

# PUTTING TEXTILES TO GOOD USE



ACCELERATING®  
CIRCULARITY





# Summary of the Problem

The linear supply chain, from the production of virgin materials to the landfill and incineration of textile waste, has huge negative environmental and social impacts on our communities.

In recognition brands have made ambitious targets to reduce these harms but lack a clear path to meet them.

## CURRENT STATISTICS:

ACP estimates that:

- 13.1 million tons of textile in US landfills and incineration (EPA, 2019)
- 35% (4.6 million tons) is currently recyclable
- 45% (5.9 million tons) is recyclable with advanced recycling tech

## VIRGIN MATERIALS HAVE HIGH ENVIRONMENTAL IMPACTS

Virgin material produced (global, 2019):

- Cotton - 25.5 million tons
- Polyester - 57.7 million tons
- MMCF - 7.1 million tons
- Social inequities along the supply chain

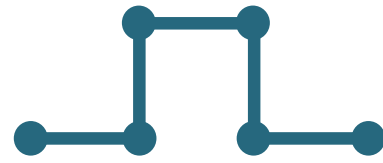
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## Commitments vs. Capacity

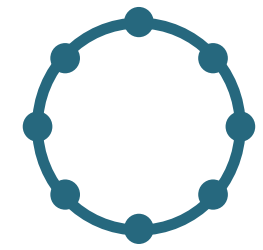
### COLLECTIVE COMMITMENTS AND APPROACHES

- Textile Exchange & UN FICCA 2025 Recycled Polyester Challenge aims to increase rPET uptake by 45% to 17.1 million metric tons by 2025
- WRAP Textiles 2030 Roadmap sets ambitious carbon and water reduction targets along a “Circularity Pathway”
- Brands have made individual commitments, including:
  - 100% of the cotton, linen, viscose and polyester used in products will be recycled or will have a more sustainable origin by 2025
  - Source 50% of nylon and polyester from recycled materials by 2025
  - Climate neutral supply chain for manufacturing and processing factories by 2030





# Changes Coming



The industry must adopt circular approaches to even begin to meet these commitments.  
What will the changes be?

LINEAR

THE BUSINESS CASE FOR CIRCULARITY

CIRCULAR

## ENVIRONMENTAL

Virgin materials → Spent textiles  
• Recycled lowers GHG ~12%, water ~18%\*

Landfill/Incineration → Post-industrial and post-consumer textile diverted to reuse, resale, repair, and recycling

## SOCIAL IMPACTS

Offshore manufacturing and used textile processing, resale, and disposal → Nearshoring shifts some jobs from Global South to consuming countries

Diversion from landfill/incineration in consuming countries → Increased employment for processing additional material in Global South


## ECONOMIC IMPACTS

- Spent textile as waste generates tipping and incineration fees (\$53.72/ton in 2019) → Spent textile as rFeedstock generates revenue
- Subsidies (\$670MM in 2019) incentivize virgin cotton production → Chemically processed rFiber costs the same or slightly more than virgin fiber, while mechanically processed rFiber costs the same or less than virgin.
- US\$20 billion in direct fossil fuel subsidies incentivize virgin polyester production → Investment in collection and mechanical sorting systems brings down feedstock costs
- Sustainably-marketed products are 16.1% of the market → 54.7% growth in Consumer Packaged Goods market share between 2015-2019
- High demand for rPET from bottles → New rPolyester feedstock adds market choice and stability

## POLICY

- Existing trade regulations create perverse incentives for textile production and use → Extended producer responsibility schemes mean higher costs to brands (France's EPR is a model; Netherlands will adopt a similar proposal in 2023)
- Existing trade regulations create perverse incentives for textile production and use → MSW textile bans require alternative solutions for spent textiles (EU 2025, Mass, CA for home textiles)
- Existing trade regulations create perverse incentives for textile production and use → Recycled Content Benchmarks: industry standards or duty rate discounts lower cost to brands

\* Textiles 2030 Roadmap. WRAP. (April 2021). <https://wrap.org.uk/resources/guide/textiles-2030-roadmap>.



Accelerating Circularity exists to build the knowledge and systems required to achieve textile-to-textile recycling at commercial scale through a collaborative, stakeholder-led approach. We are now at a stage where we will test the hypothesis built on our research through commercial scale trials. Producers throughout the circular textile system have an opportunity to participate in building the future together.

**JOIN US!**

[acceleratingcircularity.org/stakeholder-registry](https://acceleratingcircularity.org/stakeholder-registry)

# Testing Circular System Flows

## Facilitating Commercial Textile-to-Textile Product Trials

**OBJECTIVE:** To utilize post-consumer and post-industrial textiles as feedstocks for circular textile recycling processes available today, at scale and in pre-commercial stages, with output to fiber, yarn, fabric, and ultimately product for market.

**TARGETED OUTCOMES:** Demonstration of circular textile-to-textile systems that are feasible and worth engaging in for each member of the system; and reduction in GHG emissions, chemical and water dependence when compared to production of virgin materials.

### Who - Entire Circular Textile-to-Textile System

- Collectors/Sorters/Preprocessors
- Recyclers
- Yarn/Fabric/CMT
- Brands & Retailers

### What - Commercial Trials

- Feedstocks: spent post-industrial and post-consumer textile
- Recycling processes: mechanical and chemical

### When - NOW

- Two year project kicks off June 2021

### Outputs

- Definition of functioning effective circular textile supply system
- Circular textile model applicable in multiple geographies
- Circular system trial products take up 50 tons of spent post-consumer textiles

### Outcomes

- Spent textiles diverted from landfill or incineration in alignment with the ACP Textile Use Hierarchy
- Collaborative industry trials deliver commercial products that contain recycled inputs
- Adoption of robust traceability tools achieves textile use transparency
- Reduced need for virgin fibers
- Reduction in the textile industry's greenhouse gas emissions and water and chemical impacts

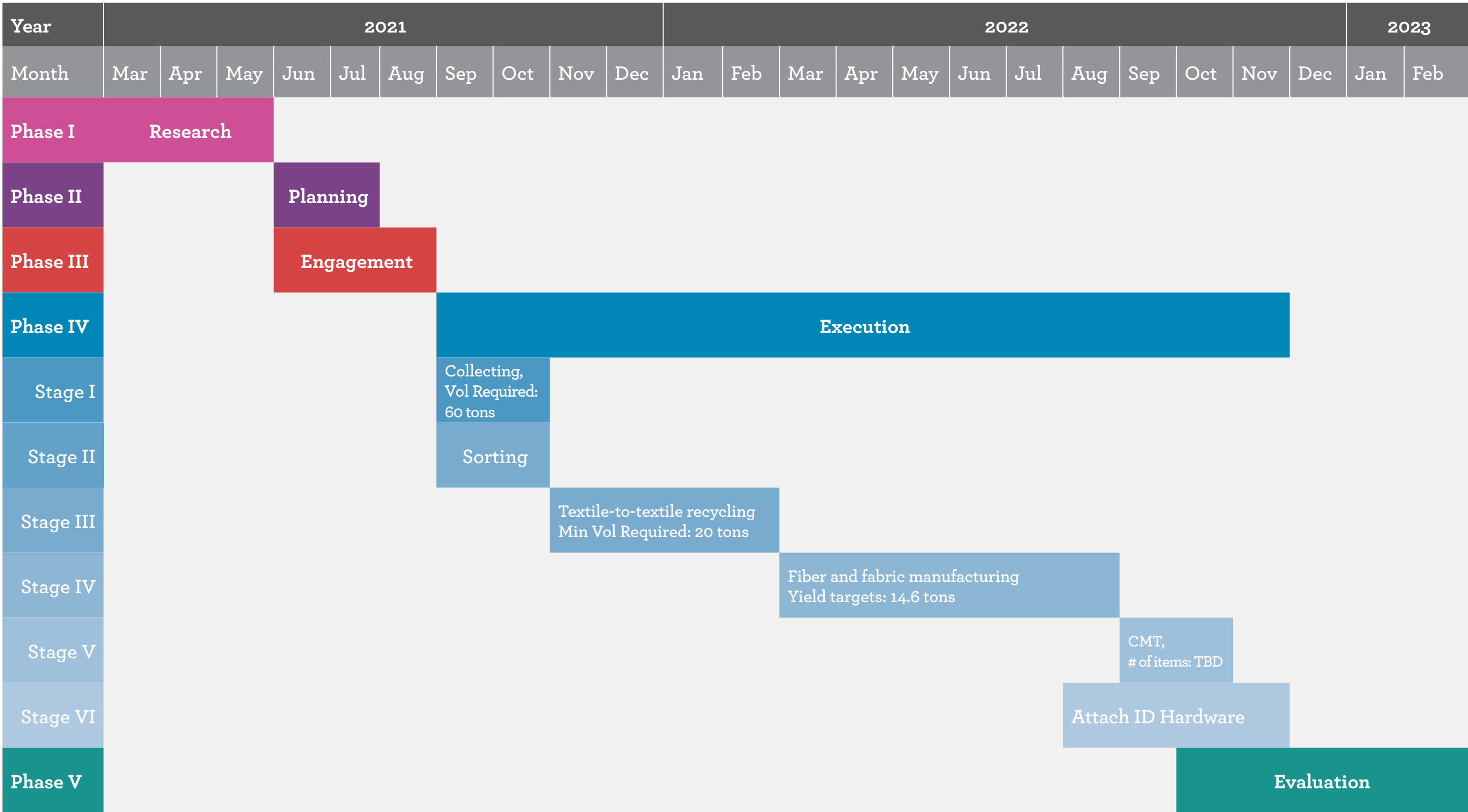


# Trial Guidelines

## What does it mean to join the trials?

|  |   |
|--|---|
| <b>Minimum recycled content</b>  | <ul style="list-style-type: none"> <li>• A minimum of 40% recycled blend is targeted for all trials. They can include both post-industrial and post-consumer from any feedstock, e.g. textiles or PET bottles.</li> <li>• A minimum of 20% recycled post-consumer textiles is targeted for all trials.</li> <li>• When technically feasible, higher levels of recycled content should be included.</li> </ul> |
| <b>Traceability</b>  | <ul style="list-style-type: none"> <li>• Outputs will potentially include a blend of post-consumer, post-industrial, and virgin inputs.</li> <li>• Documentation of each change of custody/transaction is required.</li> <li>• Any potential traceability claims will be transactional (vs. physical).</li> </ul>   |
| <b>All Trial Products include an end-of-life pathway.</b>  | <ul style="list-style-type: none"> <li>• Products are identified with information needed for recycling, deconstruction, decomposition, and/or biodegradation.</li> </ul>  |
| <b>Collection through fiber to be generated within North America.</b>  | <ul style="list-style-type: none"> <li>• Collection, sorting, processing and manufacturing activities in watershed of origin whenever technically feasible.</li> <li>• Product manufacturing outside of North American must include reporting on production location, final product fiber content and volumes produced.</li> </ul>  |
| <b>Volumes will be standard minimum order quantities or higher (not sample volumes). TBD based on specific product type.</b> | <ul style="list-style-type: none"> <li>• Spent materials - TBD</li> <li>• Recycled materials - TBD</li> <li>• Yarns - TBD</li> <li>• Fabrics - TBD</li> <li>• CMT - TBD</li> </ul>  |

# Trial Timeline





# Roles and Responsibilities

| Trial Participants      | Brands & Retailers   | Collectors/Sorters/Preprocessors (Spent Textile Partners)   | Recyclers   | Fiber Producers & Yarn Spinners  | Fabric Mills  | CMT Factories  |
|-------------------------|--|---|---|--|---|--|
| Trial Benefits          | <ul style="list-style-type: none"> <li>Influence on trial development, articulation of system needs, and final takeaways</li> <li>Visibility into a system-wide trial with direct access to Trial Partners</li> </ul>  |   |   |  |   |  |
|                         | <ul style="list-style-type: none"> <li>Ability to purchase circular materials or finished product to spec.</li> <li>Validate commercial circular system.</li> </ul>  | <ul style="list-style-type: none"> <li>Opportunities to participate in the development of rFeedstocks.</li> <li>Ability to market test rFeedstock products.</li> </ul>  |   | <ul style="list-style-type: none"> <li>Showcase validating their capabilities and fit to the circular system</li> <li>Market exposure to brands and other Trial Partners</li> </ul>  | <ul style="list-style-type: none"> <li>Access to circular inputs that meet their trial specification</li> </ul>   |  |
| Trial Requirements      | <ul style="list-style-type: none"> <li>Documentation in support of a circular system business case, including logistics, environmental data (LCA access where available), social impact data where available, feedback on economic feasibility and data to support traceability.</li> <li>Outputs of a pre-qualified specification and type, in a pre-determined format, packaged for delivery, with testing and chain of custody documentation prepared.</li> </ul> |   |   |  |   |  |
|                         | <ul style="list-style-type: none"> <li>Product and/or material order commitment that meet MOQ requirements across the system</li> <li>Provide finished goods material and testing specifications</li> <li>Provide testing support</li> <li>Grant supply chain partners permission to measure and share key social, environmental, and economic data</li> </ul>   | <ul style="list-style-type: none"> <li>Information on Inputs: volumes collected and processed, product attributes (market category, source, fabric, fiber, format, etc.), sorting fraction ratios, market data, logistics, access to delivery systems and warehousing where available.</li> <li>Post-consumer rFeedstock samples for recycler testing, if required</li> </ul> | <ul style="list-style-type: none"> <li>Information on Inputs: restrictions and requirements including volumes, fiber blend thresholds, testing requirements, format, and access to delivery systems and warehousing where available.</li> </ul> | <ul style="list-style-type: none"> <li>Sample test run on post-consumer feedstock if required</li> <li>Information on Inputs: quality (including dyeing method), fiber specifications (length and size), restrictions and requirements including volumes, monomers, polymers, pulp or fiber blend thresholds, testing requirements, format, and access to delivery systems and warehousing where available.</li> </ul> | <ul style="list-style-type: none"> <li>Information on capabilities, constructions, requirements including volumes, fiber contents, testing requirements, certifications, and access to delivery systems and warehousing where available.</li> </ul> | <ul style="list-style-type: none"> <li>Information on MOQs, quality standards, cutting yields, and certifications.</li> <li>Product capabilities.</li> </ul> |
| Trial Participation Fee | See schedule of fees   | None  | None  | See schedule of fees   | See schedule of fees  | See schedule of fees   |

| Brand Buy-In Menu  |   |                 |
|--|---|-----------------|
| Stage  | Option                                      | PO Requirements |
| 1. Fiber   | Individual or collective buy-in from brands | Meets MOQ       |
| 2. Yarn  |   |                 |
| 3. Fabric  |   |                 |
| 4. Finished Product  |   |                 |
| Optional   |   |                 |
| <ul style="list-style-type: none"> <li>Take-Back Collaboration Program</li> <li>Digital Identification with EON</li> </ul> |   |                 |

| Schedule of Fees                              |                          |
|---|--------------------------|
| System Partner Size (By Total Annual Revenue) | Annual Participation Fee |
| < \$10MM                                      | \$1,000                  |
| \$10MM < \$100MM                              | \$5,000                  |
| \$10MM < \$500MM                              | \$10,000                 |
| \$500MM+                                      | \$20,000                 |

# System Trial Elements

## TRIAL INPUTS

### COLLECTION TYPES

Commercial Bin  
Contract Commercial/  
Industrial  
Curbside  
Drop-off  
Event-based  
Mail-in  
Residential Bin  
Take-back

### SORTING RANGES

Whole garments  
Mixed color  
Mixed construction  
Mixed fibers  
Knit constructions  
Rolled goods  
Sorted colors  
Yarn waste

### SORTING REQUIREMENTS

Sort to grade  
Sort to rFeedstocks  
Feedstock aggregation

### COLOR SORTING GRADES

Mixed color  
Dark colors  
Light color  
White  
PC by color group  
PI by color group

### PREPROCESSING REQUIREMENTS

Trim removal  
Right sizing  
Shredding  
Disassembly  
Sanitation  
Testing  
Feedstock aggregation

### FEEDSTOCK TYPES

#### Post-consumer

Cotton  
Polyester  
Polyester/Cotton Blends  
Polyester/Cotton Blends with <10% other fibers  
PET Bottles

#### Post Industrial

Cotton  
Polyester  
Polyester/Cotton Blends

#### Virgin

Cotton  
Wood Pulp

### RECYCLER TYPES

Chemical Cellulosic  
Chemical PET  
Mechanical Cotton  
Mechanical Poly  
Mechanical PET  
Semi-Chemical Cellulose

## TRIAL OUTPUTS

### RECYCLED OUTPUTS

Refibra™  
Cellulose Pulp  
Staple Fiber  
Filament Fiber  
PET Monomer  
PET Chip  
Yarn  
Fabric

### TEXTILE TYPES

#### Knits

Jersey  
Fleece  
Pique

#### Wovens

Denim  
Canvas  
Terry

### PRODUCT TYPES

T-shirts  
Jeans  
Fleece  
Home Textiles

### FIBER TYPES

#### Recycled

rCotton  
rPolyester  
rPET Chip  
Refibra™

#### Virgin

Cotton  
Polyester  
Elastane  
Dupont Sorona®  
Tencel™  
Naia Renew™

### YARNS

#### Knitting

Naia Renew™/Polyester  
20/1 Cotton  
20/1 Cotton/Polyester  
20/1 Cotton/Polyester/Refibra™  
150D/78F Polyester

#### Weaving

8/1 Cotton  
10/1 Cotton  
10/1 Cotton/Polyester  
10/1 Cotton/Polyester/Refibra™





# Trial Product Proposals

## T-Shirts

| Trial                |                       | Trial 1  | Trial 2   | Trial 3   | Trial 4  | Trial 5  |
|----------------------|-----------------------|--|---|---|--|--|
| Product Type         |                       | Color Sort T-Shirt   | Dyeable T-Shirt   | Dark Heather Overdye T-Shirt  | Dark Heather Overdye T-Shirt   | Dyeable Lightweight Activewear T-Shirt   |
| Inputs               |                       | 80% Post-Consumer<br>20% Virgin  | 10% Post-Consumer<br>90% Post-Industrial  | 100% Post-Consumer  | 100% Post-Consumer   | 49% Post-Consumer<br>27% Post-Industrial<br>24% Virgin   |
| Recycling Processes  |                       | Mechanical Cotton +<br>Semi-Chemical Cellulosic  | Mechanical Cotton (White) +<br>Chemical PET+<br>Mechanical PET (Bottles)  | Mechanical Polyester+<br>Mechanical Cotton  | Mechanical Polyester + Chemical PET  | Chemical Blends +<br>Mechanical PET<br>(+ Polyester)   |
| Material Output Type | Fiber                 | 100% Cotton Fiber<br>(80%rCotton+20%Virgin)  | 60/40 Cotton/Poly Fiber Blend   | 60/40 Cotton/Poly Fiber Blend   | 100% Recycled Polyester Fiber  | (r)Polyester 60/Naia™ Renew 40   |
|                      | Yarn                  | 20/1-100% Cotton Yarn  | 20/1 Blended Cotton/Poly Yarn   | 20/1 Blended Cotton/Poly Yarn   | 150D/78F 100% Poly Yarn  | 20/1-40/1 Staple Blend or Filament Yarn  |
|                      | Fabric                | 140GSM Jersey  | 140GSM Jersey   | 140GSM Jersey   | 140GSM Jersey  | 150GSM Polyester/Naia Renew™<br>Knit Fabric  |
| Product Description  |                       | 80% targeted recycled cotton content<br>w/ limited color range and high-quality<br>hand feel   | 100% recycled content<br>w/ custom color flexibility  | 100% Post-Consumer materials with<br>potential for overdye heather effect   | 100% Post-Consumer polyester filament or<br>staple fiber with overdye heather effect   | Custom dyeable, fine gauge knit with<br>high content post-consumer input   |
| Trial Goals          |                       | <ul style="list-style-type: none"> <li>• Test Semi-Chemical Cellulosic technology</li> <li>• Test yarns with shorter staple fiber lengths</li> <li>• Maximize post-consumer content</li> </ul> | <ul style="list-style-type: none"> <li>• Demonstrate supply relationships between recycling technologies</li> <li>• Test demo scale Chemically recycled PET as feedstock for commercial scale Mechanical PET process</li> </ul> | <ul style="list-style-type: none"> <li>• Test highest threshold for post-consumer content using polyester as a stabilizing fiber</li> <li>• Work with color palette restrictions imposed by the technology</li> </ul> | <ul style="list-style-type: none"> <li>• Test demo scale Chemically recycled PET as feedstock for commercial scale Mechanical PET process</li> <li>• Work with color palette restrictions imposed by the technology</li> <li>• Design for Mono-Material recycling end of life</li> </ul> | <ul style="list-style-type: none"> <li>• Test Eastman 's Naia Renew™/rPolyester blend in staple or filament form</li> <li>• Prioritize handfeel and lightweight potential</li> <li>• Target yarn sizes: 20/1---&gt;40/1</li> </ul> |
| Considerations       | Limited Color Palette | X  | -   | X   | X  | -  |
|                      | Sorting Complexity    | X  | X   | -   | -  | -  |
|                      | Price Challenges      | X  | -   | -   | -  | -  |
|                      | High MOQ's            | -  | -   | -   | -  | X  |

# Trial Product Proposals

## Fleece, Denim, Home

| Trial                |                       | Trial 6  | Trial 7  | Trial 8   | Trial 9  | Trial 10  | Trial 11  |
|----------------------|-----------------------|--|--|---|--|---|---|
| Product Type         |                       | Poly Fleece Hoodie   | Sweatshirt Hoodie  | Black Denim Jean  | Soft Denim Jean  | Standard Denim Jean   | Bath Towel  |
| Inputs               |                       | 100% Post-Consumer   | 45% Post-Consumer<br>22% Post-Industrial<br>+33% Virgin  | 40% Post-Consumer<br>36% Post-Industrial<br>+24% Virgin   | 20% Post-Consumer<br>13% Post-Industrial<br>+67% Virgin  | 5% Post-Consumer<br>35% Post-Industrial<br>+60% Virgin  | 80% Post-Consumer<br>+20% Virgin  |
| Recycling Processes  |                       | Chemical PET +<br>Mechanical PET (+ Polyester*)  | Mechanical Cotton (White) +<br>Chemical PET+<br>Mechanical PET (Bottles)   | Mechanical Cotton +<br>Mechanical Polyester   | Chemical Cellulosic +<br>Mechanical Cotton   | Mechanical Cotton   | Mechanical Cotton +<br>Mechanical PET   |
| Material Output Type | Fiber                 | 100% Recycled Polyester Fiber  | Blended(50%rCotton+50%Virgin)/<br>(35%rPolyester/PET) Staple Fiber   | 60/40 Cotton/Poly Fiber Blend   | Blended Cotton/Refibra Fiber   | 100% Cotton Fiber<br>(40%rCotton+60%Virgin)   | 65/35 Polyester/Cotton Fiber  |
|                      | Yarn                  | 150D/78F100% Poly Yarn   | 10/1 Yarn  | 10/1 40% rCotton, 20% Virgin<br>Cotton, 36%rPoly, 4% Sorona <sup>®</sup> Yarn   | 12/1 46% Cotton/50% Refibra/4%<br>Sorona <sup>®</sup> Yarn   | 10/1 98% Cotton/2%<br>Sorona <sup>®</sup> Yarn  | 13/1 Ringspun Yarn  |
|                      | Fabric                | 150GSM Polyester Fleece Fabric   | 280GSM 65/35 Cotton/Poly Fleece<br>Fabric  | 360GSM Denim Fabric   | 360GSM Denim Fabric  | 360GSM Denim Fabric   | Terry Fabric  |
| Product Description  |                       | 100% Recycled Polyester Fleece Pile<br>can be custom dyed.   | Cotton/Polyester Sweatshirt with<br>overdye option.  | Black Cotton/Polyester Denim<br>Jean- stretch can be added  | Soft hand, over-dyeable denim jean.<br>Refibra/Cotton Blend plus Sorona <sup>®</sup><br>added for stretch and comfort.   | 100% Cotton Heavy Duty<br>Denim. Can be over-dyed.  | White terry towel   |
| Trial Goals          |                       | <ul style="list-style-type: none"> <li>• Test demo scale Chemically recycled PET as feedstock for commercial scale Mechanical PET process</li> <li>• Work with color palette restrictions imposed by the technology</li> <li>• Trial can be designed to allow for custom dyeing, or push post-consumer polyester textile inputs and test for resulting color limitations.</li> </ul> | <ul style="list-style-type: none"> <li>• Demonstrate supply relationships between recycling technologies</li> <li>• Test demo scale Chemically recycled PET as feedstock for commercial scale Mechanical PET process</li> <li>• Test reduction of virgin inputs on a heavier yarn weight and fabric construction.</li> <li>• Work with color palette restrictions imposed by the technology</li> </ul> | <ul style="list-style-type: none"> <li>• Test highest threshold for post-consumer content using polyester as a stabilizing fiber</li> <li>• Work with color palette restrictions imposed by the technology, specifically potential of pre-color black poly fibers.</li> <li>• Offer brand R&amp;D collaboration on a shared warp</li> </ul> | <ul style="list-style-type: none"> <li>• Test high percentage of Refibra™ content for performance and hand feel.</li> <li>• Pilot Lenzing's Refibra production in Mobile, AL.</li> <li>• Trial ratios of PC to PI cotton content in the rCotton</li> </ul> | <ul style="list-style-type: none"> <li>• Trial 100% Cotton starting with a 40/60 ratio of recycled to virgin content. (Fill only)</li> <li>• Subject finished goods to exhaustive wear and wash testing</li> <li>• Provide test data to support long-life durability story</li> </ul> | <ul style="list-style-type: none"> <li>• Dedicate trial for Home and Hospitality, Uniform, and Laundry industries</li> <li>• Create a demo range of yarn qualities, and turn a selected spec into a commercial product for the market testing</li> <li>• Identify leverage points for collection and sorting unique to these industries to support consistent quality feedstocks</li> </ul> |
| Considerations       | Limited Color Palette | ✘  | ✘  | ✘   | -  | -   | ✘   |
|                      | Sorting Complexity    | ✘  | ✘  | -   | ✘  | ✘   | ✘   |
|                      | Price Challenges      | -  | -  | -   | ✘  | -   | -   |
|                      | High MOQ's            | -  | -  | ✘   | ✘  | ✘   | -   |



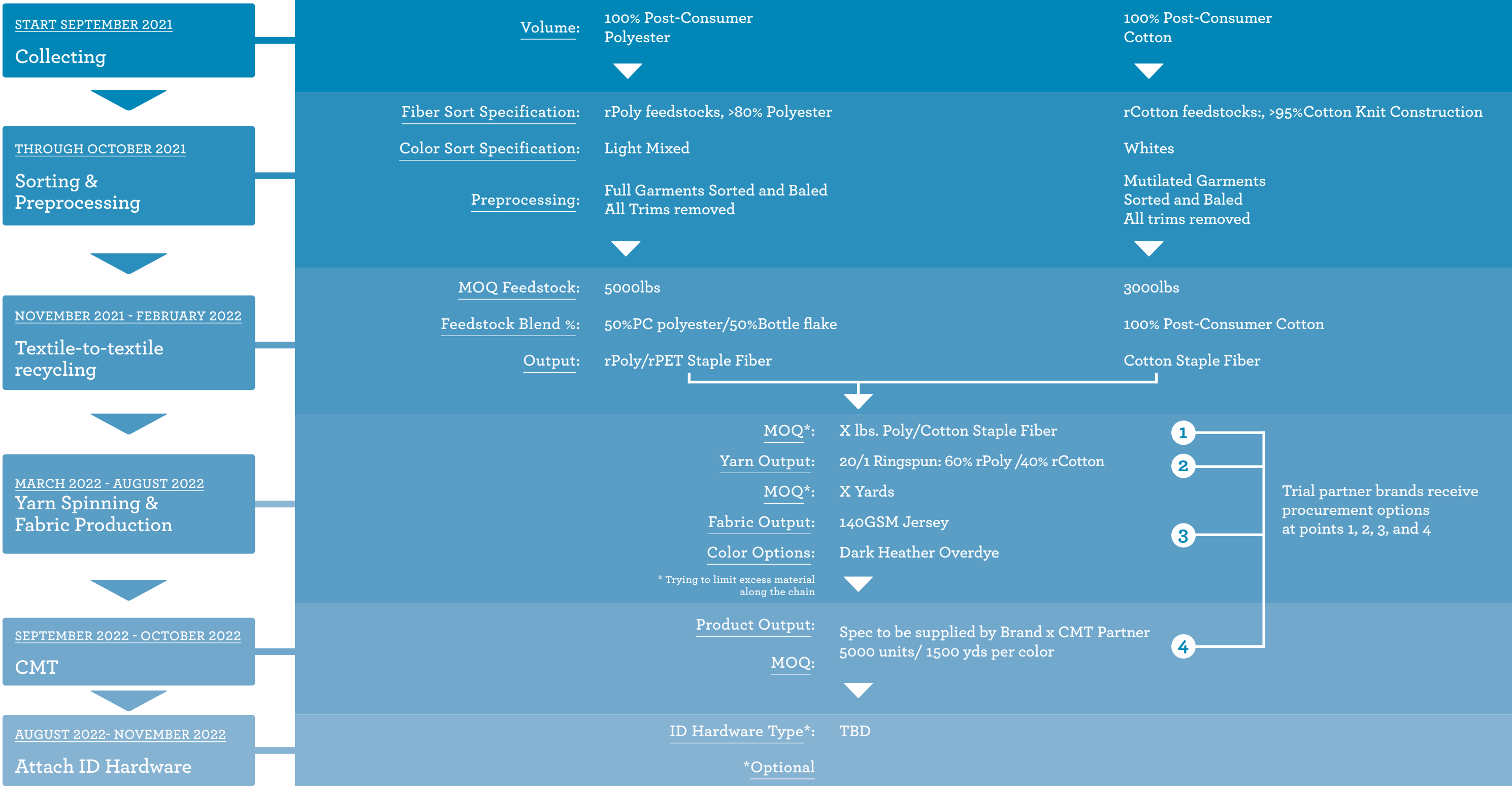
# Trial 3: 60% Cotton/40% Polyester Dark Heather Overdye T-Shirt

100% Post-consumer fiber content

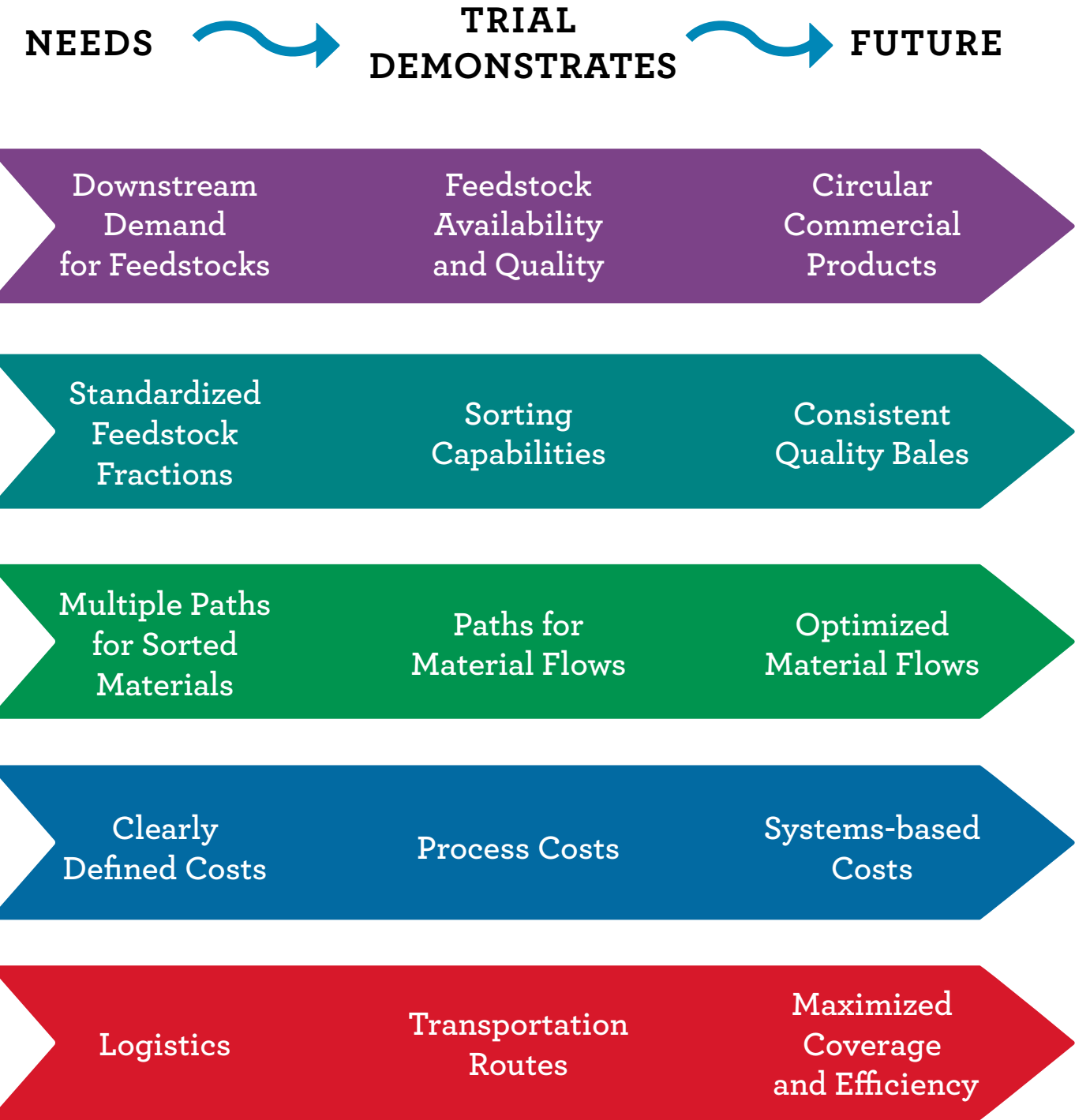
**PRODUCT SPECIFICATION:**  
 20/1 Blended Polyester/Cotton Yarn  
 140GSM Jersey  
 Target Recycled Content: 100% Post-Consumer

**TIMELINE FOR TRIAL STAGES**

**TRIAL SPECIFICATIONS:**



# Envisioning Circular Systems





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ACP Brand and Retail Working Group

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