Comparative Life Cycle Assessment of Home Textiles 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: 2026-02-17 (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
Critical review panel	Bureau Veritas Solutions Denmark A/S Waldemar C. Hemdrup - LCA & EPD consultant Edvinas Damukaitis - LCA & EPD consultant Julie M. V. Larsen - LCA & EPD consultant
LCA standard	DS/EN ISO 14040:2008 and DS/EN ISO 14044:2008
Products	Bedlinen Shower curtains Bath towels Hand towels Wash cloths Bathmats Bathrobes
Life cycle scope	Cradle-to-grave
Temporal scope	Production data collected covers 2024
Geographical scope	Raw materials: Pakistan and Türkiye 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:	2026-02-17 (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 selected home textile products from the spring 2026 line of Nord Harmony and their fall 2025 counterparts. The life cycle phases included in the LCA are:

1) Raw materials: Production of virgin or recycled organic 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 life time 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 products, to compare the spring 2026 products with their fall 2025 counterparts and look at the effects of implemented design choices such as not bleaching the textiles and replacing some virgin cotton with recycled cotton. Furthermore, the goal was to label the product packaging with the climate change impact of the products and/or the obtained reduction in 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 two factories in Pakistan to fully represent the production phase, and additional information about the supply chain of the raw materials was also collected from the factories. 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 collection was 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 all 27 products is shown in Table 1.

Table 1 – Climate change impact of the 26 products evaluated in the life cycle assessment (LCA)

ID	Product type	Product	Climate change impact (kg CO_2e)	
			Cradle-to-consumer	Cradle-to-grave (95% confidence interval)
BL1	Bedlinen 140 x 200	Fall 2025 - 100% virgin - Bleached+printed	7,9	14,3 (13,2 - 15,8)
BL1n		Spring 2026 - 100% virgin - Unbleached+printed	7,0	13,4 (12,3 - 14,6)
BL2	Bedlinen 140 x 220	Fall 2025 - 100% virgin - Bleached+printed	8,3	15,1 (13,9 - 16,4)
BL2n		Spring 2026 - 100% virgin - Unbleached+printed	7,4	14,2 (13 - 15,6)
BM1	Bathmat 50 x 80	Fall 2025 - 100% virgin - Bleached+dyed	5,2	13,6 (12,5 - 15,1)
BM1n		Spring 2026 - 55% recycled - Bleached+dyed	4,8	13,3 (12,1 - 14,6)
BM2		Fall 2025 - 100% virgin - Unbleached+undyed	3,6	12,1 (10,9 - 13,3)
BM2n		Spring 2026 - 55% recycled - Unbleached+undyed	3,3	11,7 (10,6 - 13,1)
BML1	Bathmat 50 x 100	Spring 2026 - 55% recycled - Bleached+dyed	5,9	16,4 (14,8 - 18,1)
BML2		Spring 2026 - 55% recycled - Unbleached+undyed	3,9	14,5 (13,2 - 16,3)
BR1	Bathrobe	Fall 2025 - 100% virgin - Bleached+dyed	13,4	35,4 (32,6 - 39,4)
BR1n		Spring 2026 - 55% recycled - 50% bleached+dyed	10,5	32,5 (29,6 - 36,5)
BR2		Fall 2025 - 100% virgin - Unbleached+undyed	9,4	31,4 (28,7 - 34,9)
BT1	Bath towel 70 x 140	Fall 2025 - 100% virgin - Bleached+dyed	6,2	16,5 (15 - 18,3)
BT1n		Spring 2026 - 55% recycled - Bleached+dyed	5,8	16,1 (14,7 - 17,9)
BT2		Fall 2025 - 100% virgin - Unbleached+undyed	4,3	14,7 (13,3 - 16,2)
BT2n		Spring 2026 - 55% recycled - Unbleached+undyed	3,9	14,2 (13 - 15,7)
HT1	Hand towels 50 x 100 (2-pack)	Fall 2025 - 100% virgin - Bleached+dyed	6,3	16,8 (15,3 - 18,5)
HT1n		Spring 2026 - 55% recycled - Bleached+dyed	5,9	16,4 (15 - 18,3)
HT2		Fall 2025 - 100% virgin - Unbleached+undyed	4,4	14,9 (13,5 - 16,5)
HT2n		Spring 2026 - 55% recycled - Unbleached+undyed	4,0	14,5 (13,1 - 16)
SC1	Shower curtain 150 x 200	Spring 2026 - 100% virgin - Bleached+dyed	3,4	4,1 (3,8 - 4,5)
SC2		Spring 2026 - 100% virgin - Unbleached+undyed	2,7	3,5 (3,2 - 3,8)
WC1	Wash cloths 30 x 30 (5-pack)	Fall 2025 - 100% virgin - Bleached+dyed	3,0	7,8 (7,2 - 8,6)
WC1n		Spring 2026 - 55% recycled - Bleached+dyed	2,8	7,7 (7 - 8,5)
WC2		Fall 2025 - 100% virgin - Unbleached+undyed	2,1	6,9 (6,3 - 7,6)
WC2n		Spring 2026 - 55% recycled - Unbleached+undyed	1,9	6,8 (6,2 - 7,5)

For all products except SC1 and SC2 the most contributing life cycle phase is 'Phase 5 - use of product' (41-71% contribution) – see Figure 1. This is mainly due to the electricity and detergent used for washing and drying the textiles in their whole life cycle. For shower curtains the use phase has a lower contribution, which is due to shower curtains being washed less frequently than the other products. It was found that the LCA results are sensitive to changes in washing frequency and whether the textiles are dried in a dryer or air dried. Increasing the washing frequency and machine-drying increases the environmental impact of the products in their 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 products: 48 for bedlinen products, 144 for towel products and 12 for shower curtains.
- Drying method after washing: 58% machine drying and 42% air-drying.

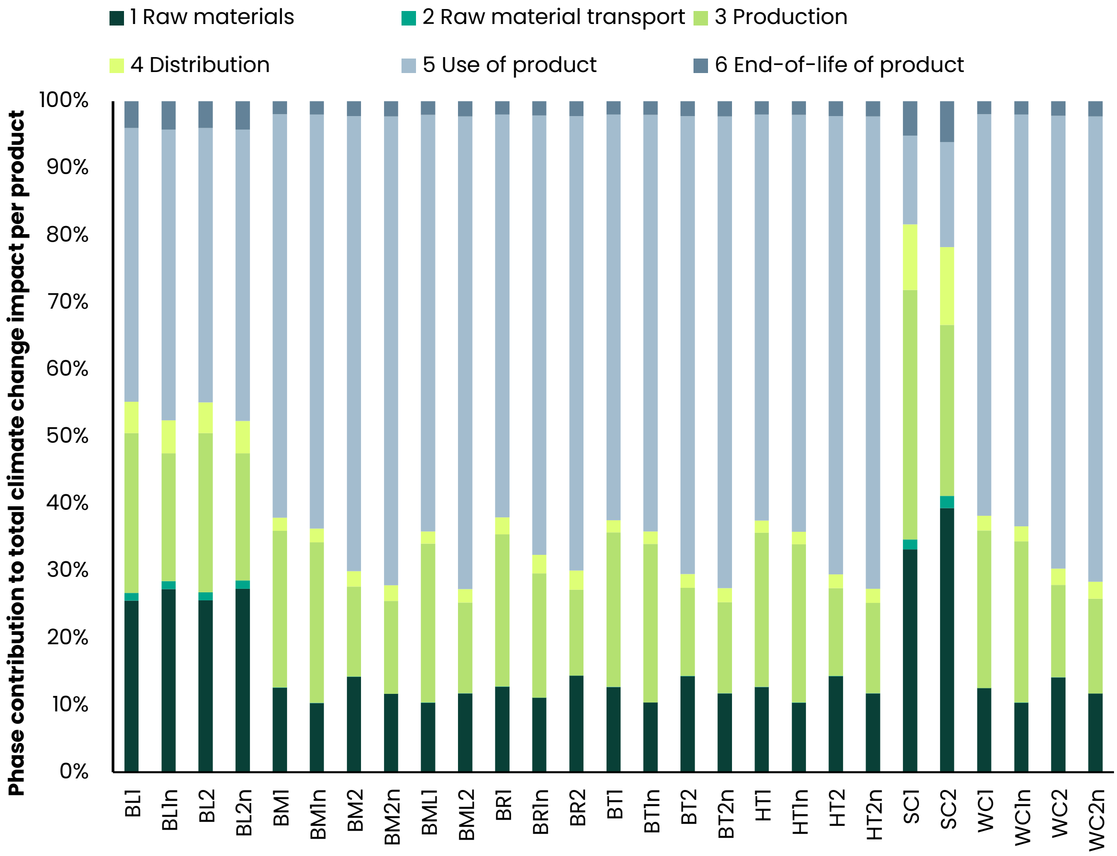

Figure 1 – Contribution analysis for the climate change impact for each product

The comparison between spring 2026 products and their fall 2025 counterparts showed reductions in the cradle-to-consumer climate change impact between 7-37% after implementing design choices such as not bleaching and dyeing the textiles and replacing some virgin cotton with recycled cotton. See Table 2 for the specific reductions. Uncertainty analysis was conducted to test the confidence in the comparative statements, which were found to be statistically significant with a confidence interval of 95%.

Table 2: %-reduction of the cradle-to-consumer climate change impact of selected products after implementing design choices such as not bleaching the textiles and replacing some virgin cotton with recycled cotton.

Products	Reduction in climate change impact from cradle-to-consumer
BL1n, 100% virgin, unbleached and printed	10% reduction by not bleaching (compared to BL1: 100% virgin, bleached and printed)
BL2n, 100% virgin, unbleached and printed	10% reduction by not bleaching (compared to BL2: 100% virgin, bleached and printed)
BM1n, 55% recycled, bleached and dyed	7% reduction by adding 55% recycled materials (compared to BM1, 100% virgin, bleached and dyed)

Products	Reduction in climate change impact from cradle-to-consumer
BM2n, 55% recycled, unbleached and undyed	10% reduction by adding 55% recycled materials (compared to BM2, 100% virgin, unbleached and undyed) 37% reduction by adding 55% recycled materials and by not bleaching/dyeing (compared to BM1, 100% virgin, bleached and dyed)
BR1n, 55% recycled, 50% bleached and dyed	22% reduction by adding 55% recycled materials and only bleaching/dyeing 50% of the product (compared to BR1, 100% virgin, 100% bleached and dyed)
BT1n, 55% recycled, bleached and dyed	7% reduction by adding 55% recycled materials (compared to BT1, 100% virgin, bleached and dyed)
BT2n, 55% recycled, unbleached and undyed	10% reduction by adding 55% recycled materials (compared to BT2, 100% virgin, unbleached and undyed) 37% reduction by adding 55% recycled materials and by not bleaching/dyeing (compared to BT1, 100% virgin, bleached and dyed)
HT1n, 55% recycled, bleached and dyed	7% reduction by adding 55% recycled materials (compared to HT1, 100% virgin, bleached and dyed)
HT2n, 55% recycled, unbleached and undyed	10% reduction by adding 55% recycled materials (compared to HT2, 100% virgin, unbleached and undyed) 37% reduction by adding 55% recycled materials and by not bleaching/dyeing (compared to HT1, 100% virgin, bleached and dyed)
WC1n, 55% recycled, bleached and dyed	5% reduction by adding 55% recycled materials (compared to WC1, 100% virgin, bleached and dyed)
WC2n, 55% recycled, unbleached and undyed	8% reduction by adding 55% recycled materials (compared to WC2, 100% virgin, unbleached and undyed) 35% reduction by adding 55% recycled materials and by not bleaching/dyeing (compared to WC1, 100% virgin, bleached and dyed)
SC2, 100% virgin, unbleached and undyed	5% reduction by not bleaching and dyeing (compared to SC1: 100% virgin, bleached and dyed)

Critical review: The LCA study was carried out by Better Green ApS and critically reviewed by an independent third-party panel 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
BL1	Bedlinen 200 cm, fall 2025	100% virgin, organic cotton	Bleached+printed
BL1n	Bedlinen 200 cm, spring 2026	100% virgin, organic cotton	Unbleached+printed
BL2	Bedlinen 220 cm, fall 2025	100% virgin, organic cotton	Bleached+printed
BL2n	Bedlinen 220 cm, spring 2026	100% virgin, organic cotton	Unbleached+printed
BM1	Bathmat 50x80 cm, fall 2025	100% virgin, organic cotton	Bleached+dyed
BM1n	Bathmat 50x80 cm, spring 2026	55% recycled, 45% organic cotton	Bleached+dyed
BM2	Bathmat 50x80 cm, fall 2025	100% virgin, organic cotton	Unbleached+undyed
BM2n	Bathmat 50x80 cm, spring 2026	55% recycled, 45% organic cotton	Unbleached+undyed
BML1	Bathmat 50x100 cm, spring 2026	55% recycled, 45% organic cotton	Bleached+dyed
BML2	Bathmat 50x100 cm, spring 2026	55% recycled, 45% organic cotton	Unbleached+undyed
BR1	Bathrobe, fall 2025	100% virgin, organic cotton	Bleached+dyed
BR1n	Bathrobe, spring 2026	55% recycled, 45% organic cotton	50% bleached+dyed 50% unbleached+undyed
BR2	Bathrobe, fall 2025	100% virgin, organic cotton	Unbleached+undyed
BT1	Bath towel, fall 2025	100% virgin, organic cotton	Bleached+dyed
BT1n	Bath towel, spring 2026	55% recycled, 45% organic cotton	Bleached+dyed
BT2	Bath towel, fall 2025	100% virgin, organic cotton	Unbleached+undyed
BT2n	Bath towel, spring 2026	55% recycled, 45% organic cotton	Unbleached+undyed
HT1	Hand towel 2-pack, fall 2025	100% virgin, organic cotton	Bleached+dyed
HT1n	Hand towel 2-pack, spring 2026	55% recycled, 45% organic cotton	Bleached+dyed
HT2	Hand towel 2-pack, fall 2025	100% virgin, organic cotton	Unbleached+undyed
HT2n	Hand towel 2-pack, spring 2026	55% recycled, 45% organic cotton	Unbleached+undyed
SC1	Shower curtain, spring 2026	100% virgin, organic cotton	Bleached+dyed
SC2	Shower curtain, spring 2026	100% virgin, organic cotton	Unbleached+undyed
WC1	Wash cloth 5-pack, fall 2025	100% virgin, organic cotton	Bleached+dyed
WC1n	Wash cloth 5-pack, spring 2026	55% recycled, 45% organic cotton	Bleached+dyed
WC2	Wash cloth 5-pack, fall 2025	100% virgin, organic cotton	Unbleached+undyed
WC2n	Wash cloth 5-pack, spring 2026	55% recycled, 45% organic cotton	Unbleached+undyed

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
TR	Türkiye

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 selected home textile products from the spring 2026 line of Nord Harmony. Furthermore, the LCA study aims to compare the spring 2026 products with their fall 2025 counterparts and look at the effects of implemented design choices such as not bleaching the textiles and replacing some virgin cotton with recycled cotton.

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) and/or labelling the products with the achieved emission reductions due to new design choices.
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

This LCA study includes an environmental impact assessment of several different products. The products are not intended to be compared across different product types. However, the products from the spring 2026 product line are intended to be compared with their fall 2025 counterparts. This comparison is meant to highlight the design choices which have been implemented (i.e. not bleaching or dyeing some of the products and including 55% recycled cotton in some products).

In order to compare different products, they have to be functionally identical. Therefore, only products which have the same functionality are compared in this study.

Furthermore, to compare different products, the LCA must have the same scope and the same data quality across the life cycle stages. In this LCA the products which are being compared have the same scope and quality, which is further discussed in section 7.

4 Scope of the study

4.1 Description of the products

This study assesses multiple home textile products from the Nord Harmony spring 2026 line. Furthermore, a selection of products from the fall 2025 line is included to facilitate comparisons and evaluate the impact of design choices implemented between the two product lines.

The products are produced at two different factories in Pakistan. Due to confidentiality the two factories are referred to as *the bedlinen factory* and *the towel factory*, respectively. In Table 3 the included products are listed per factory.

Table 3 – Products included in this LCA per factory. For some product types there are several product versions shown with their product ID. The product IDs are described in Table 4.

Factories	Bedlinen factory	Towel factory
Products from factory	Bedlinen (BL1, BL1n, BL2, BL2n) Shower curtains (SC1, SC2)	Bathmats (BM1, BM1n, BM2, BM2n) Bathmats, long (BLM1, BML2) Bathrobes (BR1, BR1n, BR2) Bath towels (BT1, BT1n, BT2, BT2n) Hand towels (HT1, HT1n, HT2, HT2n) Wash cloths (WC1, WC1n, WC2, WC2n)

Some of the products come in several sizes/dimensions and several designs/colors. In Table 4 the product variations are shown along with the product ID. Some of the variations are grouped together, meaning that one set of LCA results will represent several product variations, because the level of detail of the collected data does not allow for distinction between the product variations (i.e., two different printing designs).

The number of LCA results is 27 (six sets of LCA results for products from the bedlinen factory and 21 sets of LCA results for products from the towel factory, respectively).

The actual products with their packaging were not photographed at the time of writing this report. Illustrations of the products are shown in Section 10.1 (Appendix).

Table 4 – Textile products assessed in the LCA study incl. size and design variations and LCA ID. Dimensions are given in cm.

Product type	Product	Virgin cotton	Recycled cotton	Bleached	Dyed	Printed	Factory	Product line
Bedlinen 140 x 200	BL1*	100%	0%	Yes	-	Yes	Bedlinen factory	Fall 2025
	BL1n*	100%	0%	-	-	Yes	Bedlinen factory	Spring 2026
Bedlinen 140 x 220	BL2*	100%	0%	Yes	-	Yes	Bedlinen factory	Fall 2025
	BL2n*	100%	0%	-	-	Yes	Bedlinen factory	Spring 2026
Bathmat 50 x 80	BM1*	100%	0%	Yes	Yes	-	Towel factory	Fall 2025
	BM1n*	45%	55%	Yes	Yes	-	Towel factory	Spring 2026
	BM2	100%	0%	-	-	-	Towel factory	Fall 2025
	BM2n	45%	55%	-	-	-	Towel factory	Spring 2026
Bathmat 50 x 100	BML1	45%	55%	Yes	Yes	-	Towel factory	Spring 2026
	BML2	45%	55%	-	-	-	Towel factory	Spring 2026
Bathrobe L/XL**	BR1*	100%	0%	Yes	Yes	-	Towel factory	Fall 2025
	BR1n	45%	55%	Yes, 50% (stripes)	Yes, 50% (stripes)	-	Towel factory	Spring 2026
	BR2	100%	0%	-	-	-	Towel factory	Fall 2025
Bath towel 70 x 140	BT1*	100%	0%	Yes	Yes	-	Towel factory	Fall 2025
	BT1n*	45%	55%	Yes	Yes	-	Towel factory	Spring 2026
	BT2	100%	0%	-	-	-	Towel factory	Fall 2025
	BT2n	45%	55%	-	-	-	Towel factory	Spring 2026
Hand towels 50 x 100 (2-pack)	HT1*	100%	0%	Yes	Yes	-	Towel factory	Fall 2025
	HT1n*	45%	55%	Yes	Yes	-	Towel factory	Spring 2026
	HT2	100%	0%	-	-	-	Towel factory	Fall 2025
	HT2n	45%	55%	-	-	-	Towel factory	Spring 2026

Product type	Product	Virgin cotton	Recycled cotton	Bleached	Dyed	Printed	Factory	Product line
Shower curtain 150 x 200	SC1*	100%	0%	Yes	Yes	-	Bedlinen factory	Spring 2026
	SC2	100%	0%	-	-	-	Bedlinen factory	Spring 2026
Wash cloths 30 x 30 (5-pack)	WC1*	100%	0%	Yes	Yes	-	Towel factory	Fall 2025
	WC1n*	45%	55%	Yes	Yes	-	Towel factory	Spring 2026
	WC2	100%	0%	-	-	-	Towel factory	Fall 2025
	WC2n	45%	55%	-	-	-	Towel factory	Spring 2026

** These LCA IDs represent 2 or more product variations. That is because the level of detail of the life cycle inventory does not enable differentiation between the single products (i.e. two different print designs or two different colors).*
*** The bathrobes 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. Depending on the product, one product package may contain one or more products. The reference flow and functional unit are listed in Table 5.

Table 5 – Reference flow and functional unit per product in the LCA

Product	Reference flow	Functional unit
BL1 BL1n	One set of bedlinen (duvet cover + pillow cover)	Covering a pillow and a 140x200 cm duvet every day for two years with a washing frequency of two times per month.
BL2 BL2n	One set of bedlinen (duvet cover + pillow cover)	Covering a pillow and a 140x220 cm duvet every day for two years with a washing frequency of two times per month.
BM1 BM1n BM2 BM2n	One bathmat	Catching water and preventing slips after showers on an area of 50x80 cm one time every day for two years with a washing frequency of six times per month.
BML1 BML2	One bathmat	Catching water and preventing slips after showers on an area of 50x100 cm one time every day for two years with a washing frequency of six times per month.
BR1 BR1n BR2	One bathrobe	One full body drying every day for two years with a washing frequency of six times per month.
BT1 BT1n BT2 BT2n	One bath towel	One full body drying every day for two years with a washing frequency of six times per month.
HT1 HT1n HT2 HT2n	Two hand towels (one 2-pack)	10 hand dryings every day for two years. with a washing frequency of six times per month.
SC1 SC2	One shower curtain	Serving as a barrier to splashing water out of a shower one time every day for two years with a washing frequency of six times per year.
WC1	Five wash cloths (one 5-pack)	Acting as carrier for soap for maintaining personal hygiene during two uses per day for two years with a washing frequency of six times per month.

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 6 the activities included in each life cycle phase are presented.

Table 6 – Life cycle phases declarbedlied 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 • Recycled cotton • Transport of virgin cotton from gin to spinning mill • Transport of recycled cotton to spinning mill • Cotton yarn spinning
2) Transport of raw materials	• Transport of cotton yarn to textile mill
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 2.

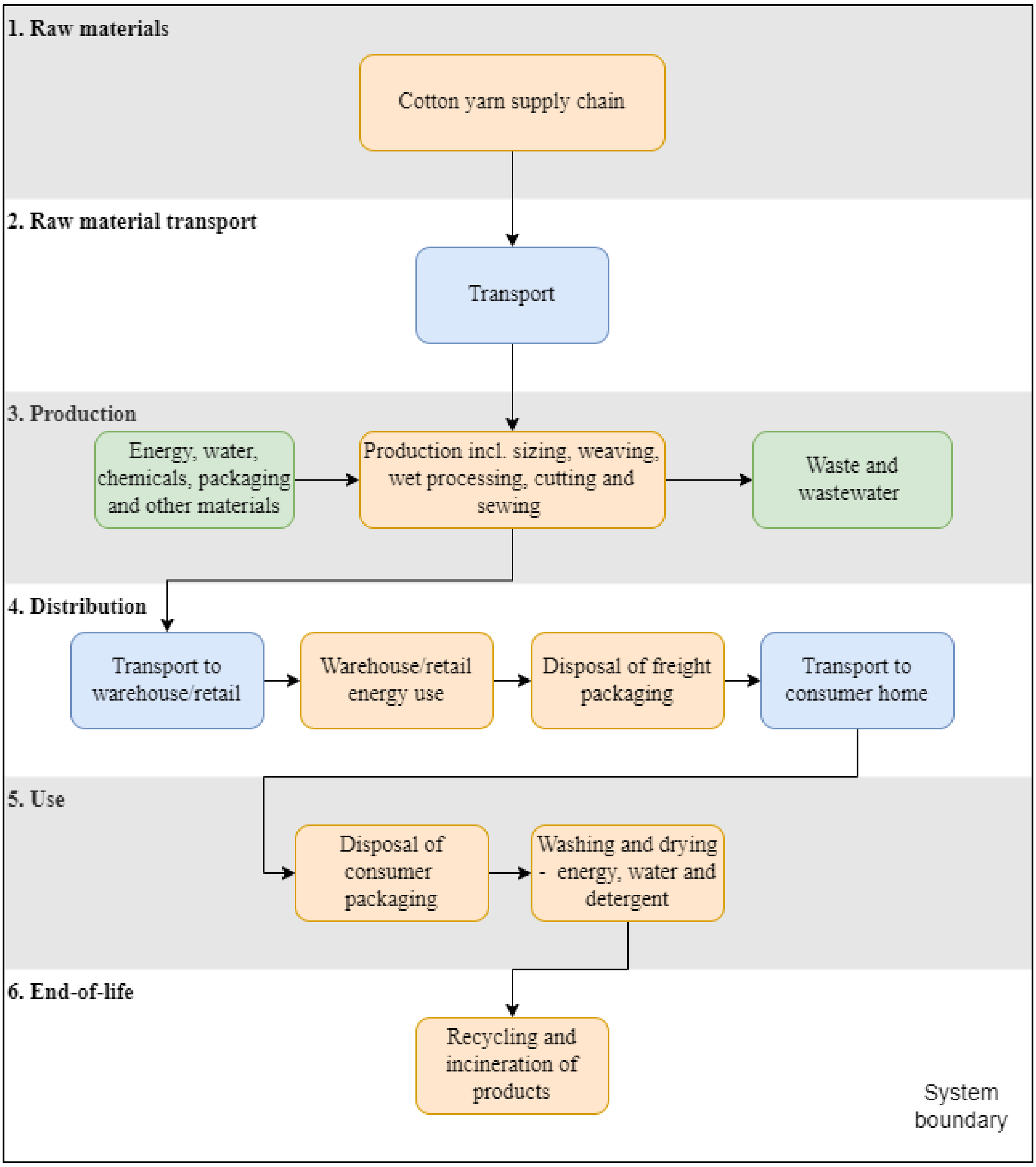

Figure 2 – Flow diagram for life cycle phases in this LCA. The figure illustrates both systems. For some products *phase 1 – Raw materials* differs depending on the use of virgin cotton or recycled cotton. For some products *phase 3 – Production* differs depending on which factory they are produced at (bedlinen factory or towel factory) and whether the products go through bleaching, dyeing and printing.

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 factories 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 7.

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 7 – 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	2024-2026	2025-2026	2025-2026	2026	2026-2027/29	2027-2029
Geographical	Türkiye/Pakistan	International	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 factories' supply chains, 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 and between the two systems. 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 expert review panel consisting of Waldemar Hemdrup, LCA & EPD Consultant, Julie M.V. Larsen, LCA & EPD Consultant, and Edvinas Damukaitis, 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 critical review panel. See dialogue between the review panel and the LCA practitioner during the review process in section 10.7 (appendix).

5 Life cycle inventory analysis (LCI)

5.1 Phase 1: Raw materials

Relevant supply chain information regarding the products is summarized in Table 8. The activity data, background data and data quality are described further in the following sections.

Table 8 – Supply chain information for cotton and polyester for the bedlinen and the towel factory.

Parameter	Supply chain information
Cotton origin	Virgin cotton (Türkiye), virgin cotton (Pakistan) or recycled cotton
Virgin cotton cultivation method	Organic
Ginning location	Türkiye or Pakistan (assumed nearby the cotton cultivation)
Recycled cotton type	Post-consumer
Yarn spinning method	Ring spinning
Yarn spinning mill location	Sindh region, Pakistan (assumed Karachi, Sindh)

In Table 9 the composition of the products can be seen. These figures are not including 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 textiles factories.

Table 9 – Product composition (grams)

Product	Product name	Main fabric (cotton)	Care label (cotton)	Thread (polyester)	Fabric bag/ribbon (cotton)	Total
BL1	Bedlinen 140 x 200	869,0	1,5	8,0	5,0	883,5
BL1n		869,0	1,5	8,0	5,0	883,5
BL2	Bedlinen 140 x 220	919,0	1,5	9,0	6,0	935,5
BL2n		919,0	1,5	9,0	6,0	935,5
BM1	Bathmat 50 x 80	400,0	10,0	3,0		413,0
BM1n		400,0	10,0	3,0		413,0
BM2		400,0	10,0	3,0		413,0
BM2n		400,0	10,0	3,0		413,0
BML1	Bathmat 50 x 100	500,0	10,0	3,0		513,0
BML2		500,0	10,0	3,0		513,0
BR1	Bathrobe L/XL**	1050,0	10,0	12,0	10,0	1082,0
BR1n		1050,0	10,0	12,0	10,0	1082,0
BR2		1050,0	10,0	12,0	10,0	1082,0
BT1	Bath towel 70 x 140	490,0	10,0	4,0		504,0
BT1n		490,0	10,0	4,0		504,0
BT2		490,0	10,0	4,0		504,0
BT2n		490,0	10,0	4,0		504,0
HT1	Hand towels 50 x 100 (2-pack)	500,0	10,0	3,0		513,0
HT1n		500,0	10,0	3,0		513,0
HT2		500,0	10,0	3,0		513,0
HT2n		500,0	10,0	3,0		513,0
SC1	Shower curtain 150 x 200	319,0	1,5	4,0	5,0	329,5
SC2		319,0	1,5	4,0	5,0	329,5
WC1	Wash cloths 30 x 30 (5-pack)	225,0	10,0	1,0		236,0
WC1n		225,0	10,0	4,0		239,0
WC2		225,0	10,0	1,0		236,0
WC2n		225,0	10,0	4,0		239,0

5.1.1 Cotton

The products assessed in this LCA consist of a main fabric of cotton, a care label of cotton and thread of polyester. Some products also have a self-fabric bag or ribbon of cotton which is part of the product packaging. Nonetheless it is treated as a part of the product in this LCA, since it is made of the same materials as the main fabric.

The products consist of >98% cotton (main fabric, care label and self-fabric bag/ribbon) and <2% of polyester (thread).

There are three different origins of the cotton used in the products – organic cotton from Türkiye, organic cotton from Pakistan and recycled cotton (post-consumer). For some products the origin of the cotton for the main fabric and the care label differs. In these cases, the care label contributes with less than 0,4% of the overall weight of cotton. For simplification reasons it has therefore been assumed that the care label cotton originates from the same source as the main fabric. The cotton origin for each product can be seen in Table 10.

Table 10 – Origin of cotton used in the products.

Product	Organic cotton Türkiye (TR)	Organic cotton Pakistan (PK)	Recycled cotton
BL1	100%*	0%	
BL1n		100%	
BL2	100%*	0%	
BL2n		100%	
BM1		100%	
BM1n		45%	55%
BM2		100%	
BM2n		45%	55%
BML1		45%	55%
BML2		45%	55%
BR1		100%	
BR1n		45%	55%
BR2		100%	
BT1		100%	
BT1n		45%	55%
BT2		100%	
BT2n		45%	55%
HT1		100%	
HT1n		45%	55%
HT2		100%	
HT2n		45%	55%
SC1		100%	
SC2		100%	
WC1		100%	
WC1n		45%	55%
WC2		100%	

Product	Organic cotton Türkiye (TR)	Organic cotton Pakistan (PK)	Recycled cotton
WC2n		45%	55%
BL1	100%*	0%	

* For these products the cotton used for the care label (<0,4% of the cotton weight) is from Pakistan, while the main fabric (>99,6% of the cotton weight) is from Türkiye. For simplification reasons it has been assumed that 100% of the cotton is from Türkiye.

5.1.1.1 *Cotton cultivation and ginning TR*

5.1.1.1.1 *Activity data*

The cotton sourced from Türkiye is grown using organic farming methods. The exact growing region is unknown but for estimation of transport distances, it is assumed that the cotton is grown in Sanliurfa, Southeastern Anatolia, which is the largest cotton-growing region in Türkiye.

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 Sanliurfa, Türkiye. 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.

5.1.1.1.2 *Background data*

The organic cultivation of cotton is modelled with secondary data, since the factories do not have primary data for their supply chains. 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 Türkiye. 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 Türkiye (TR) (Fibre, cotton {IN}| fibre production, cotton, ginning | Cut-off, U – adapted to TR). 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.

5.1.1.1.3 Data quality

Information about the cotton cultivation regions was collected from the product factories and has a good accuracy. Nonetheless, secondary LCI data for the cotton cultivation and ginning steps are not available for Türkiye. 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 Türkiye 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 Türkiye (TR) to increase the geographical representativeness. See Table 11 for data quality rating (DQR).

Table 11 – Data quality rating (DQR) for cotton cultivation and ginning in Türkiye (TR). 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 TR	Good	Very poor	Fair	Very good
Ginning	Good	Fair	Fair	Very good

5.1.1.2 Cotton cultivation and ginning PK

5.1.1.2.1 Activity data

The cotton sourced in Pakistan 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.

5.1.1.2.2 Background data

The organic cultivation of cotton is modelled with secondary data, since the factories do not have primary data for their supply chains. 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.

5.1.1.2.3 Data quality

Information about the cotton cultivation regions was collected from the product factories 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. See Table 12 for data quality rating (DQR).

Table 12 – 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 PK	Good	Fair	Fair	Very good
Ginning	Good	Fair	Fair	Very good

5.1.1.3 Recycled cotton

5.1.1.3.1 Activity data

The recycled cotton originates from post-consumer material and enters the life cycle burden-free up until after sorting, recycling and baling. This is in line with the polluter-pays principle, which is also applied in this LCA in Phase 6 – End of life of product. In this phase the complete recycling incl. sorting, recycling and baling of the product waste is included in the LCA.

The transport of the recycled cotton to the spinning mill is accounted for in section 5.1.2.

5.1.2 Transport to yarn spinning mill

5.1.2.1 Activity data

The yarn spinning mills are located in the Sindh region in Pakistan for all the products. The exact location of the spinning mill is unknown, but for estimation of transport distances, it is assumed that the spinning mill is located near Karachi, Sindh.

The transport routes and distances from the gins to the spinning mills are estimated with the EcoTransit online tool.

For cotton originating in Türkiye, the distance from the gin in Sanliurfa to the port in Tripoli, Lebanon, is estimated at 517 km by truck. The distance from the port in Tripoli to the port in Karachi, Pakistan, is estimated at 6660 km by container ship. The distance from the port in Karachi, Pakistan, to the yarn spinning mill in Karachi, Pakistan, is assumed 50 km by truck. Please note that only the products BL1 and BL2 from the fall 2025 line contain cotton from Türkiye, whereas their spring 2026 counterparts, BL1n and BL2n, contain cotton from Pakistan, meaning that the cotton origin has changed between the two lines.

For cotton originating in Pakistan, the distance from the gin in Faisalabad, Pakistan, to the yarn spinning mill in Karachi, Pakistan, is estimated at 1120 km by truck.

The transport of the recycled cotton to the spinning mills is assumed to be 1000 km by truck and 18000 by ship in line with PEF (2021) guidelines for international transport.

An overview of the transport distances for virgin cotton per product is shown in Table 13.

Table 13 – Location of gin and yarn spinning mill for each product along with the estimated transport distances by ship and truck.

Product	Gin location	Spinning location	Ship (km)	Truck (km)
BL1	Sanliurfa, TR	Karachi, PK	6660	567
BL1n	Faisalabad, PK	Karachi, PK	-	1120
BL2	Sanliurfa, TR	Karachi, PK	6660	567
BL2n	Faisalabad, PK	Karachi, PK	-	1120
BM1	Faisalabad, PK	Karachi, PK	-	1120
BM1n	Faisalabad, PK	Karachi, PK	-	1120
BM2	Faisalabad, PK	Karachi, PK	-	1120
BM2n	Faisalabad, PK	Karachi, PK	-	1120
BML1	Faisalabad, PK	Karachi, PK	-	1120
BML2	Faisalabad, PK	Karachi, PK	-	1120
BR1	Faisalabad, PK	Karachi, PK	-	1120

Product	Gin location	Spinning location	Ship (km)	Truck (km)
BR1n	Faisalabad, PK	Karachi, PK	-	1120
BR2	Faisalabad, PK	Karachi, PK	-	1120
BT1	Faisalabad, PK	Karachi, PK	-	1120
BT1n	Faisalabad, PK	Karachi, PK	-	1120
BT2	Faisalabad, PK	Karachi, PK	-	1120
BT2n	Faisalabad, PK	Karachi, PK	-	1120
HT1	Faisalabad, PK	Karachi, PK	-	1120
HT1n	Faisalabad, PK	Karachi, PK	-	1120
HT2	Faisalabad, PK	Karachi, PK	-	1120
HT2n	Faisalabad, PK	Karachi, PK	-	1120
SC1	Faisalabad, PK	Karachi, PK	-	1120
SC2	Faisalabad, PK	Karachi, PK	-	1120
WC1	Faisalabad, PK	Karachi, PK	-	1120
WC1n	Faisalabad, PK	Karachi, PK	-	1120
WC2	Faisalabad, PK	Karachi, PK	-	1120
WC2n	Faisalabad, PK	Karachi, PK	-	1120

5.1.2.2 Background data

The truck transport in Türkiye and 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).

5.1.2.3 Data quality

Information about the virgin cotton supply chain for the products was collected from the factories and has a good accuracy since the country and regions for the supply chain steps are known giving a good estimate of the transport distances. The secondary LCI data for this transport is considered of fair geographical representativeness and good technological representativeness. See Table 14 for data quality rating (DQR). The actual transport distances for recycled cotton are unknown, and the accuracy and geographical representativeness are therefore very poor.

Table 14 – Data quality rating (DQR) for transport of cotton fiber to yarn spinning mill. 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 virgin cotton	Good	Fair	Poor	Good
Transport recycled cotton	Very poor	Very poor	Poor	Fair

5.1.3 Yarn spinning

5.1.3.1 Activity data

The next step after ginning is the spinning of the cotton yarn. The yarn used in all the products is ring spun and the spinning mills are located in the Sindh region in Pakistan.

5.1.3.2 Background data

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.

5.1.3.3 Data quality

Information about the yarn spinning location and method was collected from the factories and has a good accuracy. Secondary LCI data was not available for the yarn spinning process in Pakistan. Nonetheless, it was possible to adapt the available global dataset to Pakistan to increase the geographical representativeness. See Table 15 for data quality rating (DQR).

Table 15 – Data quality rating (DQR) for yarn spinning process. 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	Fair	Fair	Very good

5.1.4 Polyester thread

5.1.4.1 Activity data

The products contain less than 2% polyester thread.

The polyester thread used for bedlinen products and towel products 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.

5.1.4.2 Background data

The polyester fiber production is modelled with secondary data since the factories do 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).

5.1.4.3 Data quality

Information about the polyester supply chain for the bedlinen and towel products was collected from the respective factories 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 16 for data quality rating (DQR).

Table 16 – Data quality rating (DQR) for towel product cotton 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

Phase 1 – unit process overview

Table 17 – 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 GLO	kg seed-cotton	1	kg	Seed-cotton, organic {GLO}| market for seed-cotton, organic | Cut-off, U	
1.2 Cotton ginning TR	kg cotton fiber	1	kg	Fibre, cotton {IN}| fibre production, cotton, ginning | Cut-off, U – adapted to TR	Background dataset adapted from India to Türkiye.
1.3 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.
1.4 Recycled cotton	kg recycled cotton	1	kg	-	
1.5 Truck transport to spinning mill	tkm	1	tkm	Transport, freight, lorry, unspecified {RoW}| market for transport, freight, lorry, unspecified | Cut-off, U	
1.6 Ship transport to spinning mill	tkm	1	tkm	Transport, freight, sea, container ship {GLO}| transport, freight, sea, container ship | Cut-off, U	
1.7 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.
1.8 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.

Table 18 – Amount of unit processes per product in phase 1 – raw materials first half of the products.

Unit process name	Unit	BL1	BL1n	BL2	BL2n	BM1	BM1n	BM2	BM2n	BML1	BML2	BR1	BR1n	BR2
1.1 Cotton cultivation incl. transport to gin	kg seed-cotton	2,122	2,122	2,246	2,246	0,999	0,450	0,999	0,450	0,559	0,559	2,607	1,173	2,607
1.2 Cotton ginning TR	kg ginning	1,081		1,145										
1.3 Cotton ginning PK	kg ginning		1,081		1,145	0,508	0,508	0,508	0,508	0,631	0,631	1,331	1,331	1,331
1.4 Recycled cotton	kg recycled cotton						0,277		0,277	0,345	0,345		0,724	
1.5 Truck transport to spinning mill	tkm	0,522	1,030	0,552	1,091	0,484	0,456	0,484	0,456	0,566	0,566	1,268	1,194	1,268
1.6 Ship transport to spinning mill	tkm	6,127		6,488			4,280		4,280	5,316	5,316		11,212	
1.7 Yarn spinning PK	kg spinning	0,920	0,920	0,974	0,974	0,432	0,432	0,432	0,432	0,537	0,537	1,133	1,133	1,133
1.8 Polyester fiber PK	kg polyester	0,008	0,008	0,009	0,009	0,003	0,003	0,003	0,003	0,003	0,003	0,012	0,012	0,012

Table 19 – Amount of unit processes per product in phase 1 – raw materials second half of the products.

Unit process name	Unit	BT1	BT1n	BT2	BT2n	HT1	HT1n	HT2	HT2n	SC1	SC2	WC1	WC1n	WC2	WC2n
1.1 Cotton cultivation incl. transport to gin	kg seed-cotton	1,218	0,548	1,218	0,548	1,243	0,559	1,243	0,559	0,789	0,789	0,573	0,258	0,573	0,258
1.2 Cotton ginning TR	kg ginning														
1.3 Cotton ginning PK	kg ginning	0,620	0,620	0,620	0,620	0,631	0,631	0,631	0,631	0,403	0,403	0,290	0,294	0,290	0,294
1.4 Recycled cotton	kg recycled cotton		0,338		0,338		0,345		0,345				0,159		0,159
1.5 Truck transport to spinning mill	tkm	0,591	0,556	0,591	0,556	0,601	0,566	0,601	0,566	0,384	0,384	0,277	0,264	0,277	0,264
1.6 Ship transport to spinning mill	tkm		5,223		5,223		5,316		5,316				2,477		2,477
1.7 Yarn spinning PK	kg spinning	0,528	0,528	0,528	0,528	0,537	0,537	0,537	0,537	0,343	0,343	0,247	0,250	0,247	0,250
1.8 Polyester fiber PK	kg polyester	0,004	0,004	0,004	0,004	0,003	0,003	0,003	0,003	0,004	0,004	0,001	0,004	0,001	0,004

5.2 Phase 2: Transport of raw materials

Phase 2 "Raw materials" includes the raw material transport from the last processing step (spinning mill) to the two factories (bedlinen factory and towel factory). See relevant information about phase 2 in Table 20. The activity data, background data and data quality are described further in the following sections.

Table 20 – Information about the transport routes from spinning mill to textile factories.

Parameter	Bedlinen factory	Towel factory
Cotton spinning location	Sindh, Pakistan (assumed Karachi)	Sindh, Pakistan (assumed Karachi)
Polyester thread production location	Punjab, Pakistan (Assumed Faisalabad)	Sindh, Pakistan (Assumed Karachi)
Factory location	Faisalabad, Punjab, Pakistan	Karachi, Sindh, Pakistan
Transport yarn spinning mill to textile factory	Leg 1: Karachi-Faisalabad truck 1120 km	Leg 1: Karachi-Karachi 50 km (estimated distance)
Transport thread to textile factory	Leg 1: Faisalabad-Faisalabad 50 km (estimated distance)	Leg 1: Faisalabad-Faisalabad 50 km (estimated distance)
Transport secondary dataset	Transport, freight, lorry, unspecified {RoW}| market for transport, freight, lorry, unspecified | Cut-off, U	Transport, freight, lorry, unspecified {RoW}| market for transport, freight, lorry, unspecified | Cut-off, U

5.2.1 Activity data

The bedlinen factory is located in Faisalabad, Punjab, and cotton yarn comes from Sindh, Pakistan (assumed Karachi). The transport distance by truck is estimated to 1120 km using the EcoTransit online tool. The bedlinen factory sources thread from Punjab (assumed Faisalabad), and a distance of 50 km is assumed.

The towel factory is located in Karachi, Sindh, and cotton yarn comes from Sindh, Pakistan (assumed Karachi). The transport distance by truck is assumed to be 50 km. The thread comes from Sindh (assumed Karachi), and a distance of 50 km is assumed.

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 22, Table 23 and Table 24.

5.2.3 Data quality

The activity data is of good quality because the factories know which region the materials come from. The specific locations are assumed in order to estimate transport distances. See Table 21 for data quality rating (DQR).

Table 21 – 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 22 – 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 23 – Amount of unit processes per product in phase 2 – transport of raw materials first half of the products.

Unit process name	Unit	BL1	BL1n	BL2	BL2n	BM1	BM1n	BM2	BM2n	BML1	BML2	BR1	BR1n	BR2
2.1 Truck transport to textile factory	tkm	1,030	1,030	1,091	1,091	0,022	0,022	0,022	0,022	0,027	0,027	0,057	0,057	0,057

Table 24 – Amount of unit processes per product in phase 1 – raw materials second half of the products.

Unit process name	Unit	BT1	BT1n	BT2	BT2n	HT1	HT1n	HT2	HT2n	SC1	SC2	WC1	WC1n	WC2	WC2n
2.1 Truck transport to textile factory	tkm	0,026	0,026	0,026	0,026	0,027	0,027	0,027	0,027	0,384	0,384	0,012	0,013	0,012	0,013

5.3 Phase 3: Production

5.3.1 Production inputs and outputs

The production of the products are modeled separately per factory. In Table 25 it is shown which products are produced at each factory.

Table 25 – Products included in this LCA per factory.

Factories	Bedlinen factory	Towel factory
Products from factory	Bedlinen (BL1, BL1n, BL2, BL2n) Shower curtains (SC1)	Bathmats (BM1, BM1n, BM2, BM2n) Bathmats, long (BLM1, BML2) Bathrobes (BR1, BR1n, BR2) Bath towels (BT1, BT1n, BT2, BT2n) Hand towels (HT1, HT1n, HT2, HT2n) Wash cloths (WC1, WC1n, WC2, WC2n)

5.3.1.1 Activity data – bedlinen factory

The products from the bedlinen factory included in this LCA can be divided into three groups: (1) bleached and printed/dyed products, (2) printed products and unbleached and undyed/unprinted products.

Bleached and printed/dyed products (group 1) undergo:

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

Printed products (group 2) undergo:

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

Unbleached and undyed/unprinted products (group 3) undergo:

1) Sizing
2) Weaving
3) Desizing

4) Wet processing (excl. bleaching and printing/dyeing)
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 bedlinen 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 in group 1, group 2, and group 3, respectively, are listed in Table 26. Outputs of waste and wastewater per kg of product in group 1, group 2, and group 3, respectively, are listed in Table 27.

Table 26 – Energy and consumables per kg of final product

Input	Unit	/kg of group 1	/kg of group 2	/kg of group 3	Source
Electricity from grid	kWh	2,48	1,95	1,68	Primary data (allocated)
Electricity from solar	kWh	0,16	0,13	0,11	Primary data (allocated)
Steam from biomass	tons	0,014	0,007	0,003	Primary data (allocated)
Natural gas	m3	0,099	0,049	0,025	Primary data (allocated)
Clean water	m3	0,069	0,034	0,017	Primary data (allocated)
Lubricants	kg	0,0046	0,0046	0,0046	Primary data (allocated)
Plastic	kg	0,0075	0,0075	0,0075	Calculated from mass balance*
Metal	kg	0,012	0,012	0,012	Calculated from mass balance*

Input	Unit	/kg of group 1	/kg of group 2	/kg of group 3	Source
Paper	kg	0,025	0,025	0,025	Calculated from mass balance*
Starch for sizing	kg	0,090	0,090	0,090	Primary data
Enzyme for desizing	kg	0,002	0,002	0,002	Primary data
Sodium hydroxide for scouring	kg	0,07	0,07	0,07	Primary data
Hydrogen peroxide for bleaching	kg	0,021	0,021	-	Primary data
Sodium hydroxide for bleaching	kg	0,013	0,013	-	Primary data
Activator for bleaching	kg	0,002	0,002	-	Primary data
Pigment agent	kg	0,15	-	-	Primary data (allocated)
Dye agent	kg	-	0,21	-	Primary data (allocated)

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

Table 27 – Waste and wastewater per kg of final product

Input	Unit	/kg of group 1	/kg of group 2	/kg of group 3	Source
Plastic waste	kg	0,0075	0,0075	0,0075	Primary data (allocated)
Metal waste	kg	0,012	0,012	0,012	Primary data (allocated)
Paper waste	kg	0,025	0,025	0,025	Primary data (allocated)
Wastewater	m3	0,083	0,041	0,021	Primary data (allocated)
Textile waste	kg	0,041	0,041	0,041	Calculated from loss rate

For a more detailed description of how each input or output flow was determined and allocated to 1 kg of each product see Section 10.2 (Appendix).

5.3.1.2 Activity data – towel factory

The towel products included in this LCA can be divided into three groups: (1) bleached and dyed products, (2) unbleached (and undyed) products and (3) striped products which are 50% unbleached and undyed and 50% bleached and dyed. Group 3 is calculated as an average of group 1 and 2.

Bleached and dyed products (group 1) undergo:

6) Sizing
7) Weaving
8) Desizing
9) Wet processing (incl. bleaching and dyeing)
10) Cut and sew

Unbleached/undyed products (group 2) undergo:

6) Sizing
7) Weaving
8) Desizing
9) Wet processing (excl. bleaching and dyeing)
10) Cut and sew

In the weaving process there is a loss of 3,5%, while in the cut and sew process there is a loss of 1%. Overall, this means that (1,035 kg x 1,010 kg =) 1,047 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 bedlinen factory in 2024:

- 1.691.492 kg fabric was woven
- 676.596 kg fabric underwent bleaching (wet processing)
- 1.014.895 kg fabric underwent dyeing (wet processing)
- 1.556.173 kg fabric underwent cut and sew (final products)

Inputs of energy, water, materials and chemicals per kg of product in group 1 and group 2, respectively, are listed in Table 28. Outputs of waste and wastewater per kg of product in group 1 and group 2, respectively, are listed in Table 29.

Table 28 – Energy and consumables per kg of final product

Input	Unit	/kg of group 1	/kg of group 2	Source
Electricity from grid	kWh	6,23	5,07	Primary data (allocated)
Natural gas	m3	1,051	0,083	Primary data (allocated)
Clean water	m3	0,035	0,0044	Primary data (allocated)
Lubricants	kg	0,0010	0,0010	Primary data (allocated)
Plastic	kg	0,0015	0,0015	Calculated from mass balance*
Metal	kg	0,0012	0,0012	Calculated from mass balance*
Paper	kg	0,00071	0,00071	Calculated from mass balance*
Starch for sizing	kg	0,086	0,086	Primary data
Acid for desizing	kg	0,0051	0,0051	Primary data
Sodium hydroxide for scouring	kg	0,03	0,03	Primary data
Hydrogen peroxide for bleaching	kg	0,030	-	Primary data

Input	Unit	/kg of group 1	/kg of group 2	Source
Sodium hydroxide for bleaching	kg	0,03	-	Primary data
Dye	kg	0,076 for BT1, BT1n, HT1, HT1n, and WC1, WC1n (500 gsm) 0,091 for BM1, BM1n, BML1, BML2 (1000 gsm) 0,066 for BR1, (350 gsm) 0,033 for BR1n (350 gsm, striped)	-	Primary data

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

Table 29 – Waste and wastewater per kg of final product

Input	Unit	/kg of group 1	/kg of group 2	Source
Plastic waste	kg	0,0015	0,0015	Primary data (allocated)
Metal waste	kg	0,0012	0,0012	Primary data (allocated)
Paper waste	kg	0,00071	0,00071	Primary data (allocated)
Wastewater	m3	0,039	0,0049	Estimated (110% of water input)
Textile waste	kg	0,047	0,047	Calculated from loss rate

For a more detailed description of how each input or output flow was determined and allocated to 1 kg of each product see Section 10.3 (Appendix). Please note that the electricity consumption for the factory is given in very rounded numbers indicating that the precision of these numbers is low.

5.3.1.3 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 (only used in bedlinen factory) 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 (only used in bedlinen factory) 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). This 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). 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 the dataset required to represent the consumption of 1 m^3 natural gas in the factory.

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

Acid for desizing (only used in towel factory) 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}| market for hydrogen peroxide, without water, in 50% solution state | 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).

Activator for bleaching was modelled with an ecoinvent 3.11 dataset for sodium silicate (a typical activator 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 33, Table 34 and Table 35.

5.3.1.4 Data quality

The data quality rating for the production phase can be seen in Table 30. Overall, the data accuracy and technological representativeness of background data is good, while the geographical and temporal representativeness is poor.

Table 30 – 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 31. Some products also have a self-fabric bag or a cotton ribbon, but these are treated as part of the actual product in this LCA and have therefore been included in Phase 1 and 2.

Table 31 Product packaging composition (grams)

LCA ID	Consumer packaging		Freight packaging	
	Stiffener (cardboard)	Belly band (printed cardboard)	Polybag (LDPE)	Box (cardboard)
BL1	36	110	0,5	125
BL1n	36	110	0,5	125
BL2	36	110	0,5	125
BL2n	36	110	0,5	125
BM1	12		3	100
BM1n	12		3	100
BM2	12		3	100
BM2n	12		3	100
BML1	12		2,4	80
BML2	12		2,4	80
BR1	12		3	103
BR1n	12		3	103
BR2	12		3	103
BT1	13		3	83
BT1n	12,5		3	83
BT2	13		3	83
BT2n	12,5		3	83
HT1	12		3	78
HT1n	12		3	78
HT2	12		3	78
HT2n	12		3	78
SC1	36	90	0,75	150
SC2	36	90	0,75	150
WC1	13		2	75
WC1n	12,5		2	75
WC2	13		2	75
WC2n	12,5		2	75

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 33 and Table 34.

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 32 for data quality rating (DQR).

Table 32 – 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 33 – 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	35	MJ	PK Heat, central or small-scale, natural gas {RoW}| heat production, natural gas, at boiler modulating <100kW | Cut-off, U	0,028888889 m3 natural gas/MJ according to dataset. 1/0,02888=34,615 MJ/m3 natural gas
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	
3.07.3 Acid for desizing	kg	1	kg	Hydrogen peroxide, without water, in 50% solution state {RoW}| hydrogen peroxide production, product in 50% solution state | 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	

Unit process name	Unit process unit	Input	Input unit	ecoinvent dataset	Comment
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	
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	

Unit process name	Unit process unit	Input	Input unit	ecoinvent dataset	Comment
3.21 Other material inputs - paper	kg	1	kg	Paper, woodfree, uncoated {RoW}| market for paper, woodfree, uncoated | Cut-off, U	

Table 34 – Amount of unit processes per product in phase 3 – production first half of the products.

Unit process name	Unit	BL1	BL1n	BL2	BL2n	BM1	BM1n	BM2	BM2n	BML1	BML2	BR1	BR1n	BR2
3.01 Electricity from grid	kWh	2,195	1,719	2,324	1,820	2,573	2,573	2,095	2,095	3,196	2,603	6,741	6,115	5,489
3.02 Electricity from solar	kWh	0,145	0,114	0,154	0,120									
3.03 Steam from biomass	tons	0,012	0,006	0,013	0,006									
3.04 Natural gas	m3	0,087	0,044	0,092	0,046	0,434	0,434	0,034	0,034	0,539	0,043	1,137	0,613	0,090
3.05 Water consumption	m3	0,061	0,030	0,065	0,032	0,015	0,015	0,002	0,002	0,018	0,002	0,038	0,022	0,005
3.06 Lubricant	kg	0,004	0,004	0,004	0,004	0,0004	0,0004	0,0004	0,0004	0,0005	0,0005	0,001	0,001	0,001
3.07.1 Starch for sizing	kg	0,082	0,082	0,087	0,087	0,035	0,035	0,035	0,035	0,044	0,044	0,093	0,093	0,093
3.07.2 Enzymes for desizing	kg	0,001	0,001	0,002	0,002									
3.07.3 Acid for desizing	kg					0,002	0,002	0,002	0,002	0,003	0,003	0,005	0,005	0,005
3.07.4 NaOH for scouring	kg	0,006	0,006	0,007	0,007	0,013	0,013	0,013	0,013	0,016	0,016	0,033	0,033	0,033
3.08.1 H2O2 for bleaching	kg	0,019		0,020		0,013	0,013			0,016		0,033	0,016	
3.08.2 NaOH for bleaching	kg	0,011		0,012		0,013	0,013			0,016		0,033	0,016	
3.08.3 Activator for bleaching	kg	0,002		0,002										
3.10 Pigment/dye	kg	0,141	0,141	0,149	0,149	0,038	0,038			0,047		0,072	0,036	
3.11 Plastic waste	kg waste	0,007	0,007	0,007	0,007	0,001	0,001	0,001	0,001	0,001	0,001	0,002	0,002	0,002
3.12 Metal waste	kg waste	0,011	0,011	0,011	0,011	0,001	0,001	0,001	0,001	0,001	0,001	0,001	0,001	0,001
3.13 Paper waste	kg waste	0,022	0,022	0,023	0,023	0,0003	0,0003	0,0003	0,0003	0,0004	0,0004	0,001	0,001	0,001
3.14 Textile waste	kg waste	0,037	0,037	0,039	0,039	0,019	0,019	0,019	0,019	0,024	0,024	0,051	0,051	0,051
3.15 Wastewater dye-polluted	kg wastewater	0,073	0,036	0,077	0,039	0,016	0,016	0,002	0,002	0,020	0,002	0,042	0,024	0,005
3.16 Packaging - printed cardboard	kg cardboard	0,036	0,036	0,036	0,036	0,012	0,012	0,012	0,012	0,012	0,012	0,012	0,012	0,012

Unit process name	Unit	BL1	BL1n	BL2	BL2n	BM1	BM1n	BM2	BM2n	BML1	BML2	BR1	BR1n	BR2
3.17 Packaging - unprinted cardboard	kg cardboard	0,235	0,235	0,235	0,235	0,100	0,100	0,100	0,100	0,080	0,080	0,103	0,103	0,103
3.18 Packaging - LDPE	kg LDPE	0,001	0,001	0,001	0,001	0,003	0,003	0,003	0,003	0,002	0,002	0,003	0,003	0,003
3.19 Other material inputs - plastic	kg plastic	0,007	0,007	0,007	0,007	0,001	0,001	0,001	0,001	0,001	0,001	0,002	0,002	0,002
3.20 Other material inputs - metal	kg metal	0,011	0,011	0,011	0,011	0,001	0,001	0,001	0,001	0,001	0,001	0,001	0,001	0,001
3.21 Other material inputs - paper	kg paper	0,022	0,022	0,023	0,023	0,0003	0,0003	0,0003	0,0003	0,0004	0,0004	0,001	0,001	0,001

Table 35 – Amount of unit processes per product in phase 3 – production second half of the products.

Unit process name	Unit	BT1	BT1n	BT2	BT2n	HT1	HT1n	HT2	HT2n	SC1	SC2	WC1	WC1n	WC2	WC2n
3.01 Electricity from grid	kWh	3,140	3,140	2,557	2,557	3,196	3,196	2,603	2,603	0,818	0,553	1,470	1,489	1,197	1,213
3.02 Electricity from solar	kWh									0,054	0,037				
3.03 Steam from biomass	tons									0,005	0,001				
3.04 Natural gas	m3	0,529	0,529	0,042	0,042	0,539	0,539	0,043	0,043	0,032	0,008	0,248	0,251	0,020	0,020
3.05 Water consumption	m3	0,018	0,018	0,002	0,002	0,018	0,018	0,002	0,002	0,023	0,006	0,008	0,008	0,001	0,001
3.06 Lubricant	kg	0,0005	0,0005	0,0005	0,0005	0,0005	0,0005	0,0005	0,0005	0,002	0,002	0,0002	0,0002	0,0002	0,0002
3.07.1 Starch for sizing	kg	0,043	0,043	0,043	0,043	0,044	0,044	0,044	0,044	0,031	0,031	0,020	0,021	0,020	0,021
3.07.2 Enzymes for desizing	kg									0,001	0,001				
3.07.3 Acid for desizing	kg	0,003	0,003	0,003	0,003	0,003	0,003	0,003	0,003			0,001	0,001	0,001	0,001
3.07.4 NaOH for scouring	kg	0,015	0,015	0,015	0,015	0,016	0,016	0,016	0,016	0,002	0,002	0,007	0,007	0,007	0,007
3.08.1 H2O2 for bleaching	kg	0,015	0,015			0,016	0,016			0,007		0,007	0,007		
3.08.2 NaOH for bleaching	kg	0,015	0,015			0,016	0,016			0,004		0,007	0,007		
3.08.3 Activator for bleaching	kg									0,001					
3.10 Pigment/dye	kg	0,039	0,039			0,039	0,039			0,004		0,018	0,018		
3.11 Plastic waste	kg waste	0,001	0,001	0,001	0,001	0,001	0,001	0,001	0,001	0,002	0,002	0,0004	0,0004	0,0004	0,0004
3.12 Metal waste	kg waste	0,001	0,001	0,001	0,001	0,001	0,001	0,001	0,001	0,004	0,004	0,0003	0,0003	0,0003	0,0003
3.13 Paper waste	kg waste	0,0004	0,0004	0,0004	0,0004	0,0004	0,0004	0,0004	0,0004	0,008	0,008	0,0002	0,0002	0,0002	0,0002
3.14 Textile waste	kg waste	0,024	0,024	0,024	0,024	0,024	0,024	0,024	0,024	0,014	0,014	0,011	0,011	0,011	0,011
3.15 Wastewater dye-polluted	kg wastewater	0,020	0,020	0,002	0,002	0,020	0,020	0,002	0,002	0,027	0,007	0,009	0,009	0,001	0,001
3.16 Packaging - printed cardboard	kg cardboard	0,013	0,013	0,013	0,013	0,012	0,012	0,012	0,012	0,036	0,036	0,013	0,013	0,013	0,013
3.17 Packaging - unprinted cardboard	kg cardboard	0,083	0,083	0,083	0,083	0,078	0,078	0,078	0,078	0,240	0,240	0,075	0,075	0,075	0,075
3.18 Packaging - LDPE	kg LDPE	0,003	0,003	0,003	0,003	0,003	0,003	0,003	0,003	0,001	0,001	0,002	0,002	0,002	0,002
3.19 Other material inputs - plastic	kg plastic	0,001	0,001	0,001	0,001	0,001	0,001	0,001	0,001	0,002	0,002	0,0004	0,0004	0,0004	0,0004
3.20 Other material inputs - metal	kg metal	0,001	0,001	0,001	0,001	0,001	0,001	0,001	0,001	0,004	0,004	0,0003	0,0003	0,0003	0,0003
3.21 Other material inputs - paper	kg paper	0,0004	0,0004	0,0004	0,0004	0,0004	0,0004	0,0004	0,0004	0,008	0,008	0,0002	0,0002	0,0002	0,0002

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 36. The activity data, background data and data quality are described further in the following sections.

Table 36 Relevant information regarding distribution of bedlinen and towel products

Parameter	Information
Transport from factory to retail in Denmark	Leg 1: 1120 km by truck for bedlinen products (Factory in Faisalabad, Pakistan to port in Karachi, Pakistan), 30 km by truck for towel products (Factory in Karachi, 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 respective factories to the Karachi port in Pakistan by truck (1120 km for bedlinen products from factory in Faisalabad and 30 km by truck for towel products from factory in Karachi). From the port in Karachi, the products are transported by container ship to the port in Copenhagen (12200 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 42 and Table 43.

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 rates as poor-fair, since the original data used for the ecoinvent datasets is a little old, however ecoinvent extrapolates the data yearly to increase the temporal representativeness. The technological representativeness is rated as good. See Table 21 for data quality rating (DQR).

Table 37 – 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
Transport to DK	Very good	Good	Poor	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 38 for warehousing and retail, respectively.

Table 38 – Occupancy rates for each product in the LCA for warehouse.

LCA ID	Storage occupancy* (m3)	Storage time warehouse	Storage time retail	Specific storage occupancy warehouse (m3-weeks)	Specific storage occupancy retail (m3-weeks)
BL1	0,012	4	5	0,046	0,058
BL1n	0,012	4	5	0,046	0,058
BL2	0,012	4	5	0,046	0,058
BL2n	0,012	4	5	0,046	0,058
BM1	0,010	4	5	0,042	0,052
BM1n	0,010	4	5	0,042	0,052
BM2	0,010	4	5	0,042	0,052
BM2n	0,010	4	5	0,042	0,052
BML1	0,010	4	5	0,042	0,052
BML2	0,010	4	5	0,042	0,052
BR1	0,049	4	5	0,197	0,246
BR1n	0,049	4	5	0,197	0,246
BR2	0,049	4	5	0,197	0,246
BT1	0,011	4	5	0,044	0,055
BT1n	0,011	4	5	0,044	0,055
BT2	0,011	4	5	0,044	0,055
BT2n	0,011	4	5	0,044	0,055
HT1	0,011	4	5	0,045	0,056
HT1n	0,011	4	5	0,045	0,056
HT2	0,011	4	5	0,045	0,056
HT2n	0,011	4	5	0,045	0,056
SC1	0,012	4	5	0,046	0,058
SC1	0,012	4	5	0,046	0,058
WC1	0,007	4	5	0,027	0,034
WC1n	0,007	4	5	0,027	0,034
WC2	0,007	4	5	0,027	0,034
WC2n	0,007	4	5	0,027	0,034

* 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 42 and Table 43.

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 39 for data quality rating (DQR).

Table 39 – 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
Warehouse	Fair	Very good	Good	Very good
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 31.

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 42 and Table 43.

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 40 for data quality rating (DQR).

Table 40 – 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

The 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 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 42, Table 43 and Table 44.

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 41 for data quality rating (DQR).

Table 41 – 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 42 – Unit processes in phase 4 – distribution.

Unit process name	Unit process unit	Input	Input unit	ecoinvent dataset	Comment
4.1 Transport of product to retail - Bedlinen factory	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)
4.2 Transport of product to retail - Towel factory	kg product incl. packaging	0,03	tkm	Transport, freight, lorry, unspecified {RoW}| market for transport, freight, lorry, unspecified | Cut-off, U	Karachi - Karachi port (30 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	

Unit process name	Unit process unit	Input	Input unit	ecoinvent dataset	Comment
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 43 – Amount of unit processes per product in phase 4 – distribution first half of the products.

Unit process name	Unit	BL1	BL1n	BL2	BL2n	BM1	BM1n	BM2	BM2n	BML1	BML2	BR1	BR1n	BR2
4.1 Transport of product to retail - Bedlinen factory	kg product incl. packaging	1,155	1,155	1,207	1,207									
4.2 Transport of product to retail - Towel factory	kg product incl. packaging					0,528	0,528	0,528	0,528	0,607	0,607	1,200	1,200	1,200
4.3 Warehouse	m^3-weeks	0,046	0,046	0,046	0,046	0,042	0,042	0,042	0,042	0,042	0,042	0,197	0,197	0,197
4.4 Retail	m^3-weeks	0,058	0,058	0,058	0,058	0,052	0,052	0,052	0,052	0,052	0,052	0,246	0,246	0,246
4.5 Freight packaging disposal cardboard	kg	0,125	0,125	0,125	0,125	0,100	0,100	0,100	0,100	0,080	0,080	0,103	0,103	0,103
4.6 Freight packaging disposal LDPE	kg	0,001	0,001	0,001	0,001	0,003	0,003	0,003	0,003	0,002	0,002	0,003	0,003	0,003
4.7 Transport to consumer home	kg product incl. packaging	1,029	1,029	1,081	1,081	0,425	0,425	0,425	0,425	0,525	0,525	1,094	1,094	1,094

Table 44 – Amount of unit processes per product in phase 4 – distribution second half of the products.

Unit process name	Unit	BT1	BT1n	BT2	BT2n	HT1	HT1n	HT2	HT2n	SC1	SC2	WC1	WC1n	WC2	WC2n
4.1 Transport of product to retail - Bedlinen factory	kg product incl. packaging									0,606	0,606				
4.2 Transport of product to retail - Towel factory	kg product incl. packaging	0,603	0,603	0,603	0,603	0,606	0,606	0,606	0,606			0,326	0,329	0,326	0,329
4.3 Warehouse	m^3-weeks	0,044	0,044	0,044	0,044	0,045	0,045	0,045	0,045	0,046	0,046	0,027	0,027	0,027	0,027
4.4 Retail	m^3-weeks	0,055	0,055	0,055	0,055	0,056	0,056	0,056	0,056	0,058	0,058	0,034	0,034	0,034	0,034

Unit process name	Unit	BT1	BT1n	BT2	BT2n	HT1	HT1n	HT2	HT2n	SC1	SC2	WC1	WC1n	WC2	WC2n
4.5 Freight packaging disposal cardboard	kg	0,083	0,083	0,083	0,083	0,078	0,078	0,078	0,078	0,150	0,150	0,075	0,075	0,075	0,075
4.6 Freight packaging disposal LDPE	kg	0,003	0,003	0,003	0,003	0,003	0,003	0,003	0,003	0,001	0,001	0,002	0,002	0,002	0,002
4.7 Transport to consumer home	kg product incl. packaging	0,517	0,517	0,517	0,517	0,525	0,525	0,525	0,525	0,455	0,455	0,249	0,252	0,249	0,252

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 36. The activity data, background data and data quality are described further in the following sections.

Table 45 Relevant information regarding distribution of bedlinen and towel products

Parameter	Information
Product life time and washing/drying frequency	Based on literature values. Bedlinen and towels are estimated to be used for 2 years according to the International Fair Claims Guide for consumer textiles (Dry Cleaning Institute of Australia, 2015). Bedlinen is assumed to be washed two times per month, towels six times per month, and shower curtains once every second month based on expert judgement by Mørkegaard. Consequently, bedlinen products are washed 24 months x 2 times/month = 48 times in their lifetime, towel products are washed 24 months x 6 times/month = 144 times in their lifetime, and shower curtains are 24 months x 0,5 times/month = 12 times in their lifetime. Use patterns of household textiles vary greatly from consumer to consumer and have a large impact on the lifetime environmental impacts on textile products. The data used for the use phase in this LCA are based on literature values of low geographical and temporal representativeness (data from 2015 in Australia) and expert judgments. It was not possible to find more representative data, i.e. more recent data from Europe from reliable sources. This introduces uncertainty in the environmental impact of the products in their lifetime and 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 7.4.5.
Washing scenario	Assumed that 100% of 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 wash cycles in the lifetime of the products is based on literature values for life time (24 months according to Dry Cleaning Institute of Australia (2015)) and assumptions regarding the number of wash cycles per month (two cycles for bedlinen products, six cycles for towel products and half a cycle for shower curtains).

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 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 48, Table 49 and Table 50.

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 vary (very good for electricity, good for water use and very low for detergent use). See Table 46 for data quality rating (DQR).

Table 46 – 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 (cardboard belly band) per product can be seen in Table 31. Fabric bags and ribbons are assumed to be disposed of together with the products at their end-of-life.

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 48, Table 49 and Table 50.

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 47 for data quality rating (DQR).

Table 47 – 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 48 – 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	50% of the cycles with washing-drying machine: 4,76 kWh/7 kg cycle 50% 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 49 – Amount of unit processes per product in phase 5 – use of product first half of the products.

Unit process name	Unit	BL1	BL1n	BL2	BL2n	BM1	BM1n	BM2	BM2n	BML1	BML2	BR1	BR1n	BR2
5.1 Washing and drying	kg-cycle	42,166	42,166	44,614	44,614	59,472	59,472	59,472	59,472	73,872	73,872	154,368	154,368	154,368
5.2 Consumer packaging disposal	kg cardboard packaging	0,146	0,146	0,146	0,146	0,012	0,012	0,012	0,012	0,012	0,012	0,012	0,012	0,012

Table 50 – Amount of unit processes per product in phase 5 – use of product second half of the products.

Unit process name	Unit	BT1	BT1n	BT2	BT2n	HT1	HT1n	HT2	HT2n	SC1	SC2	WC1	WC1n	WC2	WC2n
5.1 Washing and drying	kg-cycle	72,576	72,576	72,576	72,576	73,872	73,872	73,872	73,872	3,893	3,893	33,984	34,416	33,984	34,416
5.2 Consumer packaging disposal	kg cardboard packaging	0,013	0,013	0,013	0,013	0,012	0,012	0,012	0,012	0,126	0,126	0,013	0,013	0,013	0,013

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. Of the exported waste 10% are incinerated and 90% are either reused or recycled. When adding up the treatment methods, this means that overall:

- 60,8% of the textile waste is incinerated
- 26,5% of the textile waste is recycled*
- 12,7% of the textile waste is reused*

*This is when assuming recycling for the exported waste where it is unknown if it is reused or recycled.

Out of all the textiles which end up being incinerated, 96% of them are incinerated in Denmark. Therefore, a process for incineration in Denmark is modelled. The process 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).

Reuse of textiles (13% of all textiles) is modelled without any environmental impacts in this LCA.

For the products packed in a self-fabric bag or with a ribbon these are assumed to be disposed of together with the product itself.

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 52, Table 53 and Table 54.

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 from the draft PEF-RP for footwear and apparel (PEF-RP A&FW, 2024). See Table 47 for data quality rating (DQR).

Table 51 – 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 52 – 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
		1,085	tkm	Transport, freight, lorry, unspecified {RER}| market for transport, freight, lorry, unspecified | Cut-off, U	41,5 km to first sorting point, 1043 km to second sorting/recycling point in Poland

Table 53 – Amount of unit processes per product in phase 6 – end of life of product first half of the products.

Unit process name	Unit	BL1	BL1n	BL2	BL2n	BM1	BM1n	BM2	BM2n	BML1	BML2	BR1	BR1n	BR2
6.1 Product EOL - incineration	kg textiles to incineration	0,711	0,711	0,753	0,753	0,332	0,332	0,332	0,332	0,413	0,413	0,871	0,871	0,871
6.2 Product EOL - recycling	kg textiles to recycling	0,172	0,172	0,182	0,182	0,081	0,081	0,081	0,081	0,100	0,100	0,211	0,211	0,211

Table 54 – Amount of unit processes per product in phase 6 – end of life of product second half of the products.

Unit process name	Unit	BT1	BT1n	BT2	BT2n	HT1	HT1n	HT2	HT2n	SC1	SC2	WC1	WC1n	WC2	WC2n
6.1 Product EOL - incineration	kg textiles to incineration	0,406	0,406	0,406	0,406	0,413	0,413	0,413	0,413	0,265	0,265	0,190	0,192	0,190	0,192
6.2 Product EOL - recycling	kg textiles to recycling	0,098	0,098	0,098	0,098	0,100	0,100	0,100	0,100	0,064	0,064	0,046	0,047	0,046	0,047

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 55 and Table 56. 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 Figure 3 the climate change impact (kg CO_2e) per product is presented visually.

Table 55 LCIA results for the 19 impact categories assessed per product for the first half of products.

Impact category	Unit	BL1	BL1n	BL2	BL2n	BM1	BM1n	BM2	BM2n	BML1	BML2	BR1	BR1n	BR2
Climate change	kg CO2 eq	1,43E+01	1,34E+01	1,51E+01	1,42E+01	1,36E+01	1,33E+01	1,21E+01	1,17E+01	1,64E+01	1,45E+01	3,54E+01	3,25E+01	3,14E+01
Acidification	mol H+ eq	1,10E-01	1,01E-01	1,16E-01	1,07E-01	8,15E-02	7,44E-02	7,81E-02	7,10E-02	9,18E-02	8,76E-02	2,11E-01	1,88E-01	2,03E-01
Ecotoxicity, freshwater	CTUe	3,45E+02	2,17E+02	3,65E+02	2,30E+02	1,65E+02	1,64E+02	1,14E+02	1,13E+02	2,03E+02	1,40E+02	4,27E+02	3,59E+02	2,96E+02
Particulate matter	disease inc.	1,76E-06	1,22E-06	1,86E-06	1,29E-06	5,69E-07	5,15E-07	5,49E-07	4,96E-07	6,33E-07	6,09E-07	1,46E-06	1,29E-06	1,41E-06
Eutrophication, marine	kg N eq	1,21E-01	1,17E-01	1,28E-01	1,24E-01	7,27E-02	5,05E-02	7,16E-02	4,94E-02	6,26E-02	6,12E-02	1,89E-01	1,30E-01	1,86E-01
Eutrophication, freshwater	kg P eq	1,87E-02	1,85E-02	1,98E-02	1,95E-02	1,28E-02	9,48E-03	1,27E-02	9,32E-03	1,17E-02	1,15E-02	3,34E-02	2,45E-02	3,30E-02
Eutrophication, terrestrial	mol N eq	3,60E-01	3,28E-01	3,80E-01	3,47E-01	2,30E-01	1,95E-01	2,23E-01	1,88E-01	2,41E-01	2,32E-01	5,95E-01	4,95E-01	5,77E-01
Human toxicity, cancer	CTUh	1,39E-07	7,13E-08	1,47E-07	7,54E-08	3,58E-08	3,65E-08	9,94E-09	1,06E-08	4,53E-08	1,31E-08	9,36E-08	6,14E-08	2,58E-08
Human toxicity, non-cancer	CTUh	1,54E-05	7,65E-06	1,63E-05	8,10E-06	3,50E-06	3,57E-06	5,31E-07	5,97E-07	4,43E-06	7,39E-07	9,17E-06	5,45E-06	1,38E-06
Ionising radiation	kBq U-235 eq	1,91E+00	1,83E+00	2,02E+00	1,93E+00	2,26E+00	2,26E+00	2,20E+00	2,20E+00	2,80E+00	2,72E+00	5,89E+00	5,81E+00	5,73E+00
Land use	Pt	1,07E+03	1,01E+03	1,13E+03	1,07E+03	5,91E+02	3,95E+02	5,90E+02	3,94E+02	4,88E+02	4,86E+02	1,53E+03	1,02E+03	1,53E+03
Ozone depletion	kg CFC11 eq	3,61E-07	3,43E-07	3,89E-07	3,70E-07	2,82E-07	2,83E-07	2,53E-07	2,54E-07	3,37E-07	3,01E-07	7,93E-07	7,58E-07	7,20E-07
Photochemical ozone formation	kg NMVOC eq	6,70E-02	5,82E-02	7,07E-02	6,14E-02	5,05E-02	5,03E-02	4,65E-02	4,64E-02	6,20E-02	5,71E-02	1,30E-01	1,25E-01	1,20E-01
Resource use, fossils	MJ	1,82E+02	1,71E+02	1,92E+02	1,80E+02	1,91E+02	1,92E+02	1,67E+02	1,67E+02	2,37E+02	2,06E+02	4,97E+02	4,66E+02	4,34E+02
Resource use, minerals and metals	kg Sb eq	1,33E-04	1,30E-04	1,40E-04	1,38E-04	1,62E-04	1,62E-04	1,60E-04	1,60E-04	2,01E-04	1,98E-04	4,22E-04	4,19E-04	4,16E-04
Water use	m3 depriv.	3,40E+00	3,40E+00	3,59E+00	3,59E+00	4,05E+00	4,05E+00	4,00E+00	4,00E+00	5,01E+00	4,94E+00	1,04E+01	1,04E+01	1,03E+01

Table 56 LCIA results for the 19 impact categories assessed per product for the second half of products.

Impact category	Unit	BT1	BT1n	BT2	BT2n	HT1	HT1n	HT2	HT2n	SC1	SC2	WC1	WC1n	WC2	WC2n
Climate change	kg CO2 eq	1,65E+01	1,61E+01	1,47E+01	1,42E+01	1,68E+01	1,64E+01	1,49E+01	1,45E+01	4,13E+00	3,48E+00	7,83E+00	7,73E+00	6,95E+00	6,84E+00
Acidification	mol H+ eq	9,89E-02	9,02E-02	9,49E-02	8,62E-02	1,01E-01	9,18E-02	9,65E-02	8,77E-02	3,40E-02	2,92E-02	4,68E-02	4,33E-02	4,49E-02	4,14E-02
Ecotoxicity, freshwater	CTUe	2,00E+02	1,99E+02	1,39E+02	1,38E+02	2,04E+02	2,03E+02	1,41E+02	1,40E+02	1,11E+02	3,85E+01	9,42E+01	9,49E+01	6,55E+01	6,58E+01
Particulate matter	disease inc.	6,87E-07	6,22E-07	6,64E-07	5,99E-07	6,99E-07	6,32E-07	6,75E-07	6,09E-07	6,13E-07	2,99E-07	3,27E-07	3,01E-07	3,17E-07	2,90E-07
Eutrophication, marine	kg N eq	8,85E-02	6,14E-02	8,72E-02	6,02E-02	9,02E-02	6,26E-02	8,89E-02	6,12E-02	4,02E-02	3,81E-02	4,17E-02	2,92E-02	4,11E-02	2,86E-02
Eutrophication, freshwater	kg P eq	1,56E-02	1,15E-02	1,54E-02	1,13E-02	1,59E-02	1,17E-02	1,57E-02	1,15E-02	5,96E-03	5,78E-03	7,35E-03	5,49E-03	7,27E-03	5,40E-03
Eutrophication, terrestrial	mol N eq	2,79E-01	2,37E-01	2,71E-01	2,28E-01	2,84E-01	2,41E-01	2,75E-01	2,32E-01	1,16E-01	9,95E-02	1,32E-01	1,13E-01	1,28E-01	1,09E-01
Human toxicity, cancer	CTUh	4,37E-08	4,45E-08	1,21E-08	1,29E-08	4,45E-08	4,53E-08	1,23E-08	1,31E-08	5,07E-08	1,27E-08	2,05E-08	2,11E-08	5,70E-09	6,16E-09
Human toxicity, non-cancer	CTUh	4,28E-06	4,36E-06	6,46E-07	7,27E-07	4,35E-06	4,43E-06	6,57E-07	7,40E-07	5,69E-06	1,38E-06	2,00E-06	2,07E-06	3,04E-07	3,46E-07
Ionising radiation	kBq U-235 eq	2,75E+00	2,75E+00	2,68E+00	2,68E+00	2,80E+00	2,80E+00	2,72E+00	2,72E+00	3,67E-01	3,18E-01	1,29E+00	1,31E+00	1,26E+00	1,27E+00
Land use	Pt	7,18E+02	4,79E+02	7,17E+02	4,78E+02	7,32E+02	4,88E+02	7,30E+02	4,86E+02	3,66E+02	3,34E+02	3,40E+02	2,29E+02	3,39E+02	2,29E+02
Ozone depletion	kg CFC11 eq	3,47E-07	3,47E-07	3,12E-07	3,13E-07	3,36E-07	3,37E-07	3,01E-07	3,01E-07	1,30E-07	1,11E-07	1,51E-07	1,99E-07	1,35E-07	1,83E-07
Photochemical ozone formation	kg NMVOC eq	6,11E-02	6,09E-02	5,64E-02	5,62E-02	6,21E-02	6,19E-02	5,73E-02	5,71E-02	2,04E-02	1,52E-02	2,90E-02	2,93E-02	2,68E-02	2,71E-02
Resource use, fossils	MJ	2,32E+02	2,32E+02	2,02E+02	2,03E+02	2,36E+02	2,36E+02	2,06E+02	2,06E+02	4,96E+01	3,87E+01	1,10E+02	1,11E+02	9,57E+01	9,73E+01
Resource use, minerals and metals	kg Sb eq	1,98E-04	1,98E-04	1,95E-04	1,95E-04	2,01E-04	2,01E-04	1,98E-04	1,98E-04	2,15E-05	1,91E-05	9,28E-05	9,41E-05	9,15E-05	9,28E-05
Water use	m3 depriv.	4,92E+00	4,92E+00	4,86E+00	4,86E+00	5,00E+00	5,00E+00	4,94E+00	4,94E+00	6,29E-01	5,70E-01	2,32E+00	2,35E+00	2,29E+00	2,32E+00

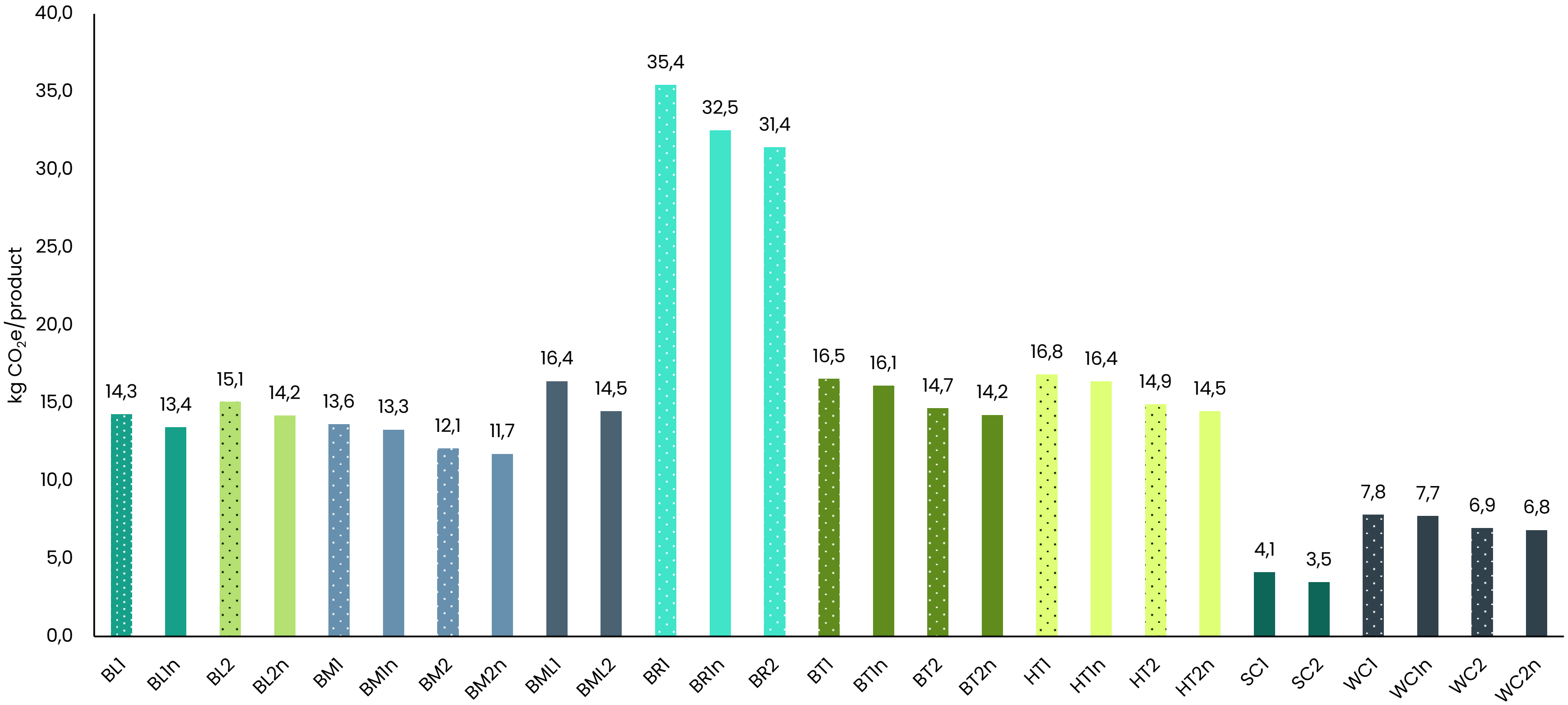

Figure 3 Climate change impact of each product in the LCA across the whole life cycle. Bars of the same color can be compared, since they are the same products but with different recycled content and treatment methods. The dotted bars indicate the fall 2025 products that are included for comparing with the spring 2026 line of products. Please note that the results for HT1, HT1n, HT2, and HT2n are for a two-pack, and the results for WC1, WC1n, WC2, and WC2n are for a 5-pack.

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. For SC1, 'Phase 3 – Production' is the most contributing life cycle phase and for SC2, 'Phase 1 – 'raw materials' is the most contributing life cycle phase. For all the remaining products 'Phase 5 - use of product' is the most contributing life cycle phase to the climate change impact, contributing with 44-75% of the impact.

The second most contributing life cycle phase is 'Phase 3 – production' or "Phase 1 – Raw materials" for all products.

Overall, 'Phase 1 – raw materials', 'Phase 3 – production', and 'Phase 5 - use of product' together account for 81-96% 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 4-19% of the total climate change impact per product. The most contributing life cycle phases will be examined further.

For the other impact categories, the contribution analyses can be found in Section 10.5 (appendix).

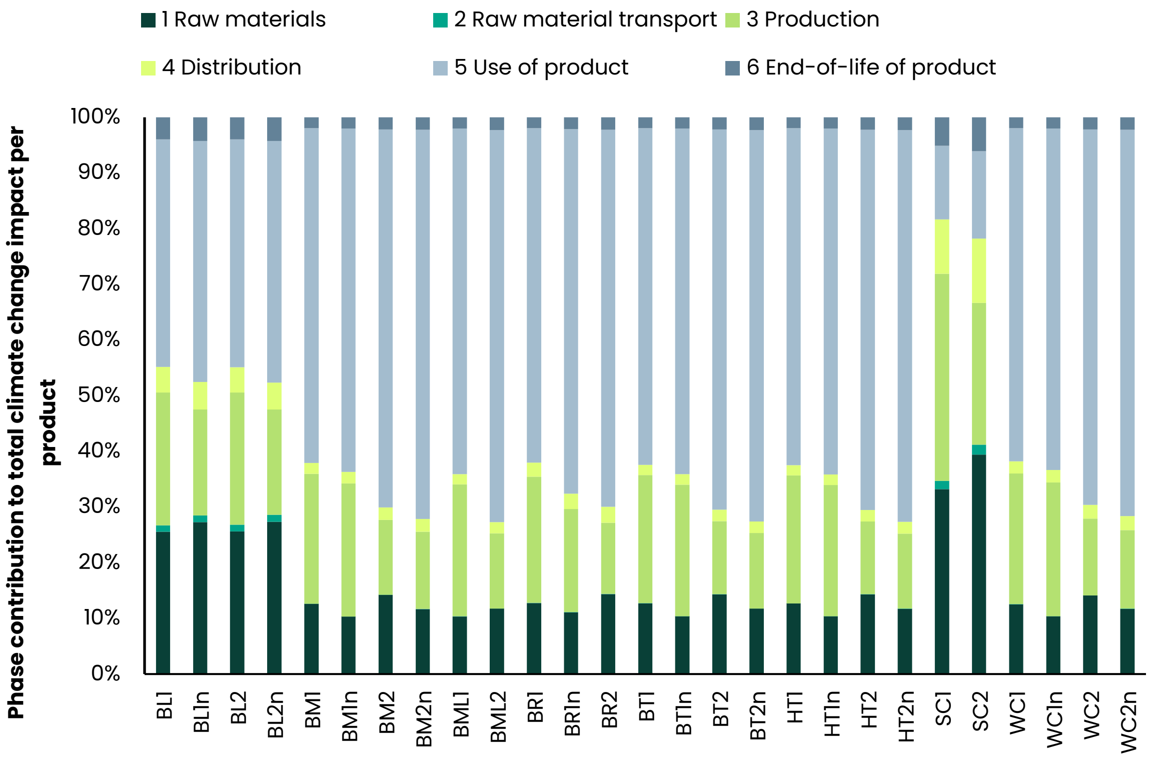

Figure 4 Contribution of each life cycle phase to the 'climate change' impact category per product in the LCA.

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 cotton cultivation and yarn spinning are the most contributing processes in this phase.

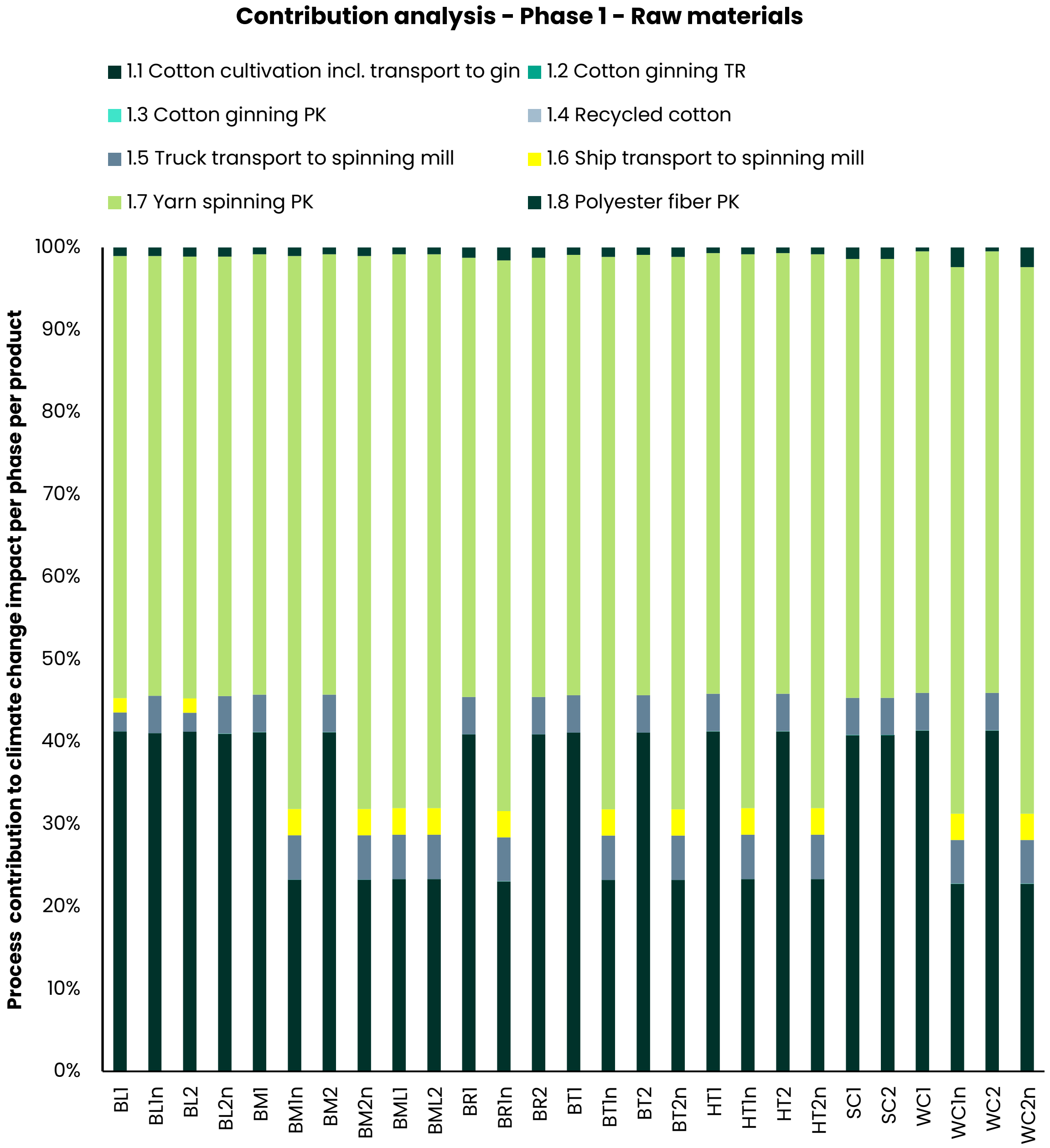

Figure 5 Contribution of processes in 'phase 1 – raw materials' to the total 'climate change' impact category for 'phase 1 – raw materials'.

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 for bedlinen products, chemicals are the most contributing process. For shower curtain products, packaging is the most contributing process. For the remaining products, the electricity and heat are the most contributing processes. Waste and wastewater, water input and inputs of other materials contribute very little. Here it should be noted that these processes may have a higher contribution in other environmental impact categories.

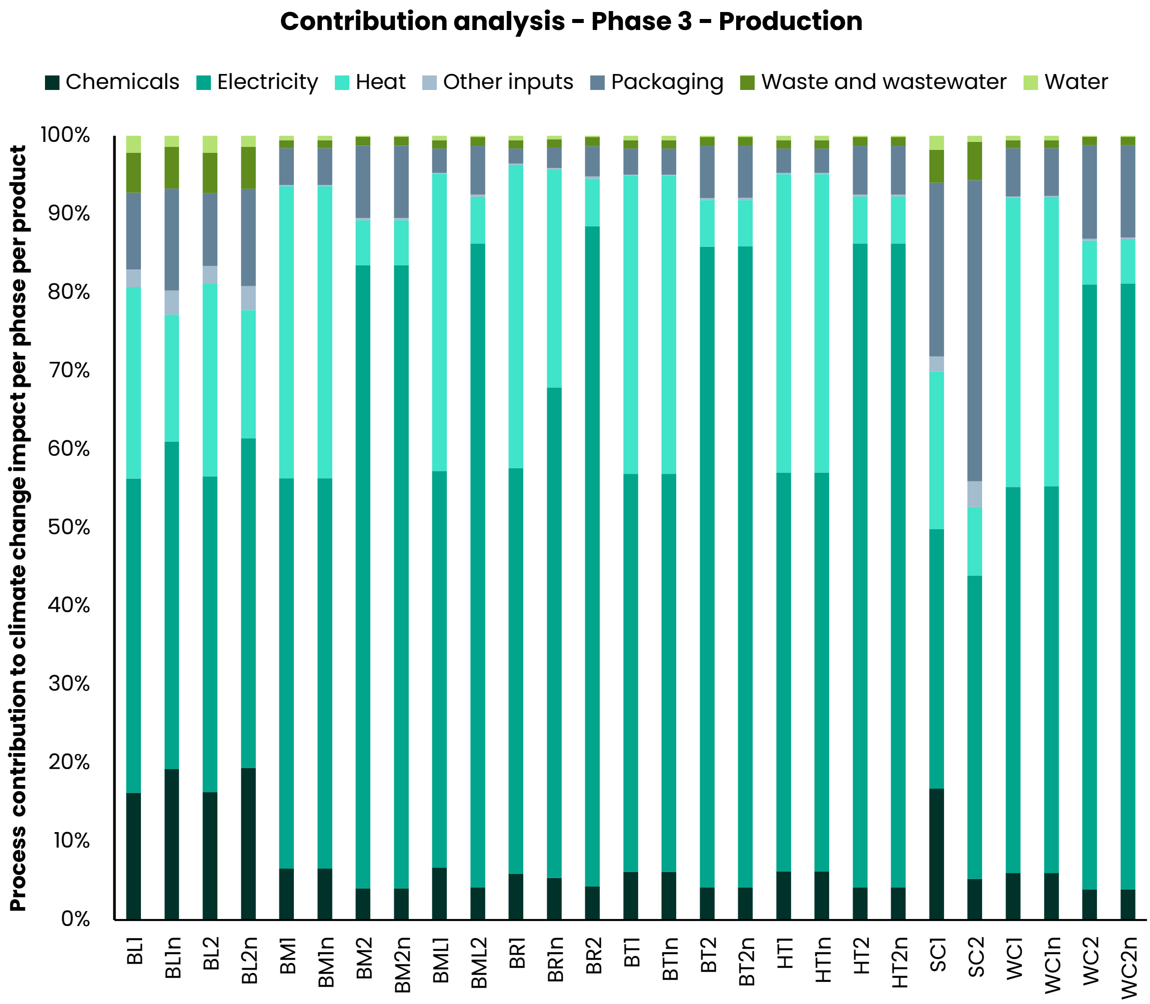

Figure 6 Contribution of processes in 'phase 3 – production' to the total 'climate change' impact category for 'phase 3 – production'.

6.3.3 Process contribution – phase 5 – climate change

In Figure 7 the contribution of washing and drying 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.

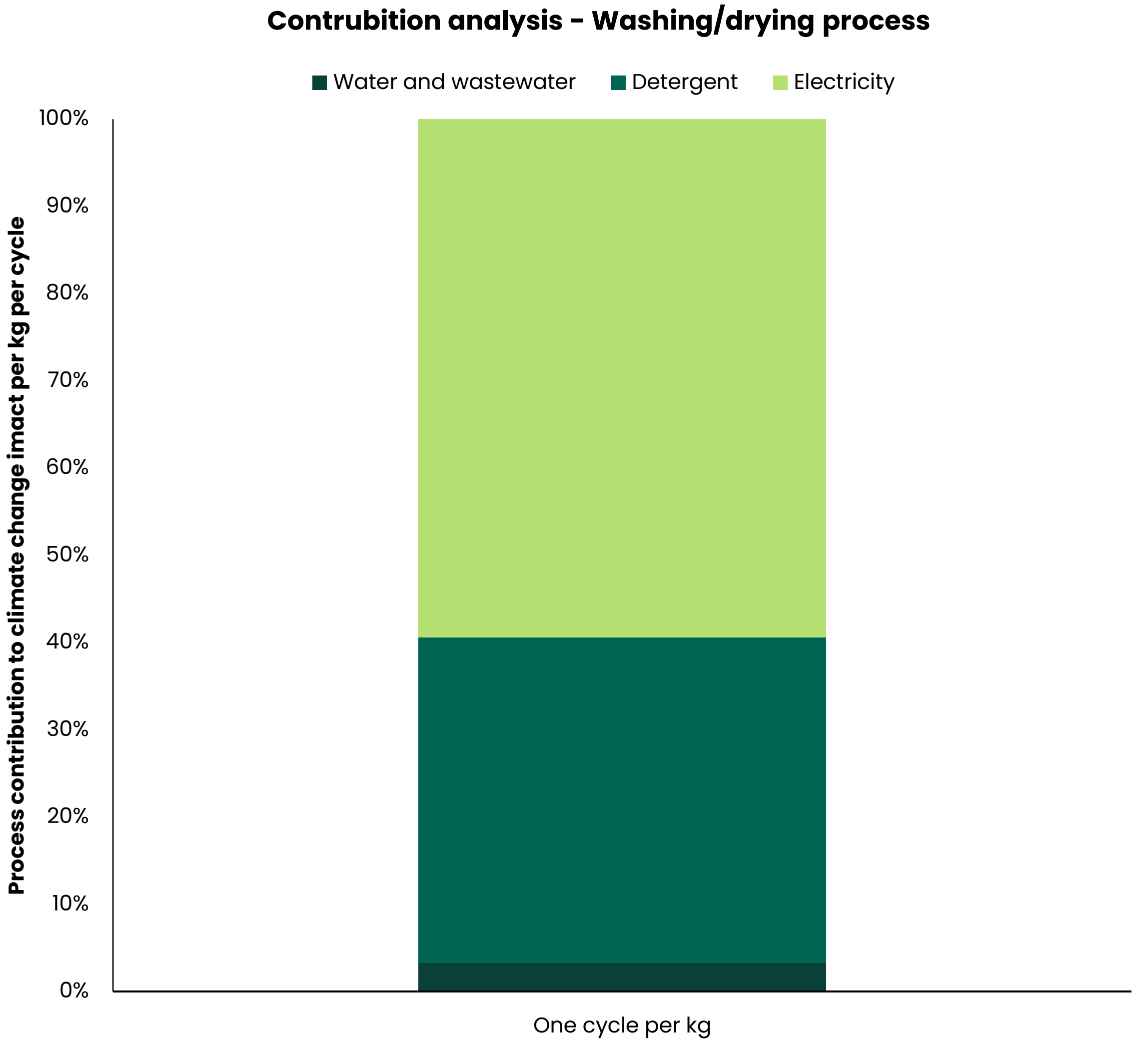

Figure 7 Contribution of processes in washing and drying in 'phase 5 – use of product' to the total 'climate change' impact category for washing and drying.

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 10.5 (appendix).

The most contributing life cycle stage per impact category is described in Table 57. Overall, it can be seen that 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 across all products.

Phase 1 is the most contributing life cycle stage to marine eutrophication, freshwater eutrophication and land use for products containing 100% virgin cotton as opposed to products containing 55% recycled cotton.

For most of the products, phase 1 is the most contributing life cycle stage to ecotoxicity and human toxicity (cancer and non-cancer effects) – more so for bleached products as opposed to unbleached products.

For most of the products, phase 5 is the most contributing life cycle stage to climate change, acidification, particulate matter, ionizing radiation, ozone depletion, resource use (fossil and minerals/metals) and water use. This pattern is clearer for products washed frequently than for products washed less frequently (i.e. shower curtains).

Table 57 – Most contributing life cycle stage per impact category evaluated in the LCA.

Impact category	Most contributing life cycle stage
Climate change	For all products: Phase 5 – Use of products Except SC1: Phase 1 – Raw materials and SC2: Phase 3 - Production
Acidification	For all products from towel factory: Phase 5 – Use of products For all products from bedlinen factory: Phase 1 – Raw materials
Ecotoxicity, freshwater	For all products from towel factory: Phase 5 – Use of products For all products from bedlinen factory: Phase 3 – Production
Particulate matter	For all products from towel factory: Phase 5 – Use of products For all products from bedlinen factory: Phase 3 – Production
Eutrophication, marine	For all products of 100% virgin cotton: Phase 1 – Raw materials For all products containing 55% recycled cotton: Phase 5 – Use of product
Eutrophication, freshwater	For all products of 100% virgin cotton: Phase 1 – Raw materials For all products containing 55% recycled cotton: Phase 5 – Use of product
Eutrophication, terrestrial	For all products from towel factory: Phase 5 – Use of products For all products from bedlinen factory: Phase 1 – Raw materials
Human toxicity, cancer	For all bleached products from towel factory: Phase 3 - Production For all unbleached products from towel factory: Phase 5 – Use of product For all products from bedlinen factory: Phase 3 - Production
Human toxicity, non-cancer	For all products: Phase 3 - Production
Ionising radiation	For all products: Phase 5 - Use of product Except SC1: Phase 3 - Production

Impact category	Most contributing life cycle stage
Land use	For all products of 100% virgin cotton: Phase 1 – Raw materials For all products containing 55% recycled cotton: Phase 5 – Use of product
Ozone depletion	For all products from towel factory: Phase 5 – Use of products For all products from bedlinen factory: Phase 1 – Raw materials
Photochemical ozone formation	For all products: Phase 5 – Use of products Except SC2: Phase 1 – Raw materials and SC1: Phase 3 - Production
Resource use, fossils	For all products: Phase 5 – Use of products Except SC2: Phase 1 – Raw materials and SC1: Phase 3 - Production
Resource use, minerals and metals	For all products: Phase 5 - Use of product
Water use	For all products: Phase 5 – Use of products Except SC1 and SC2: Phase 3 - Production

7 Life cycle interpretation

7.1 Data quality assessment

The data quality has been rated for all processes in the LCA for the accuracy of the input data and the geographical, temporal and technological representativity of the secondary datasets (background datasets from ecoinvent). The ratings have been assigned a numerical value as follows: Very poor = 5, Poor = 4, Fair = 3, Good = 2 and Very good = 1. See section 10.5 (Appendix) for an overview of the numerical values per process and data quality parameter. Furthermore, each process was weighted based on its average contribution to the climate change impact across all products to account for how much the data quality of each process affects the overall data quality in the LCA.

The overall data quality numerical score of the LCA is determined as 2,40 (Good-Fair) for the products which contain cotton grown in Pakistan and 2,43 (Good-Fair) for products which contain cotton grown in Türkiye. The difference in the scores stems from a lower data quality rating for the applied dataset for cotton growing in Türkiye.

7.2 Other data quality requirements

7.2.1 Completeness check

The completeness of the LCA is the same across the studied products, since no known processes have been excluded from the LCA, meaning that 100% of the mass and energy flows are included.

7.2.2 Consistency check

The methodology has been applied uniformly to the analyses of different products in the LCA – this means that:

- The data collected from the factories have been applied consistently across the studied products
- The same background datasets have been applied to represent processes across the studied products
- The same assumptions have been applied across the life cycle of the studied products
- The same allocation method has been used across the studied products.

Furthermore, it has been ensured that the compared product systems are comparable since they fulfill the same function.

7.2.3 Reproducibility

The methodology for the LCA is presented transparently across goal, scope, LCI and LCIA phases. Particularly, the life cycle inventory has been documented extensively with exact records of background datasets applied. Furthermore, the LCIA method has been made clear. Based on this, it should be possible for any interested party with an active license to ecoinvent 3.11 to reproduce the results of this LCA.

7.3 Significant findings

The use phase contributes highly to climate change impact

For shower curtains (SC1, SC2), 'Phase 1 – 'raw materials' and 'Phase 3 – 'Production' are the most contributing life cycle phases. For all the remaining products 'Phase 5 - use of product' is the most contributing life cycle phase to the climate change impact, contributing with 41-70% of the impact. Shower curtains are washed less frequently and therefore the use phase contributes less to this products type.

Raw material transport and distribution has little climate change contribution

Overall, 'Phase 1 – raw materials', 'Phase 3 – production', and 'Phase 5 - use of product' together account for 81-96% 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 4-19% of the total climate change impact per product.

Production and use have the highest contribution to water use

Production and use of product (washing) have 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 land use 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.

7.4 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 chang impact will be used for communication to the end-consumer and is used for comparative statements, which means that the influence of uncertain or variable parameters on this impact category is particularly important.

7.4.1 Cotton cultivation

For the products which contain cotton grown in Türkiye, the geographical representativeness of the secondary dataset is very poor, due to the selected dataset representing cotton cultivation in India. Therefore, a sensitivity scenario using a different secondary dataset for the "Rest of World" geography has been analyzed. This dataset is the only other option for organic cotton growing in ecoinvent. See Figure 8.

The RoW dataset has a 58% lower climate change impact than the Indian dataset applied in this LCA. Nonetheless, when applying the RoW dataset in this LCA, the change in overall climate change impact is just -6% for BL1 and BL2.

Sensitivity coefficient = -6%/-58% = 0,1 (low-moderate sensitivity).

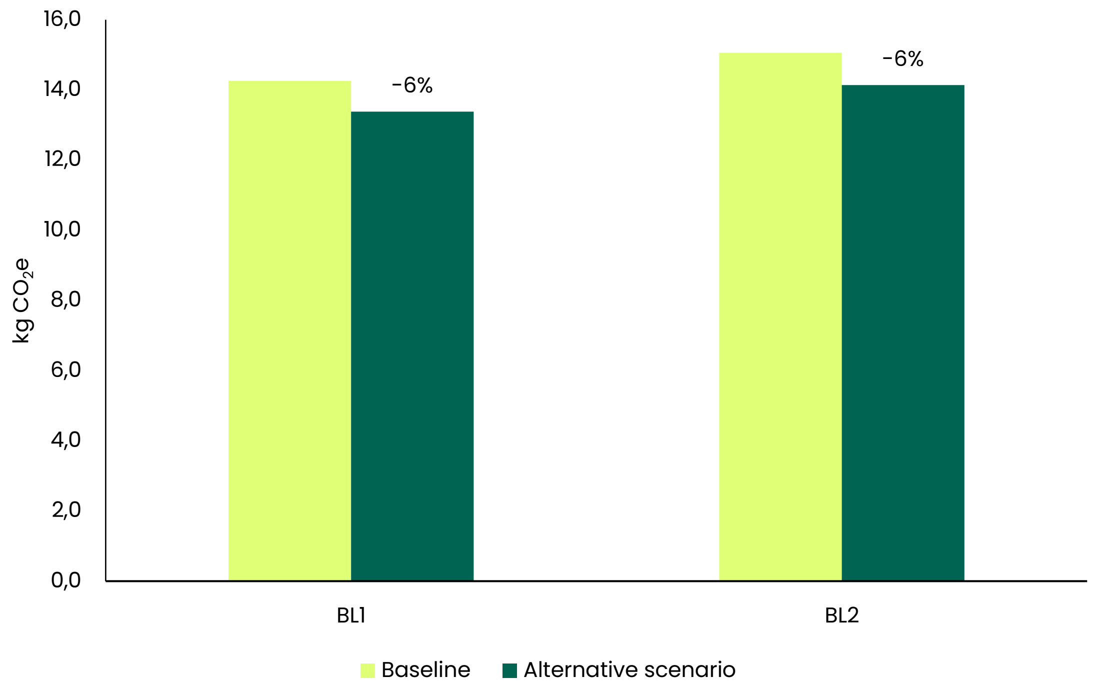

Figure 8: Scenario evaluating the change in the total climate change impact when changing the secondary dataset for organic cotton cultivation in India to an equivalent dataset for the geography "Rest of World".

7.4.2 Energy consumption of unbleached and printed products

For the bedlinen factory it is estimated in the LCA that products that are only printed and not bleached or dyed have 50% of the electricity, natural gas, steam and water consumption compared to the bleached and printed/dyed products. The effect of changing the 50% to 75% (equaling a 50% parameter increase) was analyzed - see Figure 9. It was found that changing from 50% to 75% consumption increased the climate change impact of the total life cycle of the products with 2,6%.

Sensitivity coefficient = 2,6%/50% = 0,05 (low sensitivity).

This shows that the assumptions/estimations regarding the allocation of energy in the production for products that are only printed are not very influential on the final climate change impact.

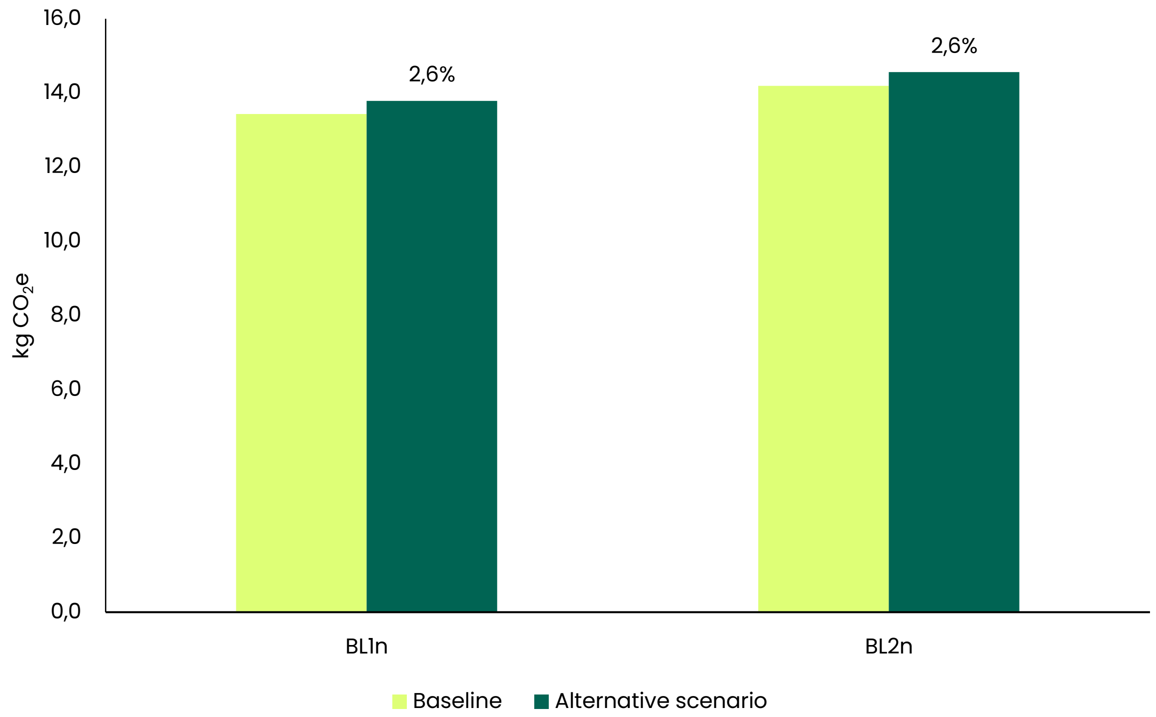

Figure 9: Scenario evaluating the change in the total climate change impact when changing the way energy is allocated to products that are only printed (baseline scenario estimates 50% of energy compared to products that are both bleached and printed/dyed, alternative scenario uses 75%).

7.4.3 Heat consumption for bleaching and dyeing

For the towel factory it is estimated that 85% of the heat consumption is allocated to bleaching and dyeing, leaving 15% of the heat consumption for the remaining processes. The effects of changing 85% to 50% (equaling a 41% parameter decrease) is analyzed - see Figure 10. It was found that the alternative scenario changed the climate change impact of the total life cycle of unbleached and undyed products with +0,1 to +3,1% and changed the climate change impact of the total life cycle of bleached and dyed products with -2,4 to -2,5%.

Sensitivity coefficient (unbleached/undyed products)= 3,1%/-41% = -0,08 (low sensitivity).

Sensitivity coefficient (bleached/dyed products) = -2,5%/-41% = 0,06 (low sensitivity).

This shows that the assumptions/estimations regarding the allocation of heat consumption in the production are not very influential on the final climate change impact.

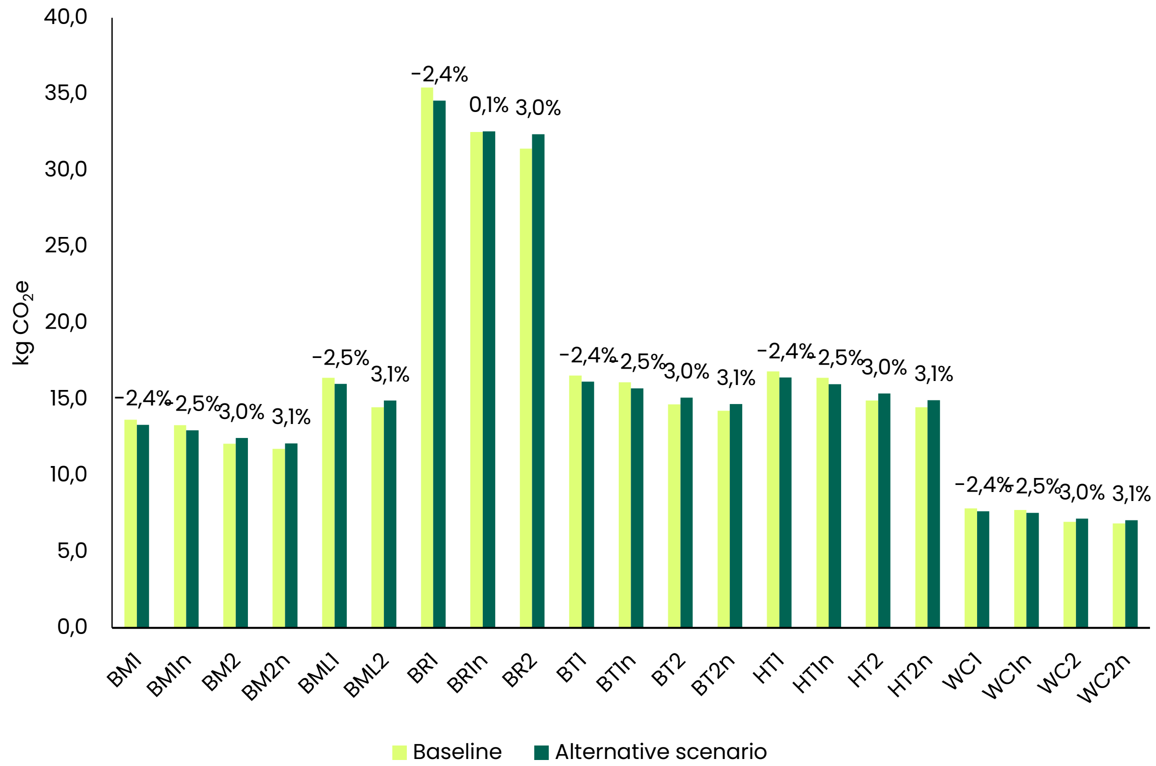

Figure 10: Scenario evaluating the change in the total climate change impact when changing the allocation factors of heat between processing steps in the production. In the baseline scenario 85% of the heat is allocated to bleaching/dyeing) leaving 15% of the heat to other processes. In the alternative scenario this is changed to 50/50% to bleaching/dyeing and other processes, respectively.

7.4.4 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 11. 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 4-5% for shower curtains, 13-14% for bedlinen products and 19-22% for towel products. This is because the change is more prominent in products with a higher washing frequency.

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

Sensitivity coefficient (bedlinen products) = 14%/72% = 0,19 (moderate sensitivity).

Sensitivity coefficient (towel products) = 22%/72% = 0,31 (moderate sensitivity).

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

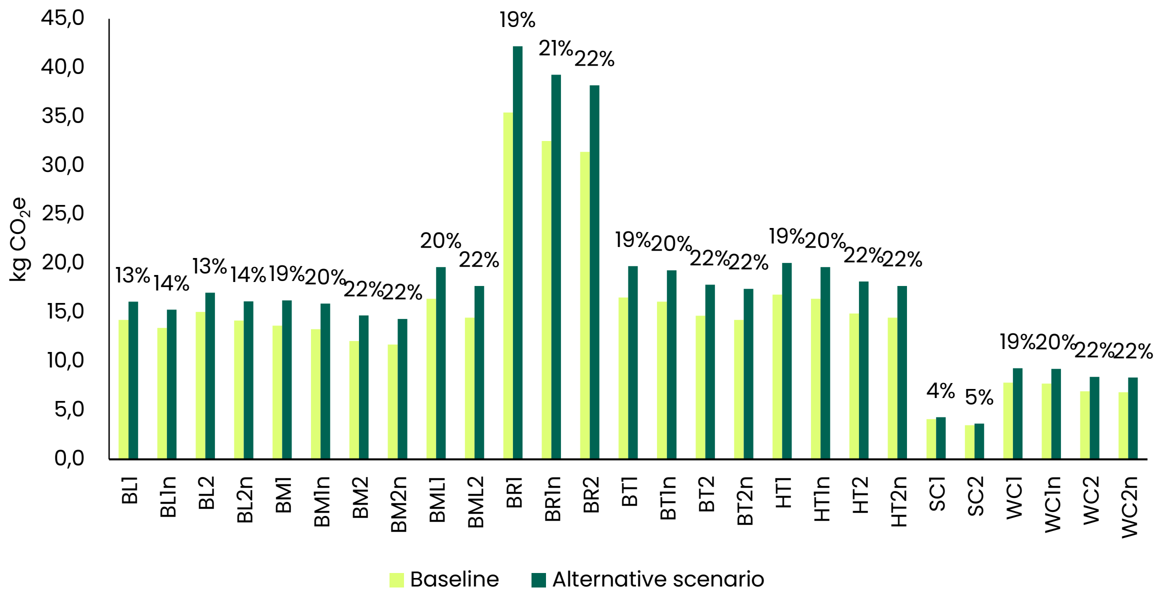

Figure 11 – Scenario evaluating the change in the total climate change impact when changing the from 58% machine drying to 100% machine drying in the use phase.

7.4.5 Washing-drying frequency

The effect of increasing the washing-drying frequency by 10% was analyzed – see Figure 12. It was found that increasing the frequency of washing and drying by 10% increased the total climate change impact with 1-2% for shower curtains, 4% for bedlinen products and 6-7% for towel products. This is because the change is more prominent in products with a higher washing frequency.

Sensitivity coefficient (shower curtains) = 2%/10% = 0,20 (moderate sensitivity).

Sensitivity coefficient (bedlinen products) = 4%/10% = 0,40 (high sensitivity).

Sensitivity coefficient (towel products) = 7%/10% = 0,70 (high sensitivity).

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

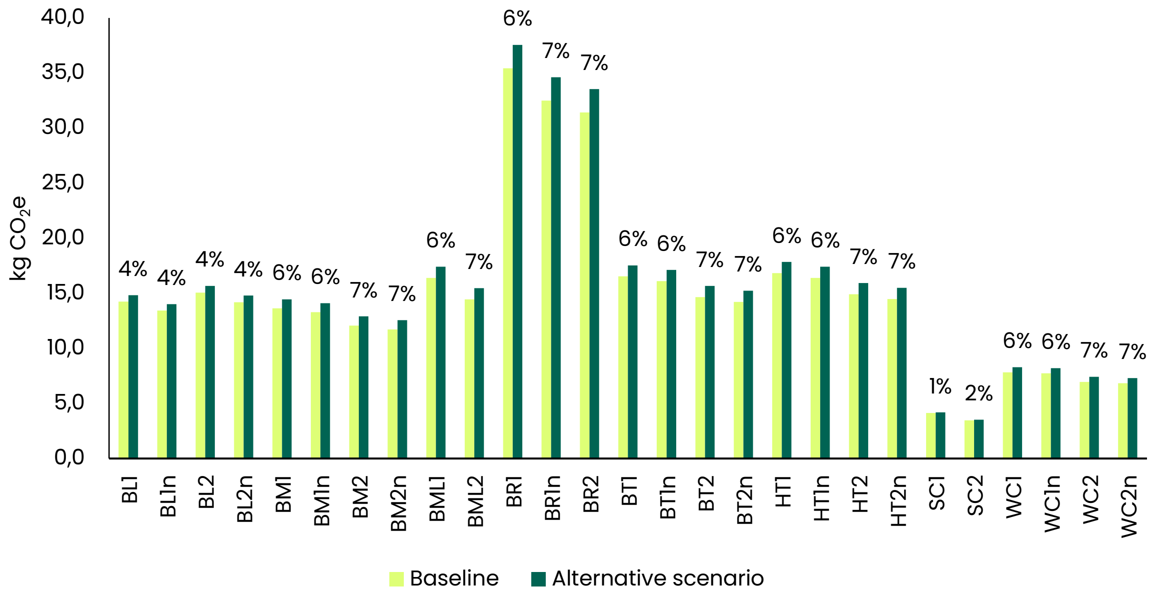

Figure 12 – Scenario evaluating the change in the total climate change impact when increasing the washing-drying frequency by 10% in the use phase.

7.4.6 Recycling rate

The effect of increasing the recycling rate by 10% was analyzed – see Figure 13. It was found that increasing the recycling rate by 10% barely changed the total climate change impact (increases in the range 0,001-0,004% were observed). This is due to the recycling process having almost the same climate change impact as incineration in this LCA (slightly higher). Please be aware that this does not necessarily mean that recycling is worse than incineration, since the derivative effects of recycling, such as substituting production of new products, are not included in this LCA.

Sensitivity coefficient = 0,004%/10% = 0,0004 (low sensitivity).

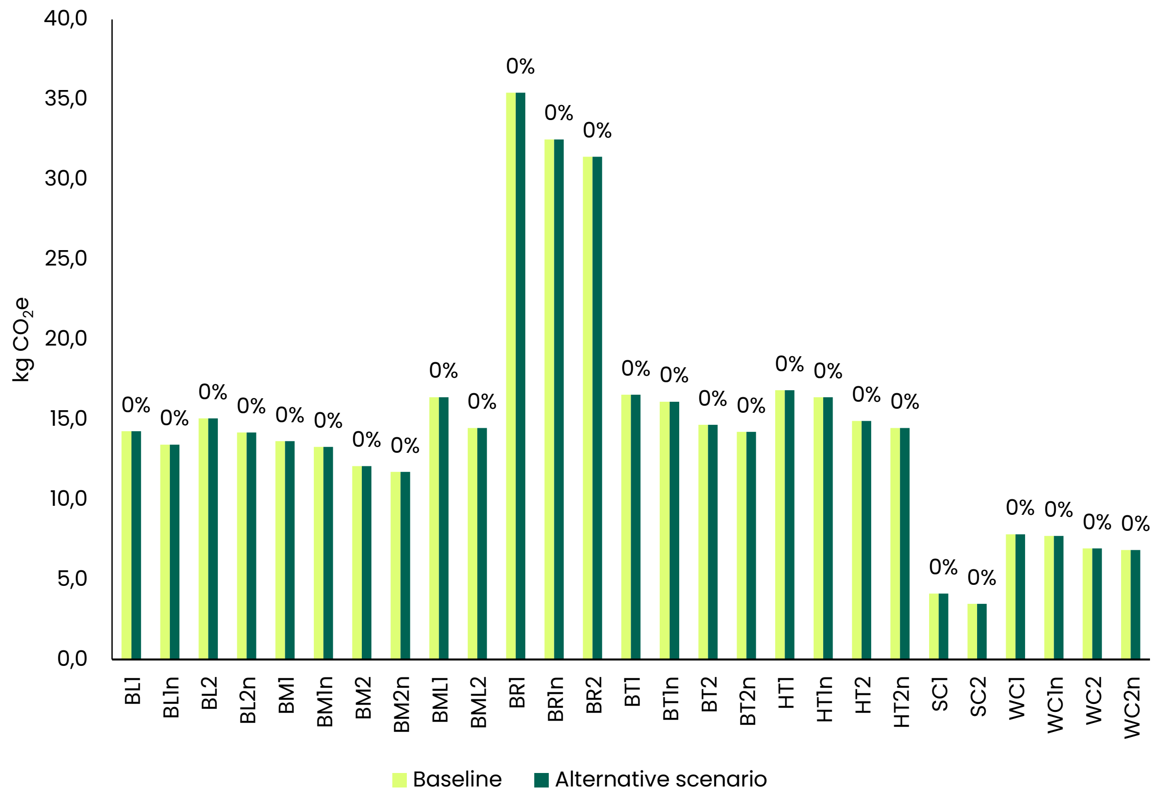

Figure 13 – Scenario evaluating the change in the total climate change impact when increasing the recycling rate by 10% (and decreasing incineration correspondingly) in the EOL phase. Please note that the graph indicates 0,0% change across all products, because the percentages are very low (in the range 0,001-0,004%).

7.5 Comparisons

7.5.1 Bedlinen 140x200 comparison

A comparison of different bedlinen 140x200 was carried out. Table 58 provides an overview of the differences between the bedlinen compared in this section.

Table 58: Overview of the input differences between the compared bedlinen in size 140x200

Parameter	BL1	BL1n
Raw material	100% virgin	100% virgin
Treatment	Bleached and printed	Unbleached and printed
Other differences	Cotton cultivation in Türkiye	Cotton cultivation in Pakistan

In Figure 14 the comparison of the climate change impact from cradle-to-consumer for bedlinen in the size 140x200 is shown. The results are indexed relative to the product with the highest impact. See Table 59 for comparative statements. See section 7.6.2 for uncertainty analysis related to comparative statements.

Bedlinen 140x200 comparison - Climate change

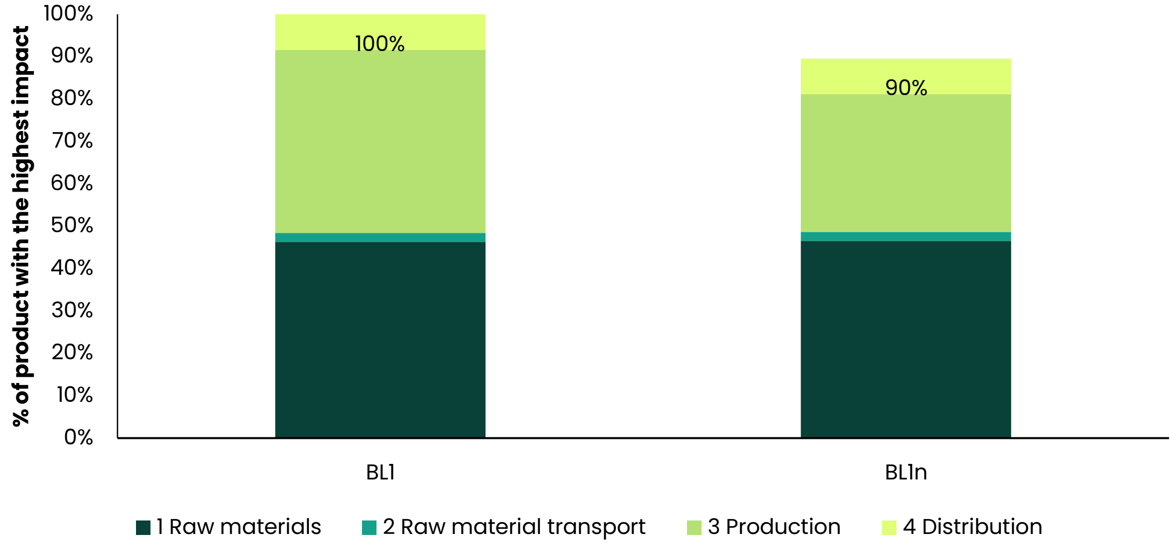

Figure 14 – Comparison of the climate change impact from cradle-to-consumer of BL1 and BL1n. The results are indexed after the product with the highest impact.

Table 59: Comparative statements for bedlinen 140x200

Product	Comparison
BL1n, 100% virgin, unbleached and printed	10% reduction by not bleaching (compared to BL1: 100% virgin, bleached and printed)

7.5.2 Bedlinen 140x220 comparison

In Figure 15 the comparison of the climate change impact from cradle-to-consumer for bedlinen in the size 140x220 is shown. Table 60 provides an overview of the differences between the bedlinen compared in this section.

Table 60: Overview of the input differences between the compared bedlinen in size 140x220

Parameter	BL2	BL2n
Raw material	100% virgin	100% virgin
Treatment	Bleached and printed	Unbleached and printed
Other differences	Cotton cultivation in Türkiye	Cotton cultivation in Pakistan

In Figure 15 the comparison of the climate change impact from cradle-to-consumer for bedlinen in the size 140x220 is shown. The results are indexed relative to the product with the highest impact. See Table 61 for comparative statements. See section 7.6.2 for uncertainty analysis related to comparative statements.

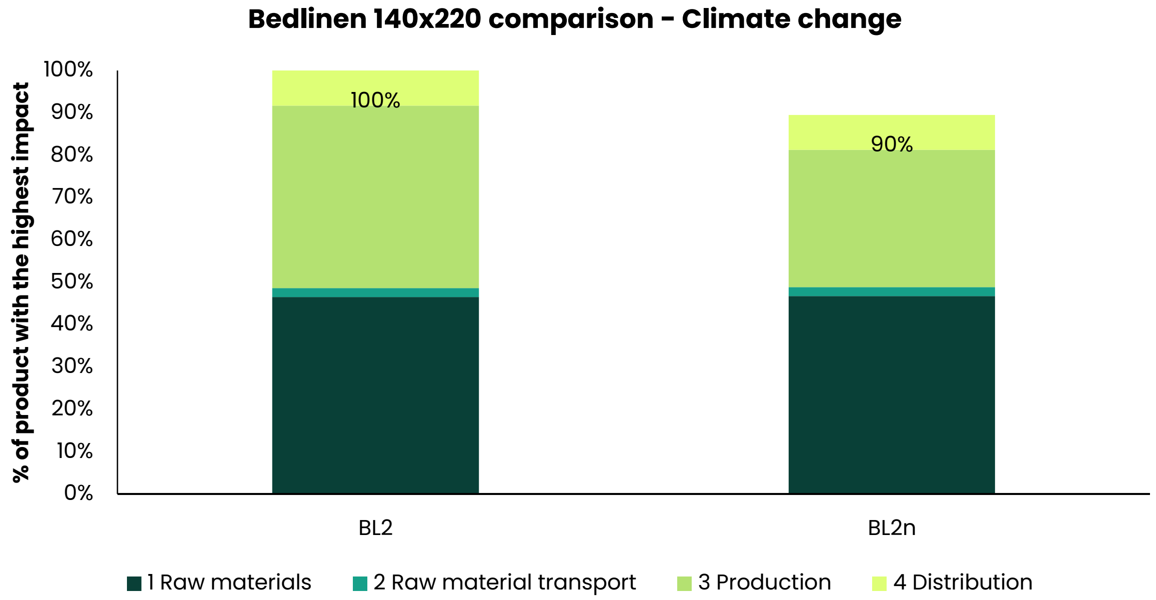

Figure 15 – Comparison of the climate change impact from cradle-to-consumer of BL2 and BL2n. The results are indexed after the product with the highest impact.

Table 61: Comparative statements for bedlinen 140x220

Product	Comparison
BL2n, 100% virgin, unbleached and printed	10% reduction by not bleaching (compared to BL2: 100% virgin, bleached and printed)

7.5.3 Bathmat comparison

A comparison of different bathmats was carried out. Table 62 provides an overview of the differences between the bathmats compared in this section.

Table 62: Overview of the input differences between the compared bathmats

Parameter	BM1	BM1n	BM2	BM2n
Raw material	100% virgin	55% recycled	100% virgin	55% recycled
Treatment	Bleached and dyed	Bleached and dyed	Unbleached and undyed	Unbleached and undyed
Other differences	None	None	None	None

In Figure 16 the comparison of the climate change impact from cradle-to-consumer for bathmats is shown. The results are indexed after the product with the highest impact. See Table 63 for comparative statements. See section 7.6.2 for uncertainty analysis related to comparative statements.

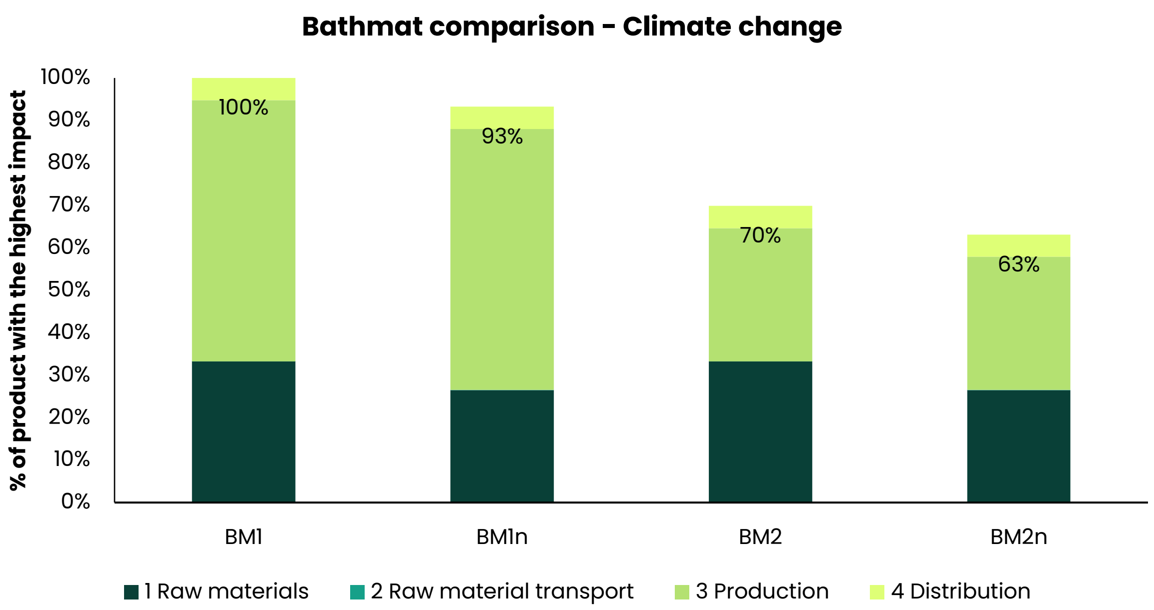

Figure 16 – Comparison of the climate change impact from cradle-to-consumer of BM1, BM1n, BM2, and BM2n. The results are indexed after the product with the highest impact.

Table 63: Comparative statements for bathmats

Product	Comparison
BM1n, 55% recycled, bleached and dyed	7% reduction by adding 55% recycled materials (compared to BM1, 100% virgin, bleached and dyed)
BM2n, 55% recycled, unbleached and undyed	10% reduction by adding 55% recycled materials (compared to BM2, 100% virgin, unbleached and undyed) 37% reduction by adding 55% recycled materials and by not bleaching/dyeing (compared to BM1, 100% virgin, bleached and dyed)

7.5.4 Bathrobe comparison

A comparison of different bathrobes was carried out. Table 64 provides an overview of the differences between the bathrobes compared in this section.

Table 64: Overview of the input differences between the compared bathrobes

Parameter	BR1	BR1n	BR2
Raw material	100% virgin	55% recycled	100% virgin
Treatment	100% leached and dyed	50% bleached and dyed, 50% unbleached and undyed	100% unbleached and undyed
Other differences	None	None	None

In Figure 17 the comparison of the climate change impact from cradle-to-consumer for bathrobes is shown. The results are indexed after the product with the highest impact. See Table 66 for comparative statements. See section 7.6.2 for uncertainty analysis related to comparative statements.

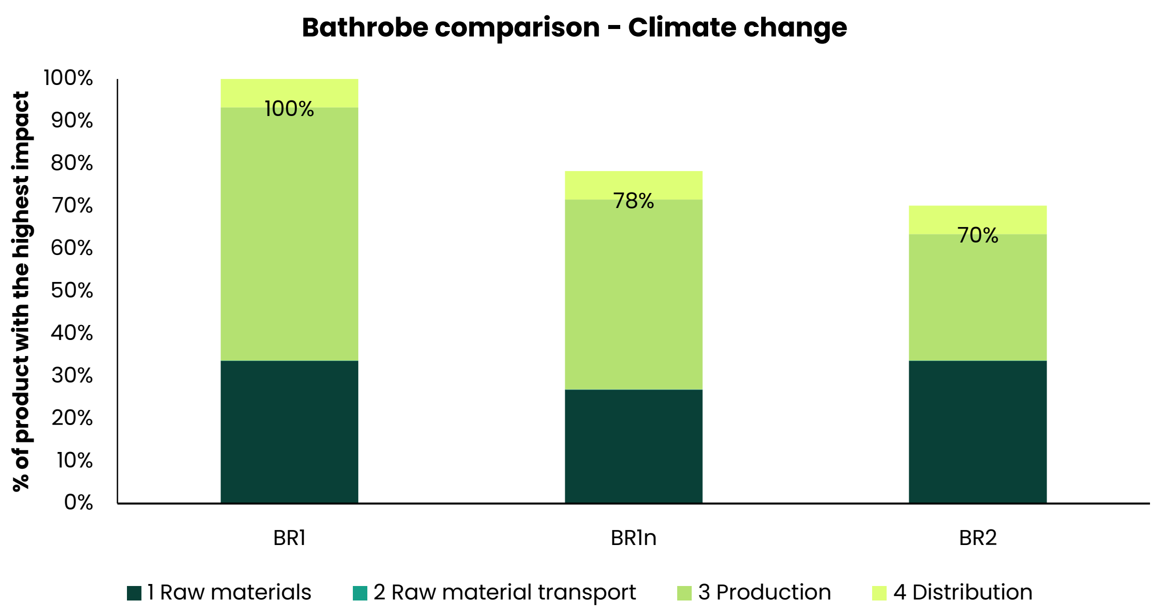

Figure 17 – Comparison of the climate change impact from cradle-to-consumer of BR1, BR1n, and BR2. The results are indexed after the product with the highest impact.

Table 65: Comparative statements for bathrobes

Product	Comparison
BR1n, 55% recycled, 50% bleached and dyed	22% reduction by adding 55% recycled materials and only bleaching/dyeing 50% of the product (compared to BR1, 100% virgin, 100% bleached and dyed)

7.5.5 Bath towel comparison

A comparison of different bath towels was carried out. Table 66 provides an overview of the differences between the bath towels compared in this section.

Table 66: Overview of the input differences between the compared bath towels

Parameter	BT1	BT1n	BT2	BT2n
Raw material	100% virgin	55% recycled	100% virgin	55% recycled
Treatment	Bleached and dyed	Bleached and dyed	Unbleached and undyed	Unbleached and undyed
Other differences	None	None	None	None

In Figure 18 the comparison of the climate change impact from cradle-to-consumer for bath towels is shown. The results are indexed after the product with the highest impact. The results are indexed after the product with the highest impact. See Table 66 for comparative statements. See section 7.6.2 for uncertainty analysis related to comparative statements.

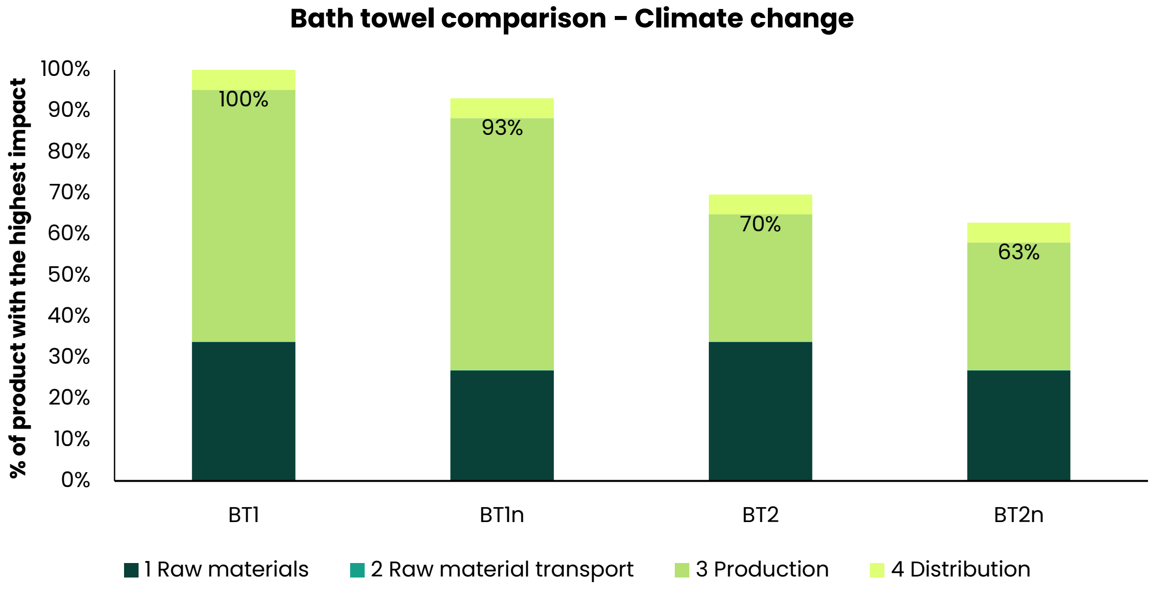

Figure 18 – Comparison of the climate change impact from cradle-to-consumer of BT1, BT1n, BT2, and BT2n. The results are indexed after the product with the highest impact.

Table 67: Comparative statements for bath towels

Product	Comparison
BT1n, 55% recycled, bleached and dyed	7% reduction by adding 55% recycled materials (compared to BT1, 100% virgin, bleached and dyed)
BT2n, 55% recycled, unbleached and undyed	10% reduction by adding 55% recycled materials (compared to BT2, 100% virgin, unbleached and undyed) 37% reduction by adding 55% recycled materials and by not bleaching/dyeing (compared to BT1, 100% virgin, bleached and dyed)

7.5.6 Hand towel comparison

A comparison of different hand towels was carried out. Table 68 provides an overview of the differences between the hand towels compared in this section.

Table 68: Overview of the input differences between the compared hand towels

Parameter	HT1	HT1n	HT2	HT2n
Raw material	100% virgin	55% recycled	100% virgin	55% recycled
Treatment	Bleached and dyed	Bleached and dyed	Unbleached and undyed	Unbleached and undyed
Other differences	None	None	None	None

In Figure 19 the comparison of the climate change impact from cradle-to-consumer for hand towels is shown. The results are indexed after the product with the highest impact. See Table 69 for comparative statements. See section 7.6.2 for uncertainty analysis related to comparative statements.

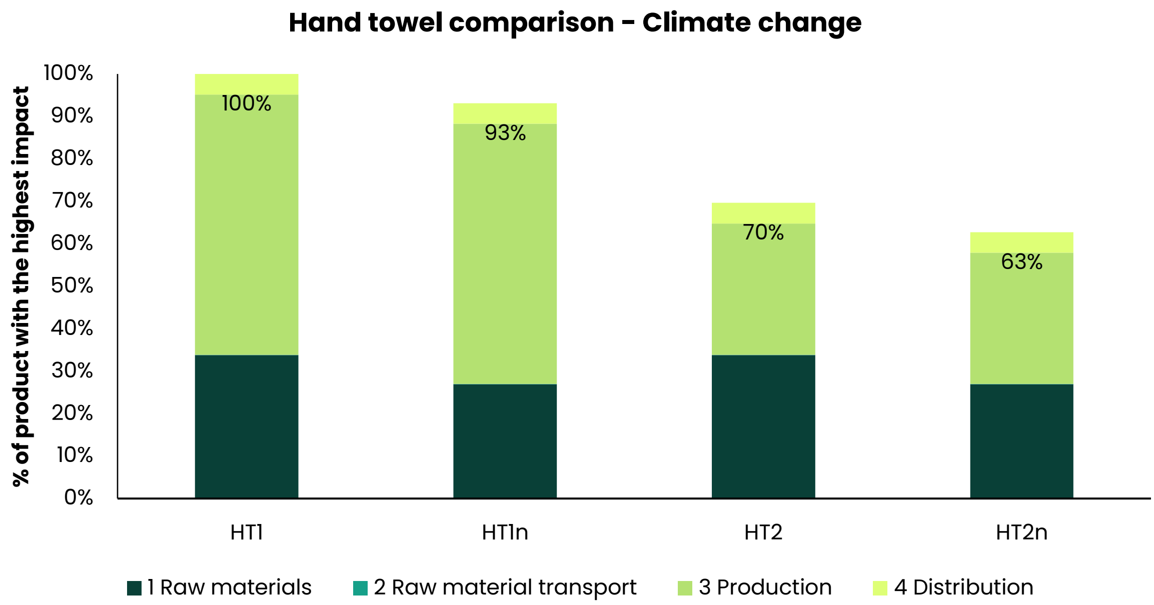

Figure 19 – Comparison of the climate change impact from cradle-to-consumer of HT1, HT1n, HT2, and HT2n. The results are indexed after the product with the highest impact.

Table 69: Comparative statements for hand towels

Product	Comparison
HT1n, 55% recycled, bleached and dyed	7% reduction by adding 55% recycled materials (compared to HT1, 100% virgin, bleached and dyed)
HT2n, 55% recycled, unbleached and undyed	10% reduction by adding 55% recycled materials (compared to HT2, 100% virgin, unbleached and undyed) 37% reduction by adding 55% recycled materials and by not bleaching/dyeing (compared to HT1, 100% virgin, bleached and dyed)

7.5.7 Washcloth comparison

A comparison of different washcloths was carried out. Table 70 provides an overview of the differences between the washcloths compared in this section.

Table 70: Overview of the input differences between the compared washcloths

Parameter	WC1	WC1n	WC2	WC2n
Raw material	100% virgin	55% recycled	100% virgin	55% recycled
Treatment	Bleached and dyed	Bleached and dyed	Unbleached and undyed	Unbleached and undyed
Other differences	None	None	None	None

In Figure 20 the comparison of the climate change impact from cradle-to-consumer for washcloths is shown. The results are indexed after the product with the highest impact. See Table 71 for comparative statements. See section 7.6.2 for uncertainty analysis related to comparative statements.

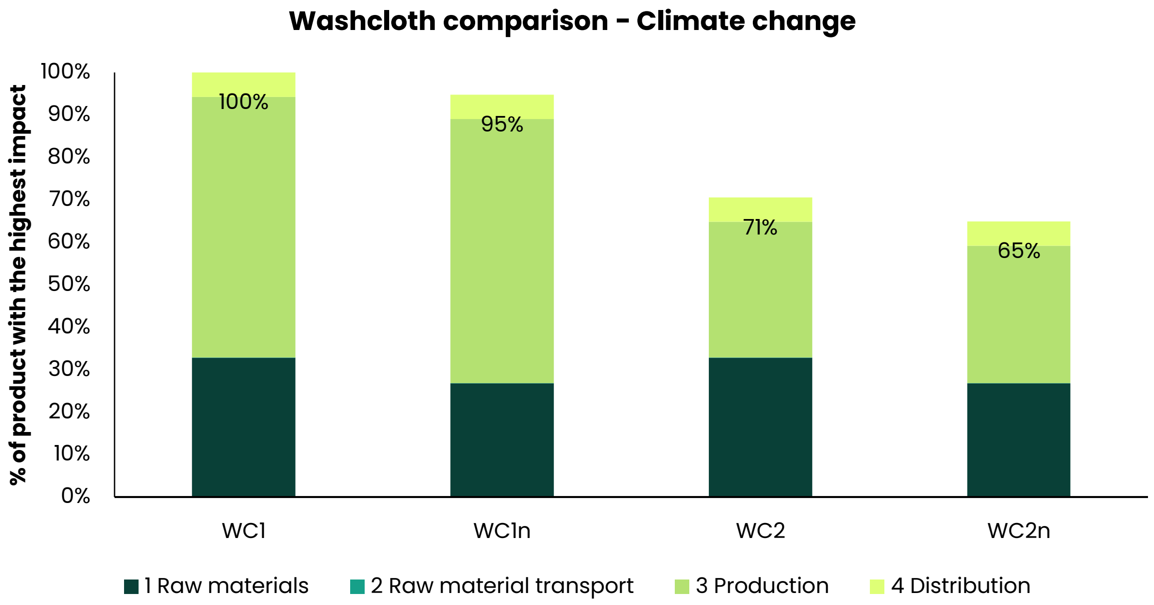

Figure 20 – Comparison of the climate change impact from cradle-to-consumer of WC1, WC1n, WC2, and WC2n. The results are indexed after the product with the highest impact.

Table 71: Comparative statements for washcloths

Product	Comparison
WC1n, 55% recycled, bleached and dyed	5% reduction by adding 55% recycled materials (compared to WC1, 100% virgin, bleached and dyed)
WC2n, 55% recycled, unbleached and undyed	8% reduction by adding 55% recycled materials (compared to WC2, 100% virgin, unbleached and undyed) 35% reduction by adding 55% recycled materials and by not bleaching/dyeing (compared to WC1, 100% virgin, bleached and dyed)

7.5.8 Shower curtain comparison

A comparison of different shower curtains was carried out. Table 72 provides an overview of the differences between the shower curtains compared in this section.

Table 72: Overview of the input differences between the compared shower curtains.

Parameter	SC1	SC2
Raw material	100% virgin	100% virgin
Treatment	Bleached and dyed	Unbleached and undyed
Other differences	None	None

In Figure 21 the comparison of the climate change impact from cradle-to-consumer for shower curtains is shown. The results are indexed after the product with the highest impact. See Table 73 for comparative statements. See section 7.6.2 for uncertainty analysis related to comparative statements.

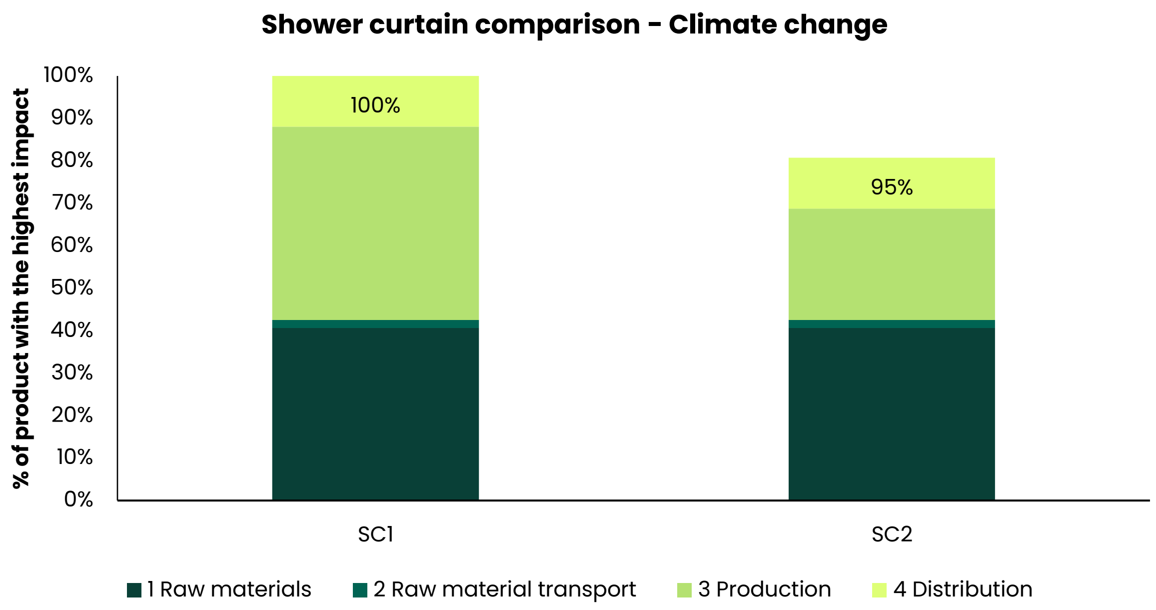

Figure 21 – Comparison of the climate change impact from cradle-to-consumer of SC1 and SC2. The results are indexed after the product with the highest impact.

Table 73: Comparative statements for shower curtains.

Product	**Comparison**
SC2, 100% virgin, unbleached and undyed	5% reduction by not bleaching and dyeing (compared to SC1: 100% virgin, bleached and dyed)

7.6 Uncertainty analysis

7.6.1 Monte Carlo for uncertainty ranges

Monte Carlo analysis was performed to generate uncertainty ranges for the LCA results. Since the climate change impact is the impact category that will be communicated directly to the end consumer, the Monte Carlo analysis was focused on this impact category. The Monte Carlo analysis had 500 runs, which was determined to be sufficient based on convergence of error in the Monte Carlo runs. Specifically, it was ensured that the standard error of the mean (SEM) divided by the mean was less than 2% for the climate change impact. A confidence interval of 95% was selected. See Table 74 for the Monte Carlo analysis results. The results are presented graphically in Figure 22.

Table 74 – Monte Carlo analysis results from 500 runs: Mean, 95% confidence interval and standard error of the mean (SEM) divided by the mean.

Product	Mean value	Confidence interval (95%)	SEM/mean
BL1	14,2	13,2 - 15,8	0,2%
BL1n	13,4	12,3 - 14,6	0,2%
BL2	15,0	13,9 - 16,4	0,2%
BL2n	14,2	13 - 15,6	0,2%
BM1	13,7	12,5 - 15,1	0,3%
BM1n	13,3	12,1 - 14,6	0,3%
BM2	12,0	10,9 - 13,3	0,3%
BM2n	11,7	10,6 - 13,1	0,3%
BML1	16,4	14,8 - 18,1	0,3%
BML2	14,6	13,2 - 16,3	0,3%
BR1	35,5	32,6 - 39,4	0,3%
BR1n	32,6	29,6 - 36,5	0,3%
BR2	31,4	28,7 - 34,9	0,3%
BT1	16,5	15 - 18,3	0,3%
BT1n	16,1	14,7 - 17,9	0,3%
BT2	14,7	13,3 - 16,2	0,3%
BT2n	14,2	13 - 15,7	0,3%
HT1	16,8	15,3 - 18,5	0,3%
HT1n	16,5	15 - 18,3	0,3%
HT2	14,9	13,5 - 16,5	0,3%
HT2n	14,4	13,1 - 16	0,3%
SC1	4,1	3,8 - 4,5	0,3%
SC2	3,5	3,2 - 3,8	0,3%
WC1	7,8	7,2 - 8,6	0,3%
WC1n	7,8	7 - 8,5	0,3%
WC2	6,9	6,3 - 7,6	0,3%
WC2n	6,8	6,2 - 7,5	0,3%

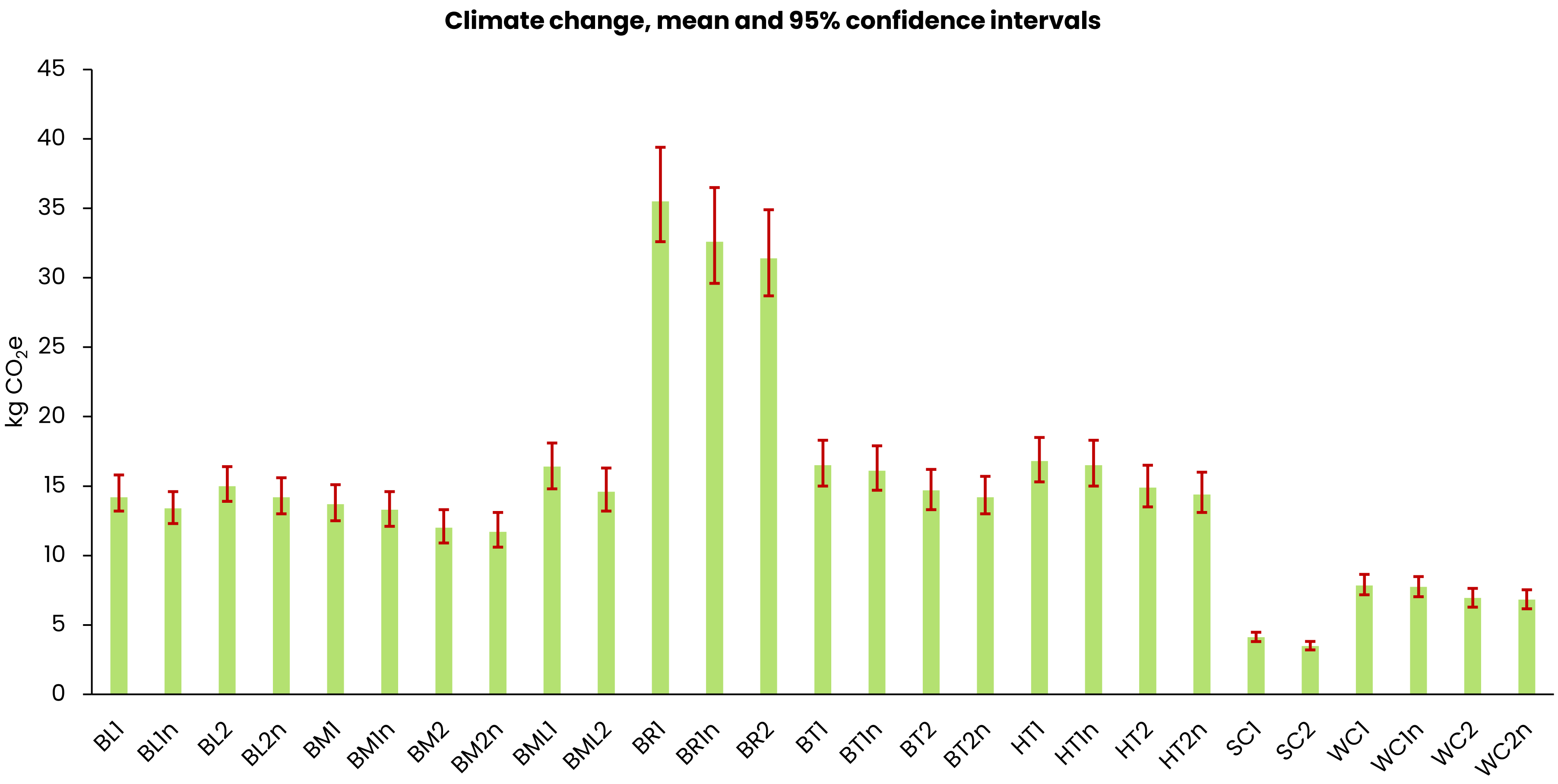

Figure 22 – Monte Carlo analysis results: Mean value and 95% confidence intervals for the climate change impact from cradle-to-grave (kg CO_2e).

7.6.2 Comparative Monte Carlo analysis

The uncertainty in the comparative statements from section 7.5 was evaluated by performing comparative Monte Carlo analysis. In a comparative Monte Carlo analysis, the *difference distribution* between two products is determined and the Monte Carlo runs are paired, meaning that the input parameters will be the same for the two products in each run (where possible). This ensures that the uncertainty of the comparison is not overestimated. 500 runs and a confidence interval of 95% was selected.

The statistical significance was evaluated using null hypothesis significance testing (NHST) on the difference distribution between two products. The null hypothesis in this case is that there is no significant difference between the two products being tested. The results were interpreted as follows: If the 95% confidence interval of the difference distribution (which was computed during Monte Carlo simulations) overlaps zero, the null hypothesis cannot be rejected – this means that it is not possible to prove that there is a significant difference between the two products. If it does not overlap zero, the null hypothesis can be rejected, meaning a significant difference between the two products has been proven with a 95% confidence. In other words, more than 95% of the 500 Monte Carlo runs must prove that product A has a higher impact than product B in order for the test to prove that product A has a significantly higher impact than product B and vice versa.

For all the comparisons carried out in section 7.5 the null-hypothesis is rejected, meaning that a significant difference between the products have been proven in this test. See Appendix 10.7 for all comparative Monte Carlo analysis results.

7.7 Assumptions and limitations

Assumptions and limitations of this LCA can be seen in Table 75.

Table 75 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 small percentage of the composition of the final products (in the range 0,2-4,2% for all products except for HA1 and HA2, where care label accounts for 9,5% of the product weight). • Cotton used for bedlinen is cultivated in Türkiye, but the specific region in Türkiye is unknown. As a major cotton hub in Türkiye, Sanliurfa in Southwest Anatolia is assumed. • 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	• Bedlinen factory:
	    o It is assumed that the steam used in the factory is low pressure saturated steam (the consumption of steam was only given in tons)
	    o It is assumed that the biomass used for steam production is "wood chips".
	    o 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.
	    o 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.
	• Towel factory:
	    o It is assumed that the amount of wastewater is equal to 110% of the water input to the factory.
	    o 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.
	    o It was estimated that 15% of natural gas use was for sizing and other wet processing steps excl. bleaching and dyeing, while 40% was for bleaching, and 45% for dyeing.
	    o It was estimated that the electricity for wet processing for unbleached products is half of that of products which are both bleached and dyed.
	    o The electricity consumption at factory level is given in very round numbers, which indicates that the precision is low.

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 as a conservative estimate that the consumer comes to the store only to buy one product, meaning that 5 km of transport is added for each product.

Phase	Assumptions and limitations
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 • It was not possible to find credible European data for use patterns regarding lifetime and washing frequency of the products in the LCA. Therefore, the use phase is based on data from Australia.
6 End-of-life of product	• Waste treatment scenario is based on information from the Danish Energy Agency: 60,8% of the products are sent to incineration, 26,5% of the products are sent to recycling and 12,7% of the products are reused. Reuse has no environmental impacts in the LCA. • Energy consumption for sorting, shredding, and baling is based on literature values from a Swedish textile recycling scenario • It is assumed that consumer packaging made of cotton fabric (self-fabric bag and cotton ribbon) is disposed of together with the product itself in phase 6. Other consumer packaging (cardboard) is disposed of in phase 5. • 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 selected home textile products from the spring 2026 line of Nord Harmony and their fall 2025 counterparts. 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, to compare the spring 2026 products with their fall 2025 counterparts and look at the effects of implemented design choices such as not bleaching the textiles and replacing some virgin cotton with recycled cotton. Furthermore, the goal was 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 products was evaluated across 16 impact categories according to the EF3.1 LCIA method. The climate change impact of all 27 products is shown in Table 76.

Table 76 – Climate change impact of the 27 products evaluated in the life cycle assessment (LCA)

ID	Product type	Product	Climate change impact (kg CO_2e)	
			Cradle-to-consumer	Cradle-to-grave
BL1	Bedlinen 140 x 200	Fall 2025 - 100% virgin - Bleached+printed	6,3	12,4
BL1n		Spring 2026 - 100% virgin - Unbleached+printed	6,0	12,1
BL2	Bedlinen 140 x 220	Fall 2025 - 100% virgin - Bleached+printed	6,6	13,1
BL2n		Spring 2026 - 100% virgin - Unbleached+printed	6,3	12,7
BM1	Bathmat 50 x 80	Fall 2025 - 100% virgin - Bleached+dyed	4,0	12,0
BM1n		Spring 2026 - 55% recycled - Bleached+dyed	3,7	11,7
BM2		Fall 2025 - 100% virgin - Unbleached+undyed	2,7	10,7
BM2n		Spring 2026 - 55% recycled - Unbleached+undyed	2,3	10,3
BML1	Bathmat 50 x 100	Spring 2026 - 55% recycled - Bleached+dyed	4,5	14,4
BML2		Spring 2026 - 55% recycled - Unbleached+undyed	2,8	12,7
BR1	Bathrobe	Fall 2025 - 100% virgin - Bleached+dyed	10,4	31,2
BR1n		Spring 2026 - 55% recycled - 50% bleached+dyed	7,8	28,5
BR2		Fall 2025 - 100% virgin - Unbleached+undyed	7,0	27,7
BT1	Bath towel 70 x 140	Fall 2025 - 100% virgin - Bleached+dyed	4,8	14,6
BT1n		Spring 2026 - 55% recycled - Bleached+dyed	4,4	14,1
BT2		Fall 2025 - 100% virgin - Unbleached+undyed	3,2	12,9
BT2n		Spring 2026 - 55% recycled - Unbleached+undyed	2,8	12,5
HT1	Hand towels 50 x 100 (2-pack)	Fall 2025 - 100% virgin - Bleached+dyed	4,9	14,8
HT1n		Spring 2026 - 55% recycled - Bleached+dyed	4,4	14,4
HT2		Fall 2025 - 100% virgin - Unbleached+undyed	3,2	13,2
HT2n		Spring 2026 - 55% recycled - Unbleached+undyed	2,8	12,7
SC1	Shower curtain 150 x 200	Spring 2026 - 100% virgin - Bleached+dyed	2,8	3,5
SC2		Spring 2026 - 100% virgin - Unbleached+undyed	2,4	3,2
WC1	Wash cloths 30 x 30 (5-pack)	Fall 2025 - 100% virgin - Bleached+dyed	2,3	6,9
WC1n		Spring 2026 - 55% recycled - Bleached+dyed	2,2	6,8
WC2		Fall 2025 - 100% virgin - Unbleached+undyed	1,6	6,1
WC2n		Spring 2026 - 55% recycled - Unbleached+undyed	1,4	6,0

It was found that 'Phase 1 – raw materials' is the most contributing life cycle phase to climate change for the shower curtains (SC1, SC2), and 'Phase 4 - use of product' is the most contributing life cycle phase to the climate change impact across all other products, contributing with 44-75% of the impact. This is due to the many wash cycles in the life cycle of the products. Shower curtains are washed less frequently than other products which is why the use phase has a lower contribution for these products. 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.

'Phase 1 – raw materials' also contributed significantly to the climate change impacts of all products, especially the cotton cultivation process and yarn spinning process. Since it was not possible to obtain data for organic cotton cultivation in Türkiye and 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 3 – production' also contributed significantly to the climate change impacts of all products, mainly due to chemicals, heat and electricity. For bedlinen the use of chemicals was more contributing than energy, while energy was more contributing for the remaining products.

In the comparison between the textile products from the spring 2026 line and their fall 2025 counterparts it was found that replacing 55% of the virgin cotton with recycled cotton reduced the climate change impact from cradle-to-consumer with 8-9%. Replacing bleached and dyed products with unbleached and undyed products reduced the climate change impact from cradle-to-consumer with 5-34%. Both replacing 55% of the virgin cotton with recycled cotton and bleached and dyed products with unbleached and undyed products reduced the climate change impact from cradle-to-consumer with 41-43%.

In a sensitivity scenario, the assumptions regarding energy consumption for unbleached and printed products from the bedlinen factory were analyzed. The baseline scenario assumed that the electricity, natural gas, steam and water consumption is 50% of the consumption for bleached and printed/dyed. The analysis showed that by changing the consumption for unbleached and printed products to 75% of their bleached and printed/dyed counterparts increased the climate change impact for the entire life cycle with 1%. This parameter was therefore not considered sensitive.

In another sensitivity scenario, the assumptions regarding heat consumption for bleaching and dyeing at the towel factory were analyzed. The baseline scenario assumed that 85% of the factory's heat consumption is used for bleaching and dyeing, leaving 15% for the remaining processes. The analysis showed that changing the distribution to 50% for bleaching and dyeing and 50% for other processes changed the climate change impact for the entire life cycle with -2,8–2,5% across products with increases seen for bleached a and dyed products and decreases seen for unbleached and undyed products. This assumption was therefore not considered sensitive.

Finally, machine drying vs. air drying was analyzed. It was found that changing from 100% machine drying to 100% air drying decreased the climate change impact of the washing-drying process with 54%. Since this process contributes 34-69% of the total life cycle climate change impacts, the effect of using air-drying instead of machine drying is considered highly significant.

9 References

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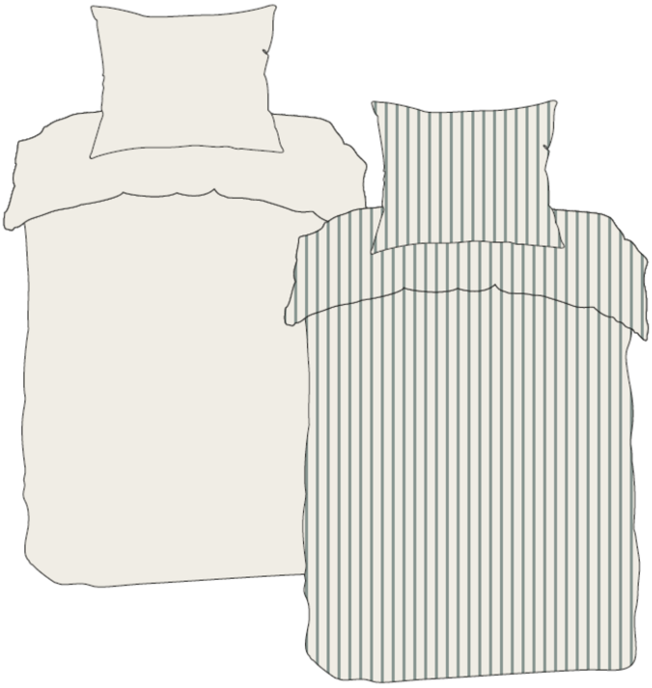
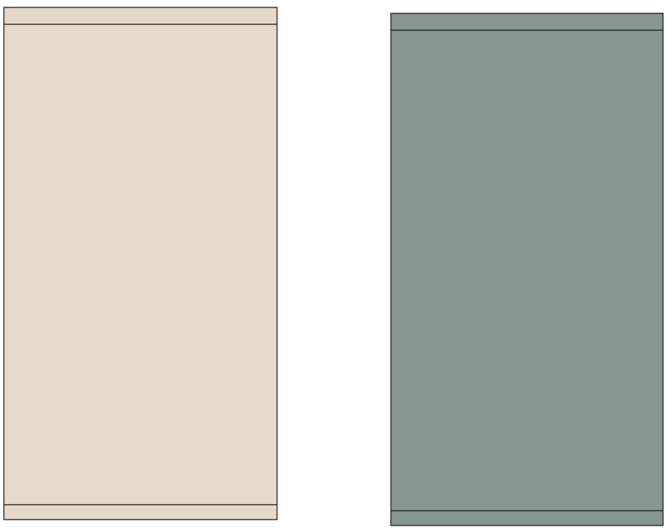
10 Appendix

10.1 Product illustrations

Bedlinen (examples)

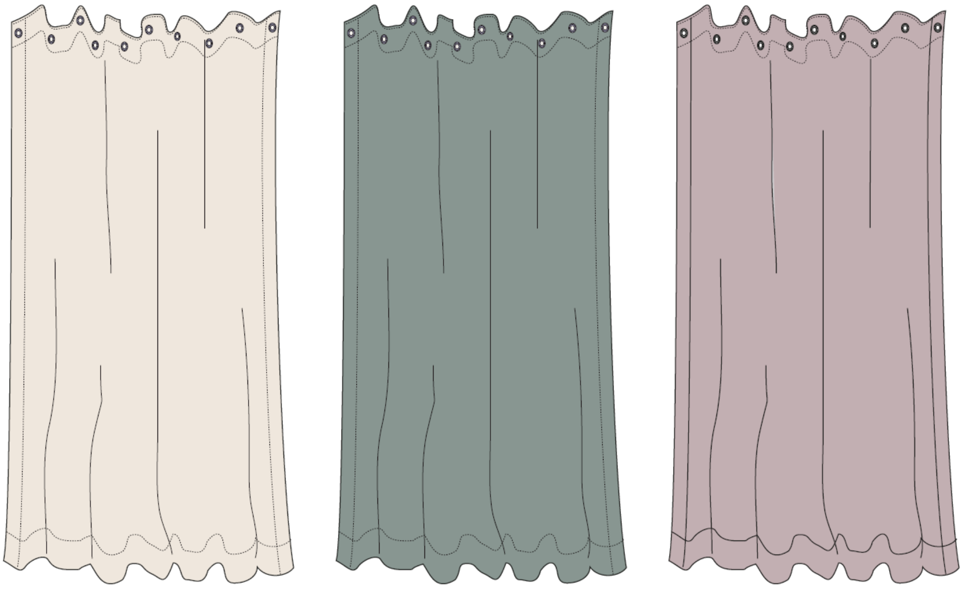


Bath towels hand towels and washcloth (examples)



Bathmats – examples

Shower curtain – examples



Bathrobes - examples

10.2 Bedlinen factory – determination of inputs and outputs

Table 77 – Determining energy and consumables per kg of final bedlinen 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.
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.

Input	Procedure for determining input per kg final product
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 printing in the factory (4.149.603 kg) and multiplied by 1,03 to account for losses in the cut and sew step.

Table 78 – Determining waste and wastewater per kg of final bedlinen 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).

10.3 Towel factory - determination of inputs and outputs

Table 79 – Determining energy and consumables per kg of final towel product

Input	Procedure for determining input per kg final product
Electricity for weaving (sub-meter)	Electricity for weaving (2.900.000 kWh) was divided by the amount of fabric woven in the factory (1.691.492 kg) and multiplied by 1,01 to account for losses in the cut and sew step.
Electricity for wet processing (sub-meter)	Electricity for wet processing (3.600.000 kWh) was divided by the amount of final product from the factory (1.556.173 kg). For unbleached and undyed products it was estimated that the consumption of electricity for wet processing was 50% of that for bleached and dyed products.
Electricity for cut and sew (sub-meter)	Electricity for cut and sew (1.800.000 kWh) was divided by the amount of final product from the factory (1.556.173 kg).
Electricity for other (sub-meter)	Electricity for other processes (1.600.000 kWh) was divided by the amount of final product from the factory (1.556.173 kg).
Natural gas for sizing	Total natural gas consumption was 32.760 mmBTU = 925.918 m3. 15% of this was estimated by the factory to be used for sizing (138.888 m3), which was divided by the amount of fabric woven in the factory (1.691.492 kg) and multiplied by 1,01 to account for losses in the cut and sew step.
Natural gas for bleaching	Total natural gas consumption was 32.760 mmBTU = 925.918 m3. 40% of this was estimated by the factory to be used for bleaching (370.367 m3), which was divided by the amount of fabric bleached in the factory (676.596 kg) and multiplied by 1,01 to account for losses in the cut and sew step.
Natural gas for dyeing	Total natural gas consumption was 32.760 mmBTU = 925.918 m3. 45% of this was estimated by the factory to be used for dyeing (416.663 m3), which was divided by the amount of fabric dyed in the factory (1.014.895 kg) and multiplied by 1,01 to account for losses in the cut and sew step.
Clean water for bleaching	Total consumption of clean water was 7.831.000 m3. The factory estimated that the same amount of water is used for bleaching and dyeing (meaning double the amount of water is used for fabrics that are both bleached and dyed compared to only bleached products). The total water consumption was divided by the sum of fabric going through bleaching (676.596 kg) and fabric going through dyeing (1.014.895 kg) and multiplied by 1,01 to account for losses in the cut and sew step.
Clean water for dyeing	Total consumption of clean water was 7.831.000 m3. The factory estimated that the same amount of water is used for bleaching and dyeing (meaning double the amount of water is used for fabrics that are both bleached and dyed compared to only bleached products). The total water consumption was divided by the sum of fabric going through bleaching (676.596 kg) and fabric going through dyeing (1.014.895 kg) and multiplied by 1,01 to account for losses in the cut and sew step.
Clean water for unbleached products	Unbleached and undyed products still go through some wet processing steps. The factory estimates that they consume 25% of the water of products that are only bleached or only dyed, or 12,5% of products that are bleached and dyed.
Lubricants	Lubricant (1.500 liter, assumed 1.500 kg) was divided by the amount of final product from the factory (1.556.173 kg).
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	8,5% of yarn weight according to factory. Multiplied by 1,01 to account for losses in the cut and sew step.
Acid for desizing	0,5% of fabric weight according to factory. Multiplied by 1,01 to account for losses in the cut and sew step.
Sodium hydroxide for scouring	3% of sodium hydroxide in solution based on CBSE (2014). Assumed 20 L solution per kg fabric. Multiplied by 1,01 to account for losses in the cut and sew step.
Hydrogen peroxide for bleaching	3% of the fabric weight according to factory. Multiplied by 1,01 to account for losses in the cut and sew step.
Sodium hydroxide for bleaching	2% of sodium hydroxide in solution based on CBSE (2014). Assumed 20 L solution per kg fabric. Multiplied by 1,01 to account for losses in the cut and sew step.
Sodium silicate for bleaching	3% of sodium silicate in solution based on CBSE (2014). Assumed 20 L solution per kg fabric. Multiplied by 1,01 to account for losses in the cut and sew step.
Dye agent	According to factory: 0,065 kg dye per kg 350 gsm fabric; 0,075 kg dye per kg 500 gsm fabric, and 0,090 kg dye per kg 1000 gsm fabric. Multiplied by 1,01 to account for losses in the cut and sew step.

Table 80 – Determining waste and wastewater per kg of final towel product

Output	Procedure for determining input per kg final product
Plastic waste	Plastic waste (2.300 kg) was divided by the amount of final product from the factory (1.556.173 kg).
Metal waste	Metal waste (1.900 kg) was divided by the amount of final product from the factory (1.556.173 kg).
Paper waste	Plastic waste (1.100 kg) was divided by the amount of final product from the factory (1.556.173 kg).
Wastewater	Wastewater to treatment was estimated as 110% of the clean water input to the factory. See calculation of water input.
Textile waste	The amount of textile waste was calculated from the loss rates according to the factory (3,5% in weaving and 1% in cut and sew).

10.5 Data quality numerical rating

Table 81 – Numerical data quality rating per process in the LCA (for products containing cotton grown in Pakistan). The weighing is based on the average contribution of each process to the overall climate change impact across all products. The weighted score is calculated as the product of the average DQR per process and the final DQR score is the sum of the weighted score for all processes.

Activity	Accuracy	Geography	Time	Technology	Average DQR	Weighing	Weighted score*
Cotton growing	2	3	3	1	2,25	5,83%	0,13
Ginning	2	3	3	1	2,25	0,00%	0,00
Transport virgin cotton	2	3	4	2	2,75	0,69%	0,02
Transport recycled cotton	5	5	4	3	4,25	0,20%	0,01
Spinning	2	3	3	1	2,25	9,19%	0,21
Fiber production	2	3	3	3	2,75	0,16%	0,00
Transport by truck	2	2	4	2	2,5	0,30%	0,01
Electricity from grid	2	1	1	1	1,25	11,22%	0,14
Electricity from solar	2	4	3	1	2,5	0,02%	0,00
Steam from biomass	2	4	3	3	3	0,00%	0,00
Natural gas	2	4	4	2	3	4,41%	0,13
Clean water	2	4	4	2	3	0,14%	0,00
Lubricant	2	4	4	2	3	0,02%	0,00
Starch for sizing	2	4	4	2	3	0,45%	0,01
Enzyme for desizing	2	4	2	3	2,75	0,03%	0,00
Acid for desizing	2	4	4	2	3	0,03%	0,00
Sodium hydroxide for scouring	4	4	4	1	3,25	0,13%	0,00
Hydrogen peroxide for bleaching	2	4	2	1	2,25	0,13%	0,00
Sodium hydroxide for bleaching	4	4	4	1	3,25	0,07%	0,00
Sodium silicate for bleaching	4	4	4	1	3,25	0,00%	0,00
Dye/pigment	2	4	4	4	3,5	0,68%	0,02
Plastic waste	2	4	4	2	3	0,01%	0,00
Metal waste	2	4	4	2	3	0,00%	0,00
Paper waste	2	4	4	2	3	0,11%	0,00

Activity	Accuracy	Geography	Time	Technology	Average DQR	Weighing	Weighted score*
Textile waste	2	4	4	2	3	0,14%	0,00
Wastewater treatment	2	4	4	2	3	0,14%	0,00
Printed cardboard	1	5	4	2	3	0,08%	0,00
Unprinted cardboard	1	5	4	2	3	1,36%	0,04
LDPE bag	1	5	4	2	3	0,06%	0,00
Plastic input	3	4	4	2	3,25	0,05%	0,00
Metal input	3	4	4	2	3,25	0,04%	0,00
Paper input	3	4	4	2	3,25	0,04%	0,00
Transport to DK	1	2	4	2	2,25	1,17%	0,03
Warehouse	3	1	2	1	1,75	0,12%	0,00
Electricity for retail	3	1	2	1	1,75	1,08%	0,02
Cardboard disposal	1	1	2	2	1,5	0,05%	0,00
LDPE disposal	1	1	2	2	1,5	0,05%	0,00
Car transport	5	2	2	3	3	0,65%	0,02
Electricity use	3	1	2	1	1,75	29,93%	0,52
Water use	3	2	4	2	2,75	2,16%	0,06
Detergent use	3	5	3	3	3,5	26,00%	0,91
Cardboard disposal	1	1	2	2	1,5	0,02%	0,00
Textile to incineration	3	3	2	1	2,25	2,41%	0,05
Textile to recycling	3	2	2	3	2,5	0,61%	0,02
Sum of processes	**-**	**-**	**-**	**-**	**-**	**100,00%**	**2,40**

Table 82 – Numerical data quality rating per process in the LCA (for products containing cotton grown in Türkiye). The weighing is based on the average contribution of each process to the overall climate change impact across all products. The weighted score is calculated as the product of the average DQR per process and the final DQR score is the sum of the weighted score for all processes.

Activity	Accuracy	Geography	Time	Technology	Average DQR	Weighing	Weighted score*
Cotton growing	2	5	3	1	2,75	39,70%	1,09
Ginning	2	3	3	1	2,25	0,00%	0,00
Transport virgin cotton	2	3	4	2	2,75	0,26%	0,01
Transport recycled cotton	2	5	3	1	2,75	5,83%	0,16
Spinning	2	3	3	1	2,25	0,00%	0,00
Fiber production	2	3	4	2	2,75	0,69%	0,02
Transport by truck	5	5	4	3	4,25	0,20%	0,01
Electricity from grid	2	3	3	1	2,25	9,19%	0,21
Electricity from solar	2	3	3	3	2,75	0,16%	0,00
Steam from biomass	2	2	4	2	2,5	0,30%	0,01
Natural gas	2	1	1	1	1,25	11,22%	0,14
Clean water	2	4	3	1	2,5	0,02%	0,00
Lubricant	2	4	3	3	3	0,00%	0,00
Starch for sizing	2	4	4	2	3	4,41%	0,13
Enzyme for desizing	2	4	4	2	3	0,14%	0,00
Acid for desizing	2	4	4	2	3	0,02%	0,00
Sodium hydroxide for scouring	2	4	4	2	3	0,45%	0,01
Hydrogen peroxide for bleaching	2	4	2	3	2,75	0,03%	0,00
Sodium hydroxide for bleaching	2	4	4	2	3	0,03%	0,00
Sodium silicate for bleaching	4	4	4	1	3,25	0,13%	0,00
Dye/pigment	2	4	2	1	2,25	0,13%	0,00
Plastic waste	4	4	4	1	3,25	0,07%	0,00
Metal waste	4	4	4	1	3,25	0,00%	0,00
Paper waste	2	4	4	4	3,5	0,68%	0,02
Textile waste	2	4	4	2	3	0,01%	0,00
Wastewater treatment	2	4	4	2	3	0,00%	0,00
Printed cardboard	2	4	4	2	3	0,11%	0,00
Unprinted cardboard	2	4	4	2	3	0,14%	0,00

Activity	Accuracy	Geography	Time	Technology	Average DQR	Weighing	Weighted score*
LDPE bag	2	4	4	2	3	0,14%	0,00
Plastic input	1	5	4	2	3	0,08%	0,00
Metal input	1	5	4	2	3	1,36%	0,04
Paper input	1	5	4	2	3	0,06%	0,00
Transport to DK	3	4	4	2	3,25	0,05%	0,00
Warehouse	3	4	4	2	3,25	0,04%	0,00
Electricity for retail	3	4	4	2	3,25	0,04%	0,00
Cardboard disposal	1	2	4	2	2,25	1,17%	0,03
LDPE disposal	3	1	2	1	1,75	0,12%	0,00
Car transport	3	1	2	1	1,75	1,08%	0,02
Electricity use	1	1	2	2	1,5	0,05%	0,00
Water use	1	1	2	2	1,5	0,05%	0,00
Detergent use	5	2	2	3	3	0,65%	0,02
Cardboard disposal	3	1	2	1	1,75	29,93%	0,52
Textile to incineration	3	2	4	2	2,75	2,16%	0,06
Textile to recycling	3	5	3	3	3,5	26,00%	0,91
Sum of processes	**-**	**-**	**-**	**-**	**-**	**100%**	**2,43**

10.6 Contribution analysis for all environmental impacts

10.6.1 Acidification

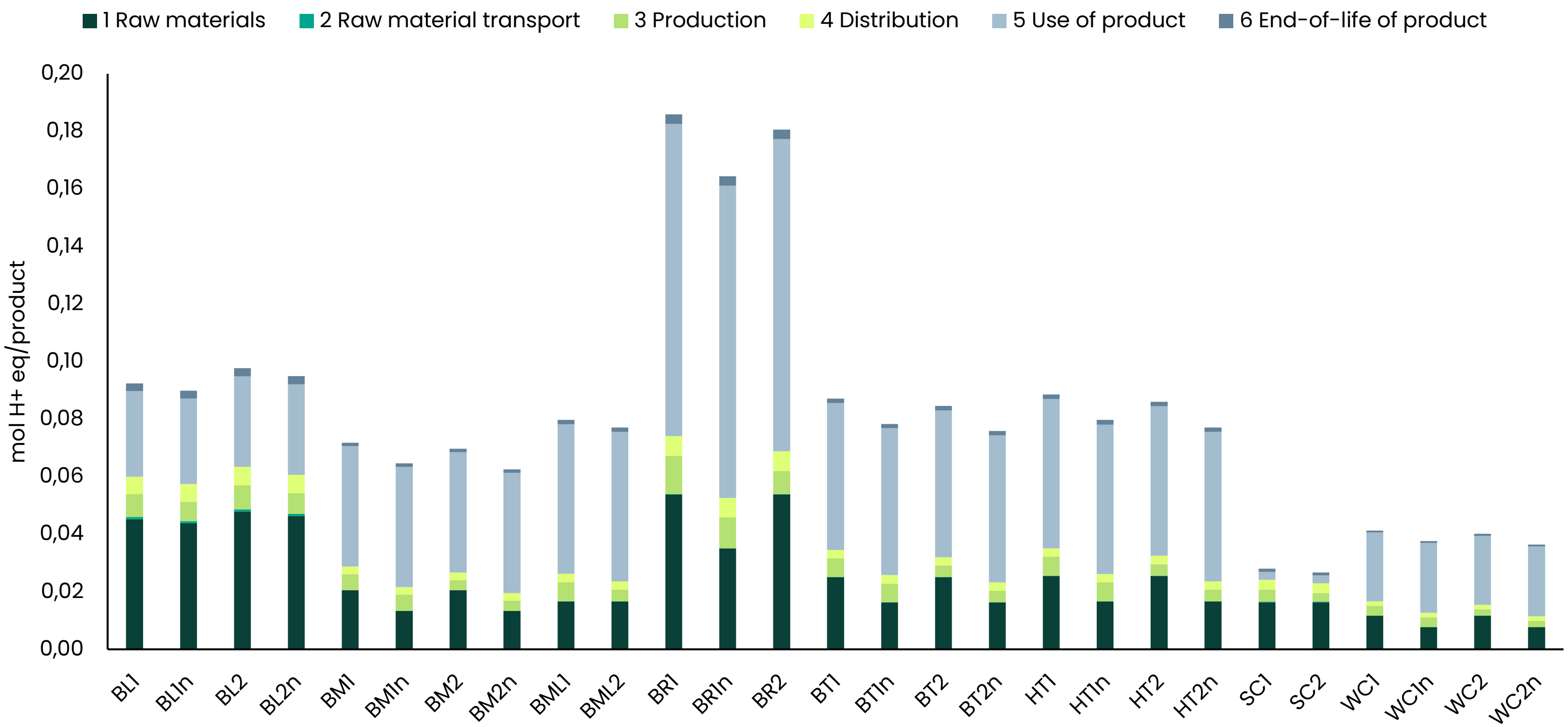


Figure 23 – Environmental impact per product in the LCA (Acidification)

10.6.2 Ecotoxicity, freshwater

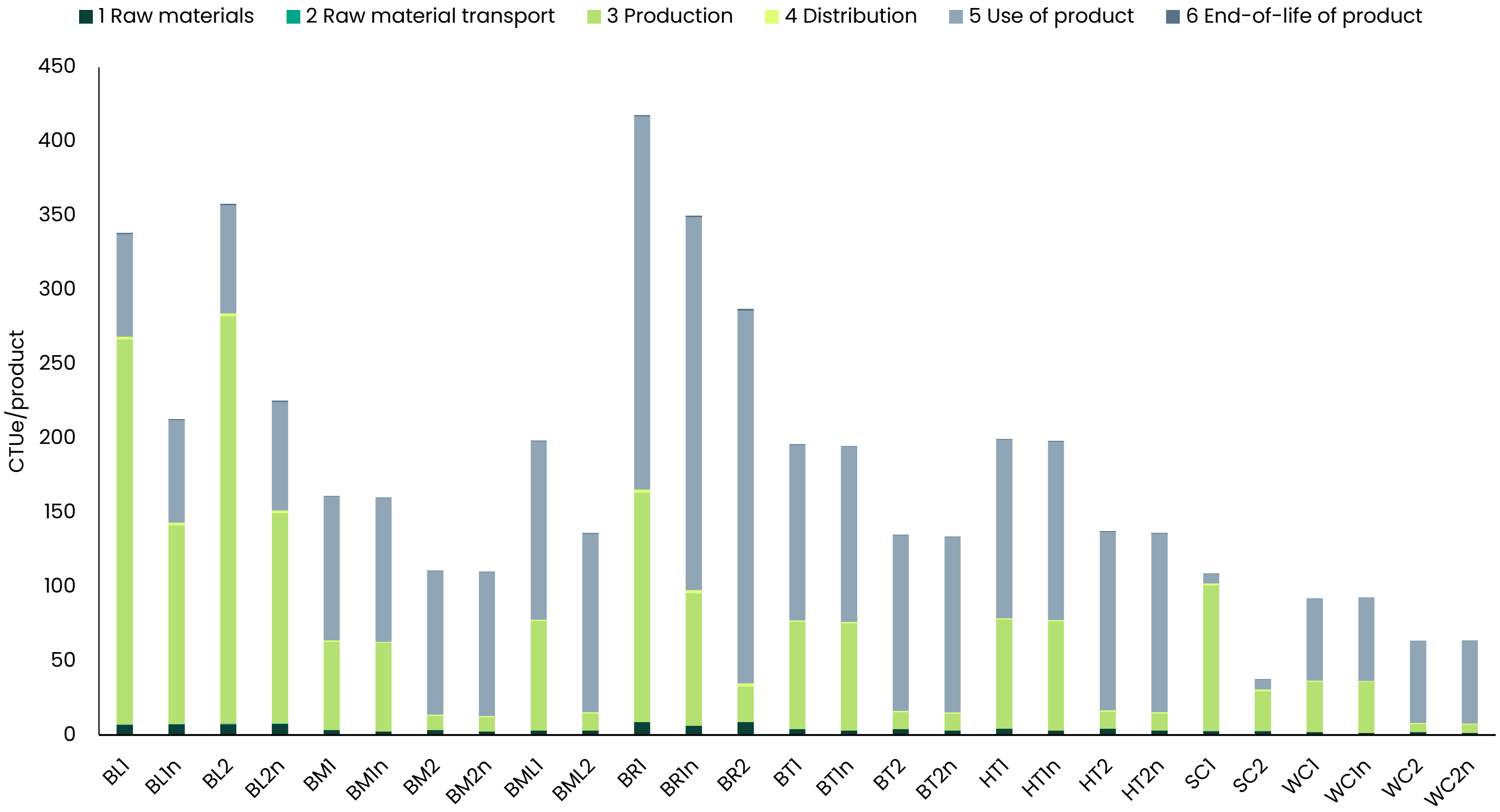


Figure 24 – Environmental impact per product in the LCA (Ecotoxicity, freshwater)

10.6.3 Eutrophication, freshwater

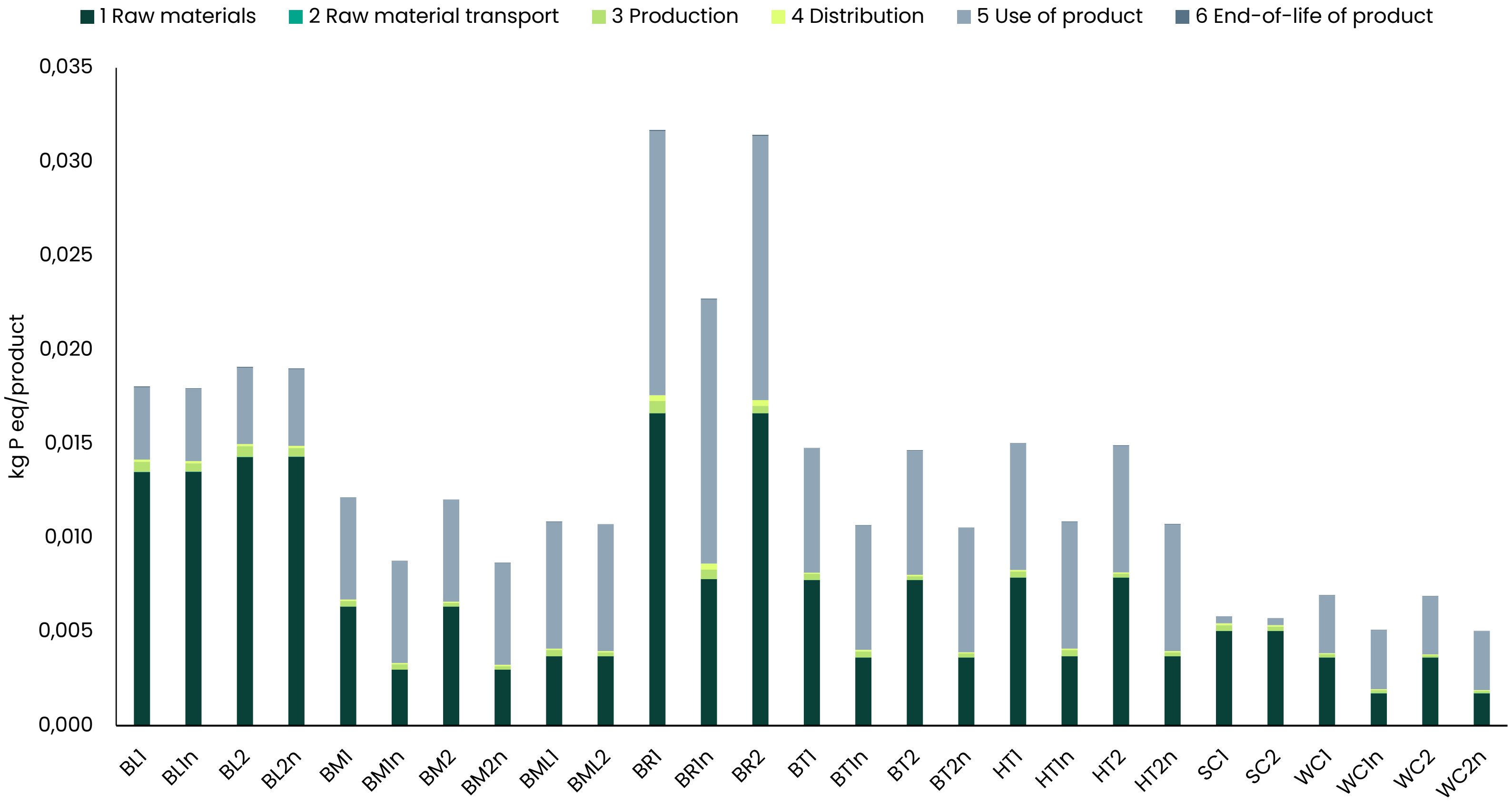


Figure 25 – Environmental impact per product in the LCA (Eutrophication, freshwater)

10.6.4 Eutrophication, marine

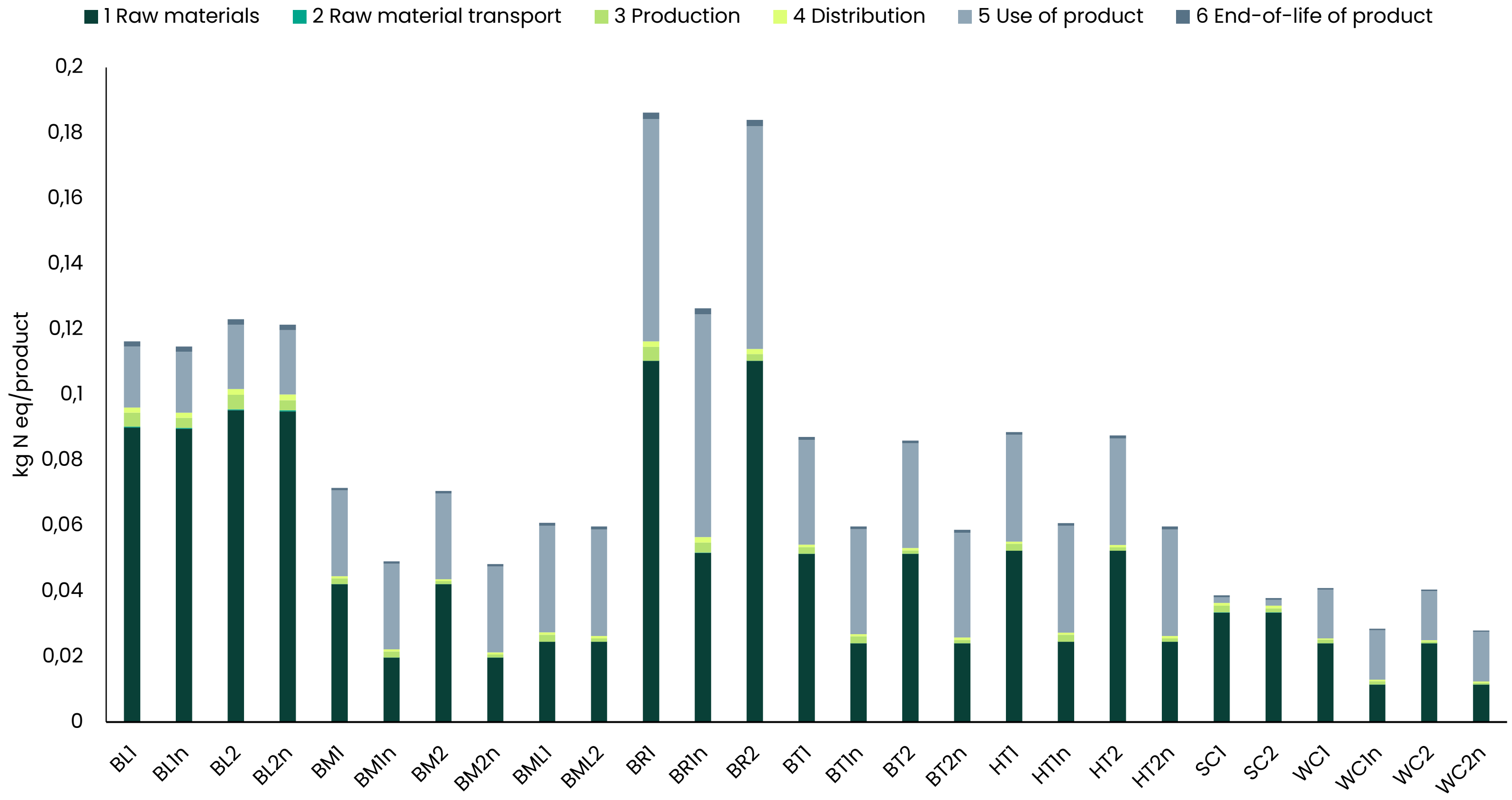


Figure 26 – Environmental impact per product in the LCA (Eutrophication, marine)

10.6.5 Eutrophication, terrestrial

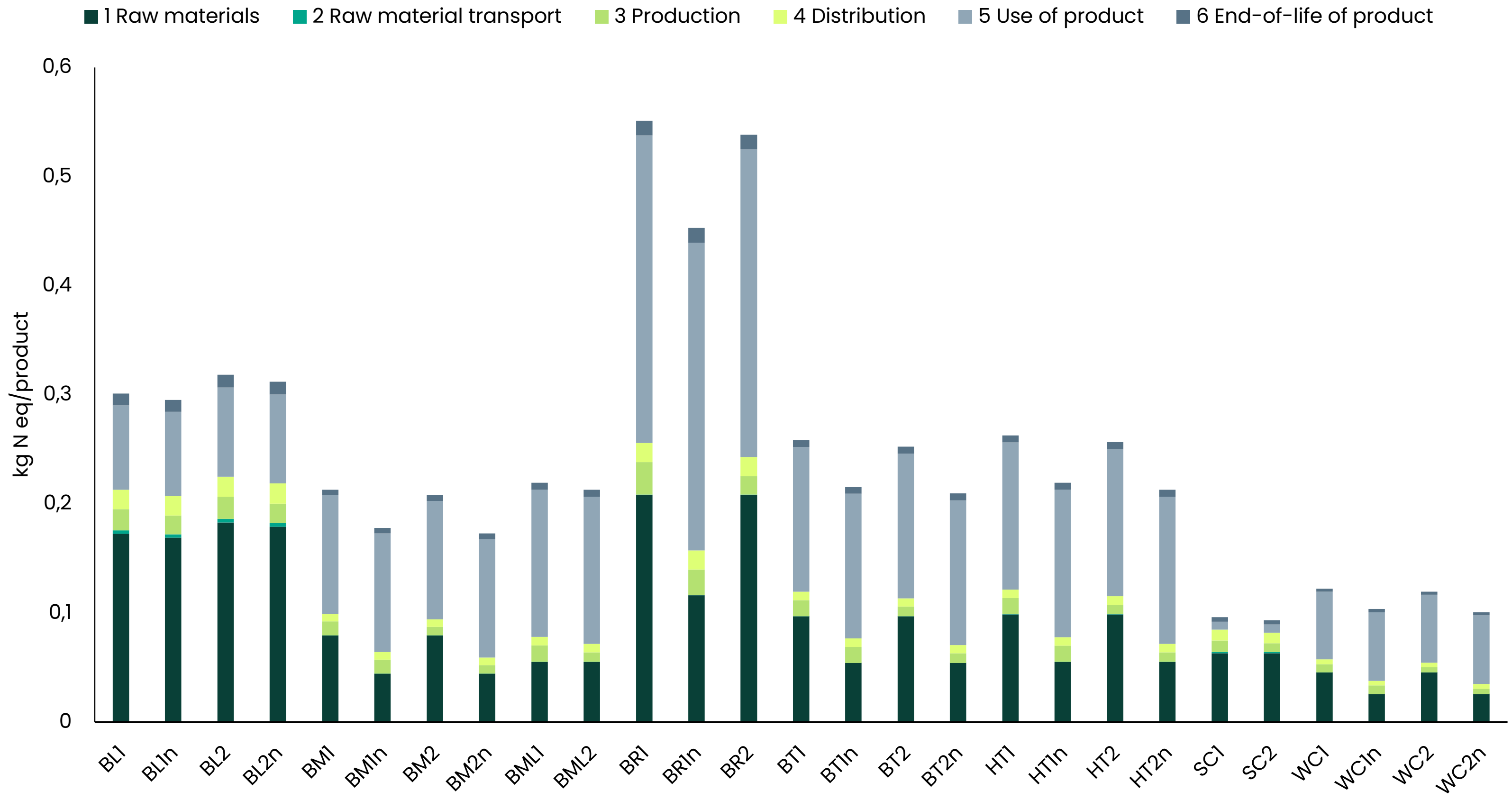


Figure 27 – Environmental impact per product in the LCA (Eutrophication, terrestrial)

10.6.6 Human toxicity, cancer

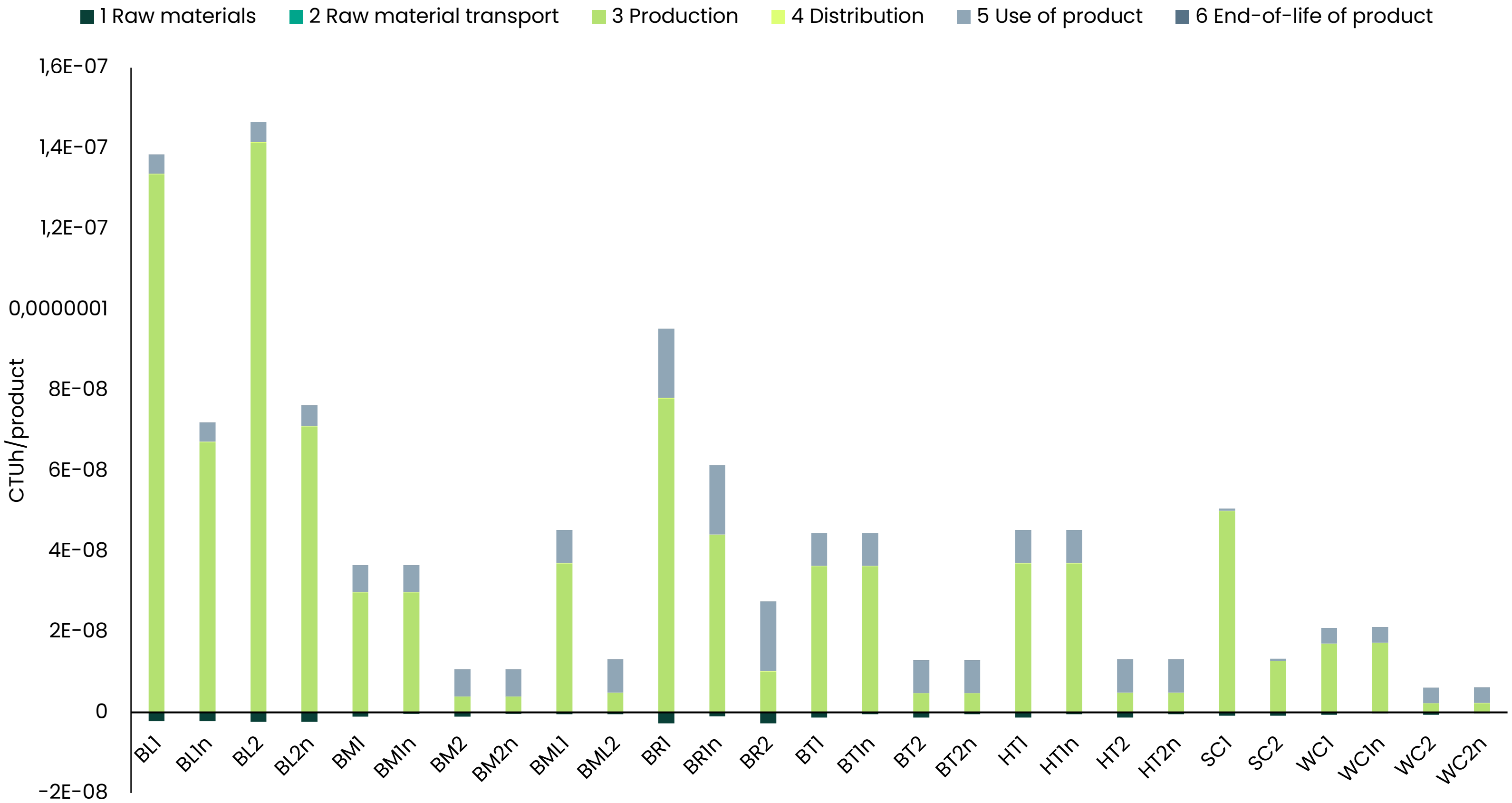


Figure 28 – Environmental impact per product in the LCA (Human toxicity, cancer)

10.6.7 Human toxicity, non-cancer

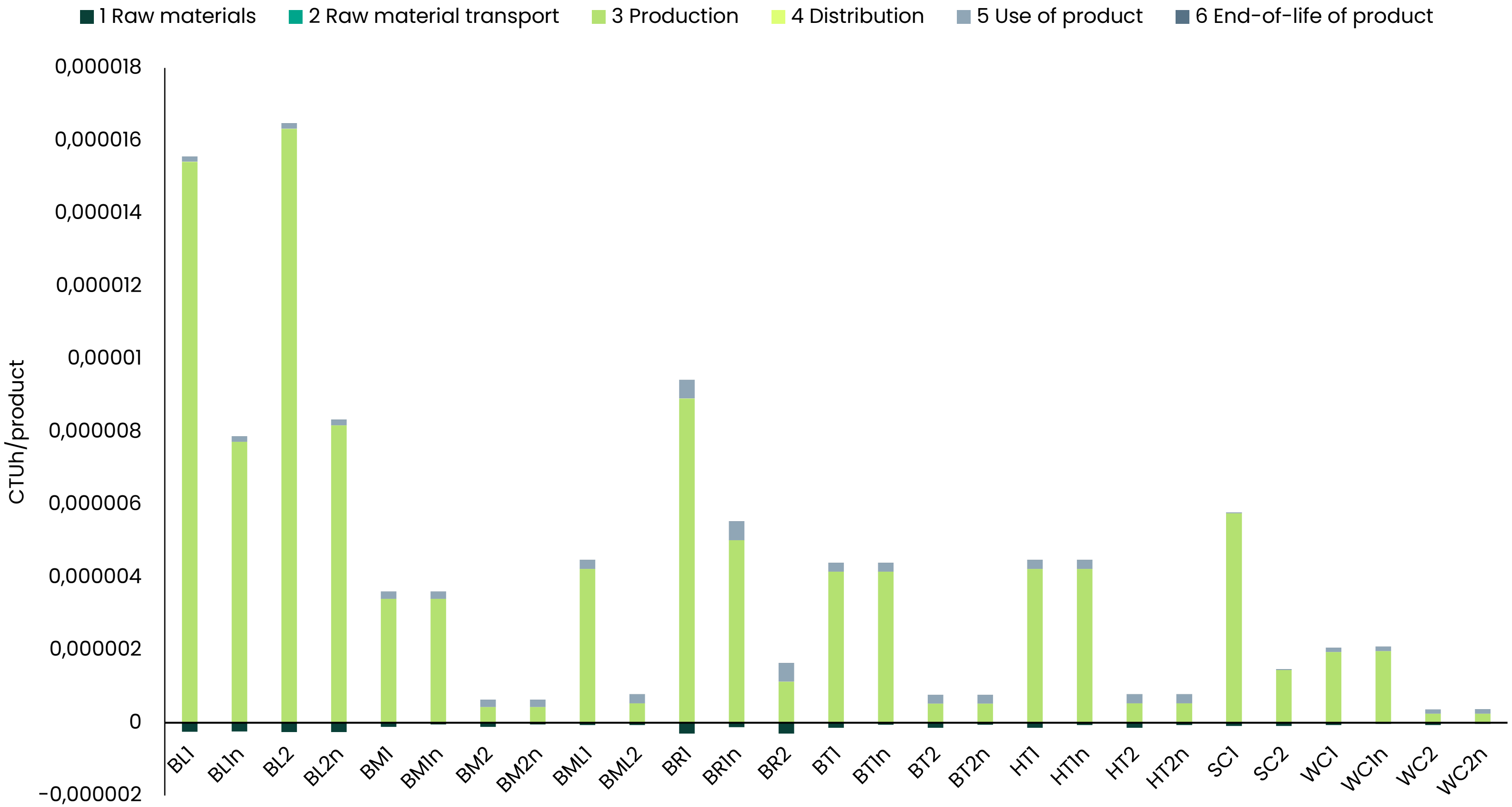


Figure 29 – Environmental impact per product in the LCA (Human toxicity, non-cancer)

10.6.8 Ionising radiation

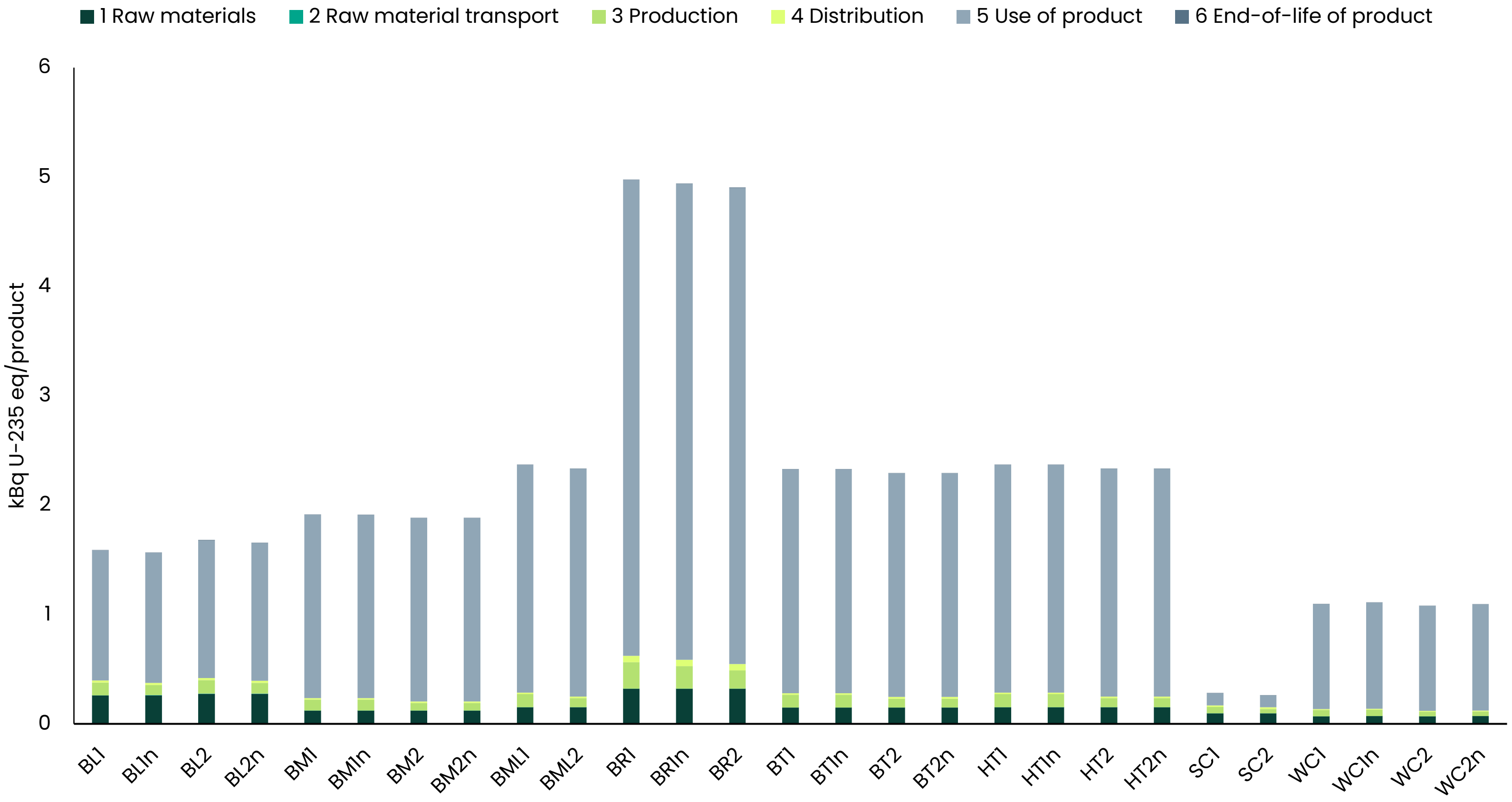


Figure 30 – Environmental impact per product in the LCA (Ionising radiation)

10.6.9 Land use

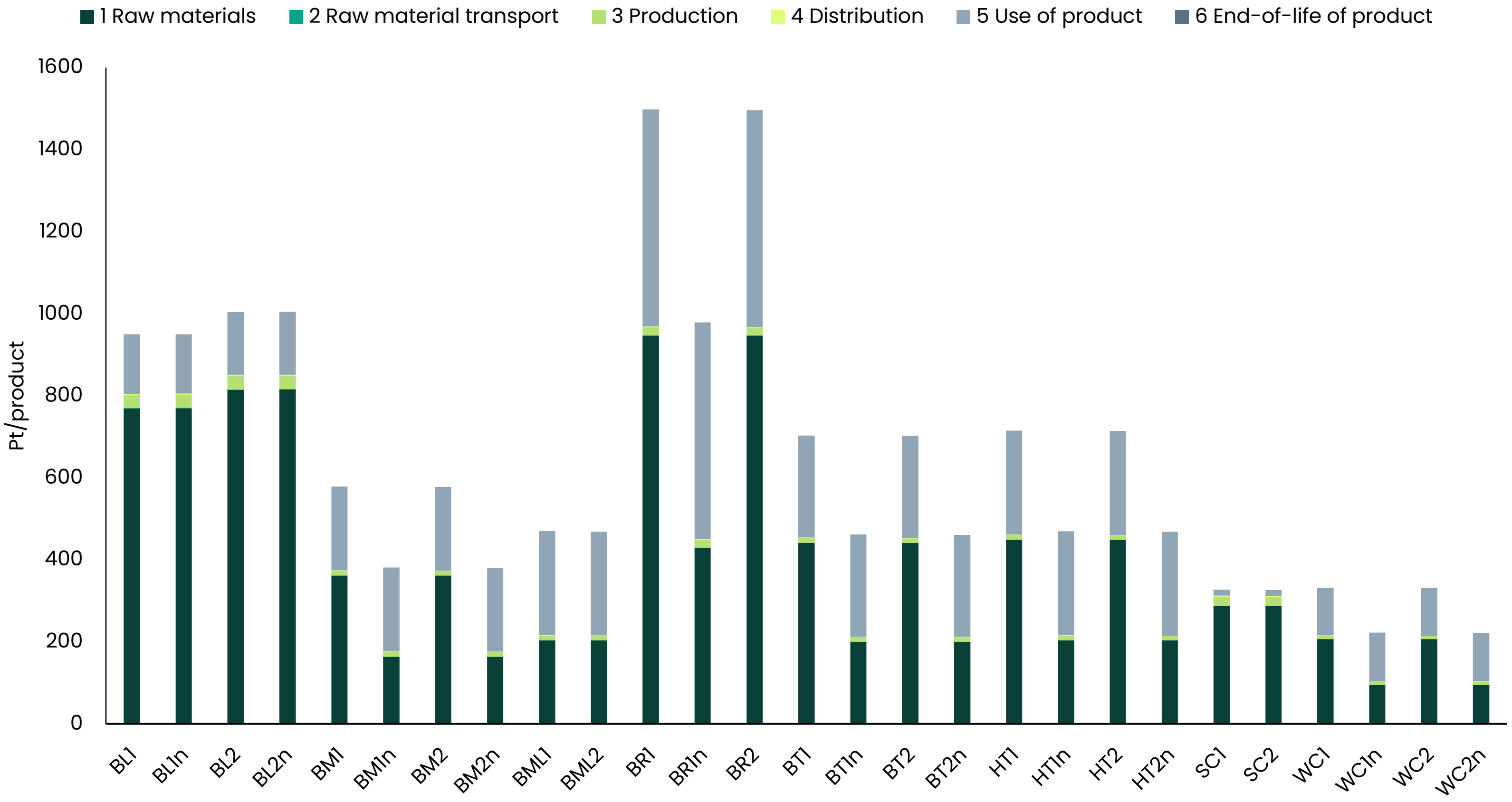


Figure 31 – Environmental impact per product in the LCA (Land use)

10.6.10 Ozone depletion

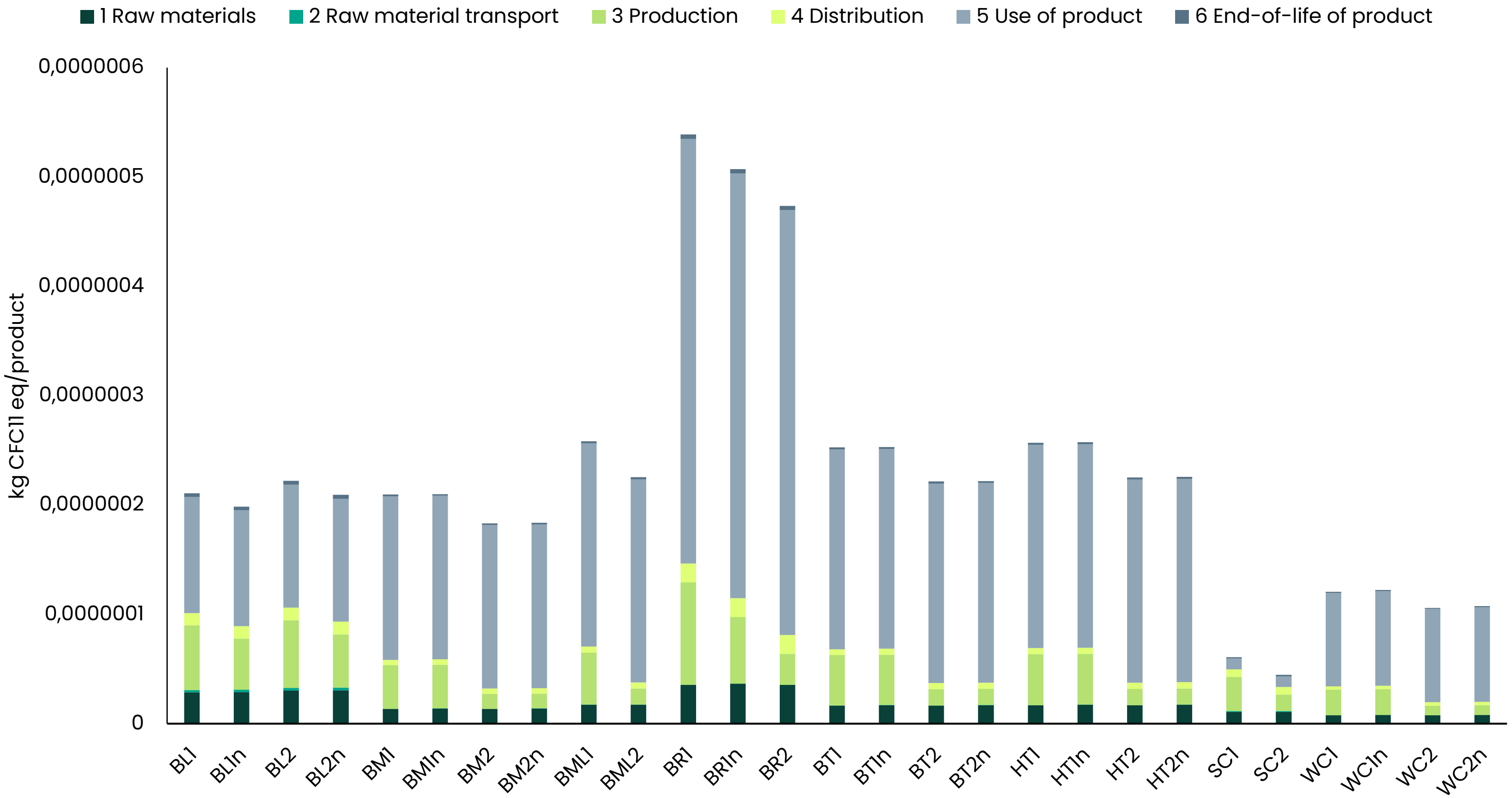


Figure 32 – Environmental impact per product in the LCA (Ozone depletion)

10.6.11 Particulate matter

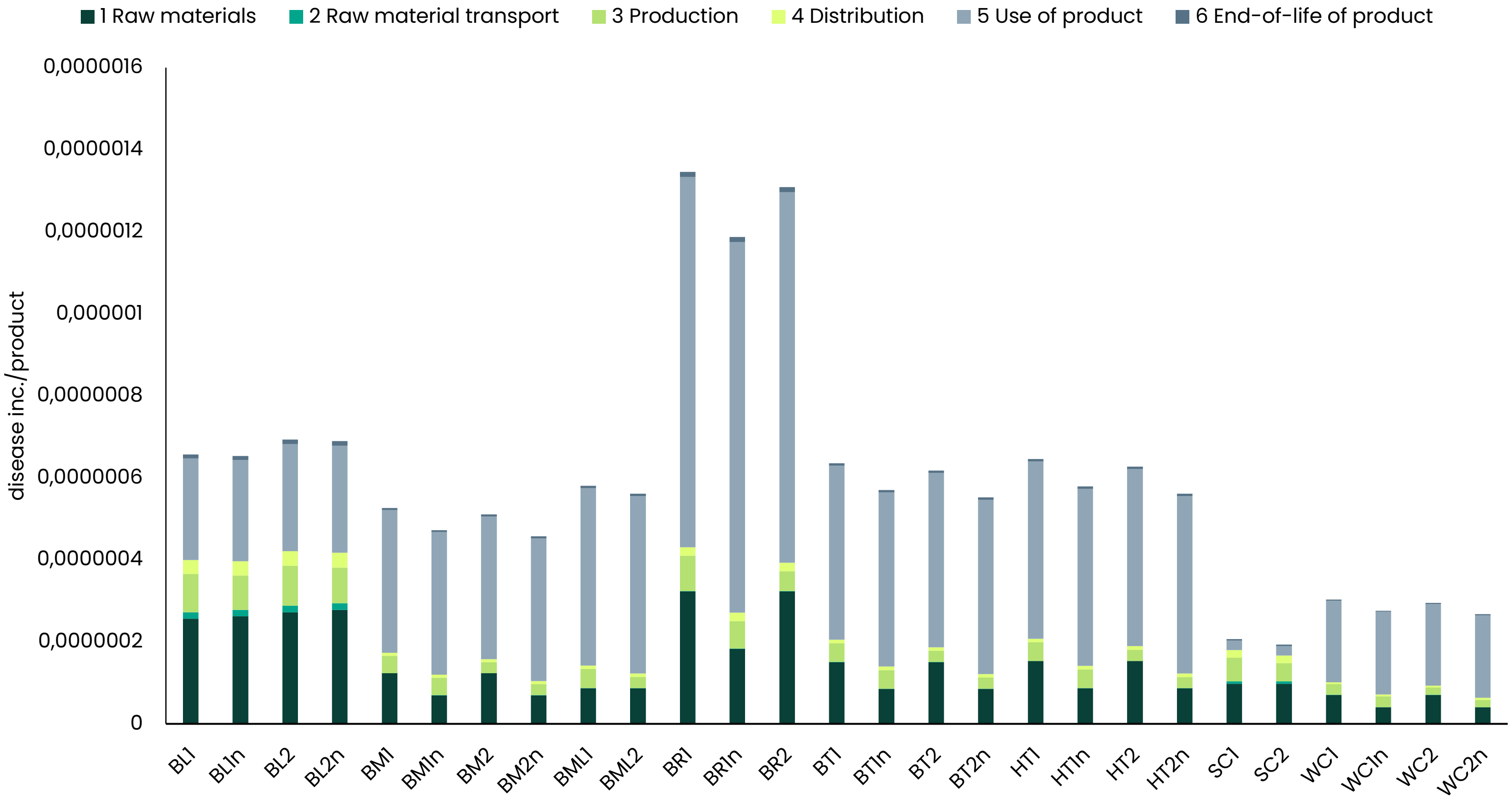


Figure 33 – Environmental impact per product in the LCA (Particulate matter)

10.6.12 Photochemical ozone formation

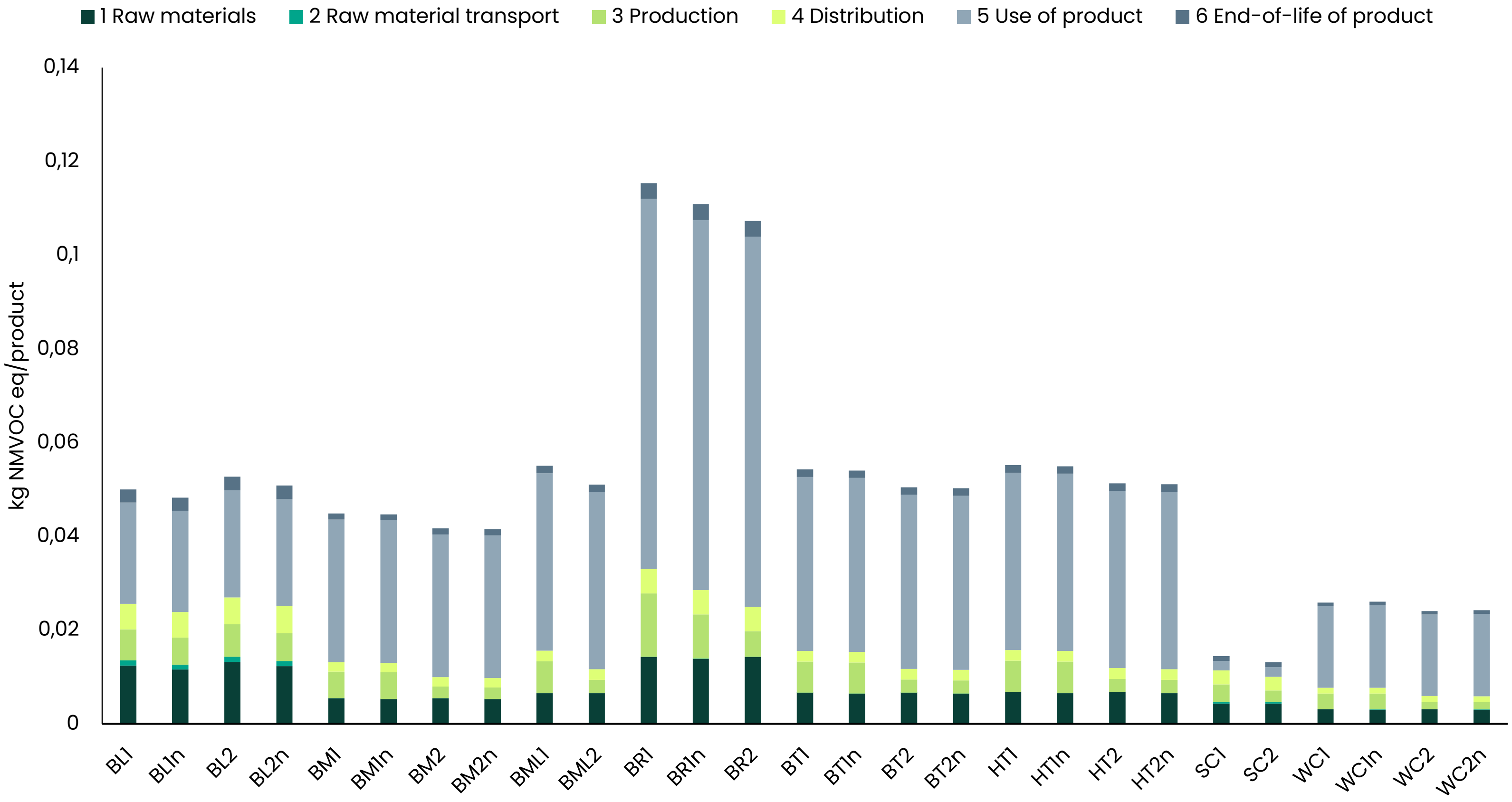


Figure 34 – Environmental impact per product in the LCA (Photochemical ozone formation)

10.6.13 Resource use, fossils

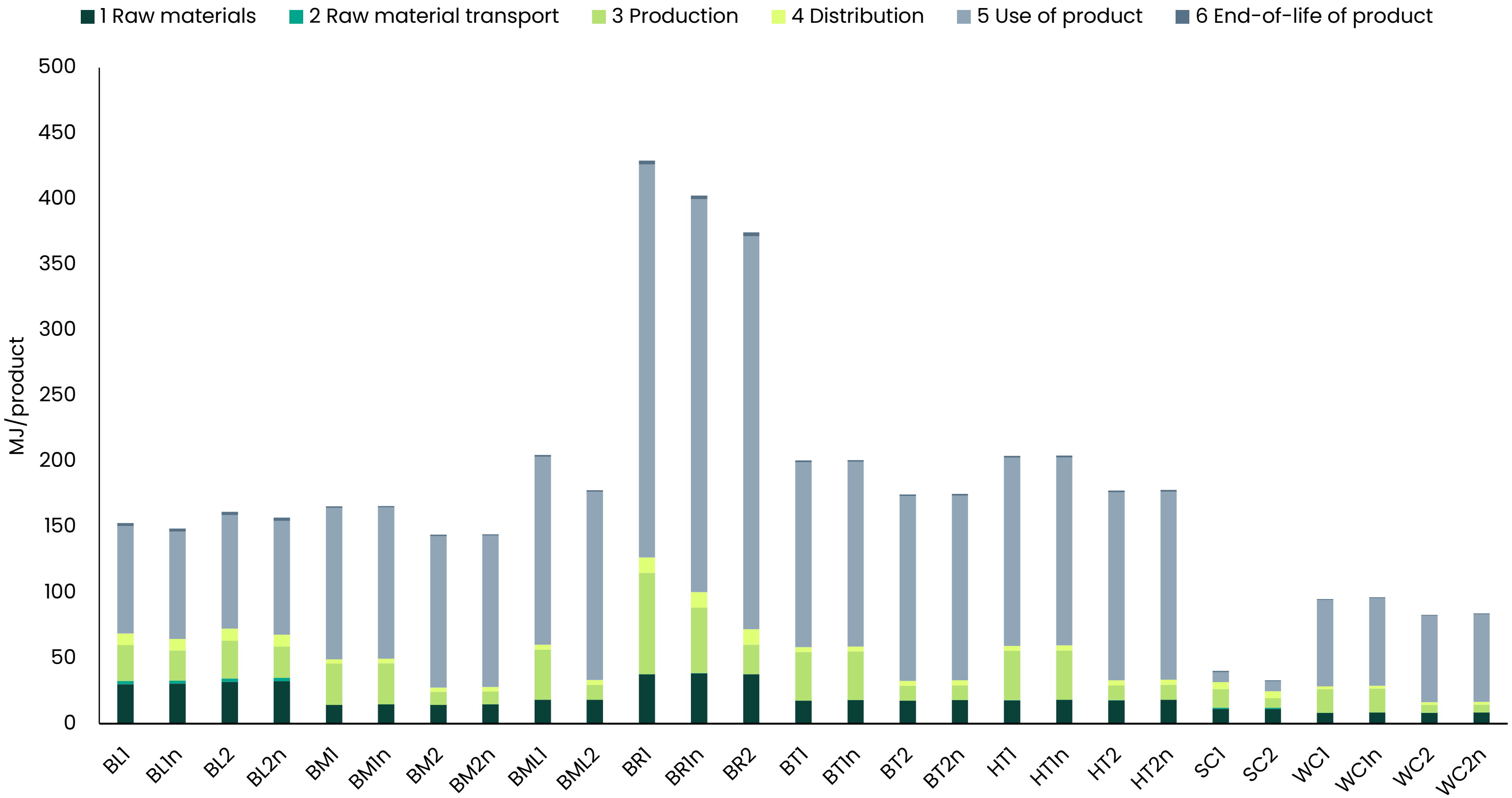


Figure 35 – Environmental impact per product in the LCA (Resource use, fossils)

10.6.14 Resource use, minerals and metals

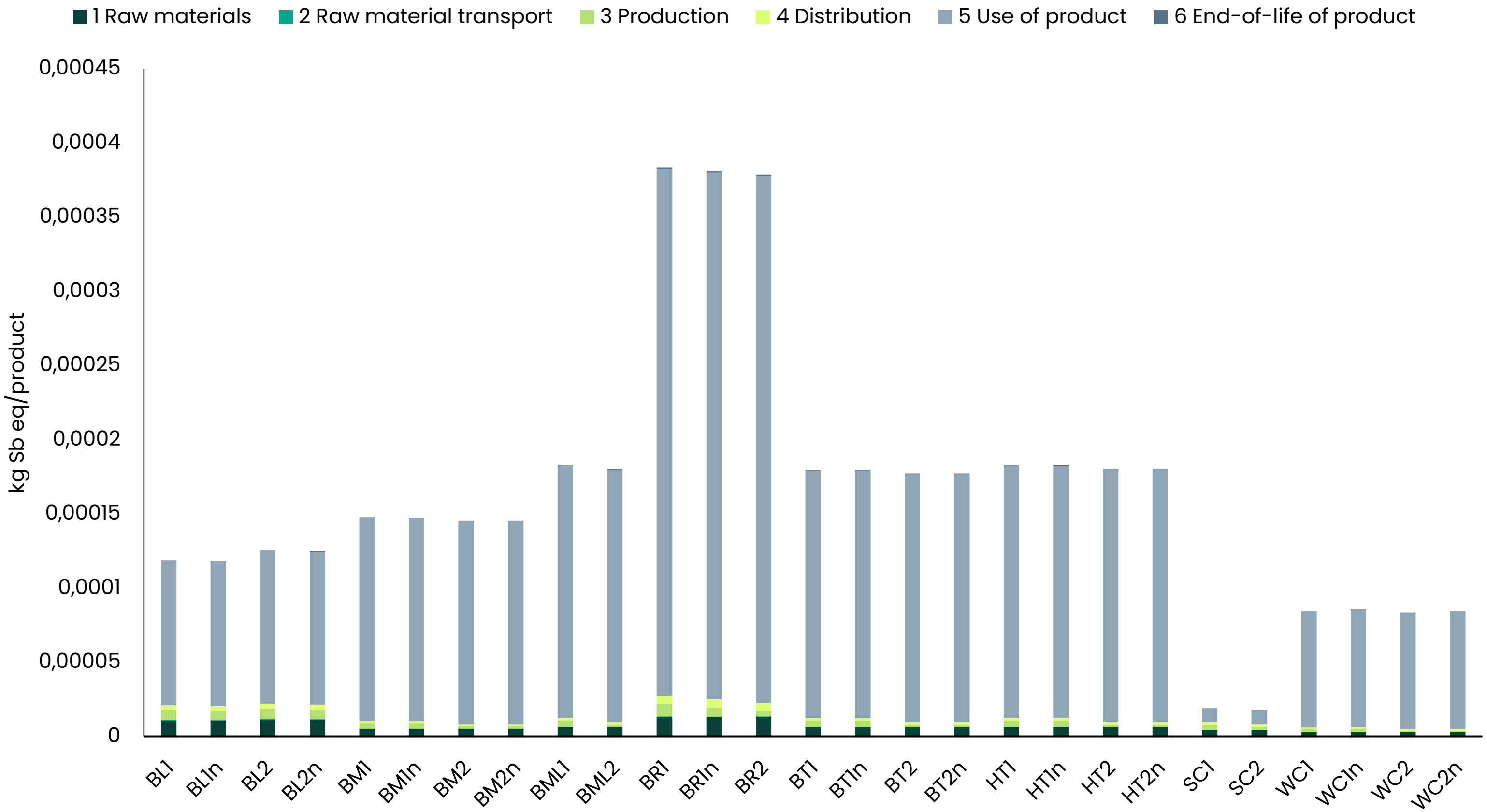


Figure 36 – Environmental impact per product in the LCA (Resource use, minerals and metals)

10.6.15 Water use

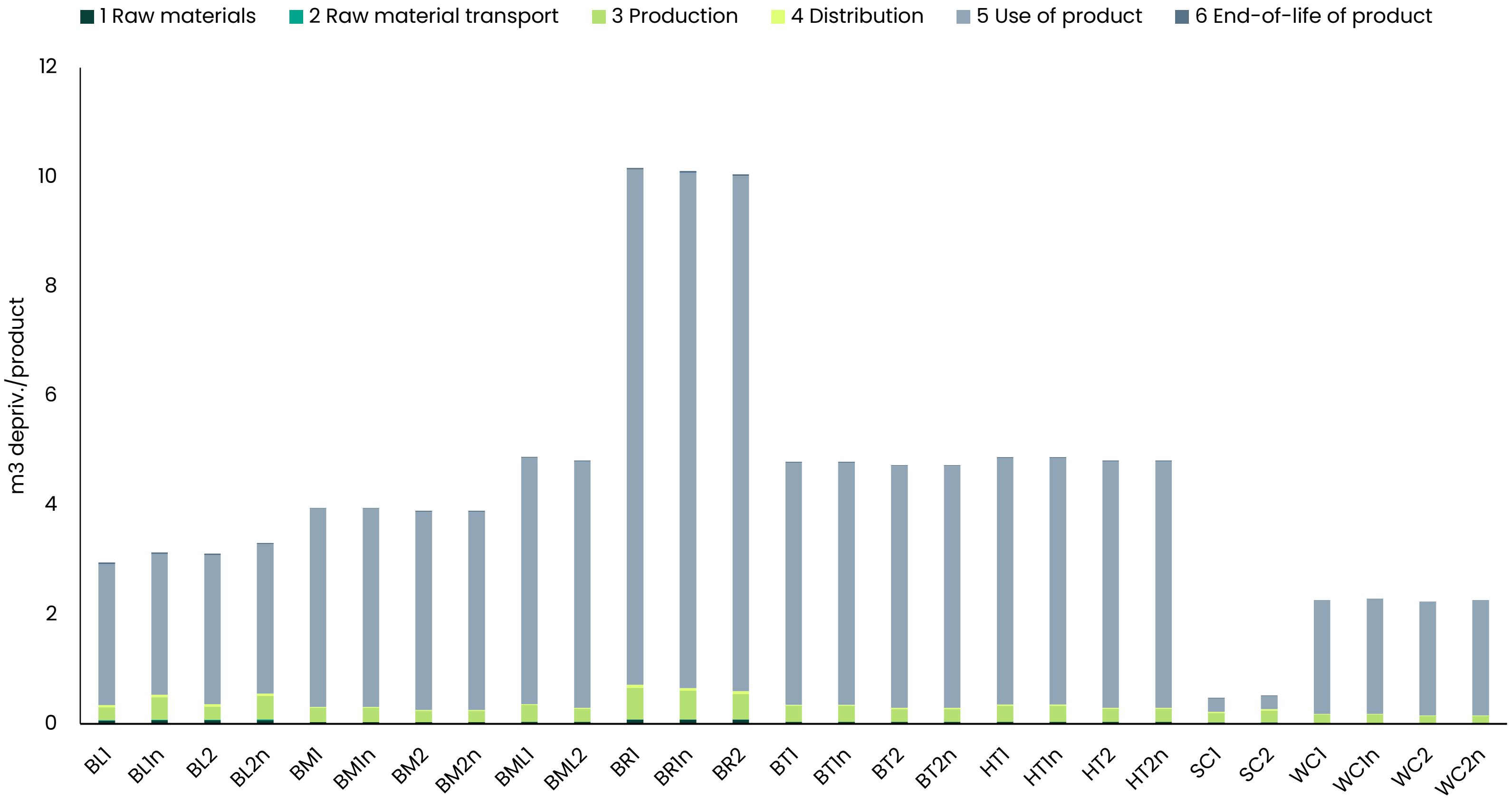


Figure 37 – Environmental impact per product in the LCA (Water use)

10.7 Uncertainty ranges from Monte Carlo analysis

10.7.1 Acidification

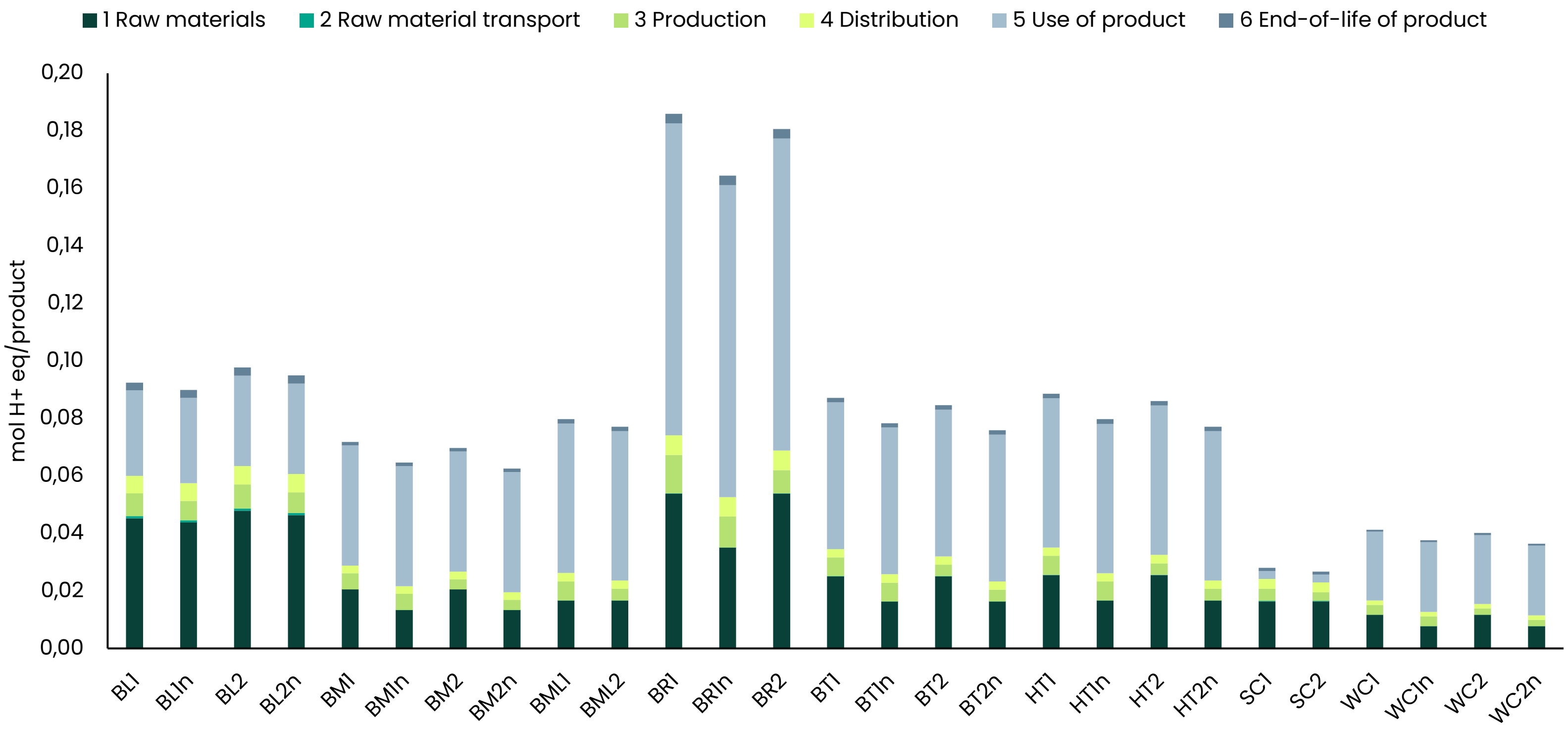


Figure 38 – Environmental impact per product in the LCA (Acidification)

10.7.2 Ecotoxicity, freshwater

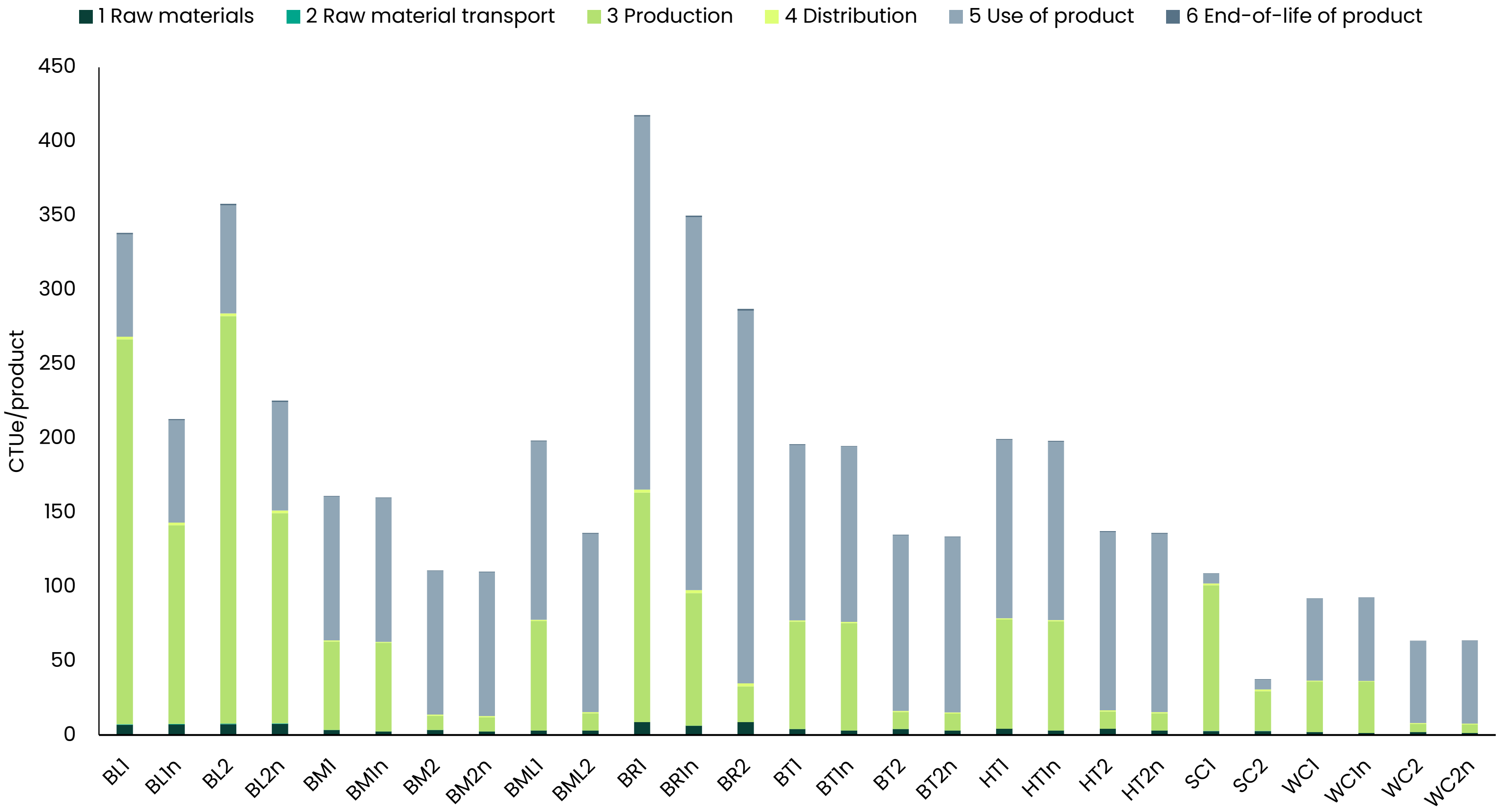


Figure 39 – Environmental impact per product in the LCA (Ecotoxicity, freshwater)

10.7.3 Eutrophication, freshwater

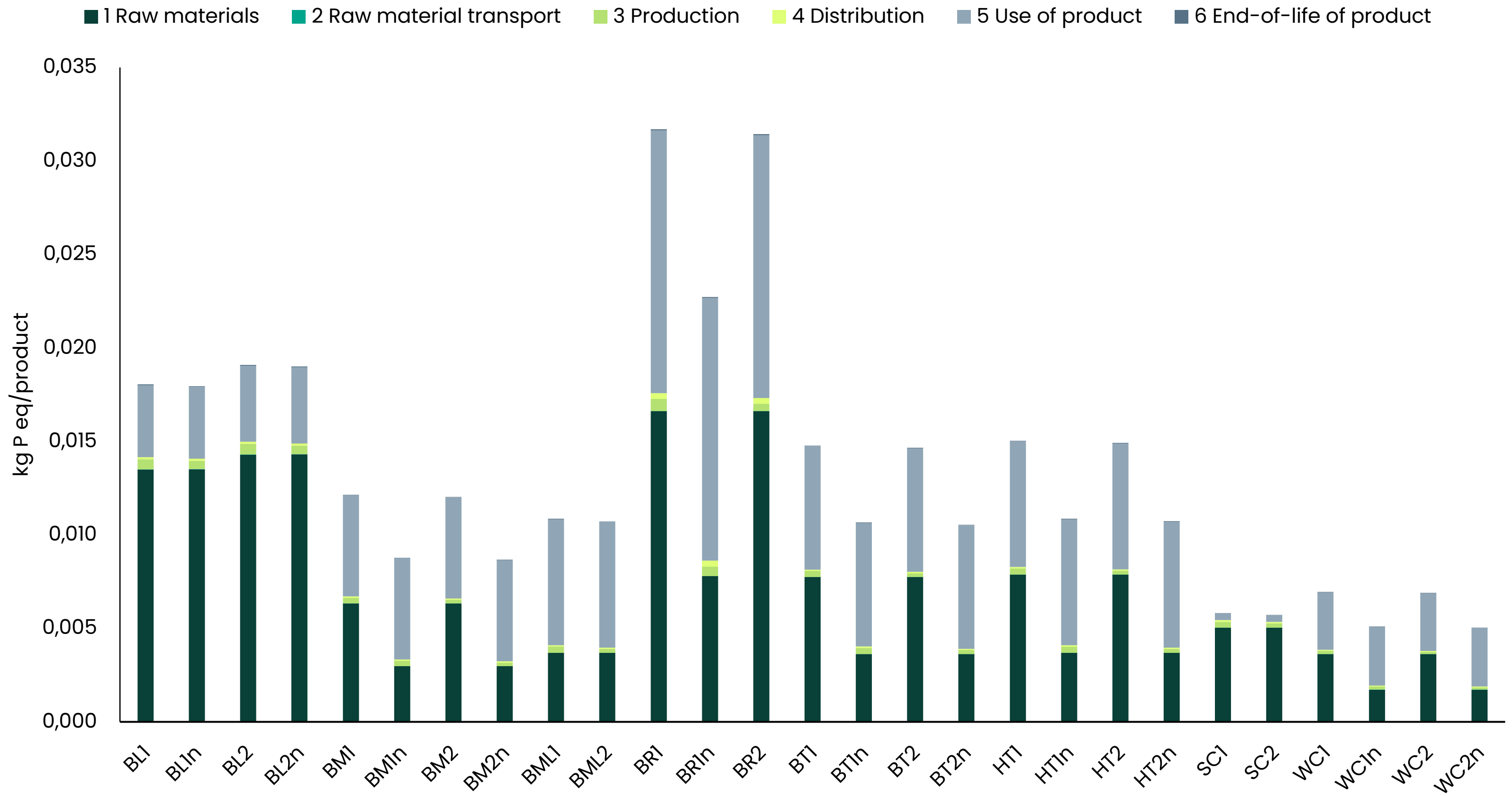


Figure 40 – Environmental impact per product in the LCA (Eutrophication, freshwater)

10.7.4 Eutrophication, marine

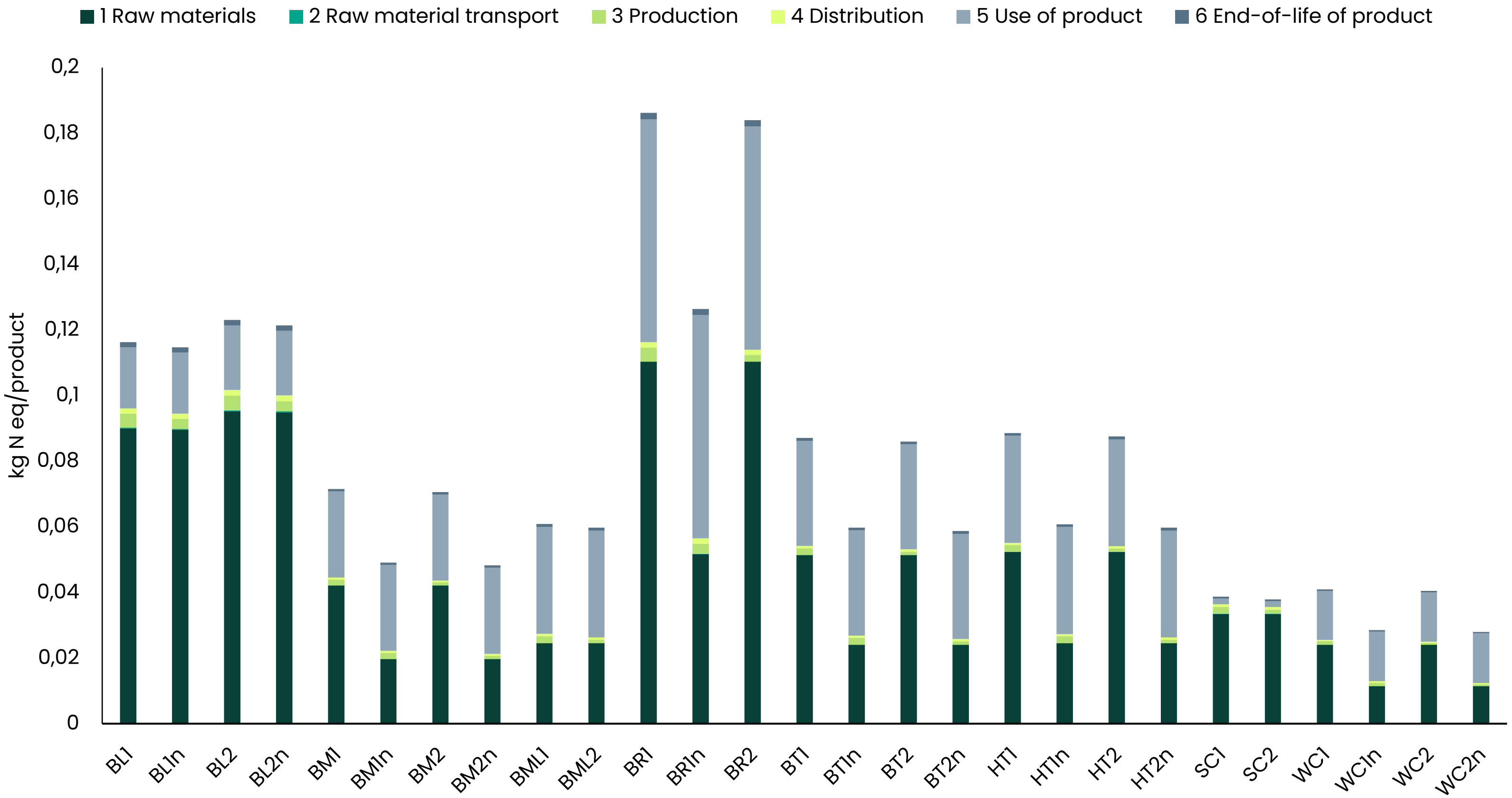


Figure 41 – Environmental impact per product in the LCA (Eutrophication, marine)

10.7.5 Eutrophication, terrestrial

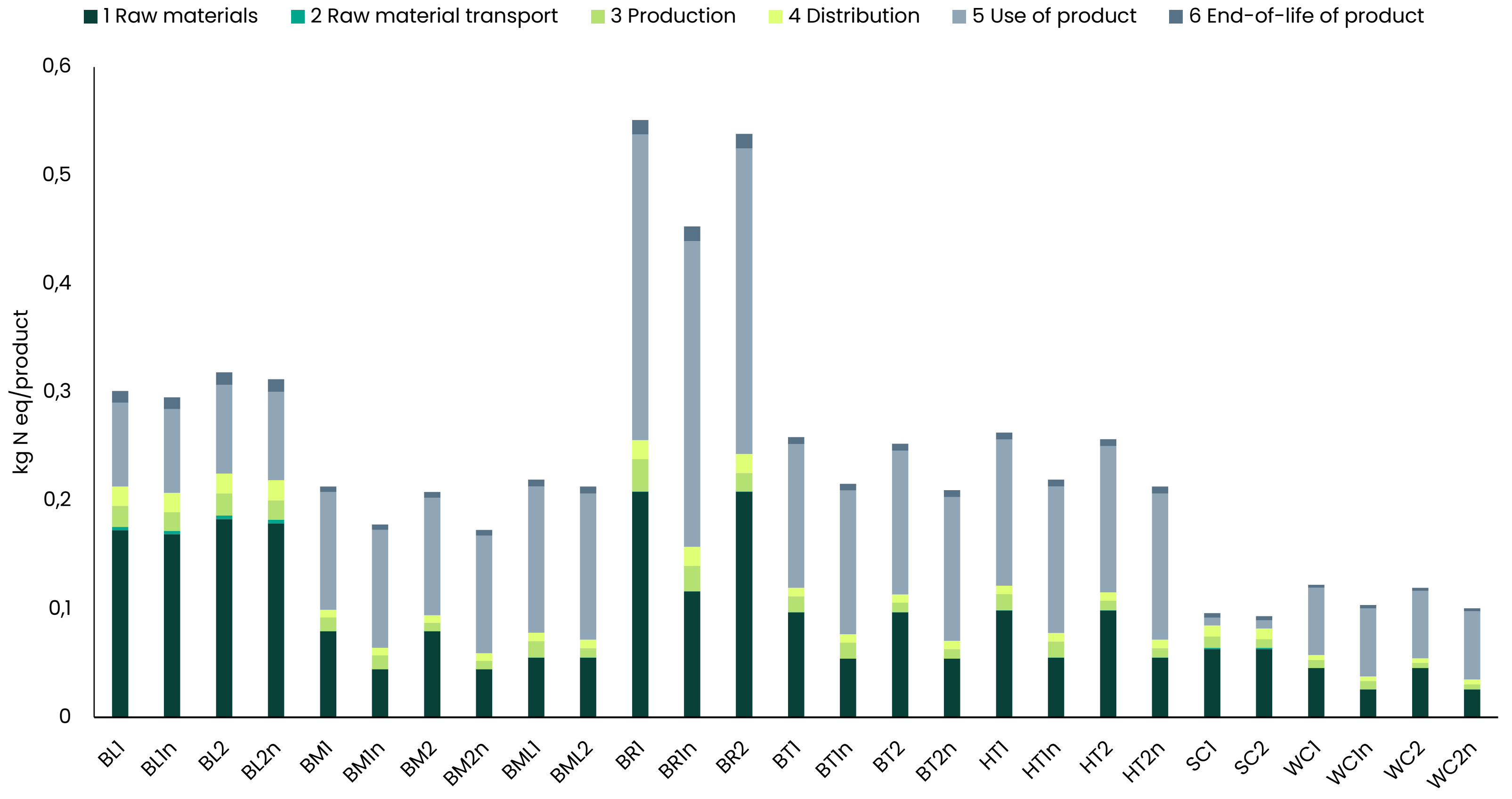


Figure 42 – Environmental impact per product in the LCA (Eutrophication, terrestrial)

10.7.6 Human toxicity, cancer

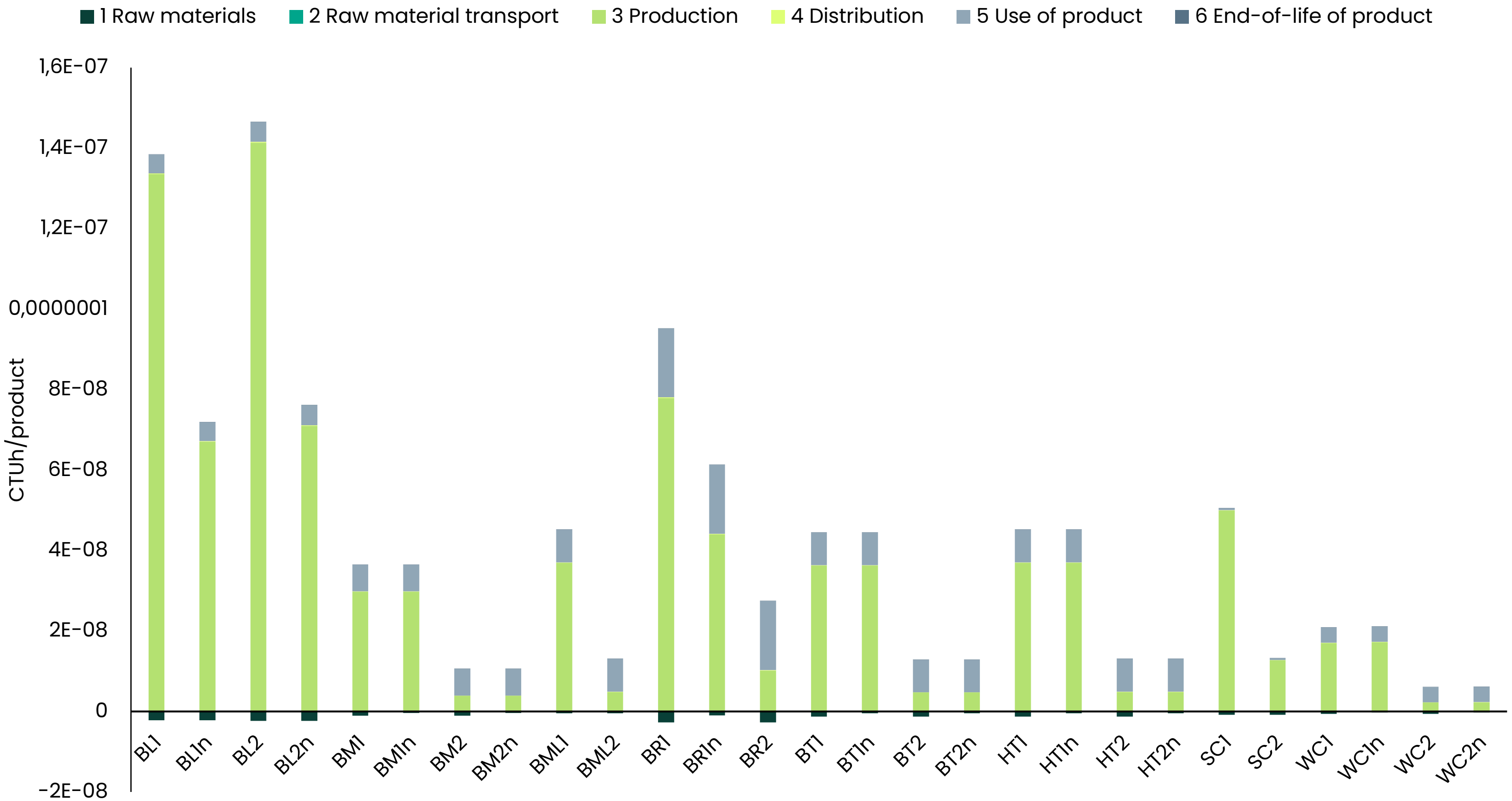


Figure 43 – Environmental impact per product in the LCA (Human toxicity, cancer)

10.7.7 Human toxicity, non-cancer

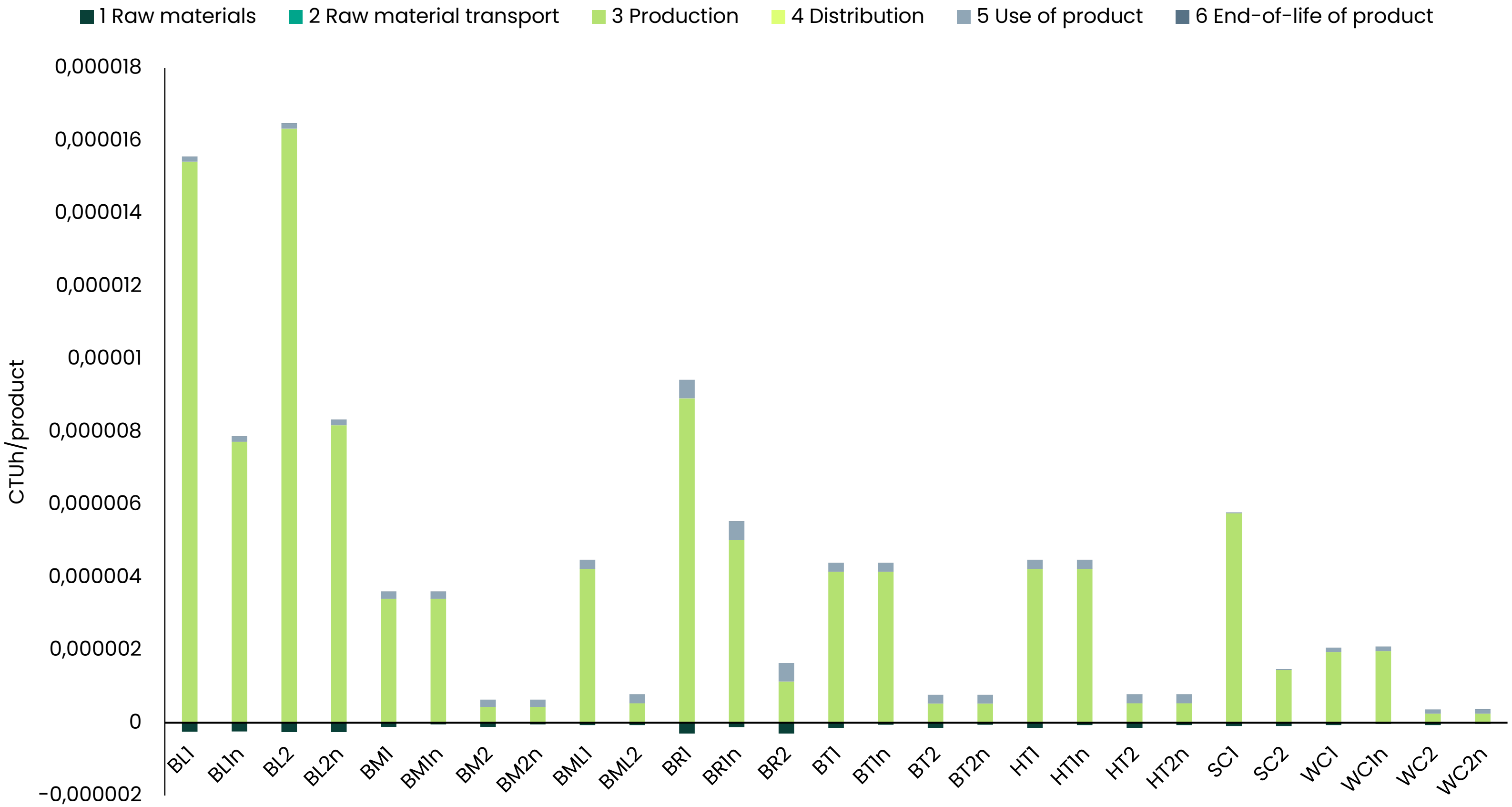


Figure 44 – Environmental impact per product in the LCA (Human toxicity, non-cancer)

10.7.8 Ionising radiation

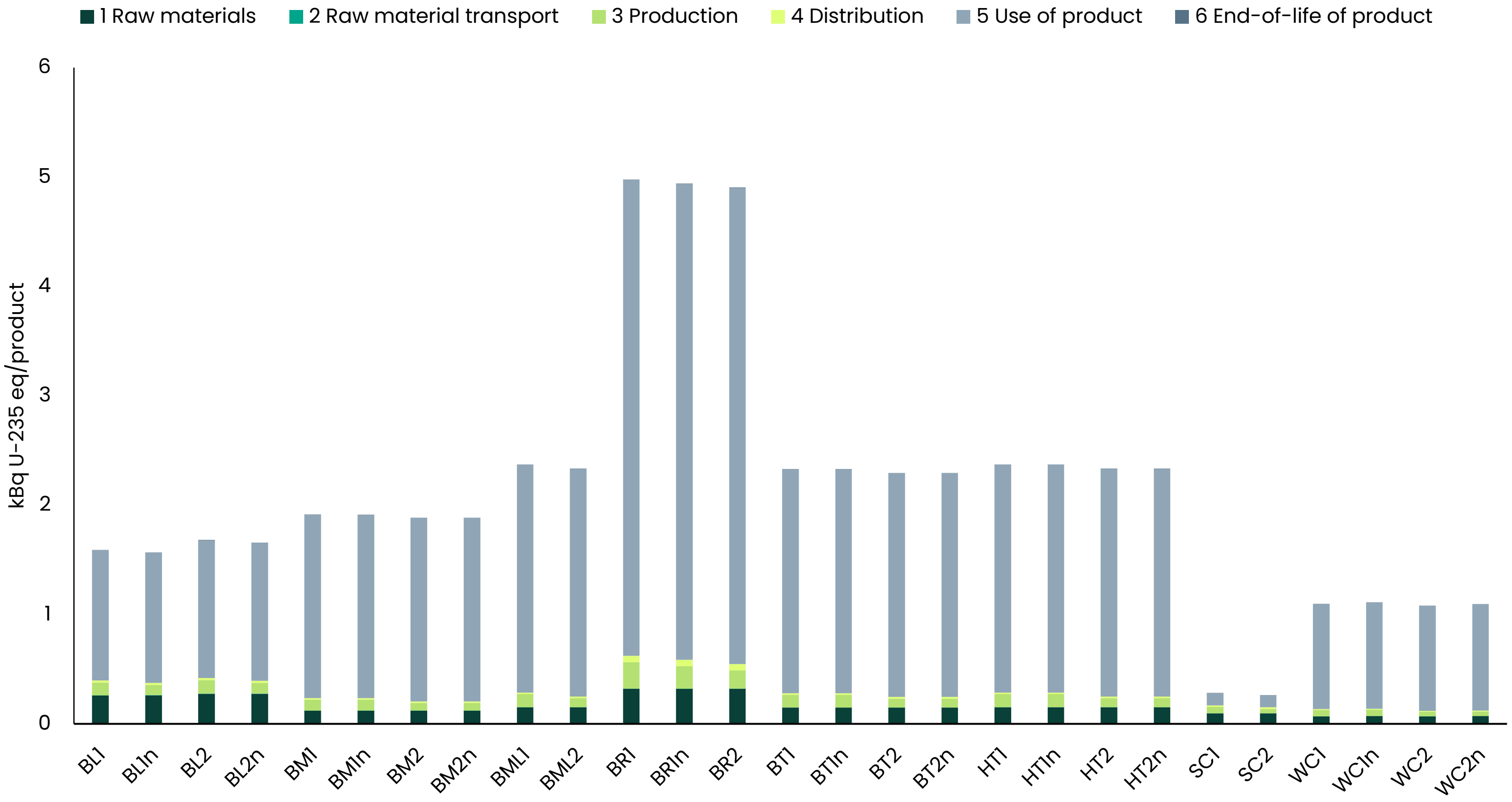


Figure 45 – Environmental impact per product in the LCA (Ionising radiation)

10.7.9 Land use

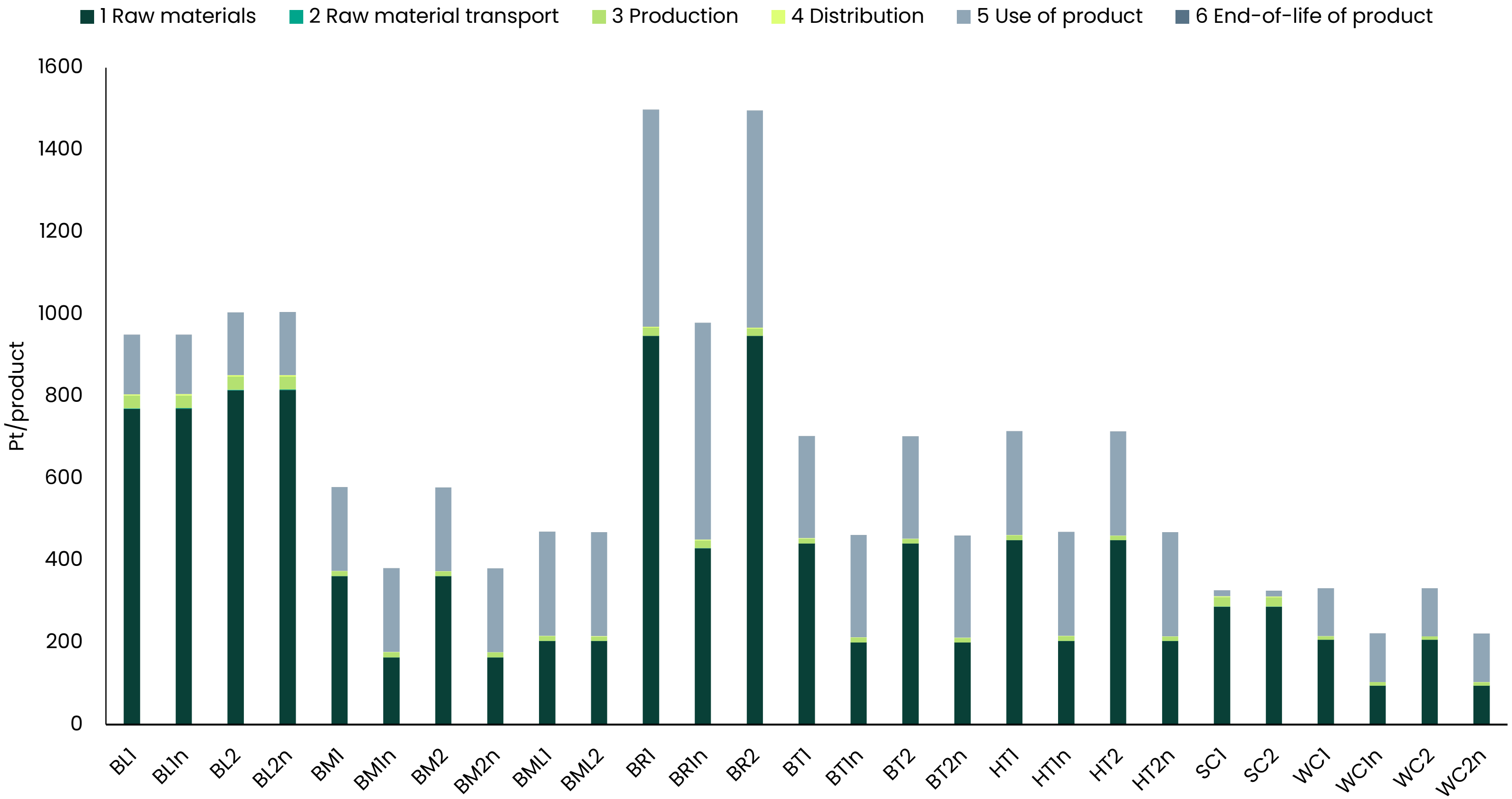


Figure 46 – Environmental impact per product in the LCA (Land use)

10.7.10 Ozone depletion

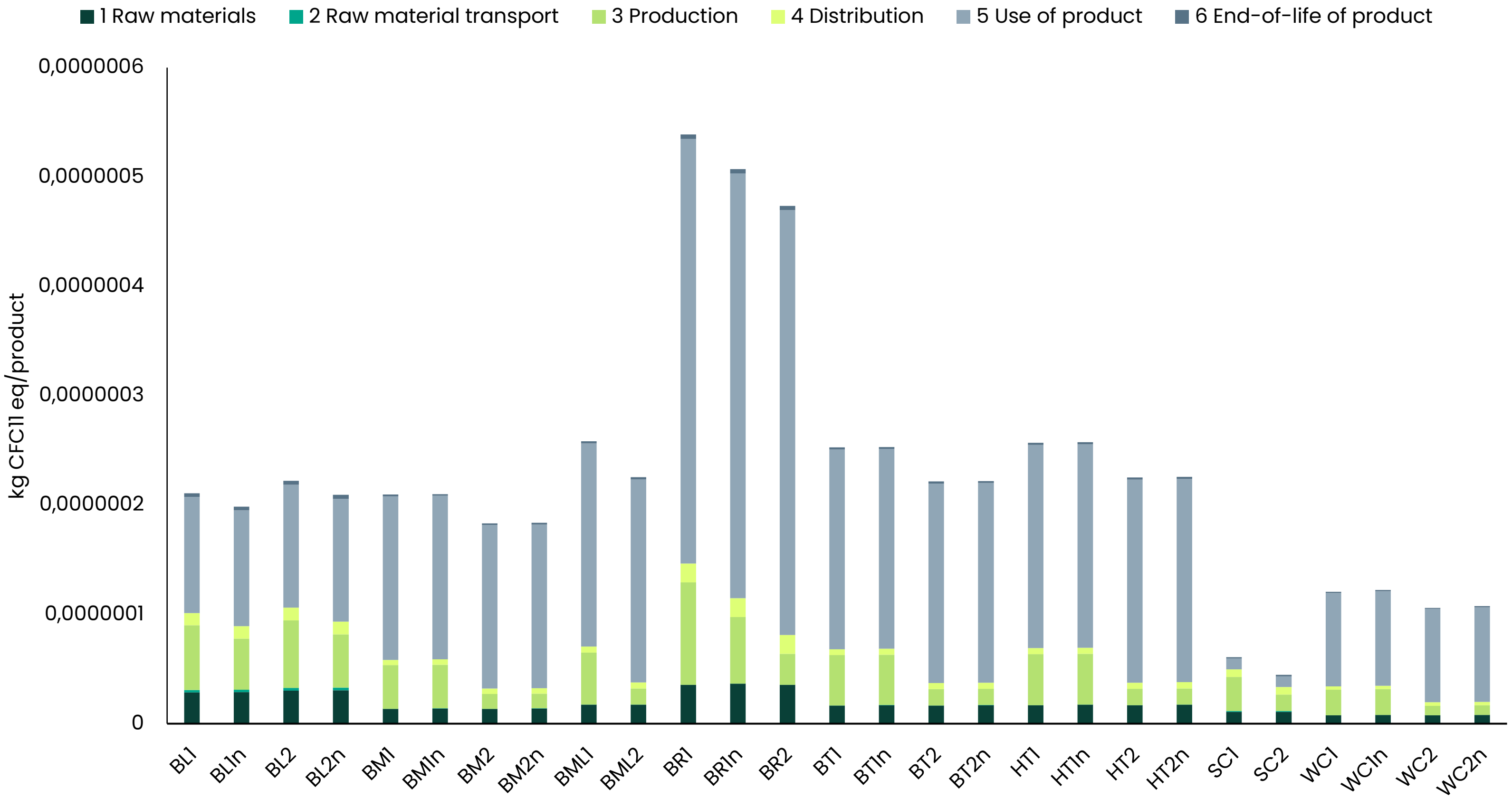


Figure 47 – Environmental impact per product in the LCA (Ozone depletion)

10.7.11 Particulate matter

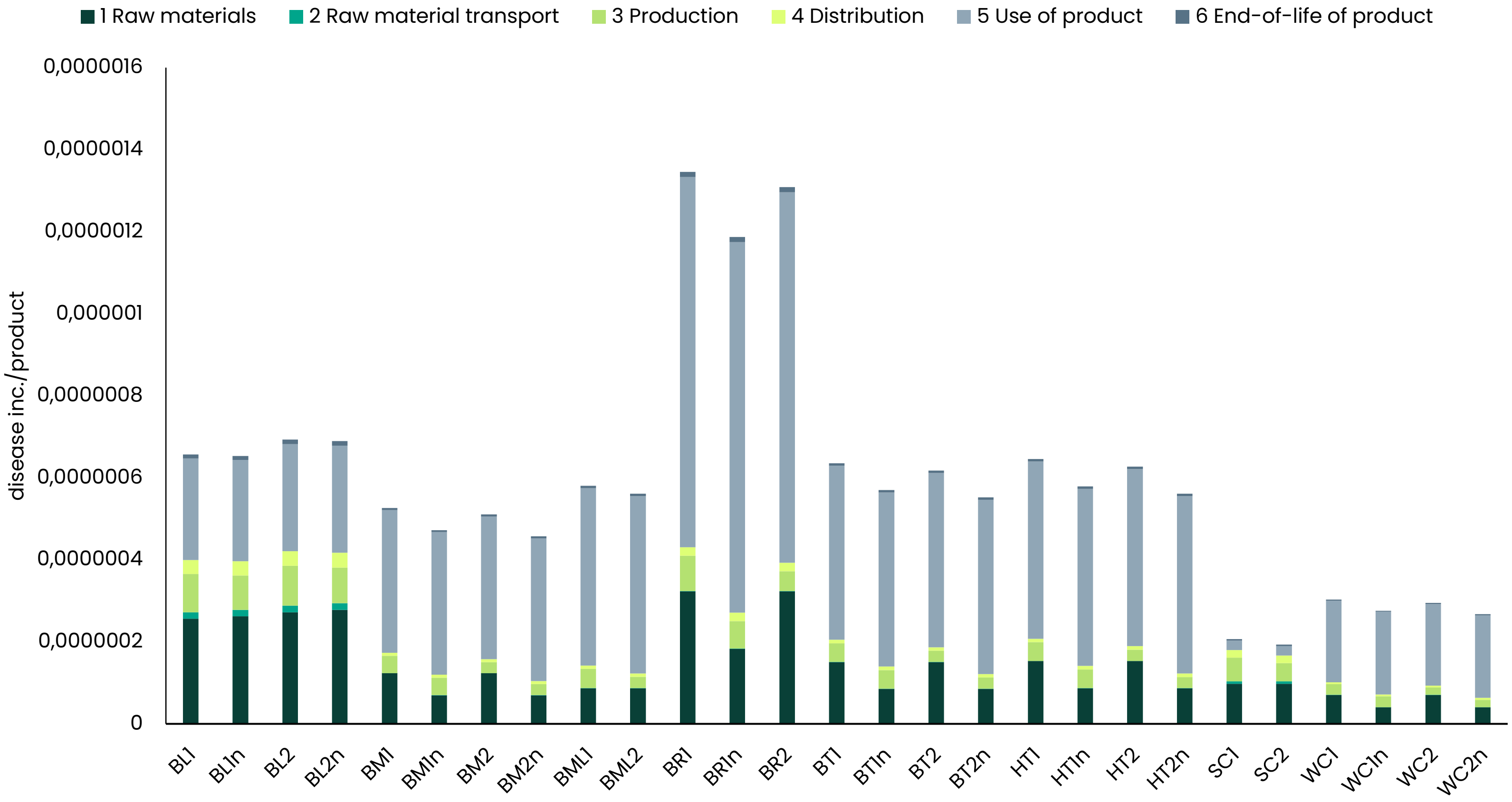


Figure 48 – Environmental impact per product in the LCA (Particulate matter)

10.7.12 Photochemical ozone formation

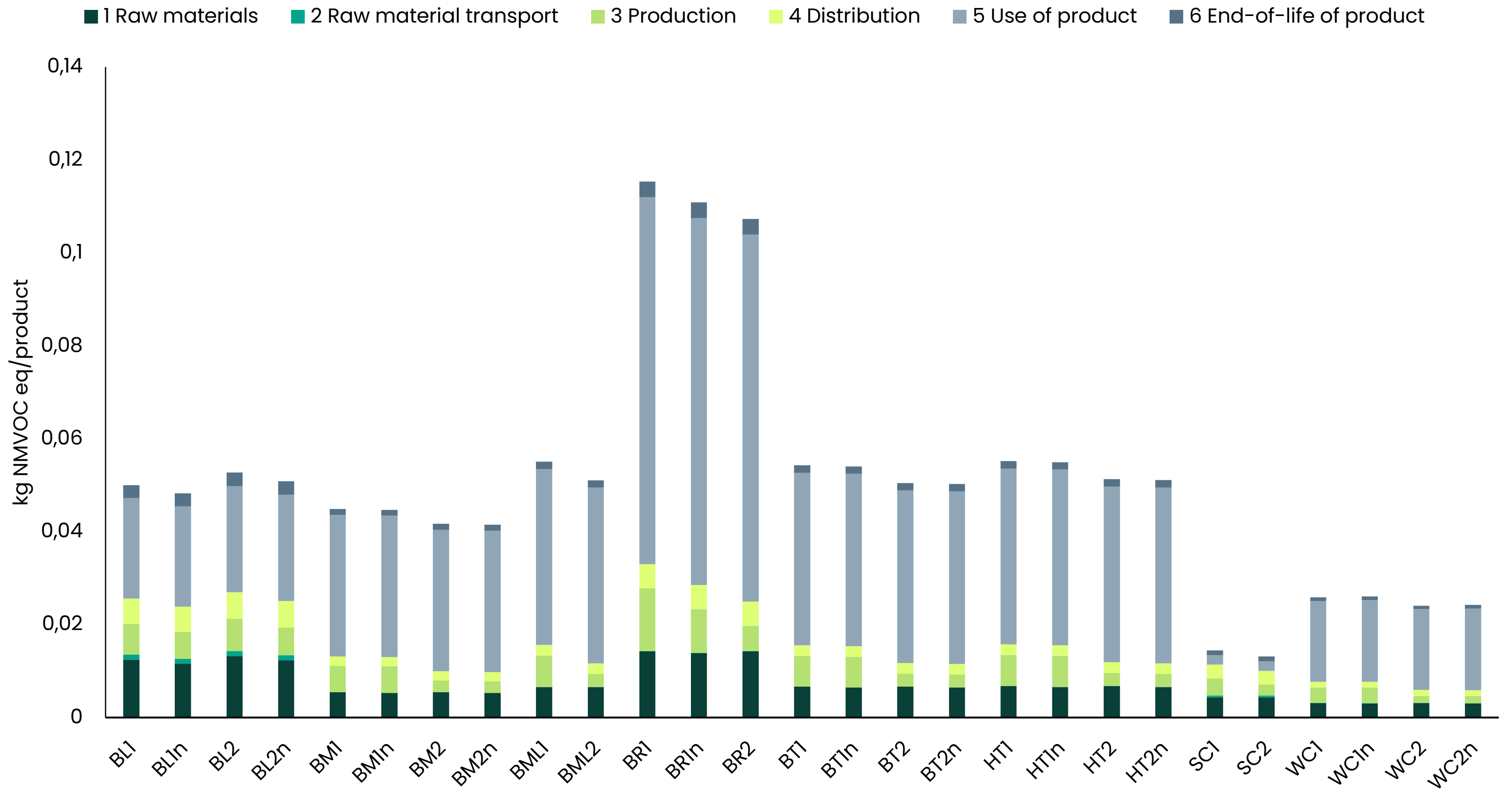


Figure 49 – Environmental impact per product in the LCA (Photochemical ozone formation)

10.7.13 Resource use, fossils

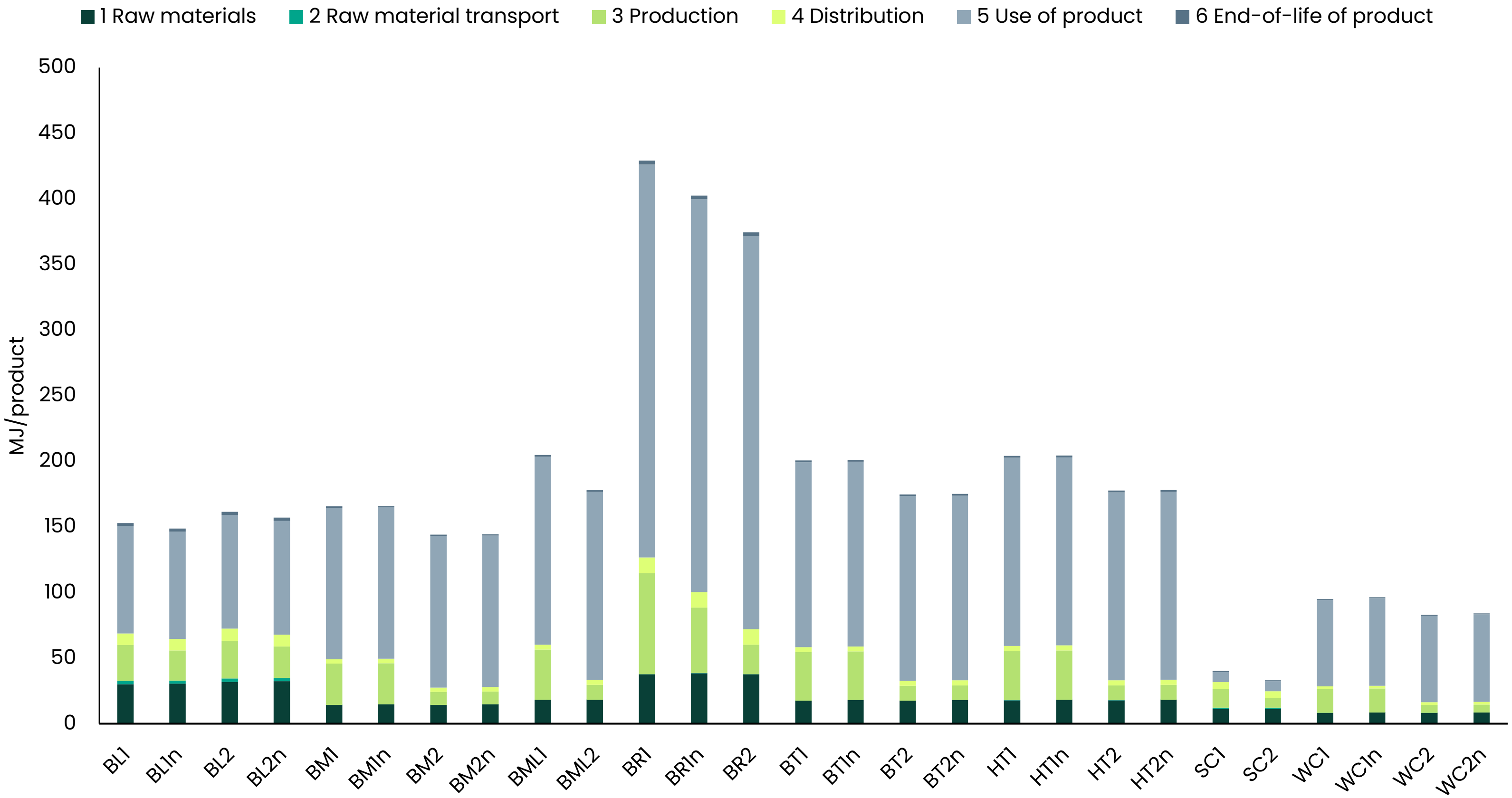


Figure 50 – Environmental impact per product in the LCA (Resource use, fossils)

10.7.14 Resource use, minerals and metals

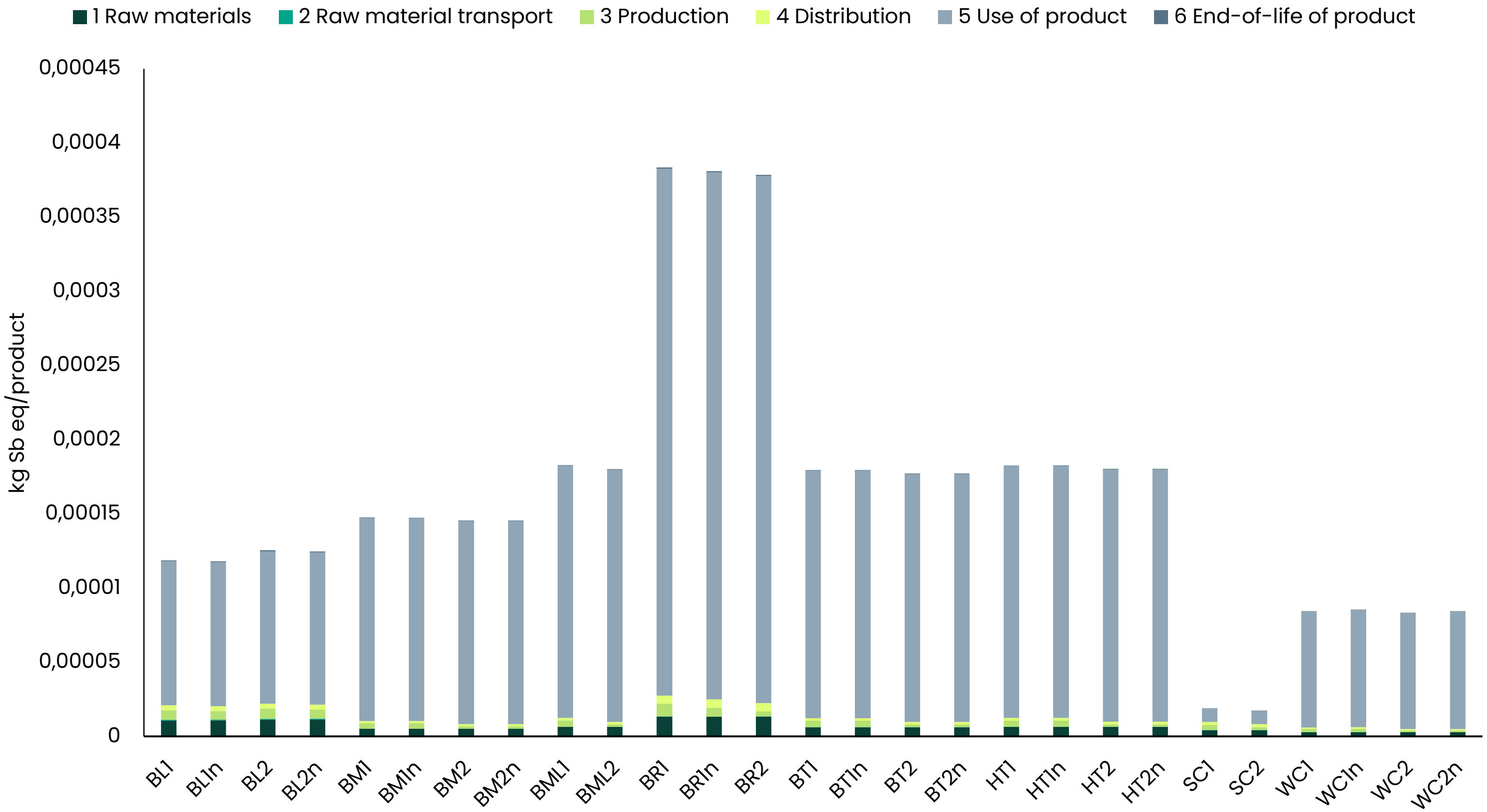


Figure 51 – Environmental impact per product in the LCA (Resource use, minerals and metals)

10.7.15 Water use

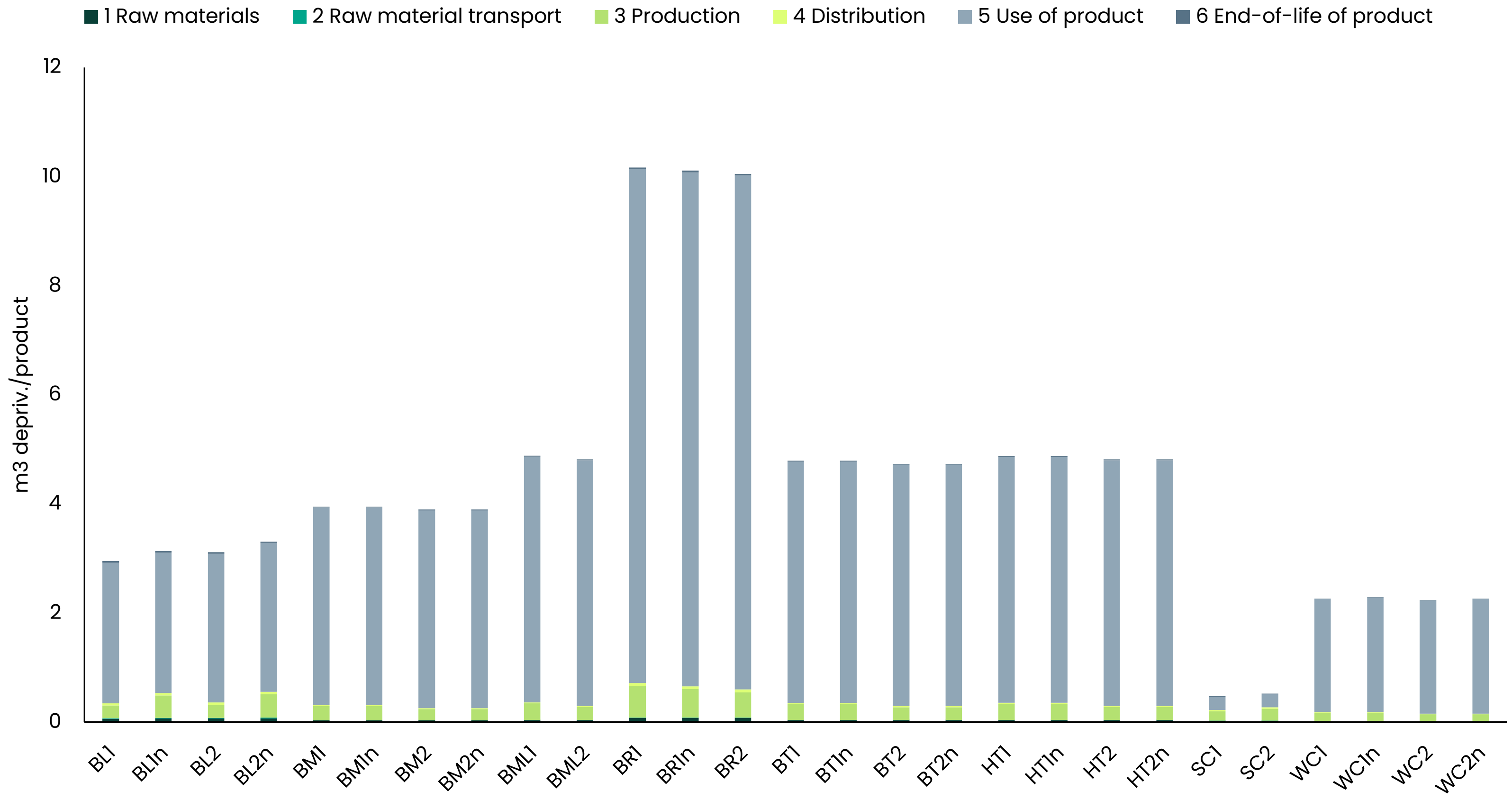


Figure 52 – Environmental impact per product in the LCA (Water use)

10.8 Comparative Monte Carlo analysis results

Table 83 - BL1 vs BL1n cradle-to-consumer: Comparative Monte Carlo results for 500 runs and confindence interval (CI) if 95%. Green means that A (BL1) is proven significantly larger than B (BL1n). Blue means that B has proven significantly larger than A. Red means that it was not possible to show a conclusion.

Impact category	A >= B (% of runs)	2,50% CI	97,50% CI
Acidification	100%	0,00741	0,0104
Climate change	100%	0,706	0,97
Ecotoxicity, freshwater	100%	44,9	205
Eutrophication, freshwater	100%	0,00011	0,000548
Eutrophication, marine	100%	0,00321	0,0048
Eutrophication, terrestrial	100,00%	0,0252	0,0391
Human toxicity, cancer	100,00%	2,64E-08	1,14E-07
Human toxicity, non-cancer	98%	1,47E-07	1,54E-05
Ionising radiation	100%	0,0252	0,233
Land use	100%	30,4	98,6
Ozone depletion	100%	1,34E-08	2,32E-08
Particulate matter	100%	3,67E-07	7,55E-07
Photochemical ozone formation	100%	7,31E-03	1,07E-02
Resource use, fossils	100%	9,28E+00	1,33E+01
Resource use, minerals and metals	100%	1,54E-06	3,58E-06
Water use	55%	-2,77E+02	2,02E+02

Table 84 – BL2 vs BL2n cradle-to-consumer: Comparative Monte Carlo results for 500 runs and confindence interval (CI) if 95%. Green means that A (BL2) is proven significantly larger than B (BL2n). Blue means that B has proven significantly larger than A. Red means that it was not possible to show a conclusion.

Impact category	A >= B (% of runs)	2,50% CI	97,50% CI
Acidification	100%	0,00791	0,011
Climate change	100%	0,751	1,03
Ecotoxicity, freshwater	99%	3,93E+01	2,26E+02
Eutrophication, freshwater	100,00%	0,000119	0,000625
Eutrophication, marine	100%	0,00338	0,005
Eutrophication, terrestrial	100%	0,0268	0,0419
Human toxicity, cancer	100,00%	3,05E-08	1,25E-07
Human toxicity, non-cancer	98,00%	2,52E-07	1,62E-05
Ionising radiation	100%	0,0268	0,247
Land use	100%	34,6	98,6
Ozone depletion	100%	1,45E-08	2,61E-08
Particulate matter	100%	3,90E-07	8,10E-07
Photochemical ozone formation	100%	0,00763	0,0114
Resource use, fossils	100%	9,99	14,3
Resource use, minerals and metals	100%	1,64E-06	3,65E-06
Water use	48,60%	-306	205

Table 85 - BM1 vs BM1n cradle-to-consumer: Comparative Monte Carlo results for 500 runs and confindence interval (CI) if 95%. Green means that A (BM1) is proven significantly larger than B (BM1n). Blue means that B has proven significantly larger than A. Red means that it was not possible to show a conclusion.

Impact category	A >= B (% of runs)	2,50% CI	97,50% CI
Acidification	100%	0,00546	0,00893
Climate change	100%	0,259	0,455
Ecotoxicity, freshwater	69,60%	-4,31	5,41
Eutrophication, freshwater	100%	0,00217	0,0049
Eutrophication, marine	100%	0,0145	0,0335
Eutrophication, terrestrial	100%	0,0275	0,0431
Human toxicity, cancer	13,40%	-2,46E-09	6,13E-10
Human toxicity, non-cancer	31,20%	-4,38E-07	2,51E-07
Ionising radiation	55,20%	-0,000161	0,000208
Land use	73,40%	-403	796
Ozone depletion	0%	-6,25E-10	-1,81E-10
Particulate matter	100%	4,20E-08	6,48E-08
Photochemical ozone formation	73%	-0,000422	0,000742
Resource use, fossils	0%	-0,551	-0,114
Resource use, minerals and metals	68,40%	-4,95E-08	5,23E-08
Water use	45,80%	-0,162	0,162

Table 86 – BM2 vs BM2n cradle-to-consumer: Comparative Monte Carlo results for 500 runs and confindence interval (CI) if 95%. Green means that A (BM2) is proven significantly larger than B (BM2n). Blue means that B has proven significantly larger than A. Red means that it was not possible to show a conclusion.

Impact category	A >= B (% of runs)	2,50% CI	97,50% CI
Acidification	100%	0,00557	0,0091
Climate change	100%	0,257	0,47
Ecotoxicity, freshwater	71,00%	-3,92	5,7
Eutrophication, freshwater	100%	0,00225	0,00482
Eutrophication, marine	100%	0,0148	0,0317
Eutrophication, terrestrial	100%	0,0279	0,0444
Human toxicity, cancer	18,00%	-2,10E-09	9,18E-10
Human toxicity, non-cancer	31,00%	-3,88E-07	3,02E-07
Ionising radiation	42,80%	-0,000192	0,000205
Land use	68,80%	-377	801
Ozone depletion	0,00%	-6,85E-10	-1,78E-10
Particulate matter	100%	4,29E-08	6,66E-08
Photochemical ozone formation	72,80%	-0,000531	0,000748
Resource use, fossils	0,00%	-0,593	-0,118
Resource use, minerals and metals	69,80%	-4,84E-08	4,65E-08
Water use	50%	-0,233	0,234

Table 87 - BM1 vs BM2n cradle-to-consumer: Comparative Monte Carlo results for 500 runs and confindence interval (CI) if 95%. Green means that A (BM1) is proven significantly larger than B (BM2n). Blue means that B has proven significantly larger than A. Red means that it was not possible to show a conclusion.

Impact category	A >= B (% of runs)	2,50% CI	97,50% CI
Acidification	100%	0,00881	0,0123
Climate change	100%	1,59	2,39
Ecotoxicity, freshwater	100%	26,5	75,5
Eutrophication, freshwater	100%	0,00241	0,005
Eutrophication, marine	100%	0,0149	0,0331
Eutrophication, terrestrial	100%	0,0352	0,0503
Human toxicity, cancer	100%	1,07E-08	4,17E-08
Human toxicity, non-cancer	100%	4,75E-07	5,58E-06
Ionising radiation	100%	0,0208	0,22
Land use	78%	-429	794
Ozone depletion	100%	2,43E-08	3,49E-08
Particulate matter	100%	6,11E-08	8,87E-08
Photochemical ozone formation	100%	0,0027	0,00586
Resource use, fossils	100%	20,8	29,2
Resource use, minerals and metals	100%	1,55E-06	3,66E-06
Water use	52%	-295	203

Table 88 - BR1 vs BR1n cradle-to-consumer: Comparative Monte Carlo results for 500 runs and confindence interval (CI) if 95%. Green means that A (BR1) is proven significantly larger than B (BR1n). Blue means that B has proven significantly larger than A. Red means that it was not possible to show a conclusion.

Impact category	A >= B (% of runs)	2,50% CI	97,50% CI
Acidification	100%	0,0187	0,0274
Climate change	100%	2,43	3,54
Ecotoxicity, freshwater	100%	33,9	102
Eutrophication, freshwater	100%	0,00603	0,013
Eutrophication, marine	100%	0,0396	0,0891
Eutrophication, terrestrial	100%	0,0815	0,12
Human toxicity, cancer	100%	1,36E-08	5,28E-08
Human toxicity, non-cancer	98,80%	6,22E-07	6,52E-06
Ionising radiation	100%	0,0277	0,372
Land use	72,40%	-1,18E+03	2,17E+03
Ozone depletion	100%	2,97E-08	4,21E-08
Particulate matter	100%	1,35E-07	1,96E-07
Photochemical ozone formation	100%	0,00324	0,00802
Resource use, fossils	100%	25,8	37
Resource use, minerals and metals	100%	1,93E-06	4,28E-06
Water use	53%	-379	283

Table 89 - BT1 vs BT1n cradle-to-consumer: Comparative Monte Carlo results for 500 runs and confindence interval (CI) if 95%. Green means that A (BT1) is proven significantly larger than B (BT1n). Blue means that B has proven significantly larger than A. Red means that it was not possible to show a conclusion.

Impact category	A >= B (% of runs)	2,50% CI	97,50% CI
Acidification	100%	0,00652	0,011
Climate change	100%	0,313	0,563
Ecotoxicity, freshwater	72%	-4,38	7,12
Eutrophication, freshwater	100%	0,00268	0,00595
Eutrophication, marine	100%	0,0174	0,0402
Eutrophication, terrestrial	100%	0,0327	0,0526
Human toxicity, cancer	14,20%	-2,54E-09	1,32E-09
Human toxicity, non-cancer	34,20%	-4,89E-07	3,65E-07
Ionising radiation	67%	-0,000155	0,00029
Land use	73,20%	-510	889
Ozone depletion	0%	-7,88E-10	-1,83E-10
Particulate matter	100%	5,09E-08	8,10E-08
Photochemical ozone formation	68,40%	-0,000555	0,00101
Resource use, fossils	0%	-0,67	-0,13
Resource use, minerals and metals	71,80%	-5,12E-08	6,30E-08
Water use	47,20%	-0,192	0,195

Table 90 – BT2 vs BT2n cradle-to-consumer: Comparative Monte Carlo results for 500 runs and confindence interval (CI) if 95%. Green means that A (BT2) is proven significantly larger than B (BT2n). Blue means that B has proven significantly larger than A. Red means that it was not possible to show a conclusion.

Impact category	A >= B (% of runs)	2,50% CI	97,50% CI
Acidification	100%	0,00667	0,011
Climate change	100%	0,319	0,551
Ecotoxicity, freshwater	70,80%	-5,33	7,7
Eutrophication, freshwater	100%	0,00266	0,00582
Eutrophication, marine	100%	0,0178	0,0394
Eutrophication, terrestrial	100%	0,0333	0,0526
Human toxicity, cancer	17,60%	-2,92E-09	1,22E-09
Human toxicity, non-cancer	34,80%	-5,62E-07	3,79E-07
Ionising radiation	57,80%	-0,000203	0,000287
Land use	75,40%	-547	963
Ozone depletion	0%	-7,71E-10	-1,46E-10
Particulate matter	100%	5,18E-08	8,11E-08
Photochemical ozone formation	69,40%	-0,000596	0,000902
Resource use, fossils	0,20%	-0,696	-0,109
Resource use, minerals and metals	68,60%	-7,45E-08	5,95E-08
Water use	47,80%	-0,184	0,28

Table 91 - BT1 vs BT2n cradle-to-consumer: Comparative Monte Carlo results for 500 runs and confindence interval (CI) if 95%. Green means that A (BT1) is proven significantly larger than B (BT2n). Blue means that B has proven significantly larger than A. Red means that it was not possible to show a conclusion.

Impact category	A >= B (% of runs)	2,50% CI	97,50% CI
Acidification	100%	0,0105	0,015
Climate change	100%	1,9	2,92
Ecotoxicity, freshwater	100%	36,7	92,2
Eutrophication, freshwater	100%	0,00284	0,00623
Eutrophication, marine	100%	0,0181	0,0408
Eutrophication, terrestrial	100%	0,0419	0,0609
Human toxicity, cancer	100%	1,54E-08	5,29E-08
Human toxicity, non-cancer	99,80%	1,01E-06	6,73E-06
Ionising radiation	100%	0,0244	0,256
Land use	76,20%	-529	924
Ozone depletion	100%	2,85E-08	3,99E-08
Particulate matter	100%	7,17E-08	1,07E-07
Photochemical ozone formation	100%	0,00329	0,00693
Resource use, fossils	100%	25,1	34,8
Resource use, minerals and metals	100%	1,79E-06	4,25E-06
Water use	54,20%	-362	261

Table 92 - HT1 vs HT1n cradle-to-consumer: Comparative Monte Carlo results for 500 runs and confindence interval (CI) if 95%. Green means that A (HT1) is proven significantly larger than B (HT1n). Blue means that B has proven significantly larger than A. Red means that it was not possible to show a conclusion.

Impact category	A >= B (% of runs)	2,50% CI	97,50% CI
Acidification	100%	0,00678	0,011
Climate change	100%	0,32	0,563
Ecotoxicity, freshwater	67,80%	-5,29	7,06
Eutrophication, freshwater	100%	0,00278	0,00594
Eutrophication, marine	100%	0,0186	0,0406
Eutrophication, terrestrial	100%	0,0343	0,0529
Human toxicity, cancer	14,80%	-2,82E-09	1,20E-09
Human toxicity, non-cancer	30,40%	-5,86E-07	3,59E-07
Ionising radiation	56,80%	-0,000195	0,000314
Land use	72,80%	-444	955
Ozone depletion	0%	-8,23E-10	-1,93E-10
Particulate matter	100%	5,26E-08	8,18E-08
Photochemical ozone formation	73,20%	-0,000607	0,00106
Resource use, fossils	0%	-0,703	-0,134
Resource use, minerals and metals	68,80%	-5,17E-08	6,23E-08
Water use	48,40%	-0,173	0,173

Table 93 – HT2 vs HT2n cradle-to-consumer: Comparative Monte Carlo results for 500 runs and confindence interval (CI) if 95%. Green means that A (HT2) is proven significantly larger than B (HT2n). Blue means that B has proven significantly larger than A. Red means that it was not possible to show a conclusion.

Impact category	A >= B (% of runs)	2,50% CI	97,50% CI
Acidification	100%	0,0067	0,0111
Climate change	100%	0,321	0,565
Ecotoxicity, freshwater	72,20%	-4,42	7,56
Eutrophication, freshwater	100%	0,00269	0,0059
Eutrophication, marine	100%	0,0175	0,0417
Eutrophication, terrestrial	100%	0,0336	0,0536
Human toxicity, cancer	15,20%	-2,59E-09	1,02E-09
Human toxicity, non-cancer	29,60%	-4,63E-07	3,42E-07
Ionising radiation	53%	-0,000197	0,000206
Land use	73,80%	-482	958
Ozone depletion	0%	-8,41E-10	-1,85E-10
Particulate matter	100%	5,19E-08	8,09E-08
Photochemical ozone formation	69,40%	-0,00059	0,000928
Resource use, fossils	0,20%	-0,712	-0,104
Resource use, minerals and metals	70%	-6,23E-08	6,69E-08
Water use	47,80%	-0,226	0,245

Table 94 – HT1 vs HT2n cradle-to-consumer: Comparative Monte Carlo results for 500 runs and confindence interval (CI) if 95%. Green means that A (HT1) is proven significantly larger than B (HT2n). Blue means that B has proven significantly larger than A. Red means that it was not possible to show a conclusion.

Impact category	A >= B (% of runs)	2,50% CI	97,50% CI
Acidification	100%	0,0109	0,0152
Climate change	100%	1,94	2,85
Ecotoxicity, freshwater	100%	32,3	93,5
Eutrophication, freshwater	100%	0,00295	0,00626
Eutrophication, marine	100%	0,0195	0,0418
Eutrophication, terrestrial	100%	0,0435	0,0616
Human toxicity, cancer	100%	1,42E-08	5,18E-08
Human toxicity, non-cancer	99,60%	8,79E-07	6,43E-06
Ionising radiation	100%	0,0245	0,387
Land use	74,40%	-482	1,02E+03
Ozone depletion	100%	2,91E-08	4,17E-08
Particulate matter	100%	7,43E-08	1,07E-07
Photochemical ozone formation	100%	0,00352	0,00719
Resource use, fossils	100%	25,1	35,6
Resource use, minerals and metals	100%	1,92E-06	4,24E-06
Water use	55,20%	-295	255

Table 95 - SC1 vs SC2 cradle-to-consumer: Comparative Monte Carlo results for 500 runs and confindence interval (CI) if 95%. Green means that A (SC1) is proven significantly larger than B (SC2). Blue means that B has proven significantly larger than A. Red means that it was not possible to show a conclusion.

Impact category	A >= B (% of runs)	2,50% CI	97,50% CI
Acidification	100%	0,00403	0,00556
Climate change	100%	0,57	0,733
Ecotoxicity, freshwater	99,40%	19,9	129
Eutrophication, freshwater	100%	7,96E-05	0,000367
Eutrophication, marine	100%	0,00175	0,00257
Eutrophication, terrestrial	100%	0,0137	0,0203
Human toxicity, cancer	99,80%	1,25E-08	6,58E-08
Human toxicity, non-cancer	96,60%	-2,80E-07	8,81E-06
Ionising radiation	100%	0,0175	0,153
Land use	100%	18,7	55,5
Ozone depletion	100%	1,54E-08	2,46E-08
Particulate matter	100%	2,21E-07	4,43E-07
Photochemical ozone formation	100%	0,00432	0,00624
Resource use, fossils	100%	9,32	13,2
Resource use, minerals and metals	100%	1,51E-06	3,71E-06
Water use	53,60%	-146	117

Table 96 – WC1 vs WC1n cradle-to-consumer: Comparative Monte Carlo results for 500 runs and confindence interval (CI) if 95%. Green means that A (WC1) is proven significantly larger than B (WC1n). Blue means that B has proven significantly larger than A. Red means that it was not possible to show a conclusion.

Impact category	A >= B (% of runs)	2,50% CI	97,50% CI
Acidification	100%	0,00293	0,00503
Climate change	100%	0,102	0,216
Ecotoxicity, freshwater	51,20%	-5,06	4,91
Eutrophication, freshwater	100%	0,00127	0,00274
Eutrophication, marine	100%	0,00802	0,0186
Eutrophication, terrestrial	100%	0,0151	0,0248
Human toxicity, cancer	49,80%	-3,66E-08	3,28E-08
Human toxicity, non-cancer	49,60%	-4,28E-06	3,83E-06
Ionising radiation	0%	-0,0137	-0,0012
Land use	75,20%	-181	476
Ozone depletion	0%	-1,02E-07	-2,15E-08
Particulate matter	100%	2,28E-08	3,67E-08
Photochemical ozone formation	31,60%	-0,000479	0,000256
Resource use, fossils	0%	-1,11	-0,758
Resource use, minerals and metals	0%	-2,96E-07	-9,37E-08
Water use	44%	-12,5	14,8

Table 97 – WC2 vs WC2n cradle-to-consumer: Comparative Monte Carlo results for 500 runs and confindence interval (CI) if 95%. Green means that A (WC2) is proven significantly larger than B (WC2n). Blue means that B has proven significantly larger than A. Red means that it was not possible to show a conclusion.

Impact category	A >= B (% of runs)	2,50% CI	97,50% CI
Acidification	100%	0,00297	0,0051
Climate change	100%	0,116	0,23
Ecotoxicity, freshwater	57,40%	-4,88	6,14
Eutrophication, freshwater	100%	0,00125	0,00276
Eutrophication, marine	100%	0,00787	0,0187
Eutrophication, terrestrial	100%	0,0155	0,0248
Human toxicity, cancer	51,20%	-3,98E-08	3,52E-08
Human toxicity, non-cancer	50,80%	-4,71E-06	4,14E-06
Ionising radiation	0%	-0,012	-0,00104
Land use	72,60%	-208	457
Ozone depletion	0%	-9,51E-08	-2,15E-08
Particulate matter	100%	2,34E-08	3,70E-08
Photochemical ozone formation	36,20%	-0,000418	0,000294
Resource use, fossils	0%	-0,908	-0,585
Resource use, minerals and metals	0%	-2,87E-07	-8,48E-08
Water use	46,60%	-10,7	15,4

Table 98 - WC1 vs WC2n cradle-to-consumer: Comparative Monte Carlo results for 500 runs and confindence interval (CI) if 95%. Green means that A (WC1) is proven significantly larger than B (WC2n). Blue means that B has proven significantly larger than A. Red means that it was not possible to show a conclusion.

Impact category	A >= B (% of runs)	2,50% CI	97,50% CI
Acidification	100%	0,00482	0,00689
Climate change	100%	0,866	1,29
Ecotoxicity, freshwater	100%	16,3	42
Eutrophication, freshwater	100%	0,00135	0,00288
Eutrophication, marine	100%	0,0089	0,0187
Eutrophication, terrestrial	100%	0,0194	0,0286
Human toxicity, cancer	77%	-1,98E-08	5,73E-08
Human toxicity, non-cancer	76,80%	-2,46E-06	6,79E-06
Ionising radiation	100%	0,0109	0,138
Land use	74%	-213	422
Ozone depletion	0,20%	-7,80E-08	-4,09E-09
Particulate matter	100%	3,39E-08	5,01E-08
Photochemical ozone formation	100%	0,00143	0,00313
Resource use, fossils	100%	11	16,1
Resource use, minerals and metals	100%	7,30E-07	1,72E-06
Water use	51,60%	-130	106

10.9 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 BV Notes	FINAL REVIEWER STATEMENT
1	Front page	Ed	ISO 14040:2008 ISO 14044:2008	Page numbers missing on some pages	Has been added.	21/01/2026 Checked. Approved.
2	LIFE CYCLE ASSESSMENT (LCA) INFORMATION	Ge	ISO 14040:2008 ISO 14044:2008	Please add Edvinas Damukaitis and Julie M. V. Larsen	Added.	21/01/2026 Checked. Approved.
3	LIFE CYCLE ASSESSMENT (LCA) INFORMATION	Ge	ISO 14040:2008 ISO 14044:2008	Standards should be listed separately.	Added.	21/01/2026 Checked. Approved.
4	LIFE CYCLE ASSESSMENT (LCA) INFORMATION	Ge	ISO 14040:2008 ISO 14044:2008	Please add version number - year of standard	Added.	21/01/2026 Checked. Approved.
5	Table 1	Te	ISO 14040:2008 ISO 14044:2008	For a great deal of them you are comparing a bleached or dyed 2025 product with an unbleached or undyed 2026 product. In other words the old product is "worse" compared to the new product. Was there no products in the 2025 collection that where exactly the same?	Comment resolved at review meeting. The decision to print on unbleached material is an action to reduce the impact, therefore it is relevant to compare the two products.	21/01/2026 Checked. Approved.
6	1 Summary	Ge	ISO 14044:2006, 4.5.3.3:	In comparative assertions, the uncertainty of the results shall be calculated and reported, and the results shall be presented in such a manner that the uncertainty of the outcome of the comparison can be seen clearly. Where is the uncertainty analysis supporting these statements?	See Monte Carlo analysis.	21/01/2026 Checked. Approved.

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				Section 7.6 provides only qualitative uncertainty assessment (low/medium/high) without numerical ranges. Please elaborate		
7	1 Summary	Ge	ISO 14040:2008 ISO 14044:2008	Remember to update	Updated.	21/01/2026 Checked. Approved.
8	Product IDs	Ge	ISO 14040:2008 ISO 14044:2008	How is the product 50% bleached and dyed?	It is striped. 50% of the yarn is bleached and dyed and 50% of the yarn in unbleached and undyed. Elaborated in the table.	21/01/2026 Checked. Approved.
9	List of Abbreviations	Ge	ISO 14040:2008 ISO 14044:2008	DST does have an english version of their name: Statistics Denmark.	Changed.	21/01/2026 Checked. Approved.
10	3.3 Target audience	Ge	ISO 14040:2008 ISO 14044:2008	Very nice and transparent to see! Please be aware of trade secrets		OK. Closed
11	3.4 Comparative claims	Ge	ISO 14040:2008 ISO 14044:2008	Please provide documentation or certificates for the recycled content, as well as how it is ensured that this amount is in the product.	Mørkegaard will share these.	OK
12	4.1 Description of the products	Ge	SO 14040:2008 SO 14044:2008	Please indicate during the meeting where the two factories are located so we can assess the transportation distances etc.	Resolved at review meeting (Locations shown on Google Maps and confirmed to the exact addresses in Pakistan).	OK. Closed
13	Table 4	Ge	ISO 14040:2008 ISO 14044:2008	Are all products only made from cotton with no Polyester	This is mentioned later on in the LCA - this is just an overview of the most important attributes of the products which are shown to highlight the implemented changes in the products (i.e.	OK. Closed

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					introduction of recycled cotton and avoiding bleaching/dyeing).	
14	Table 5	Ge	ISO 14040:2008 ISO 14044:2008	What is the lifespan of 2 years based on? What is the washing frequency based on?	See section 5.5 and answer to the comments in that section,	21/01/2026 Checked. Approved.
15	Table 6	Ge	ISO 14040:2008 ISO 14044:2008	Have you included all other elements of the product such as threads and hang tags	Resolved during review meeting. The product packaging is a belly band and the products don't have hang-tags. See other comments regarding polyester thread.	OK. Closed
16	Figure 2	Ge	ISO 14040:2008 ISO 14044:2008	What sales avenues have you included. Have you included more than one?	There is only one relevant sales avenue – the products arrive from the factory to the warehouse in Køge and then to the retail stores across Denmark. A retail store in Odense has been selected for its central location in Denmark and is considered representative. Since distribution has a small contribution across all environmental impacts this is not considered a sensitive assumption.	21/01/2026 Checked. Approved.
17	4.4.1 LCA Standard	Ge	ISO 14040:2008 ISO 14044:2008	Please write that it is the PEFCR that you are following to be fully transparent	Added.	21/01/2026 Checked. Approved.
18	4.4.4 Handling of multifunctional processes	Ge	ISO 14044:2006, 4.3.4:	Data collected at factory level is allocated by mass without justification for why physical allocation by mass is appropriate versus other physical relationships -	The reason for selecting mass allocation has been elaborated.	21/01/2026 Checked. Approved.

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				processing time or surface area. Please elaborate.		
19	4.4.5 Cut-off criteria	Te	ISO 14044:2006, 4.2.3.3.3:	Study states a 5% cut-off threshold but then assumes "100% of the product's weight is cotton", excluding polyester thread (<2% by weight) without demonstrating that this meets the cumulative 5% threshold when considering all exclusions. Document all exclusions and demonstrate cumulative exclusions are <5% by mass and energy. What impact it has on the total environmental reuslt, not considering only mass? Conduct sensitivity analysis on polyester exclusion to verify insignificance. Clarify whether 5% threshold applies per life cycle stage or to entire study. If you have done this assessment in other study, please refer to it.	The exclusion criteria have been elaborated to make it clear that the 5% mass and energy threshold is considered cumulative across the entire life cycle. Please refer to section regarding raw materials for update of modelling regarding polyester thread.	21/01/2026 Checked. Approved.
20	4.7 Critical review	Ge	ISO 14040:2008 ISO 14044:2008	Waldemar Hemdrup, LCA & EPD Consultant Julie M.V. Larsen, LCA & EPD Consultant Edvinas Damukaitis, LCA & EPD Consultant	Added.	21/01/2026 Checked. Approved.
21	Table 8	Ge	ISO 14040:2008 ISO 14044:2008	What is the origin of recycled cotton?	This is not known.	Ok – certificates provided
22	5.1.1 Cotton	Ge	ISO 14040:2008 ISO 14044:2008	Is this only the case for climate change or a general impression on all impact categories?	It is the case for all environmental impacts (less than two procent contribution) except	21/01/2026 Checked. Approved.

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					for ozone depletion potential. To avoid skewing the ozone depletion LCIA results due to modelling polyester as part of the cotton, the model is changed so polyester is now included.	
23	5.1.1.1.1 Activity data	Ge	ISO 14040:2008 ISO 14044:2008	Has there been made a sensitivity analysis on this?	We assess that there are more relevant sensitivity analyses in the LCA, therefore it has not been prioritized to make sensitivity analysis for this assumption in particular.	21/01/2026 Checked. Approved.
24	5.1.1.1.2 Background data	Ge	ISO 14040:2008 ISO 14044:2008	India and Turkey are not as similar as Pakistan and India - Needs to be reflected in a sensitivity	See added sensitivity analysis.	21/01/2026 Checked. Approved.
25	5.1.1.2.2 Background data	Ge	ISO 14044:2006, 4.2.3.6:	Data shall be collected from those unit processes that are most representative of the product system under study. Cotton cultivation contributes significantly to multiple impact categories (20-40% for climate change in products with 100% virgin cotton). The use of non-representative data introduces substantial uncertainty that is not adequately quantified. Conduct sensitivity analysis using multiple cotton cultivation datasets to establish uncertainty ranges, or clearly state in all comparative claims that results are subject	See sensitivity analysis of cotton cultivation. It is not that sensitive.	21/01/2026 Checked. Approved.

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				to high uncertainty due to data limitations and may not be valid for decision-making.		
26	5.1.1.2.3 Data quality	Ge	ISO 14040:2008 ISO 14044:2008	Please indicate what the differnet rankings indicate (e.g., Very good temporale is data that is no more than x year old)	This information has been added to all DQR tables.	21/01/2026 Checked. Approved.
27	5.1.1.3.2 Background data and 5.1.1.3.3 Data quality	Ge	ISO 14040:2008 ISO 14044:2008	If not relevant, then please do not include	Deleted empty sections.	21/01/2026 Checked. Approved.
28	Table 13	Ge	ISO 14040:2008 ISO 14044:2008	Has the geography for BL2 and BL1 changed from Fall 2025 to Spring 2026?	Yes, the geography has changed for these products. This has been added to the text.	21/01/2026 Checked. Approved.
29	5.3.1.2 Activity data – towel factory	Ge	ISO 14040:2008 ISO 14044:2008	Would this not be 1,045	Calculation has been checked and it is correct as it is. Further elaboration added to avoid confusion.	21/01/2026 Checked. Approved.
30	5.3.1.3 Background data	Ge	ISO 14040:2008 ISO 14044:2008	Was residual mix used?	Resolved during review meeting. Pakistan does not have a residual mix.	OK. Closed
31	5.3.1.3 Background data	Ge	ISO 14040:2008 ISO 14044:2008	Please provide certificates for this	Declaration of off-grid solar power usage is shared as an attachment to avoid including the name of the factory in the LCA report (due to confidentiality).	OK approved
32	5.5 Phase 5: Use of product	Ge	ISO 14044:2006, 4.2.3.3:	The use phase assumptions significantly affect results (44-75% contribution to climate change) but are based on generic literature values for product lifetime and washing frequency. 50/50 assumption for machine drying versus	Machine drying figures updated with data from 2023 (58%) - we haven't been able to finder newer statistics since this statistic has been discontinued by DST. See other comments regarding use phase assumptions.	21/01/2026 Checked. Approved.

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				air drying based on 2019 statistics. EU Ecodesign benchmarks for washing machine performance. Any other references, PEF guidance? Please elaborate.		
33	Table 44	Ge	ISO 14040:2008 ISO 14044:2008	Old data from Australia - do you have something that is more representative, or please include a justification including a sensitivity analysis	We have repeated our search for European and more recent data (which we also searched for extensively in the first iteration of this LCA) and we have not found more representative data that is from reliable sources. Most available information comes from specific product manufacturers claiming the lifetime of the products in years or consumer magazines recommending different washing frequencies. Neither are based on actual consumer behavior data, which is in its nature variable. Therefore we will accept this variability in the results stemming from the use phase assumptions and report the assumptions clearly in the report, and in the summary of the report.	21/01/2026 Checked. Approved.
34	5.5.1.1 Activity data	Ge	ISO 14040:2008 ISO 14044:2008	Is there not newer data available - 6 years	Updated with data from 2023 (58%) - we	21/01/2026 Checked.

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				(close to 7 years) old data	haven't been able to finder newer statistics since this statistic has been discontinued by DST.	Approved.
35	5.5.1.3 Data quality	Ge	ISO 14044:2006, 4.2.3.6.2:	Data quality ratings are presented in multiple tables throughout the report using a 5-level scale (very good, good, fair, poor, very poor). Create a summary table showing overall data quality for each life cycle phase. Using a numerical Data Quality Rating (DQR) system (e.g., 1-5 scale) for easier interpretation. Comparative assertions intended to be disclosed to the public, the data quality requirements stated in a) to j) below shall be addressed: a) time-related coverage b) geographical coverage c) technology coverage d) precision: measure of the variability of the data values for each data expressed (e.g. variance); e) completeness: percentage of flow that is measured or estimated; f) representativeness: qualitative assessment of the degree to which the data set reflects the true population of interest (i.e. geographical coverage, time period	a) time-related coverage: see DQR tables. b) geographical coverage: see DQR tables. c) technology coverage: see DQR tables. d) precision: see added monte carlo analysis. e) completeness: See section "Completeness check" in interpretation section. f) representativeness: see DQR tables. g) consistency: See section Consistency check" in interpretation section. h) reproducibility: see added section "Reproducibility" in interpretation section. i) sources of the data; see LCI section. j) uncertainty of the information: see added monte carlo analysis.	21/01/2026 Checked. Approved.

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				and technology coverage); g) consistency: qualitative assessment of whether the study methodology is applied uniformly to the various components of the analysis; h) reproducibility: qualitative assessment of the extent to which information about the methodology and data values would allow an independent practitioner to reproduce the results reported in the study; i) sources of the data; j) uncertainty of the information (e.g. data, models and assumptions). Please elaborate.		
36	5.6.1 Activity data	Ge	ISO 14044:2006, 4.2.3.3:	Draft PEF-RP data may not be representative of Danish textile waste management. Verify end-of-life scenario with Danish waste management data (e.g., from Danish EPA. Any sensitivity analysis on recycling rates? Please elaborate.	We have updated the scenario for EOL in Denmark based on data from the Danish Energy Agency to improve the representativity to the Danish context.	21/01/2026 Checked. Approved.
37	5.6.1 Activity data	Ge	ISO 14044:2006, 4.2.3.3:	Clarify ferry transport modelling or use appropriate ferry dataset.	As discussed on review meeting the model is updated so transport is calculated from Odense (where the retail store is located) to Poland by land.	21/01/2026 Checked. Approved.
38	Figure 5	Ge	ISO 14040:2008 ISO 14044:2008	It is a bit difficult to differentiate the Dark green colour - could this be changed?	Changed.	21/01/2026 Checked. Approved.

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39	7.1 Equivalence of the system	Ge	ISO 14040:2008 ISO 14044:2008	Are they not comparable as they fulfil the same Function?	Updated text according to comment.	OK. Closed
40	7.4 Sensitivity analysis	Ge	ISO 14040:2008 ISO 14044:2008	Please indicate when something is sensitive	Explanation added.	21/01/2026 Checked. Approved.
41	7.4 Sensitivity analysis	Ge	ISO 14040:2008 ISO 14044:2008	Please justify why you only look at climate change in the sensitivity analysis	Explanation added.	21/01/2026 Checked. Approved.
42	Figure 8	Ge	ISO 14040:2008 ISO 14044:2008	Recommendation: could be beneficial to zoom in on the part that is relevant and not included all with a gap on the y-axis of 2	We believe this would make the sensitivity look higher than it is in fact. Since the purpose of these graphs is to show how large the change in impact is when changing the parameters, we will maintain the current presentation of the sensitivity results.	21/01/2026 Checked. Approved.
43	7.5.1 Bedlinen 140x200 comparison	Ge	ISO 14040:2008 ISO 14044:2008	Please refrain from using the word normalized in this context as it is a separate LCA term and can cause confusion	Wording changed to avoid confusion.	21/01/2026 Checked. Approved.
44	Table 61	Ge	ISO 14040:2008 ISO 14044:2008	This is not consistent with Product IDs on page 9 - please go through all the tables in the comparison section to ensure consistency	Corrected.	21/01/2026 Checked. Approved.
45	Page 78	Ge	ISO 14040:2008 ISO 14044:2008	Please include Monte Carlo analysis for the values.	Added.	21/01/2026 Checked. Approved.