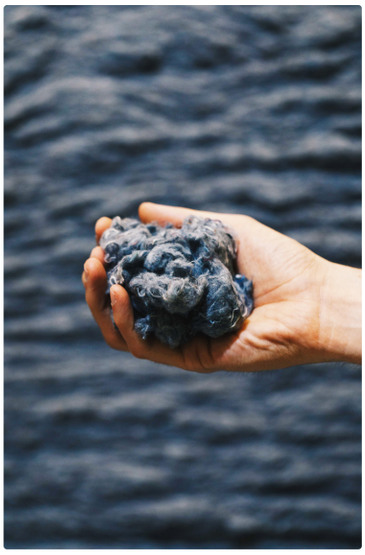
ACCELERATING®
CIRCULARITY



Project Europe Update
Spring 2023

Phase:
Pilot textile-to-textile supply networks

✓ **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.

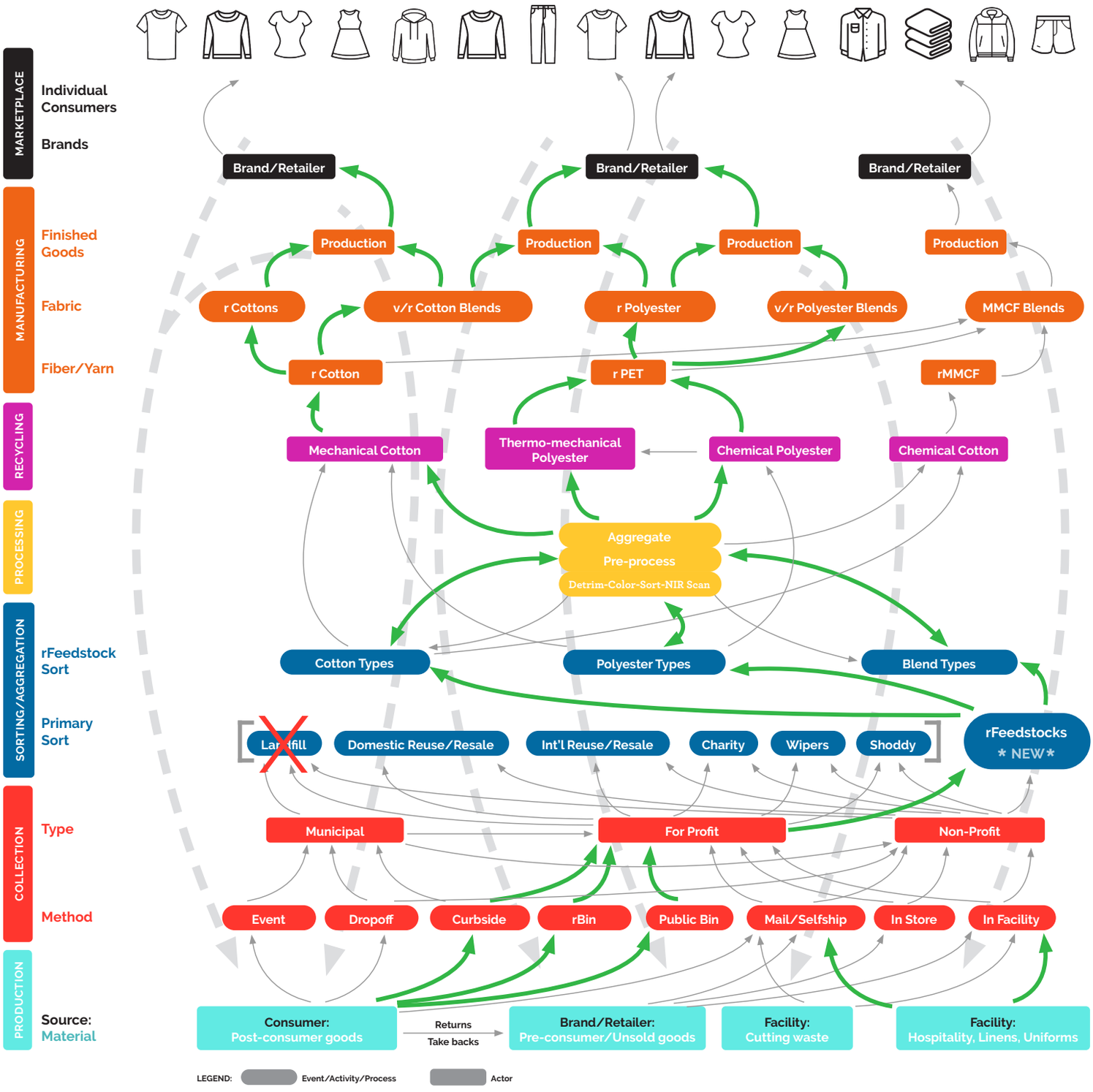
The goal of our Accelerating Circularity Project Europe (ACPE) pilots is to pressure test a circular textile-to-textile system in light of our mission line that Textiles are Too Good to Waste™. Under our Accelerating Circularity Textile Use Case Hierarchy (based on the Waste Framework Directive (1)), potential exists for a marketplace that will divert textiles from landfill or incineration to keep textiles at their best, highest use in a circular system.

Our pilots utilize post-consumer and post-industrial textiles as feedstocks for textile-to-textile recycling processes available today, at scale and in pre-commercial stages, with output to fiber, yarn, fabric, and ultimately product. Running multiple pilots at once helps to model scenarios that touch various recycling technologies, upstream input requirements, and downstream output possibilities. We need to move beyond proof of concept and turn spent textiles into mainstream raw materials for a wide variety of products.

1) Link to Project Europe Update: Fall 2022

System Ecology

Early on, Accelerating Circularity envisioned a textile-to-textile circular system encompassing a wide variety of interconnected stakeholders. Direct relationships and interactions between multiple stakeholders are required for the system to work, and the interconnectedness within a system and thus the impacts of individual decisions must be grasped.



Pilot Strategies and Goals

- Pre-competitive collaboration of 40 pilot member companies
- Use different recycling technologies available today at scale, or at pre-commercial scale
- Demonstrate logistical and technical feasibility of circular, textile-to-textile systems
- Execute sorting and pre-processing activities that fulfill recyclers' requirements in quality and quantity within a commercial lead-time
- Address feedstock pre-processing and refining bottlenecks
- Meet industry-standard MOQs per value chain segment
- Develop yarns and fabrics with a 20% of post-consumer textiles

- Replace, not add to, conventional product ranges
- Boost demand for recycled fibers by rethinking and removing brand-internal complexities and traditional ways of working
- Challenge perceptions that “recycled is expensive,” and “recycled is of inferior quality”

Pilot Member Companies

Pilot Guidelines

Minimum recycled content	• A 40% recycled content is targeted for all pilots. This can include both post-industrial factory waste, eg. cutting scraps, and post-consumer textiles supplied by sorting facilities. The pilot's focus is on processing post-consumer waste which we prefer calling SPENT TEXTILES. • A minimum of 20% recycled post-consumer textiles is targeted for all pilots. • When technically still challenging, we agree to lower contents for best possible product outcome to date.
Traceability	• Outputs will potentially include a blend of post-consumer, post-industrial, and virgin inputs. • Documentation of each change of custody/transaction is required. • Any potential traceability claims will be transactional (vs. physical).
All Pilot Products include an end-of-life pathway.	• Products are identified with key data points needed for recycling, deconstruction, decomposition, and/or biodegradation.
Product Production	• Our regional scope includes the EU-27, Switzerland, Norway, UK, Serbia, Morocco, Tunisia and Turkey. • When technically feasible, product production needs to be within our region of scope.

Pilot Phase Overview

Accelerating Circularity's primary focus has always been on making use of cotton- and polyester-rich spent textiles because global fiber demand is the highest for synthetic fibers, followed by cotton. Why do we call these materials "spent textiles," and not "waste?" We like to say that 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."

In 2021, we researched and mapped a circular textile-to-textile system together with 80+ value chain members, of which 40 decided to join us in our actual pilot phase.

WE FORMED TWO GROUPS

1) **Cellulosic:** This group's scope includes mechanical recyclers processing cotton and cotton polyester blends. It includes Steering Committee member Lenzing with the objective to use their fiber with REFIBRA™ technology as a blending fiber at the spinning stage.

1) **Polyester:** This group includes chemical recyclers and a thermo-mechanical equipment supplier to process polyester feedstocks into chip.

MILESTONES TO-DATE

April 2022	Official ACPE Pilots launch meeting
May to June 2022	Stage is set by determining: Who is in? Who are the recyclers? Where is their facility? What are their technologies? Who are the collectors, sorters and pre-processors signing on? Who are the brands joining, and which products could they make? Do we have suitable yarn and fabric manufacturers open to work with fibers made of post-consumer waste?
July to October 2022	8 value chains are formed, comprising of collector / sorter / preprocessor + recycler + yarn and fabric manufacturer and brands Material assessments according to recyclers' feedstock specifications. Development sample post-consumer feedstock orders placed upon completed material analysis.
November 2022	First quantity of 6,500 kgs of post-consumer spent textile baled and ready to ship.
January 2023 to-date	Recycling runs of development sampling MOQs. Yarn and fabric developments with the output of sample yardages for brand submissions.

MILESTONES TO COME

April to June 2023:	Cellulosic: Completing development yarns and fabrics for review meetings between value chains and brands. Swatches will be available. Polyester: Feedstock processing for output of chip to go into yarn manufacturing.
July 2023	Bulk order consolidation and bulk preparation.

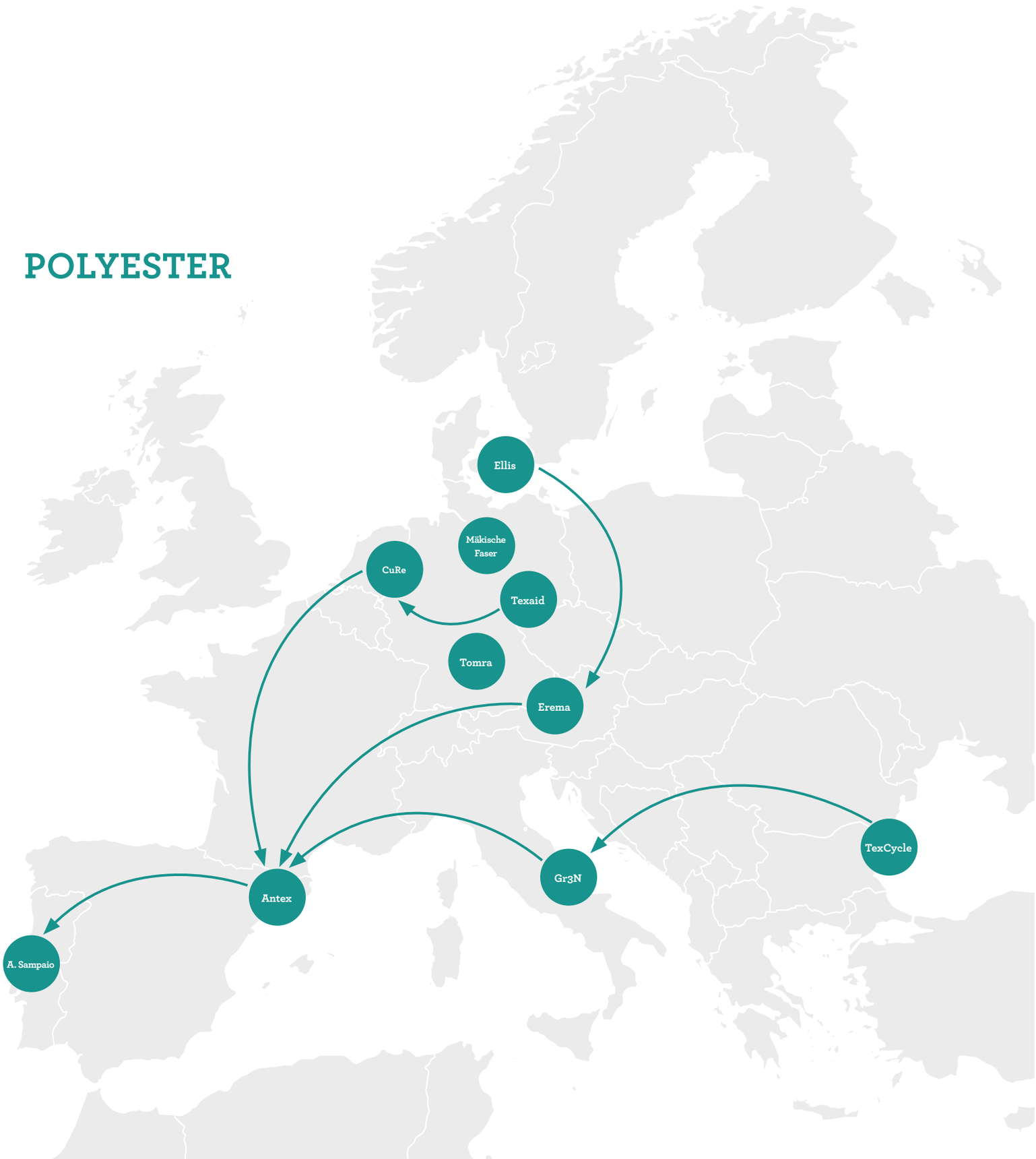
Product Models

CELLULOSIC

Product types that can be made								
Inputs	Post-consumer spent textiles							
Recycling process	Mechanical cotton @Valérius 360		Mechanical cotton @Pure Waste		Mechanical cotton @Recover™			Mechanical cotton @Wolkat
Fiber output	Recycled Cotton		Recycled Cotton	Cotton polyester blends	Recycled Cotton			Recycled Cotton
Blended with	Post-industrial cotton scraps + virgin organic cotton	Post-industrial cotton scraps + Refibra™	Post-industrial cotton scraps + virgin organic cotton	N/A	Post-industrial cotton scraps + virgin organic cotton	Virgin organic cotton		Virgin organic cotton or: Refibra™
Yarn	Ne 20/1 OE		Ne 24/1 ring spun		Ne 24/1 ring spun	Ne 30/1 ring spun	Ne 14/1 ring spun	Nm 15/1
Fabric	Single jersey American fleece		Sweatshirt quality Loop back / Brush back		Single jersey American fleece	Light woven yarn-dyes	Toweling	3/1 twill 8.5 oz
Designing from recycled: What's the newness?	Versatile yarn count with 20% PC 20% PI for different constructions; Possibility to overdye fabric creates variety of design options; All of the above leads to a wide variety of product applications.	Using Refibra™ as carrier fiber for strength and increases the recycled % overall; Versatile yarn count with 20% PC 20% PI for different constructions; Possibility to overdye fabric creates variety of design options; All of the above leads to a wide variety of product applications.	Value chain includes manufacturing powerhouse Türkiye; Versatile yarn count with 20% PC 20% PI for different constructions; Possibility to overdye fabric creates variety of design options; All of the above leads to a wide variety of product applications.	Utilizing blends as feedstock diverts vastly from landfills. Blend input = blend output (learning objective); Value chain includes manufacturing powerhouse Türkiye; No mono-material!	Ring spun; Versatile yarn count for different constructions; Possibility to overdye fabric creates variety of design options; All of the above leads to a wide variety of product applications.	Ring spun; Light-woven yarn-dyed fabric utilizing post-consumer content; Both warp and weft with post-consumer recycled cotton content; Fact of yarn-dye creates a huge variety of pattern and design options.	Post-consumer recycled fiber content for first weaving trials for toweling.	Basic twill fabric using high ppst-consumer cotton content for non-stretch product application; Foundational development to build on.

Sorting complexity	Recyclers' specifications must be met
Detrimming	Trims, embellishments and seams to be removed
Color, dyes, coatings	Color sorting required
Fabric construction	Depending on recycler's individual specifications
Capacity	Capacity available
Design for recycling	ACPE pilot goal is to design for recycling
Current bottlenecks	**PREPROCESSING (hard part removal, embellishment removal, seams and ribbings removal, sanitizing, right-sizing)**

POLYESTER



Inputs	Post-consumer garments, home textiles, bedding			
Recycling process	Chemical polyester @Gr3n	Chemical polyester @CuRe	Thermo-mechanical polyester @Erema	Physical-chemical polyester @Märkische Faser
Output	rPET chip			
Yarn	100% polyester filament or staple fiber blended with rPET from bottle or virgin PET			
Fabric	Circular knits basic jersey; fleece; woven fabric plain			
Pilot Goals	To trial demo-scale depolymerisation of post-consumer feedstock and repolymerisation to test rPET quality fit for yarn filament extrusion.		To collaborate with equipment supplier to support advancing their technology along the material chain of post-industrial fabric scraps to well sorted "post-use" materials.	To assess post-consumer spent textiles on feasibility for process at scale with the output of fiber for spinning.
Sorting complexity	Min. 70% PET easier to find	100% PET post-consumer feedstock not easily available		
Detrimming	Metal trims to be removed prior to processing			
Color, dyes, coatings	Depending on technology			
Fabric construction	Fabric construction is not relevant			
Capacity	Under scaling		N/A	At industrial scale
Design for recycling	ACPE pilot goal is to design for recycling			
Current bottlenecks	SORTING FOR PURITY and ACCURACY + PREPROCESSING			

Thinking in Systems

DATA COLLECTION

We developed a series of questionnaires that will allow our pilot partners to record vital information about the production and transfer of materials in the pilots. These surveys record information based on each partner's industry, including the spent textile, recycling, fiber, yarn, and brand-and-retail sections of the textile value chain. We will collect data on each partner's material inputs, production costs, output yields, and shipments to other pilot partners. This will allow us to capture the entire production process from start to finish. This data set will provide crucial evidence to evaluate the efficiency of this alternative production pathway and allow us to directly understand the areas where the industry can improve in the future.

DIGITIZATION SUPPORTING OUR ACPE PILOTS

Reverse Resources

AVERY DENNISON

Together with our partners Reverse Resources and Avery Dennison, our ACPE pilots will serve as a testing ground for circularity, transparency and traceability. Our collaboration supports upcoming digital product passport requirements from the European Union to track and trace post-consumer spent textiles from the sorting facilities to the recyclers and back into yarn, fabric and garment manufacturers.

JUBEL.AI

As our pilots will utilize post-consumer spent textiles, the recycling process outputs will be independently tested by a third-party laboratory for restricted substances according to current standards. We will be supported by JUBEL.AI, a cutting-edge cloud-based platform transforming the way chemicals and product safety testing is managed for brands, retailers, and manufacturers globally. With its advanced AI technology, the JUBEL.AI platform offers smarter, faster and cost-efficient testing solutions and enables risk-informed decisions, minimizes product safety issues, and manages compliance needs in complex regulatory landscapes. One of JUBEL.AI's unique features is its anonymized data sharing capability, which enables companies to benchmark their performance against industry data, accelerate research and development, and foster innovation. Our ACPE pilots' test results will be a valuable contribution to building industry data.

Glossary

Advanced recycling: see chemical recycling

Chemical Recycling: Any process that changes a polymer's chemical structure involving some form of dissolution or chemical reaction to produce substances that can be used as raw materials to manufacture new products. Sometimes called advanced recycling.

Contaminant: A polluting or poisonous substance that makes something impure[1]. A contaminated textile is a material containing unwanted substances not deliberately added. Contamination can also mean when other waste streams are received when collecting used clothing. Contamination is sometimes referred to hardware (trims) which need to be removed for some types of recycling.

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

Deadstock: Fabric that has not been used due to quantity, quality, out-of-season or IP-relaed issues, and there is no plan for use.

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/

Mass balance accounting: A chain of custody approach used to document and trace the flow of materials through a complex value chain. This approach is often applied when recycled feedstock replaces an equivalent amount of virgin feedstock at the beginning of the value chain (input) to be allocated to the product (output) in such a manner that the input and output match[9].

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. The term can further be separated into "mechanical / fiber-to-fiber recycling" referring to shredding of natural and/ or synthetic textiles into fiber for spinning and "mechanical polymer / thermal recycling" referring to melting of synthetics for extrusion.

Pre-consumer: (see post-industrial) Pre-consumer can sometimes also refer to finished garments available in supply chain that are unsellable or cannot be used due to defects.

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.

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[16].

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.

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[17].

or recycled. Disassembly is defined as the process of separating a product into its different parts[2].

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. Furthermore, it can be referred to designing products to aling with a specific recycling technology in mind.

Durability: The ability of a material to remain serviceable for a long time without significant deterioration in quality or value[3], the ability of a textile product to perform its function during an intended service life. Generally, it is determined by fiber type, fabric and garment construction and can be tested through, e.g. abrasion resistance, fabric pilling, fabric handle, fabric stiffness, colorfastness, dimensional stability and stretch recovery.

Downcycling: Textile recycling processes that result in a lower value or lower quality output than the originating product[4]. Also referred to as open-loop recycling where textiles are deconstructed, shredded or otherwise processed and used as inputs for the manufacture of lower value, such as insulation or fill[5].

Feedstock: A raw material supplied to a machine or processing plant[6]. A general term for raw material for a process.

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." ISO defines incineration as the controlled burning of waste products or other combustible materials in an incinerator or similar apparatus[7].

Landfill: A waste disposal site for the deposit of waste on to or into land under controlled or regulated conditions[8].

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[10].

Post-industrial: Describes material diverted from the waste stream during the manufacturing process and are leftover materials generated during manufacturing operations, e.g. spinning soft waste or clips or scraps from garment manufacturing. 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[11] as per ISO.

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[12].

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 during recycling and returned to use in the form of raw materials or products[13].

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[14]. We acknowledge the comment of our member GftZ Gemeinschaft für textile Zukunft that "recycled content should (only) include post-consumer materials" underlining ACs targets of a minimum of 20% recycled post-consumer textiles and an overall minimum of 40% recycled content originating from pre-, post-consumer and post-industrial for all trials with the clear ambition for higher levels when technically feasible.

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[15].

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)[18].

Transparency: Open, comprehensive and understandable presentation of information relating 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[19].

Unsold Goods: Goods that have been available to sell and not sold, or merchandise with defects or quality issues.

Virgin material: Previously unused raw material such as wood, plant or animal fiber, metal ores, or petroleum. Material that has not been subjected to use or processing other than that required for its initial manufacture.

Waste: Anything for which the generator or holder has no further use and which is discarded or is released to the environment[20]. Textile waste are discarded textiles not recycled or reused.

Waste hierarchy: A conceptual framework to guide decision making in waste management prioritizing the efficient use of resources and the reduction of environmental harm.

For AC, we strictly follow the waste hierarchy as described in the European Waste Framework Directive in priority order: a) prevention, b) preparing for re-use, c) recycling, d) other recovery, e.g.energy recovery, e) disposal[21].

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. Also referred to wastage.

1) "Contaminant." Definition of Contaminant by Oxford Dictionary on Lexico.com Also Meaning of Contaminant" Lexico Dictionaries | English, Lexico Dictionaries, www.lexico.com/definition/contaminant.
2) "CEN/TC 248 N 2338 Plastics - Environmental aspects - Vocabulary WI00249A29, 3.97".
3) "Durable." Merriam-Webster, Merriam-Webster, 2020, www.merriam-webster.com/dictionary/durable.
4) WRAP, 2018, Fibre to Fibre Recycling: An Economic & Financial Sustainability Assessment, https://drive.google.com/drive/folders/1Hj9igZ4Enj5yuaszYOmIygIlIT3hA2KB
5) Fashion Takes Action, 2021, A Feasibility Study of Textile Recycling in Canada, https://fashiontakesaction.com/wp-content/uploads/2021/06/FTA-A-Feasibility-Study-of-Textile-Recycling-in-Canada-EN-June-17-2021.pdf
6) "Feedstock." Merriam-Webster, Merriam-Webster, 2020, www.merriam-webster.com/dictionary/feedstock.
7) "ISO 16165:2013, 2.11.1".
8) "ISO 15270:2008, 3.18".
9) Ellen MacArthur Foundation, 2020, Enabling a Circular Economy For Chemicals with a Mass Balance Approach, https://www.ellenmacarthurfoundation.org/assets/downloads/Mass-Balance-White-Paper-2020.pdf.
10) "ISO 14021:2016." Mar. 2016.
11) "ISO 14021:2016." Mar. 2016.
12) ibid.
13) ibid.
14) ibid.
15) ibid.
16) ibid.
17) 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.
18) 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.
19) 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.
20) "ISO 14021:2016." Mar. 2016.
21) DIRECTIVE (EU) 2018/851 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 30 May 2018 amending Directive 2008/98/EC on waste, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32018L0851

Acknowledgments

Photo Credits

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A big THANK YOU to all of our pilot partners for their time and contributions to our work.

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