Declaration Owner

Camira Fabrics Ltd
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Products

Blazer, Synergy 140 & 170, Blazer Lite, Main Line Flax, Main Line Plus, Aquarius, Sumi, and Hemp

Declared Unit

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

EPD Number and Period of Validity

SCS-EPD-08783
EPD Valid March 21, 2023 through March 20, 2028

Product Category Rule

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

Program Operator

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Declaration Validity Period:	EPD Valid March 21, 2023 through March 20, 2028
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:	For intermediate products with many different potential uses and functions
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
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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 natural textile products are shown in **Figure 1** below.

1.2 Product Descriptions

Natural Textile Fabric Products

Blazer: Blazer is a classic pure new wool upholstery fabric with a billiard cloth felted finish. It is made from premium New Zealand lambswool, where responsible farming provides the highest quality raw material which is soft, clean and bright, which is ideal for spinning, weaving and dyeing. The color palette is an exciting mix of solids and mélanges across the full color spectrum, creating a versatile fabric suitable for wide-ranging furniture applications.

Synergy 140 & 170: Epitomizing natural simplicity, Synergy is a wool rich fabric which is at once both irresistibly soft and ultra-high performing. Delicately felted, with a beautifully relaxed drape, the understated aesthetics showcase the intriguing coloration of this considered textile. Featuring exquisite fiber dyed shades and sumptuous piece dyed solids within its palette of 75 colorways, there truly is a tone for every scheme.

Blazer Lite: Blazer Lite is a finer version of our Blazer upholstery fabric making it lighter in weight for use on desk screens, panels and other vertical surfaces. The felted, milled finish sports a color palette consisting of mélange mixes and plain shades, as well as subtle pastels and iridescent brights.

Main Line Flax: Main Line Flax is the natural progression of our all-time favorite Main Line Plus fabric, building on our industry leading bast fiber expertise to create a new inherently flame-retardant fabric from sustainable sources. A symbol of purity, wild flax has been used in textiles for thousands of years thanks to its strong, long and smooth fibers found inside the stem of the plant. The fiber is spun into a 75/25 wool flax blend, then fiber dyed to create beautiful mixture yarns which are woven into interesting solids and cross-colors inspired by the rich tones of rare jewels.

Main Line Plus: One of the most popular seating fabrics in the Camira collection which has sold over 30 million meters since launch. Available in an extensive color palette, this versatile plain weave fabric gives a smart appearance to most seating styles.

Aquarius: Aquarius is a tried and tested, versatile crêpe weave fabric that is suitable for task chairs and soft seating. It's made from 100% natural wool, which is not only rapidly renewable but also fully biodegradable. The color palette offers a great balance of subdued organic shades and confident brights.

Sumi: Understated in its elegance and refined in its coloration, Sumi is a fabric which exudes serenity and style. Woven from worsted wool using fine marl yarns, this natural textile embraces a purity of composition and an impeccably simple aesthetic which makes it both without age, yet achingly current. Evoking the ancient Japanese painting technique from which it takes its name, Sumi's perfectly considered palette of organic, refined hues are made to bring timeless beauty to commercial and residential interiors.

Hemp: Expertly woven from a blend of wool and hemp, Hemp is a fabric of natural beauty. With a soft handle and inherent flame retardancy, this sustainable textile has a classic plain weave that perfectly showcases its natural composition and multi-tonal coloration.

Craggan Flax: Warmly welcoming, Craggan Flax is a textile to make any interior feel like home. Deeply textured and thickly woven, it effortlessly blends comfort with style to bring irresistible tactility and visual detail to both task and soft seating. Crafted from a blend of wool and flax, this sustainable fabric retains the raw appeal of its natural composition, whilst possessing the contemporary aesthetic of a chunky weave to provide an element of stylized texture.

Yoredale: Taking its name from the ancient title of Wensleydale in the UK, Yoredale is a fabric steeped in heritage. A highly textured textile with undulations reflective of its Yorkshire roots, its fascinating bouclé style yarn includes a contrasting black binder, creating subtle details within the weave that brings added depth to its saturated tones. Woven from British wool, Yoredale is truly timeless, blending its rich history with a contemporary appeal.

Figure 1. *Example images of Camira's natural fabric products. Shown here, from top left clockwise, are the Aquarius, Blazer Lite, and Main Line Plus 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 ten natural 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 natural textile products consist of either 100% wool or a blend of wool with flax, hemp, viscose, and virgin polyamide. **Table 1** also shows the locations of the Camira facilities that spin, weave, and then dye the textile products.

Table 1. *Each product's material composition, area density, and the location of involved Camira facilities.*

Textile Product	UN CPC Classification Code	Composition (%)	Area Density (g/m2)	Camira Facility Locations
Blazer	Group 265 Class 2652	100% Wool	460	Huddersfield, UK Meltham Mills, UK Holmfirth Dyers, UK
Synergy (140 & 170)	Group 265 Class 2652	95% Wool, 5% Polyamide	400	Huddersfield, UK Meltham Mills, UK Holmfirth Dyers, UK
Blazer Lite	Group 265 Class 2652	100% Wool	364	Huddersfield, UK Meltham Mills, UK Holmfirth Dyers, UK
Main Line Flax	Group 265 Class 2654	75% Wool, 25% Flax	437	Huddersfield, UK Meltham Mills, UK
Main Line Plus	Group 265 Class 2654	67% Wool, 20% FR Viscose, 13% Viscose	425	Huddersfield, UK Meltham Mills, UK
Aquarius	Group 265 Class 2653	100% Wool	370	Meltham Mills, UK Holmfirth Dyers, UK
Sumi	Group 265 Class 2653	95% Wool, 5% Polyamide	340	Meltham Mills, UK
Hemp	Group 265 Class 2654	60% Wool, 40% True Hemp	460	Huddersfield, UK Meltham Mills, UK Holmfirth Dyers, UK
Craggan Flax	Group 265 Class 2652	85% Wool, 10% Flax, 5% Polyamide	630	Meltham Mills, UK
Yoredale	Group 265 Class 2653	95% Wool, 3% Polyester, 2% Polyamide	631	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**			
Blazer	140cm	3 (2,000)	Not Tested	Not Tested	Not Washable	5	Not Tested	Wet: 4 Dry: 4	Y	N	N
Synergy (140 & 170)	140cm or 170cm	3 (2000)	Not Tested	Not Tested	Not Washable	5	Not Tested	Wet: 4 Dry: 4	Y	Y	N
Blazer Lite	170cm	Not Spec'd for Panel	Not Tested	Not Tested	Not Washable	5	Not Tested	Wet: 4 Dry: 4	Y	N	N
Main Line Flax	140cm	4 (2000)	Not Tested	Not Tested	Not Washable	5	Not Tested	Wet: 3 Dry: 4	Y	Y	N
Main Line Plus	130cm	4 (2000)	Not Tested	Not Tested	Not Washable	5	Not Tested	Wet: 3/4 Dry: 4	N	N	N
Aquarius	140cm	4 (2000)	Not Tested	Not Tested	Not Washable	5	Not Tested	Wet: 4 Dry: 4	Y	N	N
Sumi	138cm	4 (2000)	Not Tested	Not Tested	Not Washable	4-6	Not Tested	Wet: 4 Dry: 4	Y	Y	N
Hemp	140cm	4 (2000)	Not Tested	Not Tested	Not Washable	5	Not Tested	Wet: 3 Dry: 4	Y	Y	N
Craggan Flax	140cm	3 (2000)	Not Tested	Not Tested	Not Washable	5	Not Tested	Wet: 3/4 Dry: 4	Y	N	N
Yoredale	138cm	3/4 (2000)	Not Tested	Not Tested	Not Washable	5	Not Tested	Wet: 4 Dry: 4	Y	N	N

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 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

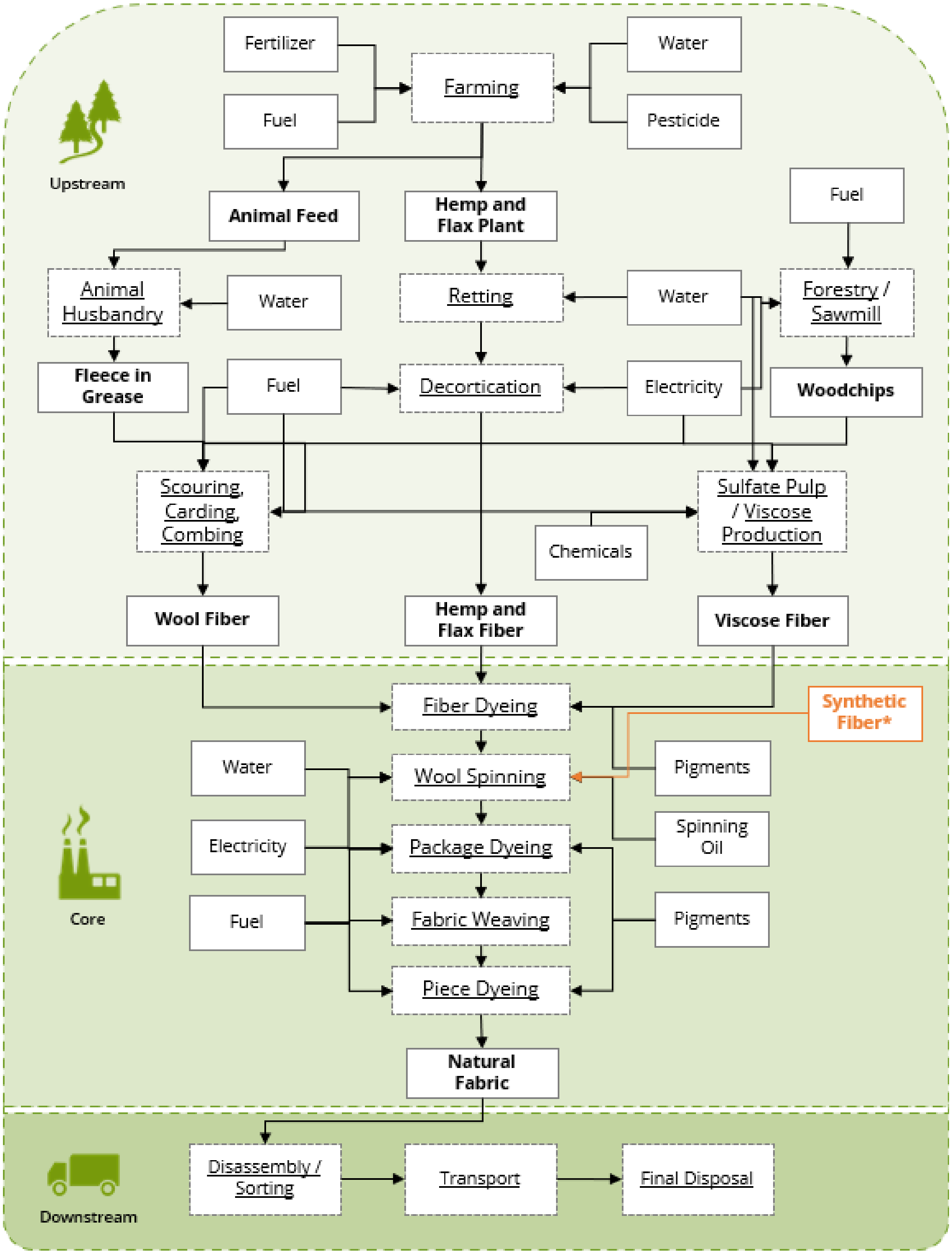

Figure 2. *Flow Diagram representing the major processes in each life stage included within the life cycle of the natural textile products. Underlined text in dashed line boxes represent processes, while plain text-solid line boxes represent inputs, and bold text boxes represent key outputs. A portion of the fabrics include synthetic fibers, which is shown in orange.*

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 natural fibers used within each product (viscose, flax, hemp, and wool), as well as the addition of a small amount of polyamide in a few of the natural textile products. This stage also includes product packaging (cardboard tubes and polyethylene plastic wrap).

For the viscose, flax, and hemp fibers this includes any fertilizers and pesticides, land, water, as well as the electricity and fuel to operate farm equipment, transport intermediate upstream products, and perform any processing required to produce the natural fibers. For instance, after hemp and flax are farmed they are retted—the process of allowing water and bacteria to breakdown plant materials and makes separating the usable bast fibers from the inner core of the plant easier—and then decorticated, the process of separating the bast fibers from the inner core. The production of the viscose fiber involves the harvesting of wood, which is converted to sulphate pulp, and finally to a spinnable fiber using carbon disulfide. In addition, the Main Line Plus product contains Visil, a flame-retardant viscose fiber. Based on an SDS supplied by Camira Fabrics, the material composition of Visil is 70% cellulose and 30% silicon dioxide.

The production of wool fiber requires raising sheep—including the inputs required to produce the animal feed—to produce greasy wool which then requires scouring, carding, and combing. A conversion rate of 1.087 kg greasy wool to 1 kg clean wool is used and is based on Wiedemann et al. (2020) [2]. The quantity of electricity and heat used to clean the greasy wool is based on Barber and Pellow (2006) [3].

The secondary data used to model the hemp upstream processes are based on the 2016 ADEME [4] study selected by the Agribalyse database v3.0 (June 2020) and is based on the operations of the hemp cooperative "La Chanvrière" (formerly La Chanvrière De l'Aube) located in the Champagne area in France. The secondary data used to model the flax, viscose, Visil (flame-retardant viscose), and wool fiber production come from the Ecoinvent v3.8 database [5].

The production of the polyamide fibers are modeled as 50% nylon 6 and 50% nylon 6.6, which is based on the global market share of nylon 6 and nylon 6.6 within the Ecoinvent v3.8 database. Nylon is produced via condensation polymerization utilizing carbon-based chemicals found in coal and petroleum in a high-pressure, heated environment.

The cardboard tube used as packaging contains biogenic carbon (**Table 4**).

Table 4. *The mass of packaging material that contains biogenic carbon, and the biogenic carbon within this 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% [6], which is converted to carbon using a cellulose carbon content of 43% [7, 8] 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 spinning, weaving, and dyeing of the final fabric product, as well as the spinning, weaving, and dyeing processes themselves.

As shown in **Table 5**, to produce the various natural fabrics a combination of dyeing, spinning, and weaving occurs. Three different types of dyeing occur, albeit not for all natural fabric products: fiber dyeing, package dyeing, and piece dyeing. As Camira Fabrics does not own or manage any of the facilities involved in the fiber or package dyeing processes, primary data was not available for any of the dyeing processes. Instead, secondary datasets from the Ecoinvent v3.8 database were used. Primary data for the piece dyeing of certain natural fabrics (**Table 5**) was provided by Camira Fabrics for their Holmfirth Dyeing facility, which is located in the United Kingdom. The quantity of inputs required, and outputs generated from the Holmfirth Dyeing facility are shown in **Table 6**.

Five different wool spinning facilities were involved within the natural fabric supply chain, however primary data was only available for the Camira Yarn facility. It is assumed that the four other wool spinning facilities require the same inputs (electricity, heat from natural gas, and spinning oil) and generate the same outputs (municipal waste and a small amount of hazardous waste) as the Camira Yarn facility. As the Camira Yarn facility is located in Great Britain, the Ecoinvent v3.8 dataset for electricity produced in Great Britain is used.

Primary data from the Camira owned Meltham weaving facility was used to model the weaving of the yarns into the final fabric, which requires electricity, heat from natural gas, and water, and generates non-hazardous waste and a small amount of hazardous waste. As the Meltham facility is located in Great Britain, the Ecoinvent v3.8 dataset for electricity produced in Great Britain is used. All fabric products are packaged with cardboard tubes and polyethylene wrap. The fabric products which contain hemp, flax, and viscose all contain biogenic carbon. The biogenic carbon content of these materials is shown in **Table 6**.

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 [9], 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 5. *The fiber type and supplier location, whether the product is fiber dyed, spun, package dyed, woven, and/or piece dyed. Note that a value of "X" indicates that the product underwent that process, while a value of "-" indicates that the textile product in question did not undergo that particular process.*

Textile Product	Fiber Type & Supplier Location	Fiber Dyed	Spun	Package Dyed	Woven	Piece Dyed
Aquarius	100% Wool – New Zealand	X	X	-	X	X
Blazer & Blazer Lite	100% Wool – New Zealand	X	X	-	X	X
Synergy 140 & Synergy 170	95% Wool – New Zealand 5% Polyamide – Bulgaria	X	X	X	X	X
Sumi	95% Wool – New Zealand 5% Polyamide – Bulgaria	X	X	-	X	-
Yoredale	95% Wool – United Kingdom 3% Polyester – United Kingdom 2% Polyamide – Bulgaria	-	X	-	X	X
Craggan Flax	85% Wool – New Zealand 10% Flax - Germany 5% Polyamide – Bulgaria / United Kingdom	-	X	X	X	-
Main Line Flax	75% Wool – New Zealand 25% Flax – Belgium	X	X	-	X	-
Main Line Plus	67% Wool – New Zealand 20% Visil – United Kingdom 13% Viscose – United Kingdom	X	X	-	X	-
Hemp	60% Wool – New Zealand 40% Hemp – United Kingdom	-	X	-	X	X

Table 6. *The type and mass of biogenic carbon containing fibers within three different fabric products and the respective biogenic carbon content of each material. Note that all values are reported per square meter of fabric.*

Biogenic Fabric Material	Mass Fabric Material (kg / m^2)	Biogenic Carbon Content (kg CO2e / m^2)
Main Line Flax		
Flax*	0.109	0.180
Main Line Plus		
Viscose**	0.140	0.206
Hemp		
Hemp***	0.184	0.256

*The carbon content of flax fibers is 45% [10] and is converted to CO2eq using a conversion factor of 3.67
**The carbon content of viscose fibers is 40% [11] and is converted to CO2eq using a conversion factor of 3.67
***The carbon content of hemp fibers is 1.39 kg CO2/kg fiber [12]

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 (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 [13] 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 [14]. To produce LCA results for the ten 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 [5], specifically the Allocation, cut-off, EN15804 v2 database [15] is used. Detailed descriptions of unit processes can be found in the accompanying documentation [5].

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

Flow	Dataset
Upstream Processes	
Wool Yarn	Greasy Wool - market for sheep fleece in the grease | sheep fleece in the grease | EN15804, U - GLO Scouring, carding, and combing - market for electricity, medium voltage | electricity, medium voltage | EN15804, U – NZ; market for heat, district or industrial, natural gas | heat, district or industrial, natural gas | EN15804, U – RoW
Hemp Fiber	Farming - bale loading | bale loading | EN15804, U – RoW; combine harvesting | combine harvesting | EN15804, U – CH; haying, by rotary tedder | haying, by rotary tedder | Cutoff, U – CH; market for linseed | linseed | EN15804, U – GLO; market for manure, solid, cattle | manure, solid, cattle | EN15804, U – GLO; mowing, by rotary mower | mowing, by rotary mower | EN15804, U – CH; market for packaging, for fertilisers | packaging, for fertilisers | EN15804, U – GLO; sowing | sowing | EN15804, U – CH; tillage, ploughing | tillage, ploughing | EN15804, U - CH Decortication - market group for diesel | diesel | Cutoff, U – RER; market for electricity, medium voltage | electricity, medium voltage | EN15804, U – FR; market for metal working, average for steel product manufacturing | metal working, average for steel product manufacturing | EN15804, U – GLO; market for propane | propane | EN15804, U – GLO; market for steel, low-alloyed | steel, low-alloyed | EN15804, U – GLO; transport, freight, lorry 16-32 metric ton, EURO4 | transport, freight, lorry 16-32 metric ton, EURO4 | EN15804, U – RER; market for cast iron | cast iron | EN15804, U – GLO; market for metal working, average for metal product manufacturing | metal working, average for metal product manufacturing | EN15804, U - GLO
Flax Fiber	market for fibre, flax | fibre, flax | EN15804, U - GLO
Viscose Fiber	fibre production, visil | fibre, viscose | EN15804, U - GLO
Visil Viscose* Fiber	fibre production, visil | fibre, viscose | EN15804, U - GLO
Core Processes	
Fiber Dyeing	continuous dyeing, fibre, cotton | continuous dyeing, fibre, cotton | EN15804, U - GLO
Package Dyeing	batch dyeing, fibre, cotton | batch dyeing, fibre, cotton | EN15804, U - RoW
Yarn Spinning and 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 - RER
Textile landfilling	treatment of municipal solid waste, sanitary landfill | municipal solid waste | EN15804, U - CH
Textile incineration	treatment of municipal solid waste, incineration | municipal solid waste | EN15804, U - GB

* The fiber production process used to model the Visil flame-retardant fiber has been adjusted to account for a material composition of 70% cellulose and 30% silicon dioxide

** All pigments were modeled as half iron oxide and half carbon black

*** All masses of ancillary chemicals were adjusted to match the concentration listed within the SDSs provided by Camira Fabrics

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 Fabric natural 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 t[o] 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 methodolog[y] 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, weaving, 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 wool and hemp fiber. 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 10 fabric products is low. However, there is uncertainty regarding the type of polyamides utilized, as well as the inputs and outputs for non-Camira owned spinning facilities. Primary data from the Camira Yarns spinning facility was used in place of primary data from non-Camira owned and operated spinning facilities and is thought to be a suitable proxy. There is uncertainty regarding the production of greasy wool from sheep. As no primary data was available from wool suppliers, secondary datasets from Ecoinvent v3.8 were used. However, given that the production of greasy wool contributes >50% of the total product impact for all impact categories, this LCA would benefit from obtaining primary data on wool production. 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 [16] 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 spinning, weaving, and piece dyeing of the ten natural 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 [17]: "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.

- All modeled polyamides are assumed to by 50% nylon 6 and 50% nylon 6.6
- Truck transport is assumed to be done by diesel truck compliant to Euro 4 emission standards
- The inputs and outputs used at the four non-Camira owned wool spinning facilities are assumed to be the same as those at the Camira Yarns facility, for which primary data was available
- 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 with end-of-life 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.

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

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 natural fabric product. Note that the EP – freshwater, EP – terrestrial, and ADP – minerals & metals abbreviations have been further shortened to EP – fw, EP – t, and ADP – mm respectively. The ADP – fossil indicator uses net calorific values.*

Fabric Product	Life Cycle Stage	GWP – total	GWP - fossil	GWP - biogenic	GWP - LULC	AP	EP – fw	EP – marine	EP – t	POCP	ODP	ADP – mm	ADP – fossil	WDP
Blazer	Total	22.2	8.57	11.3	2.35	0.580	6.31×10^{-3}	0.100	2.56	2.71×10^{-2}	4.40×10^{-7}	5.54×10^{-5}	13.4	6.25
	Upstream	20.4	6.95	11.1	2.35	0.574	6.08×10^{-3}	9.85×10^{-2}	2.54	2.30×10^{-2}	2.41×10^{-7}	4.81×10^{-5}	8.36	5.68
	Core	1.70	1.59	0.107	3.93×10^{-3}	5.07×10^{-3}	2.28×10^{-4}	1.24×10^{-3}	1.24×10^{-2}	4.09×10^{-3}	1.98×10^{-7}	7.31×10^{-6}	5.05	0.566
	Downstream	0.166	2.91×10^{-2}	0.137	1.30×10^{-6}	3.56×10^{-5}	3.31×10^{-6}	2.61×10^{-4}	1.30×10^{-4}	6.44×10^{-5}	8.71×10^{-10}	1.69×10^{-8}	6.38×10^{-3}	4.35×10^{-3}
Synergy 140 & 170	Total	18.1	7.16	9.03	1.88	0.464	5.07×10^{-3}	8.02×10^{-2}	2.04	2.26×10^{-2}	3.74×10^{-7}	4.57×10^{-5}	11.5	5.10
	Upstream	16.5	5.79	8.84	1.88	0.459	4.88×10^{-3}	7.90×10^{-2}	2.03	1.91×10^{-2}	2.04×10^{-7}	3.92×10^{-5}	7.42	4.67
	Core	1.43	1.34	9.06×10^{-2}	2.43×10^{-3}	4.30×10^{-3}	1.85×10^{-4}	1.04×10^{-3}	1.07×10^{-2}	3.48×10^{-3}	1.69×10^{-7}	6.50×10^{-6}	4.05	0.432
	Downstream	0.126	2.20×10^{-2}	0.104	9.86×10^{-7}	2.69×10^{-5}	2.51×10^{-6}	1.97×10^{-4}	9.85×10^{-5}	4.87×10^{-5}	6.59×10^{-10}	1.28×10^{-8}	4.82×10^{-3}	3.29×10^{-3}
Blazer Lite	Total	17.6	6.84	8.93	1.86	0.459	4.99×10^{-3}	7.93×10^{-2}	2.02	2.19×10^{-2}	3.65×10^{-7}	4.40×10^{-5}	10.5	4.92
	Upstream	16.2	5.54	8.76	1.86	0.455	4.82×10^{-3}	7.80×10^{-2}	2.01	1.84×10^{-2}	2.00×10^{-7}	3.82×10^{-5}	6.66	4.50
	Core	1.37	1.29	8.33×10^{-2}	3.09×10^{-3}	4.15×10^{-3}	1.75×10^{-4}	1.05×10^{-3}	1.06×10^{-2}	3.46×10^{-3}	1.64×10^{-7}	5.74×10^{-6}	3.86	0.418
	Downstream	0.104	1.82×10^{-2}	8.58×10^{-2}	8.16×10^{-7}	2.23×10^{-5}	2.08×10^{-6}	1.63×10^{-4}	8.15×10^{-5}	4.03×10^{-5}	5.46×10^{-10}	1.06×10^{-8}	3.99×10^{-3}	2.73×10^{-3}
Main Line Flax	Total	14.5	6.33	6.43	1.69	0.420	4.58×10^{-3}	7.48×10^{-2}	1.85	2.06×10^{-2}	3.20×10^{-7}	3.91×10^{-5}	10.6	7.88
	Upstream	13.1	5.20	6.21	1.69	0.417	4.43×10^{-3}	7.39×10^{-2}	1.85	1.78×10^{-2}	1.90×10^{-7}	3.61×10^{-5}	7.27	7.58
	Core	1.20	1.10	9.43×10^{-2}	1.05×10^{-3}	3.02×10^{-3}	1.49×10^{-4}	6.99×10^{-4}	7.53×10^{-3}	2.68×10^{-3}	1.29×10^{-7}	2.95×10^{-6}	3.35	0.295
	Downstream	0.150	2.63×10^{-2}	0.124	1.18×10^{-6}	3.21×10^{-5}	2.99×10^{-6}	2.35×10^{-4}	1.18×10^{-4}	5.82×10^{-5}	7.86×10^{-10}	1.52×10^{-8}	5.76×10^{-3}	3.93×10^{-3}
Main Line Plus	Total	14.0	5.77	6.83	1.42	0.355	4.02×10^{-3}	6.11×10^{-2}	1.55	1.82×10^{-2}	3.74×10^{-7}	4.25×10^{-5}	12.8	4.24
	Upstream	12.8	4.73	6.63	1.42	0.353	3.88×10^{-3}	6.02×10^{-2}	1.55	1.57×10^{-2}	2.54×10^{-7}	3.97×10^{-5}	9.68	3.95
	Core	1.10	1.01	8.53×10^{-2}	9.64×10^{-4}	2.78×10^{-3}	1.38×10^{-4}	6.44×10^{-4}	6.91×10^{-3}	2.44×10^{-3}	1.20×10^{-7}	2.75×10^{-6}	3.10	0.279
	Downstream	0.142	2.48×10^{-2}	0.117	1.11×10^{-6}	3.04×10^{-5}	2.83×10^{-6}	2.23×10^{-4}	1.11×10^{-4}	5.50×10^{-5}	7.44×10^{-10}	1.44×10^{-8}	5.44×10^{-3}	3.72×10^{-3}
Aquarius	Total	18.5	7.27	9.31	1.94	0.479	5.22×10^{-3}	8.28×10^{-2}	2.11	2.35×10^{-2}	4.13×10^{-7}	4.68×10^{-5}	11.3	5.17
	Upstream	16.9	5.81	9.13	1.94	0.474	5.02×10^{-3}	8.14×10^{-2}	2.10	1.94×10^{-2}	2.18×10^{-7}	4.00×10^{-5}	6.99	4.69
	Core	1.53	1.44	8.76×10^{-2}	3.24×10^{-3}	4.91×10^{-3}	1.97×10^{-4}	1.26×10^{-3}	1.28×10^{-2}	4.11×10^{-3}	1.95×10^{-7}	6.88×10^{-6}	4.31	0.476
	Downstream	0.108	1.88×10^{-2}	8.87×10^{-2}	8.43×10^{-7}	2.30×10^{-5}	2.14×10^{-6}	1.69×10^{-4}	8.43×10^{-5}	4.17×10^{-5}	5.64×10^{-10}	1.09×10^{-8}	4.13×10^{-3}	2.82×10^{-3}
Sumi	Total	17.3	6.81	8.71	1.82	0.449	4.88×10^{-3}	7.77×10^{-2}	1.98	2.19×10^{-2}	3.37×10^{-7}	4.15×10^{-5}	10.6	4.88
	Upstream	16.1	5.74	8.56	1.82	0.446	4.75×10^{-3}	7.67×10^{-2}	1.97	1.87×10^{-2}	1.89×10^{-7}	3.84×10^{-5}	7.71	4.62
	Core	1.13	1.05	7.26×10^{-2}	8.98×10^{-4}	3.38×10^{-3}	1.31×10^{-4}	8.94×10^{-4}	9.64×10^{-3}	3.14×10^{-3}	1.48×10^{-7}	3.04×10^{-6}	2.88	0.256
	Downstream	9.08×10^{-2}	1.59×10^{-2}	7.49×10^{-2}	7.12×10^{-7}	1.94×10^{-5}	1.81×10^{-6}	1.42×10^{-4}	7.11×10^{-5}	3.52×10^{-5}	4.76×10^{-10}	9.21×10^{-9}	3.48×10^{-3}	2.38×10^{-3}
Hemp	Total	15.4	6.25	7.60	1.56	0.387	4.29×10^{-3}	6.72×10^{-2}	1.70	1.95×10^{-2}	3.51×10^{-7}	3.94×10^{-5}	10.6	4.30
	Upstream	13.6	4.65	7.35	1.56	0.382	4.06×10^{-3}	6.58×10^{-2}	1.69	1.54×10^{-2}	1.64×10^{-7}	3.22×10^{-5}	5.63	3.78
	Core	1.69	1.57	0.112	3.94×10^{-3}	4.82×10^{-3}	2.26×10^{-4}	1.12×10^{-3}	1.13×10^{-2}	4.04×10^{-3}	1.87×10^{-7}	7.16×10^{-6}	4.94	0.520
	Downstream	0.166	2.91×10^{-2}	0.137	1.35×10^{-6}	3.59×10^{-5}	3.33×10^{-6}	2.61×10^{-4}	1.31×10^{-4}	6.46×10^{-5}	8.64×10^{-10}	1.70×10^{-8}	7.08×10^{-3}	4.36×10^{-3}
Craggan Flax	Total	26.4	10.7	12.9	2.84	0.702	7.62×10^{-3}	0.123	3.09	3.43×10^{-2}	5.30×10^{-7}	6.46×10^{-5}	16.5	9.03
	Upstream	24.4	8.99	12.6	2.83	0.697	7.42×10^{-3}	0.121	3.08	3.00×10^{-2}	3.29×10^{-7}	6.05×10^{-5}	12.1	8.72
	Core	1.74	1.61	0.126	1.43×10^{-3}	4.60×10^{-3}	1.99×10^{-4}	1.15×10^{-3}	1.24×10^{-2}	4.25×10^{-3}	1.99×10^{-7}	4.16×10^{-6}	4.38	0.305
	Downstream	0.312	5.46×10^{-2}	0.257	2.44×10^{-6}	6.68×10^{-5}	6.22×10^{-6}	4.89×10^{-4}	2.44×10^{-4}	1.21×10^{-4}	1.63×10^{-9}	3.16×10^{-8}	1.20×10^{-2}	8.16×10^{-3}
Yoredale	Total	31.2	12.0	15.9	3.29	0.805	8.83×10^{-3}	0.139	3.56	3.51×10^{-2}	9.29×10^{-7}	7.86×10^{-5}	18.9	8.76
	Upstream	28.6	9.84	15.5	3.28	0.798	8.54×10^{-3}	0.137	3.54	2.93×10^{-2}	6.61×10^{-7}	6.84×10^{-5}	12.6	8.08
	Core	2.28	2.13	0.140	5.27×10^{-3}	6.81×10^{-3}	2.87×10^{-4}	1.70×10^{-3}	1.72×10^{-2}	5.65×10^{-3}	2.66×10^{-7}	1.02×10^{-5}	6.28	0.675
	Downstream	0.313	5.47×10^{-2}	0.258	2.45×10^{-6}	6.70×10^{-5}	6.24×10^{-6}	4.91×10^{-4}	2.45×10^{-4}	1.21×10^{-4}	1.64×10^{-9}	3.17×10^{-8}	1.20×10^{-2}	8.19×10^{-3}

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 [18], 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	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 natural fabric product reported for. 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, NVC)	PERM (MJ, NCV)	PERT (MJ, NCV)	PENRE (MJ, NCV)	PENRM (MJ, NCV)	PENRT (MJ, NCV)	SM (kg)	RSF (MJ, NCV)	NRSF (MJ, NCV)	FW (m3)
Blazer	Total	3.91	69.6	73.5	24.3	46.4	88.0	0.313	2.16×10^{-2}	7.23×10^{-2}	0.210
	Upstream	1.62	67.5	69.1	9.39	21.7	48.4	0.282	1.29×10^{-2}	3.75×10^{-2}	0.194
	Core	2.28	2.10	4.38	14.9	24.6	39.6	3.06×10^{-2}	8.60×10^{-3}	3.45×10^{-2}	1.57×10^{-2}
	Downstream	5.25×10^{-3}	6.08×10^{-4}	5.85×10^{-3}	1.20×10^{-2}	5.61×10^{-2}	6.82×10^{-2}	3.88×10^{-4}	1.43×10^{-4}	3.21×10^{-4}	1.02×10^{-4}
Synergy 140 & 170	Total	3.23	55.5	58.7	20.7	41.0	75.4	0.252	1.83×10^{-2}	6.05×10^{-2}	0.169
	Upstream	1.36	53.8	55.2	8.55	20.0	42.3	0.228	1.12×10^{-2}	3.17×10^{-2}	0.158
	Core	1.86	1.65	3.51	12.1	20.9	33.1	2.37×10^{-2}	7.03×10^{-3}	2.86×10^{-2}	1.14×10^{-2}
	Downstream	3.97×10^{-3}	4.60×10^{-4}	4.43×10^{-3}	9.11×10^{-3}	4.24×10^{-2}	5.16×10^{-2}	2.94×10^{-4}	1.08×10^{-4}	2.42×10^{-4}	7.70×10^{-5}
Blazer Lite	Total	3.09	55.0	58.1	19.2	37.9	70.7	0.249	1.73×10^{-2}	5.84×10^{-2}	0.164
	Upstream	1.29	53.4	54.7	7.49	17.8	38.9	0.224	1.04×10^{-2}	3.04×10^{-2}	0.153
	Core	1.80	1.66	3.46	11.7	20.1	31.8	2.44×10^{-2}	6.84×10^{-3}	2.78×10^{-2}	1.09×10^{-2}
	Downstream	3.28×10^{-3}	3.81×10^{-4}	3.67×10^{-3}	7.54×10^{-3}	3.51×10^{-2}	4.27×10^{-2}	2.43×10^{-4}	8.94×10^{-5}	2.01×10^{-4}	6.38×10^{-5}
Main Line Flax	Total	3.12	70.5	73.6	19.8	34.4	66.6	0.710	1.66×10^{-2}	5.55×10^{-2}	0.301
	Upstream	1.25	69.0	70.2	8.11	16.8	37.3	0.692	9.98×10^{-3}	2.83×10^{-2}	0.277
	Core	1.87	1.55	3.42	11.7	17.5	29.2	1.73×10^{-2}	6.52×10^{-3}	2.69×10^{-2}	2.42×10^{-2}
	Downstream	4.73×10^{-3}	5.49×10^{-4}	5.28×10^{-3}	1.09×10^{-2}	5.07×10^{-2}	6.15×10^{-2}	3.50×10^{-4}	1.29×10^{-4}	2.89×10^{-4}	9.19×10^{-5}
Main Line Plus	Total	3.05	45.3	48.3	21.6	32.3	64.3	0.248	1.94×10^{-2}	6.32×10^{-2}	0.152
	Upstream	1.36	43.9	45.2	10.9	16.2	37.6	0.231	1.33×10^{-2}	3.84×10^{-2}	0.129
	Core	1.69	1.40	3.09	10.6	16.1	26.7	1.59×10^{-2}	5.97×10^{-3}	2.45×10^{-2}	2.21×10^{-2}
	Downstream	4.48×10^{-3}	5.19×10^{-4}	5.00×10^{-3}	1.03×10^{-2}	4.79×10^{-2}	5.82×10^{-2}	3.31×10^{-4}	1.22×10^{-4}	2.74×10^{-4}	8.69×10^{-5}
Aquarius	Total	3.25	57.4	60.6	20.3	41.2	75.7	0.262	1.88×10^{-2}	6.35×10^{-2}	0.173
	Upstream	1.35	55.6	57.0	7.86	19.0	41.1	0.234	1.10×10^{-2}	3.24×10^{-2}	0.160
	Core	1.89	1.72	3.61	12.4	22.1	34.5	2.72×10^{-2}	7.68×10^{-3}	3.09×10^{-2}	1.32×10^{-2}
	Downstream	3.39×10^{-3}	3.94×10^{-4}	3.79×10^{-3}	7.79×10^{-3}	3.63×10^{-2}	4.41×10^{-2}	2.51×10^{-4}	9.24×10^{-5}	2.07×10^{-4}	6.59×10^{-5}
Sumi	Total	2.82	53.4	56.2	18.4	36.8	68.5	0.238	1.73×10^{-2}	5.53×10^{-2}	0.175
	Upstream	1.36	52.2	53.6	9.04	20.5	42.9	0.221	1.12×10^{-2}	3.07×10^{-2}	0.155
	Core	1.46	1.19	2.65	9.31	16.2	25.5	1.66×10^{-2}	5.99×10^{-3}	2.44×10^{-2}	1.95×10^{-2}
	Downstream	2.87×10^{-3}	3.32×10^{-4}	3.20×10^{-3}	6.58×10^{-3}	3.07×10^{-2}	3.72×10^{-2}	2.12×10^{-4}	7.80×10^{-5}	1.75×10^{-4}	5.56×10^{-5}
Hemp	Total	3.54	47.0	50.6	22.4	39.9	73.8	0.261	1.82×10^{-2}	6.37×10^{-2}	0.142
	Upstream	1.12	44.8	45.9	6.92	14.6	33.0	0.229	9.06×10^{-3}	2.73×10^{-2}	0.129
	Core	2.41	2.22	4.63	15.5	25.2	40.7	3.09×10^{-2}	9.03×10^{-3}	3.62×10^{-2}	1.27×10^{-2}
	Downstream	5.21×10^{-3}	6.07×10^{-4}	5.81×10^{-3}	1.26×10^{-2}	5.61×10^{-2}	6.87×10^{-2}	3.83×10^{-4}	1.39×10^{-4}	3.03×10^{-4}	1.02×10^{-4}
Craggan Flax	Total	4.64	92.9	97.6	29.6	58.2	109	0.596	2.72×10^{-2}	8.83×10^{-2}	0.312
	Upstream	2.12	90.8	93.0	14.0	32.3	67.1	0.571	1.78×10^{-2}	4.98×10^{-2}	0.303
	Core	2.50	2.08	4.58	15.6	25.7	41.3	2.45×10^{-2}	9.16×10^{-3}	3.79×10^{-2}	8.73×10^{-3}
	Downstream	9.84×10^{-3}	1.14×10^{-3}	1.10×10^{-2}	2.26×10^{-2}	0.105	0.128	7.28×10^{-4}	2.68×10^{-4}	6.01×10^{-4}	1.91×10^{-4}
Yoredale	Total	5.40	97.1	102	33.8	65.9	124	0.438	3.07×10^{-2}	0.102	0.291
	Upstream	2.36	94.3	96.6	14.4	32.0	70.5	0.397	1.92×10^{-2}	5.52×10^{-2}	0.275
	Core	3.03	2.81	5.84	19.5	33.7	53.2	4.03×10^{-2}	1.12×10^{-2}	4.60×10^{-2}	1.65×10^{-2}
	Downstream	9.87×10^{-3}	1.14×10^{-3}	1.10×10^{-2}	2.27×10^{-2}	0.106	0.128	7.31×10^{-4}	2.69×10^{-4}	6.03×10^{-4}	1.92×10^{-4}

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 natural 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)
Blazer	Total	1.52	4.65	6.92×10^{-3}	4.66×10^{-2}	3.70×10^{-2}
	Upstream	1.20	3.50	7.15×10^{-4}	4.36×10^{-2}	1.40×10^{-2}
	Core	0.134	1.15	6.20×10^{-3}	2.34×10^{-3}	2.30×10^{-2}
	Downstream	0.182	2.81×10^{-3}	3.84×10^{-6}	7.10×10^{-4}	2.56×10^{-5}
Synergy 140 & 170	Total	1.27	3.85	5.73×10^{-3}	3.92×10^{-2}	2.86×10^{-2}
	Upstream	0.994	2.90	6.40×10^{-4}	3.66×10^{-2}	1.13×10^{-2}
	Core	0.138	0.941	5.09×10^{-3}	2.03×10^{-3}	1.72×10^{-2}
	Downstream	0.137	2.13×10^{-3}	2.91×10^{-6}	5.37×10^{-4}	1.94×10^{-5}
Blazer Lite	Total	1.24	3.67	5.48×10^{-3}	3.75×10^{-2}	2.97×10^{-2}
	Upstream	0.984	2.78	5.78×10^{-4}	3.50×10^{-2}	1.12×10^{-2}
	Core	0.146	0.889	4.90×10^{-3}	1.99×10^{-3}	1.84×10^{-2}
	Downstream	0.114	1.76×10^{-3}	2.41×10^{-6}	4.44×10^{-4}	1.61×10^{-5}
Main Line Flax	Total	1.17	3.55	5.84×10^{-3}	4.65×10^{-2}	1.20×10^{-2}
	Upstream	0.960	2.81	5.82×10^{-4}	3.34×10^{-2}	1.06×10^{-2}
	Core	4.54×10^{-2}	0.733	5.25×10^{-3}	1.25×10^{-2}	1.42×10^{-3}
	Downstream	0.164	2.54×10^{-3}	3.47×10^{-6}	6.40×10^{-4}	2.31×10^{-5}
Main Line Plus	Total	0.965	3.80	5.57×10^{-3}	4.97×10^{-2}	1.07×10^{-2}
	Upstream	0.768	3.12	8.27×10^{-4}	3.77×10^{-2}	9.32×10^{-3}
	Core	4.17×10^{-2}	0.677	4.73×10^{-3}	1.14×10^{-2}	1.31×10^{-3}
	Downstream	0.155	2.40×10^{-3}	3.28×10^{-6}	6.06×10^{-4}	2.19×10^{-5}
Aquarius	Total	1.39	3.92	5.73×10^{-3}	3.99×10^{-2}	3.24×10^{-2}
	Upstream	1.05	2.91	6.14×10^{-4}	3.70×10^{-2}	1.18×10^{-2}
	Core	0.220	1.00	5.11×10^{-3}	2.42×10^{-3}	2.06×10^{-2}
	Downstream	0.118	1.82×10^{-3}	2.49×10^{-6}	4.59×10^{-4}	1.66×10^{-5}
Sumi	Total	1.22	3.53	4.71×10^{-3}	4.87×10^{-2}	1.27×10^{-2}
	Upstream	0.932	2.88	6.54×10^{-4}	3.61×10^{-2}	1.09×10^{-2}
	Core	0.190	0.646	4.06×10^{-3}	1.23×10^{-2}	1.81×10^{-3}
	Downstream	9.93×10^{-2}	1.54×10^{-3}	2.10×10^{-6}	3.88×10^{-4}	1.40×10^{-5}
Hemp	Total	1.07	3.49	7.46×10^{-3}	3.30×10^{-2}	3.30×10^{-2}
	Upstream	0.810	2.35	8.49×10^{-4}	3.02×10^{-2}	9.63×10^{-3}
	Core	7.40×10^{-2}	1.15	6.61×10^{-3}	2.11×10^{-3}	2.33×10^{-2}
	Downstream	0.182	2.89×10^{-3}	3.75×10^{-6}	7.04×10^{-4}	2.65×10^{-5}
Craggan Flax	Total	2.09	5.56	8.11×10^{-3}	6.12×10^{-2}	3.56×10^{-2}
	Upstream	1.59	4.58	1.04×10^{-3}	5.75×10^{-2}	1.76×10^{-2}
	Core	0.164	0.975	7.06×10^{-3}	2.35×10^{-3}	1.80×10^{-2}
	Downstream	0.341	5.27×10^{-3}	7.21×10^{-6}	1.33×10^{-3}	4.81×10^{-5}
Yoredale	Total	2.25	6.53	9.37×10^{-3}	6.68×10^{-2}	4.96×10^{-2}
	Upstream	1.68	5.05	1.08×10^{-3}	6.23×10^{-2}	1.89×10^{-2}
	Core	0.223	1.47	8.29×10^{-3}	3.22×10^{-3}	3.06×10^{-2}
	Downstream	0.342	5.29×10^{-3}	7.23×10^{-6}	1.34×10^{-3}	4.83×10^{-5}

6. Additional Environmental Information

The Hemp, Main Line Flax, Sumi, and Synergy (140 & 170) 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

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