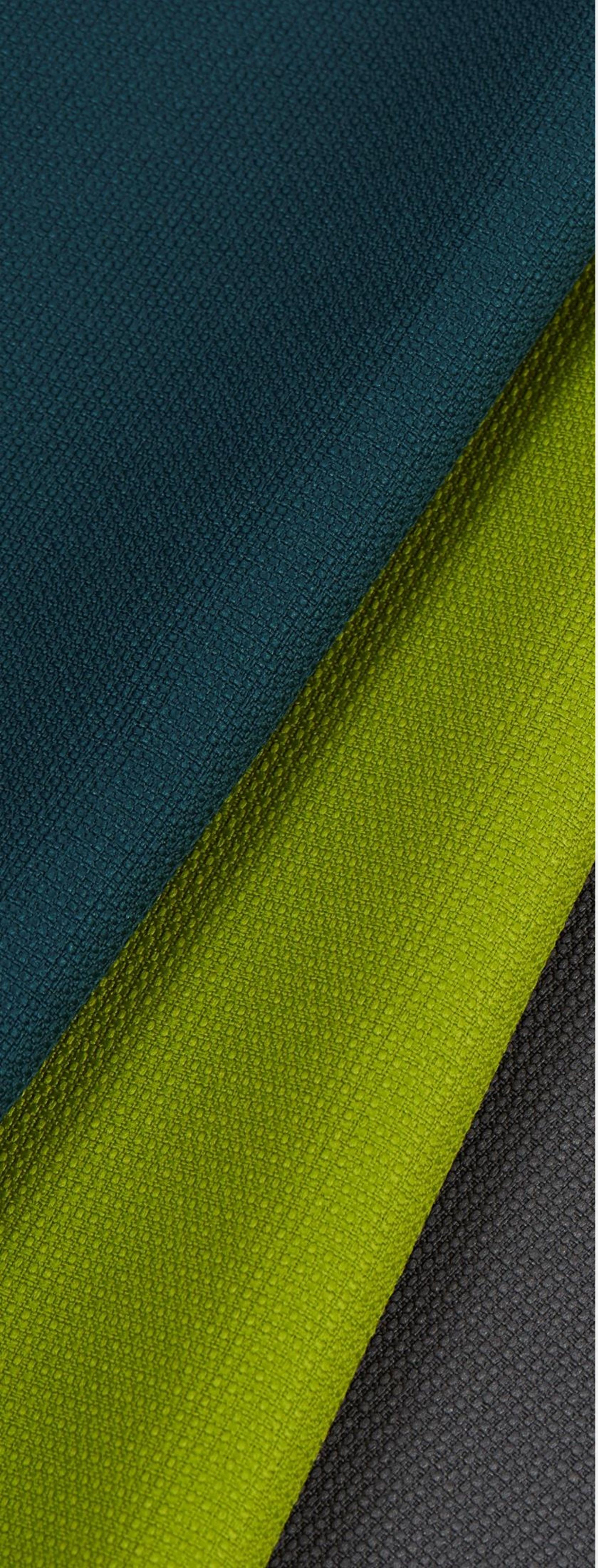

Declaration Owner

Camira Fabrics Ltd
The Watermill Wheatley Park, Mirfield WF14 8HE
United Kingdom
Phone: +44 333-032-4568
https://www.camirafabrics.com

Products

Xtreme, Era 140 & 170, Phoenix, Rivet, Lucia CS, Manhattan, and Oceanic

Declared Unit

The declared unit is one square meter of manufactured textile fabric and its packaging

EPD Number and Period of Validity

SCS-EPD-08784
EPD Valid March 21, 2023 through March 20, 2028
Version Date: October 4, 2024

Product Category Rule

International EPD® System: Fabrics. PCR 2022:04, Version 1.0.1

Program Operator

SCS Global Services
2000 Powell Street, Ste. 600, Emeryville, CA 94608
+1.510.452.8000 | www.SCSglobalServices.com

Declaration owner:	Camira Fabrics Ltd.
Address:	The Watermill Wheatley Park, Mirfield WF14 8HE, United Kingdom
Declaration Number:	SCS-EPD-08784
Declaration Validity Period:	EPD Valid March 21, 2023 through March 20, 2028
Version Date:	October 4, 2024
Program Operator:	SCS Global Services
Declaration URL Link:	https://www.scsglobalservices.com/certified-green-products-guide
LCA Practitioner:	Ilan MacAdam-Somer, SCS Global Services
LCA Software and LCI database:	OpenLCA 1.11.0 software and the Ecoinvent v3.8 database
Product's Intended Application:	N/A
Product RSL:	N/A
Markets of Applicability:	Domestic and International
EPD Type:	Product-Specific
EPD Scope:	Cradle-to-Gate with End-of-Life
LCIA Method and Version:	Core Environmental Impact Indicators of EN 15804:2012+A2:2019/AC:2021
Independent critical review of the LCA and data, according to ISO 14044 and ISO 14071	☐ internal ☒ external
LCA Reviewer:	Lindita Bushi Lindita Bushi, Ph.D., Athena Sustainable Materials Institute
Product Category Rule:	EPD International (2022), Fabrics. PCR 2022:04, v1.0.1
PCR Review conducted by:	Gorka Benito (Chair); Technical Committee of the International EPD® System
Independent verification of the declaration and data, according to ISO 14025 and the PCR	☐ internal ☒ external
EPD Verifier:	Lindita Bushi Lindita Bushi, Ph.D., Athena Sustainable Materials Institute
Declaration Contents:	

Disclaimers: *This EPD conforms to ISO 14025, 14040, and 14044.*

Scope of Results Reported: *The PCR requirements limit the scope of the LCA metrics such that the results exclude environmental and social performance benchmarks and thresholds, and exclude impacts from the depletion of natural resources, land use ecological impacts, ocean impacts related to greenhouse gas emissions, risks from hazardous wastes and impacts linked to hazardous chemical emissions.*

Accuracy of Results: *Due to PCR constraints, this EPD provides estimations of potential impacts that are inherently limited in terms of accuracy.*

Comparability: *EPDs within the same product category but from different programs may not be comparable. For two EPDs to be comparable, they must be based on the same PCR (including the same version number) or be based on fully aligned PCRs or versions of PCRs; cover products with identical functions, technical performances and use (e.g. identical declared/functional units); have equivalent system boundaries and descriptions of data; apply equivalent data quality requirements, methods of data collection, and allocation methods; apply identical cut-off rules and impact assessment methods (including the same version of characterization factors); have equivalent content declarations; and be valid at the time of comparison.*

Ownership: *The EPD owner has the sole ownership, liability, and responsibility of the EPD.*

1. Declaration Owner and Product Descriptions

1.1 Camira Fabrics

Camira Fabrics, referred to here on out as Camira, is a global textile innovator, designing and manufacturing fabrics for a wide range of spaces and places: commercial office interiors; hotels, cinema and auditoria; universities and colleges; mainline and underground trains; city buses, minibuses and long-distance coaches. Fabrics are woven, knitted and printed for a multitude of applications including computer workstations, sofas and pods, acoustic panels and wallcoverings, headboards and sofa beds, curtains and drapery, bus and train seats, and ancillary trims in transport interiors. Clients include Transport for London, Google, Adobe, BBC, Intercontinental Hotel Group, First Group, Lloyds Banking Group and many more blue-chip companies. Images of the synthetic products are shown in **Figure 1** below.

1.2 Product Descriptions

Synthetic Textile Fabric Products

Xtreme: Xtreme is a flame-retardant crepe weave fabric made from 100% post-consumer recycled polyester, diverting waste from landfill and saving virgin raw materials. Its stretch properties, coupled with high flame retardancy, durability and non-pilling properties make Xtreme an ever-popular fabric for task seating.

Era 140 & 170: Era is a subtle, two-tone polyester fabric containing stretch in both directions for ease of upholstery. The baby herringbone weave offers an understated contemporary texture while its coloring technique provides close up intrigue. The palette incorporates playful brights and sophisticated muted tones.

Phoenix: Phoenix is a cost-effective simple crêpe weave fabric available in a wide selection of commercial colorways, suitable for task seating.

Rivet: Rivet is a fixating fabric which not only connects with the modern collaborative workplace, but also forms a bridge between textile traditions and future innovation. Designed to blend the aesthetic qualities of luxury woolen apparel with modern performance sportswear, Rivet is a lightly textured hopsack which emulates the swathe of suiting in a well-heeled synthetic. Made from 100% post-consumer recycled polyester from used plastic bottles, Rivet celebrates Camira's 20 years' experience in designing and manufacturing recycled fabrics.

Lucia CS: Lucia CS has been engineered from 100% Trevira CS yarn and is an inherently flame-retardant version of our popular screen fabric Lucia. We have created a sophisticated color palette that effortlessly coordinates with Xtreme CS and adopts some of our most popular colorways. This fabric is largely acoustically transparent and as such is ideal to be used as a decorative facing for sound absorbing boards.

Manhattan: Manhattan is a dobby weave fabric with a modern, geometric texture mimicking the architectural grid system within an urban landscape. Made from 100% post-consumer recycled polyester, the fabric has in-built stretch for easy upholstery. The global color palette follows the color blocking and modular fashion trend.

Oceanic: Oceanic is a fabric born of the SEAQUAL INITIATIVE designed to combat marine plastic pollution and achieve a waste free environment. It is created entirely from post-consumer recycled plastic - from debris floating discarded in our seas, used to make SEAQUAL® YARN, to bottles thrown away and destined for landfill. One small drop in the mission to clean both the earth and its ocean, this contemporary fabric is a recycled polyester with a purpose.

Figure 1. *Example images of the Camira's synthetic fabric products. Shown here, from top left, are the Lucia CS, Manhattan, Oceanic, and Era products.*

1.3 FURTHER INFORMATION

Further information on the product can be found on the Camira's website at https://www.camirafabrics.com.

2. Scope of the Study

2.1 Declared Unit and Product Specifications

The seven synthetic textile fabric products serve a variety of purposes depending on the final industry to which they are destined. In accordance with the PCR, a declared unit of one square meter of manufactured fabric product and their packaging, including the end-of-life (EOL) of each product, is used. A reference service life is not applicable for this product category. The product composition, density of each product, suppliers of yarn, and Camira facilities involved are listed in **Table 1,** while the technical characteristics required by the PCR [1] are reported in **Table 2**.

As shown in **Table 1,** Camira's synthetic textile products consist of virgin or mechanically recycled polyester, some of which have been treated to be flame-retardant.

Table 1. *Each product's material composition, density, yarn suppliers, and the Camira facility name and location in which it is located.*

Textile Product	UN CPC Classification Code	Composition (%)	Area Density (g/m^2)	Camira Facilities and Locations
Xtreme	Group 267 Class 2672	100% Post-Consumer Recycled Polyester (topical flame-retardant treatment)	310	Meltham Mills, UK Holmfirth Dyers, UK
Era (170 & 140)	Group 267 Class 2672	100% Polyester	320	Meltham Mills, UK Holmfirth Dyers, UK
Phoenix	Group 267 Class 2672	100% Polyester	285	Meltham Mills, UK Holmfirth Dyers, UK
Rivet	Group 267 Class 2672	100% Post-Consumer Recycled Polyester	280	Meltham Mills, UK Holmfirth Dyers, UK
Lucia CS	Group 267 Class 2672	100% Trevira CS® Flame Retardant Polyester	265	Meltham Mills, UK Holmfirth Dyers, UK
Manhattan	Group 267 Class 2672	100% Post-Consumer Recycled Polyester	290	Meltham Mills, UK Holmfirth Dyers, UK
Oceanic	Group 267 Class 2672	100% Post-Consumer Recycled Polyester, (inc. 50% SEAQUAL)	497	Meltham Mills, UK Holmfirth Dyers, UK

Table 2. *Each products' technical specifications, with specific tests recommended by the PCR.*

Technical Specification	Width and length	Surface fuzzing and pilling	Determination of pH	Elasticity	Dimensional change to washing	Color fastness to artificial light	Color fastness to water	The resistance of color	Indoor Advantage Gold	EU Ecolabel	Oeko-Tex 100
Test Standard	**EN 1773: 1998**	**ISO 12945-2:2002**	**ISO 3071:2006**	**EN 14704-1:2005**	**ISO 6330: 2012**	**ISO 105 B02:2014**	**ISO 105 E01:2013**	**ISO 105-X12:2016**			
Xtreme	140cm	4 (2000)	Not Tested	Not Tested	± 3%	6	Not Tested	Wet: 4 Dry: 4	Y	Y	Y
Era (170 & 140)	140cm or 170cm	4 (2000)	Not Tested	Not Tested	± 3%	5	Not Tested	Wet: 4 Dry: 4	Y	N	Y
Phoenix	140cm	4 (2000)	Not Tested	Not Tested	± 3%	6	Not Tested	Wet: 4 Dry: 4	Y	N	Y
Rivet	140cm	4 (2000)	Not Tested	Not Tested	± 3%	5 - 6	Not Tested	Wet: 4 Dry: 4	Y	Y	N
Lucia CS	170cm	Not Spec'd for Panel	Not Tested	Not Tested	Not spec'd	6	Not Tested	Wet: 4 Dry: 4	Y	N	Y
Manhattan	140cm	4 (2000)	Not Tested	Not Tested	± 3%	6	Not Tested	Wet: 4 Dry: 4	Y	Y	N
Oceanic	140cm	4 (2000)	Not Tested	Not Tested	Not spec'd	4/5 - 5	Not Tested	Wet: 4 Dry: 4	Y	Y	Y

2.2 SYSTEM BOUNDARY

The system under study includes three life cycle stages as dictated by the PCR: upstream processes (cradle-to-gate), core processes (gate-to-gate), and downstream processes (gate-to-grave). The processes included within each life cycle stage are listed in **Table 3**. The actual processes modeled are described in detail in **Section 2.3**. The major individual unit processes that make up each life cycle stage are also shown in **Figure 2**.

Table 3. *A description of the life cycle phases included in this fabric product's system boundary.*

Life Cycle Stage	Life Cycle Module	Processes Included with Each Life Cycle Stage	Included in Scope (Y/N)
Upstream	A1) Raw Material Supply	■ Extraction and processing of raw materials (fibers that construct the fabric and chemicals used in the manufacturing are included) ■ Recycling processes of secondary materials from other product life cycles ■ Production of input components ■ Transport of raw materials and components along the upstream supply chain to a distribution point (e.g., a stockroom or warehouse) ■ Production of distribution and consumer packaging ■ Generation of electricity and production of fuels, steam, and other energy carriers used in upstream processes	Yes
Core	A2) Transport	■ Transportation of materials and components to the manufacturing of the product under study ■ Generation of electricity and production of fuels, steam and other energy carriers used in transportation	Yes
	A3) Manufacturing	■ Manufacturing of the product under study ■ building (or dismantling) of a production site, infrastructure, production, and maintenance of manufacturing equipment, if they make up a significant share of the overall attributable environmental impact ■ End-of-life treatment of manufacturing waste, even if carried out by third parties, including transportation ■ Generation of electricity and production of fuels, steam and other energy carriers used in manufacturing	Yes
Downstream	A4) Transport of fabric to retailer	*Not included within scope*	No
	A5) Further processing of the fabric	*Not included within scope*	No
	B1) Transportation of the fabric to the use phase	*Not included within scope*	No
	B2) Use of the fabric by the consumer	*Not included within scope*	No
	C1) Disassembling / sorting	■ operations for the separation of product components and subsequent sorting, and recycling processes, and ■ generation of electricity and production of fuels, steam and other energy carriers used in the disassembling/sorting	Yes
	C2) Transport to recovery/disposal	■ transportation of the discarded product accounts for part of waste processing, e.g. to a recycling site or to final sorting yard or disposal	Yes
	C3) Final disposal	■ generation of electricity and production of fuels, steam and other energy carriers used in the transportation to recovery/disposal ■ Waste disposal including physical pre-treatment and management of the disposal site. Emissions from waste disposal are considered part of the product system under study and therefore are part of this module, according to the "polluter pays principle"	Yes

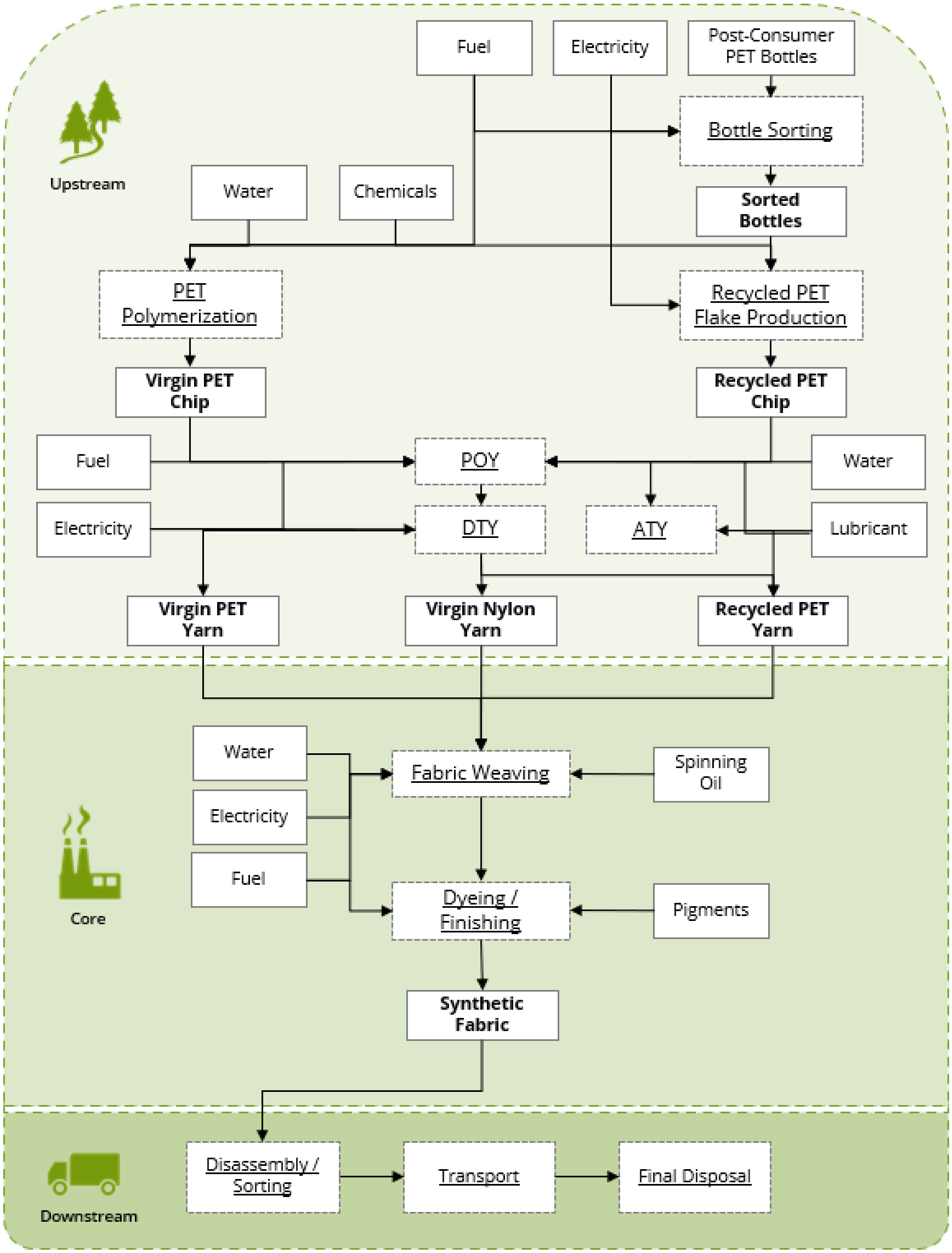

Figure 2. *Flow Diagram representing the major processes in each life stage included within the life cycle of the synthetic textile products. Underlined text in dashed line boxes represent processes, while plain text-solid line boxes represent inputs, and bold text boxes represent key outputs.*

3. Technical Information and Scenarios

3.1 Life Cycle Stages and Associated Processes

Upstream Processes

This life cycle stage includes all the inputs and outputs required to produce the virgin and post-consumer (PC) mechanically recycled polyester fibers used within each product. This stage also includes product packaging (cardboard tubes and polyethylene wraps). Producing the synthetic fiber involves the production of virgin polyester chip and recycled polyester flake, which are then processed into a partially oriented yarn (POY) and finally into a drawn textured yarn (DTY), except for the Oceanic product which is processed from POY to air textured yarn (ATY). While the production of the virgin chip and PC recycled polyester flake are different, the processing of POY and DTY is assumed to be the same.

The production of virgin polyester fiber involves first producing an amorphous polyethylene terephthalate (PET) chip by condensing monoethylene glycol and purified terephthalic acid, derived primarily from petrochemical sources [2]. The production of virgin polyester is based on secondary data from the Ecoinvent v3.8 database [3].

The 100% post-consumer recycled (PC) polyester fiber is produced from recycled PET bottles, except for Oceanic in which the SEAQUAL yarn, which comprises 50% of the product, contains both PC marine plastic waste and recycled PET bottles. The PC PET waste is first collected, sorted to remove other non-PET waste, bailed, then transported to a facility, where electricity, steam, water, and sanitizing chemicals are used to clean and shred the PET waste into flake. The quantity of inputs required, and outputs generated, to produce the flake are based on Kuczenski and Geyer (2011) [4]; it is assumed that the production of recycled flake from the marine waste used in the Oceanic fabric is identical to that of the PC PET bottles.

Next, the virgin chip and recycled flake are processed into partially oriented yarn (POY). POY refers to continuous filament polyester that has been stretched, or drawn, multiple times to meet the desired evenness, strength, shrinkage, and elongation properties, however as the name implies, POY has not been fully stretched to meet the final characteristics of the textile product for which it is destined [5]. To produce POY, the PET chip is first dried to remove any moisture, then passed through an extruder where the chip is heated to a molten state. The molten chip is pushed through a spinneret to extrude fiber. Finally, the fiber is drawn (or stretched) between different rollers as a spin finish oil is added to help lubricate the yarn, reduce static electricity, and increase the cohesion of the yarn. The inputs required to produce POY, electricity and steam, are based on van der Velden et al., (2014) [6]. The geographic region modeled for the POY electricity and natural gas processes are based on the location of the yarn suppliers and are summarized in **Table 4**.

Next, the POY is processed into DTY, except for the Oceanic fabric which is processed into ATY. DTY is fully drawn, fully oriented polyester multifilament yarn [7]. To produce DTY, the POY is heated and passed through a machine which simultaneously stretches and twists the yarn; this produces permanent distortions (such as crimps, loops, coils, and crinkles) in the yarn to increase the comfort and warmth the yarn can provide through this texturing process. The inputs required to produce DTY (electricity) are based on van der Velden et al., (2014) [6]. The geographic region modeled for the DTY electricity process is based on the location of the yarn suppliers and are summarized in **Table 4.**

The ATY, used to produce the Oceanic fabric, involves using a cold air stream to produce a linear density yarn of low extensibility [8]. The inputs required to produce ATY include electricity based on van der Velden et al., (2014) [6]. The geographic region modeled for the ATY electricity process is based on the location of the yarn suppliers and are summarized in **Table 4**.

In addition to the above processes, the Lucia CS fabric includes a flame-retardant polyester (Trevira CS®) which utilizes a phosphorus containing comonomer (propionyl methylphosphinate) [9]. This compound is added to the polyester fiber during the POY spinning process. While the exact mass of additive mixed into one kilogram of polyester is unknown, the literature suggests that flame-retardant phosphorus-based additives typically comprise 2 – 10%, by weight, of flame-retardant polyester [10]. To avoid underestimating the impacts from this additive, it is assumed to comprise 10% of the polyester yarn. Due to lack of primary or secondary data on the production of the propionyl methylphosphinate, the production of an organic chemical compound was used as a proxy from the Ecoinvent v3.8 database [3].

Parameters taken from the literature and used to model the recycled PET flake, POY, DTY, and ATY processing are summarized in **Table 5**. The cardboard tubes used as packaging contain biogenic carbon, which is shown in **Table 6**.

Table 4. *The synthetic fabric products and the type of yarn contained along with the energy grid used by the suppliers of the yarn polymer type.*

Synthetic Fabric Product	Yarn Polymer Type	Country Electricity Grid
Oceanic	Recycled PET	Spain
Era (140 & 170), Phoenix and Rivet	Recycled PET, Virgin PET	USA – SERC NERC region
Xtreme and Manhattan	Recycled PET	Thailand
Lucia CS	Virgin Flame-Retardant PET	Germany

Table 5. *Modeling parameters taken from the literature and used to model the production of PET flake, as well as the processing of POY, DTY, and ATY.*

Synthetic Yarn Process	Parameters Used (per kg fiber)	Data Source
Recycled PET Bottle flake	1.25 kg sorted PC PET bottles 0.458 kWh electricity 2.08 MJ heat from natural gas 0.05 kg sodium hydroxide 0.32 L water	Kuczenski, B. & Geyer, R. (2011) [3]
POY	0.89 kWh electricity 0.48 MJ heat from natural gas	van der Velden, Patel, & Vogtländer (2014) [5]
DTY	2.18 kWh electricity	van der Velden, Patel, & Vogtländer (2014) [5]
ATY	3.1 kWh electricity	van der Velden, Patel, & Vogtländer (2014) [5]

Table 6. *The mass of packaging material and biogenic carbon within the packaging reported per square meter of fabric.*

Biogenic Packaging Material	Mass Fabric Material (kg / m^2)	Biogenic Carbon Content (kg CO2e / m^2)
Product Packaging		
Cardboard tube*	5.92×10^{-5}	8.88×10^{-5}

*The cellulose content of 1kg of paper products are assumed to be 95% [11], which is converted to carbon using a cellulose carbon content of 43% [12, 13] and a CO_2eq using a conversion factor of 3.67

Core Processes

This life cycle stage accounts for the inputs and outputs from transporting the yarn to the various facilities involved in the weaving, and dyeing of the final fabric product, as well as the spinning and dyeing processes themselves. The spinning and weaving processes involve material losses, also referred to as scrap loss, while the piece dyeing incurs no material loss

To produce the synthetic fabrics, synthetic fibers are transported to Camira's Meltham facility where they are woven then transported to the Holmfirth Dyers facility for piece dyeing, with the exception of the Rivet fabric product which is package dyed at a different facility. Primary data was unavailable for the package dyeing of the Rivet product and secondary data from the Ecoinvent v3.8 database [3] was used instead. Primary data is used to model the weaving process at the Meltham facility and the dyeing at the Holmfirth facility. All truck transport is assumed to be done by a diesel truck compliant to Euro 4 emissions standards. **Table 7** contains the fuel and capacity utilization of the truck and ship datasets used to model all transport within the *Core* life cycle stage. Transport for disposal of all manufacturing waste is based on the EPA WARM model [14], which assumes a distance of 20 miles (~32km) from point of generation of waste to a disposal facility (e.g., landfill, recycling or incineration).

Table 7. *The fuel utilization and capacity utilization (percentage of vehicle's freight capacity occupied on the roundtrip) of transport used within the Core life cycle stage.*

Transport Specifications	Value	Unit
EURO 4, 16-32 Metric Ton Freight Lorry		
Diesel Fuel Utilization	3.67×10^{-2}	kg/tkm
Capacity Utilization	37%	%
43,000 Metric Ton Sea Container Ship		
Heavy Fuel Oil Utilization	2.52×10^{-3}	kg/tkm
Capacity Utilization	70%	%

Downstream Processes

This life cycle stage includes the inputs and outputs from dissembling and sorting the products at end-of-life (EOL) (C1 module), transporting the product to a disposal or recovery site (C2 module), and disposing of the product (C3 module). Disassembly of the fabric products is assumed to be done by hand with no tools, or not done at all, and to generate a negligible amount of environmental impact. Transport to a recovery or waste treatment facility is based on the EPA WARM model, which assumes a distance of 20 miles (~32km) from point of generation of waste to a disposal facility (e.g., landfill, recycling or incineration). Transport is assumed to be done by a diesel truck using the transport parameters shown in **Table 7**. Although only 6% of Camira's fabrics were distributed to the US in 2020, with 87% distributed within the EU, US EPA data [15] is used to determine the percentage of textiles that are landfilled, recycled, or incinerated; US EPA data was used as a proxy on textile waste disposal statistics. The disposal statistics are shown in **Table 8** below.

Table 8. *The total distance and mode of transport used to transport all Camira fabric products to an average retailer or distributor.*

Disposal Pathway	Percentage of Textile Waste
Landfilling	66%
Incineration	19%
Recycling	15%
Total	**100%**

3.2 Data Sources

Unit processes were developed within openLCA v1.11.0 software [16]. To produce LCA results for the seven textile products, confidential primary data were provided by Camira. Where primary upstream data were unavailable, secondary data were used. Secondary datasets with the greatest degree of representativeness were chosen. The principal source of secondary LCI data is Ecoinvent v3.8 database [3], specifically the Allocation, cut-off, EN15804 v2 database [17] is used. Detailed descriptions of unit processes can be found in the accompanying documentation [3].

Table 9. *The LCI datasets from the Ecoinvent v3.8 (2021) database used to model the product systems for Camira Fabrics.*

Flow	Dataset
Upstream Processes	
Virgin Polyester Fiber	market for fibre, polyester | fibre, polyester | EN15804, U – GLO
Trevira CS® flame-retardant	market for chemical, organic | chemical, organic | EN15804, U - GLO
Recycled Polyester Flake	market for waste polyethylene terephthalate, for recycling, sorted | waste polyethylene terephthalate, for recycling, sorted | EN15804, U – RoW; market for sodium hydroxide, without water, in 50% solution state | sodium hydroxide, without water, in 50% solution state | EN15804, U – GLO; heat production, natural gas, at industrial furnace >100kW | heat, district or industrial, natural gas | EN15804, U – RoW; market for electricity, medium voltage | electricity, medium voltage | EN15804, U – TH; market for electricity, medium voltage | electricity, medium voltage | EN15804, U – ES; market for electricity, medium voltage | electricity, medium voltage | EN15804, U - US-SERC
POY	market for electricity, medium voltage | electricity, medium voltage | EN15804, U - US-SERC; market for electricity, medium voltage | electricity, medium voltage | EN15804, U – NZ; market for electricity, medium voltage | electricity, medium voltage | EN15804, U – DE; market for electricity, medium voltage | electricity, medium voltage | EN15804, U – ES; market for electricity, medium voltage | electricity, medium voltage | EN15804, U – TH; heat production, natural gas, at industrial furnace >100kW | heat, district or industrial, natural gas | EN15804, U (US Production) - Europe without Switzerland
DTY	market for electricity, medium voltage | electricity, medium voltage | EN15804, U - US-SERC; market for electricity, medium voltage | electricity, medium voltage | EN15804, U – NZ; market for electricity, medium voltage | electricity, medium voltage | EN15804, U – DE; market for electricity, medium voltage | electricity, medium voltage | EN15804, U – ES; market for electricity, medium voltage | electricity, medium voltage | EN15804, U – TH
ATY	market for electricity, medium voltage | electricity, medium voltage | EN15804, U – ES
Core Processes	
Yarn Weaving	market for electricity, medium voltage | electricity, medium voltage | EN15804, U – GB; market for heat, district or industrial, natural gas | heat, district or industrial, natural gas | EN15804, U - Europe without Switzerland; lubricating oil production | lubricating oil | EN15804, U – RER; process-specific burdens, municipal waste incineration | process-specific burdens, municipal waste incineration | EN15804, U - Europe without Switzerland; treatment of bilge oil, hazardous waste incineration | bilge oil | EN15804, U - Europe without Switzerland; treatment of hazardous waste, hazardous waste incineration | hazardous waste, for incineration | EN15804, U - Europe without Switzerland
Holmfirth Pigments*	iron ore mine operation, 63% Fe | iron ore, crude ore, 63% Fe | EN15804, U - RoW
	carbon black production | carbon black | EN15804, U - GLO
Holmfirth Ancillary Chemicals	*Proprietary data*
Downstream Processes	
Truck Transport	transport, freight, lorry 16-32 metric ton, EURO4 | transport, freight, lorry 16-32 metric ton, EURO4 | EN15804, U - REI
Synthetic Fiber Landfilling	treatment of waste polyethylene terephthalate, sanitary landfill | waste polyethylene terephthalate | Cutoff, U - CH
Synthetic Fiber incineration	treatment of waste polyethylene terephthalate, municipal incineration | waste polyethylene terephthalate | Cutoff, U - CH

* All pigments were modeled with a representative pigment with half iron oxide and half carbon black

3.3 Data Quality

The data quality assessment is discussed in **Table 10** below for each of the data quality parameters. No data gaps were allowed which were expected to significantly affect the outcome of the impact indicator or LCI resource results.

Table 10. *Data quality assessment of the Camira synthetic textile fabric products.*

Data Quality Parameter	Data Quality Discussion
Time-Related Coverage: Age of data and the minimum length of time over which data is collected	The most recent available data are used, based on other considerations such as data quality and similarity to the actual operations. Typically, these data are less than 10 years old (typically 2015 or more recent). All of the data used represented an average of at least one year's worth of data collection. Manufacturer-supplied data (primary data) are based on annual production for 2020.
Geographical Coverage: Geographical area from which data for unit processes is collected to satisfy the goal of the study	The data used in the analysis provide the best possible representation available with current data. Electricity use for product manufacture is modeled using representative data for regional power mixes from the Ecoinvent LCI database. Surrogate data used in the assessment are representative of global or European operations. Data representative of global operations are considered sufficiently similar to actual processes.
Technology Coverage: Specific technology or technology mix	For the most part, data are representative of the actual technologies used for processing, transportation, and manufacturing operations.
Precision: Measure of the variability of the data values for each data expressed	Precision of results are not quantified due to a lack of data. Data collected for operations were typically averaged for one or more years and over multiple operations, which is expected to reduce the variability of results.
Completeness: Percentage of flow that is measured or estimated	The LCA model included all known mass and energy flows for production of the textile products. In some instances, surrogate data used to represent upstream and downstream operations may be missing some data which is propagated in the model. No known processes or activities contributing to more than 1% of the total environmental impact for each indicator are excluded.
Representativeness: Qualitative assessment of the degree to which the data set reflects the true population of interest	Data used in the assessment represent typical or average processes as currently reported from multiple data sources and are therefore generally representative of the range of actual processes and technologies for production of these materials. Considerable deviation may exist among actual processes on a site-specific basis; however, such a determination would require detailed data collection throughout the supply chain back to resource extraction.
Consistency: Qualitative assessment of whether the study methodology is applied uniformly to the various components of the analysis	The consistency of the assessment is considered to be high. All secondary inventory data are from the Ecoinvent v3.8 database and are of similar quality and age.
Reproducibility: Qualitative assessment of the extent to which information about the methodology and data values would allow an independent practitioner to reproduce the results reported in the study	Based on the description of data and assumptions used, this assessment would be reproducible by other practitioners. All assumptions, models, and data sources are documented.
Sources of the Data: Description of all primary and secondary data sources	Data representing quantity and type of raw materials, mode and distance of raw material transport, spinning, and piece dyeing inputs/outputs, and mode and distance of downstream transport were provided by Camira. Literature sources were used to model the production of recycled PET flake and POY, DTY, and ATY processing of synthetic fibers. Manufacturing inputs represent an annual average and are considered of high quality due to the length of time over which these data are collected (one year), as compared to a snapshot that may not accurately reflect fluctuations in production. The Ecoinvent v3.8 database is used for secondary LCI datasets.
Uncertainty of the Information: Uncertainty related to data, models, and assumptions	Uncertainty related to materials in the 9 fabric products is low. Upstream operations are modeled using background data and the study relied upon the use of existing representative datasets. These datasets contain relatively recent data (<10 years) and are generally geographically representative. Uncertainty related to the impact assessment methods used in the study are high. The impact assessment method required by the PCR includes impact potentials, which lack characterization of providing and receiving environments or tipping points. Due to lack of primary data on the production of pigments used at the Holmfirth Dyers facility, iron oxide and carbon black were used as proxies. In addition, some proxies were used to model the ancillary chemicals used at the Holmfirth Dyers facility (Table 11).

3.4 Allocation

This study follows the allocation guidelines of ISO 14044 [18] and allocation rules specified in the PCR [1] and minimized the use of allocation wherever possible.

Mass allocation was deemed the most accurate and reproducible way of calculating the energy and material requirements for the weaving and piece dyeing of the seven synthetic textile products. Primary data for resource use (e.g., electricity, natural gas, water), waste and emissions released, are allocated on a mass-basis as a fraction of total annual production.

Transportation was allocated based on the mass and distance the material transported. Allocation of waste follow the polluter pays principle and its interpretation in EN 15804 [19]: "processes of waste processing shall be assigned to the product system that generates the waste until the end-of-waste state is reached".

3.5 Cut-Off Rules

The cut-off criteria for including or excluding materials, energy, and emissions data from the study are in accordance with the PCR and are listed below.

- Data for elementary flows to and from the product system contributing to a minimum of 99% of the declared environmental impacts were included (excluding processes that are explicitly outside of the system boundary).
- All inputs and outputs to a unit process are included in the LCA calculation for which data are available. Any data gaps are filled with representative data. Assumptions used for filling data gaps are documented in the LCA report.

3.6 Summary of Assumptions

The assessment relied on several assumptions, described below.

- The production of the SEAQUAL fiber, which is comprised of recycled PET from marine plastic waste and PC PET bottles, is assumed to be identical to recycled PET from PC PET bottles
- Truck transport is assumed to be done by diesel truck compliant to Euro 4 emission standards
- All hazardous waste is assumed to be incinerated
- Disassembly of the textile products at end-of-life is assumed to have negligible impacts

3.7 Period of Review

The period of review, the time period over which primary data was collected, is January 1, 2020 through December 31, 2020.

3.8 COMPARABILITY

The PCR this EPD was based on was not written to support comparative assertions. EPDs based on different PCRs, or different calculation models, may not be comparable. When attempting to compare EPDs or life cycle impacts of products from different companies, the user should be aware of the uncertainty in the final results, due to and not limited to, the practitioner's assumptions, the source of the data used in the study, and the specifics of the product modeled.

4. LCA Results

The cradle-to-gate LCIA results are calculated using the characterization methods associated with the core environmental impact indicators of EN 15804:2012+A2:2019/AC:2021, as required by the PCR [1], and presented in **Tables 12. Table 11** shows the full impact category name, abbreviation, and units used. It should be noted that the indicators prescribed by the PCR do not represent all categories of potential environmental and human health impact associated with the life cycle of the product, and this represents a general limitation of the LCA study. Additionally, these indicators have no “environmental relevance,” as defined in the ISO-14044 §4.4.2.2.2, 4.4.2.2.4, and 4.4.5, with the exception of the “Global Warming Potential” indicator, which has low environmental relevance. That is, these “potential” results may or may not have any relationship to actual impacts occurring.

Any comparison of EPDs shall be subject to the requirements of the PCR [1]. EPDs are not comparative assertions and are either not comparable or have limited comparability when they have different system boundaries, are based on different product category rules or are missing relevant environmental impacts. Such comparison can be inaccurate and could lead to erroneous selection of materials or products which are higher impact, at least in some impact categories.

Table 11. *All LCIA indicator category names and abbreviations. All energy values are reported as net calorific.*

Indicator Category	Abbreviation	Units
Total Climate Change Potential Impact	GWP - total	kg CO_2 eq.
Fossil Fuel Climate Change Potential Impact	GWP - biogenic	kg CO_2 eq.
Biogenic Climate Change Potential Impact	GWP - fossil	kg CO_2 eq.
Land Use and Land Use Change Climate Change Impact	GWP - LULC	kg CO_2 eq.
Acidification Potential Impact	AP	mol H+ eq.
Freshwater Eutrophication Potential Impact	EP – freshwater	kg PO_4
Marine Eutrophication Potential Impact	EP – marine	kg N eq.
Terrestrial Eutrophication Potential Impact	EP – terrestrial	mol N eq.
Photochemical Ozone Formation Potential Impact	POCP	kg NMVOC eq.
Ozone Depletion Potential Impact	ODP	kg CFC-11 eq.
Abiotic Depletion Potential of Minerals and Metals	ADP – minerals & metals	kg Sb eq.
Abiotic Depletion Potential of Fossil Fuels	ADP – fossil	MJ, NCV
Water Deprivation Potential	WDP	m^3 world eq. deprived

Table 12. *The total and life cycle stage impacts (Upstream – A1, Core – A2-A3, Downstream – C1-C3) of each environmental impact category reported per square meter of each synthetic fabric product. The ADP – fossil indicator uses net calorific values.*

Fabric Product	Life Cycle Stage	GWP – total	GWP – fossil	GWP – biogenic	GWP – LULC	AP	EP – fresh water	EP – marine	EP – ter-restrial	POCP	ODP	ADP – minerals & metals	ADP – fossil	WDP
Xtreme	Total	1.77	1.76	-2.31×10^{-3}	9.89×10^{-3}	8.44×10^{-3}	9.40×10^{-4}	2.25×10^{-3}	1.56×10^{-2}	4.51×10^{-3}	1.50×10^{-7}	6.55×10^{-6}	8.34	0.464
	Upstream	0.927	0.921	3.69×10^{-3}	2.37×10^{-3}	3.01×10^{-3}	5.70×10^{-4}	6.10×10^{-4}	5.40×10^{-3}	1.61×10^{-3}	5.44×10^{-8}	1.39×10^{-6}	4.01	0.187
	Core	0.700	0.699	-6.04×10^{-3}	7.52×10^{-3}	5.39×10^{-3}	3.70×10^{-4}	1.16×10^{-3}	1.00×10^{-2}	2.83×10^{-3}	9.42×10^{-8}	5.14×10^{-6}	4.27	0.277
	Downstream	0.141	0.141	3.72×10^{-5}	1.40×10^{-6}	4.16×10^{-5}	4.05×10^{-7}	4.80×10^{-4}	2.10×10^{-4}	6.81×10^{-5}	1.11×10^{-9}	1.49×10^{-8}	5.63×10^{-2}	6.50×10^{-4}
Era140 & 170	Total	2.63	2.62	7.22×10^{-3}	3.06×10^{-3}	9.87×10^{-3}	7.42×10^{-4}	2.60×10^{-3}	1.99×10^{-2}	8.42×10^{-3}	5.19×10^{-6}	1.62×10^{-5}	16.0	0.948
	Upstream	1.98	1.97	8.50×10^{-3}	1.40×10^{-3}	7.73×10^{-3}	6.70×10^{-4}	1.62×10^{-3}	1.46×10^{-2}	6.98×10^{-3}	5.13×10^{-6}	1.36×10^{-5}	12.7	0.835
	Core	0.501	0.501	-1.32×10^{-3}	1.66×10^{-3}	2.10×10^{-3}	7.11×10^{-5}	4.80×10^{-4}	5.13×10^{-3}	1.37×10^{-3}	6.59×10^{-8}	2.58×10^{-6}	3.20	0.112
	Downstream	0.146	0.146	3.89×10^{-5}	1.39×10^{-6}	4.25×10^{-5}	3.95×10^{-7}	5.00×10^{-4}	2.20×10^{-4}	7.00×10^{-5}	1.15×10^{-9}	1.53×10^{-8}	5.76×10^{-2}	6.60×10^{-4}
Phoenix	Total	2.39	2.38	6.53×10^{-3}	2.75×10^{-3}	8.96×10^{-3}	6.74×10^{-4}	2.34×10^{-3}	1.81×10^{-2}	7.64×10^{-3}	4.72×10^{-6}	1.47×10^{-5}	14.5	0.861
	Upstream	1.80	1.79	7.72×10^{-3}	1.27×10^{-3}	7.02×10^{-3}	6.10×10^{-4}	1.47×10^{-3}	1.32×10^{-2}	6.34×10^{-3}	4.66×10^{-6}	1.24×10^{-5}	11.6	0.759
	Core	0.453	0.453	-1.22×10^{-3}	1.48×10^{-3}	1.90×10^{-3}	6.40×10^{-5}	4.30×10^{-4}	4.64×10^{-3}	1.24×10^{-3}	5.94×10^{-8}	2.31×10^{-6}	2.88	0.101
	Downstream	0.130	0.130	3.47×10^{-5}	1.23×10^{-6}	3.79×10^{-5}	3.52×10^{-7}	4.40×10^{-4}	2.00×10^{-4}	6.24×10^{-5}	1.03×10^{-9}	1.36×10^{-8}	5.13×10^{-2}	5.90×10^{-4}
Rivet	Total	1.24	1.23	3.85×10^{-3}	3.06×10^{-4}	3.62×10^{-3}	4.14×10^{-4}	1.20×10^{-3}	7.73×10^{-3}	2.23×10^{-3}	1.10×10^{-7}	1.97×10^{-6}	9.46	0.225
	Upstream	0.749	0.747	2.33×10^{-3}	8.51×10^{-5}	2.09×10^{-3}	3.80×10^{-4}	3.90×10^{-4}	3.46×10^{-3}	1.05×10^{-3}	6.39×10^{-8}	1.31×10^{-6}	7.58	0.144
	Core	0.359	0.358	1.49×10^{-3}	2.20×10^{-4}	1.49×10^{-3}	3.33×10^{-5}	3.70×10^{-4}	4.08×10^{-3}	1.12×10^{-3}	4.52×10^{-8}	6.41×10^{-7}	1.84	8.11×10^{-2}
	Downstream	0.128	0.128	3.40×10^{-5}	1.21×10^{-6}	3.72×10^{-5}	3.46×10^{-7}	4.40×10^{-4}	1.90×10^{-4}	6.13×10^{-5}	1.01×10^{-9}	1.33×10^{-8}	5.04×10^{-2}	5.80×10^{-4}
Lucia CS	Total	2.50	2.45	4.88×10^{-2}	3.33×10^{-3}	8.50×10^{-3}	1.16×10^{-3}	2.48×10^{-3}	1.80×10^{-2}	7.58×10^{-3}	4.65×10^{-6}	1.52×10^{-5}	14.9	0.923
	Upstream	1.89	1.83	4.98×10^{-2}	1.93×10^{-3}	6.89×10^{-3}	1.10×10^{-3}	1.60×10^{-3}	1.38×10^{-2}	6.42×10^{-3}	4.58×10^{-6}	1.29×10^{-5}	12.0	0.824
	Core	0.465	0.465	-1.11×10^{-3}	1.40×10^{-3}	1.57×10^{-3}	6.32×10^{-5}	3.80×10^{-4}	4.00×10^{-3}	1.09×10^{-3}	6.46×10^{-8}	2.32×10^{-6}	2.80	9.83×10^{-2}
	Downstream	0.146	0.146	3.90×10^{-5}	1.39×10^{-6}	4.27×10^{-5}	3.96×10^{-7}	5.00×10^{-4}	2.20×10^{-4}	7.03×10^{-5}	1.16×10^{-9}	1.53×10^{-8}	5.78×10^{-2}	6.60×10^{-4}
Manhattan	Total	1.56	1.55	2.44×10^{-3}	3.88×10^{-3}	6.07×10^{-3}	6.37×10^{-4}	1.78×10^{-3}	1.33×10^{-2}	3.70×10^{-3}	1.23×10^{-7}	3.80×10^{-6}	7.05	0.291
	Upstream	0.918	0.912	3.65×10^{-3}	2.35×10^{-3}	2.99×10^{-3}	5.70×10^{-4}	6.10×10^{-4}	5.35×10^{-3}	1.59×10^{-3}	5.39×10^{-8}	1.38×10^{-6}	3.98	0.185
	Core	0.505	0.505	-1.25×10^{-3}	1.53×10^{-3}	3.04×10^{-3}	6.71×10^{-5}	7.20×10^{-4}	7.75×10^{-3}	2.05×10^{-3}	6.83×10^{-8}	2.41×10^{-6}	3.02	0.105
	Downstream	0.132	0.132	3.53×10^{-5}	1.26×10^{-6}	3.85×10^{-5}	3.58×10^{-7}	4.50×10^{-4}	2.00×10^{-4}	6.35×10^{-5}	1.05×10^{-9}	1.38×10^{-8}	5.22×10^{-2}	6.00×10^{-4}

Fabric Product	Life Cycle Stage	GWP – total	GWP – fossil	GWP – biogenic	GWP – LULC	AP	EP – fresh water	EP – marine	EP – ter-restrial	POCP	ODP	ADP – minerals & metals	ADP – fossil	WDP
Oceanic	Total	2.51	2.50	$2.92x10^{-3}$	$1.12x10^{-2}$	$1.30x10^{-2}$	$5.50x10^{-4}$	$2.99x10^{-3}$	$2.57x10^{-2}$	$7.03x10^{-3}$	$2.71x10^{-7}$	$8.46x10^{-6}$	25.6	0.622
	Upstream	1.24	1.23	$4.91x10^{-3}$	$8.46x10^{-3}$	$9.34x10^{-3}$	$4.10x10^{-4}$	$1.51x10^{-3}$	$1.56x10^{-2}$	$4.22x10^{-3}$	$1.13x10^{-7}$	$3.62x10^{-6}$	19.2	0.416
	Core	1.11	1.10	$-2.03x10^{-3}$	$2.73x10^{-3}$	$3.63x10^{-3}$	$1.40x10^{-4}$	$9.20x10^{-4}$	$9.86x10^{-3}$	$2.73x10^{-3}$	$1.57x10^{-7}$	$4.82x10^{-6}$	6.26	0.206
	Downstream	0.163	0.163	$4.34x10^{-5}$	$1.55x10^{-6}$	$4.75x10^{-5}$	$4.41x10^{-7}$	$5.60x10^{-4}$	$2.50x10^{-4}$	$7.81x10^{-5}$	$1.29x10^{-9}$	$1.70x10^{-8}$	$6.43x10^{-2}$	$7.40x10^{-4}$

5. LCI Results

The life cycle inventory (LCI) primary and secondary resource waste, and outflow indicators, calculated using the characterization methods associated with EN 15804:2012+A2:2019/AC:2021, as specified by the PCR, are shown in **Tables 14** and **15** below. The PCR [1] and EN 15804+A2 requires all energy indicators to be reported in NCV. Per Version 2.0 of the default list of indicators, the six indicators for primary energy resources are mandatory for non-construction products (in this case, fabrics), and the other four indicators are optional. **Table 13** contains the full indicator name, abbreviation, and units used.

Table 13. *The full name, abbreviation, and unit of additional LCI indicators required by the PCR. All energy units are reported as net calorific values (NCV).*

Indicator Category	Abbreviation	Units
Primary and Secondary Resource use		
Use of renewable primary energy resources used as an energy carrier (PERE)	PERE	MJ, NCV
Use of renewable primary energy resources with energy content used as raw materials	PERM	MJ, NCV
Total use of renewable primary energy resources	PERT	MJ, NCV
Use of non-renewable primary energy resources used an energy carrier	PENRE	MJ, NCV
Use of non-renewable primary energy resources with energy content used as a material	PENRM	MJ, NCV
Total use of non-renewable primary energy resources	PENRT	MJ, NCV
Use of secondary material	SM	kg
Use of renewable secondary fuels	RSF	MJ, NCV
Use of non-renewable secondary fuels	NRSF	MJ, NCV
Use of net fresh water	FW	m^3
Waste		
Non-hazardous waste disposed	NHWD	kg
Hazardous waste disposed	HWD	kg
Radioactive waste disposed	RW	kg
Outflows		
Materials for recycling	MFR	kg
Materials for energy recovery	MER	MJ, NCV

Table 14. Primary and Secondary Resource Use Indicator Results. *The total and life cycle stage (Upstream – A1, Core – A2-A3, Downstream – C1-C3) resource use results for one square meter of each synthetic fabric product. All values are rounded to three significant digits. Results representing energy flows are calculated using lower heating (i.e., net calorific) values.*

Fabric Product	Life Cycle Stage	PERE (MJ, NCV)	PERM (MJ, NCV)	PERT (MJ, NCV)	PENRE (MJ, NCV)	PENRM (MJ, NCV)	PENRT (MJ, NCV)	SM (kg)	RSF (MJ, NCV)	NRSF (MJ, NCV)	FW (m^3)
Xtreme	Total	1.11	0.750	1.86	11.5	17.8	29.3	0.422	4.90×10^{-3}	1.37×10^{-2}	1.15×10^{-2}
	Upstream	0.419	3.03×10^{-2}	0.449	6.21	8.05	14.3	0.406	6.60×10^{-4}	1.41×10^{-3}	4.48×10^{-3}
	Core	0.688	0.720	1.41	5.21	9.69	14.9	1.56×10^{-2}	4.24×10^{-3}	1.23×10^{-2}	6.98×10^{-3}
	Downstream	2.97×10^{-3}	8.41×10^{-5}	3.06×10^{-3}	5.88×10^{-2}	2.26×10^{-2}	8.14×10^{-2}	1.78×10^{-5}	2.53×10^{-6}	4.57×10^{-6}	3.03×10^{-6}
Era 140 & 170	Total	1.56	1.17	2.73	20.5	35.0	55.5	6.29×10^{-2}	2.15×10^{-2}	4.35×10^{-2}	3.20×10^{-2}
	Upstream	1.01	0.630	1.64	16.8	27.2	44.0	5.58×10^{-2}	1.93×10^{-2}	3.50×10^{-2}	2.91×10^{-2}
	Core	0.550	0.544	1.09	3.65	7.78	11.4	7.09×10^{-3}	2.18×10^{-3}	8.44×10^{-3}	2.91×10^{-3}
	Downstream	3.13×10^{-3}	8.95×10^{-5}	3.22×10^{-3}	5.98×10^{-2}	2.34×10^{-2}	8.32×10^{-2}	2.60×10^{-5}	7.74×10^{-6}	3.14×10^{-5}	3.03×10^{-6}
Phoenix	Total	1.41	1.06	2.48	18.6	31.8	50.4	5.71×10^{-2}	1.95×10^{-2}	3.94×10^{-2}	2.91×10^{-2}
	Upstream	0.914	0.572	1.49	15.3	24.7	40.0	5.07×10^{-2}	1.75×10^{-2}	3.18×10^{-2}	2.65×10^{-2}
	Core	0.496	0.491	0.987	3.29	7.03	10.3	6.42×10^{-3}	1.98×10^{-3}	7.62×10^{-3}	2.62×10^{-3}
	Downstream	2.79×10^{-3}	7.97×10^{-5}	2.87×10^{-3}	5.33×10^{-2}	2.08×10^{-2}	7.41×10^{-2}	2.31×10^{-5}	6.89×10^{-6}	2.79×10^{-5}	3.03×10^{-6}
Rivet	Total	0.539	0.700	1.24	11.6	11.8	23.4	0.448	1.09×10^{-2}	7.58×10^{-3}	6.83×10^{-3}
	Upstream	0.220	0.433	0.653	9.47	6.15	15.6	0.444	9.45×10^{-3}	2.31×10^{-3}	3.60×10^{-3}
	Core	0.317	0.266	0.583	2.08	5.63	7.72	4.25×10^{-3}	1.49×10^{-3}	5.24×10^{-3}	3.23×10^{-3}
	Downstream	2.74×10^{-3}	7.83×10^{-5}	2.82×10^{-3}	5.23×10^{-2}	2.05×10^{-2}	7.28×10^{-2}	2.27×10^{-5}	6.77×10^{-6}	2.75×10^{-5}	3.03×10^{-6}
Lucia CS	Total	2.21	0.864	3.07	19.9	30.6	50.5	0.405	0.224	5.06×10^{-2}	3.05×10^{-2}
	Upstream	1.72	0.393	2.11	16.7	23.3	40.0	0.398	0.221	4.25×10^{-2}	2.80×10^{-2}
	Core	0.482	0.471	0.953	3.20	7.21	10.4	6.65×10^{-3}	2.07×10^{-3}	8.09×10^{-3}	2.54×10^{-3}
	Downstream	3.14×10^{-3}	8.97×10^{-5}	3.23×10^{-3}	6.00×10^{-2}	2.35×10^{-2}	8.35×10^{-2}	2.60×10^{-5}	7.76×10^{-6}	3.15×10^{-5}	3.03×10^{-6}
Manhattan	Total	0.936	0.541	1.48	9.65	15.7	25.4	0.410	2.74×10^{-3}	9.39×10^{-3}	7.16×10^{-3}
	Upstream	0.415	3.00×10^{-2}	0.445	6.15	7.98	14.1	0.403	6.50×10^{-4}	1.40×10^{-3}	4.44×10^{-3}
	Core	0.518	0.511	1.03	3.45	7.74	11.2	6.93×10^{-3}	2.08×10^{-3}	7.96×10^{-3}	2.72×10^{-3}
	Downstream	2.84×10^{-3}	8.11×10^{-5}	2.92×10^{-3}	5.42×10^{-2}	2.12×10^{-2}	7.54×10^{-2}	2.35×10^{-5}	7.01×10^{-6}	2.84×10^{-5}	3.03×10^{-6}
Oceanic	Total	6.22	1.51	7.73	29.9	26.1	56.0	0.990	2.69×10^{-2}	0.205	1.71×10^{-2}
	Upstream	5.14	0.481	5.62	22.7	8.90	31.6	0.975	2.20×10^{-2}	0.186	1.18×10^{-2}
	Core	1.08	1.03	2.11	7.13	17.2	24.3	1.53×10^{-2}	4.86×10^{-3}	1.90×10^{-2}	5.33×10^{-3}
	Downstream	3.49×10^{-3}	9.98×10^{-5}	3.59×10^{-3}	6.67×10^{-2}	2.61×10^{-2}	9.28×10^{-2}	2.90×10^{-5}	8.63×10^{-6}	3.50×10^{-5}	3.03×10^{-6}

Table 15. Waste and Outflow Indicator Results. *The total and life cycle stage (Upstream – A1, Core – A2-A3, Downstream – C1-C3) waste and outflow results for one square meter of each synthetic fabric product. All values are rounded to three significant digits. Results representing energy flows are calculated using lower heating (i.e., net calorific) values.*

Fabric Product	Life Cycle Stage	NHWD (kg)	HWD (kg)	RW (kg)	MFR (kg)	MER (MJ, NCV)
Xtreme	Total	0.171	3.61	1.62×10^{-3}	1.37×10^{-2}	1.83×10^{-3}
	Upstream	0.112	2.81	4.91×10^{-5}	1.80×10^{-3}	5.40×10^{-4}
	Core	5.71×10^{-2}	0.797	1.57×10^{-3}	1.19×10^{-2}	1.28×10^{-3}
	Downstream	1.27×10^{-3}	6.70×10^{-4}	3.63×10^{-7}	1.29×10^{-5}	7.04×10^{-6}
Era 140 & 170	Total	0.173	3.60	4.42×10^{-3}	4.22×10^{-2}	3.45×10^{-3}
	Upstream	0.126	3.29	2.96×10^{-3}	3.69×10^{-2}	2.70×10^{-3}
	Core	4.53×10^{-2}	0.304	1.46×10^{-3}	5.19×10^{-3}	7.40×10^{-4}
	Downstream	1.31×10^{-3}	5.70×10^{-4}	5.12×10^{-7}	2.16×10^{-5}	5.94×10^{-6}
Phoenix	Total	0.157	3.27	4.00×10^{-3}	3.83×10^{-2}	3.13×10^{-3}
	Upstream	0.115	2.99	2.69×10^{-3}	3.36×10^{-2}	2.45×10^{-3}
	Core	4.08×10^{-2}	0.274	1.31×10^{-3}	4.70×10^{-3}	6.70×10^{-4}
	Downstream	1.17×10^{-3}	5.10×10^{-4}	4.56×10^{-7}	1.92×10^{-5}	5.29×10^{-6}
Rivet	Total	0.116	2.04	3.41×10^{-3}	1.95×10^{-2}	1.15×10^{-3}
	Upstream	8.33×10^{-2}	1.88	2.55×10^{-3}	1.63×10^{-2}	6.00×10^{-4}
	Core	3.14×10^{-2}	0.161	8.60×10^{-4}	3.17×10^{-3}	5.40×10^{-4}
	Downstream	1.15×10^{-3}	5.00×10^{-4}	4.48×10^{-7}	1.89×10^{-5}	5.20×10^{-6}
Lucia CS	Total	0.202	5.61	3.20×10^{-3}	0.374	3.41×10^{-3}
	Upstream	0.128	5.33	1.92×10^{-3}	0.369	2.68×10^{-3}
	Core	7.28×10^{-2}	0.273	1.28×10^{-3}	4.92×10^{-3}	7.20×10^{-4}
	Downstream	1.32×10^{-3}	5.70×10^{-4}	5.13×10^{-7}	2.16×10^{-5}	5.96×10^{-6}
Manhattan	Total	0.155	3.07	1.43×10^{-3}	6.92×10^{-3}	1.40×10^{-3}
	Upstream	0.111	2.78	4.86×10^{-5}	1.78×10^{-3}	5.30×10^{-4}
	Core	4.22×10^{-2}	0.289	1.38×10^{-3}	5.12×10^{-3}	8.60×10^{-4}
	Downstream	1.19×10^{-3}	5.20×10^{-4}	4.64×10^{-7}	1.96×10^{-5}	5.38×10^{-6}
Oceanic	Total	0.406	2.68	1.08×10^{-2}	5.01×10^{-2}	3.96×10^{-3}
	Upstream	0.200	2.08	7.88×10^{-3}	3.87×10^{-2}	2.15×10^{-3}
	Core	0.205	0.599	2.88×10^{-3}	1.14×10^{-2}	1.80×10^{-3}
	Downstream	1.46×10^{-3}	6.30×10^{-4}	5.71×10^{-7}	2.41×10^{-5}	6.63×10^{-6}

6. Additional Environmental Information

The Lucia CS, Manhattan, Oceanic, Rivet, and Xtreme products were certified to the European Union Ecolabel, which certifies products with a guaranteed, independently verified low environmental impact. Additional information on the EU Ecolabel can be found here: https://environment.ec.europa.eu/topics/circular-economy/eu-ecolabel-home_en

7. References

1. EPD International (2022). Fabrics. PCR 2022:04, v1.0.1
2. UNFCCC, 2021. Phase I: Identifying Low Carbon Sources of Cotton and Polyester Fibers. Fashion Industry Charter for Climate Action. https://unfccc.int/documents/273670
3. Wernet, G., Bauer, C., Steubing, B., Reinhard, J., Moreno-Ruiz, E., and Weidema, B., 2016. The ecoinvent database version 3 (part I): overview and methodology. The International Journal of Life Cycle Assessment, [online] 21(9), pp.1218–1230. Available at: http://link.springer.com/10.1007/s11367-016-1087-8
4. Kuczenski, B. & Geyer, R. (2011). Life Cycle Assessment of Polyethylene Terephthalate (PET) Beverage Bottles Consumed in the State of California. CalRecycle. https://www2.calrecycle.ca.gov/Publications/Details/1487
5. Service Thread, N.D. POY and FOY in Continuous Filament Polyester Sewing Thread. https://www.servicethread.com/blog/most-common-corms-of-polyestersHon, D. 1996. Chemical Modification of Lignocellulosic Materials. ISBN 0-8247-9472-
6. van der Velden, N. M., Patel, M. K., & Vogtländer, J. G. (2014). LCA benchmarking study on textiles made of cotton, polyester, nylon, acryl, or elastane. *The International Journal of Life Cycle Assessment*, *19*(2), 331-356.
7. IndoRama, 2017. Draw Texturised Yarn. https://www.indoramaindia.com/draw_texturised_yarn.php
8. Filatex, (2020). Air Textured Yarn (ATY). https://www.filatex.com/products/air-textured-yarn-aty
9. Salmeia, K. A., Gaan, S., & Malucelli, G. (2016). Recent advances for flame retardancy of textiles based on phosphorus chemistry. *Polymers*, *8*(9), 319.
10. Total Connection, N.D. Flame Retardants, Polymer Additives, and How to Ship Them. https://totalconnection.com/flame-retardants-polymer-additives-and-how-to-ship-them/
11. Sahin and Arslan, 2008. A Study on Physical and Chemical Properties of Cellulose Paper Immersed in Various Solvent Mixtures. Int J Mol Sci; 9(1): 78-88. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2635603/#:~:text=A%20paper%20based%20product%20typically,component%20influencing%20end%20use%20properties.
12. Hon, D. 1996. Chemical Modification of Lignocellulosic Materials. ISBN 0-8247-9472-
13. Cagnon et al., 2009. Contributions of hemicellulose, cellulose and lignin to the mass and the porous properties of chars and steam activated carbons from various lignocellulosic precursors. https://pubmed.ncbi.nlm.nih.gov/18650083/
14. US EPA, 2004. "WARM Model Transportation Research - Draft." Memorandum from ICF Consulting to United States Environmental Protection Agency.http://epa.gov/epawaste/conserve/tools/warm/SWMGHGreport.html#background
15. US EPA (2022). Facts and Figures about Materials, Waste and Recycling. Textiles: Material-Specific Data. https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/textiles-material-specific-data#TextilesTableandGraph
16. openLCA (2022). https://www.openlca.org/download/
17. Green Delta (2022). openLCA Nexus. EN 15804. https://nexus.openlca.org/database/EN15804%20add-on
18. ISO-14044:2006/Amd1:2017/Amd2:2020 Environmental management – Life Cycle Assessment – Requirements and guidelines
19. CEN, 2019. EN 15804:2012+A2:2019 Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products
20. EPD International (2022). Environmental Performance Indicators. https://www.environdec.com/indicators
21. SCS (2024). Life Cycle Assessment of Seventeen Textile Fabric Products. Camira Fabrics Ltd.
22. SCS Type III Environmental Declaration Program: Program Operator Manual. V11.0 November 2021. SCS Global Services
23. ISO 14040: 2006/Amd1: 2020 Environmental Management – Life cycle assessment – Principles and Framework
24. ISO 14025:2006. Environmental labels and declarations — Type III environmental declarations — Principles and procedures

For more information, contact:

Camira Fabrics Ltd
The Watermill Wheatley Park, Mirfield WF14 8HE
United Kingdom
+44 333-032-4568
https://www.camirafabrics.com

SCS Global Services
2000 Powell Street, Ste. 600, Emeryville, CA 94608 USA
Main +1.510.452.8000 | fax +1.510.452.8001