

Product Carbon Footprint: Life Cycle Assessment Report for Wuka



**A study of Wuka's Bikini, Midi Brief,
Seamless, Basics, Everyday Pants & Bralette**



Executive Summary

This report provides an analysis of the greenhouse gas (GHG) emissions associated with **Wuka's Bikini, Midi Brief, Seamless, Basics, Everyday Pants & Bralette and associated packaging**. The assessment includes the full lifecycle of the products; from the embodied raw materials, and transportation of these materials; the manufacture and distribution of the finished product; as well as the usage and disposal.

Wuka's products are designed to be sustainable, made predominately from a mix of cotton, Tencel modal, thermoplastic polyurethane (TPU) and elastane. All the materials are sourced from China where they are manufactured in the Shantou factory before being sent to St Albans in the UK for distribution. The life cycles have been modelled as 2 years for the Bralette and period pants (Bikini, Midi Brief, Seamless, Basics) and 5 years for the Everyday Pants. Usage (cleaning) was modelled as all products being washed within a washing machine and line dried once a month. The period pants were also modelled to be rinsed under a cold tap pre-wash. The products can be recycled at the end of life.

Total **cradle to grave** product carbon emissions for each of Wuka's products are shown in the following table and chart; split by lifecycle stage. The majority of emissions are associated with the raw materials and product usage.

| Lifecycle Stage | GHG Emissions (gCO ₂ e) | | | | | |
|--------------------------|------------------------------------|---------------|---------------|---------------|----------------|---------------|
| | Bikini | Midi Brief | Seamless | Basics | Everyday Pants | Bralette |
| Raw materials – embodied | 282.54 | 273.80 | 217.32 | 243.03 | 114.05 | 112.11 |
| Raw materials transport | 6.08 | 6.16 | 6.13 | 5.86 | 0.70 | 0.64 |
| Manufacture | 150.90 | 150.90 | 150.90 | 150.90 | 150.90 | 150.90 |
| Product distribution | 29.94 | 32.86 | 31.04 | 20.08 | 26.66 | 22.27 |
| Usage | 185.58 | 199.76 | 190.90 | 137.75 | 234.74 | 72.64 |
| Disposal | 1.53 | 1.70 | 1.59 | 0.95 | 1.33 | 1.08 |
| Total Emissions | 656.57 | 665.18 | 597.87 | 558.58 | 528.38 | 359.64 |

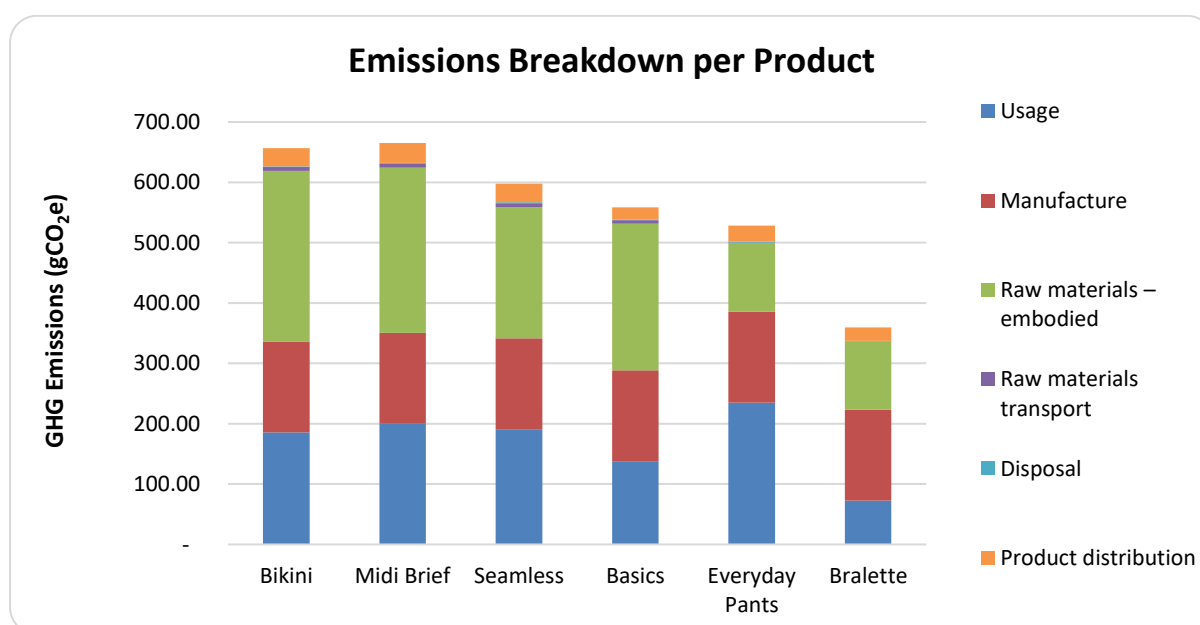


Table of Contents

| | |
|--|----|
| 1. Introduction..... | 3 |
| 2. Product overview..... | 5 |
| 3. Accuracy of the Product Carbon Footprint Calculation..... | 6 |
| 4. Product Carbon Footprint Results | 7 |
| 5. Carbon Footprint Standard..... | 12 |
| 6. References | 13 |
| Annex 1: Emission Factors | 14 |

Quality Control

Report issue number: 1.1
Date: 11 August 2021

Calculations completed by: Grace Parker & Myles Howard
Calculations reviewed by: Rebecca Pattison

Report produced by: Grace Parker & Myles Howard
Report reviewed by: Katie Elmer

Director: John Buckley

1. Introduction

1.1 Scope of this Assessment

Wuka produce a range of sustainable underwear, specialising in reusable period pants. The aim of this assessment is to demonstrate the environmental credentials of Wuka's Bikini, Midi Brief, Seamless, Basics, Everyday Pants & Bralette and to enable Wuka to achieve carbon neutrality for these products. This will be a key marketing point for the company and will help to demonstrate Wuka's commitment to monitoring its impact to its consumers, as well as providing consumers with an eco-alternative fashion brand.

Carbon emissions for the product assessed in this report include those derived from:

- the raw materials
- the transport of the raw materials to the factory
- the manufacturing of materials to finished product
- modelled global distribution of products to consumers
- modelled usage/cleaning of product
- disposal of the product

1.2 What is a Product Carbon Footprint Assessment?

This assesses the green-house gas impacts of a product or service during its life cycle. It incorporates the analysis of raw materials, manufacture, transport, usage and disposal.

The product carbon footprint detailed in this report is for *Cradle-to-Grave* carbon impact.

1.3 How is the product carbon footprint calculated?

The product carbon footprint is derived from a combination of activity data provided by Wuka and emission factors extracted from internationally recognised metrics. Greenhouse gas (GHG) activity data is then multiplied by GHG emission factors to produce carbon metrics.

To guarantee transparency and reproducibility, the emission factors used in this report are shown in Annex 1 detailing the exact name of the emission factor as it appears on its respective database. All material emissions factors are sourced either from Ecolnvent's database (v3.7.1) or the UK Government (BEIS, 2020). When an exact material emissions factor was not available for some raw materials, a suitable alternative was researched and used instead.

China electricity generation and transmission and distribution factors are sourced from Climate Transparency Report (2019) and Defra/BEIS factors; published in June 2017 (v1.0).

1.4 Abbreviations

| | |
|-------------------|---|
| CO ₂ | Carbon Dioxide |
| CO ₂ e | Carbon Dioxide Equivalent |
| BEIS | Department for Business, Energy and Industrial Strategy |
| Defra | Department of Environment, Food and Rural Affairs |
| g | Grammes |
| GHG | Greenhouse Gas |
| GLO | Global |
| kg | Kilogrammes |
| km | Kilometres |
| kWh | Kilowatt Hours |
| LCA | Life Cycle Assessment |
| RER | Europe |
| RoW | Rest of World |
| TPU | Thermoplastic polyurethane |

2. Product overview

Wuka produce all their products in a factory in Shantou, China. All the materials are sourced from within China, which are then transported by truck to the factory. The main components of the underwear are all made from cotton, Tencel modal or nylon and the period pants also include a layer of thermoplastic polyurethane (TPU) which is used to absorb the menstruation.

Once manufactured, they are then shipped to the UK and sent to the distribution centre in St Albans. The products are distributed to individual customers (B2C) and businesses (B2B). The distribution was modelled as 70% sent to B2C to individual customers. Of those sent B2C, 70% were modelled to be located in the UK (50 km used as proxy distance); and 30% within Europe (for which Berlin was used as proxy). The 30% of products sent to B2B were modelled to be split evenly between Cardiff, Edinburgh and London.

The Bralette and period pants (Bikini, Midi Brief, Seamless, Basics) are modelled to have a life expectancy of 2 years, whilst the Everyday Pants were modelled as 5 years. Each product is expected to be cleaned on a monthly basis within a washing machine, and line dried once a month. The period pants were also modelled to be rinsed under a cold tap for 30 seconds pre-wash. The products can be recycled at the end of life.

Wuka produce the products in several different sizes. This assessment focuses on garments of the most popular size sold (medium). All the products are packaged in a biodegradable plastic bag.

Table 1 details the individual materials which make up the product.

Table 1: Overview of all raw material mass

| Component | Material | Material mass in final product (g) | | | | | |
|-----------------------------|-------------------------------|------------------------------------|------------|-----------|-----------|----------------|-----------|
| | | Bikini | Midi Brief | Seamless | Basics | Everyday Pants | Bralette |
| Product | | | | | | | |
| Main Garment | Organic cotton | 30 | - | - | - | - | - |
| Main Garment | Cotton | - | - | - | 3 | - | - |
| Main Garment | Tencel modal | - | 34 | - | - | 44 | 32 |
| Main Garment | Recycled nylon | - | - | 40 | - | - | - |
| Sanitary pad layer | TPU | 6 | 6 | 6 | 6 | - | - |
| Sanitary pad layer | Absorbent Poly / Cotton Blend | 16 | 16 | 16 | 16 | - | - |
| Waistband / stretch mix | Elastane | 10 | 10 | - | 10 | 9 | 9 |
| Waistband | Organic cotton | - | - | 3 | - | - | - |
| Side Panels to main garment | Polyester mesh | - | 4 | - | - | - | - |
| Subtotal | | 62 | 70 | 65 | 35 | 53 | |
| Packaging | | | | | | | |
| Packaging | Biodegradable plastic | 20 | 20 | 20 | 20 | 20 | 20 |
| Total Mass (kg) | | 82 | 90 | 85 | 55 | 73 | 61 |

3. Accuracy of the Product Carbon Footprint Calculation

The accuracy of the overall carbon footprint calculation (Table 2) is considered good. The primary raw material data was submitted by Wuka. Usage and disposal were modelled by Carbon Footprint based on assumptions discussed with Wuka.

Table 2: Source data and calculation accuracy

| Dataset | Source of data and comments | Accuracy |
|--|--|-----------|
| Raw materials Embodied emissions | Product specifications (materials and weight (g)) supplied by Wuka for medium sized garments. The main garment is modelled as 5% elastane and the sanitary pad layer (absorbent poly/cotton blend) is modelled as 80% polyester fibre and 20% cotton. | Very Good |
| Raw materials Transport | Destinations and distances provided. Materials sourced within Shantou were modelled as 35 km. | Good |
| Manufacturing Products | Annual energy consumption data was provided, which was then apportioned using the percentage of the business that Wuka accounts for (10%) and the total number of products made (20,000). | Very Good |
| Product distribution | Distribution was modelled as 70% sent to B2C to individual customers, 70% of which being located in the UK (50 km used as proxy distance) and 30% within Europe (for which Berlin was used as proxy). The 30% of products sent to B2B were modelled to be split evenly between Cardiff, Edinburgh and London. | Good |
| Usage | Each product was modelled to be cleaned on a monthly basis within a washing machine and line dried once a month. The period pants were also modelled to be rinsed in the shower pre-wash. The energy consumption for the washing machine was modelled assuming a 4kg load using 40 litres water and 1 kWh per cycle which was apportioned to each garment based on weight. Rinsing in the shower was modelled as consuming 8 litres of water. | Good |
| Disposal | All materials are recyclable except the packaging which is compostable. | Good |

4. Product Carbon Footprint Results

4.1 Summary of results

This report provides an analysis of the greenhouse gas (GHG) emissions associated with a medium sized Bikini, Midi Brief, Seamless, Basics, Everyday Pants and Bralette and associated packaging. The assessment focuses on the embodied raw materials, and transportation of these materials, the manufacture and distribution of the products, as well as the usage and disposal.

Total **cradle to grave** product carbon emissions for each product are presented below. A breakdown of the carbon emissions for each product is shown below (Table 3 and Figure 2); split by lifecycle stage. The majority of emissions (22-44%) are associated with the embodied emissions of the materials. The emissions associated with cleaning of the garments are also significant, accounting for a similar 20-44% of the total product footprint.

Table 3: Breakdown of the product footprint by lifecycle stage

| Lifecycle Stage | GHG Emissions (gCO ₂ e) | | | | | |
|--------------------------|------------------------------------|---------------|---------------|---------------|----------------|---------------|
| | Bikini | Midi Brief | Seamless | Basics | Everyday Pants | Bralette |
| Raw materials – embodied | 282.54 | 273.80 | 217.32 | 243.03 | 114.05 | 112.11 |
| Raw materials transport | 6.08 | 6.16 | 6.13 | 5.86 | 0.70 | 0.64 |
| Manufacture | 150.90 | 150.90 | 150.90 | 150.90 | 150.90 | 150.90 |
| Product distribution | 29.94 | 32.86 | 31.04 | 20.08 | 26.66 | 22.27 |
| Usage | 185.58 | 199.76 | 190.90 | 137.75 | 234.74 | 72.64 |
| Disposal | 1.53 | 1.70 | 1.59 | 0.95 | 1.33 | 1.08 |
| Total Emissions | 656.57 | 665.18 | 597.87 | 558.58 | 528.38 | 359.64 |

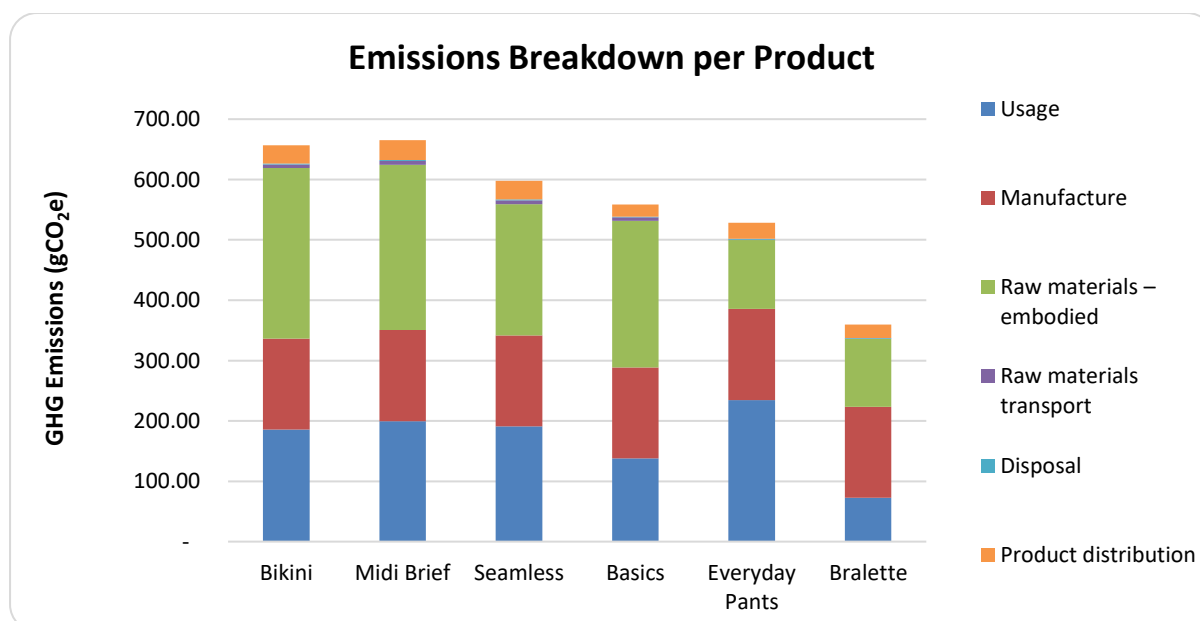


Figure 1: Breakdown of product footprint by lifecycle stage

4.2 Embodied emissions from raw materials

Table 4 provides a breakdown of embodied emissions. It shows that the sanitary pad layers and the elastane use in the waistbands/stretch mix have the greatest impact, with the emissions accounting for the majority of the embodied emissions (44-78% of the total embodied emissions). This is because the absorbent poly, elastane and TPU are the most energy intensive to produce. In comparison, the Tencel Modal has the lowest associated emissions, accounting for only 5-16% of the total embodied emissions associated with Midi Brief, Everyday Pants and Bralette despite accounting for 38-60% of the total weight.

Table 4: Embodied emissions from raw materials

| Component | Material | Raw Material Emissions (gCO ₂ e) | | | | | |
|-----------------------------|-------------------------------|---|---------------|---------------|---------------|----------------|---------------|
| | | Bikini | Midi Brief | Seamless | Basics | Everyday Pants | Bralette |
| Main Garment | Organic cotton | 44.83 | - | - | - | - | - |
| Main Garment | Cotton | - | - | - | 7.71 | - | - |
| Main Garment | Tencel modal | - | 13.52 | - | - | 17.91 | 13.03 |
| Main Garment | Recycled nylon | - | - | 31.20 | - | - | - |
| Sanitary pad layer | TPU | 41.56 | 42.64 | 42.13 | 39.35 | - | - |
| Sanitary pad layer | Absorbent Poly / Cotton Blend | 94.40 | 94.40 | 94.40 | 94.40 | - | - |
| Waistband / stretch mix | Elastane | 56.03 | 56.03 | - | 56.03 | 50.42 | 53.36 |
| Waistband | Organic cotton | - | - | 3.86 | - | - | - |
| Side Panels to main garment | Polyester mesh | - | 21.48 | - | - | - | - |
| Packaging | Biodegradable plastic | 45.72 | 45.72 | 45.72 | 45.72 | 45.72 | 45.72 |
| Total | | 282.54 | 273.80 | 217.32 | 243.03 | 114.05 | 112.11 |

4.3 Emissions from Manufacturing

All the products are manufactured in a Shantou factory in China. Wuka accounts for 10% of the factory's business, and produced 20,000 products in the last year. The factory provided production energy consumption which was apportioned to a single product and multiplied by the appropriate emission factor for each energy type. A summary of manufacturing emissions is provided in Table 5 below.

Table 5: Production Emissions

| Factory Location | Manufacturing emissions (gCO ₂ e) |
|------------------|--|
| China | 150.90 |

4.4 Emissions from Transport (Raw material and Distribution)

The emissions associated with transport reflect the mass of materials, the mode of transport and the distance travelled.

4.3.1 Raw materials transport

Wuka provided the locations and distances between the suppliers and the factory. All the materials are sourced from within China and are transported by a truck. The raw materials for the main garments and elastane are sourced locally, whilst the materials for the sanitary pad layer are sourced from Dongbei. After manufacture, the products are taken to Guangzhou Port and shipped to Portsmouth, before being trucked to the distribution centre in St Albans.

Table 6 shows the raw material transport emissions.

Table 6: Total Raw material transport emissions per product

| Raw material transport emissions (gCO ₂ e) | | | | | |
|---|------------|----------|--------|----------------|----------|
| Bikini | Midi Brief | Seamless | Basics | Everyday Pants | Bralette |
| 6.08 | 6.16 | 6.13 | 5.86 | 0.70 | 0.64 |

4.3.2 Product distribution

Product distribution from the St Albans site was modelled as 70% sent to B2C to individual customers, 30% of products sent to B2B. The B2C deliveries were modelled as 70% being sent to locations in the UK (for which 50 km used as proxy distance) and 30% within Europe (for which Berlin was used as proxy). For the B2B deliveries, it was modelled that the products were split evenly between Cardiff, Edinburgh and London.

Table 7 shows the average carbon emissions associated with product distribution. The majority of emissions are associated with B2C distribution to the UK, which is to be expected as it accounts for the largest proportion of distribution.

Table 7: Modelled product distribution emissions (including apportioned packaging weights)

| Clients | Destination | % of products | Product distribution emissions (gCO ₂ e) | | | | | |
|--------------|-------------|---------------|---|--------------|--------------|--------------|----------------|--------------|
| | | | Bikini | Midi Brief | Seamless | Basics | Everyday Pants | Bralette |
| B2C | UK | 49% | 13.40 | 14.70 | 13.89 | 8.99 | 11.93 | 9.97 |
| | Europe | 21% | 7.68 | 8.43 | 7.96 | 5.15 | 6.83 | 5.71 |
| B2B | Cardiff | 10% | 2.93 | 3.22 | 3.04 | 1.97 | 2.61 | 2.18 |
| | Edinburgh | 10% | 3.22 | 3.54 | 3.34 | 2.16 | 2.87 | 2.40 |
| | London | 10% | 2.71 | 2.98 | 2.81 | 1.82 | 2.41 | 2.02 |
| Total | - | 100% | 29.94 | 32.86 | 31.04 | 20.08 | 26.66 | 22.27 |

4.3.3 Usage

Emissions associated with usage of the product have been modelled on the following assumptions:

- Each product is cleaned on a monthly basis within a washing machine, and line dried once a month. The energy consumption for the washing machine was modelled assuming a 4kg load using 40 litres water and 1 kWh per cycle which was apportioned to each garment based on weight.
- The period pants were also modelled to be rinsed under the tap pre-wash. Rinsing under the tap was modelled as consuming 3 litres of water.
- The period pant products and Bralette have a 2-year life expectancy whilst the Everyday Pants have a 5-year life expectancy.

Table 8 highlights the emissions associated with the cleaning per product. The Midi Brief period pants have the highest associated period pant cleaning emissions, due to it being the style of period pant with the largest weight. Overall, the period pants have a larger cleaning footprint than the Bralette, due to the increase in water consumption, as they require rinsing prior to washing. In comparison, the emissions associated with water consumption is much lower for the Everyday Pants, however, the emissions associated with electricity consumption is considerably higher. This is due to the extended life expectancy of this product meaning that they are cleaned 2.5 times more than the period pants and Bralette.

To reduce emissions, I recommend that Wuka considers ways that the water consumption could be reduced, such as recommending/enabling consumers to soak the products rather than rinse.

Table 8: Usage Emissions

| Destination | Product distribution emissions (gCO ₂ e) | | | | | |
|--|---|---------------|---------------|---------------|----------------|--------------|
| | Bikini | Midi Brief | Seamless | Basics | Everyday Pants | Bralette |
| Water consumption per wash (litres) | 3.62 | 3.70 | 3.65 | 3.35 | 0.53 | 0.41 |
| Electricity consumption per wash (kWh) | 0.0155 | 0.0175 | 0.0163 | 0.0088 | 0.0133 | 0.0103 |
| Total Water consumption (gCO ₂ e) | 91.40 | 93.42 | 92.16 | 84.58 | 33.45 | 10.35 |
| Total Electricity consumption (gCO ₂ e) | 94.19 | 106.34 | 98.74 | 53.17 | 201.29 | 62.28 |
| Total consumption (gCO₂e) | 185.58 | 199.76 | 190.90 | 137.75 | 234.74 | 72.64 |

4.3.4 Disposal

The products are regarded as recyclable and packaging is regarded as compostable at the end of life. Table 9 shows emissions from the disposal of the product and the packaging.

Table 9: Disposal Emissions

| Product Element | Disposal emissions (gCO ₂ e) | | | | | |
|-----------------|---|-------------|-------------|-------------|----------------|-------------|
| | Bikini | Midi Brief | Seamless | Basics | Everyday Pants | Bralette |
| Product | 1.32 | 1.49 | 1.39 | 0.75 | 1.13 | 0.87 |
| Packaging | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 |
| Total | 1.53 | 1.70 | 1.59 | 0.95 | 1.33 | 1.08 |

5. Carbon Footprint Standard

Wuka in conjunction with Carbon Footprint Ltd, has assessed the *cradle to grave* carbon emissions associated with its **Wuka's Bikini, Midi Brief, Seamless, Basics, Everyday Pants & Bralette and associated packaging**. By achieving this, Wuka has qualified to use the Carbon Footprint Standard branding. This can be used on all marketing materials, including web site and customer tender documents, to demonstrate your carbon management achievements.



The Carbon Footprint Standard is in recognition of your organisations commitment to managing your products' carbon emissions. The text to the right-hand side of the logo demonstrates what level you have achieved in line with international best practice.

6. References

1. Climate Transparency (2019 Report)
2. Bulim Choi, Seungwoo Yoo & Su-il Park, Carbon Footprint of Packaging Films Made From LDPE, PLA, and PLA/PBAT Blends in South Korea, (2018), available at [Sustainability | Free Full-Text | Carbon Footprint of Packaging Films Made from LDPE, PLA, and PLA/PBAT Blends in South Korea | HTML \(mdpi.com\)](#)
3. Ecoinvent database v3.7.1 (2020), available at <http://www.Ecoinvent.org/>
4. Guidelines to Defra's Greenhouse Gas (GHG) Conversion Factors for Company Reporting – annexes (June 2013)
5. The Textile Exchange, The Life Cycle Assessment of Organic Cotton Fibre, 2014, available at [TE-LCA of Organic Cotton-Fiber-Summary of Findings.pdf \(textileexchange.org\)](#)
6. UK Government GHG Conversion Factors for Company Reporting (2017)
7. UK Government GHG Conversion Factors for Company Reporting (v1.0 June 2020)

Annex 1: Emission Factors

The following table shows the emission factors used for the calculations contained in this report.

Table 10: Emissions factors used in this assessment

| Element | Emissions factor | Comments | Unit | Database |
|---|------------------|--|--|--|
| Raw Materials (embodied) | | | | |
| Organic Cotton | 0.978 | | kgCO ₂ e per kg | Textile Exchange, 2014 |
| Cotton | 1.808 | | | Ecoinvent v3.7.1 |
| Tencal Modal | See below | Market for cellulose fibre, RoW | | UK Government 2020 |
| Recycled Nylon | 0.6 | | | Ecoinvent v3.7.1 |
| TPU | See below | Market for polyurethane, flexible foam RER | | |
| Absorbent Poly | See below | Market for polyurethane, flexible foam, RoW | | |
| Elastane | See below | Market for polyurethane, flexible foam RER | | |
| Polyester Mesh | See below | Market for fibre, polyester, GLO | | |
| Biodegradable Plastic | 2.29 | | | Choi, Yoo & Park, 2018 |
| Production | | | | |
| Electricity (generation and transmission & distribution) | 0.6036 | China | kgCO ₂ e per kWh | Climate Transparency (2019 Report) (generation) and Defra 2017 (transmission and distribution) |
| Transport | | | | |
| All HGV's (average) | 0.1065 | | kg CO ₂ e per tonne.km | UK Government 2020 |
| General Cargo | 0.013232 | | | |
| Rail Freight | 0.02556 | | | |
| Usage | | | | |
| Water supply | 344 | | kg CO ₂ e per million litres | UK Government 2020 |
| Water treatment | 708 | | | |
| Electricity (generation and transmission & distribution) | 0.25319 | United Kingdom | kgCO ₂ e per kWh | |
| Disposal | | | | |
| Composting | 10.2039 | | kg CO ₂ e per tonne | UK Government 2020 |
| Recycling | 21.3167 | | | |

Please note – In accordance with Ecoinvent's End User Licence Agreement (EULA) emissions factors cannot be presented in the report. A full emissions factor reference has been provided which will allow users with an active Ecoinvent account to search for the emissions factor. Please see <http://www.Ecoinvent.org/> for further details and to search for factors.