



"Carbon Footprint of Knitted Garments" Final Report

Performed for Qingdao Sino Textile Technique Co.,Ltd

Report TSNT01679381

By Intertek

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1. INTRODUCTION

This study is commissioned by Qingdao Sino Textile Technique Co., Ltd(www.sinotextile.net) to assess the partial product carbon footprint with the support of a Life Cycle Assessment (LCA) approach concerning the knitted garments product produced by Qingdao Sino Textile Technique Co., Ltd, which locates in Zoujiawa Village, Fuan Industrial Park, Jiaozhou, 266300 Qingdao, Shandong China.

This carbon footprint assessment study is performed following:

- the *ISO 14040 & ISO 14044* standards but cannot be fully compliant because:
 - it is a single-indicator assessment: contribution to Climate Change (kg CO₂e), and
 - it is not peer reviewed.
- the *ISO 14067:2018* standard: *Greenhouse gases — Carbon footprint of products — Requirements and guidelines for quantification*.

1.1 Introduction of the Commissioner

The commissioner of this CFP study is Qingdao Sino Textile Technique Co., Ltd (www.sinotextile.net), which is located in Zoujiawa Village, Fuan Industrial Park, Jiaozhou, 266300 Qingdao, Shandong China.

Qingdao Sino Textile Technique Co., Ltd, is one of the leading Merino wool baby & kid products manufacturer and specialist in China. It focuses on circular knitting Merino wool products and export to Scandinavia/France/Germany /UK and other countries in Europe around 20 years.

1.2 Introduction of the Product

This CFP study is to focus on the evaluation of the greenhouse effect of the wool jacquard knitted top/body/ longjohn made of 100% RWS wool interlock jacquard 190g fabric described as bellow:

- Wool jacquard knitted top- heather rose (order#PO-00001340)
- Wool jacquard knitted top- mood indigo (order#PO-00001340)
- Wool jacquard knitted body -heather rose (order#PO-00001334)
- Wool jacquard knitted body - mood indigo (order#PO-00001334)
- Wool jacquard knitted longjohn -heather rose (order#PO-00001384)
- Wool jacquard knitted longjohn -Mood indigo (order#PO-00001384)

2. GOAL AND SCOPE

2.1 Goal of the Study

The goals of the study are to:

- build an up-to-date and well-documented Life Cycle Inventory (LCI) for wool jacquard knitted top/body/longjohn produced by Qingdao Sino Textile Technique Co., Ltd. The carbon footprint profile shall be presented for one piece of wool jacquard knitted top/body/longjohn.
- evaluate the impact of climate change of the product from cradle to gate, excluding the distribution, maintenance, use phase, or the end-of-life phase of the product.

2.1.1 Reasons for the Study

This carbon footprint assessment study is to enhance the competitiveness of Sino's products in the sustainable consumer market, government procurement and evaluation of green financial product. It could also respond to the challenge of disclosure needs of stakeholders and the management requirements of sustainable supply chains.

2.1.2 Intended Application

The results of the study are to be applied as carbon footprint of wool jacquard knitted top/body/longjohn. This study is not intended to support any comparative assertion as defined in the *ISO 14040*, *ISO 14044*, and *ISO 14067:2018* standards. Available published data is used to set the results of the study into perspective, for discussion and interpretation.

2.1.3 Intended Audience

The study is not intended to be published. The intended audience includes internal and external stakeholders. The internal stakeholders include those involved in operations, marketing, and communications. The external stakeholders include customers/consumers, the LCA community as well as the general public.

2.2 Scope of the Study

2.2.1 System Description

In the study, the product system of wool jacquard knitted top/body/longjohn is studied, including the manufacture and transportation of raw materials, the manufacture/packaging/transportation (to Qingdao port) process of garments.

The wool jacquard knitted top/body/longjohn delivery (from Qingdao port to customer), use and end-of-life treatment process are beyond the scope of the study.

2.2.2 Declared Unit

The declared units for the partial PCF study are defined as:

- The carbon footprint for processing one piece of wool jacquard knitted top-heather rose (order#PO-00001340);
 - The carbon footprint for processing one piece of wool jacquard knitted top-mood indigo (order#PO-00001340);
 - The carbon footprint for processing one piece of wool jacquard knitted body-heather rose (order#PO-00001334);
 - The carbon footprint for processing one piece of wool jacquard knitted body-mood indigo (order#PO-00001334);
 - The carbon footprint for processing one piece of wool jacquard knitted longjohn-heather rose (order#PO-00001384);
 - The carbon footprint for processing one piece of wool jacquard knitted longjohn-Mood indigo (order#PO-00001384);
- The reference flow associated with the declared unit is one piece of wool jacquard knitted top/body/longjohn and its primary packaging.

2.2.3 System Boundaries

The study is from cradle to gate, starts with the producing of raw wool, and ends by the wool knitted top/body/longjohn delivery to Qingdao port.

The processes included in the study to perform the assessment are

- The manufacture and transportation of raw materials,
- The manufacture of wool jacquard knitted top/body/longjohn,
- The packaging of wool jacquard knitted top/body/longjohn,
- The transportation of wool jacquard knitted top/body/longjohn.

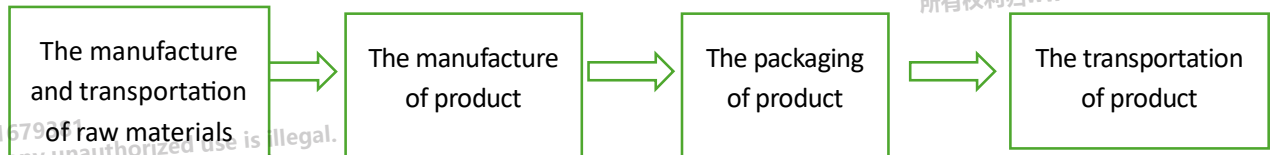


Figure 2-1: Schematic Diagram of System Boundaries

2.2.4 Assumptions

There is only one electricity meter in the semi-finished heather rose jacquard knitted fabric/interlock knitted fabric manufacturing workshop, and there is no separate reading of a single production line. Based on experience, we assume that the electricity consumption is distributed according to the equipment power and calculate a coefficient to get the electricity consumption.

2.2.5 Cut-off Criteria

To delimit the system, the inclusion criterion has been set to 1%. Meanwhile, the sum of emissions from processes excluded from the system represents less than 5% of total impacts of the system contributing at each of the impact categories studied here. This value of 5% is the result of modelling constraints, including the availability of data.

In practice, modelling iterations were used, first by maximizing the potential impacts of each process throughout the life cycle. This allows identification of the processes that contribute more than 5% of total emissions of the system. Inventory data and modelling parameters of these processes were subsequently refined.

Exclusion due to cut-off criteria applies to the following parts of the system:

- plant infrastructure,
- any consumption and Wastes generated by office employees,
- domestic Wastes generated on site, and
- some extremely low inputs/outputs of the study system.

2.2.6 Data Collection

The primary data related to the study system were collected through data collection questionnaires designed by Intertek and provided by Qingdao Sino Textile Technique Co., Ltd. without an onsite verification of the data. When bias appears between two sets of data considering the same subject, the one with more robust evidence is adopted, e.g., electricity invoices are preferred to meter reading data collected by the company employees.

The upstream primary data were collected through data collection questionnaires designed by Intertek and filled out by the material suppliers of Qingdao Sino Textile Technique Co., Ltd, without an onsite verification of the data.

2.2.7 Geographical Area and Time Horizon

The geographical area considered is China for the materials and product manufacturing phase, the packaging and transportation of products. The calculations are made with primary data related to the production, collected from December 1st, 2022 to November 30th, 2023.

All the processes (life cycle inventories from the LCA databases) are from LCA for Experts 10.7.1.28 (GaBi) and ecoinvent 3.9 database.

2.2.8 Data Quality Assessment

2.2.8.1 Representativeness

All the active data collected cover the whole production of the corresponding products, and therefore can represent the average production and emission status.

2.2.8.2 Completeness

All the counted active data related to the manufacturing process of wool jacquard knitted top/body/longjohn are collected.

2.2.8.3 Reliability

The primary data of wool, yarn, fabric and wool jacquard knitted top/body/longjohn production were collected and provided by Qingdao Sino Textile Technique Co., Ltd and its suppliers, without an onsite verification of the data. The secondary data related to all production process are from LCA for Experts 10.7.1.28 (GaBi), ecoinvent 3.9 database and literature.

2.2.8.4 Consistency

Each part of data is collected and selected through accordant quality requirements and rules.

2.2.8.5 Reproducibility

The data, methods and modelling processes in this study can be reproduced in the Experts 10.7.1.28 (GaBi) calculation software.

2.2.8.6 Data quality evaluation

Table II-1: Data Quality Evaluation

Data Category		Data Source	Data Quality
Primary data	Site-specific data	Inputs, outputs, energy consumption	+++
Secondary data	Transportation	Raw material transportation (from supplier gate to factory gate) and product transportation (from factory gate to Qingdao port) Baidu Map	++
	Emission factors	Raw materials, Waste, energy, resource, etc. LCA for Experts 10.7.1.28 (GaBi) ecoinvent 3.9 Literature	++

Estimate data	Low quality	+
Secondary data	Medium quality	++
Primary data	High quality	+++

2.2.9 Allocation Procedures

2.2.9.1 Allocation of foreground data

In the system studied the allocation rules are needed for production of the workshops. For example, in the manufacturing of wool jacquard knitted top, the data of energy consumption (Electricity), tap water, Waste generation and packaging are the overall data of the whole workshop, which need to be allocated by value, equipment power and weight.

2.2.9.2 Recycling

Recycling does not take place within the system boundaries.

2.2.10 LCIA Methodology and Impact Types

A detailed description is provided in Chapter 3.

2.2.11 Software and Database

The LCA modelling and calculations are made with LCA for Experts 10.7.1.28 (GaBi) software with database in both Experts 10.7.1.28 (GaBi) and ecoinvent 3.9.

2.3 Critical Review

No critical review is required. The critical review may be performed in the future if required.

3. LIFE CYCLE IMPACT ASSESSMENT (LCIA)

3.1 Impact Category: Climate Change

The climate change is a natural process of global warming which is involved in the radiation balance of the Earth. It is due to greenhouse gas (GHG) emissions in the atmosphere, mainly water vapor (which contributes most to the greenhouse effect), carbon dioxide (CO₂), and methane (CH₄). The GHGs absorb infrared radiation and increase the atmospheric temperature.

This originally natural phenomenon is becoming problematic because of GHG emission increase due to human activities. Each GHG has a different warming potential. It is calculated based a reference called the warming potential of CO₂, and a time horizon, 100 years here (GWP100). Each GHG is assigned with a characterization factor expressing how many times more important the warming potential of this greenhouse gas is compared to CO₂, whose characterization factor equals 1 when averaged over the time horizon considered.

The calculation methodology is adopted from *IPCC 2021* and the characterization factors are from *IPCC AR6* according to the requirements of ISO 14067:2018.

The GHGs and their characterization factors for GWP100 are listed in **Table III-1**.

Table III-1: Characterization Factors for The Climate Change Impact Category, 100 Years

Category Name	Category Unit	Coefficient	Operator	Impact Unit	Impact Name
IPCC-Greenhouse effect (direct, 100 years)	g CO ₂ e	1	X	g	Carbon dioxide (CO ₂)
IPCC-Greenhouse effect (direct, 100 years)	g CO ₂ e	7,380	X	g	Carbon tetrafluoride (CF ₄)
IPCC-Greenhouse effect (direct, 100 years)	g CO ₂ e	29.8	X	g	Methane (CH ₄ , fossil)
IPCC-Greenhouse effect (direct, 100 years)	g CO ₂ e	27	X	g	Methane (CH ₄ , non-fossil)
IPCC-Greenhouse effect (direct, 100 years)	g CO ₂ e	265	X	g	Nitrous oxide (N ₂ O)
IPCC-Greenhouse effect (direct, 100 years)	g CO ₂ e	14,600	X	g	HFC-23 (CHF ₃)

According to the requirements of *ISO 14067:2018*, specific GHG emissions of the partial carbon footprint of the systems studied shall be included and documented separately. **Table III-2** shows the information about the specific GHG emissions.

Table III-2: Impact Categories of Carbon Footprint

Specific GHG Emissions	Reference Unit	Calculation Methodology
Fossil and biogenic GHG emissions and removals	kg CO ₂ e	Climate change, ISO 14067 GWP.
GHG emissions and removals from direct land use change (dLUC)	kg CO ₂ e	Climate change-Emissions from Land use change, ISO 14067 GWP
Aircraft GHG emissions	kg CO ₂ e	Climate change-Air craft emission, ISO 14067 GWP
Biogenic carbon in product	kg CO ₂ e	Climate change, Biogenic GHG emission, ISO 14067 GWP

Additionally, Net fossil and biogenic GHG emissions and removals are reported separately in the study report, as well.

3.2 LCIA Methodology

A life cycle assessment (LCA) approach is adopted to make the analysis of product carbon footprint. This consists of considering all direct and indirect environmental effects for the realisation of a function or for a declared unit (see **Chapter 2**).

The utilised methodology makes it possible to estimate the emissions, and to evaluate afterwards the partial carbon footprint during the life cycle of the studied system. This "Life Cycle Assessment" is standardised in the *ISO 14040:2006* and *ISO 14044:2006* norms, and the "Product Carbon Footprint" is standardised in the *ISO 14067:2018* norm. Calculations are made with LCA for Experts 10.7.1.28 (GaBi), sphera®'s calculation software.

The main steps of the assessment are the following:

- elaboration of the process tree for each studied system,
- description of the incomes and outcomes of each process, and
- data research of consumptions and emissions ("elementary streams") for each process.

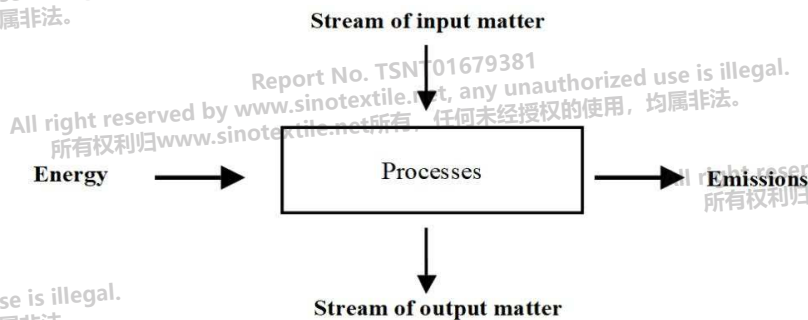


Figure III-1: Scheme of a Process in the Model Tree

Each process is characterised by:

- one (or more) streams of matter incoming from another process,
- one (or more) streams of matter outgoing to another process,
- consumption of energy, water, and mineral resources; and
- emissions of pollutants (in air, water, soil).

Once all processes are identified, their integration makes it possible to set up the whole system. The modelling of the studied declared unit ends up in a process tree, designed to make it possible to model different systems and to distinguish the impacts of the different phases of the studied system. The environmental balance is calculated by aggregating the elementary flows of the different processes. As a result, all the direct and indirect elementary flows are automatically attributed to the declared unit. In the LCIA phase, the different emissions are grouped in categories according to the degree of impact on environmental problems, climate change is the specific impact category in this study. For the impact category, some characterisation factors are associated to each emission value to express this effect on the global warming in a common unit (e.g., "kg CO₂e" is a unit for comparing the radiative forcing of a greenhouse gas to that of CO₂). The carbon footprint thus can be quantified and evaluated, and the most contributing phases can be identified. Subsequently, some measures can be taken to prevent or limit the carbon footprint of these phases. The LCA approach can also help prevent taking decision about life cycle stages that only transfer the carbon footprint from one stage to another.

3.3 Categories of Contribution

Raw materials

Includes resource use and emissions associated with the production of all the main raw materials, which are raw wool, wool yarn, fabric, accessories, packaging materials..., plus the transportation of them to the factory gate, from cradle.

Manufacturing process

Includes resource use and emissions associated with the manufacturing process of the target product and all the additives taking part in the process from cradle.

Packaging

Includes resource use and emissions associated with the packaging materials of the target product from cradle.

Transportation

Includes resource use and emissions associated with the raw materials delivery from cradle and the target product delivery to the Qingdao port.

4. LIFE CYCLE INVENTORY (LCI) ANALYSIS

4.1 General

Primary data on manufacturing process of scoured wool, yarn, fabric and the wool jacquard knitted top/body/longjohn were collected and provided by Qingdao Sino Textile Technique Co., Ltd and its suppliers. All the detailed data please refer to the following tables:

Tables from IV-1-1 to IV-1-10 show the LCI results of all relative raw data collection of manufacturing of light/dark coloured wool yarn (1/74Nm)

**Table IV-1-1: Raw Data Collection– Manufacturing of Scoured Wool
(Zhejiang New Chuwa Wool Co., Ltd)**

Product Name: Scoured Wool		
Manufacturing 1 kg of Scoured Wool		
Item	Consumption	Unit
Material Consumption		
Greasy wool	1.3697	kg/kg
Sodium carbonate	0.008	kg/kg
Detergent	0.0181	kg/kg
Energy & Resource Consumption		
Tap water	12.0153	kg/kg
Electricity- National Grid	0.3185	kWh/kg
Self-produced photovoltaic power generation	0.2640	kWh/kg
Purchased steam (Pressure:0.6MPa, Temperature:200℃)	1.9568	kg/kg
Diesel for forklift	0.0016	kg/kg
Consumables	0.0000	¥ /kg
Parts - Hardware	0.0425	¥ /kg
Parts - Machine accessories	0.0394	¥ /kg
Lubricating oil - gear oil	0.0382	g/kg
Lubricating oil - butter	0.0132	g/kg
Lubricating oil - hydraulic oil	0.0260	g/kg
Waste Generated		
Wastewater - treated in own ETP	12.6803	kg/kg
Fallen wool (recycled)	0.0059	kg/kg
Waste short wool (recycled)	0.0488	kg/kg
Hazardous Waste (Waste oil)	0.0475	g/kg
Hazardous Waste (Packaging materials for chemicals)	0.1264	g/kg
Carbon dioxide emitted from diesel combustion	0.0051	kgCO ₂ e/kg
Carbon dioxide emitted from sodium carbonate	0.0033	kgCO ₂ e/kg
CH ₄ generated from Wastewater treatment	0.4621	kgCO ₂ e/kg
Solid content in sludge (Combustion power generation)	0.2571	kg/kg
Water content in sludge	0.3142	kg/kg
Evaporation and loss of water	0.9716	kg/kg
HFCs generated from refrigerant in air conditioners	0.0121	gCO ₂ e/kg
Transport of Raw Materials and Waste		
By ship	6400.0000	km
By truck	120.3453	km

**Table IV-1-2: Raw Data Collection– Manufacturing Of Greige Wool Sliver (Finer Than 70s)
(Zhejiang New Chuwa Wool Co., Ltd)**

Product Name: Greige Wool Sliver (Finer Than 70s)		
Manufacturing 1 kg of Greige Wool Sliver (Finer Than 70s)		
Item	Consumption	Unit
Material Consumption		
Scoured wool	1.1195	kg/kg
Wool spinning lubrication agent	0.0068	kg/kg
Antistatic agent	0.0119	kg/kg
Energy & Resource Consumption		
Electricity- National Grid	0.9213	kWh/kg
Purchased steam (Pressure:0.6MPa, Temperature:200°C)	0.1186	kg/kg
Consumables	0.0026	¥/kg
Parts – Hardware	0.0052	¥/kg
Parts - Machine accessories	0.6335	¥/kg
Lubricating oil - gear oil	0.1829	g/kg
Lubricating oil – butter	0.0390	g/kg
Lubricating oil - hydraulic oil	0.1767	g/kg
Packaging		
Plastic bag (polyethylene)	0.0025	kg/kg
Waste Generated		
Waste wool sliver (recycled)	0.1115	kg/kg
Hazardous Waste (Waste oil)	0.0551	g/kg
HFCs generated from refrigerant in air conditioners	2.3058	gCO ₂ e/kg
Transport of Raw Materials and Waste		
By truck	28.7273	km

**Table Iv-1-3: Raw Data Collection– Manufacturing of Shrinkproof Greige Wool Sliver (Finer Than 70s)
(Zhejiang New Chuwa Wool Co., Ltd)**

Product Name: Shrinkproof Greige Wool Sliver (Finer Than 70s)		
Manufacturing 1 kg of Shrinkproof Greige Wool Sliver (Finer Than 70s)		
Item	Consumption	Unit
Material Consumption		
Greige wool sliver (finer than 70s)	1.0227	kg/kg
Softener	0.0600	kg/kg
Sodium pyrosulfite	0.0167	kg/kg
Sulphuric acid (98%)	0.0495	kg/kg
DUROSLIP RT (Quaternized fatty amine ethoxylate)	0.0019	kg/kg
Resin finishing agent (12.5% solid content)	0.1594	kg/kg
Sodium carbonate	0.0425	kg/kg
Sodium hypochlorite	0.2350	kg/kg
Energy & Resource Consumption		
Tap water	19.0661	kg/kg
Electricity- National Grid	0.6424	kWh/kg
Purchased steam (Pressure:0.6MPa, Temperature:200℃)	1.6224	kg/kg
Consumables	0.0002	¥ /kg
Parts – Hardware	0.0092	¥ /kg
Parts - Machine accessories	0.1601	¥ /kg
Lubricating oil - gear oil	0.0909	g/kg
Lubricating oil – butter	0.0159	g/kg
Lubricating oil - hydraulic oil	0.0490	g/kg
Packaging		
Plastic bag (polyethylene)	0.0031	kg/kg
Waste Generated		
Waste wool sliver (recycled)	0.0046	kg/kg
Wastewater - treated in own ETP	20.1008	kg/kg
Carbon dioxide emissions from sodium carbonate	0.0177	kg/kg
CH ₄ generated from Wastewater treatment	0.2037	kg/kg
Solid content in sludge (Combustion power generation)	0.0173	kg/kg
Water content in sludge	0.0212	kg/kg
Evaporation and loss of water	0.5605	kg/kg
HFCs generated from refrigerant in air conditioners	5.9439	gCO ₂ e/kg
Transport of Raw Materials and Waste		
By truck	33.8782	km

**Table IV-1-4: Treating of Wastewater
(Zhejiang New Chuwa Wool Co., Ltd)**

Product Name: Treating of Wastewater		
Treating 1 kg of Wastewater		
Item	Consumption	Unit
Material Consumption		
Liquid caustic soda, 32%	0.0037	kg/kg
Ferric sulfate	0.0064	kg/kg
Polyaluminum chloride (PAC)	0.0030	kg/kg
Polyacrylamide (PAM)	0.0001	kg/kg
Energy & Resource Consumption		
Electricity- National Grid	0.0082	kWh/kg
Parts – Hardware	0.0001	¥ /kg
Parts - Machine accessories	0.0007	¥ /kg
Lubricating oil - gear oil	0.0002	g/kg
Lubricating oil – butter	0.0000	g/kg
Lubricating oil - hydraulic oil	0.0018	g/kg
Waste Generated		
Wastewater discharge	0.8159	kg/kg
Sludge (Combustion power generation, solid content 45%)	0.0170	kg/kg
Hazardous Waste (Waste oil)	0.0013	g/kg
Hazardous Waste (Packaging materials for chemicals)	0.0035	g/kg
Evaporation and loss of water	0.1747	kg/kg
HFCs generated from refrigerant in air conditioners	0.0006	gCO ₂ e/kg
Transport of Raw Materials and Waste		
By truck	44.5031	km

Table IV-1-5: Raw Data Collection– Manufacturing of Shrinkproof Light Coloured Wool Sliver (Finer Than 70s) (Zhejiang Houyuan Textiles Inc.)

Product Name: Shrinkproof Light Coloured Wool Sliver (Finer Than 70s)		
Manufacturing 1 kg of Shrinkproof Light Coloured Wool Sliver (Finer Than 70s)		
Item	Consumption	Unit
Material Consumption		
Shrinkproof greige wool sliver (finer than 70s)	1.0091	kg/kg
Reactive dyes	0.0126	kg/kg
Levelling agent (34% solid content)	0.0112	kg/kg
Soaping agent (30% solid content)	0.0055	kg/kg
Softener (10% solid content)	0.0010	kg/kg
Caustic soda flakes	0.0022	kg/kg
Sodium carbonate	0.0279	kg/kg
Glacial acetic acid	0.0159	kg/kg
Energy & Resource Consumption		
Rainwater	3.4984	kg/kg
River water	29.9854	kg/kg
Reclaimed water	24.5555	kg/kg
Electricity- National Grid	0.6088	kWh/kg
Self-produced photovoltaic power generation	0.1564	kWh/kg
Purchased steam (Pressure:0.6MPa, Temperature:200℃)	4.2076	kg/kg
Packaging		
Plastic woven bag (polyethylene)	0.0053	kg/kg
Waste Generated		
Sludge (Combustion power generation, solid content 30%)	0.0892	kg/kg
Wastewater - treated in own ETP	58.0065	kg/kg
Evaporation and loss of water	4.2300	kg/kg
Waste wool sliver (recycled)	0.0084	kg/kg
HFCs generated from refrigerant in air conditioners	3.9373	gCO ₂ e/kg
Transport of Raw Materials		
By truck	5.5077	km

**Table IV-1-6: Raw Data Collection– Manufacturing of Shrinkproof Dark Coloured Wool Sliver (Finer Than 70s)
 (Zhejiang Houyuan Textiles Inc.)**

Product Name: Shrinkproof Dark Coloured Wool Sliver (Finer Than 70s)		
Manufacturing 1 kg of Shrinkproof Dark Coloured Wool Sliver (Finer Than 70s)		
Item	Consumption	Unit
Material Consumption		
Shrinkproof greige wool sliver (finer than 70s)	1.0091	kg/kg
Reactive dyes	0.0504	kg/kg
Penetrant agent (25% solid content)	0.0062	kg/kg
Levelling agent (34% solid content)	0.0223	kg/kg
Soaping agent (30% solid content)	0.0221	kg/kg
Softener (10% solid content)	0.0021	kg/kg
Caustic soda flakes	0.0022	kg/kg
Sodium carbonate	0.0279	kg/kg
Glacial acetic acid	0.0159	kg/kg
Energy & Resource Consumption		
Rainwater	5.0343	kg/kg
River water	43.1498	kg/kg
Reclaimed water	35.2856	kg/kg
Electricity- National Grid	0.7460	kWh/kg
Self-produced photovoltaic power generation	0.1919	kWh/kg
Purchased steam (Pressure:0.6MPa, Temperature:200℃)	5.6443	kg/kg
Packaging		
Plastic woven bag (polyethylene)	0.0053	kg/kg
Waste Generated		
Sludge (Combustion power generation, solid content 30%)	0.0892	kg/kg
Wastewater - treated in own ETP	83.4727	kg/kg
Evaporation and loss of water	5.8961	kg/kg
Waste wool sliver (recycled)	0.0084	kg/kg
HFCs generated from refrigerant in air conditioners	3.9373	gCO ₂ e/kg
Transport of Raw Materials		
By truck	12.4055	km

**Table IV-1-7: Treating of Wastewater
(Zhejiang Houyuan Textiles Inc.)**

Product Name: Treating of Wastewater		
Treating 1 kg of Wastewater		
Item	Consumption	Unit
Material Consumption		
Ferric sulfate	0.0004	kg/kg
Polyaluminum chloride (PAC)	0.0003	kg/kg
Polyacrylamide (PAM)	0.0003	g/kg
Energy & Resource Consumption		
Electricity- National Grid	0.0015	kWh/kg
Self-produced photovoltaic power generation	0.0004	kWh/kg
Waste Generated		
Wastewater discharge	0.5823	kg/kg
Circulating water untreated	0.3966	kg/kg
Sludge (Combustion power generation, solid content 30%)	0.0011	kg/kg
CH ₄ generated from Wastewater treatment	0.0014	kgCO ₂ e/kg
Evaporation and loss of water	0.0210	kg/kg
Transport of Raw Materials and Waste		
By truck	29.8271	km

**Table IV-1-8: Treating of Reclaimed Water
(Zhejiang Houyuan Textiles Inc.)**

Product Name: Treating Of Reclaimed Water		
Treating 1 kg of Reclaimed Water		
Item	Consumption	Unit
Material Consumption		
Citric acid	0.0088	g/kg
Oxalic acid	0.0097	g/kg
Sodium pyrosulfite	0.0091	g/kg
Sodium hydroxide	0.0063	g/kg
Reverse osmosis membrane (polyamide film composite)	0.0042	g/kg
Energy & Resource Consumption		
Circulating water untreated	1.0014	kg/kg
Electricity- National Grid	0.0012	kWh/kg
Self-produced photovoltaic power generation	0.0003	kWh/kg
Waste Generated		
Evaporation and loss of water	0.0014	kg/kg
Transport of Raw Materials		
By truck	15.0000	km

**Table IV-1-9: Raw Data Collection– Manufacturing of Light Coloured Wool Yarn (1/74Nm)
(Zhejiang Xiniao Textiles Inc.)**

Product Name: Light Coloured Wool Yarn (1/74Nm)		
Manufacturing 1 kg of Light Coloured Wool Yarn (1/74Nm)		
Item	Consumption	Unit
Material Consumption		
Shrinkproof light coloured wool sliver (finer than 70s)	1.0612	kg/kg
Wool spinning lubrication agent	0.0032	kg/kg
Antistatic agent	0.0021	kg/kg
Wax	0.0016	kg/kg
Energy & Resource Consumption		
Lubricating oil	0.0002	kg/kg
Diesel for forklift	0.0022	kg/kg
Electricity- National Grid	7.9414	kWh/kg
Self-produced photovoltaic power generation	0.6659	kWh/kg
Purchased steam (Pressure:0.6MPa, Temperature:200℃)	0.2823	kg/kg
Packaging		
Plastic bag (polyethylene)	0.0465	kg/kg
Corrugated box	0.0769	kg/kg
Paper tube	0.0409	kg/kg
Packing belt (PP)	0.0006	kg/kg
Waste Generated		
Waste yarn (recycled)	0.0299	kg/kg
Waste wax (recycled)	0.0002	kg/kg
Waste packing belt (PP) (recycled)	0.0005	kg/kg
Waste paper tube (recycled)	0.0000	kg/kg
Waste wool (recycled)	0.0093	kg/kg
Carbon dioxide emissioned come from diesel combustion	0.0070	kgCO ₂ e/kg
HFCs generated from refrigerant in air conditioners	0.0215	kgCO ₂ e/kg
Water loss (discrease in yarn moisture regain rate)	0.0156	kg/kg
Transport of Raw Materials		
By truck	76.4955	km

**Table IV-1-10: Raw Data Collection– Manufacturing of Dark Coloured Wool Yarn (1/74Nm)
(Zhejiang Xinao Textiles Inc.)**

Product Name: Dark Coloured Wool Yarn (1/74Nm)		
Manufacturing 1 kg of Dark Coloured Wool Yarn (1/74Nm)		
Item	Consumption	Unit
Material Consumption		
Shrinkproof dark coloured wool sliver (finer than 70s)	1.0612	kg/kg
Wool spinning lubrication agent	0.0032	kg/kg
Antistatic agent	0.0021	kg/kg
Wax	0.0016	kg/kg
Energy & Resource Consumption		
Lubricating oil	0.0002	kg/kg
Diesel for forklift	0.0022	kg/kg
Electricity- National Grid	7.9414	kWh/kg
Self-produced photovoltaic power generation	0.6659	kWh/kg
Purchased steam (Pressure:0.6MPa, Temperature:200℃)	0.2823	kg/kg
Packaging		
Plastic bag (polyethylene)	0.0465	kg/kg
Corrugated box	0.0769	kg/kg
Paper tube	0.0409	kg/kg
Packing belt (PP)	0.0006	kg/kg
Waste Generated		
Waste yarn (recycled)	0.0299	kg/kg
Waste wax (recycled)	0.0002	kg/kg
Waste packing belt (PP) (recycled)	0.0005	kg/kg
Waste paper tube (recycled)	0.0000	kg/kg
Waste wool (recycled)	0.0093	kg/kg
Carbon dioxide emissioned come from diesel combustion	0.0070	kgCO ₂ e/kg
HFCs generated from refrigerant in air conditioners	0.0215	kgCO ₂ e/kg
Water loss (discrease in yarn moisture regain rate)	0.0156	kg/kg
Transport of Raw Materials		
By truck	76.4955	km

Tables from IV-2-1 to IV-2-6 show the LCI results of all relative raw data collection of manufacturing of semi-finished jacquard knitted fabric/interlock knitted fabric/rib knitted fabric in heather rose/mood indigo colour.

Table IV-2-1 Raw Data Collection – Manufacturing of Semi-Finished Heather Rose Jacquard Knitted Fabric

Product Name: Semi-Finished Heather Rose Jacquard Knitted Fabric(100% RWS Wool 190g)		
Manufacturing 1 kg of Semi-Finished Heather Rose Jacquard Knitted Fabric		
Item	Consumption	Unit
Material Consumption		
Light coloured wool yarn (1/74Nm)	0.6005	kg/kg
Dark coloured wool yarn (1/74Nm)	0.4522	kg/kg
Lubricating oil	0.0003	kg/kg
Energy & Resource Consumption		
Electricity- national grid	2.6544	kWh/kg
Waste Generated		
Waste yarn(recycled)	0.0528	kg/kg
Waste lubricating oil (recycled)	0.0008	kg/kg
Waste packaging paper (recycled)	0.1288	kg/kg
Waste packaging plastic (recycled)	0.0034	kg/kg
Transport of Raw Materials		
By truck	789.8026	km

Table IV-2-2 Raw Data Collection – Manufacturing of Semi-Finished Mood Indigo Jacquard Knitted Fabric

Product Name: Semi-Finished Mood Indigo Jacquard Knitted Fabric (100% RWS Wool 190g)		
Manufacturing 1 kg of Semi-Finished Mood Indigo Jacquard Knitted Fabric		
Item	Consumption	Unit
Material Consumption		
Light coloured wool yarn (1/74Nm)	0.6936	kg/kg
Dark coloured wool yarn (1/74Nm)	0.3590	kg/kg
Lubricating oil	0.0016	kg/kg
Energy & Resource Consumption		
Electricity- national grid	2.6544	kWh/kg
Waste Generated		
Waste yarn(recycled)	0.0526	kg/kg
Waste lubricating oil (recycled)	0.0008	kg/kg
Waste packaging paper (recycled)	0.1288	kg/kg
Waste packaging plastic (recycled)	0.0034	kg/kg
Transport of Raw Materials		
By truck	789.8025	km

Table IV-2-3 Raw Data Collection – Manufacturing of Semi-Finished Heather Rose Interlock Knitted Fabric

Product Name: Semi-Finished Heather Rose Interlock Knitted Fabric (100% RWS Wool 190g)		
Manufacturing 1 kg of Semi-Finished Heather Rose Interlock Knitted Fabric		
Item	Consumption	Unit
Material Consumption		
Light coloured wool yarn (1/74Nm)	1.0526	kg/kg
Lubricating oil	0.0016	kg/kg
Energy & Resource Consumption		
Electricity- national grid	0.7964	kWh/kg
Waste Generated		
Waste yarn(recycled)	0.0526	kg/kg
Waste lubricating oil (recycled)	0.0008	kg/kg
Waste packaging paper (recycled)	0.1288	kg/kg
Waste packaging plastic (recycled)	0.0034	kg/kg
Transport of Raw Materials		
By truck	789.8025	km

Table IV-2-4 Raw Data Collection – Manufacturing of Semi-Finished Mood Indigo Interlock Knitted Fabric

Product Name: Semi-Finished Mood Indigo Interlock Knitted Fabric (100% RWS Wool 190g)		
Manufacturing 1 kg of Semi-Finished Mood Indigo Interlock Knitted Fabric		
Item	Consumption	Unit
Material Consumption		
Dark coloured wool yarn (1/74Nm)	1.0526	kg/kg
Lubricating oil	0.0016	kg/kg
Energy & Resource Consumption		
Electricity- national grid	0.7964	kWh/kg
Waste Generated		
Waste yarn(recycled)	0.0526	kg/kg
Waste lubricating oil (recycled)	0.0008	kg/kg
Waste packaging paper (recycled)	0.1288	kg/kg
Waste packaging plastic (recycled)	0.0034	kg/kg
Transport of Raw Materials		
By truck	789.8025	km

Table IV-2-5 Raw Data Collection – Manufacturing of Semi-Finished Heather Rose Rib Knitted Fabric ()

Product Name: Semi-Finished Heather Rose Rib Knitted Fabric (95% RWS Wool 5% Elastane 1*1 Rib 230g)		
Manufacturing 1 kg of Semi-Finished Heather Rose Rib Knitted Fabric		
Item	Consumption	Unit
Material Consumption		
Light coloured wool yarn (1/74Nm)	1.0476	kg/kg
Polyurethane fiber	0.0429	kg/kg
Lubricating oil	0.0016	kg/kg
Energy & Resource Consumption		
Electricity- national grid	0.7964	kWh/kg
Waste Generated		
Waste yarn(recycled)	0.0476	kg/kg
Waste lubricating oil (recycled)	0.0008	kg/kg
Waste packaging paper (recycled)	0.1288	kg/kg
Waste packaging plastic (recycled)	0.0034	kg/kg
Transport of Raw Materials		
By truck	803.2785	km

Table IV-2-6 Raw Data Collection – Manufacturing of Semi-Finished Mood Indigo Rib Knitted Fabric ()

Product Name: Semi-Finished Mood Indigo Rib Knitted Fabric (95% RWS Wool 5% Elastane 1*1 Rib 230g)		
Manufacturing 1 kg of Semi-Finished Mood Indigo Rib Knitted Fabric		
Item	Consumption	Unit
Material Consumption		
Dark coloured wool yarn (1/74Nm)	1.0500	kg/kg
Polyurethane fiber	0.0455	kg/kg
Lubricating oil	0.0016	kg/kg
Energy & Resource Consumption		
Electricity- national grid	0.7964	kWh/kg
Waste Generated		
Waste yarn(recycled)	0.0500	kg/kg
Waste lubricating oil (recycled)	0.0008	kg/kg
Waste packaging paper (recycled)	0.0160	kg/kg
Waste packaging plastic (recycled)	0.0054	kg/kg
Transport of Raw Materials		
By truck	804.0331	km

Tables from IV-3-1 to IV-3-6 show the LCI results of all relative raw data collection of manufacturing of finished jacquard knitted fabric/interlock knitted fabric/rib knitted fabric in heather rose/mood indigo colour.

Table IV-3-1: Raw Data Collection- Manufacturing of Finished Heather Rose Jacquard Knitted Fabric

Product Name: Finished Heather Rose Jacquard Knitted Fabric (100% RWS Wool 190g)		
Manufacturing 1 kg of Finished Heather Rose Jacquard Knitted Fabric (100% RWS Wool 190g)		
Item	Consumption	Unit
Material Consumption		
Semi-finished heather rose jacquard knitted fabric	1.0989	kg/kg
Sodium fatty alcohol polyoxyethylene ether sulfate	0.0110	kg/kg
Glacial acetic acid	0.0110	kg/kg
Mercerizing softener (40% solid content)	0.0879	kg/kg
Wool softener	0.0440	kg/kg
Solubilised press agent	0.0220	kg/kg
Polyester thread for sewing	0.0000	kg/kg
Energy & Resource Consumption		
Electricity-national grid	1.0248	kWh/kg
Water-underground water	65.9361	kg/kg
Natural gas	0.1170	kg/kg
Purchased steam (Pressure:0.4MPa, Temperature:160°C)	7.6027	MJ/kg
Midea air conditioner (R32 refrigerating fluid)	0.0000	kg/kg
Gree air conditioner (R410A refrigerating fluid)	0.0001	kg/kg
Packaging		
PVC packing bag	0.0020	kg/kg
Waste generated		
Waste Finished Knitted Fabric (recycled)	0.0974	kg/kg
Rejected material-plastic (recycled)	0.0009	kg/kg
Rejected material-paper (recycled)	0.0004	kg/kg
Rejected material-fabric (recycled)	0.0002	kg/kg
Waste water	65.9361	kg/kg
Transport of Raw Materials		
By truck	211.6750	km

Table IV-3-2: Raw Data Collection– Manufacturing of Finished Mood Indigo Jacquard Knitted Fabric

Product Name: Finished Mood Indigo Jacquard Knitted Fabric (100% RWS Wool 190g)		
Manufacturing 1 kg of Finished Mood Indigo Jacquard Knitted Fabric (100% RWS Wool 190g)		
Item	Consumption	Unit
Material Consumption		
Semi-finished mood indigo jacquard knitted fabric	1.0989	kg/kg
Sodium fatty alcohol polyoxyethylene ether sulfate	0.0110	kg/kg
Glacial acetic acid	0.0110	kg/kg
Mercerizing softener (40% solid content)	0.0879	kg/kg
Wool softener	0.0440	kg/kg
Solubilised press agent	0.0220	kg/kg
Polyester thread for sewing	0.0000	kg/kg
Energy & Resource Consumption		
Electricity-national grid	1.0247	kWh/kg
Water-underground water	65.9325	kg/kg
Natural gas	0.1170	kg/kg
Purchased steam (Pressure:0.4MPa, Temperature:160℃)	7.6023	MJ/kg
Midea air conditioner (R32 refrigerating fluid)	0.0000	kg/kg
Gree air conditioner (R410A refrigerating fluid)	0.0001	kg/kg
Packaging		
PVC packing bag	0.0020	kg/kg
Waste generated		
Waste Finished Knitted Fabric (recycled)	0.0973	kg/kg
Rejected material-plastic (recycled)	0.0009	kg/kg
Rejected material-paper (recycled)	0.0004	kg/kg
Rejected material-fabric (recycled)	0.0002	kg/kg
Waste water	65.9325	kg/kg
Transport of Raw Materials		
By truck	211.6750	km



Total Quality. Assured.

Table IV-3-3: Raw Data Collection– Manufacturing of Finished Heather Rose Interlock Knitted Fabric

Product Name: Finished Heather Rose Interlock Knitted Fabric (100% RWS Wool 190g)		
Manufacturing 1 kg of Finished Heather Rose Interlock Knitted Fabric (100% RWS Wool 190g)		
Item	Consumption	Unit
Material Consumption		
Semi-finished heather rose interlock knitted fabric	1.0991	kg/kg
Sodium fatty alcohol polyoxyethylene ether sulfates	0.0110	kg/kg
Glacial acetic acid	0.0110	kg/kg
Mercerizing softener (40% solid content)	0.0879	kg/kg
Wool softener	0.0440	kg/kg
Solubilised press agent	0.0220	kg/kg
Polyester thread for sewing	0.0000	kg/kg
Energy & Resource Consumption		
Electricity-national grid	1.0249	kWh/kg
Water-underground water	65.9436	kg/kg
Natural gas	0.1170	kg/kg
Purchased steam (Pressure:0.4MPa, Temperature:160°C)	7.6036	MJ/kg
Midea air conditioner (R32 refrigerating fluid)	0.0000	kg/kg
Gree air conditioner (R410A refrigerating fluid)	0.0001	kg/kg
Packaging		
PVC packing bag	0.0020	kg/kg
Waste generated		
Waste Finished Knitted Fabric (recycled)	0.0975	kg/kg
Rejected material-plastic (recycled)	0.0009	kg/kg
Rejected material-paper (recycled)	0.0004	kg/kg
Rejected material-fabric (recycled)	0.0002	kg/kg
Waste water	65.9436	kg/kg
Transport of Raw Materials		
By truck	211.6750	km

Table IV-3-4: Raw Data Collection– Manufacturing of Finished Mood Indigo Interlock Knitted Fabric

Product Name: Finished Mood Indigo Interlock Knitted Fabric (100% RWS Wool 190g)		
Manufacturing 1 kg of Finished Mood Indigo Interlock Knitted Fabric (100% RWS Wool 190g)		
Item	Consumption	Unit
Material Consumption		
Semi-finished mood indigo interlock knitted fabric	1.0989	kg/kg
Sodium fatty alcohol polyoxyethylene ether sulfate	0.0110	kg/kg
Glacial acetic acid	0.0110	kg/kg
Mercerizing softener (40% solid content)	0.0879	kg/kg
Wool softener	0.0440	kg/kg
Solubilised press agent	0.0220	kg/kg
Polyester thread for sewing	0.0000	kg/kg
Energy & Resource Consumption		
Electricity-national grid	1.0247	kWh/kg
Water-underground water	65.9323	kg/kg
Natural gas	0.1170	kg/kg
Purchased steam (Pressure:0.4MPa, Temperature:160°C)	7.6023	MJ/kg
Midea air conditioner (R32 refrigerating fluid)	0.0000	kg/kg
Gree air conditioner (R410A refrigerating fluid)	0.0001	kg/kg
Packaging		
PVC packing bag	0.0020	kg/kg
Waste generated		
Waste Finished Knitted Fabric (recycled)	0.0973	kg/kg
Rejected material-plastic (recycled)	0.0009	kg/kg
Rejected material-paper (recycled)	0.0004	kg/kg
Rejected material-fabric (recycled)	0.0002	kg/kg
Waste water	65.9323	kg/kg
Transport of Raw Materials		
By truck	211.6750	km

Table IV-3-5: Raw Data Collection– Manufacturing of Finished Heather Rose Rib Knitted Fabric

Product Name: Finished Heather Rose Rib Knitted Fabric (95% RWS Wool 5% Elastane 1*1 Rib 230g)		
Manufacturing 1 kg of Finished Heather Rose Rib Knitted Fabric (95% RWS Wool 5% Elastane 1*1 Rib 230g)		
Item	Consumption	Unit
Material Consumption		
Semi-finished heather rose rib knitted fabric	1.0995	kg/kg
Sodium fatty alcohol polyoxyethylene ether sulfate	0.0110	kg/kg
Glacial acetic acid	0.0110	kg/kg
Mercerizing softener (40% Solid content)	0.0880	kg/kg
Wool softener	0.0440	kg/kg
Solubilised press agent	0.0220	kg/kg
Polyester thread for sewing	0.0000	kg/kg
Energy & Resource Consumption		
Electricity-national grid	1.0253	kWh/kg
Water-underground water	65.9686	kg/kg
Natural gas	0.1171	kg/kg
Purchased steam (Pressure:0.4MPa, Temperature:160°C)	7.6065	MJ/kg
Midea air conditioner (R32 refrigerating fluid)	0.0000	kg/kg
Gree air conditioner (R410A refrigerating fluid)	0.0001	kg/kg
Packaging		
PVC packing bag	0.0020	kg/kg
Waste generated		
Waste Finished Knitted Fabric (recycled)	0.0979	kg/kg
Rejected material-plastic (recycled)	0.0009	kg/kg
Rejected material-paper (recycled)	0.0004	kg/kg
Rejected material-fabric (recycled)	0.0002	kg/kg
Waste water	65.9686	kg/kg
Transport of Raw Materials		
By truck	211.6750	km

Table IV-3-6: Raw Data Collection-- Manufacturing of Finished Mood Indigo Rib Knitted Fabric

Product Name: Finished Mood Indigo Rib Knitted Fabric (95% RWS Wool 5% Elastane 1*1 Rib 230g)		
Manufacturing 1 kg of Finished Mood Indigo Rib Knitted Fabric (95% RWS Wool 5% Elastane 1*1 Rib 230g)		
Item	Consumption	Unit
Material Consumption		
Semi-finished mood indigo rib knitted fabric	1.1000	kg/kg
Sodium fatty alcohol polyoxyethylene ether sulfate	0.0110	kg/kg
Glacial acetic acid	0.0110	kg/kg
Mercerizing softener (40% Solid content)	0.0880	kg/kg
Wool softener	0.0440	kg/kg
Solubilised press agent	0.0220	kg/kg
Polyester thread for sewing	0.0000	kg/kg
Energy & Resource Consumption		
Electricity-national grid	1.0258	kWh/kg
Water-underground water	66.0000	kg/kg
Natural gas	0.1172	kg/kg
Purchased steam (Pressure:0.4MPa, Temperature:160°C)	7.6101	MJ/kg
Midea air conditioner (R32 refrigerating fluid)	0.0000	kg/kg
Gree air conditioner (R410A refrigerating fluid)	0.0001	kg/kg
Packaging		
PVC packing bag	0.0020	kg/kg
Waste generated		
Waste Finished Knitted Fabric (recycled)	0.0984	kg/kg
Rejected material-plastic (recycled)	0.0009	kg/kg
Rejected material-paper (recycled)	0.0004	kg/kg
Rejected material-fabric (recycled)	0.0002	kg/kg
Waste water	66.0000	kg/kg
Transport of Raw Materials		
By truck	211.6750	km

Tables from IV-4-1 to IV-4-3 show the LCI results of all relative raw data collection of manufacturing of 6 types of wool jacquard knitted top/ body/longjohn in heather rose/mood indigo colour.

Table IV-4-1: Raw Data Collection– Manufacturing of Wool Jacquard Knitted Top-Heather Rose/Mood Indigo (Order#PO-00001340) (Qingdao Sino Textile Technique Co.,Ltd)

Product Name: Wool Jacquard Knitted Top-Heather Rose/Mood Indigo (Order#PO-00001340)		
Declared Unit: Manufacturing One Piece of Wool Jacquard Knitted Top-Heather Rose/Mood Indigo		
Item	Consumption	Unit
Material Consumption		
Finished Jacquard Knitted Fabric	0.0659	kg/piece
Finished Interlock Knitted Fabric	0.0600	kg/piece
Dry cleaning agent	0.0190	g/piece
Lubricating oil	0.0060	g/piece
Care label	0.7045	g/piece
Satin loop	0.0283	g/piece
Polyester core spun thread	0.6279	g/piece
Polyester thread	1.1664	g/piece
Nylon thread	2.2927	g/piece
String	2.3804	g/piece
Energy & Resource Consumption		
Electricity	0.8414	kWh/kg
Tap water	0.1768	kg/piece
Gree air conditioner (R32 refrigerating fluid)	1.0929	g/piece
Packaging		
Plastic film	0.0048	g/piece
GRS polybag	0.5209	g/piece
Carton	12.8236	g/piece
Price sticker	0.4547	g/piece
FSC rice sticker	0.2730	g/piece
Transparent adhesive tape	0.1071	g/piece
Waste Generated		
Waste paper	0.0022	kg/piece
Plastic Waste bag	0.0001	kg/piece
Waste cloth	0.0138	kg/piece
Transport of Raw Materials and Final Product		
By truck	75.8250	km

Table IV-4-2: Raw Data Collection– Manufacturing of Wool Jacquard Knitted Body -Heather Rose/Mood Indigo (Order#PO-00001334)(Qingdao Sino Textile Technique Co.,Ltd)

Product Name: Wool Jacquard Knitted Body -Heather Rose/Mood Indigo (Order#PO-00001334)		
Declared Unit: Manufacturing One Piece of Wool Jacquard Knitted Body -Heather Rose/Mood Indigo		
Item	Consumption	Unit
Material Consumption		
Finished Jacquard Knitted Fabric	0.0604	kg/piece
Finished Interlock Knitted Fabric	0.0370	kg/piece
Finished Rib Knitted Fabric	0.0119	kg/piece
Dry cleaning agent	0.0154	g/piece
Lubricating oil	0.0049	g/piece
560D Spandex	0.1585	g/piece
Care label	0.8370	g/piece
Satin loop	0.0238	g/piece
Woven tape	0.6342	g/piece
15L YKK popper	3.3158	g/piece
Polyester core spun thread	0.9568	g/piece
Polyester thread	0.8208	g/piece
Nylon thread	2.1338	g/piece
String	2.3804	g/piece
Energy & Resource Consumption		
Electricity	0.8058	kWh/kg
Tap water	0.1431	kg/piece
Gree air conditioner (R32 refrigerating fluid)	0.8849	g/piece
Packaging		
Plastic film	0.0039	g/piece
GRS polybag	0.4182	g/piece
Carton	10.2962	g/piece
Price sticker	0.4547	g/piece
FSC price sticker	0.2730	g/piece
Transparent adhesive tape	0.0859	g/piece
Waste Generated		
Waste paper	0.0018	kg/piece
Plastic Waste bag	0.0001	kg/piece
Waste cloth	0.0112	kg/piece
Transport of Raw Materials and Final Product		
By truck	88.1912	km

**Table IV-4-3: Raw Data Collection– Manufacturing of Wool Jacquard Knitted Longjohn
-Heather Rose/Mood Indigo (Order#PO-00001384)
(Qingdao Sino Textile Technique Co.,Ltd)**

Product Name: Wool Jacquard Knitted Longjohn -Heather Rose/Mood Indigo (Order#PO-00001384)		
Declared Unit: Manufacturing One Piece of Wool Jacquard Knitted Longjohn -Heather Rose/Mood Indigo		
Item	Consumption	Unit
Material Consumption		
Finished Jacquard Knitted Fabric	0.0875	kg/piece
Finished Interlock Knitted Fabric	0.0111	kg/piece
Dry cleaning agent	0.0150	g/piece
Lubricating oil	0.0048	g/piece
Care label	0.8370	g/piece
Satin loop	0.0283	g/piece
Elastic tape	3.3830	g/piece
Polyester core spun thread	0.4784	g/piece
Polyester thread	0.9720	g/piece
Nylon thread	1.7479	g/piece
String	2.3804	g/piece
Energy & Resource Consumption		
Electricity	1.0063	kWh/kg
Tap water	0.1399	kg/piece
Gree air conditioner (R32 refrigerating fluid)	0.8648	g/piece
Packaging		
Plastic film	0.0038	g/piece
GRS polybag	0.4194	g/piece
Carton	10.3249	g/piece
Price sticker	0.4547	g/piece
FSC price sticker	0.2730	g/piece
Transparent adhesive tape	0.0862	g/piece
Waste Generated		
Waste paper	0.0017	kg/piece
Plastic Waste bag	0.0001	kg/piece
Waste cloth	0.0110	kg/piece
Transport of Raw Materials and Final Product		
By truck	77.8964	km

4.2 Electricity

National grid electricity and photovoltaic power are used in this study. The electricity consumption of each process is shown in the table below:

Table IV-5: Electricity Consumption

Item	Consumption	Unit
Scoured wool-national grid	0.3185	kWh/kg
Scoured wool- self-produced photovoltaic power	0.2640	kWh/kg
Greige wool sliver (finer than 70s)- national grid	0.9213	kWh/kg
Shrinkproof greige wool sliver (finer than 70s)- national grid	0.6424	kWh/kg
Treating of wastewater (zhejiang new chuwa wool co., ltd)- national grid	0.0082	kWh/kg
Shrinkproof light coloured wool sliver (finer than 70s)- national grid	0.6088	kWh/kg
Shrinkproof light coloured wool sliver (finer than 70s) - self-produced photovoltaic power	0.1564	kWh/kg
Shrinkproof dark coloured wool sliver (finer than 70s) - national grid	0.7460	kWh/kg
Shrinkproof dark coloured wool sliver (finer than 70s) - self-produced photovoltaic power	0.1919	kWh/kg
Treating of wastewater (zhejiang houyuan textiles inc.) - national grid	0.0015	kWh/kg
Treating of wastewater (zhejiang houyuan textiles inc.) - self-produced photovoltaic power	0.0004	kWh/kg
Treating of reclaimed water (zhejiang houyuan textiles inc.) - national grid	0.0012	kWh/kg
Treating of reclaimed water (zhejiang houyuan textiles inc.) - self-produced photovoltaic power	0.0003	kWh/kg
Light/dark coloured wool yarn (1/74nm) - national grid	7.9414	kWh/kg
Light/dark coloured wool yarn (1/74nm) - self-produced photovoltaic power	0.6659	kWh/kg
Semi-finished heather rose /mood indigo jacquard knitted fabric - national grid	2.6544	kWh/kg
Semi-finished heather rose /mood indigo interlock knitted fabric - national grid	0.7964	kWh/kg
Semi-finished heather rose /mood indigo rib knitted fabric - national grid	0.7964	kWh/kg
Finished heather rose jacquard knitted fabric - national grid	1.0248	kWh/kg
Finished mood indigo jacquard knitted fabric- national grid	1.0247	kWh/kg
Finished heather rose interlock knitted fabric- national grid	1.0249	kWh/kg
Finished mood indigo interlock knitted fabric- national grid	1.0247	kWh/kg
Finished heather rose rib knitted fabric- national grid	1.0253	kWh/kg
Finished mood indigo rib knitted fabric- national grid	1.0258	kWh/kg
Heather rose / mood indigo wool jacquard top(order#po-00001340) - national grid	0.8414	kWh/piece
Heather rose / mood indigo wool jacquard body (order#po-00001334) - national grid	0.8058	kWh/piece
Heather rose / mood indigo wool jacquard longjohn - (order#po-00001384) - national grid	1.0063	kWh/piece

4.3 Secondary Data

The secondary data used are summarized in **Table IV-6** as below:

Table IV-6: Secondary Data And Source

Data Name	Data Source
CN: Process steam from hard coal 85% sphaera	LCA for Experts 10.7.1.28 (GaBi)
CN: Electricity grid mix sphaera	LCA for Experts 10.7.1.28 (GaBi)
CN: Natural gas mix sphaera	LCA for Experts 10.7.1.28 (GaBi)
GLO: Copper (99.99%, cathode) ICA	LCA for Experts 10.7.1.28 (GaBi)
CN: Electricity grid mix sphaera	LCA for Experts 10.7.1.28 (GaBi)
CN: Tap water from surface water sphaera	LCA for Experts 10.7.1.28 (GaBi)
CN: Electricity from photovoltaic sphaera	LCA for Experts 10.7.1.28 (GaBi)
CN: Process steam from hard coal 85% sphaera	LCA for Experts 10.7.1.28 (GaBi)
CN: Heavy fuel oil at refinery (1.0 wt.% S) sphaera	LCA for Experts 10.7.1.28 (GaBi)
CN: Diesel mix at filling station (100% fossil) sphaera	LCA for Experts 10.7.1.28 (GaBi)
DE: Hazardous Waste in Waste incineration plant sphaera <p-agg>	LCA for Experts 10.7.1.28 (GaBi)
DE: Hazardous Waste in Waste incineration plant sphaera <p-agg>	LCA for Experts 10.7.1.28 (GaBi)
GLO: Antistatic agent (quaternary ammonium compound) sphaera	LCA for Experts 10.7.1.28 (GaBi)
RER: Polyethylene film (PE-LD) plasticseurope	LCA for Experts 10.7.1.28 (GaBi)
GLO: Softener (fatty acids amino compounds) sphaera	LCA for Experts 10.7.1.28 (GaBi)
EU-28: Sulphuric acid (96%) sphaera	LCA for Experts 10.7.1.28 (GaBi)
EU-28: Sodium hypochlorite (NaOCl, 175 g Cl ₂ /l) plasticseurope	LCA for Experts 10.7.1.28 (GaBi)
CN: Wax / Paraffins at refinery sphaera	LCA for Experts 10.7.1.28 (GaBi)
GLO: Reactive dyes sphaera	LCA for Experts 10.7.1.28 (GaBi)
GLO: Non-ionic surfactant (fatty acid derivate) sphaera	LCA for Experts 10.7.1.28 (GaBi)
GLO: Equalizing agent (on basis alcohol ethoxylate) sphaera	LCA for Experts 10.7.1.28 (GaBi)
GLO: Soaping agent (acrylic polymer) sphaera	LCA for Experts 10.7.1.28 (GaBi)
DE: Sodium hydroxide (caustic soda) mix (100%) sphaera	LCA for Experts 10.7.1.28 (GaBi)
GLO: Detergent (fatty acid sulphonate derivate) sphaera	LCA for Experts 10.7.1.28 (GaBi)
CH: Epoxy Resin (EP) sphaera	LCA for Experts 10.7.1.28 (GaBi)
GLO: Palm kernel oil methylester (incl. LUC, incl. peat emissions, 75 cm) erasm	LCA for Experts 10.7.1.28 (GaBi)
GLO: Equalizing agent (on basis fatty amines and ethoxylates) sphaera	LCA for Experts 10.7.1.28 (GaBi)
AUS: Greasy wool, PPhilippa M. Brock, Phillip Graham, Patrick Madden and Douglas J. Alcock (Greenhouse gas emissions profile for 1 kg of wool produced in the Yass Region, New South Wales: A	Literature
RER: Polypropylene film (PP) plasticseurope	LCA for Experts 10.7.1.28 (GaBi)
EU-28: Kraftliner 2018; by-products: tall oil, turpentine; substitution EoL; [mass allocation] sphaera/FEFCO <p-agg>	LCA for Experts 10.7.1.28 (GaBi)
US: Corrugated product sphaera/AF&PA <p-agg>	LCA for Experts 10.7.1.28 (GaBi)



Total Quality. Assured.

Number: TSNT01679381

Data Name	Data Source
GLO: Truck, Euro 3, 7.5 t - 12t gross weight / 5t payload capacity sphaera <u-so>	LCA for Experts 10.7.1.28 (GaBi)
GLO: Truck, Euro 3, up to 7.5t gross weight / 2.7t payload capacity sphaera <u-so>	LCA for Experts 10.7.1.28 (GaBi)
GLO: Truck, Euro 3, 12 - 14t gross weight / 9.3t payload capacity sphaera <u-so>	LCA for Experts 10.7.1.28 (GaBi)
GLO: Truck, Euro 3, 14 - 20t gross weight / 11.4t payload capacity sphaera <u-so>	LCA for Experts 10.7.1.28 (GaBi)
GLO: Truck, Euro 3, 20 - 26t gross weight / 17.3t payload capacity sphaera <u-so>	LCA for Experts 10.7.1.28 (GaBi)
GLO: Truck, Euro 3, 26 - 28t gross weight / 18.4t payload capacity sphaera <u-so>	LCA for Experts 10.7.1.28 (GaBi)
GLO: Truck, Euro 3, 28 - 32t gross weight / 22t payload capacity sphaera <u-so>	LCA for Experts 10.7.1.28 (GaBi)
GLO: Truck, Euro 3, more than 32t gross weight / 24.7t payload capacity sphaera <u-so>	LCA for Experts 10.7.1.28 (GaBi)
GLO: Container ship, 5,000 to 200,000 dwt payload capacity, ocean going sphaera <u-so>	LCA for Experts 10.7.1.28 (GaBi)
Nylon 6 {RoW} market for nylon 6 Cut-off, U	ecoinvent 3.9
Nylon 6-6 {RoW} market for nylon 6-6 Cut-off, U	ecoinvent 3.9
Polyaluminium chloride {GLO} market for polyaluminium chloride Cut-off, U	ecoinvent 3.9
Polyacrylamide {GLO} market for polyacrylamide Cut-off, U	ecoinvent 3.9
Acetic acid, without water, in 98% solution state {GLO} market for acetic acid, without water, in 98% solution state Cut-off, U	ecoinvent 3.9
Butyl acrylate {RoW} market for butyl acrylate Cut-off, U	ecoinvent 3.9
Oxalic acid {GLO} market for oxalic acid Cut-off, U	ecoinvent 3.9
Fibre, polyester {GLO} market for fibre, polyester Cut-off, U	ecoinvent 3.9
Glycerine {RER} market for glycerine Cut-off, U	ecoinvent 3.9
Tetrachloroethylene {RoW} market for tetrachloroethylene Cut-off, U	ecoinvent 3.9
Polyacrylamide {GLO} market for polyacrylamide Cut-off, U	ecoinvent 3.9
Sodium pyrophosphate {GLO} market for sodium pyrophosphate Cut-off, U	ecoinvent 3.9
Textile, nonwoven polypropylene {GLO} market for textile, nonwoven polypropylene Cut-off, U	ecoinvent 3.9
Polypropylene, granulate {GLO} market for polypropylene, granulate Cut-off, U	ecoinvent 3.9
Polyethylene, low density, granulate {GLO} market for polyethylene, low density, granulate Cut-off, U	ecoinvent 3.9
Aluminium chloride {GLO} market for aluminium chloride Cut-off, U	ecoinvent 3.9
Citric acid {GLO} market for citric acid Cut-off, U	ecoinvent 3.9
Neutralising agent, sodium hydroxide-equivalent {GLO} market for neutralising agent, sodium hydroxide-equivalent Cut-off, U	ecoinvent 3.9
Calcium carbonate, precipitated {RoW} market for calcium carbonate, precipitated Cut-off, U	ecoinvent 3.9
Potato starch {GLO} market for potato starch Cut-off, U	ecoinvent 3.9
Maize starch {GLO} textile production, woven cotton Cut-off, U	ecoinvent 3.9
Textile, nonwoven polyester {GLO} market for textile, nonwoven polyester Cut-off, U	ecoinvent 3.9
Cellulose fibre {RoW} market for cellulose fibre Cut-off, U	ecoinvent 3.9
Acrylic binder, with water, in 54% solution state {RoW} market for acrylic binder, with water, in 54% solution state Cut-off, U	ecoinvent 3.9
Others	Literature

5. RESULTS

5.1 Fossil and Biogenic Climate Change

The fossil and biogenic climate change of 6 types of knitted garments are reported separately, results detailed by phase are as follows:

Table V-1-1: Fossil And Biogenic Climate Change of One Piece of Wool Jacquard Knitted Top- Heather Rose (Order#PO-00001340)

Phase Contribution	Climate Change, Fossil (kg CO ₂ e)	Climate Change, Biogenic (kg CO ₂ e)	Total (kg CO ₂ e)	Percentage Share (%)
[1] Raw materials	8.8994	0.1362	9.0356	97.83%
[2] Product manufacturing	0.1878	0.0000	0.1878	2.03%
[3] Packaging	0.0092	0.0000	0.0092	0.10%
[4] Transportation	0.0034	0.0001	0.0035	0.04%
Total	9.0998	0.1363	9.2361	100.0%

Table V-1-2: Fossil And Biogenic Climate Change of One Piece of Wool Jacquard Knitted Top- Mood Indigo (Order#PO-00001340)

Phase Contribution	Climate Change, Fossil (kg CO ₂ e)	Climate Change, Biogenic (kg CO ₂ e)	Total (kg CO ₂ e)	Percentage Share (%)
[1] Raw materials	9.0803	0.1411	9.2214	97.87%
[2] Product manufacturing	0.1878	0.0000	0.1878	1.99%
[3] Packaging	0.0092	0.0000	0.0092	0.10%
[4] Transportation	0.0034	0.0001	0.0035	0.04%
Total	9.2807	0.1412	9.4219	100.0%

Table V-1-3: Fossil And Biogenic Climate Change of One Piece of Wool Jacquard Knitted Body -Heather Rose (Order#PO-00001334)

Phase Contribution	Climate Change, Fossil (kg CO ₂ e)	Climate Change, Biogenic (kg CO ₂ e)	Total (kg CO ₂ e)	Percentage Share (%)
[1] Raw materials	7.7503	0.1184	7.8687	92.30%
[2] Product manufacturing	0.6445	-0.0002	0.6443	7.56%
[3] Packaging	0.0074	0.0000	0.0074	0.09%
[4] Transportation	0.0043	0.0002	0.0045	0.05%
Total	8.4065	0.1184	8.5249	100.0%

Table V-1-4: Fossil And Biogenic Climate Change of One Piece of Wool Jacquard Knitted Body - Mood Indigo (Order#PO-00001334)

Phase Contribution	Climate Change, Fossil (kg CO ₂ e)	Climate Change, Biogenic (kg CO ₂ e)	Total (kg CO ₂ e)	Percentage Share (%)
[1] Raw materials	7.9001	0.1224	8.0225	92.44%
[2] Product manufacturing	0.6445	-0.0002	0.6443	7.42%
[3] Packaging	0.0074	0.0000	0.0074	0.09%
[4] Transportation	0.0043	0.0002	0.0045	0.05%
Total	8.5563	0.1224	8.6787	100.0%

Table V-1-5: Fossil And Biogenic Climate Change of One Piece of Wool Jacquard Knitted Longjohn -Heather Rose (Order#PO-00001384)

Phase Contribution	Climate Change, Fossil (kg CO ₂ e)	Climate Change, Biogenic (kg CO ₂ e)	Total (kg CO ₂ e)	Percentage Share (%)
[1] Raw materials	7.0765	0.1079	7.1844	98.95%
[2] Product manufacturing	0.0651	-0.0002	0.0649	0.89%
[3] Packaging	0.0074	0.0000	0.0074	0.10%
[4] Transportation	0.0039	0.0002	0.0041	0.06%
Total	7.1529	0.1079	7.2608	100.0%

Table V-1-6: Fossil And Biogenic Climate Change of One Piece of Wool Jacquard Knitted Longjohn- Mood Indigo (Order#PO-00001384)

Phase Contribution	Climate Change, Fossil (kg CO ₂ e)	Climate Change, Biogenic (kg CO ₂ e)	Total (kg CO ₂ e)	Percentage Share (%)
[1] Raw materials	7.1100	0.1088	7.2188	98.95%
[2] Product manufacturing	0.0651	-0.0002	0.0649	0.89%
[3] Packaging	0.0074	0.0000	0.0074	0.10%
[4] Transportation	0.0039	0.0002	0.0041	0.06%
Total	7.1864	0.1088	7.2952	100.0%

5.2 Climate Change from Direct Land Use Change (dLUC)

Climate change from dLUC of 6 types of wool jacquard knitted top/body/longjohn are reported as below:

Table V-2-1 Climate Change of One Piece of Wool Jacquard Knitted Top- Heather Rose (Order#PO-00001340) from dLUC

Phase Contribution	Climate Change, dLUC (kg CO ₂ e)	Percentage Share (%)
[1] Raw materials	0.0691	99.86%
[2] Product manufacturing	0.0001	0.14%
[3] Packaging	0.0000	0.00%
[4] Transportation	0.0000	0.00%
Total	0.0692	100.0%

Table V-2-2 Climate Change of One Piece of Wool Jacquard Knitted Top- Mood Indigo
 (Order#PO-00001340) from dLUC

Phase Contribution	Climate Change, dLUC (kg CO ₂ e)	Percentage Share (%)
[1] Raw materials	0.0700	99.86%
[2] Product manufacturing	0.0001	0.14%
[3] Packaging	0.0000	0.00%
[4] Transportation	0.0000	0.00%
Total	0.0701	100.0%

Table V-2-3 Climate Change of One Piece of Wool Jacquard Knitted Body - Heather Rose
 (Order#PO-00001334) from dLUC

Phase Contribution	Climate Change, dLUC (kg CO ₂ e)	Percentage Share (%)
[1] Raw materials	0.0600	99.34%
[2] Product manufacturing	0.0004	0.66%
[3] Packaging	0.0000	0.00%
[4] Transportation	0.0000	0.00%
Total	0.0604	100.0%

Table V-2-4 Climate Change of One Piece of Wool Jacquard Knitted Body - Mood Indigo
 (Order#PO-00001334) from dLUC

Phase Contribution	Climate Change, dLUC (kg CO ₂ e)	Percentage Share (%)
[1] Raw materials	0.0608	99.35%
[2] Product manufacturing	0.0004	0.65%
[3] Packaging	0.0000	0.00%
[4] Transportation	0.0000	0.00%
Total	0.0612	100.0%

Table V-2-5 Climate Change of One Piece of Wool Jacquard Knitted Longjohn - Heather Rose
 (Order#PO-00001384) from dLUC

Phase Contribution	Climate Change, dLUC (kg CO ₂ e)	Percentage Share (%)
[1] Raw materials	0.0544	99.09%
[2] Product manufacturing	0.0005	0.91%
[3] Packaging	0.0000	0.00%
[4] Transportation	0.0000	0.00%
Total	0.0549	100.0%

Table V-2-6 Climate Change of One Piece of Wool Jacquard Knitted Longjohn - Mood Indigo
 (Order#PO-00001384) from dLUC

Phase Contribution	Climate Change, dLUC (kg CO ₂ e)	Percentage Share (%)
[1] Raw materials	0.0546	99.09%
[2] Product manufacturing	0.0005	0.91%
[3] Packaging	0.0000	0.00%
[4] Transportation	0.0000	0.00%
Total	0.0551	100.0%



5.3 Climate Change from Aircraft

Climate change from aircraft of 6 types of wool jacquard knitted top/body/longjohn are reported as below:

Table V-3-1: Climate Change of One Piece of Wool Jacquard Knitted Top- Heather Rose (Order#PO-00001340) From Aircraft

Phase Contribution	Climate Change, Aircraft (kg CO ₂ e)	Percentage Share (%)
[1] Raw materials	0.0000E+00	0.00%
[2] Product manufacturing	5.2259E-08	99.96%
[3] Packaging	5.0822E-12	0.01%
[4] Transportation	1.4160E-11	0.03%
Total	5.2278E-08	100.0%

Table V-3-2: Climate Change of One Piece of Wool Jacquard Knitted Top-Mood Indigo (Order#PO-00001340) From Aircraft

Phase Contribution	Climate Change, Aircraft (kg CO ₂ e)	Percentage Share (%)
[1] Raw materials	0.0000E+00	0.00%
[2] Product manufacturing	5.2259E-08	99.96%
[3] Packaging	5.0822E-12	0.01%
[4] Transportation	1.4160E-11	0.03%
Total	5.2278E-08	100.0%

Table V-3-3: Climate Change of One Piece of Wool Jacquard Knitted Body- Heather Rose (Order#PO-00001334) From Aircraft

Phase Contribution	Climate Change, Aircraft (kg CO ₂ e)	Percentage Share (%)
[1] Raw materials	0.0000E+00	0.00%
[2] Product manufacturing	1.8015E-07	99.99%
[3] Packaging	4.1293E-12	0.00%
[4] Transportation	1.7706E-11	0.01%
Total	1.8018E-07	100.0%

Table V-3-4: Climate Change of One Piece of Wool Jacquard Knitted Body - Mood Indigo (Order#PO-00001334) From Aircraft

Phase Contribution	Climate Change, Aircraft (kg CO ₂ e)	Percentage Share (%)
[1] Raw materials	0.0000E+00	0.00%
[2] Product manufacturing	1.8015E-07	99.99%
[3] Packaging	4.1293E-12	0.00%
[4] Transportation	1.7706E-11	0.01%
Total	1.8018E-07	100.0%

**Table V-3-5: Climate Change of One Piece of Wool Jacquard Knitted Longjohn -Heather Rose
(Order#PO-00001384) From Aircraft**

Phase Contribution	Climate Change, Aircraft (kg CO ₂ e)	Percentage Share (%)
[1] Raw materials	0.0000E+00	0.00%
[2] Product manufacturing	2.2498E-07	99.99%
[3] Packaging	4.0234E-12	0.00%
[4] Transportation	1.6143E-11	0.01%
Total	2.2500E-07	100.0%

**Table V-3-6: Climate Change of One Piece of Wool Jacquard Knitted Longjohn- Mood Indigo
(Order#PO-00001384) From Aircraft**

Phase Contribution	Climate Change, Aircraft (kg CO ₂ e)	Percentage Share (%)
[1] Raw materials	0.0000E+00	0.00%
[2] Product manufacturing	2.2498E-07	99.99%
[3] Packaging	4.0234E-12	0.00%
[4] Transportation	1.6143E-11	0.01%
Total	2.2500E-07	100.0%

5.4 Summary

The Total value of carbon footprint from cradle to gate of 6 types of wool jacquard knitted top/body/longjohn are reported as below:

Table V-4-1: Partial Carbon Footprint of One Piece of Wool Jacquard Knitted Top- Heather Rose (Order#PO-00001340) from Cradle to Gate

Phase Contribution	Fossil (kg CO ₂ e)	Biogenic (kg CO ₂ e)	dLUC (kg CO ₂ e)	AIRCRAFT (kg CO ₂ e)	Total (kg CO ₂ e)	Percentage Share (%)
[1] Raw materials	8.8994	0.1362	0.0691	0.0000E+00	9.1047	97.84%
[2] Product manufacturing	0.1878	0.0000	0.0001	5.2259E-08	0.1879	2.02%
[3] Packaging	0.0092	0.0000	0.0000	5.0822E-12	0.0092	0.10%
[4] Transportation	0.0034	0.0001	0.0000	1.4160E-11	0.0035	0.04%
Total	9.0998	0.1363	0.0692	5.2278E-08	9.3053	100.0%

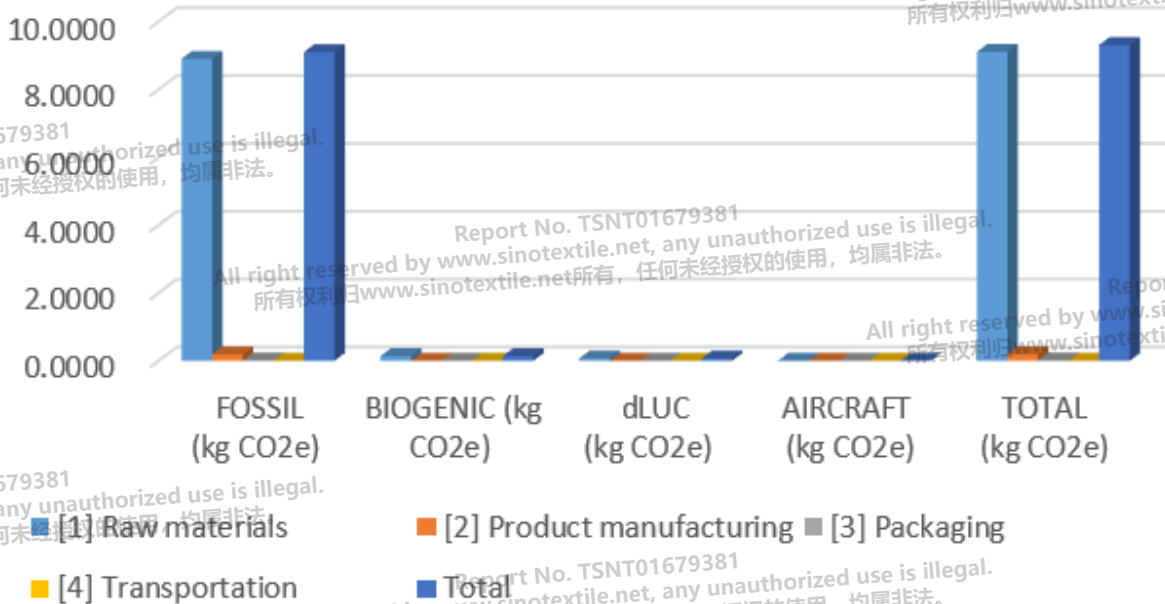


Figure V-4-1: Partial Carbon Footprint of One Piece of Wool Jacquard Knitted Top- Heather Rose (Order#PO-00001340) from Cradle to Gate

Table V-4-2: Partial Carbon Footprint of One Piece of Wool Jacquard Knitted Top- Mood Indigo (Order#PO-00001340) from Cradle to Gate

Phase Contribution	Fossil (kg CO ₂ e)	Biogenic (kg CO ₂ e)	dLUC (kg CO ₂ e)	Aircraft (kg CO ₂ e)	Total (kg CO ₂ e)	Percentage Share (%)
[1] Raw materials	9.0803	0.1411	0.0700	0.0000E+00	9.2914	97.89%
[2] Product manufacturing	0.1878	0.0000	0.0001	5.2259E-08	0.1879	1.98%
[3] Packaging	0.0092	0.0000	0.0000	5.0822E-12	0.0092	0.10%
[4] Transportation	0.0034	0.0001	0.0000	1.4160E-11	0.0035	0.04%
Total	9.2807	0.1412	0.0701	5.2278E-08	9.4920	100.0%

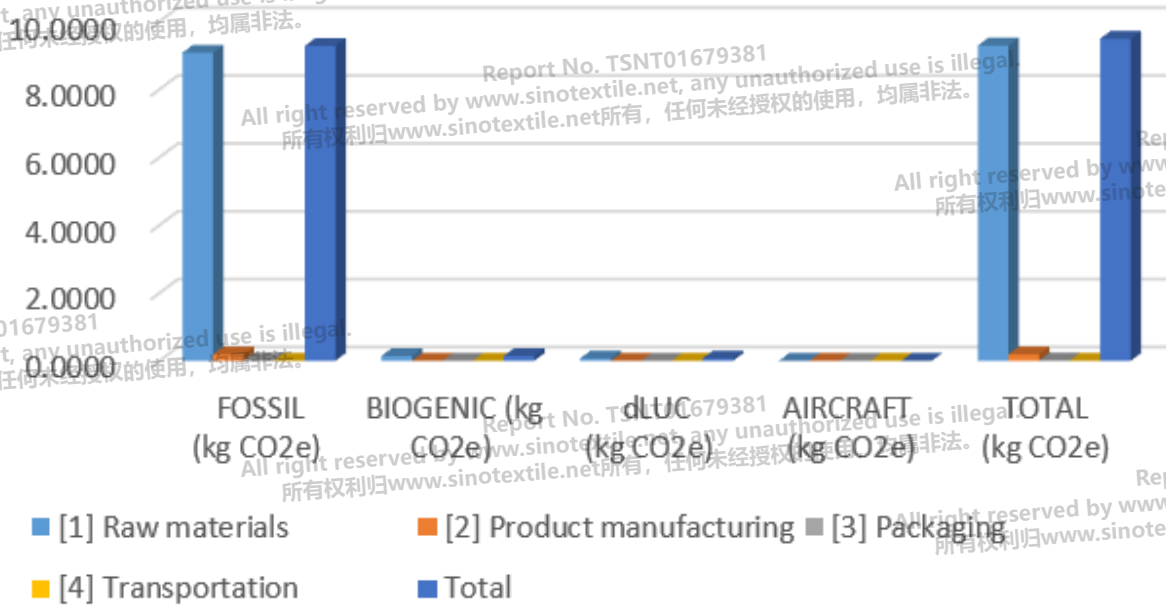


Figure V-4-2: Partial Carbon Footprint of One Piece of Wool Jacquard Knitted Top- Mood Indigo (Order#PO-00001340) from Cradle to Gate

Table V-4-3: Partial Carbon Footprint of One Piece of Wool Jacquard Knitted Body -Heather Rose (Order#PO-00001334) from Cradle to Gate

Phase Contribution	Fossil (kg CO ₂ e)	Biogenic (kg CO ₂ e)	dLUC (kg CO ₂ e)	Aircraft (kg CO ₂ e)	Total (kg CO ₂ e)	Percentage Share (%)
[1] Raw materials	7.7503	0.1184	0.0600	0.0000E+00	7.9287	92.35%
[2] Product manufacturing	0.6445	-0.0002	0.0004	1.8015E-07	0.6447	7.51%
[3] Packaging	0.0074	0.0000	0.0000	4.1293E-12	0.0074	0.09%
[4] Transportation	0.0043	0.0002	0.0000	1.7706E-11	0.0045	0.05%
Total	8.4065	0.1184	0.0604	1.8018E-07	8.5853	100.0%

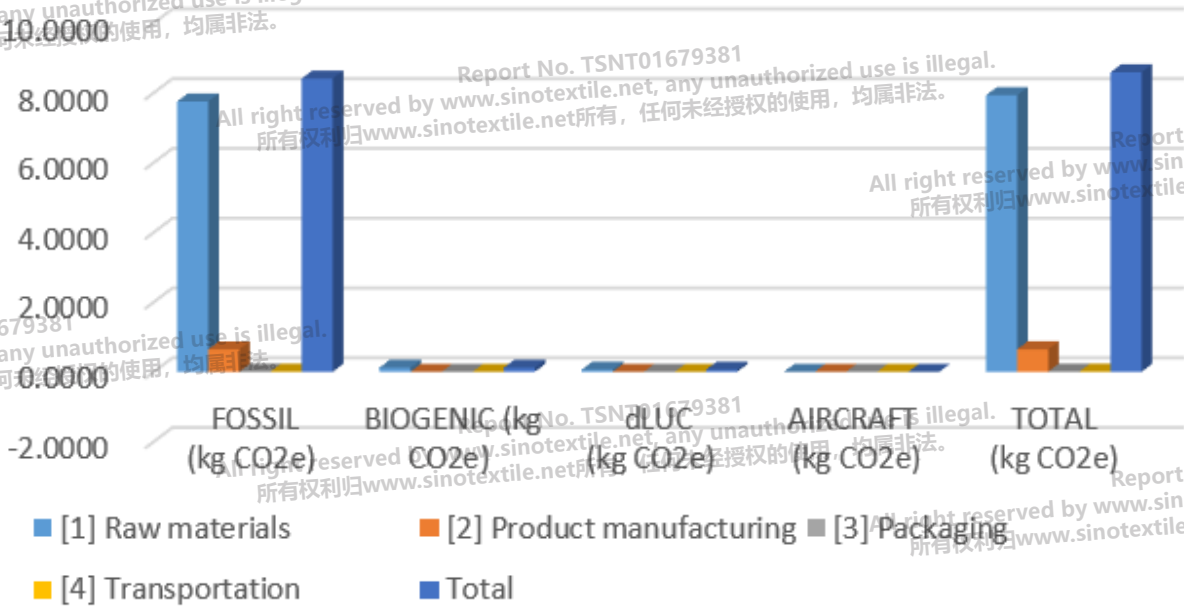


Figure V-4-3: Partial Carbon Footprint of One Piece of Wool Jacquard Knitted Body -Heather Rose (Order#PO-00001334) from Cradle to Gate

Table V-4-4: Partial Carbon Footprint of One Piece of Wool Jacquard Knitted Body- Mood Indigo (Order#PO-00001334) from Cradle to Gate

Phase Contribution	Fossil (kg CO ₂ e)	Biogenic (kg CO ₂ e)	dLUC (kg CO ₂ e)	Aircraft (kg CO ₂ e)	Total (kg CO ₂ e)	Percentage Share (%)
[1] Raw materials	7.9001	0.1224	0.0608	0.0000E+00	8.0833	92.49%
[2] Product manufacturing	0.6445	-0.0002	0.0004	1.8015E-07	0.6447	7.38%
[3] Packaging	0.0074	0.0000	0.0000	4.1293E-12	0.0074	0.08%
[4] Transportation	0.0043	0.0002	0.0000	1.7706E-11	0.0045	0.05%
Total	8.5563	0.1224	0.0612	1.8018E-07	8.7399	100.0%

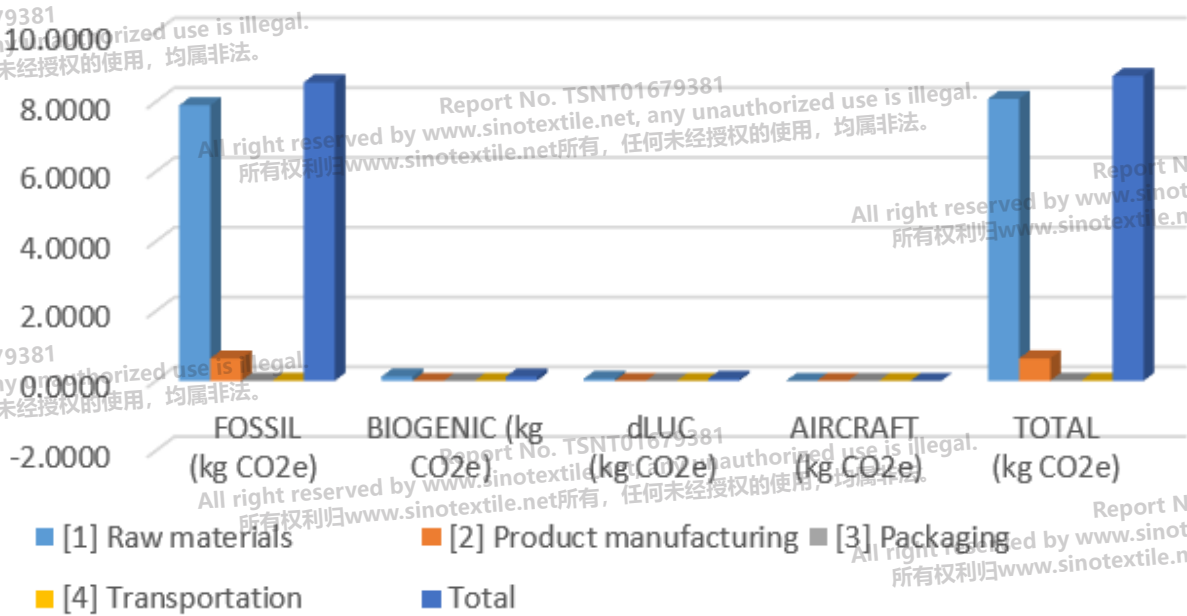


Figure V-4-4: Partial Carbon Footprint of One Piece of Wool Jacquard Knitted Body- Mood Indigo (Order#PO-00001334) from Cradle to Gate

Table V-4-5: Partial Carbon Footprint of One Piece Of Wool Jacquard Knitted Longjohn -Heather Rose (Order#PO-00001384) from Cradle to Gate

Phase Contribution	Fossil (kg CO ₂ e)	Biogenic (kg CO ₂ e)	dLUC (kg CO ₂ e)	Aircraft (kg CO ₂ e)	Total (kg CO ₂ e)	Percentage Share (%)
[1] Raw materials	7.0765	0.1079	0.0544	0.0000E+00	7.2388	98.95%
[2] Product manufacturing	0.0651	-0.0002	0.0005	2.2498E-07	0.0654	0.89%
[3] Packaging	0.0074	0.0000	0.0000	4.0234E-12	0.0074	0.10%
[4] Transportation	0.0039	0.0002	0.0000	1.6143E-11	0.0041	0.06%
Total	7.1529	0.1079	0.0549	2.2500E-07	7.3157	100.0%

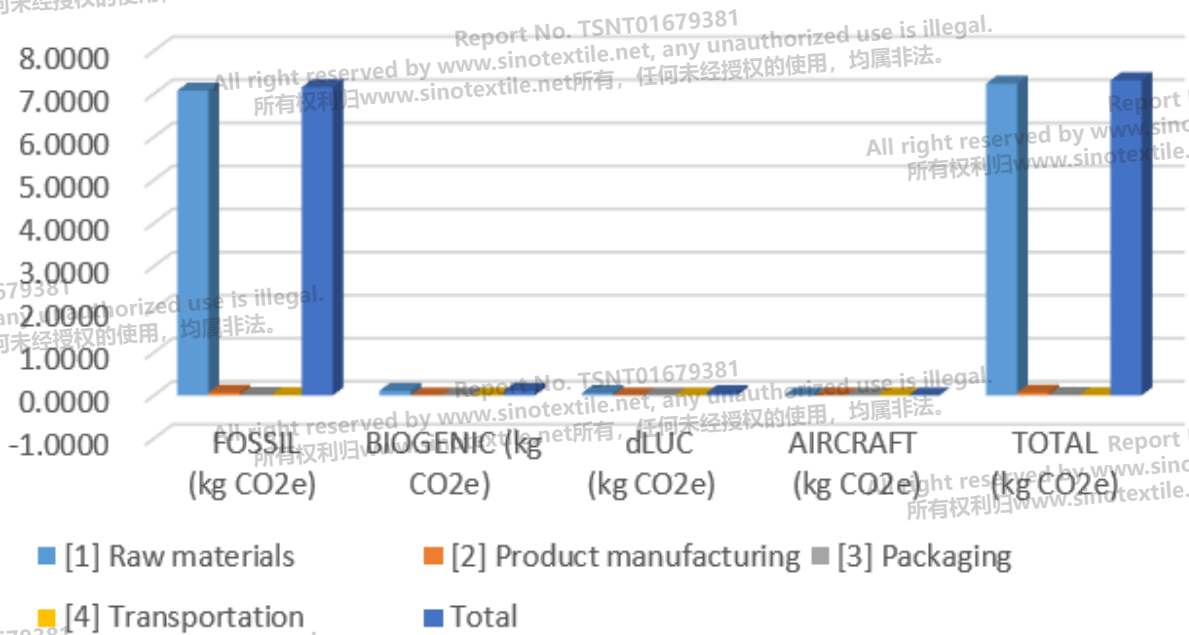


Figure V-4-5: Partial Carbon Footprint of One Piece of Wool Jacquard Knitted Longjohn -Heather Rose (Order#PO-00001384) from Cradle to Gate

Table V-4-6: Partial Carbon Footprint One Piece Of Wool Jacquard Knitted Longjohn - Mood Indigo (Order#Po-00001384) from Cradle to Gate

Phase Contribution	Fossil (kg CO ₂ e)	Biogenic (kg CO ₂ e)	dLUC (kg CO ₂ e)	Aircraft (kg CO ₂ e)	Total (kg CO ₂ e)	Percentage Share (%)
[1] Raw materials	7.1100	0.1088	0.0546	0.0000E+00	7.2734	98.95%
[2] Product manufacturing	0.0651	-0.0002	0.0005	2.2498E-07	0.0654	0.89%
[3] Packaging	0.0074	0.0000	0.0000	4.0234E-12	0.0074	0.10%
[4] Transportation	0.0039	0.0002	0.0000	1.6143E-11	0.0041	0.06%
Total	7.1864	0.1088	0.0551	2.2500E-07	7.3503	100.0%

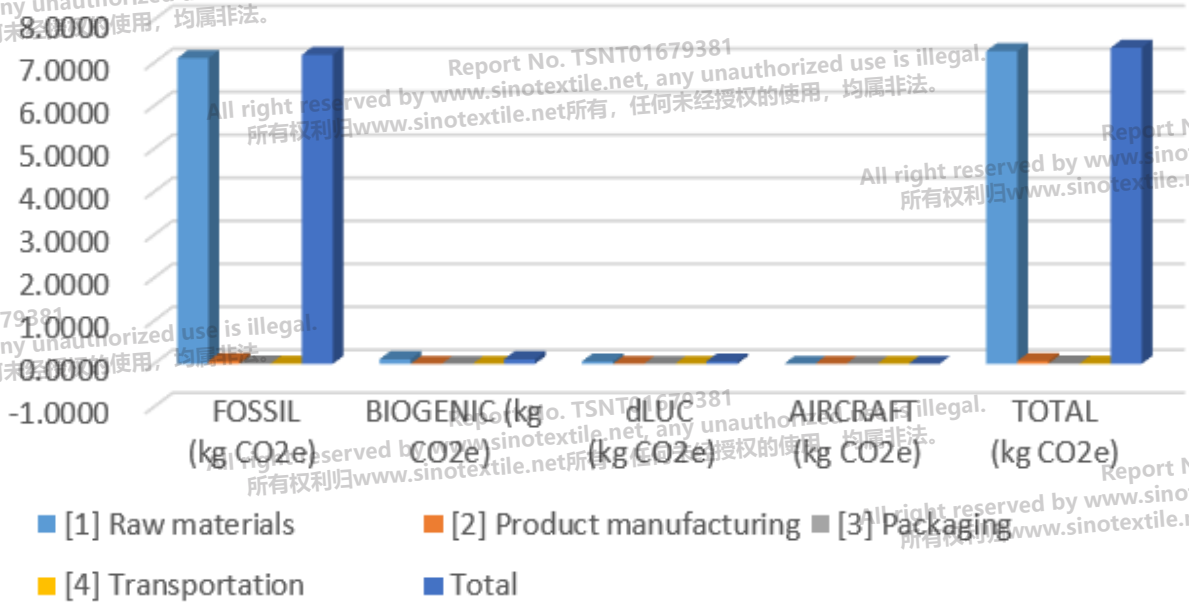


Figure V-4-6: Partial Carbon Footprint of One Piece of Wool Jacquard Knitted Longjohn- Mood Indigo (Order#PO-00001384) from Cradle to Gate

6. INTERPRETATION

6.1 Conclusions

A result overview refers to **Table V-4 in Chapter 5**.

The partial LCA study reveals that depending on type:

- Regarding greenhouse effect, the 6 types of garments have different influence on total GHG emission, which are ranged from 7.3157 kg CO₂ eq to 9.4920 kg CO₂ eq. However, the raw materials used in these products have much greatly influence on total GHG emission, which account from 92.35% to 98.95%.
- Energy and resource consumption in product manufacturing account for 0.89% to 7.51% of the total impact, which is the second influential factor after the raw materials.
- The effect of product package and transportation are limited relatively

6.2 Completeness, Consistency, and Sensitivity Analysis

6.2.1 Completeness Analysis

The principles of data collection, cut-off rules and allocation methods used in this study meet the integrity requirements of LCA.

6.2.2 Consistency Analysis

The primary data, secondary data, system boundaries, etc. consistent with the research purpose and scope of this study.

6.2.3 Sensitivity Analysis

The sensitivity analysis is to identifies the significance of the impacts on carbon footprint regarding the variability of the parameters and the data.

As there is no separate meter, the total electricity consumption used in one piece of wool jacquard knitted top-heather rose during the semi-finished jacquard knitted fabric/interlock knitted fabric manufacturing process in this study is assumed to be 2.6544 kWh/kg / 0.7964 kWh/kg, in alternative scenario 1, calculated by the ratio of equipment power to the total power of the workshop.

On the other hand, in alternative scenario 2, the total electricity consumption used in one piece of wool jacquard knitted top-heather rose during the semi-finished jacquard knitted fabric/interlock knitted fabric manufacturing process in this study is assumed to be 1.4469 kWh/kg / 1.4469 kWh/kg, calculated by the ratio of the weight of this kind of fabric to the total weight of the fabric produced in the workshop.

Take one piece of wool jacquard knitted top-heather rose as an example. Under scenario 1 and scenario 2, the sensitivity analysis results for the electricity consumption in the manufacturing process of semi-finished heather rose jacquard knitted fabric/interlock knitted fabric are as below. Sensitivity can be expressed as a percentage change of results present in **Table VI-1**.

Table VI-1: Sensitivity Analysis Of The Alternative Scenarios Of The Electricity Consumption

Alternative Scenario	Electricity Consumption (kWh/kg)		GWP100, Total (kg Co ₂ e)	Sensitivity (%)
	Semi-Finished Jacquard Knitted Fabric	Semi-Finished Interlock Knitted Fabric		
Alternative scenario 1	2.6544	0.7964	9.3053	1.95%
Alternative scenario 2	1.4469	1.4469	9.2697	1.73%

6.3 Uncertainty Assessment

The Monte Carlo method is used to calculate the uncertainty of the results. For raw data themselves, uncertainties may exist due to limitations of accuracy of the instruments, inconsistencies between the time spots of data recording, and the actual production time, etc. Take wool jacquard knitted top-heather rose as an example, the overview of uncertainty analysis result is shown in **Figure VI-2**. The horizontal axis represents the possible results, and the vertical axis represents the probability of the corresponding result occurring. The specific results refer to **Table VI-2** below:

Figure VI-2: Uncertainty Analysis of The Partial CFP Result

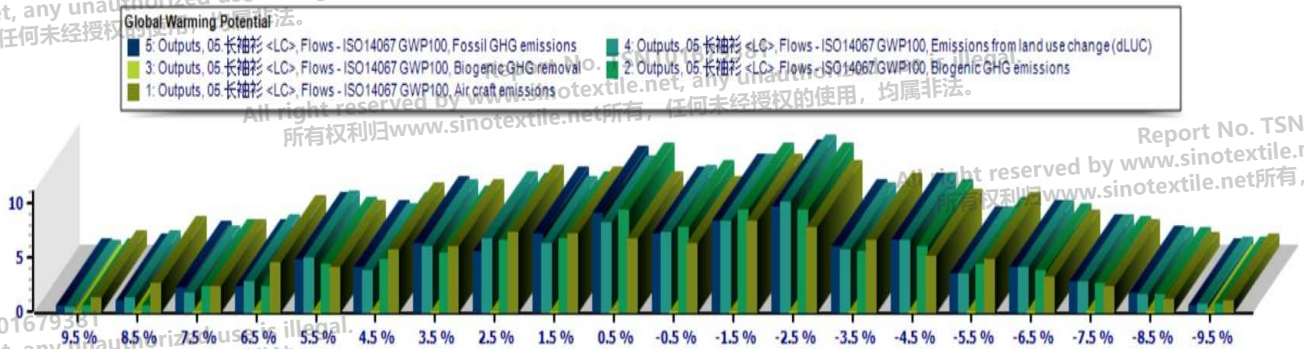


Table VI-2: Uncertainty Analysis Results

Data	Average Value (kg CO ₂ e)	Mid-Value (kg CO ₂ e)	Standard Deviation	Lower Limit of 80% Confidence Interval	Upper Limit Of 80% Confidence Interval
Aircraft (kg CO ₂ e)	5.2446E-008	5.2379E-008	4.93%	4.9311E-008	5.5783E-008
Biogenic Removal (kg CO ₂ e)	0.0000	0.0000	0.00%	0.0000	0.0000
Biogenic (kg CO ₂ e)	0.1418	0.1418	4.80%	0.1332	0.1505
dLUC (kg CO ₂ e)	0.0688	0.0688	5.01%	0.0645	0.0732
Fossil (kg CO ₂ e)	9.0460	9.0369	4.91%	8.4867	9.6076

6.4 Limit of the Study

Since the electricity consumption in fabric production is allocated by equipment power, there is limitation in this study.



6.5 Recommendations

Based on the above report, the recommendations are as follows:

- Additional measuring instruments, such as electric meters, may be added in the workshops to minimize assumptions and make the collected data more accurate.
- Increased use of renewable energy sources such as green electricity should reduce the total carbon emissions of finished products.

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