Reformation

RefScale methodology

The Reformation sustainability team created a life-cycle assessment tool to calculate the CO2 and water footprints of Reformation products, as well as comparable products. The tool used primary data whenever available; otherwise it referenced secondary data and existing life-cycle assessments for select fabrics or processes. Finally, a third-party sustainability consulting team, reviewed their methodology and data sources to verify the validity of Reformation's calculations[1].

Goal and scope

The goal of this RefScale is to compare the environmental impact of manufacturing clothes at Reformation vs comparable products. The scope is a cradle-to-grave assessment including raw material inputs into fabric manufacturing, fabric dying, product manufacturing, packaging, transportation, customer care, and end-of-life disposal. A generic system diagram for the tool is shown in **Figure 1.**

The tool is built for calculating the environmental impact of a garment made with one fabric (i.e. self) or two fabrics (i.e. self & lining). A garment made just with one fabric will follow all the processes outlined in **Figure 1** and detailed in the Inventory Analysis. For garments that have a self fabric and a lining fabric, lining fabric emissions are calculated separately, following the same process, and added to the total emissions of the garment.

Deadstock fabrics are defined as verified old, leftover, and over-ordered fabric from other designers and fabric warehouses. For deadstock fabrics we do not assign a fabric impact since these come from secondary markets. However, we do calculate the rest of the life cycle impacts defined in **Figure 1**.
The system boundary for the RefScale tool for shoes only focuses on found major components of shoe production. These four major components are the upper, sock, and the bottom (both outsole & heel). For shoe bottoms, ABS & rubber weights were assumed to be the rest of the total shoe weight. E.g. **[Total weight-(upper weight +sock weight)] =Bottom weight**. If the shoes had both ABS & rubber the weight was split in half.

Functional unit

The functional unit in this tool is defined as one garment of clothing. It can be a dress, a jumper, a blouse, etc. The emission factors that are used in calculating the processes defined in **Figure 1** (i.e. fabric dying, transportation, etc.) are normalized to one pound and are used to calculate the CO2 and water for one garment of clothing made at Reformation and one garment of comparable conventional clothing.

To allow comparison at a larger scale, Ref's individual garment impact is multiplied by the total units manufactured for that style. The conventional garment's impact is also multiplied by the same total units manufactured for that specific style.

A notable exclusion from the tool is trims such as zippers, buttons, and fasteners. Previous studies have

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[1]Last reviewed: April 2022 by Sustainable Business Consulting

found trims are not relevant relative to other life cycle stages. Another notable exclusion is e-commerce impacts (per product). Reformation researched resource use of data centers and customers' computer usage and found that the impacts were negligible. However, the footprint of Reformation's online shopping platform (i.e. CO_2 eq emissions) of servers and customer screen power consumption is calculated and offset separately.

Inventory analysis

Fabric Manufacturing

1. Emission Factors

The main source of our fabric impacts comes from the Higg Materials Sustainability Index (Higg MSI) developed by the Sustainable Apparel Coalition (SAC). The Higg MSI assesses impacts of materials from cradle-to-gate for a finished material (i.e. to the point at which materials are ready to be assembled into a product). The Higg MSI scores or percent calculations provided herein account for a single production stage within the Higg MSI scope (e.g. fiber or raw material). They do not provide a holistic view of the impacts involved with material production.

If a specific fabric is not listed in the MSI we've identified LCAs that have similar boundaries and geographic focus for secondary sources. We've done our best to compare "apples-to-apples" but in some cases, this is very difficult with existing data. We try to focus on cradle-to-gate, and will select the most thorough and conservative estimates when competing studies and data are available.

2. Comparable Conventional Clothing

Our conventional clothing comparisons are in line with Textile Exchange's conventional assumptions in their Corporate Fiber & Materials Benchmark (CFMB), Program Sustainability Weight. The Program Sustainability Weight refers to the weight allocated to each fiber to help determine a company's relative uptake performance score based on the share of preferred material uptake relative to conventional. It's important to note that not all fibers are listed in the CFMB so some comparisons are made based on what fabrics and processes that Reformation assumes are most common for products sold in the US. All conventional comparisons are listed in **Figure 2**.

3. Blended Fabrics

For blended fabrics, fabric impacts are calculated by fabric composition. E.g. a fabric that is 50% organic cotton and 50% linen, the fabric impacts would be calculated assuming 50% of the impact is attributed from organic cotton and 50% is from linen.

For conventional blended fabrics, the impacts are calculated the same way and mapped to the applicable conventional fabric defined in **Figure 2**. E.g. for the same fabric listed above the impacts would be calculated assuming 50% of the impact is attributed from conventional cotton and 50% is from linen.

4. Deadstock Fabrics

Deadstock fabrics are defined as verified old, leftover, and over-ordered fabric from other designers and fabric warehouses. For deadstock fabrics we do not assign a fabric impact since these come from secondary markets.

Fabric Dyeing

Dyeing calculations assume reactive dyeing processes for Reformation and Conventional garments. Solid fabrics use an emission factor for reactive dyeing done in India & China. Printed fabrics use a conventional print emission factor. Reformation uses third-party certifications (i.e. GOTS, GRS, Bluesign, Oeko-Tex) for low-impact and safe dye practices when available. The tool is currently unable to identify LCA reporting for dyeing emission factors when these certifications are being used so the low-impact dyeing is not taken into consideration in this version of the tool. The tool does not assign a dyeing impact for Reformation garments made with deadstock. The corresponding conventional garment does assume the emission factor for a solid dyed fabric.

Material Transit

Reformation defines material as finished material (i.e. fabric, leather) that is ready for product manufacturing. Material transportation is calculated in miles from the material vendor's location to Los Angeles. The specific emission factor that is used to calculate the impact is dependent on the transportation mode (i.e. truck, ship, air). The material transit for conventional clothing is assumed to be air transport from China to LA.

Product Manufacturing

Manufacturing impacts are calculated on a per unit basis based on the sew vendor location. The facilities are broken down into three categories: In House, Out House, and Overseas. In House is defined by garments that are produced in the Reformation factory in Vernon, CA. Out House is defined by garments that are produced in Los Angeles at one of Reformation's partner factories. Overseas is defined by garments that are produced overseas at one of Reformation's partner factories.

Depending on which category the garment is sewn in a different emission factor is applied for product manufacturing CO_2 & water. The emission factors used for CO_2 and water were gathered by collecting primary data on their energy & water bills from various vendors at different manufacturing locations. Manufacturing impacts were calculated by dividing the monthly average (kWh & HCF) by the average monthly volume of units.

A notable assumption for conventional clothing is that it is manufactured in China in a factory without carbon offsets.

Commercial Garment Wash

The tool assumes that for both Reformation & conventional clothing, only denim is commercially washed in a commercial-top load machine with a container volume of 2.8 cu.ft. and a maximum test-load weight of 11.7 lb/cycle. Reformation primarily makes denim in Los Angeles & Turkey so the emission factor associated with the commercial garment wash is dependent on the sewing vendor location. Conventional denim assumes that the commercial washing process occurs in China.

Packaging

Reformation packaging includes a 100% recycled LDPE polybag in a 100% recycled content mailer. Conventional packaging assumes 100% conventional plastic polybag in a 100% conventional plastic mailer. Packaging impact includes manufacturing as well as the end-of-life impact for all materials used for both clothes and shoes.

Shipment

Reformation shipping is assumed to be small-package, ground shipping with carbon offsets. The tool notes this by zeroing out the impacts for shipping for Reformation garments because the impacts are calculated by the shipping providers and offset through a carbon neutral shipping program. Conventional clothing shipping is assumed to be small-package, ground shipping without carbon offsets.

Garment Care

Reformation would like to assume that the customer follows their lower impact recommended garment care instructions but that may not always be the case. Moreover, some customers may have access to higher-efficiency front-loading machines and others may not. For that reason, the tool uses an average emissions factor for all wash types for both Ref & conventional impact. Garment care emission factors for machine washing include both wash & dry. Taking into consideration both physical & emotional durability in regards to the lifespan of a garment, the tool assumes that the average active life of a garment is 3.3 years. We are assuming that this is the equivalent to approximately 30 washes for both Reformation & conventional clothing.
The tool assumes Reformation customers recycle at a slightly higher rate than the US average (16% vs.14%) according to the EPA. This can be attributed in part to our free clothing recycling service and resale initiatives, and our customers increased awareness of clothing waste.
associated with the commercial garment wash is dependent on the sewing vendor location. Conventional denim assumes that the commercial washing process occurs in China.

Current limitations

There are some slight variations in system boundary and geographic focus for secondary sources. We've done our best to compare "apples-to-apples" but in some cases, this is very difficult with existing data. We do our best to focus on cradle-to-gate, and will select the most thorough and conservative estimates when competing studies and data are available.

We are currently unable to identify LCA reporting on Recycled Cashmere yarn, and are looking for better data for Alpaca, Cashmere, and Silk. If you can help, please let us know!

End-of-life

The tool assumes Reformation customers recycle at a slightly higher rate than the US average (16% vs.14%) according to the EPA. This can be attributed in part to our free clothing recycling service and resale initiatives, and our customers increased awareness of clothing waste.
operating waste).

Sources

Sources used to calculate the environmental footprint include a mix of primary and secondary data, including other life cycle assessments, material databases, and scientific literature reviews. Primary data is used when available and is triangulated with reputable, industry-specific data. A summary of key data sources by life cycle stage is listed below:

Life Cycle Stage	**Dats Sources**
Fabric Manufacturing	•Carbon & Water intensities from Higg Materials Sustainability Index, supplier LCAs, and LCA databases. •2019 CFMB Scoring Methodology Textile Exchange © 2019 https://textileexchange.org/wp-content/uploads/2020/01/2019_CFMB_Scoring_Methodology.pdf
Fabric dyeing	•"SimaPro (Ecoinvent Database, Method Ecoindicator 95)"
Material Transit	•WTW emission factors from the 2019 GLEC Framework
Product Manufacturing	•Primary energy & water consumption data from the Reformation factory and partner factories.
Commercial Garment Wash	•California Source: (2016, egrid) •Turkey Source: Ecoinvent •China Source: https://www.carbonfootprint.com/docs/2019_06_emissions_factors_sources_for_2019_electricity.pdf •Energy Efficiency and Renewable Energy Office, 2006

Packaging	•Earthsmart •Al-Ma'adeed, M., Ozerkan, G., Kahraman, R., Rajendran, S., & Hodzic, A. (2011). Life Cycle Assessment of Particulate Recycled Low Density Polyethylene and Recycled Polypropylene Reinforced with Talc and Fiberglass. Key Engineering Materials, 471–472, 999–1004. https://doi.org/10.4028/www.scientific.net/kem.471-472.999
Shipment	•Primary Data from our shipping providers
Garment Care	•Apparel Industry Life Cycle Carbon Mapping, Business for Social Responsibility, June 2009 •Barthel, Claus., Gotz, Thomas., What users can save with energy and water efficient washing machines, BigEE March 2013 •Do all laundry by hand, Three Actions Project, As of October 2010 •Residential Clothes Washer Introduction, Alliance for Water Efficiency, As of October 2016 •The Jeans Redesign Guidelines https://www.ellenmacarthurfoundation.org/assets/downloads/Jeans-Guidelines-MASTER.pdf •Laitala, K., & Klepp, I. G. (2015). Age and active life of clothing. Product Lifetimes And The Environment, 182. •Langley, E., Durkacz, S., & Tanase, S. (2013). Clothing longevity and measuring active use. Summary report). Banbury: Ipsos Mori for WRAP. •Residential Clothes Washer Introduction, Alliance for Water Efficiency, As of October 2016
End-of-Life	•EPA •Earthsmart

Figure 1 RefScale system boundary.

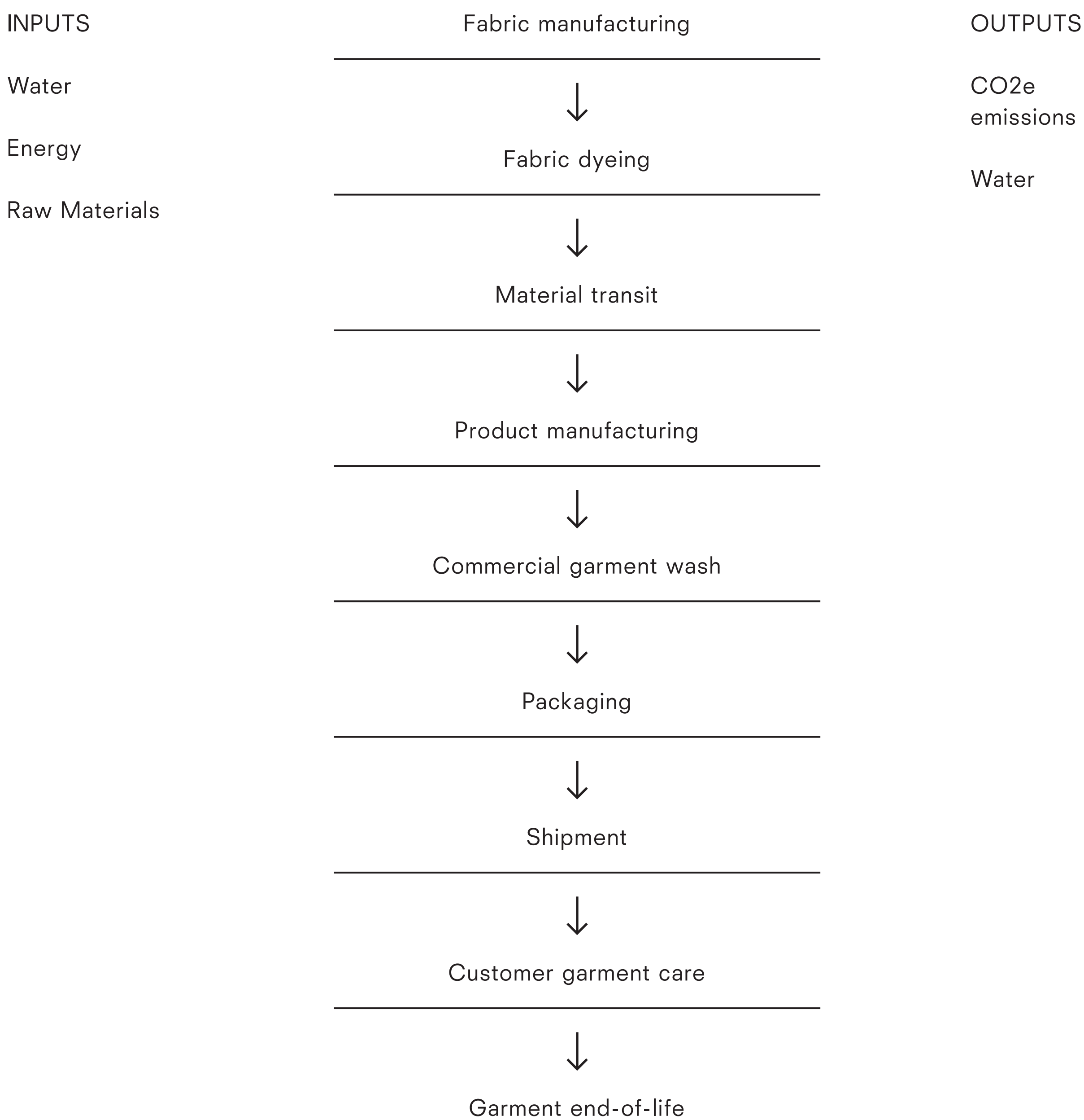

Figure 2 Comparable conventional clothing assumptions.

Reformation Fabric	Conventional Fabric
Jute	Jute
Linen	Linen
Tencel™ Lyocell	Generic Viscose
Tencel™ Modal	Generic Viscose
Tencel™ x Refibra	Generic Viscose
Generic Viscose/Rayon	Generic Viscose
Lenzing Asia Viscose	Generic Viscose
Lenzing Europe Viscose	Generic Viscose
Silk	Silk
Cotton	Cotton
Recycled Cotton	Cotton
Organic Cotton	Cotton
Leather	Leather
Alpaca	Alpaca
Yak	Wool
Wool	Wool
Cashmere	Cashmere
Recycled Cashmere	Cashmere
Polyester	Polyester
Recycled Polyester	Polyester
Nylon	Nylon
Regenerated Nylon	Nylon
Recycled Nylon	Nylon
Acetate	Acetate
Acrylic	Acrylic
Spandex	Spandex