Textile Exchange

Life Cycle Assessment for Polyester

Frequently asked questions

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What is Textile Exchange's role and approach to developing Life Cycle Assessment (LCA) studies and using LCA data?

There are many impact data gaps and a clear need to strengthen the quality, transparency, and accessibility of LCA data for the fashion, textile, and apparel industry at Tier 4 of the supply chain, where raw materials are produced and initially processed.

Textile Exchange facilitates the development of LCA studies to help fill critical data gaps on impacts related to key fibers and materials, supporting better-informed industry action and impact measurement.

In 2022, we launched a series of priority LCA studies. As of June 2026, Textile Exchange's LCA-related work covers cotton, polyester, cashmere, Responsible Wool Standard Wool, Responsible Mohair Standard Mohair, nylon, and leather hide. The studies are designed to improve the availability of consistent, high-quality impact data for these materials.

Before exploring the individual LCA reports, we strongly encourage reviewing our position paper, *Ensuring Integrity in the Use of Life Cycle Assessment Data*, which provides the full foundation and context for this work. The paper explains:

- Why Textile Exchange conducts LCA studies and how this effort supports the industry's transition to preferred production systems.
- Our role and guiding principles in developing LCA studies, including engagement with producers and expert partners.
- The scope and design of the studies, including cradle-to-gate system boundaries and data sources.
- The measures taken to ensure credibility and transparency, such as third-party critical reviews and multi-stakeholder technical input.
- Why Textile Exchange LCA studies are non-comparative, and how to use the results responsibly.
- The resources and deliverables available for each study and where the resulting datasets will be published.
- Our ongoing work and next steps, including expanding data coverage, incorporating our LCA+ approach, and opportunities for industry collaboration.

Supplementary to this paper, a second paper, *LCA Model Comparison—Case Study: Cotton* outlines the variations across LCA methodologies and provides specific examples for why LCA data should not be compared unless specific conditions are met.

To learn more about Textile Exchange's LCA work, visit textileexchange.org/life-cycle-assessment-studies or contact the Impact Data and Measurement team at impactdata@textileexchange.org.

Goal and scope

What data sources are used for this LCA study?

Primary data from recycled and virgin polyester production facilities was collected from five data providers, which included all inputs and outputs required for a functional unit. Any data gaps, such as waste collection distances, were filled with representative data, primarily from the ecoinvent v3.11 database.

All data sources were assessed using a structured data quality review (DQR) based on the European Commission Product Environmental Footprint (PEF) methodology.

NOTE: Further information can be found in Life Cycle Assessment for Polyester, section 4.4.1 Data collection and sources.

What production systems are covered in this study?

The study aims to address the critical data gaps in existing polyester LCA studies by generating new datasets for virgin, thermomechanical recycled, and chemical recycled polyethylene terephthalate (PET) across key producing countries.

What are the boundaries for the processes included for virgin polyester production?

The system boundary for each virgin polyethylene terephthalate (PET) product is from cradle to the respective manufacturing gate (for example, cradle-to-staple fiber, cradle-to-partially oriented yarn (POY), or cradle-to-drawn textured yarn (DTY)). This covers all processes required to produce each of these virgin PET products, including the upstream extraction and processing of petrochemical feedstocks. Each product system also includes transportation of materials, energy inputs, and waste management.

Downstream applications and packaging are excluded.

NOTE: Further information can be found in Life Cycle Assessment for Polyester, section 5.1 System boundary and related diagrams.

What are the boundaries for the processes included for recycled polyester technologies?

The chemically recycled polyethylene terephthalate (PET) chip system boundary is cradle-to-manufacturing gate, covering all processes from the collection and pre-treatment of waste textile feedstocks to the production of chemically recycled PET chips. Each product system also includes transportation of materials, energy inputs, and waste management.

The system boundary for thermomechanically recycled polyester chip is cradle-to-manufacturing gate, covering all processes from the collection of waste PET bottles to the production of thermomechanically recycled PET chips. For one data provider, data was also available for a flake-to-staple fiber process, which eliminates the need to produce chips. Each product system also includes transportation of materials, energy inputs, and waste management.

Downstream applications and packaging are excluded.

NOTE: Further information can be found in Life Cycle Assessment for Polyester, section 3.1 System boundary (chemical recycling) and 4.1 System boundary (thermomechanical recycling).

Why is it important to have data on pre-commercial data providers?

Pre-commercial data providers are not currently producing at a commercial scale. This makes the results uncertain, and caution should be used when drawing any conclusions from their data.

However, pre-commercial data providers were included in the study as it is important to gain an understanding of the potential impacts from new and emerging chemical recycling processes given that the commercialization of chemical recyclers is far behind thermomechanical recyclers for polyester. The majority of chemical recyclers for polyester are still at a pre-commercial stage.

NOTE: Further information can be found in Life Cycle Assessment for Polyester, section 3. Chemical recycling product system.

How representative is the data geographically for polyester production?

The questionnaire sample was small—and only four out of five of the data providers were at commercial scale and able to provide relevant information—which should be taken into consideration when interpreting this document. It is worth noting, however, that several of them are large corporations playing a significant role in the global production of polyester.

Pre-commercial data providers are not yet operating at a commercial scale, which introduces uncertainty to the results. Caution should be used when interpreting and drawing any conclusions from this data.

NOTE: Further information can be found in Life Cycle Assessment for Polyester, section 1.3 Scope of the study.

How were data providers chosen for the study?

Potential data providers were identified via the Textile Exchange network, consultants, and brand sponsorship groups. Potential data providers were contacted, and meetings were set up with those who were interested in taking part. All data providers who were willing and able to be included in the study were included.

NOTE: Further information can be found in Life Cycle Assessment for Polyester, section 2. Methodology.

When was the data collected for the study?

The data collection period ran from early 2022 to the end of 2024 for recycled polyester producers. For virgin polyester producers, the data collection period ran from January to December 2022.

NOTE: Further information can be found in Life Cycle Assessment for Polyester, sections 1. Introduction; 3. Chemical recycling product system; 4. Thermomechanical recycling product systems; and 5. Virgin production product systems.

Why is the topic of microplastics/microfibers/fiber fragment shedding not included in the scope of the LCA study?

The Textile Exchange Life Cycle Assessment (LCA) studies focus on the impacts of raw material production and primary processing (Tier 4).

For polyester, this means that the LCA boundary extends to pellet, chip, or staple fiber production, depending on the technology. As a result, the scope does not cover the fiber and fabric manufacturing and finishing, cutting and sewing, and consumer use phases—when impacts from

fiber fragment shedding primarily occur. While there may be microplastic or fiber fragment shedding associated with the production of polyester pellet, chip, or staple fiber at the Tier 4 level, we have not included this in the LCA study due to the current lack of a common and accepted methodology and calculation approach.

NOTE: Further information can be found in Life Cycle Assessment for Polyester, section 1. Introduction.

How is the Circular Footprint Formula considered in the Textile Exchange polyester LCA study?

The Circular Footprint Formula (CFF) allocates the impacts of recycling and the potential benefits of reduced virgin material production between the those who generate recyclable waste and those who recycle it. The approach can be used to account for the environmental impacts of recycled and reused materials within the EU Product Environmental Footprint (PEF) methodology framework.

This LCA study includes an appendix that explores how the thermomechanical and chemical recycling results, calculated using the recycled content allocation approach reported in the main body of the report, change when the PEF CFF allocation approach is used. It should be noted that these results are only intended to illustrate how the CFF allocation approach differs from the recycled content allocation approach; they should not be considered appropriate for use in PEF compliance efforts.

NOTE: Further information can be found in Life Cycle Assessment for Polyester, Appendix A—Circular Footprint Formula.

Modeling, impact assessment results, and interpretation

How are the different impact categories calculated for this study?

Within a Life Cycle Assessment (LCA) study, the input and output data required to produce a product, known as the life cycle inventory (LCI), are collected and then characterized to generate environmental impact results. This process links specific inputs (for example, freshwater use) and outputs (for example, greenhouse gas emissions) to corresponding impact categories (for example, water scarcity and climate change).

Two main approaches are used in this step:

- Midpoint characterization, which focuses on problem-oriented impact categories such as climate change, eutrophication, and ozone depletion.
- Endpoint characterization, which models damage-oriented impacts related to areas of protection such as human health, ecosystem quality, and resource availability.

Because endpoint modeling involves greater complexity, more assumptions, and higher uncertainty, most LCA studies emphasize midpoint characterization. Accordingly, this study assesses environmental impacts at the midpoint level.

NOTE: Further information can be found in Life Cycle Assessment for Polyester, section 2. Methodology.

How is the social impact of polyester production considered in the LCA study?

Textile Exchange and our project partners believe it is important to consider the impacts of fiber and material production holistically. This underpins Textile Exchange's "LCA+" approach, which considers impact areas not typically covered by LCA studies, such as biodiversity, soil health, freshwater, animal welfare, and social livelihoods.

The social assessment component for the polyester LCA study was developed as part of the LCA+ approach, designed to capture human rights impact elements related to polyester production. It provides a foundational overview of some of the most common social impacts associated with polyester production, and is intended to serve as a general reference, highlighting key themes and offering useful resources for further exploration. It does not represent an in-depth assessment and should not be treated as such.

NOTE: Further information can be found in Life Cycle Assessment for Polyester, Appendix B—Examining human rights impacts in polyester production: Social assessment for polyester.

How was transportation included in the LCA study?

The Textile Exchange polyester LCA study accounts for all transport in the supply chain up to the manufacturing gate (encompassing the production of polyethylene terephthalate (PET) chip, staple fiber, and yarn before distribution to the next part of the supply chain).

Primary data was available for all transport of raw materials and chemicals from the supplier to the PET recycler or virgin producer. Some primary data was available for the collection of the waste feedstock (post-consumer PET bottles, textile waste, and post-industrial textile waste). Secondary data from the ecoinvent database and published literature was used where there were data gaps in feedstock collection. The ecoinvent database was used for all transport upstream of feedstock collection and raw material and chemical transport.

In addition, a sensitivity analysis on the truck transport used to collect waste feedstock for recycling was conducted. This was because there was uncertainty around secondary data used to close data gaps, and because waste collection transport varies greatly, since these recycling technologies can be used anywhere in the world. For each chemical and thermomechanical recycler, one high and one low truck transport scenario was modeled. The scenarios varied the distance traveled to collect PET waste and the intensity of the trucks' fuel combustion emissions.

Truck transport was the sole focus of this scenario. Virgin production of PET was excluded from this sensitivity analysis, as there was very high certainty for raw material transport distances and modes.

NOTE: Further information can be found in Life Cycle Assessment for Polyester, sections 2.4 Modeling approach and 6.2 Truck transport scenarios.