, 3132+3133 working loss was estimated at 5% (vs. 7% for 314).

# Annex 4

## NAICS Code Descriptions

The North American Industry Classification System (NAICS) is the standard used by Federal statistical agencies in classifying business establishments for the purpose of collecting, analyzing, and publishing statistical data related to the U.S. business economy.<sup>24</sup> Full definitions of each NAICS code can be found in the U.S. Census Bureau's 2017 NAICS manual.<sup>25</sup>

NAICS Code	Description
<b>313</b>	<b>Textile Mills</b> <b>3131</b> - Fiber, Yarn, and Thread Mills <b>3132</b> - Fabric Mills <i>Broadwoven Fabric Mills, Narrow Fabric Mills and Schiffli Machine Embroidery, Nonwoven Fabric Mills, Knit Fabric Mills</i> <b>3133</b> - Textile and Fabric Finishing / Coating Mills <i>Textile and Fabric Finishing Mills, Fabric Coating Mills</i>
<b>314</b>	<b>Textile Product Mills</b> <b>3141</b> - Textile Furnishings Mills <i>Curtain and Linen Mills                      Carpet Mills</i> <b>3149</b> - Other Textile Product Mills <i>Textile Bag and Canvas Mills</i>
<b>315</b>	<b>Apparel Manufacturing</b> <b>3151</b> - Apparel Knitting Mills <i>Hosiery and Sock Mills</i> <b>3152</b> - Cut and Sew Apparel Manufacturing <i>Cut and Sew Apparel Contractors, Other Cut and Sew Apparel Manufacturing</i> <b>3159</b> - Apparel Accessories and Other Apparel Mfg <i>Apparel Accessories and Other Apparel Manufacturing, Commercial Printing (except Screen and Books), Commercial Screen Printing, Other Apparel Knitting Mills</i>

<sup>24</sup> U.S. Census Bureau. "North American Industry Classification System". U.S. Census Bureau website, Business & Industry, [www.census.gov/eos/www/naics/](http://www.census.gov/eos/www/naics/), Accessed September 23, 2020.

<sup>25</sup> U.S. Census Bureau. "North American Industry Classification System". U.S. Census Bureau website, Business & Industry, 2017, pp. 167-175, [www.census.gov/eos/www/naics/2017NAICS/2017\\_NAICS\\_Manual.pdf](http://www.census.gov/eos/www/naics/2017NAICS/2017_NAICS_Manual.pdf).

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# ANTI-TRUST STATEMENT

Accelerating Circularity exists to divert textiles from landfill and incineration for textile-to-textile recycling in circular supply networks. The contents of this report were developed with the contributions of a broad range of industry stakeholders to advance this mission. In accordance with anti-trust regulations, participants did not and may not discuss past, current, or future, prices, terms or conditions of sale, or profits for any products or services. There were and will be no discussions of where, or the companies with whom, any participant chooses or does not choose to do business now or in the future. There was and will be no discussion of production plans or intentions.

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