Life Cycle Assessment of Pyjamas Pants of Organic Cotton

Commissioner: Mørkegaard A/S in collaboration with Salling Group A/S

Product brand: Nord Harmony

LCA practitioner: Better Green ApS

Critical reviewer: Bureau Veritas Solutions Denmark A/S

Date and version: 2026-02-18 (v1.0)

LIFE CYCLE ASSESSMENT (LCA) INFORMATION	
Commissioner	Mørkegaard A/S in collaboration with Salling Group A/S
Product brand	Nord Harmony
LCA practitioner	Better Green ApS Julie Kathrine Lyager & Marie Astrid Steenberg Holm
Independent critical reviewer	Bureau Veritas Solutions Denmark A/S Waldemar C. Hemdrup - LCA & EPD Consultant
LCA standard	DS/EN ISO 14040:2008 DS/EN ISO 14044:2008
Product	Pyjamas pants
Life cycle scope	Cradle-to-grave
Temporal scope	Production data collected covers 2024
Geographical scope	Raw materials: Pakistan Production: Pakistan Use and end-of-life: Denmark
Background database	ecoinvent v3.11 (cut-off)
Software	SimaPro 10.2.0.3
Modeling/allocation approach	Attributional LCA and physical allocation in phase 3 (production)
LCIA method	Environmental Footprint 3.1
Impact categories	Climate change; Ecotoxicity, freshwater; Particulate matter; Eutrophication, marine; Eutrophication, freshwater; Eutrophication, terrestrial; Human toxicity, cancer; Human toxicity, non-cancer; Ionising radiation; Land use; Ozone depletion; Photochemical ozone formation; Resource use, fossils; Resource use, minerals and metals; Water use
Date and version:	2026-02-18 (v1.0)

1 Summary

Goal and scope: A life cycle assessment (LCA) was carried out to investigate the environmental impacts arising in the full life cycle of pyjamas pants from the spring 2026 line of Nord Harmony. The life cycle phases included in the LCA are:

1) Raw materials: Production of cotton yarn
2) Raw material transport: Transport of raw materials to the factory
3) Production: Transformation of yarn into final products incl. packaging.
4) Distribution: Transport to Denmark, warehouse, retail, disposal of transport packaging, and transport to the consumer home.
5) Use phase: Washing and drying cycles in the whole product lifetime and disposal of consumer packaging.
6) End-of-life: Disposal of the products through mixed waste for incineration and through textile sorting scheme for recycling.

The goal of the assessment was to get a deeper understanding of the environmental impacts of the product and to label the product packaging with the climate change impact.

Data collection and data quality: Data was collected to represent the six life cycle phases of the LCA. Primary data was collected from the factory in Pakistan to fully represent the production phase, and additional information about the supply chain of the raw materials was also collected from the factory. The life cycle phases before and after production generally rely on secondary data. The data quality in the study is generally good, although a significant limitation in the data quality is the lack of country-specific data for organic cotton cultivation.

Results and conclusions: The environmental impact of the products was evaluated across 16 impact categories according to the EF3.1 LCIA method. The climate change impact of the product is shown in Table 1.

Table 1 – Climate change impact of the product evaluated in the life cycle assessment (LCA)

ID	Product type	Climate change impact (kg CO_2e)	
		Cradle-to-consumer	Cradle-to-grave
PJ1	Pyjamas pants	2,4	3,1

It was found that 'Phase 3 – production' is the most contributing life cycle phase to climate change, contributing with 35%. This is mainly due to the electricity consumption and packaging. See Figure 1.

It was found that the consumer behavior regarding washing frequency and drying method (machine drying or air drying) can influence the overall climate change impact of the product. Increasing the washing frequency and machine-drying increases the environmental impact of the product in its life cycle. These figures can vary significantly between different consumers, so when using the results it is worth noting the following assumptions in this LCA:

- Number of washes in the lifetime of the product: 14.
- Drying method after washing: 58% machine drying and 42% air-drying.

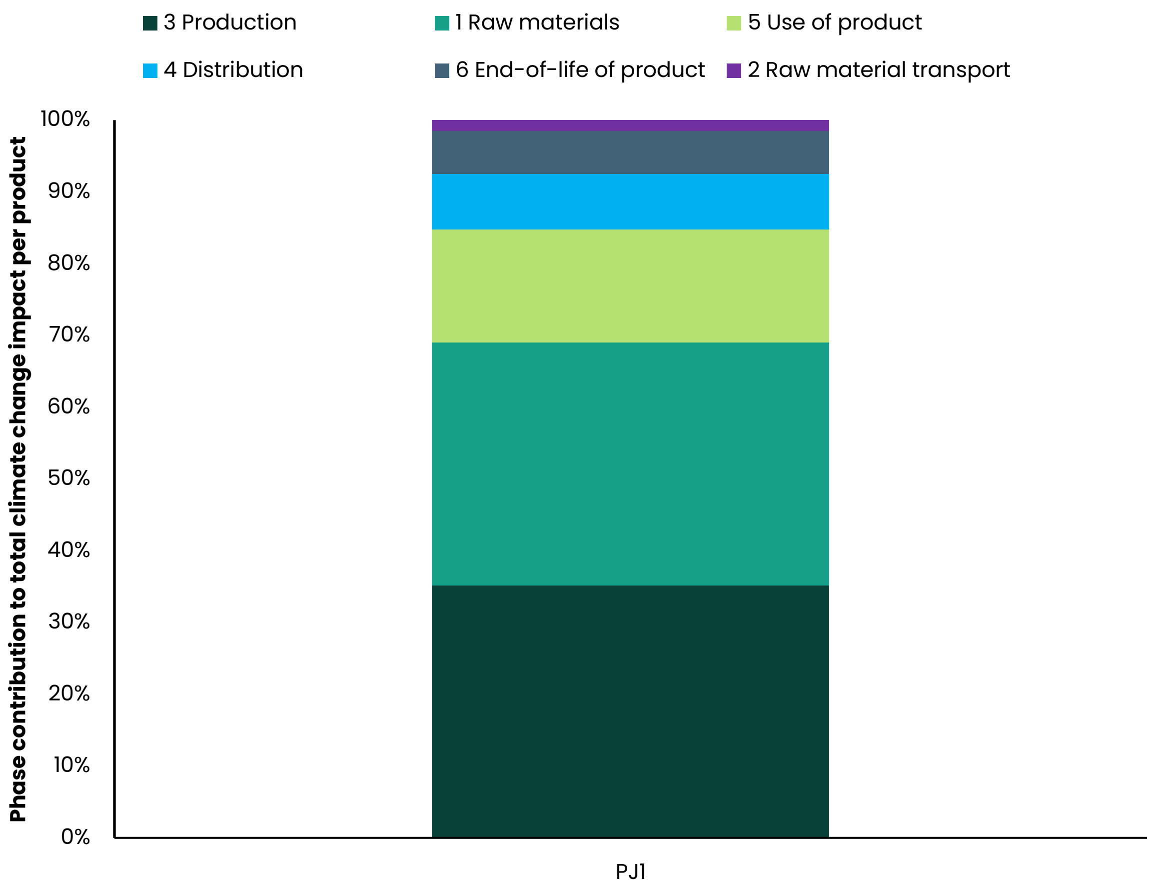

Figure 1 – Contribution analysis for the climate change impact

Critical review: The LCA study was carried out by Better Green ApS and critically reviewed by Waldemar C. Hemdrup - LCA & EPD Consultant from Bureau Veritas Solutions Denmark A/S. The review took place post-study and the LCA study was updated to accommodate suggestions and comments for improvement from the third-party reviewer. The review took place between December 2025 and February 2026.

2 Contents

Product IDs

ID	Product type and line	Raw material	Treatment
PJ1	Pyjamas pants	100% virgin, organic cotton	Bleached+printed

List of abbreviations

Abbreviation	Full expression
A&FW	Apparel and Footwear
DK	Denmark
DPP	Digital product passport
DQR	Data quality rating
DST	Statistics Denmark
EF	Environmental Footprint
ESPR	Ecodesign for Sustainable Products Regulation
EU	European Union
GLO	Global
IN	India
IVL	Swedish Environmental Research Institute
LCA	Life cycle assessment
LCI	Life cycle inventory
LCIA	Life cycle impact assessment
N.D.	No date
PEF	Product Environmental Footprint
PEFCR	Product Environmental Footprint Category Rules
PEF-RF	Product Environmental Footprint Representative Product
PES	Polyester
PK	Pakistan
RER	Europe
RoW	Rest of World

3 Goal of the study

3.1 Reasons for carrying out the study

Mørkegaard A/S is preparing for the expected future requirements related to the EU Ecodesign for Sustainable Products Regulation (ESPR), which entered into force on July 18, 2024. One of the planned requirements of the ESPR is the digital product passport (DPP) - a digital identity card for products, components, and materials - which will store relevant information to support product sustainability, circularity, and compliance. The DPP requirements are still being developed for various product categories.

Mørkegaard A/S is carrying out a DPP pilot project aiming at providing transparent product information to the consumer. The DPP pilot project focuses on the product line, *Nord Harmony*, which is being continuously developed with the aim of improving the environmental footprint and circularity of the products.

The aim of this LCA study is to evaluate the environmental footprint of pyjamas pants from the spring 2026 line of Nord Harmony.

An equally important goal of the LCA study is to give Mørkegaard A/S a deep understanding of the environmental impact drivers in the life cycle of the assessed products. This will inform future product design and operational decisions for Mørkegaard A/S aiming to further minimize the environmental impact of their products and business.

3.2 Intended applications

The results of this LCA study are intended to be communicated to the business partners of Mørkegaard A/S (i.e., retail partners). Furthermore, the results will be communicated to the consumer of the home textile products by:

1) labelling the products with their climate change impact (kg CO_2e per product)
2) labelling the products with a QR code which links to a simplified digital product passport containing a summary of the findings in this LCA including the LCIA results and the external review statement.

3.3 Target audience

The target audience of this LCA study is the business partners of Mørkegaard A/S (retail partners) and the end consumer of the products. The LCA report will be shared with relevant business partners of Mørkegaard A/S as well as the end consumer.

3.4 Comparative claims

The product in this LCA study is not intended to be compared.

4 Scope of the study

4.1 Description of the products

This study assesses pyjamas pants from the Nord Harmony spring 2026 line. See Figure 2 for illustrations of the two designs.

Figure 2 – Pyjamas pants in two different designs

The products are produced at a factory in Pakistan. Due to confidentiality the factory is not named in this LCA.

The pyjamas pants come in two designs: Flower print and green stripes. The products undergo the same production steps, and it has not been possible to differentiate the consumption for each design. Therefore, the LCA study does not differentiate between them. The results of this LCA cover both designs.

The pyjamas pants come in two sizes: S/M and L/XL. This LCA is based on the L/XL version of the pyjamas pants, which is a conservative approach applied in order to avoid different climate labels for the packaging of the different sizes. The number of LCA results is one.

Table 2 – Products assessed in the LCA study incl. size variations and LCA ID.

Product type	ID	Organic cotton	Recycled cotton	Bleached	Dyed	Printed
Pyjamas pants*	PJ1	100%	0%	Yes	No	Yes

** The pyjamas pants come in both S/M and L/XL. In this LCA both sizes are represented by the size L/XL as a conservative estimate, since it is impractical to label different environmental profiles for different sizes of clothing.*

4.2 Functional unit

In line with the purpose of the LCA, which is to inform the consumer of the environmental impact of the product they are purchasing, the LCA results will be declared based on the product package that the consumer will see in the store. The reference flow and functional unit are listed in Table 3.

Table 3 – Reference flow and functional unit per product in the LCA

Product	Reference flow	Functional unit
PJ1	One pair of pyjamas pants	Garment covering the lower body providing sleepwear comfort for 70 uses and 14 wash cycles*

** Based on 5 uses prior to washing (70 uses/5 uses per wash cycle = 14 wash cycles). Number of uses and uses prior to washing based on PEFCR Apparel and Footwear (2025).*

4.3 System boundary

The life cycle of this LCA is cradle-to-grave and has been divided into the following life cycle phases: (1) Raw materials, (2) Transport of raw materials, (3) Production, (4) Distribution, (5) Use of product, and (6) End-of-life of product. In Table 4 the activities included in each life cycle phase are presented.

Table 4 – Life cycle phases declared in this LCA, and the activities included per life cycle phase.

Life cycle phase	Activities included:
1) Raw materials	• Cotton cultivation • Transport from cotton farm to gin • Cotton ginning • Transport of cotton from gin to spinning mill • Cotton yarn spinning • Polyester thread production • Waistband production
2) Transport of raw materials	• Transport of cotton yarn, polyester thread and waistband to textile mill

Life cycle phase	Activities included:
3) Production	• Energy consumption • Water consumption • Chemicals consumption • Lubricant consumption • Waste and wastewater treatment • Packaging for products • Other materials consumption
4) Distribution	• Transport of product to warehouse • Warehouse energy consumption • Transport of product from warehouse to retail • Retail energy consumption • Waste treatment of freight packaging • Transport to consumer home
5) Use	• Washing and drying of products • Waste treatment of consumer packaging
6) End-of-life	• Waste treatment of products after end-of-life

A flow diagram for the life cycle phases in this LCA is shown in Figure 3.

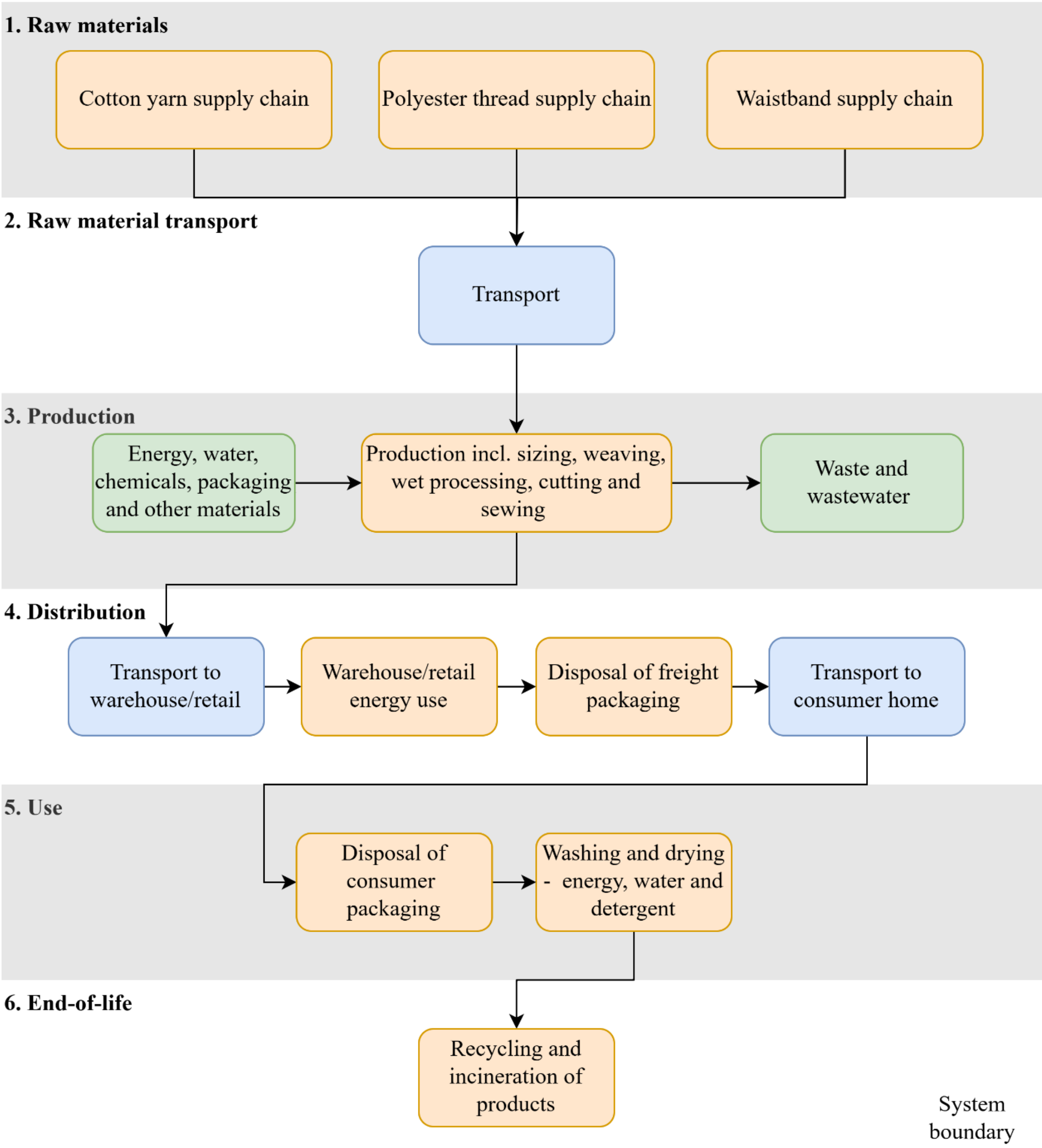

Figure 3 – Flow diagram for life cycle phases in this LCA.

4.4 Modelling approach

4.4.1 LCA standard

This LCA follows the DS/EN ISO 14040:2008 and DS/EN ISO 14044:2008 standards for life cycle assessment. ISO 14040 provides the principles and framework for conducting a Life Cycle Assessment (LCA), while ISO 14044 specifies the requirements and guidelines for carrying out each phase of an LCA, including goal definition, inventory analysis, impact assessment, and interpretation. These LCA standards were followed since they are widely recognized international standards. For assumptions the study has been inspired by the Product Environmental Footprint (PEF) Method from the European Union (PEF, 2021), and the specific category rules for apparel and footwear (PEFCR Apparel and Footwear, 2025).

4.4.2 Database and software

The ecoinvent 3.11 database ("cut-off by classification") has been used for background LCI datasets. The software SimaPro 10.2.0.3 and Microsoft Excel have been used for LCA modelling.

4.4.3 LCA method

This is an attributional LCA, meaning the LCA models the environmental impacts of the activities included in the life cycle of the product. This LCA method is commonly adopted for LCA of single products and is the LCA method adopted by the European Union "Product Environmental Footprint". In this type of LCA the background system uses "average" processes. An alternative LCA method called consequential LCA models the environmental impact related to the decision of buying the product. This method requires the LCA model to account for long-term market trends and market constraints. In this type of LCA the background system uses "marginal" processes.

4.4.4 Handling of multifunctional processes

According to ISO 14044 allocation should be avoided wherever possible by (1) dividing multifunctional processes into multiple sub-processes and collecting input and output data for these sub-processes, or (2) by system expansion. If not avoidable ISO 14040/44 prioritizes physical allocation, and economic allocation if a physical relationship is not established.

In this LCA, for the foreground system (Phase 3: Production) the data is collected as far as possible for single processes in the factory (i.e., using submeters) and if that is not possible the data is collected for the whole factory. Data at the process level is distributed to each product by means of mass allocation (kg of material resulting from each process, and kg of material used in each product). Data at the factory level is also distributed to each product by means of mass allocation (kg of final products leaving the factory). Mass allocation was selected for this LCA because data for the total mass of processed material was available at the factory across different processing steps allowing for a consistent application of allocation methods. Although there is not a direct relationship between the mass of a textile product and the consumption of energy and auxiliaries in the manufacturing process - there are many factors affecting this - , it is assessed to be the best available data and a fair approximation. Data was not available for other physical units such as total processing time or surface area processed per processing step.

For the background system, the ecoinvent 3.11 system model "cut-off by classification" was used. This system model handles multifunctionality by economic allocation (i.e., allocation based on price) with few exceptions, such as for energy, for which allocation is based on exergy.

4.4.5 Cut-off criteria

In this LCA, a cut-off threshold is set at a maximum of 5%, meaning that the cumulative exclusion of mass inputs (kg) and energy inputs (MJ) must not exceed this limit across the whole life cycle. This approach ensures that all significant inputs are considered while allowing minor contributions to be omitted to streamline the analysis. Furthermore, any processes which are known to have a high environmental impact intensity per kg or MJ shall not be excluded.

4.5 Temporal and geographical scope

The temporal and geographical scope of this LCA is presented in Table 5.

The temporal scope of the production is 2025/26, which is the year where the products studied in this LCA will be manufactured. Data for the production is, however, collected for 2024, which is considered representative for the production of similar products in 2025/26.

Table 5 – Temporal and geographical scope of this LCA per life cycle phase

Scope	Raw materials	Transport of raw materials	Production	Distribution	Use of product	End-of-life of product
Temporal	2025-2026	2025-2026	2025-2026	2026	2026-2029	2027-2029
Geographical	Pakistan and Global	Global	Pakistan	Denmark	Denmark	Denmark

4.6 Data quality requirements

4.6.1 Temporal representativeness

Data collected for the LCA should reflect the temporal scope of the LCA as far as possible. For upstream processes the background datasets should be as recent and up-to-date as possible. For the production process, primary data should be collected for the most recently completed year (2024). For the distribution phase the background datasets should be as recent and up-to-date as possible. For the use phase and end-of-life phase that may take place until 2-3 years in the future, it is assumed that no major differences to current practices will occur, meaning the background datasets should be as recent and up-to-date as possible.

4.6.2 Geographical representativeness

Data collected for the LCA should reflect the geographical scope of the LCA as far as possible. Country-specific background datasets should be prioritized over regional and global datasets, when they are available. If they are not available, the geographical representativeness can be improved by adapting the datasets, i.e. by exchanging the electricity mix.

4.6.3 Technological Representativeness

Data collected for the LCA should reflect the technologies used in the value chain of the products. For the production phase, this is ensured through collection of primary data. For upstream processes it is ensured by collecting information about the different technologies used in the supply chain, i.e. farming method for cotton or yarn-spinning method. The downstream processes can vary a lot based on the consumer behavior. The most commonly used technologies should be assumed downstream.

4.6.4 Other data quality requirements

The data quality requirements are applied uniformly to ensure consistency throughout the study. Furthermore, the methodology and assumptions are reported as transparently as possible regarding sources of the data, modelling choices and uncertainty.

4.7 Critical review

This LCA has undergone a critical review by an independent expert from Bureau Veritas Solutions Denmark A/S, Waldemar C. Hemdrup – LCA & EPD Consultant. The critical review took place between December 2025 and February 2026 and included written feedback and a review meeting. The study was adapted based on the comments from the reviewer.

See dialogue between the reviewer and the LCA practitioner during the review process in section 10.3 (appendix).

5 Life cycle inventory analysis (LCI)

5.1 Phase 1: Raw materials

In Table 6 the composition of the product can be seen. These figures do not include the material losses occurring in the life cycle. For modelling of phase 1 and 2 the amount of raw material used per product considers the losses in each processing step including the textile factory.

The products assessed in this LCA consist of a main fabric of cotton (96,4%), care label of cotton (0,6%), thread of polyester (0,8%), and a waistband of polyester and latex (2,2%).

Table 6 – Product composition (grams)

ID	Product name	Main fabric (cotton)	Care label (cotton)	Thread (polyester)	Waistband (polyester and latex)	Total
PJ1	Pyjamas pants	241,0	1,5	2,0	5,5	250

Relevant supply chain information regarding the product is summarized in Table 7. The activity data, background data and data quality are described further in the following sections.

Table 7 – Supply chain information for raw materials.

Material	Parameter	Supply chain information
Cotton	Cotton origin	Punjab region, Pakistan (assumed Faisalabad, Punjab)
	Virgin cotton cultivation method	Organic
	Ginning location	Unknown (assumed nearby the cotton cultivation)
	Yarn spinning method	Ring spinning
	Yarn spinning mill location	Sindh region, Pakistan (assumed Karachi, Sindh)
Polyester	Fibre origin	Punjab region, Pakistan (assumed Faisalabad, Punjab)
	Thread production location	Punjab region, Pakistan (assumed Faisalabad, Punjab)
Elastic	Fibre origin	Punjab region, Pakistan (assumed Faisalabad, Punjab)
	Elastic production location	Punjab region, Pakistan (assumed Faisalabad, Punjab)

5.1.1 Cotton cultivation, ginning and spinning

5.1.1.1 Activity data

The origin of the cotton for the main fabric and the care label differs. Since the care label contributes with less than 0,6% of the overall weight of cotton, it has been assumed that the care label cotton originates from the same source as the main fabric.

The cotton is grown using organic farming methods in Punjab, Pakistan. The exact growing location is unknown but for estimation of transport distances, it is assumed that the cotton is grown near Faisalabad, Punjab, which is a major textile industry hub in Pakistan.

The next step, ginning of seed-cotton to obtain cotton fiber, usually takes place in the same region as the cotton growing. Therefore, it is assumed in this LCA that the ginning also takes place in Faisalabad, Punjab. The transport distance from cotton farm to gin is assumed to be 15 km, which is the distance used by ecoinvent in the datasets for cotton ginning.

The next step after ginning is the spinning of the cotton yarn. The yarn used in the products is ring spun and the spinning mill is located in Sindh, Pakistan, although the specific city is unknown. For estimation of transport distances, it is assumed that the spinning mill is located near Karachi, Sindh. The transport routes and distances from the gin to the spinning mill are estimated with the EcoTransit online tool. The distance from the gin in Faisalabad, Pakistan, to the yarn spinning mill in Karachi, Pakistan, is estimated at 1120 km by truck.

5.1.1.2 Background data

The organic cultivation of cotton is modelled with secondary data, since the factory does not have primary data for their supply chain. A literature search for LCI datasets for organic cotton cultivation was carried out, but it was not possible to find a suitable LCI dataset representing organic cotton growing in Pakistan. Therefore, an Indian dataset from ecoinvent 3.11 for cultivation of organic cotton was used (Seed-cotton, organic {IN-OR}| seed-cotton production, organic | Cut-off, U). The Indian dataset was selected instead of a global dataset, which was also available in the ecoinvent database. This was done for transparency reasons, because the global dataset in ecoinvent was based solely on the Indian dataset.

The ginning process was modelled with an ecoinvent 3.11 dataset for ginning in India, where the electricity mix was changed from India (IN) to Pakistan (PK) (Fibre, cotton {IN}| fibre production, cotton, ginning | Cut-off, U – adapted to PK). Furthermore, the seed-cotton input and its transport were removed from the dataset, since seed-cotton is modelled separately and its transport to the gin is included in the seed-cotton dataset.

The truck transport from ginning to spinning mill was modelled with an ecoinvent 3.11 dataset for unspecified truck in the 'Rest of World' (RoW) geography (Transport, freight, lorry, unspecified {RoW}| market for transport, freight, lorry, unspecified | Cut-off, U).

The yarn spinning process was modelled with an ecoinvent 3.11 dataset for cotton yarn spinning globally, where the electricity mix was changed from Global (GLO) to Pakistan (PK) (Yarn, cotton {GLO}| yarn production, cotton, ring spinning, for weaving | Cut-off, U – adapted to PK). Furthermore, the cotton fiber input was removed from the dataset, since the cotton input and ginning are modelled separately.

5.1.1.3 Data quality

Information about the cotton cultivation region was collected from the product factory and has a good accuracy. Nonetheless, secondary LCI data for the cotton cultivation and ginning steps are not available for Pakistan. Cotton cultivation is a very location specific process, since it is significantly affected by environmental factors such as temperature, rainfall, soil conditions etc. Therefore, the lack of a cotton cultivation dataset for Pakistan makes the geographical representativity low. The ginning process is not location specific, and it was possible to adapt the available dataset from India (IN) to Pakistan (PK) to increase the geographical representativeness. The same is the case for the spinning process which was adapted a global dataset to Pakistan to increase the geographical representativeness. See Table 8 for data quality rating (DQR).

Table 8 – Data quality rating (DQR) for cotton cultivation and ginning in Pakistan (PK). Accuracy is rated for the activity data. Geographical, temporal and technological representativeness is rated for the secondary data used to represent the activity data. DQR based on UN Environment Global Guidance on LCA database development with the following scale: 'very good', 'good', 'fair', 'poor', and 'very poor'. Temporal representativeness is rated as follows: Very good = data is no more than 3 years old, Good = data is no more than 6 years old, Fair = data is no more than 10 years old, Poor = data is no more than 15 years old, Very poor = data is older than 15 years old or unknown.

Activity	Accuracy	Geography	Time	Technology
Cotton growing	Good	Very poor	Fair	Very good
Ginning	Good	Fair	Fair	Very good
Transport of cotton to spinning mill	Good	Fair	Poor	Good
Spinning	Good	Fair	Fair	Very good

5.1.2 Polyester thread supply chain

5.1.2.1 Activity data

The products contain less than 1% polyester thread.

The polyester thread used for the product is produced in Pakistan (fiber production in Pakistan and thread production in Pakistan). No transport is modelled between the processing steps, assuming they take place in the same factory. Transport of PET granules to the polyester fiber production is included with global average distances in the applied ecoinvent datasets.

5.1.2.2 Background data

The polyester fiber production is modelled with secondary data since the factory does not have primary data for their supply chain. The process was modelled with an ecoinvent 3.11 dataset for polyester fiber production in India, where regional inputs (surface water and electricity) were changed from India (IN) to Pakistan (PK) (Fibre, polyester {IN}| polyester fibre production, finished | Cut-off, U – adapted to PK).

5.1.2.3 Data quality

Information about the polyester supply chain for the product was collected from the factory and has a good accuracy since the country and regions for the supply chain steps are known. Nonetheless, secondary LCI data for the supply chain steps are not available for the actual countries and regions. The processing is not location specific, and it was possible to adapt the available dataset to the actual location to increase the geographical representativeness. See Table 9 for data quality rating (DQR).

Table 9 – Data quality rating (DQR) for polyester thread supply chain. Accuracy is rated for the activity data. Geographical, temporal and technological representativeness is rated for the secondary data used to represent the activity data. DQR based on UN Environment Global Guidance on LCA database development with the following scale: 'very good', 'good', 'fair', 'poor', and 'very poor'. Temporal representativeness is rated as follows: Very good = data is no more than 3 years old, Good = data is no more than 6 years old, Fair = data is no more than 10 years old, Poor = data is no more than 15 years old, Very poor = data is older than 15 years old or unknown.

Activity	Accuracy	Geography	Time	Technology
Fiber production	Good	Fair	Fair	Fair

5.1.3 Waistband supply chain

5.1.3.1 Activity data

The waistband is produced in Punjab, Pakistan. The waistband consists of 60% polyester and 40% latex.

5.1.3.2 Background data

The production of the waistband is modelled using three ecoinvent 3.11 datasets – two for polyester and latex, respectively, and one dataset for weaving the materials together to a waistband:

- 0,406 kg *Latex {RoW}| market for latex | Cut-off, U* per kg waistband
- 0,609 kg *Fibre, polyester {GLO}| market for fibre, polyester | Cut-off, U* per kg waistband
- 1 kg *Weaving, synthetic fibre {GLO}| market for weaving, synthetic fibre | Cut-off, U* per kg waistband

The input of materials for 1 kg waistband accounts for 1,5% loss in the weaving process in accordance with the ecoinvent dataset applied for weaving.

5.1.3.3 Data quality

The production location of the waistband is unknown and therefore the geographical representativeness is low. The temporal and technological representativeness are evaluated as fair. See Table 10 for data quality rating (DQR).

Table 10 – Data quality rating (DQR) for waistband supply chain. Accuracy is rated for the activity data. Geographical, temporal and technological representativeness is rated for the secondary data used to represent the activity data. DQR based on UN Environment Global Guidance on LCA database development with the following scale: 'very good', 'good', 'fair', 'poor', and 'very poor'. Temporal representativeness is rated as follows: Very good = data is no more than 3 years old, Good = data is no more than 6 years old, Fair = data is no more than 10 years old, Poor = data is no more than 15 years old, Very poor = data is older than 15 years old or unknown.

Activity	Accuracy	Geography	Time	Technology
Spinning	Good	Poor	Fair	Fair

Phase 1 – unit process overview

Table 11 – Unit processes in phase 1 – raw materials.

Unit process name	Unit process unit	Input	Input unit	ecoinvent dataset	Comment
1.1 Cotton cultivation incl. transport to gin	kg seed-cotton	1	kg	Seed-cotton, organic {GLO}| market for seed-cotton, organic | Cut-off, U	
1.2 Cotton ginning PK	kg cotton fiber	1	kg	Fibre, cotton {IN}| fibre production, cotton, ginning | Cut-off, U – adapted to PK	Background dataset adapted from India to Pakistan.
1.3 Truck transport to spinning mill	tkm	1	tkm	Transport, freight, lorry, unspecified {RoW}| market for transport, freight, lorry, unspecified | Cut-off, U	
1.4 Yarn spinning PK	kg yarn	1	kg	Yarn, cotton {GLO}| yarn production, cotton, ring spinning, for weaving | Cut-off, U – adapted to PK	Background dataset adapted from Global to Pakistan.
1.5 Polyester fiber PK	kg polyester	1	kg	Fibre, polyester {IN}| polyester fibre production, finished | Cut-off, U – adapted to PK	Background dataset adapted from India to Pakistan.
1.6 Waistband supply chain	kg waistband	0,406	kg	Latex {RoW}| market for latex | Cut-off, U	Accounts for 40% of the waistband and 1,5% loss in the weaving process
		0,609	kg	Fibre, polyester {GLO}| market for fibre, polyester | Cut-off, U	Accounts for 60% of the waistband and 1,5% loss in the weaving process
		1	kg	Weaving, synthetic fibre {GLO}| market for weaving, synthetic fibre | Cut-off, U	

Table 12 – Amount of unit processes per product in phase 1 – raw materials.

Unit process name	Unit	PJ1
1.1 Cotton cultivation incl. transport to gin	kg seed-cotton	0,588
1.2 Cotton ginning PK	kg ginning	0,306
1.3 Truck transport to spinning mill	tkm	0,292
1.4 Yarn spinning PK	kg spinning	0,260
1.5 Polyester fiber PK	kg polyester	0,002
1.6 Waistband supply chain	kg waistband	0,006

5.2 Phase 2: Transport of raw materials

Phase 2 "Raw materials" includes the raw material transport from the last processing step of cotton (spinning mill) and from the waistband production facility to the factory. See relevant information about phase 2 in Table 13. The activity data, background data and data quality are described further in the following sections.

Table 13 – Information about the transport routes from spinning mill to textile factory.

Parameter	Transport information
Factory location	Faisalabad, Punjab, Pakistan
Spinning location	Sindh region, Pakistan (assumed Karachi, Sindh)
Transport distance cotton yarn	Karachi-Faisalabad 1120 km
Polyester thread production location	Punjab, Pakistan (assumed Faisalabad, Punjab)
Transport distance polyester thread	Faisalabad-Faisalabad 50 km (assumed distance)
Waistband production location	Punjab, Pakistan (assumed Faisalabad, Punjab)
Transport distance waistband	Faisalabad-Faisalabad 50 km (assumed distance)
Transport secondary dataset	Transport, freight, lorry, unspecified {RoW}| market for transport, freight, lorry, unspecified | Cut-off, U

5.2.1 Activity data

The factory is located in Faisalabad, Punjab, and the yarn spinning facility - which is known to be in Sindh, Pakistan - is assumed to be located in the city of Karachi, Sindh. The transport distance by truck of cotton yarn is estimated at 1120 km. The thread and waistband come from Punjab (assumed Faisalabad), and a distance of 50 km is assumed, since it is within the same city area.

5.2.2 Background data

The truck transport in Pakistan was modelled with an ecoinvent 3.11 dataset for unspecified truck in the 'Rest of World' (RoW) geography (Transport, freight, lorry, unspecified {RoW}| market for transport, freight, lorry, unspecified | Cut-off, U).

See overview of LCI data for phase 2 (Transport of raw materials) in Table 15 and Table 16.

5.2.3 Data quality

The activity data is of fair quality because the factory knows most of the details of the cotton supply chain, which makes up most of the product. See Table 14 for data quality rating (DQR).

Table 14 – Data quality rating (DQR) for transport of raw materials. Accuracy is rated for the activity data. Geographical, temporal and technological representativeness is rated for the secondary data used to represent the activity data. DQR based on UN Environment Global Guidance on LCA database development with the following scale: 'very good', 'good', 'fair', 'poor', and 'very poor'. Temporal representativeness is rated as follows: Very good = data is no more than 3 years old, Good = data is no more than 6 years old, Fair = data is no more than 10 years old, Poor = data is no more than 15 years old, Very poor = data is older than 15 years old or unknown.

Activity	Accuracy	Geography	Time	Technology
Transport by truck	Good	Good	Poor	Good

5.2.4 Phase 2 – unit process overview

Table 15 – Unit processes in phase 2 – transport of raw materials.

Unit process name	Unit process unit	Input	Input unit	ecoinvent dataset	Comment
2.1 Truck transport to textile factory	tkm	1	tkm	Transport, freight, lorry, unspecified {RoW}| market for transport, freight, lorry, unspecified | Cut-off, U	

Table 16 – Amount of unit processes per product in phase 2 – transport of raw materials.

Unit process name	Unit	PJ1
2.1 Truck transport to textile factory	tkm	0,292

5.3 Phase 3: Production

5.3.1 Production inputs and outputs

5.3.1.1 Activity data

The products included in this LCA undergo the following processes in the factory:

1) Sizing
2) Weaving
3) Desizing
4) Wet processing (incl. bleaching and printing)
5) Cut and sew

In the weaving process there is a loss of 1%, while in the cut and sew process there is a loss of 3%. Overall, this means that 1,04 kg of yarn input to the factory is needed to produce 1 kg of product.

Data from the factory has been collected on:

- input of energy and consumables
- output of waste and wastewater
- product flows

The product flows (in kg) at different processing steps in the factory have been used for allocation of the inputs and outputs to the single products. In the factory in 2024:

- 1.517.529 kg fabric was woven
- 12.302.165 kg fabric underwent bleaching (wet processing)
- 4.149.603 kg fabric underwent dyeing (wet processing)
- 4.509.466 kg fabric underwent printing (wet processing)
- 4.866.310 kg fabric underwent cut and sew

A large amount of pre-woven fabric is processed commercially in the factory (i.e. bleached, dyed, printed, cut and sewn).

Inputs of energy, water, materials and chemicals per kg of product are listed in Table 17. Outputs of waste and wastewater per kg of product are listed in Table 18. For a more detailed description of how each input or output flow was determined and allocated to 1 kg of product see Section 10.1 (Appendix).

Table 17 – Energy and consumables per kg of final product

Input	Unit	/kg of product	Source
Electricity from grid	kWh	2,48	Primary data (allocated)
Electricity from solar	kWh	0,16	Primary data (allocated)
Steam from biomass	tons	0,014	Primary data (allocated)
Natural gas	m3	0,099	Primary data (allocated)
Clean water	m3	0,069	Primary data (allocated)
Lubricants	kg	0,0046	Primary data (allocated)
Plastic	kg	0,0075	Calculated from mass balance*
Metal	kg	0,012	Calculated from mass balance*
Paper	kg	0,025	Calculated from mass balance*
Starch for sizing	kg	0,090	Primary data
Enzyme for desizing	kg	0,002	Primary data
Sodium hydroxide for scouring	kg	0,007	Primary data
Hydrogen peroxide for bleaching	kg	0,021	Primary data
Sodium hydroxide for bleaching	kg	0,013	Primary data
Activator for bleaching	kg	0,002	Primary data
Pigment agent	kg	0,15	Primary data (allocated)
Dye agent	kg	-	Primary data (allocated)

* The amount of plastic, metal and paper waste is assumed to enter the factory i.e., misc. packaging etc.

Table 18 – Waste and wastewater per kg of final product

Input	Unit	/kg of product	Source
Plastic waste	kg	0,0075	Primary data (allocated)
Metal waste	kg	0,012	Primary data (allocated)
Paper waste	kg	0,025	Primary data (allocated)
Wastewater	m3	0,083	Primary data (allocated)
Textile waste	kg	0,041	Calculated from loss rate

5.3.1.2 Background data

The electricity consumption from the grid was modelled with an ecoinvent 3.11 dataset for electricity in Pakistan (PK) (Electricity, medium voltage {PK}| market for electricity, medium voltage | Cut-off, U).

The electricity consumption from solar energy was modelled with an ecoinvent 3.11 dataset for solar electricity in the geography 'Rest of World' (RoW) (Electricity, low voltage {RoW}| electricity production, photovoltaic, 3kWp flat-roof installation, multi-Si | Cut-off, U).

The steam from biomass was modelled with an ecoinvent 3.11 dataset for heat from wood chips in the geography 'Rest of World' (RoW) (Heat, central or small-scale, other than natural gas {RoW}| heat production, wood chips from industry, at furnace 50kW | Cut-off, U). 1600 MJ of that dataset was used for 1 ton of steam, based on low pressure saturated steam according to TSE (N.D).

The natural gas for heating was modelled with an ecoinvent 3.11 dataset for heat production from natural gas in the geography 'Rest of World' (RoW) where the electricity mix was changed from various geographies to Pakistan (PK) (Heat, central or small-scale, natural gas {RoW}| heat production, natural gas, at boiler modulating <100kW | Cut-off, U – adapted to PK). The unit for this dataset is MJ, while the natural gas consumption in the factory is defined in mmBTU. Conversion from mmBTU to m^3 natural gas was carried out (28,26 m^3 natural gas per mmBTU according to Index Mundi, (n.d.)). Then the amount of m^3 natural gas needed to produce 1 MJ heat was taken from within the dataset (0,029 m^3 natural gas/MJ) to define the amount of MJ of the dataset required to represent the consumption of 1 m^3 natural gas in the factory (34,6 MJ/kg).

The water consumption was modelled with an ecoinvent 3.11 dataset for tap water in the geography 'Rest of World' (RoW) (Tap water {RoW}| market for tap water | Cut-off, U).

The consumption of lubricants was modelled with an ecoinvent 3.11 dataset for lubricating oil the geography 'Rest of World' (RoW) (Lubricating oil {RoW}| market for lubricating oil | Cut-off, U).

Starch for sizing was modelled with an ecoinvent 3.11 dataset for maize starch in the geography 'Global' (GLO) (Maize starch {GLO}| market for maize starch | Cut-off, U).

Enzyme for desizing was modelled with an ecoinvent 3.11 dataset for enzymes in the geography 'Global' (GLO) (Enzymes {GLO}| market for enzymes | Cut-off, U).

Sodium hydroxide for scouring and for bleaching was modelled with an ecoinvent 3.11 dataset for sodium hydroxide in the geography 'Rest of World' (RoW) (Sodium hydroxide, without water, in 50% solution state {RoW}| market for sodium hydroxide, without water, in 50% solution state | Cut-off, U).

Hydrogen peroxide (H_2O_2) for bleaching was modelled with an ecoinvent 3.11 dataset for hydrogen peroxide in the geography 'Rest of World' (RoW) (Hydrogen peroxide, without water, in 50% solution state {RoW}| hydrogen peroxide production, product in 50% solution state | Cut-off, U).

Stabilizer for bleaching was modelled with an ecoinvent 3.11 dataset for sodium silicate (a typical stabilizer agent) in the geography 'Rest of World' (RoW) (Sodium silicate, without water, in 48% solution state {RoW}| market for sodium silicate, without water, in 48% solution state | Cut-off, U).

Pigment and dye were modelled with an ecoinvent 3.11 dataset for generic organic chemicals in the geography 'Global' (GLO) (Chemical, organic {GLO}| market for chemical, organic | Cut-off, U).

The disposal of plastic waste was modelled with an ecoinvent 3.11 dataset for disposal of waste polyethylene in the geography 'Rest of World' (RoW) (Waste polyethylene {RoW}| market for waste polyethylene | Cut-off, U).

The disposal of metal waste was modelled with an ecoinvent 3.11 dataset for disposal of scrap steel in the geography 'Rest of World' (RoW) (Scrap steel {RoW}| market for scrap steel | Cut-off, U).

The disposal of paper waste was modelled with an ecoinvent 3.11 dataset for disposal of paperboard in the geography 'Rest of World' (RoW) (Waste paperboard {RoW}| market for waste paperboard | Cut-off, U).

The disposal of textile waste was modelled with an ecoinvent 3.11 dataset for disposal of soiled textile in the geography 'Rest of World' (RoW) (Waste textile, soiled {RoW}| market for waste textile, soiled | Cut-off, U).

The disposal of dye-polluted wastewater was modelled with an ecoinvent 3.11 dataset for disposal of soiled textile in the geography 'Global' (GLO) (Wastewater from textile production {GLO}| market for wastewater from textile production | Cut-off, U).

The input of plastics to the factory was modelled with an ecoinvent 3.11 dataset for LDPE film in the geography 'Global' (GLO) (Packaging film, low density polyethylene {GLO}| market for packaging film, low density polyethylene | Cut-off, U).

The input of metals to the factory was modelled with an ecoinvent 3.11 dataset for low-alloyed steel in the geography 'Global' (GLO) (Steel, low-alloyed {GLO}| market for steel, low-alloyed | Cut-off, U).

The input of paper to the factory was modelled with an ecoinvent 3.11 dataset for woodfree paper in the geography 'Rest of World' (RoW) (Paper, woodfree, uncoated {RoW}| market for paper, woodfree, uncoated | Cut-off, U).

See overview of LCI data for phase 3 (production) in Table 22 and Table 23.

5.3.1.3 Data quality

The data quality rating for the production phase can be seen in Table 19. Overall, the data accuracy and technological representativeness of background data is good, while the geographical and temporal representativeness is poor.

Table 19 – Data quality rating (DQR) for production. Accuracy is rated for the activity data. Geographical, temporal and technological representativeness is rated for the secondary data used to represent the activity data. DQR based on UN Environment Global Guidance on LCA database development with the following scale: 'very good', 'good', 'fair', 'poor', and 'very poor'. Temporal representativeness is rated as follows: Very good = data is no more than 3 years old, Good = data is no more than 6 years old, Fair = data is no more than 10 years old, Poor = data is no more than 15 years old, Very poor = data is older than 15 years old or unknown.

Activity	Accuracy	Geography	Time	Technology
Electricity from grid	Good	Very good	Very good	Very good
Electricity from solar	Good	Poor	Fair	Very good
Steam from biomass	Good	Poor	Fair	Fair
Natural gas	Good	Poor	Poor	Good
Clean water	Good	Poor	Poor	Good
Lubricant	Good	Poor	Poor	Good
Starch for sizing	Good	Poor	Poor	Good
Enzyme for desizing	Good	Poor	Good	Fair
Acid for desizing	Good	Poor	Poor	Good
Sodium hydroxide for scouring	Poor	Poor	Poor	Very good
Hydrogen peroxide for bleaching	Good	Poor	Good	Very good
Sodium hydroxide for bleaching	Poor	Poor	Poor	Very good
Sodium silicate for bleaching	Poor	Poor	Poor	Very good
Dye/pigment	Good	Poor	Poor	Poor
Plastic waste	Good	Poor	Poor	Good
Metal waste	Good	Poor	Poor	Good
Paper waste	Good	Poor	Poor	Good
Textile waste	Good	Poor	Poor	Good
Wastewater treatment	Good	Poor	Poor	Good
Plastic input	Fair	Poor	Poor	Good
Metal input	Fair	Poor	Poor	Good
Paper input	Fair	Poor	Poor	Good

5.3.2 Product packaging

5.3.2.1 Activity data

The amount of packaging per product can be seen in Table 20.

Table 20 Product packaging composition (grams)

LCA ID	Consumer packaging		Freight packaging	
	Belly band (printed cardboard)	Stiffener (cardboard)	Polybag (LDPE)	Box (cardboard)
PJ1	16	80	0,5	63

5.3.2.2 Background data

The stiffener cardboard and freight box were modelled with an ecoinvent 3.11 dataset for cardboard box in the 'Rest of World' (RoW) geography (Corrugated board box {RoW}| market for corrugated board box | Cut-off, U).

The bellyband which is printed was modelled with an ecoinvent 3.11 dataset for printed carton board in the 'Global' (GLO) geography (Carton board box production, with offset printing {GLO}| market for carton board box production, with offset printing | Cut-off, U).

The poly bag was modelled with an ecoinvent 3.11 dataset for LDPE packaging film in the 'Global' (GLO) geography (Packaging film, low density polyethylene {GLO}| market for packaging film, low density polyethylene | Cut-off, U).

See overview of LCI data for phase 3 (production) in Table 22 and Table 23.

5.3.2.3 Data quality

The accuracy of the activity data is very good. The geographical and temporal representativeness is poor-very poor and the technological representativeness is good. See Table 21 for data quality rating (DQR).

Table 21 – Data quality rating (DQR) for product packaging. Accuracy is rated for the activity data. Geographical, temporal and technological representativeness is rated for the secondary data used to represent the activity data. DQR based on UN Environment Global Guidance on LCA database development with the following scale: 'very good', 'good', 'fair', 'poor', and 'very poor'. Temporal representativeness is rated as follows: Very good = data is no more than 3 years old, Good = data is no more than 6 years old, Fair = data is no more than 10 years old, Poor = data is no more than 15 years old, Very poor = data is older than 15 years old or unknown.

Activity	Accuracy	Geography	Time	Technology
Unprinted cardboard	Very good	Very poor	Poor	Good
Printed cardboard	Very good	Very poor	Poor	Good
LDPE bag	Very good	Very poor	Poor	Good

5.3.3 Phase 3 – unit process overview

Table 22 – Unit processes in phase 3 – production.

Unit process name	Unit process unit	Input	Input unit	ecoinvent dataset	Comment
3.01 Electricity from grid	kWh	1	kWh	Electricity, medium voltage {PK}| market for electricity, medium voltage | Cut-off, U	
3.02 Electricity from solar	kWh	1	kWh	Electricity, low voltage {RoW}| electricity production, photovoltaic, 3kWp flat-roof installation, multi-Si | Cut-off, U	
3.03 Steam from biomass	tons	2600	MJ	Heat, central or small-scale, other than natural gas {RoW}| heat production, wood chips from industry, at furnace 50kW | Cut-off, U	Assuming low pressure saturated steam at 100 ˚C, which requires 2.6 GJ/ton (TSA, N.D).
3.04 Natural gas	m^3	34,6	MJ	Heat, central or small-scale, natural gas {RoW}| heat production, natural gas, at boiler modulating <100kW | Cut-off, U – adapted to PK	0,0289 m^3 natural gas/MJ according to dataset. 1/(0,0289 m^3/MJ) = 34,6 MJ/m^3.
3.05 Water consumption	m^3	1000	kg	Tap water {RoW}| market for tap water | Cut-off, U	
3.06 Lubricant	kg	1	kg	Lubricating oil {RoW}| market for lubricating oil | Cut-off, U	
3.07.1 Starch for sizing	kg	1	kg	Maize starch {GLO}| market for maize starch | Cut-off, U	
3.07.2 Enzymes for desizing	kg	1	kg	Enzymes {GLO}| market for enzymes | Cut-off, U	
3.07.4 NaOH for scouring	kg	1	kg	Sodium hydroxide, without water, in 50% solution state {RoW}| market for sodium hydroxide, without water, in 50% solution state | Cut-off, U	
3.08.1 H2O2 for bleaching	kg	1	kg	Hydrogen peroxide, without water, in 50% solution state {RoW}| hydrogen peroxide production, product in 50% solution state | Cut-off, U	
3.08.2 NaOH for bleaching	kg	1	Kg	Sodium hydroxide, without water, in 50% solution state {RoW}| market for sodium hydroxide, without water, in 50% solution state | Cut-off, U	

Unit process name	Unit process unit	Input	Input unit	ecoinvent dataset	Comment
3.08.3 Activator for bleaching	kg	1	kg	Sodium silicate, without water, in 48% solution state {RoW}| market for sodium silicate, without water, in 48% solution state | Cut-off, U	
3.10 Pigment/dye	kg	1	kg	Chemical, organic {GLO}| market for chemical, organic | Cut-off, U	
3.11 Plastic waste	kg	1	kg	Waste polyethylene {RoW}| market for waste polyethylene | Cut-off, U	
3.12 Metal waste	kg	1	kg	Scrap steel {RoW}| market for scrap steel | Cut-off, U	
3.13 Paper waste	kg	1	kg	Waste paperboard {RoW}| market for waste paperboard | Cut-off, U	
3.14 Textile waste	kg	1	kg	Waste textile, soiled {RoW}| market for waste textile, soiled | Cut-off, U	
3.15 Wastewater dye-polluted	m^3	1	m^3	Wastewater from textile production {GLO}| market for wastewater from textile production | Cut-off, U	
3.16 Packaging - printed cardboard	kg	1	kg	Carton board box production, with offset printing {GLO}| market for carton board box production, with offset printing | Cut-off, U	
3.17 Packaging - unprinted cardboard	kg	1	kg	Corrugated board box {RoW}| market for corrugated board box | Cut-off, U	
3.18 Packaging - LDPE	kg	1	kg	Packaging film, low density polyethylene {GLO}| market for packaging film, low density polyethylene | Cut-off, U	
3.19 Other material inputs - plastic	kg	1	kg	Packaging film, low density polyethylene {GLO}| market for packaging film, low density polyethylene | Cut-off, U	
3.20 Other material inputs - metal	kg	1	kg	Steel, low-alloyed {GLO}| market for steel, low-alloyed | Cut-off, U	
3.21 Other material inputs - paper	kg	1	kg	Paper, woodfree, uncoated {RoW}| market for paper, woodfree, uncoated | Cut-off, U	

Table 23 – Amount of unit processes per product in phase 3 – production.

Unit process name	Unit	PJ1
3.01 Electricity from grid	kWh	0,621
3.02 Electricity from solar	kWh	0,041
3.03 Steam from biomass	ton	0,003
3.04 Natural gas	m^3	0,025
3.05 Water consumption	m^3	0,017
3.06 Lubricant	kg	0,001
3.07.1 Starch for sizing	kg	0,023
3.07.2 Enzymes for desizing	kg	0,0004
3.07.4 NaOH for scouring	kg	0,002
3.08.1 H2O2 for bleaching	kg	0,005
3.08.2 NaOH for bleaching	kg	0,003
3.08.3 Activator for bleaching	kg	0,001
3.10 Pigment/dye	kg	0,050
3.11 Plastic waste	kg waste	0,002
3.12 Metal waste	kg waste	0,003
3.13 Paper waste	kg waste	0,006
3.14 Textile waste	kg waste	0,010
3.15 Wastewater dye-polluted	kg wastewater	0,021
3.16 Packaging - printed cardboard	kg cardboard	0,016
3.17 Packaging - unprinted cardboard	kg cardboard	0,143
3.18 Packaging - LDPE	kg LDPE	0,001
3.19 Other material inputs - plastic	kg plastic	0,002
3.20 Other material inputs - metal	kg metal	0,003
3.21 Other material inputs - paper	kg paper	0,006

5.4 Phase 4: Distribution

Phase 4 "Distribution" is divided into four sections:

1) Transport to retail in Denmark
2) Warehouse and retail
3) Disposal of freight packaging
4) Transport to consumer

The products are sold in stores all over Denmark. The distribution phase is based on a representative scenario, where the products are sold at a retail store in Odense, Denmark. Odense was selected because the city has a central location in Denmark.

Relevant information regarding distribution is summarized in Table 24. The activity data, background data and data quality are described further in the following sections.

Table 24 Relevant information regarding distribution of products

Parameter	Information
Transport from factory to retail in Denmark	Leg 1: 1.120 km by truck (Factory in Faisalabad, Pakistan to port in Karachi, Pakistan). Leg 2: 12.200 km by ship from port in Karachi, Pakistan to port in Copenhagen, Denmark. Leg 3: 50 km truck transport from port in Copenhagen, Denmark to warehouse in Køge, Denmark. Leg 4: 140 km truck transport from warehouse in Køge, Denmark, to retail in Odense, Denmark.
Warehouse	Ambient storage in warehouse located in Køge. The products are assumed to take up four times the space of their actual volume. The products are expected to spend 4 weeks in the warehouse. Total warehouse capacity in 'm^3-weeks' is estimated based on PEF standard scenarios. Electricity and heating included based on the capacity taken up by each product.
Retail	Ambient storage in retail store located in Odense. The products are assumed to take up four times the space of their actual volume. The products are expected to spend 5 weeks in the retail store. Total retail store capacity in 'm^3-weeks' is estimated based on PEF standard scenarios. Electricity included based on the capacity taken up by each product.
Transport to consumer	5 km by small passenger car assumed

5.4.1 Transport to retail in Denmark

5.4.1.1 Activity data

The products are transported from the factory in Faisalabad to the Karachi port in Pakistan by truck (1120 km). From the port in Karachi, the products are transported by container ship to the port in Copenhagen (12.200 km). From the port in Copenhagen, the products are transport by truck to the warehouse in Køge (50 km). From the warehouse in Køge, the products are transported to a retail store in Odense, Denmark (140 km). The truck transport distances are estimated using the EcoTransit online tool. The sea distance was calculated using the searates.org online tool, since EcoTransit would not estimate the specific sea route.

The weight of packaging is included in the transported weight when calculating the ton-kilometers for each mode of transport.

5.4.1.2 Background data

The truck transport in Pakistan was modelled with an ecoinvent 3.11 dataset for unspecified truck in the 'Rest of World' (RoW) geography (Transport, freight, lorry, unspecified {RoW}| market for transport, freight, lorry, unspecified | Cut-off, U).

The ship transport was modelled with an ecoinvent 3.11 dataset for global container shipping (Transport, freight, sea, container ship {GLO}| transport, freight, sea, container ship | Cut-off, U).

The truck transport in Denmark was modelled with an ecoinvent 3.11 dataset for >32 ton, EURO 4 truck in the 'Rest of Europe' (RER) geography (Transport, freight, lorry >32 metric ton, EURO4 {RER}| transport, freight, lorry >32 metric ton, EURO4 | Cut-off, U).

See overview of LCI data for phase 4 (distribution) in Table 30 and Table 31.

5.4.1.3 Data quality

The accuracy of activity data is very good since Mørkegaard knows the exact locations of each distribution step until the selected retail store. The geographical representativeness is good overall, with the datasets representing larger regions, where the exact locations fall under. The temporal representativeness is rated as poor-fair, since the original data used for the ecoinvent datasets are a little old, however ecoinvent extrapolates the data yearly to increase the temporal representativeness. The technological representativeness is rated as good. See Table 14 for data quality rating (DQR).

Table 25 – Data quality rating (DQR) for product transport to Denmark. Accuracy is rated for the activity data. Geographical, temporal and technological representativeness is rated for the secondary data used to represent the activity data. DQR based on UN Environment Global Guidance on LCA database development with the following scale: 'very good', 'good', 'fair', 'poor', and 'very poor'. Temporal representativeness is rated as follows: Very good = data is no more than 3 years old, Good = data is no more than 6 years old, Fair = data is no more than 10 years old, Poor = data is no more than 15 years old, Very poor = data is older than 15 years old or unknown.

Activity	Accuracy	Geography	Time	Technology
Truck transport Pakistan	Very good	Good	Poor	Good

Activity	Accuracy	Geography	Time	Technology
Ship transport	Very good	Good	Poor	Good
Truck transport Denmark	Very good	Good	Fair	Good

5.4.2 Warehouse and retail

5.4.2.1 Activity data

Energy consumption for warehousing and retail is included in the LCA based on standard scenarios defined in the Product Environmental Footprint (PEF) Method (PEF, 2021) and the pilot PEF category rules (PEFCR) (PEFCR, 2018).

Warehousing: According to PEF (2021) the electricity consumption for an average distribution center is 30 kWh/m^2/yr, while the heating consumption is 360 MJ/m^2/yr. The heating is assumed to come from natural gas. An average distribution center has a size of 30.000 m^2 and a storage volume of 60.000 m^3 (PEF, 2021; PEFCR, 2018). The total electricity consumption for a year is calculated as 900.000 kWh, and the total heating consumption for a year is calculated as 10.800.000 MJ. The specific storage volume is calculated to be 3.120.000 m^3-weeks. The specific electricity consumption is calculated as 0,29 kWh/m^3-week, and the specific heating consumption is calculated as 3,46 MJ/m^3-week.

Retail: According to PEF (2021) the electricity consumption for an average retail store is 150 kWh/m^2/yr. An average retail store center has a size of 2.000 m^2 and a storage volume of 2.000 m^3 (PEF, 2021; PEFCR, 2018). The total electricity consumption for a year is calculated as 300.000 kWh. The specific storage volume is calculated to be 104.000 m^3-weeks. The specific electricity consumption is calculated as 2,88 kWh/m^3-week.

The storage occupancy of each product is determined based on its actual volume times four based on PEFCR (2018) guidelines. The specific storage occupancy in m^3-weeks is then calculated based on the average time the product spends in storage, which is expected to be four weeks in warehouse and five weeks in the retail store. See specific occupancy of each product in Table 26 for warehousing and retail, respectively.

Table 26 – Occupancy rates for the product in the LCA for warehouse.

LCA ID	Storage occupancy* (m^3)	Storage time warehouse	Storage time retail	Specific storage occupancy warehouse (m^3-weeks)	Specific storage occupancy retail (m^3-weeks)
PJ1	0,012	4	5	0,05	0,06

* Estimated as four times the actual volume of the products

5.4.2.2 *Background data*

The electricity consumed at the warehouse and the retail store was modelled with an ecoinvent 3.11 dataset for Danish residual electricity mix (Electricity, low voltage {DK}| electricity, low voltage, residual mix | Cut-off, U).

The heating consumed at the warehouse was modelled with an ecoinvent 3.11 dataset for heating from natural gas in Denmark (Heat, district or industrial, natural gas {DK}| heat and power co-generation, natural gas, combined cycle power plant, 400MW electrical | Cut-off, U).

See overview of LCI data for phase 4 (distribution) in Table 30 and Table 31.

5.4.2.3 *Data quality*

The activity data is of fair quality because this phase is based on a standard scenario, meaning no data was collected for the actual warehouse and retail store that the products go to. The geographical representativeness of the secondary is rated as very good, since they are representative for Denmark. See Table 27 for data quality rating (DQR).

Table 27 – Data quality rating (DQR) for warehouse and retail energy consumption. Accuracy is rated for the activity data. Geographical, temporal and technological representativeness is rated for the secondary data used to represent the activity data. DQR based on UN Environment Global Guidance on LCA database development with the following scale: 'very good', 'good', 'fair', 'poor', and 'very poor'. Temporal representativeness is rated as follows: Very good = data is no more than 3 years old, Good = data is no more than 6 years old, Fair = data is no more than 10 years old, Poor = data is no more than 15 years old, Very poor = data is older than 15 years old or unknown.

Activity	Accuracy	Geography	Time	Technology
Electricity for warehouse	Fair	Very good	Good	Very good
Heating for warehouse	Fair	Very good	Good	Good
Electricity for retail	Fair	Very good	Good	Very good

5.4.3 Disposal of freight packaging

5.4.3.1 *Activity data*

The freight packaging is disposed of after distribution. The amount of freight packaging (cardboard box and LDPE polybag) per product can be seen in Table 20.

5.4.3.2 *Background data*

The disposal of cardboard box was modelled with an ecoinvent 3.11 dataset for waste paperboard disposal in Denmark (Waste paperboard {DK}| market for waste paperboard | Cut-off, U).

The disposal of LDPE polybag was modelled with an ecoinvent 3.11 dataset for waste polyethylene disposal in Denmark (Waste polyethylene {DK}| market for waste polyethylene | Cut-off, U).

See overview of LCI data for phase 4 (distribution) in Table 30 and Table 31.

5.4.3.3 Data quality

The activity data is of very good quality because the packaging weight is based on the actual packaging designs. The secondary datasets are geographically representative of Denmark and waste fractions very similar to the packaging materials. See

Table 28 for data quality rating (DQR).

Table 28 – Data quality rating (DQR) for disposal of freight packaging. Accuracy is rated for the activity data. Geographical, temporal and technological representativeness is rated for the secondary data used to represent the activity data. DQR based on UN Environment Global Guidance on LCA database development with the following scale: 'very good', 'good', 'fair', 'poor', and 'very poor'. Temporal representativeness is rated as follows: Very good = data is no more than 3 years old, Good = data is no more than 6 years old, Fair = data is no more than 10 years old, Poor = data is no more than 15 years old, Very poor = data is older than 15 years old or unknown.

Activity	Accuracy	Geography	Time	Technology
Cardboard disposal	Very good	Very good	Good	Good
LDPE disposal	Very good	Very good	Good	Good

5.4.4 Transport to consumer

5.4.4.1 Activity data

Transport to the consumer is based on a 5 km round trip in a personal car. It was assumed that the consumer purchased 10 kg of goods, so the 5 km round trip was distributed across that amount of goods.

5.4.4.2 Background data

The transport to consumer home was modelled with an ecoinvent 3.11 dataset for a small petrol car in Europe (Transport, passenger car, small size, petrol, EURO 5 {RER}| transport, passenger car, small size, petrol, EURO 5 | Cut-off, U). See overview of LCI data for phase 4 (distribution) in Table 30 and Table 31.

5.4.4.3 Data quality

The activity data for this process is of very low quality since the distances travelled, and the amount of goods purchased per trip is highly variable. Therefore, it is based on an estimated scenario. See Table 29 for data quality rating (DQR).

Table 29 – Data quality rating (DQR) for product transport to consumer home. Accuracy is rated for the activity data. Geographical, temporal and technological representativeness is rated for the secondary data used to represent the activity data. DQR based on UN Environment Global Guidance on LCA database development with the following scale: 'very good', 'good', 'fair', 'poor', and 'very poor'. Temporal representativeness is rated as follows: Very good = data is no more than 3 years old, Good = data is no more than 6 years old, Fair = data is no more than 10 years old, Poor = data is no more than 15 years old, Very poor = data is older than 15 years old or unknown.

Activity	Accuracy	Geography	Time	Technology
Car transport	Very low	Good	Good	Fair

5.4.5 Phase 4 – unit process overview

Table 30 – Unit processes in phase 4 – distribution.

Unit process name	Unit process unit	Input	Input unit	ecoinvent dataset	Comment
4.2 Transport of product to retail	kg product incl. packaging	1,12	tkm	Transport, freight, lorry, unspecified {RoW}| market for transport, freight, lorry, unspecified | Cut-off, U	Faisalabad - Karachi port (1120 km)
		12,2	tkm	Transport, freight, sea, container ship {GLO}| transport, freight, sea, container ship | Cut-off, U	Karachi port - Copenhagen port (12200 km)
		0,19	tkm	Transport, freight, lorry >32 metric ton, EURO4 {RER}| transport, freight, lorry >32 metric ton, EURO4 | Cut-off, U	Copenhagen port - Køge - Odense (50 km + 140 km)
4.3 Warehouse	m^3-weeks	0,29	kWh	Electricity, low voltage {DK}| electricity, low voltage, residual mix | Cut-off, U	
		3,46	MJ	Heat, district or industrial, natural gas {DK}| heat and power co-generation, natural gas, combined cycle power plant, 400MW electrical | Cut-off, U	
4.4 Retail	m^3-weeks	2,88	kWh	Electricity, low voltage {DK}| electricity, low voltage, residual mix | Cut-off, U	
4.5 Freight packaging disposal cardboard	kg	1	kg	Waste paperboard {DK}| market for waste paperboard | Cut-off, U	
4.6 Freight packaging disposal LDPE	kg	1	kg	Waste polyethylene {DK}| market for waste polyethylene | Cut-off, U	
4.7 Transport to consumer home	kg product incl. packaging	0,5	km	Transport, passenger car, small size, petrol, EURO 5 {RER}| transport, passenger car, small size, petrol, EURO 5 | Cut-off, U	5 km divided by 10 kg of goods

Table 31 – Amount of unit processes per product in phase 4 – distribution.

Unit process name	Unit	PJ1
4.2 Transport of product to retail	kg product incl. packaging	0,409
4.3 Warehouse	m^3-weeks	0,019
4.4 Retail	m^3-weeks	0,024
4.5 Freight packaging disposal cardboard	kg	0,063
4.6 Freight packaging disposal LDPE	kg	0,001
4.7 Transport to consumer home	kg product incl. packaging	0,346

5.5 Phase 5: Use of product

Phase 5 "Use of product" is divided into two sections:

1) Washing and drying
2) Disposal of consumer packaging

Relevant information regarding the use phase is summarized in Table 24. The activity data, background data and data quality are described further in the following sections.

Table 32 Relevant information regarding use of the product

Parameter	Information
Product life time and washing/drying frequency	Based on literature values. Pyjamas pants are assumed to be washed 14 times in their lifetime based on PEFCR Apparel & Footwear (2025)). This is a rough estimate and may vary depending on specific use cases. For example, the number of times the consumer wears the pants between wash cycles may vary. The data used for the use phase in this LCA are based on literature values which introduces uncertainty in the environmental impact of the products in their lifetime. This should be noted when interpreting the results. The sensitivity of the number of washes in the lifetime has been evaluated in a sensitivity analysis – see section 7.2.3.
Washing scenario	Assumed that the products are machine washed
Drying scenario	Assumed that 58% of the products are dried in a washing/drying machine, and 42% are air dried based on DST (2023). Energy consumption for washing/drying machine based on EU Ecodesign benchmark for 7 kg machine as defined in (EU) 2019/2023.

5.5.1 Washing and drying

5.5.1.1 Activity data

The number of use and wash cycles in the lifetime of the products is based on average values for pants according to PEFCR Apparel & Footwear (2025). According to this source pants are used 70 times in their average lifetime, which can be divided between several users. Furthermore, it states that pants made of non-animal fibres are on average washed after every 5 uses. This means that the number of washing cycles in the lifetime is 14 (70 uses/5 uses per washing cycle = 14 washing cycles).

Based on DST (2023) it was assumed that 42% of the cycles were in a washing machine combined with air drying and 58% of the cycles were in a washer-dryer. According to this statistic approximately 58% of the Danish households had a dryer in 2023.

The electricity and water consumption per cycle was taken from (EU) 2019/2023 laying down ecodesign requirements for household washing machines and household washer-dryers. The benchmark established for washing machines with a load capacity of 7 kg and washer-dryers with a load capacity of 7 kg were used. The washing in a washing machine requires 0,8 kWh/cycle and 72 L water/cycle with 7 kg textiles, while washing-drying in a washer-dryer requires 4,76 kWh/cycle and 72 L water/cycle with 7 kg textiles. These benchmarks are based on a "cotton 60 degrees" program.

The amount of detergent per kg laundry was estimated based on the ecoinvent 3.11 dataset "Washing, drying and finishing laundry {GLO}| washing, drying and finishing laundry | Cut-off, U".

5.5.1.2 Background data

The water consumption was modelled with the following ecoinvent 3.11 dataset: Tap water {Europe without Switzerland}| tap water production, direct filtration treatment | Cut-off, U.

The detergent consumption was modelled with the following ecoinvent 3.11 dataset: Non-ionic surfactant {GLO}| market for non-ionic surfactant | Cut-off, U.

The electricity consumption was modelled with the following ecoinvent 3.11 dataset: Electricity, low voltage {DK}| market for electricity, low voltage | Cut-off, U.

See overview of LCI data for phase 5 (use of product) in Table 35 and Table 36.

5.5.1.3 Data quality

The activity data is of fair quality because this phase is based on a standard scenario, but the ecodesign benchmark is considered a good approximation. The geographical representativeness of the secondary datasets varies (very good for electricity, good for water use and very low for detergent use). See Table 33 for data quality rating (DQR).

Table 33 – Data quality rating (DQR) for product washing and drying. Accuracy is rated for the activity data. Geographical, temporal and technological representativeness is rated for the secondary data used to represent the activity data. DQR based on UN Environment Global Guidance on LCA database development with the following scale: 'very good', 'good', 'fair', 'poor', and 'very poor'. Temporal representativeness is rated as follows: Very good = data is no more than 3 years old, Good = data is no more than 6 years old, Fair = data is no more than 10 years old, Poor = data is no more than 15 years old, Very poor = data is older than 15 years old or unknown.

Activity	Accuracy	Geography	Time	Technology
Electricity use	Fair	Very good	Good	Very good
Water use	Fair	Good	Poor	Good
Detergent use	Fair	Very low	Fair	Fair

5.5.2 Disposal of consumer packaging

5.5.2.1 Activity data

The consumer packaging is disposed of by the consumer. The amount of consumer packaging per product can be seen in Table 20.

5.5.2.2 Background data

The disposal of cardboard was modelled with an ecoinvent 3.11 dataset for waste paperboard disposal in Denmark (Waste paperboard {DK}| market for waste paperboard | Cut-off, U). See overview of LCI data for phase 5 (use of product) in Table 35 and Table 36.

5.5.2.3 Data quality

The activity data is of very good quality because the packaging weight is based on the actual packaging designs. The secondary dataset is geographically representative of Denmark, and the waste fraction is very similar to the packaging material. See Table 34 for data quality rating (DQR).

Table 34 – Data quality rating (DQR) for disposal of consumer packaging. Accuracy is rated for the activity data. Geographical, temporal and technological representativeness is rated for the secondary data used to represent the activity data. DQR based on UN Environment Global Guidance on LCA database development with the following scale: 'very good', 'good', 'fair', 'poor', and 'very poor'. Temporal representativeness is rated as follows: Very good = data is no more than 3 years old, Good = data is no more than 6 years old, Fair = data is no more than 10 years old, Poor = data is no more than 15 years old, Very poor = data is older than 15 years old or unknown.

Activity	Accuracy	Geography	Time	Technology
Cardboard disposal	Very good	Very good	Good	Good

5.5.3 Phase 5 – unit process overview

Table 35 – Unit processes in phase 5 – use of product.

Unit process name	Unit process unit	Input	Input unit	ecoinvent dataset	Comment
5.1 Washing and drying	kg-cycle	10,3	kg	Tap water {Europe without Switzerland}| tap water production, direct filtration treatment | Cut-off, U	72 liter water per 7 kg cycle
		0,011	kg	Non-ionic surfactant {GLO}| market for non-ionic surfactant | Cut-off, U	
		0,40	kWh	Electricity, low voltage {DK}| market for electricity, low voltage | Cut-off, U	58% of the cycles with washing-drying machine: 4,76 kWh/7 kg cycle 42% of the cycles with washing machine and air drying: 0,8 kWh/7 kg cycle
5.2 Consumer packaging disposal	kg cardboard packaging	1,00	kg	Waste paperboard {DK}| market for waste paperboard | Cut-off, U	

Table 36 – Amount of unit processes per product in phase 5 – use of product.

Unit process name	Unit	PJ1
5.1 Washing and drying	kg-cycle	12,500
5.2 Consumer packaging disposal	kg cardboard packaging	0,096

5.6 Phase 6: End-of-life of product

5.6.1 Activity data

In DEA (2023) the Danish Energy Agency has attempted to make a mass flow analysis of the fate of textiles at their end-of-life in Denmark. In this mass flow analysis, it is estimated that 57% of textiles are discarded in the mixed waste while 43% are collected separately.

The 57% of textiles which are discarded in the mixed waste end up in Danish waste-to-energy (incineration) plants.

Out of the 43% textiles which are collected separately, 28% are reused, 6% end up in Danish waste-to-energy (incineration) plants, 2% are recycled in Denmark and 63% are exported. In this LCA reuse is not considered as an option at the end-of-life because the number of uses included in the LCA (70 uses) are already accounting for reuse.

. Therefore, the distribution among incineration, recycling and export is scaled to 100% thereby dividing the reuse among other treatment methods. This results in the following fate for the textiles collected separately: 9% end up in Danish waste-to-energy (incineration) plants, 3% are recycled in Denmark and 88% are exported.

Of the exported waste 10% are incinerated and 90% are either reused or recycled – in this LCA it is assumed that all 90% of this fraction are recycled rather than reused. When adding up the treatment methods, this means that overall:

- 64% of the textile waste is incinerated
- 36% of the textile waste is recycled

Out of all the textiles which end up being incinerated, 94% of them are incinerated in Denmark. Therefore, a process for incineration in Denmark is modelled.

The process flow includes collection and transport to incineration facility, and the incineration process. The distance is estimated to be 41,5 km (0,0415 tkm/kg waste sent to incineration) based on data from Eurostat included in the ecoinvent dataset for mixed municipal waste in Denmark.

Out of all the textiles which end up being recycled, 96% of them are recycled outside of Denmark. Therefore, a process for textile recycling outside of Denmark is modelled.

The process flow was adapted from information from Københavns Kommune (2025). According to this source the textile collected in Copenhagen is first presorted locally, then transported to Poland where it is sorted and sold to recycling companies. For simplicity it is assumed that the recycling process (incl. shredding and baling) also takes place in

Poland. The presorting process in Copenhagen and sorting process in Poland is assumed to consume 16,9 kWh/ton textile waste each based on a report evaluating textile recycling in a Swedish context (IVL, 2022). For shredding and baling of the sorted textiles an energy consumption of 552 kWh/ton waste is assumed based on a more recent study in the mechanical recycling of textiles in a Swedish context (IVL, 2024). The distance to presorting in Denmark is estimated to be 41,5 km (0,0415 tkm/kg waste) based on data from Eurostat included in the ecoinvent dataset for mixed municipal waste in Denmark.

The sorting and recycling location in Poland is unknown. A city located centrally in Poland (Lodz) is used for calculating the transport distance using EcoTransit. The distance by truck is 1043 km from Odense to Lodz (1,043 tkm/kg waste).

5.6.2 Background data

For waste transport in the incineration and recycling process flows, an ecoinvent 3.11 dataset for truck transport in Europe is applied (Transport, freight, lorry, unspecified {RER}| market for transport, freight, lorry, unspecified | Cut-off, U).

For incineration, an ecoinvent 3.11 dataset for waste textile incineration in Switzerland is applied (Waste textile, soiled {CH}| treatment of waste textile, soiled, municipal incineration FAE | Cut-off, U). Switzerland is considered to have a technology level in waste incineration similar to that of Denmark.

For recycling, the presorting energy consumption in Copenhagen is represented by an ecoinvent 3.11 dataset for the residual electricity mix in Denmark (Electricity, low voltage {DK}| electricity, low voltage, residual mix | Cut-off, U). The energy consumption for sorting, shredding a baling in Poland is represented by an ecoinvent 3.11 dataset for the residual electricity mix in Poland (Electricity, low voltage {PL}| electricity, low voltage, residual mix | Cut-off, U

See overview of LCI data for phase 6 (end-of-life) in Table 38 and Table 39.

5.6.3 Data quality

The activity data is of fair quality because the distribution between incineration and recycling is based on a standard scenario. See Table 34 for data quality rating (DQR).

Table 37 – Data quality rating (DQR) for EOL of textile products. Accuracy is rated for the activity data. Geographical, temporal and technological representativeness is rated for the secondary data used to represent the activity data. DQR based on UN Environment Global Guidance on LCA database development with the following scale: 'very good', 'good', 'fair', 'poor', and 'very poor'. Temporal representativeness is rated as follows: Very good = data is no more than 3 years old, Good = data is no more than 6 years old, Fair = data is no more than 10 years old, Poor = data is no more than 15 years old, Very poor = data is older than 15 years old or unknown.

Activity	Accuracy	Geography	Time	Technology
Textile to incineration	Fair	Fair	Good	Very good
Textile to recycling	Fair	Good	Good	Fair

5.6.4 Phase 6 – unit process overview

Table 38 – Unit processes in phase 6 – end of life of product.

Unit process name	Unit process unit	Input	Input unit	ecoinvent dataset	Comment
6.1 Product EOL - incineration	kg textile to incineration	1	kg	Waste textile, soiled {CH}| treatment of waste textile, soiled, municipal incineration FAE | Cut-off, U	
		0,0415	tkm	Transport, freight, lorry, unspecified {RER}| market for transport, freight, lorry, unspecified | Cut-off, U	41,5 km to waste incinerator
6.2 Product EOL - recycling	kg textile to recycling	0,017	kWh	Electricity, low voltage {DK}| electricity, low voltage, residual mix | Cut-off, U	Electricity for first sorting
		0,017	kWh	Electricity, low voltage {PL}| electricity, low voltage, residual mix | Cut-off, U	Electricity for second sorting
		0,552	kWh	Electricity, low voltage {PL}| electricity, low voltage, residual mix | Cut-off, U	Electricity for shredding/baling
		0,945	tkm	Transport, freight, lorry, unspecified {RER}| market for transport, freight, lorry, unspecified | Cut-off, U	41,5 km to first sorting point, 903 km to second sorting/recycling point in Poland
6.3 Product EOL - reuse	kg textile to reuse	1	Kg	-	

Table 39 – Amount of unit processes per product in phase 6 – end of life of product.

Unit process name	Unit	PJ1
6.1 Product EOL - incineration	kg textiles to incineration	0,152
6.2 Product EOL - recycling	kg textiles to recycling	0,066
6.3 Product EOL – reuse	kg textiles to reuse	0,031

6 Life cycle impact assessment (LCIA)

6.1 LCIA procedures and calculations

The LCIA method Environmental Footprint (EF) 3.1 was selected for this project. It is an internationally accepted LCIA method developed by the European Commission as part of the PEF initiative. EF 3.1 covers a broad range of environmental impact categories. No impact categories have been excluded from the study. All impact categories are listed below:

1. Climate change
2. Acidification
3. Ecotoxicity, freshwater
4. Particulate matter
5. Eutrophication, marine
6. Eutrophication, freshwater
7. Eutrophication, terrestrial
8. Human toxicity, cancer
9. Human toxicity, non-cancer
10. Ionising radiation
11. Land use
12. Ozone depletion
13. Photochemical ozone formation
14. Resource use, fossils
15. Resource use, minerals and metals
16. Water use

The impact category "climate change" is the sum of "climate change – biogenic", "climate change – fossil" and "climate change – land use and land use change". SimaPro v. 10.2.0.3 was used to conduct the calculations.

The LCA has been conducted according to this LCIA method to have a broad overview of environmental impacts, and to avoid burden shifting, when the results are used for minimizing the environmental impact of the products. Climate change is a particularly relevant impact category for Mørkegaard since this impact category is more well known by the average consumer and the impact category result will be printed on the product packaging. This impact category will also be the main focus of the contribution analysis and sensitivity analysis carried out in this study.

6.2 LCIA results

The LCIA results per product can be seen in

Table 40. Please note that the numbers have different units per impact category meaning that the impact categories cannot be compared to each other. The numbers are shown using scientific notation due to some very small numbers in certain impact categories (i.e., human toxicity). An example of how to read scientific notation is as follows: "1,2E+01" means 12, while "1,2E-01" means 0,12.

In

Table 40 the climate change impact (kg CO_2e) per product is presented visually.

Table 40 – LCIA results for the 19 impact categories.

Impact category	Unit	PJ1
Climate change	kg CO2 eq	3,11E+00
Acidification	mol H+ eq	2,55E-02
Ecotoxicity, freshwater	CTUe	8,47E+01
Particulate matter	disease inc.	4,62E-07
Eutrophication, marine	kg N eq	3,02E-02
Eutrophication, freshwater	kg P eq	4,47E-03
Eutrophication, terrestrial	mol N eq	8,71E-02
Human toxicity, cancer	CTUh	3,85E-08
Human toxicity, non-cancer	CTUh	4,32E-06
Ionising radiation	kBq U-235 eq	2,89E-01
Land use	Pt	2,73E+02
Ozone depletion	kg CFC11 eq	1,32E-07
Photochemical ozone formation	kg NMVOC eq	1,53E-02
Resource use, fossils	MJ	3,75E+01
Resource use, minerals and metals	kg Sb eq	1,73E-05
Water use	m3 depriv.	4,95E-01

6.3 Contribution analysis

The % contribution of each life cycle phase to the climate change impact can be seen in Figure 4 for each product. 'Phase 3 – production' is the most contributing life cycle phase contributing with 35% of the impact. The second most contributing life cycle phase is 'Phase 1 – Raw materials' contributing with 34% followed by 'Phase 5 – Use of product' contributing with 16%.

Overall, ‘Phase 1 – raw materials’, ‘Phase 3 – production’, and ‘Phase 5 - use of product’ together account for approximately 85% of the total climate change impact, meaning that the life cycle phases ‘Phase 2 – raw material transport’, ‘Phase 4 - distribution’, and ‘Phase 6 – end-of-life of product’ contribute with approximately 15% of the total climate change impact. The most contributing life cycle phases will be examined further.

For the other impact categories, the contribution analyses can be found in Section 10.2 (appendix).

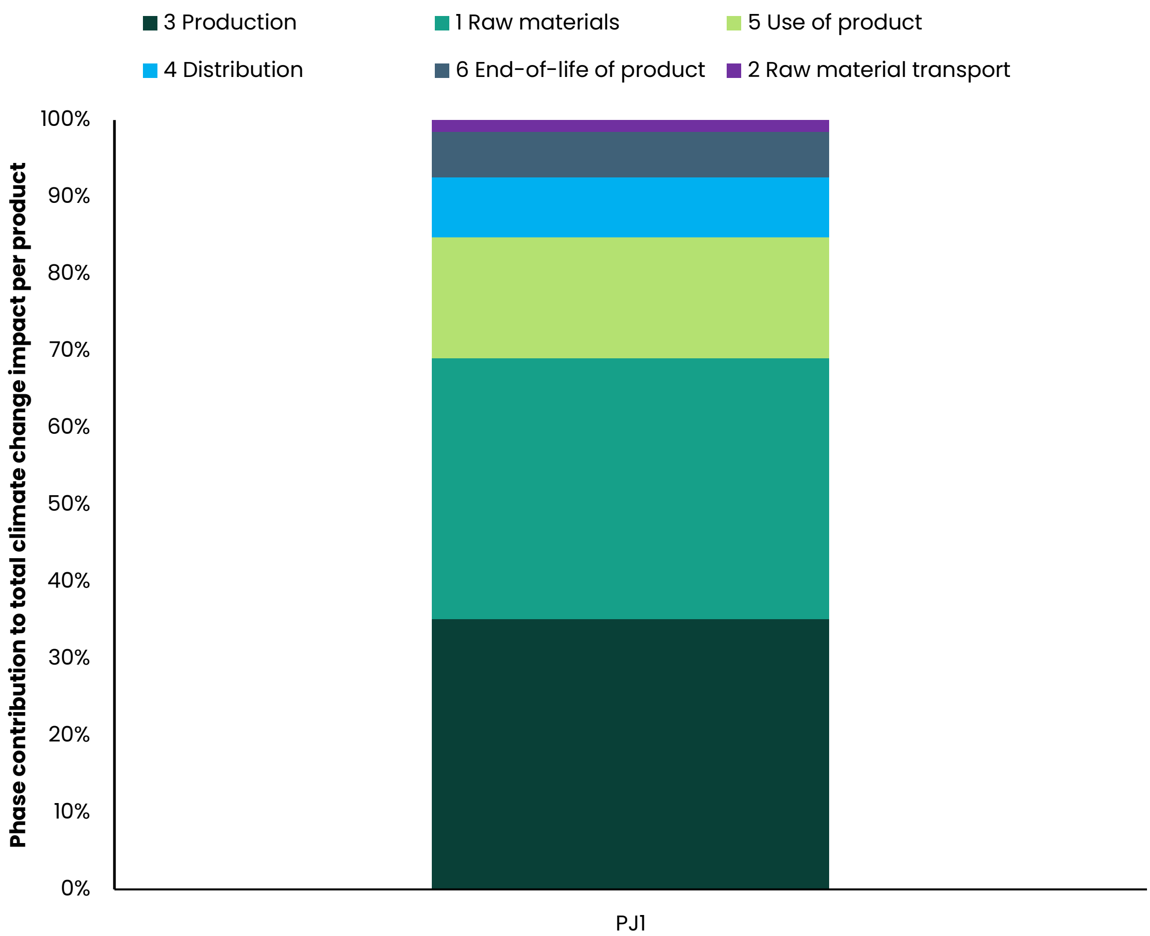

Figure 4 - Contribution of each life cycle phase to the ‘climate change’ impact category in the LCA.

6.3.1 Process contribution – phase 1 – climate change

In Figure 5 the contribution of processes in 'Phase 1 – raw materials' to the total climate change impact in phase 1 can be seen. It shows that yarn spinning and cotton cultivation are the most contributing processes in this phase.

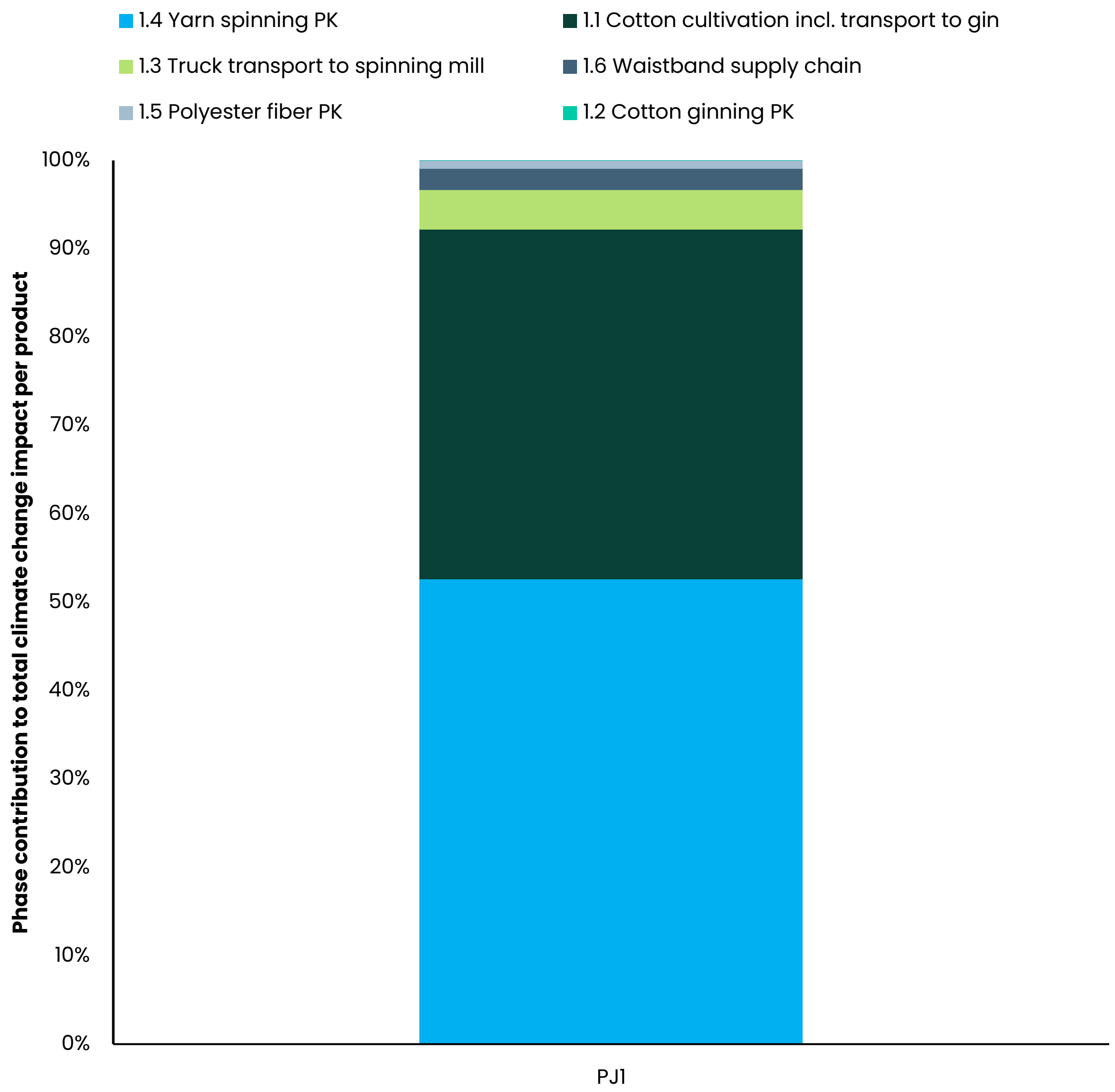

Figure 5 - Contribution of processes in 'phase 1 – raw materials' to the total 'climate change' impact category for 'phase 1 – raw materials'.

6.3.2 Process contribution – phase 3 - climate change

In Figure 6 the contribution of processes in 'Phase 3 – production' to the total climate change impact in phase 3 can be seen. It shows that electricity consumption is the most contributing process followed by packaging, chemicals and steam. Waste and wastewater, water, gas, and inputs of other materials contribute very little. Here it should be noted that these processes may have a higher contribution to other environmental impact categories.

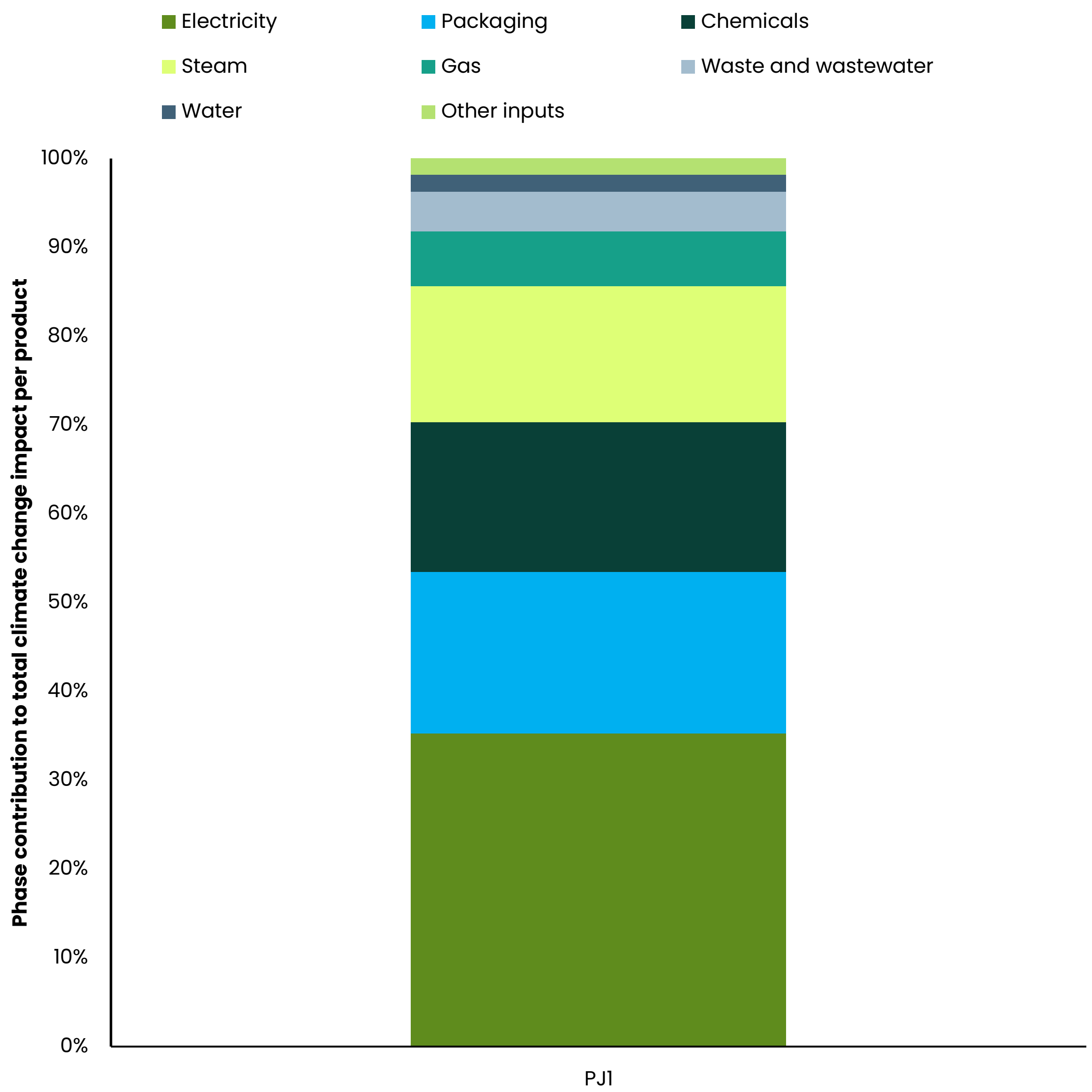

Figure 6 - Contribution of processes in 'phase 3 – production' to the total 'climate change' impact category for 'phase 3 – production'.

6.3.3 Process contribution – phase 5 – climate change

In Figure 7 the contribution of the processes in 'Phase 5 – use of product' to the total climate change impact in phase 5 can be seen. The contribution from disposal of consumer packaging is not included in the contribution analysis, since it contributed <1% of the climate change impact to phase 5. Figure 7 shows that electricity and detergent are the most contributing processes in this phase.

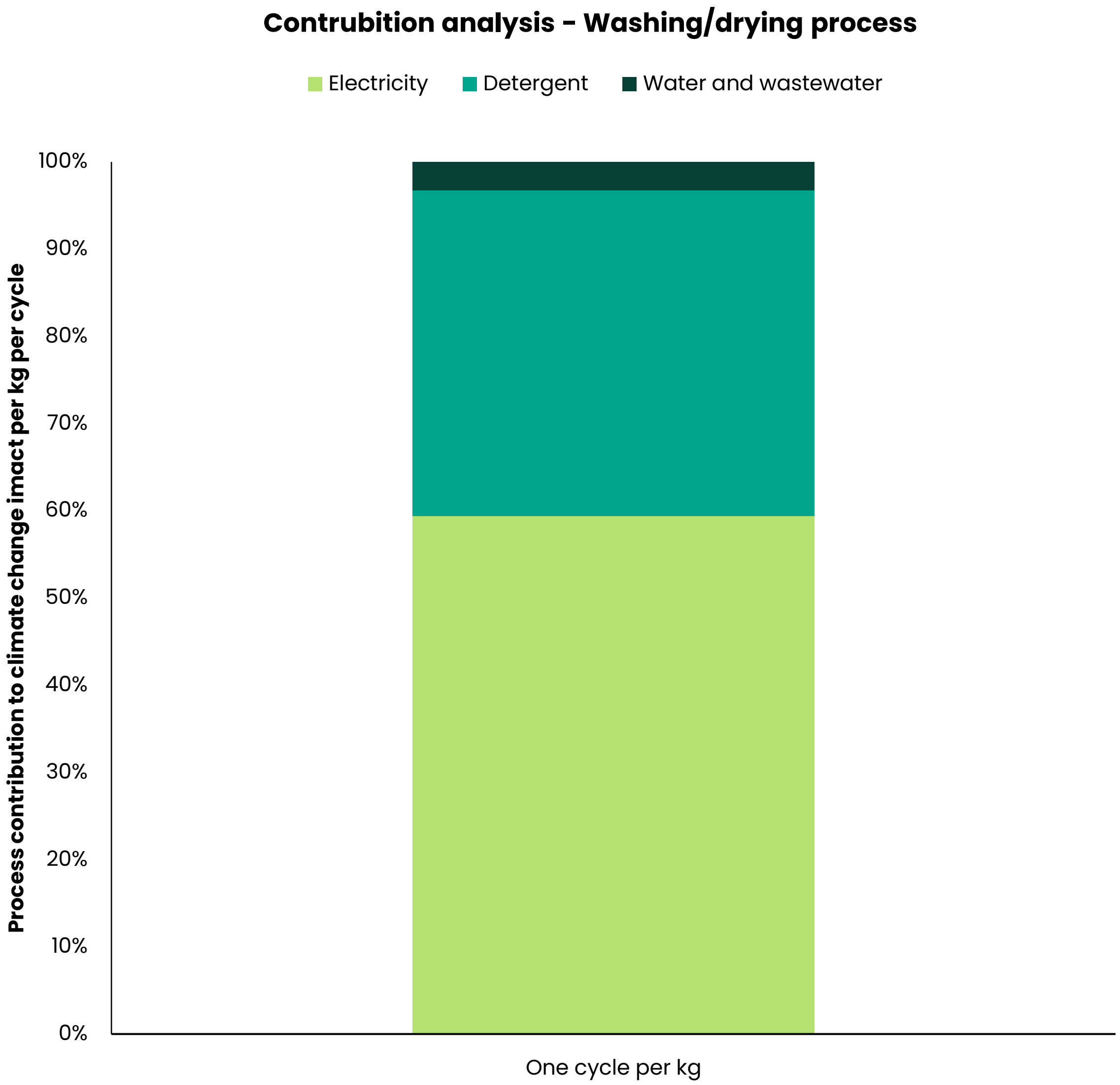

Figure 7 - Contribution of processes in washing and drying in 'phase 5 – use of product' to the total 'climate change' impact category for washing and drying.

6.3.4 Contribution to other environmental impacts

The contribution of each life cycle stage to each of the environmental impact categories aside from climate change are shown in Section 10.2 (appendix).

The most contributing life cycle stage per impact category is described in Table 41. Overall, Phase 2 – Raw material transport, Phase 4 – Distribution and Phase 6 – End-of-life of product are not the most contributing life cycle stage for any impact categories.

Phase 1 is the most contributing life cycle stage to acidification, marine eutrophication, freshwater eutrophication, terrestrial eutrophication, land use, and ozone depletion.

Phase 3 is the most contributing to climate change, freshwater ecotoxicity, particulate matter, human toxicity cancer and non-cancer, photochemical ozone formation and fossil resource use.

Phase 5 is the most contributing life cycle stage to ionizing radiation, minerals and metals resource use and water use.

Table 41 – Most contributing life cycle stage per impact category evaluated in the LCA.

Impact category	Most contributing life cycle stage
Climate change	3 Production
Acidification	1 Raw materials
Ecotoxicity, freshwater	3 Production
Particulate matter	3 Production
Eutrophication, marine	1 Raw materials
Eutrophication, freshwater	1 Raw materials
Eutrophication, terrestrial	1 Raw materials
Human toxicity, cancer	3 Production
Human toxicity, non-cancer	3 Production
Ionising radiation	5 Use of product
Land use	1 Raw materials
Ozone depletion	1 Raw materials
Photochemical ozone formation	3 Production
Resource use, fossils	3 Production
Resource use, minerals and metals	5 Use of product
Water use	5 Use of product

7 Life cycle interpretation

7.1 Significant findings

The production contributes highly to climate change impact

'Phase 1 – raw materials' is the most contributing life cycle phase to the climate change impact, contributing with 35% of the impact.

The second most contributing life cycle phase is 'Phase 1 – raw materials' followed by 'Phase 5 – use of product'.

Raw material transport, distribution and end-of-life have little climate change contribution

Overall, 'Phase 1 – raw materials', 'Phase 3 – production', and 'Phase 5 - use of product' together account for 85% of the total climate change impact, meaning that the life cycle phases 'Phase 2 – raw material transport', 'Phase 4 - distribution', and 'Phase 6 – end-of-life of product' contribute with 15% of the total climate change impact per product.

Use of product has the highest contribution to water use

Use of product (washing) has the highest contribution to water use. Raw materials do not contribute significantly to the water use impact, due to the background dataset assuming no irrigation of cotton fields.

Raw materials contribute the most to acidification, land use, ozone depletion, and eutrophication

The raw materials phase contributes the most to the land use impact due to cotton growing activities taking up land. The amount of land used for cotton growing and the land use change (i.e., deforestation) is not specifically accounted for in this LCA, although the effect is included in the generic background dataset for cotton cultivation.

Raw materials also contribute highly to the eutrophication impact categories (addition of nutrients to land, sea and freshwater), which is mainly due to the use of manure in the cotton farm. The contribution to acidification is mainly due to air emissions from cotton cultivation and the spinning mill, while the contribution to ozone depletion is mainly due to emissions of ozone depleting substances from production of the polyester in the thread and the waistband.

7.2 Sensitivity analysis

Sensitivity was evaluated by comparing baseline scenarios to alternative scenarios and calculating sensitivity coefficients. The sensitivity coefficient is defined as the ratio between relative change in results and relative change in input parameters. Parameters with coefficients below 0.1 were considered to have low influence on results, values between 0.1 and 0.5 moderate influence, and values above 0.5 high influence. For scenario analyses where multiple input parameters were changed simultaneously, and it was not possible to determine a single sensitivity coefficient, absolute changes below 10% were considered to have low influence on the results, absolute changes between 10-20% were considered to have moderate influence, and absolute changes above 20% were considered to have high influence.

The sensitivity analysis was focused on the change in climate change impact. This is chosen because the climate change impact will be used for communication to the end-consumer, which means that the influence of uncertain or variable parameters on this impact category is particularly important.

7.2.1 Sources for electricity consumption

There is a consumption of electricity from the grid of 0,62 kWh/product, 0,04 kWh/product from solar energy in 'Phase 3: production'. The effects of consuming 100% of the electricity from solar energy are analyzed. The alternative scenario can be seen compared to the baseline scenario in Figure 8. It was found that the alternative scenario decreased the climate change impact of the total life cycle with 10,8%. This shows that the source of the electricity consumption in the production is not particularly sensitive since it is a large change in the input leading to this reduction. Nonetheless, it shows that there is a significant reduction potential in the overall climate change impact by moving towards solar energy.

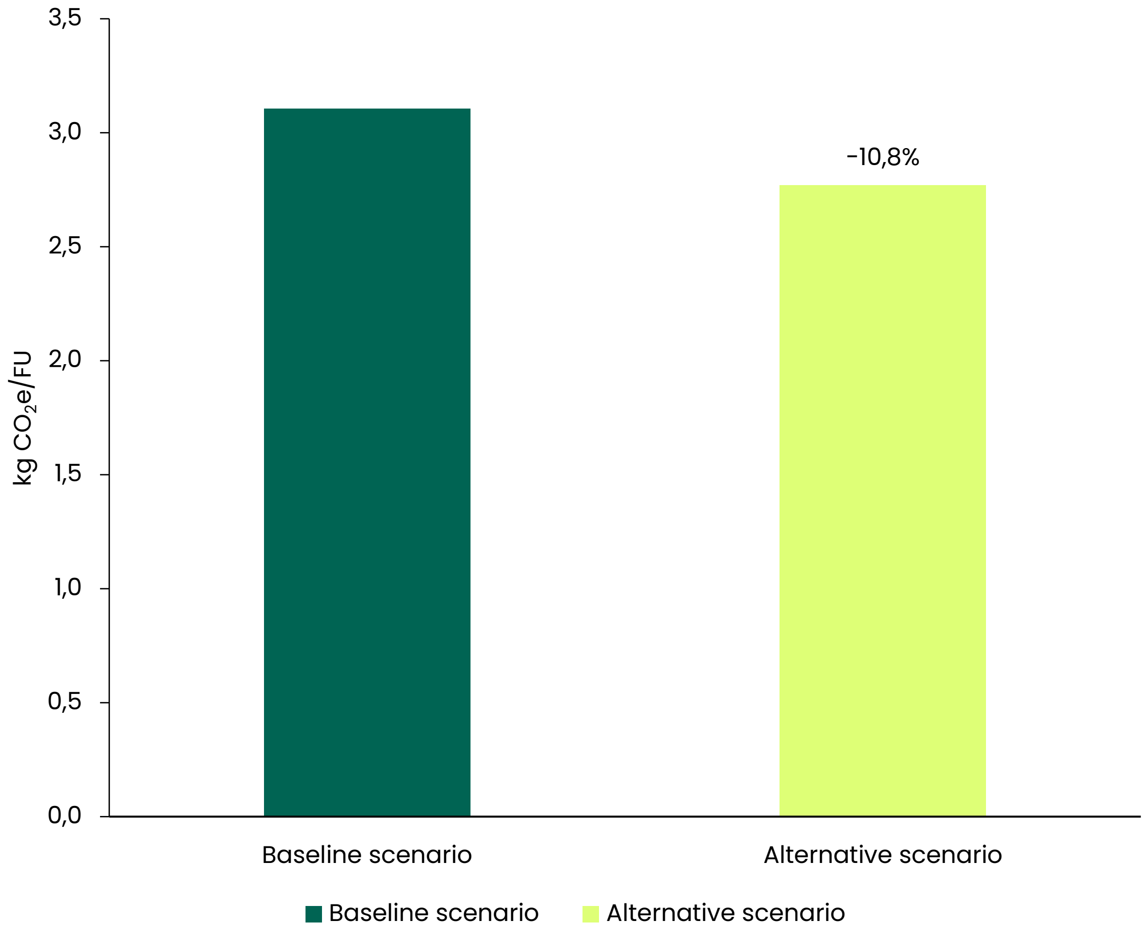

Figure 8 - Scenario evaluating the climate change impact on the total life cycle for the baseline scenario (electricity from grid and solar energy) and alternative scenario (electricity only from solar energy)

7.2.2 Machine drying vs. airdrying of textiles

The effect of using 100% machine drying instead of 58% machine drying and 42% air drying (as assumed in this LCA) was analyzed. See Figure 9. It was found that changing from 58% machine drying to 100% machine drying (equaling a 72% parameter increase) increased the total climate change impact with 5%.

- Sensitivity coefficient = 5%/72% = 0,07 (low sensitivity).

Although the sensitivity of this parameter is evaluated to be low, the analysis shows that the consumer behavior regarding drying method can influence the overall climate change impact of the product.

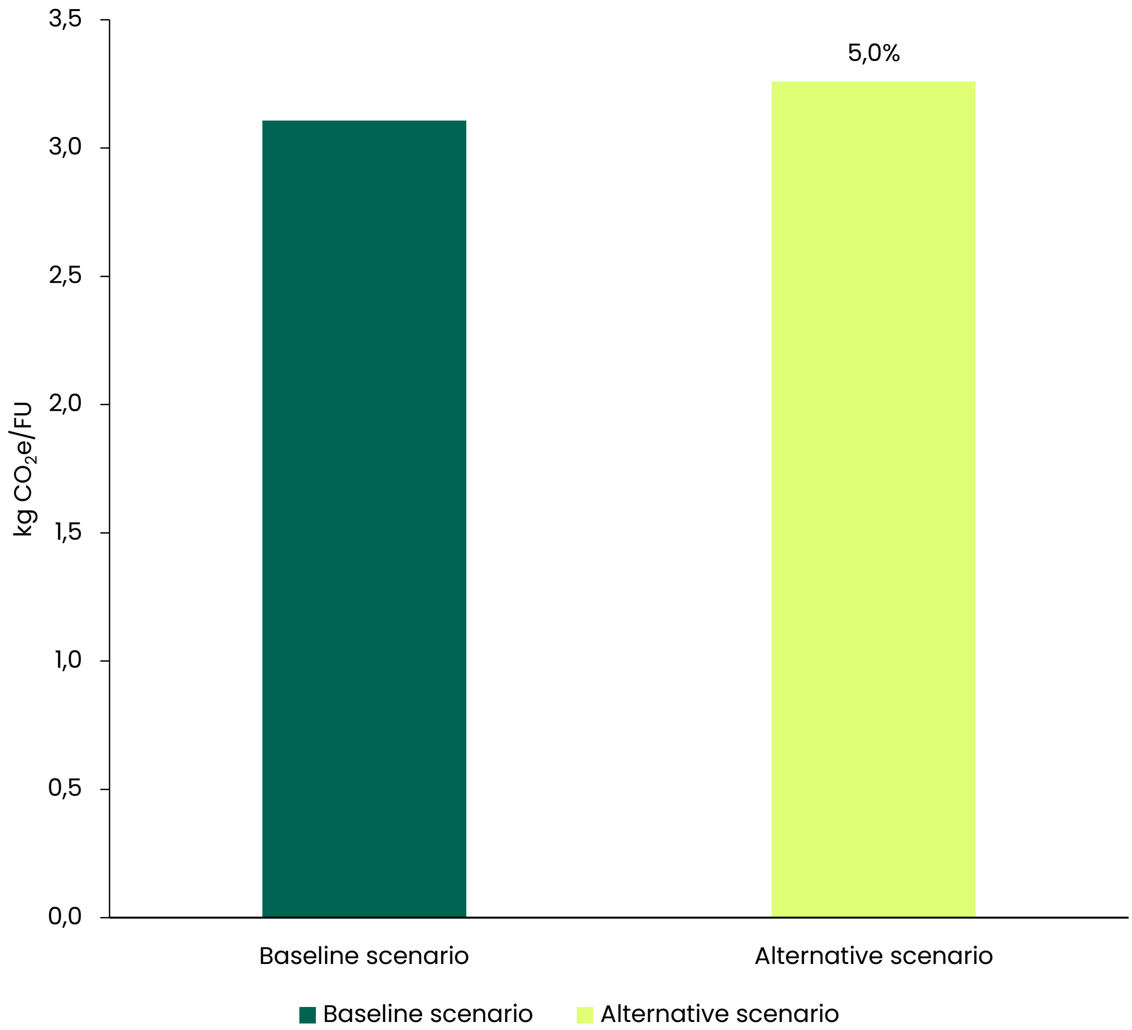

Figure 9 – Scenario evaluating the change in the total climate change impact when changing the from 58% machine drying to 100% machine drying in the use phase.

7.2.3 Washing-drying frequency

The effect of increasing the washing-drying frequency by 10% was analyzed – see Figure 10. It was found that increasing the frequency of washing and drying by 10% increased the total climate change impact with 1,6%.

- Sensitivity coefficient = 1,6%/10% = 0,16 (moderate sensitivity).

This shows that the consumer behavior regarding washing and drying frequency has a significant influence on the overall climate change impact of the products.

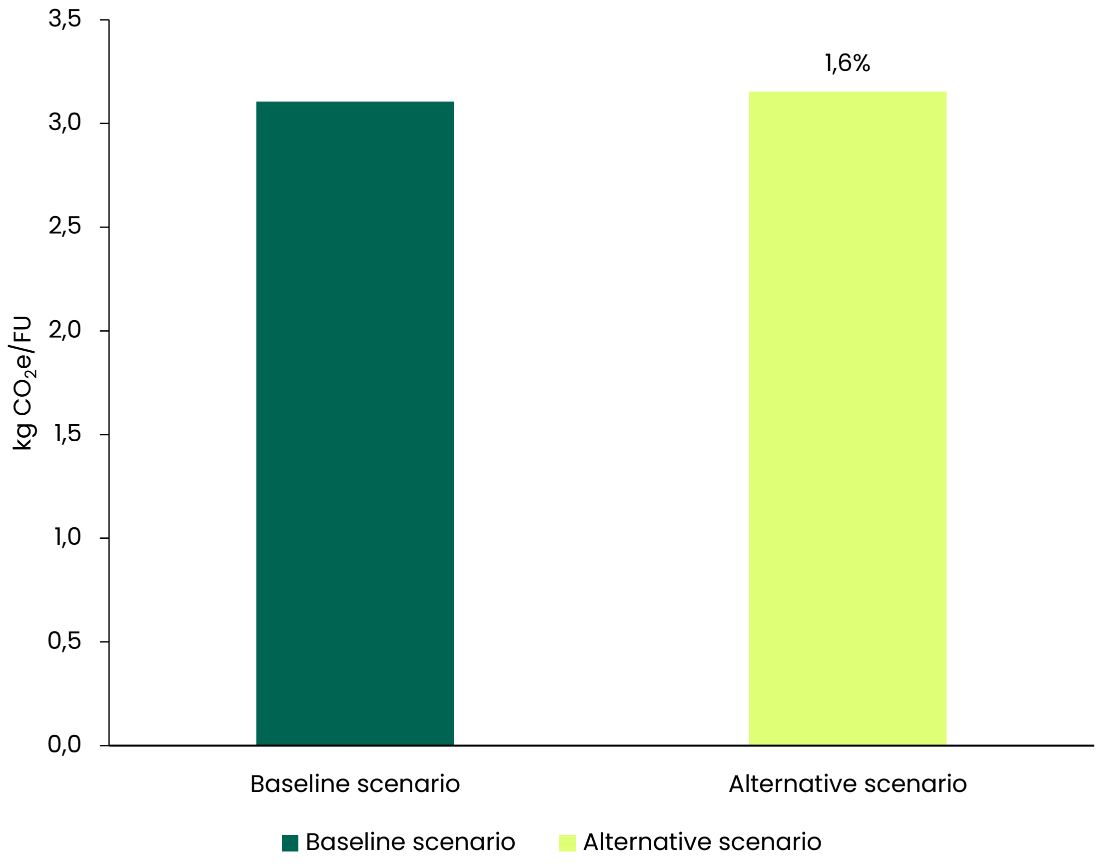

Figure 10 - Scenario evaluating the change in the total climate change impact when increasing the washing-drying frequency by 10% in the use phase.

7.3 Uncertainty analysis

The uncertainty in the LCA has been evaluated qualitatively by performing the following steps:

- Identifying key parameters and assumptions that may influence the results
- Classifying each parameter's uncertainty level (low/medium/high) based on data quality
- Assessing how sensitive the results are to these uncertain parameters (qualitatively: low/medium/high influence)

See Table 42 for the identified key parameters.

Table 42 – Key parameters affecting the uncertainty of the LCA results

Key parameters and assumptions	Uncertainty level (qualitative estimate)	Sensitivity
Cotton cultivation	Medium – based on data from India instead of Pakistan.	Medium – not tested.
Electricity consumption in the production	Low-medium	Low – tested in sensitivity analysis.
Use phase washing scenario	High – based on scenario.	Moderate – tested in sensitivity analysis.

The data used for cotton cultivation is a key parameter for this LCA. This parameter has a medium uncertainty and sensitivity. Since more accurate data were not available it was not possible to mitigate the uncertainty stemming from this parameter. This should be considered when interpreting the results.

The energy consumption in the production is a key parameter for this LCA. This parameter has a low-to medium uncertainty since most inputs are based on measurements, while some were allocated based on the experience of the factory. The sensitivity was evaluated as low.

The use phase is highly uncertain while the LCA results are moderately sensitive to changes in the use phase. As it is not possible to collect primary data for the use phase of the product this level of uncertainty must be accepted, and it is important to account for this uncertainty when interpreting the results.

7.4 Assumptions and limitations

Assumptions and limitations of this LCA can be seen in Table 43.

Table 43 Assumptions and limitations per life cycle phase in the LCA

Phase	Assumptions and limitations
1 Raw materials and 2 Raw material transport	• Care labels made of cotton have different supply chains than the cotton for the main fabric, however, in the LCA it is assumed that the care label cotton has the same supply chain as the main fabric cotton. Care labels only account for a 0,6% of the material in the product. • For some processes in the supply chain only the region in Pakistan is known. For the region Sindh, Pakistan, the city of Karachi is generally assumed, and for the region of Punjab, Pakistan, the city of Faisalabad is generally assumed. • For transport within the same city a distance of 50 km is assumed. • It is assumed that ginning takes place near the cotton farms. • A major limitation in the raw materials phase is the lack of regionalized datasets for organic cotton. Therefore, a secondary dataset from ecoinvent for organic cotton cultivation in India was used. • It is assumed that polyester fiber production and polyester spinning are carried out in the same factory
3 Production	• It is assumed that the steam used in the factory is low pressure saturated steam (the consumption of steam was only given in tons) • It is assumed that the biomass used for steam production is "wood chips". • It is assumed that the amount of plastic, metal and paper waste leaving the factory is plastic, metal and paper that enters the factory as i.e., packaging. • It was estimated that the electricity for wet processing, steam, natural gas, clean water and wastewater for products that are only printed is half of that of products which are both bleached and dyed/printed.
4 Distribution	• The distribution scenario is based on distribution to a retail store in Odense, Denmark (selected for its central location within Denmark). • Energy consumption for warehouse and retail is estimated based on standard scenarios defined in PEF. • Transport to consumer home is assumed to be 5 km and in a small passenger car. It is assumed that the consumer buys 10 kg of products in the trip.
5 Use of product	• It is assumed that for 42% of the use cycles the products are air dried and for 58% of the use cycles the products are machine dried. • Consumption of electricity and water are based on European ecodesign benchmarks for 7 kg washer-dryers operating on a 60 degrees cotton program. • Consumption of detergent per kg laundry is based on an ecoinvent 3.11 dataset for commercial laundry operation.
6 End-of-life of product	• Waste treatment scenario is based on adapted information from the Danish Energy Agency: 64 % of the products are sent to incineration and 36% of the products are sent to recycling. • Energy consumption for sorting, shredding, and baling is based on literature values from a Swedish textile recycling scenario • The sorting and recycling location in Poland is unknown. A city located centrally in Poland (Lodz) is assumed.

8 Conclusions and recommendations

A life cycle assessment (LCA) was carried out to investigate the environmental impacts arising in the full life cycle of pyjamas pants from the spring 2026 line of Nord Harmony. The assessed life cycle phases were (1) Raw materials, (2) Raw material transport, (3) Production, (4) Distribution, (5) Use of product, and (6) End-of-life of product.

The goal of the assessment was to get a deeper understanding of the environmental impacts of the products and to label the product packaging with the climate change impact of the products and/or the obtained reduction in climate change impact.

The environmental impact of the product was evaluated across 16 impact categories according to the EF3.1 LCIA method. The climate change impact of the product is shown in Table 44.

Table 44 – Climate change impact of the pyjamas pants evaluated in the life cycle assessment (LCA)

ID	Product type	Product	Climate change impact (kg CO_2e)	
			Cradle-to-consumer	Cradle-to-grave
PJ1	Pyjamas pants	Pyjamas pants	2,4	3,1

* Pyjamas pants are produced in the sizes S/M and L/XL. The results of this LCA are based on the L/XL size and are used to represent the environmental impact of both size variations.

It was found that 'Phase 3 – production' is the most contributing life cycle phase to climate change, contributing with 35%. This is mainly due to the electricity consumption and packaging.

'Phase 1 – raw materials' is the second most contributing life cycle phase to the climate change impacts, especially the cotton cultivation process and yarn spinning process. Since it was not possible to obtain data for organic cotton cultivation in Pakistan, a dataset for India was used. This is considered an important limitation of this LCA study. In the future, it is recommended that the LCA is updated with country- or region-specific data for organic cotton cultivation.

'Phase 5 – use of product' is the third most contributing life cycle phase to climate change, mainly due to washing and drying of the product. The number of wash cycles and the consumption of water, electricity and detergent for washing was based on literature data, which could be improved for higher accuracy.

In a sensitivity scenario, the source of electricity in the factory was analyzed. In the baseline scenario the factory uses both electricity from the grid and from solar energy. The analysis showed that changing the source of electricity to 100% solar energy decreased the climate change impact for the entire life cycle with 10,8%. This highlights the opportunity to reduce the overall climate change impact of the product by increasing the amount of solar power used in the factory.

In another sensitivity scenario, machine drying vs. air drying was analyzed. It was found that changing from 58% machine drying to 100% machine drying increased the climate change impact for the entire life cycle with 5%. This parameter was evaluated to have a low sensitivity.

Finally, the washing frequency was analyzed. The analysis showed increasing the washing frequency with 10% increased the climate change impact for the entire life cycle with 1,6%. This parameter was evaluated to be moderately sensitive, and therefore it is concluded that consumer behavior regarding washing and drying frequency has a significant influence on the overall climate change impact of the products and should be taken into consideration when interpreting the results.

9 References

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10 Appendix

10.1 Factory data - determination of inputs and outputs

Table 45 – Determining energy and consumables per kg of final product

Input	Procedure for determining input per kg final product
Electricity for weaving (sub-meter)	Electricity for weaving (1.956.299 kWh) was divided by the amount of fabric woven in the factory (1.517.529 kg) and multiplied by 1,03 to account for losses in the cut and sew step. 6,2% of the electricity comes from solar, the rest comes from the grid.
Electricity for wet processing (sub-meter)	Electricity for wet processing (13.687.418 kWh) was divided by the amount of fabric passing through wet processing in the factory (12.302.165 kg) and multiplied by 1,03 to account for losses in the cut and sew step. 6,2% of the electricity comes from solar, the rest comes from the grid. For unbleached and dyed/printed products it was estimated that the consumption of electricity for wet processing was 50% of that for bleached and dyed/printed products, and 25% for unbleached and undyed/unprinted products.
Electricity for cut and sew (sub-meter)	Electricity for cut and sew (762.731 kWh) was divided by the amount of fabric passing through cut and sew in the factory (4.866.310 kg) and multiplied by 1,03 to account for losses in the cut and sew step. 6,2% of the electricity comes from solar, the rest comes from the grid.
Electricity for other (sub-meter)	Electricity for other processes (126.693 kWh) was divided by the amount of fabric passing through wet processing in the factory (12.302.165 kg) and multiplied by 1,03 to account for losses in the cut and sew step. 6,2% of the electricity comes from solar, the rest comes from the grid.
Steam from biomass	Steam from biomass (163.326 tons) was divided by the amount of fabric passing through wet processing in the factory (12.302.165 kg) and multiplied by 1,03 to account for losses in the cut and sew step. For unbleached and dyed/printed products it was estimated that the consumption of steam was 50% of that for bleached and dyed/printed products, and 25% for unbleached and undyed/unprinted products.
Natural gas	Natural gas (41.635 mmBTU = 1.176.785 m3) was divided by the amount of fabric passing through wet processing in the factory (12.302.165 kg) and multiplied by 1,03 to account for losses in the cut and sew step. For products that are not bleached it was estimated that the consumption of natural gas was 50% of that for bleached and dyed/printed products.
Clean water	Clean water (823.011 m3) was divided by the amount of fabric passing through wet processing in the factory (12.302.165 kg) and multiplied by 1,03 to account for losses in the cut and sew step. For unbleached and dyed/printed products it was estimated that the consumption of water was 50% of that for bleached and dyed/printed products, and 25% for unbleached and undyed/unprinted products.
Lubricants	Lubricant (54.743 kg) was divided by the amount of fabric passing through wet processing in the factory (12.302.165 kg) and multiplied by 1,03 to account for losses in the cut and sew step.
Plastic	Plastic input to the factory was assumed to be the same amount as the plastic waste leaving the factory. See calculation of plastic waste.
Metal	Metal input to the factory was assumed to be the same amount as the metal waste leaving the factory. See calculation of metal waste.

Input	Procedure for determining input per kg final product
Paper	Paper input to the factory was assumed to be the same amount as the paper waste leaving the factory. See calculation of paper waste.
Starch for sizing	8-10% of yarn weight according to factory (9% assumed). Multiplied by 1,03 to account for losses in the cut and sew step.
Enzyme for desizing	0,2% of enzyme in solution according to factory. 0,8 L solution per kg fabric. Multiplied by 1,03 to account for losses in the cut and sew step.
Sodium hydroxide for scouring	1% of sodium hydroxide in solution according to factory. 0,7 L solution per kg fabric. Multiplied by 1,03 to account for losses in the cut and sew step.
Hydrogen peroxide for bleaching	3% of the fabric weight according to factory. Multiplied by 1,03 to account for losses in the cut and sew step.
Sodium hydroxide for bleaching	1,8% of sodium hydroxide in solution according to factory. 0,7 L solution per kg fabric. Multiplied by 1,03 to account for losses in the cut and sew step.
Activator for bleaching	0,3% of activator in solution according to factory. 0,7 L solution per kg fabric. Multiplied by 1,03 to account for losses in the cut and sew step.
Pigment agent	Pigment agent (664.451 kg) was divided by the amount of fabric passing through printing in the factory (4.509.466 kg) and multiplied by 1,03 to account for losses in the cut and sew step.
Dye agent	Dye agent (823.011 kg) was divided by the amount of fabric passing through dyeing in the factory (4.149.603 kg) and multiplied by 1,03 to account for losses in the cut and sew step.

Table 46 – Determining waste and wastewater per kg of final product

Output	Procedure for determining input per kg final product
Plastic waste	Plastic waste (1.429 kg) and 50% of "Empty drums and cans" (87.900 kg) was divided by the amount of fabric passing through wet processing in the factory (12.302.165 kg) and multiplied by 1,03 to account for losses in the cut and sew step.
Metal waste	Metal waste (56.899 kg) and 50% of "Empty drums and cans" (87.900 kg) was divided by the amount of fabric passing through wet processing in the factory (12.302.165 kg) and multiplied by 1,03 to account for losses in the cut and sew step.
Paper waste	Plastic waste (293.345 kg) was divided by the amount of fabric passing through wet processing in the factory (12.302.165 kg) and multiplied by 1,03 to account for losses in the cut and sew step.
Wastewater	Wastewater (985.505 m3) was divided by the amount of fabric passing through wet processing in the factory (12.302.165 kg) and multiplied by 1,03 to account for losses in the cut and sew step.
Textile waste	The amount of textile waste was calculated from the loss rates according to the factory (1% in weaving and 3% in cut and sew).

10.2 Contribution analysis for all environmental impacts

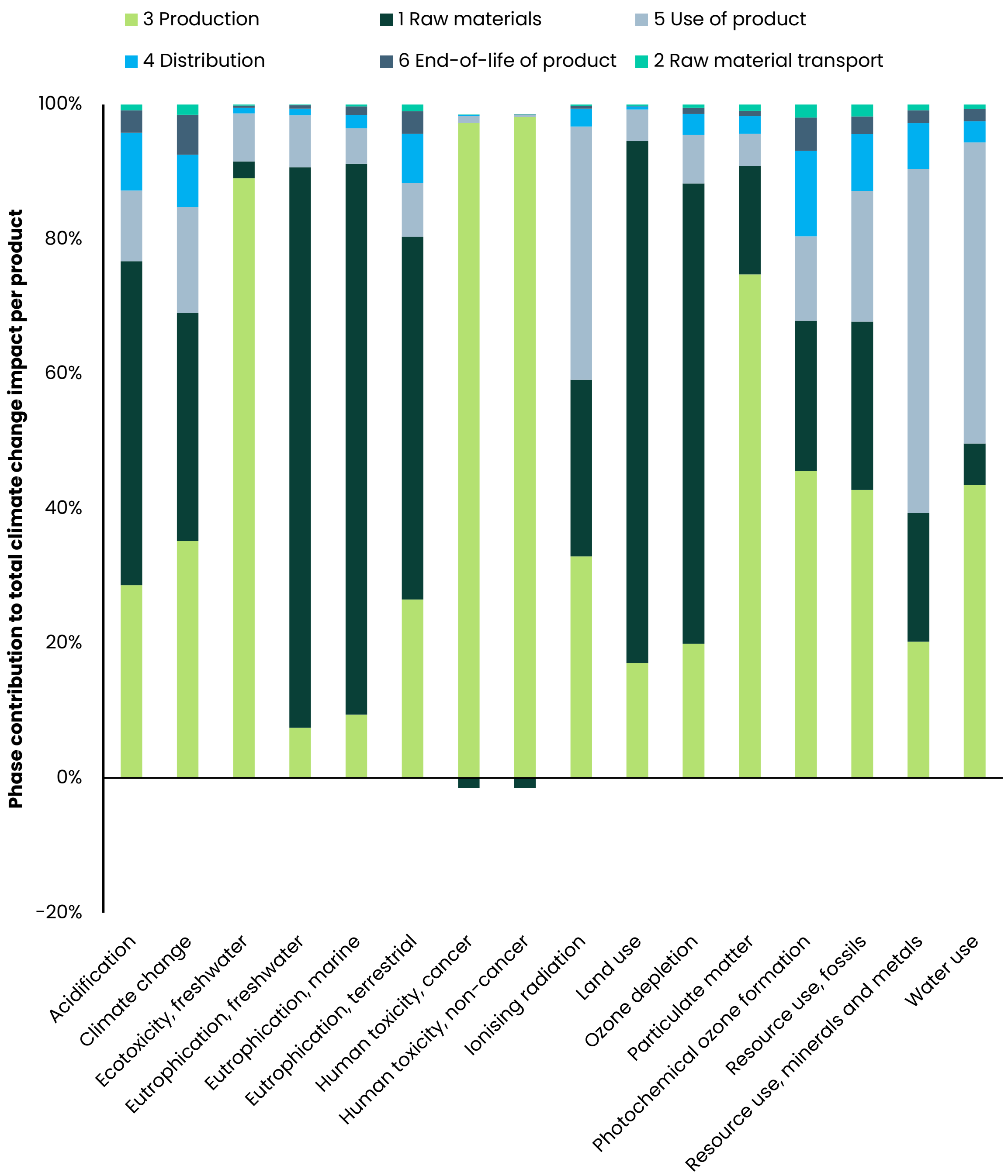

Figure 11 – Environmental impact per indicator for PJ1 per life cycle phase.

10.3 Dialogue between critical reviewer and LCA practitioner

Type of comment: (ED: Editorial, TE: Technical, GE: Generic)

No.	CHAPTER, ARTICLE, PARAGRAPH, TABLE	TYPE OF COMMENT	REFERENCE TO CHECKLIST OR PRANDRAMME INSTRUCTIONS	REVIEWER COMMENT AND RECOMMENDATION	LCA PRACTITIONER ANSWER	FINAL REVIEWER STATE-MENT
1	LCA information – page 2	Ed	ISO 14040:2008 ISO 14044:2008	The standards shall be stated in full, with reference to the version	Corrected.	Ok
2	Product IDs	Ge	ISO 14040:2008 ISO 14044:2008	Please provide certificates for organic cotton	Ongoing dialogue between Mørkegaard and reviewer.	Ok
3	4.2 Functional unit	Te	ISO 14040:2008 ISO 14044:2008	What is this based on? In e.g. the PEFCR for Apparel and Footwear table 6 it states that the use 70 times, and in table it states that the use before a wash is 5 times for pants. This means 70/5=14 washes during its life cycle. You don't need to use the PEFCR but due to the high difference there is a need for justification	Adapted according to PEFCR for A&F (pants).	Ok
4	4.7 Critical review	Ed	ISO 14040:2008 ISO 14044:2008	Remember to update	Updated.	Ok
5	5.1 Phase 1: Raw materials	Ed	ISO 14040:2008 ISO 14044:2008	Missing a reference to table	Reference added.	Ok
6	5.1 Phase 1: Raw materials	Ed	ISO 14040:2008 ISO 14044:2008	I would include one or two digits after the comma to be more precise as the values and rounding is not done completely correct - or at least	Adapted according to comment.	Ok

No.	CHAPTER, ARTICLE, PARAGRAPH, TABLE	TYPE OF COMMENT	REFERENCE TO CHECKLIST OR PRANDRAMME INSTRUCTIONS	REVIEWER COMMENT AND RECOMMENDATION	LCA PRACTITIONER ANSWER	FINAL REVIEWER STATE-MENT
				note that it is rounded values		
7	Table 10	Ge	ISO 14040:2008 ISO 14044:2008	This shall be determined	Accuracy rated "Good".	Ok
8	Table 12	Ed	ISO 14040:2008 ISO 14044:2008	Formatting issue	Fixed.	Ok
9	Table 17	Ge	ISO 14040:2008 ISO 14044:2008	Please provide certificates or statement for the solar panel.	Has been provided.	Ok
10	Table 17	Te	ISO 14040:2008 ISO 14044:2008	Please show during the meeting how this is done	Comment resolved during reveiw meeting - based on assumption that materials leaving the factory as waste, which are not otherwise accounted for in the LCA, are added as inputs to the factory (i.e. paper, plastic and metal waste is assumed to enter the factory as raw material packaging etc.).	OK
11	Table 17	Ed	ISO 14040:2008 ISO 14044:2008	What does this star refer to? I don't seem to be able to find it in the document	The comment relating to the star was missing - it has been added and describes the assumption regarding paper, plastic and metal inputs as described in previous comment.	Ok
12	Table 19	Ed	ISO 14040:2008 ISO 14044:2008	Formatting issue	Fixed.	Ok
13	Table 23	Ed	ISO 14040:2008 ISO 14044:2008	Formatting issues	Fixed.	Ok

No.	CHAPTER, ARTICLE, PARAGRAPH, TABLE	TYPE OF COMMENT	REFERENCE TO CHECKLIST OR PRANDRAMME INSTRUCTIONS	REVIEWER COMMENT AND RECOMMENDATION	LCA PRACTITIONER ANSWER	FINAL REVIEWER STATE-MENT
14	5.5.1.1 Activity data	Te	ISO 14040:2008 ISO 14044:2008	It is a relatively old source (almost 20 years old) and the PEFCR has standard values - why have the PEFCR values not been used?	The study has been adapted so it now adopts the PEFCR standard values.	Ok
15	5.5.1.1 Activity data	Ge	ISO 14040:2008 ISO 14044:2008	Is this the most recent data available?	Data for 2023 is used. Reference updated accordingly.	Ok
16	5.6.1 Activity data	Te	ISO 14040:2008 ISO 14044:2008	What does the use of the product entail? Some studies analyse the full life cycle (incl. Reuse of the textile) and some only for the first use. There is a need to be specific regarding this and also ensure that the reuse is not double counted.	The scenario has been updated in accordance with the use scenario from the PEFCR, which already includes reuse in the 70 uses in the lifetime. Now the EOL only includes incineration or recycling.	Ok
17	Table 40	Ed	ISO 14040:2008 ISO 14044:2008	Formatting issue	Fixed.	Ok
18	Figure 4	Ed	ISO 14040:2008 ISO 14044:2008	Please arrange it so the highest contributor is at the bottom and then the second smallest etc. This comment is for all the figures that show the contribution as this one does	Adapted according to comment.	Ok
19	Table 45	Ed	ISO 14040:2008 ISO 14044:2008	Formatting issue **Round 2:** This is how it looks for me without track changes – still seem to be an issue with it	Fixed.	Ok

No.	CHAPTER, ARTICLE, PARAGRAPH, TABLE	TYPE OF COMMENT	REFERENCE TO CHECKLIST OR PRANDRAMME INSTRUCTIONS	REVIEWER COMMENT AND RECOMMENDATION	LCA PRACTITIONER ANSWER	FINAL REVIEWER STATE-MENT
						
20	Excel sheet – BOM tab	Ge	ISO 14040:2008 ISO 14044:2008	Please delete all references to PJ2 as it is not included in the study	PJ2 deleted in LCA model.	Ok