Life Cycle Assessment Report

CONFORMANT with ISO 14067:2018 and GHG protocol Product Life Cycle Accounting and Reporting Standard.

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Abstract

The environmental impact of EF Educational Tours Backpack produced in China and marketed in United States, by Ef educational tours , was analyzed using an attributional life cycle assessment (LCA) approach, in adherence with the guidelines described by the ISO14040 and 14044-standard.

The main objective of the study was to evaluate the potential environmental impacts of the product throughout the product life cycle for the aforementioned product, and to identify hotspots in areas of high environmental impact. The results of the study are specific to the analyzed product(s) and market conditions.

Results show that 1.0 Unit of EF Educational Tours Backpack contributes 7.2078e+00 kg of CO2eq. The analysis showed that more than 89.19% of the overall carbon emissions occurs during the Raw Materials stage. This was followed by Manufacturing contributing to 4.98% of the overall emissions. The Use Phase was responsible for the least amount of impact with 0.00% of overall emissions.

Based on the analysis, several opportunities to reduce environmental impacts were identified across the product life cycle. These include exploring alternative raw materials and packaging, optimizing production processes, adopting renewable energy sources, improving transportation efficiency, and enhancing recyclability of materials.

While these opportunities provide actionable insights, further evaluation is recommended to align mitigation strategies with stakeholder priorities and maximize environmental benefits. The results of this study offer a robust foundation for decision-making and continuous improvement in the product's environmental performance.

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1. Goal & Scope

1.1. Background

Life Cycle Assessment (LCA) has been recognized as a scientific method for making comprehensive, quantified evaluations of the environmental benefits and tradeoffs for the entire life cycle of a product system, beginning with raw material extraction and continuing through disposition at the end of its useful life. The LCA method therefore establishes the basic environmental profile for any product, and is critical in understanding greenhouse gas emissions and other environmental impacts arising from upstream and downstream activities that occur along the value chain.

In this study, a technical analysis of the environmental impact of EF Educational Tours Backpack
produced in China and marketed in United States, by Ef educational tours was performed using the life cycle assessment method, in adherence with the guidelines described by ISO 14067:2018 and GHG protocol Product Life Cycle Accounting and Reporting Standard. In accordance with this methodology, this LCA report assesses the relative environmental impact of each life cycle stage of EF Educational Tours Backpack in order to obtain an overall environmental profile of the product, to identify high impact areas along the supply chain, and to inform a science-based approach to prioritizing opportunities for reduction.

1.2. Goal & Scope

The main objective of the study is to conduct an environmental assessment for all stages of the product life cycle for the investigated product. Analysis of the results of the study are intended to improve the understanding of reduction opportunities as well as facilitate and leverage inputs from stakeholders to prioritize and reduce emissions in areas of high environmental impact.

1.3. Intended Audience

The study results are prepared for Ef educational tours ’s internal use. Specific audiences may include the company’s internal stakeholders, and external stakeholders (business partners, customers, and/or the general public), as determined by Ef educational tours , at its discretion.

1.4. Intended Applications

Further analysis of the environmental impact in each area of the product life cycle for EF Educational Tours Backpack, can be used to inform decision-making in the following application areas:

- Scientific support for **environmental claims** used in marketing: LCA results can be used for eco-labeling and providing environmental information to consumers. Certifications and labels based on LCA help consumers make more informed and sustainable purchasing decisions, promoting products with lower environmental impacts.

- Evaluating the **environmental performance of the supply chain**: By assessing the environmental impacts of suppliers, transportation, and other stages of the life cycle, organizations can make more informed choices to reduce their supply chain's overall environmental footprint.
- Informing **waste management and recycling strategies**: LCA results can assist in assessing the environmental benefits of waste management options, (such as recycling, incineration, or landfilling,) and help inform decisions to improve waste management practices and promote recycling programs.
- Support decision making on **sustainable product design**: Results can guide product designers in making environmentally informed decisions by identifying opportunities to reduce the environmental impacts associated with a product's life cycle (ex. alternative materials, packaging, processes, logistics, and processes that have lower environmental footprints).

1.5. Functional Unit

The functional unit (FU) of the investigated product system consists of 1.0 Unit of EF Educational Tours Backpack. When defined as a ‘typical application’ of the product, the functional unit is based on recommended dosages or expert opinion for the product category.

1.6. Life Cycle Impact Assessment Method

The study is to be conformant with ISO 14067:2018 and GHG protocol Product Life Cycle Accounting and Reporting Standard. The study uses the attributional approach to life cycle accounting. This means that all significant activities and their emissions in the production are considered, and their combined climate impact is attributed to the product. For the purpose of this study, results in terms of environmental impact are expressed as Carbon Dioxide equivalents (CO_2e) allowing stakeholders to benchmark products with other studies completed to the same standard. Emissions factors sourced for this study are expressed in CO_2e which have taken into consideration the global warming potential (GWP) of other greenhouse gasses and expressed them as a factor of CO_2, which has a GWP of 1.

1.7. Allocation Procedures

The product system as shown in Figure 1 contained several multi-product processes, which required an allocation of resources and emissions. Three allocation approaches were used in the context of background systems, i.e. mass allocation, economic allocation, or allocation by energy. Additionally, mass allocation and economic allocation were used for foreground systems. Where possible and reasonable, mass allocation was preferred. All energy and raw material consumption and environmental emissions listed in individual inventory are allocated to a product LCI/LCA on a mass basis, according to the specified functional unit. Energy consumption and environmental emissions for each stage are calculated from the level of each raw material input in the product and the corresponding values from each material input inventory based upon the functional unit. End-of-Life allocation generally follows the requirements of ISO 14044. With respect to any recyclable material in the product system, the cut-off allocation approach is used.

1.8. System Boundary

The study will consider the cradle to grave life cycle of the product**.** The boundary of the system studied includes all activities necessary to produce the product, including all steps of the life cycle from the production of material inputs and packaging, transportation to the production facility, the production process itself, storage and distribution of the finished product, consumer use, and finally disposal.

Figure 1 shows a process map for the system boundary of EF Educational Tours Backpack

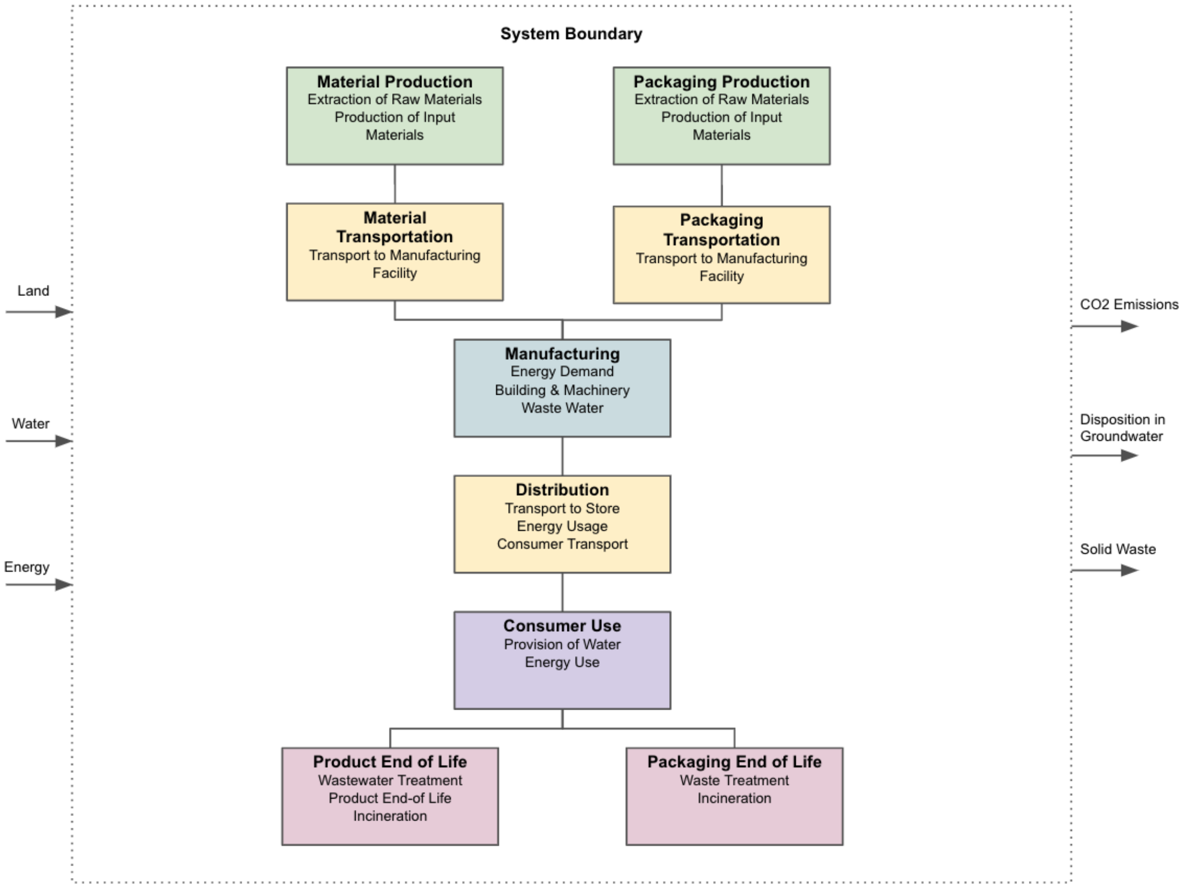


Figure 1 - System Boundary

Table 1.1 describes each of the stages within the product system boundaries.

Stage	Description
Raw Materials	This stage involves identifying and quantifying the environmental impacts associated with extracting the raw material inputs required for the product. It considers factors such as resource depletion, energy consumption, water use, and emissions associated with mining, agriculture, and other extraction processes.
Packaging	This stage examines the processes involved in producing the chosen packaging materials, including primary, secondary, and tertiary packing (if applicable.) It considers factors such as energy consumption, emissions, water usage, and waste generation.
Manufacturing	During this stage, the energy, resources, and emissions involved in transforming the raw material inputs into the final product are evaluated. The assessment considers the energy consumption, emissions, waste generation, and other environmental impacts of various manufacturing processes, such as assembly, fabrication, and chemical reactions.
Distribution	The transportation of raw materials, components, and finished products from one location to another is analyzed in this phase. The LCA looks at energy consumption, emissions, and other impacts associated with various transportation methods, such as road, rail, sea, and air transportation to the manufacturing facility, and from the manufacturing facility to distribution and retail locations.
Consumer Use	This stage involves assessing the environmental impact of using the product over its expected lifetime.
End-of-Life	This stage deals with the disposal or recycling of the product and its packaging once it reaches the end of its useful life. The LCA assesses the environmental impacts of various disposal methods, such as landfilling, incineration, and recycling.

Table 1.1 Description of System Processes

1.9. Assumptions and Limitations

In conducting a comprehensive Life Cycle Assessment (LCA) for the assessed product/system, it is imperative to recognize and acknowledge certain inherent assumptions and limitations that shape the scope, boundaries, and precision of this environmental evaluation. As such, the following assumptions and limitations are fundamental to the modeling and interpretation of results, providing necessary context for stakeholders and decision-makers:

- The results and conclusions described in this report are valid only within the specified scope of the study. The study was carried out in July 2025 with the most current data available being used.
- Geographically, the study was conducted for United States, where EF Educational Tours Backpack is marketed, distributed, used, and disposed of.
- The availability of inventory data for many chemicals and packaging materials is very limited. Whenever possible, the emissions data for key material inputs are obtained from external commercial databases such as ecoinvent, or otherwise obtained from reputable academic literature or industry averages.
- Supply chain models for the product have been developed based on typical transport distances and supplier locations. Results may differ slightly when modeling from specific suppliers to specific locations or from suppliers that are external to the assessed region. With respect to the material inputs and packaging material of the product, the countries of extraction and production were considered as well.
- The transport from retail to consumers' homes is assumed to be part of a typical shopping trip and therefore outside of the system boundary being reviewed. Activities not included are employee commuting, heat and light for retail stores and manufacturing facilities due to these activities not being directly related to the life cycle of the product. Nominal energy is required for retail storage therefore this stage has been omitted from the study.
- As stated in ISO 14044, it should be noted that LCA shall not be the sole basis for making comparative assertions. Other social, economic and environmental aspects should also be considered.

1.10. Data Quality Requirements

The data used to create the inventory model is intended to be as precise, complete, consistent, and representative as possible with regards to the goal and scope of the study under given time and budget constraints.

- Measured primary data is considered of highest precision, followed by calculated data, literature data, and estimated data. Where possible, the goal is to model all foreground processes using measured or calculated primary data.
- Completeness is judged based on the completeness of the inputs and outputs per unit process and the completeness of the unit processes themselves. The goal is to capture all data in this regard.

- Consistency refers to modeling choices and data sources. The goal is to ensure that differences in results reflect actual differences between product systems and are not due to inconsistencies in modeling choices, data sources, emission factors, or other artifacts.
- Reproducibility expresses the degree to which third parties would be able to reproduce the results of the study based on the information contained in this report. The goal is to provide enough transparency with this report so that third parties are able to approximate the reported results. This ability may be limited by the exclusion of confidential primary data (company-specific) and access to the same background data sources.
- Representativeness expresses the degree to which the data matches the geographical, temporal, and technological requirements defined in the study's goal and scope. The goal is to use the most representative primary data for all foreground processes and the most representative industry-average data for all background processes. Whenever such data were not available (e.g., no industry-average data available for a certain country), best- available proxy data were employed.

2. Life Cycle Inventory (LCI)

The life cycle inventory (LCI) analysis is a “cradle to grave” accounting of the environmentally significant inputs and outputs of the system. The inventory involves the compilation and quantification of the inputs (materials and resources) and outputs for each stage of the product’s life-cycle, as described below.

2.1. Overview of Product System

2.1.1. Raw Materials

The exact raw material inputs/formulations for EF Educational Tours Backpack are obtained directly from the manufacturer, its suppliers, or other indirect commercial or verified public sources. In the event that exact proportions were not available, an approximation based on standard formulations of the product class was applied in order to determine the likely proportion, taking into account the type of material input, its function in the product and primary data from other products in the same product category. Accordingly, the primary material inputs present in EF Educational Tours Backpack are listed in Table 1.1 below.

To account for the production of these raw materials, emission factors were also inventoried and allocated. Where emission factors were not available, substitute emission factors have been used following the standard considerations outlined in Section 3.3 (Data Collection and Quality).

Table 1.1 Material Inputs for EF Educational Tours Backpack

Raw Material	**Mass** (kg)	**Emission Factor Source**
RPET 300D	2.99e-01	CarbonBright
RPET 190T	4.25e-02	CarbonBright
Metal zipper puller	2.04e-02	CarbonBright
Zipper tape	2.18e-02	CarbonBright
Metal D Ring	1.20e-02	Ecoinvent 3.11
PP Webbing	2.02e-02	Ecoinvent 3.11
Plastic Buckle	4.80e-03	CarbonBright
Nylon Binding tape	2.83e-03	CarbonBright
Polyester Elastic Band	1.71e-03	Ecoinvent 3.11
Pearl cotton	4.61e-03	Ecoinvent 3.11
Polyester Sewn label	1.32e-04	Ecoinvent 3.11
Triangle fabric	8.62e-03	CarbonBright
Hangtag	1.42e-03	DEFRA

2.1.2. Packaging

For the purpose of this study, it is assumed that EF Educational Tours Backpack is packaged into its primary consumer packaging at the manufacturing facility. Similar to the raw materials, data on packaging is obtained directly from the manufacturer, its suppliers, or other indirect commercial or verified public sources. Secondary packaging is also considered. Tertiary packaging such as wooden pallets and plastic shrink wrap was not counted as it is deemed to be part of the usual running of transport and distribution operations and had a nominal contribution to the overall emissions associated with the functional unit.

Packing material data including associated emission factors for the packaging materials used in this study can be found in the table below:

Table 1.2 Packaging Inputs/Outputs for EF Educational Tours Backpack

Packaging Material	**Mass** (kg)	**Emissions Factor Source**
5-ply corrugated board	2.80e-02	Ecoinvent 3.11
Polyethylene (PE)	2.67e-03	Ecoinvent 3.11
Anti-cutting Corrugated Board	8.67e-03	Ecoinvent 3.11
Nylon Carton Straps	1.33e-03	Ecoinvent 3.11

Packaging materials required per functional unit were determined by multiplying the amount of material in one pack by the same factor as the pack size in L divided by the functional unit.

2.1.3. Manufacturing

The manufacturing stage starts when the raw materials enter the production site of the product and ends when the finished product leaves the production gate.

Manufacturing data for EF Educational Tours Backpack are obtained directly from the manufacturer, or other indirect commercial or verified public sources. Typical production processes and technologies used to manufacture the studied product have been analyzed in order to account for the use of energy and generation of emissions associated with the production process. The quantification of emissions per functional unit for each process are reflected in the table below.

Table 1.3 Manufacturing Inputs/Outputs for EF Educational Tours Backpack

Manufacturing Process	**Emission Factor Source**
Cut and Sew	CarbonBright

2.1.4. Distribution & Transport

There are multiple phases of transport in the system boundary. The first is upstream transport and delivery of primary raw material inputs and packaging to the manufacturing facility. The second is the transport of products to distribution centers and retail locations.The study models a multi-point logistics route consisting of likely modes of transport and distance depending on the locations of suppliers of primary materials, manufacturing facilities, distribution facilities, and retail points of sale. The transportation parameters considered for EF Educational Tours Backpack (distance and mode of transport) are shown in the table below.

Table 1.4 Transportation Inputs/Outputs for EF Educational Tours Backpack

Transport Leg	**Distance** (km)	**Emission Factor Source**
RPET 190T Transportation Segment 1	3.96e+02	Ecoinvent 3.11
Metal zipper puller Transportation Segment 1	3.96e+02	Ecoinvent 3.11
Metal D Ring Transportation Segment 1	3.96e+02	Ecoinvent 3.11
Plastic Buckle Transportation Segment 1	3.96e+02	Ecoinvent 3.11
Nylon Binding tape Transportation Segment 1	3.96e+02	Ecoinvent 3.11
Polyester Elastic Band Transportation Segment 1	3.96e+02	Ecoinvent 3.11
Polyester Sewn label Transportation Segment 1	3.96e+02	Ecoinvent 3.11
Hangtag Transportation Segment 1	3.96e+02	Ecoinvent 3.11
EF Educational Tours Backpack Transportation Segment 1	1.44e-02	Ecoinvent 3.11
EF Educational Tours Backpack Transportation Segment 2	1.74e+04	Ecoinvent 3.11
EF Educational Tours Backpack Transportation Segment 3	4.74e+01	Ecoinvent 3.11
Nylon Carton Straps disposal (incineration) Transport	3.20e+01	Ecoinvent 3.11
Nylon Carton Straps disposal (landfilling) Transport	3.20e+01	Ecoinvent 3.11
Nylon Carton Straps disposal (recycling) Transport	3.20e+01	Ecoinvent 3.11
Anti-cutting Corrugated Board	3.20e+01	Ecoinvent 3.11

disposal (incineration) Transport		
Anti-cutting Corrugated Board disposal (landfilling) Transport	3.20e+01	Ecoinvent 3.11
Anti-cutting Corrugated Board disposal (recycling) Transport	3.20e+01	Ecoinvent 3.11
Polyethylene (PE) disposal (incineration) Transport	3.20e+01	Ecoinvent 3.11
Polyethylene (PE) disposal (landfilling) Transport	3.20e+01	Ecoinvent 3.11
Polyethylene (PE) disposal (recycling) Transport	3.20e+01	Ecoinvent 3.11
5-ply corrugated board disposal (incineration) Transport	3.20e+01	Ecoinvent 3.11
5-ply corrugated board disposal (landfilling) Transport	3.20e+01	Ecoinvent 3.11
5-ply corrugated board disposal (recycling) Transport	3.20e+01	Ecoinvent 3.11
Hangtag disposal (incineration) Transport	3.20e+01	Ecoinvent 3.11
Hangtag disposal (landfilling) Transport	3.20e+01	Ecoinvent 3.11
Hangtag disposal (recycling) Transport	3.20e+01	Ecoinvent 3.11
Polyester Sewn label disposal (incineration) Transport	3.20e+01	Ecoinvent 3.11
Polyester Sewn label disposal (landfilling) Transport	3.20e+01	Ecoinvent 3.11
Polyester Sewn label disposal (recycling) Transport	3.20e+01	Ecoinvent 3.11
Polyester Elastic Band disposal (incineration) Transport	3.20e+01	Ecoinvent 3.11
Polyester Elastic Band disposal (landfilling) Transport	3.20e+01	Ecoinvent 3.11
Polyester Elastic Band disposal (recycling) Transport	3.20e+01	Ecoinvent 3.11
Nylon Binding tape disposal (incineration) Transport	3.20e+01	Ecoinvent 3.11
Nylon Binding tape disposal (landfilling) Transport	3.20e+01	Ecoinvent 3.11
Nylon Binding tape disposal (recycling) Transport	3.20e+01	Ecoinvent 3.11
Plastic Buckle disposal (incineration) Transport	3.20e+01	Ecoinvent 3.11
Plastic Buckle disposal (landfilling) Transport	3.20e+01	Ecoinvent 3.11

Plastic Buckle disposal (recycling) Transport	3.20e+01	Ecoinvent 3.11
PP Webbing disposal (incineration) Transport	3.20e+01	Ecoinvent 3.11
PP Webbing disposal (landfilling) Transport	3.20e+01	Ecoinvent 3.11
PP Webbing disposal (recycling) Transport	3.20e+01	Ecoinvent 3.11
Zipper tape disposal (incineration) Transport	3.20e+01	Ecoinvent 3.11
Zipper tape disposal (landfilling) Transport	3.20e+01	Ecoinvent 3.11
Zipper tape disposal (recycling) Transport	3.20e+01	Ecoinvent 3.11
RPET 190T disposal (incineration) Transport	3.20e+01	Ecoinvent 3.11
RPET 190T disposal (landfilling) Transport	3.20e+01	Ecoinvent 3.11
RPET 190T disposal (recycling) Transport	3.20e+01	Ecoinvent 3.11
RPET 300D disposal (incineration) Transport	3.20e+01	Ecoinvent 3.11
RPET 300D disposal (landfilling) Transport	3.20e+01	Ecoinvent 3.11
RPET 300D disposal (recycling) Transport	3.20e+01	Ecoinvent 3.11

2.1.5. Use Phase

The use phase begins with the consumer's acquisition of the product. Quantification of the inputs and outputs for the usage stage is influenced by factors such as the recommended usage, frequency of use, and the efficiency of the product in performing its intended function. Depending on the type of product, energy usage and emissions outputs associated with the use phase activity may be considered to be negligible, and are noted as such when applicable.

For EF Educational Tours Backpack, the emission factors attributed to the use phase of the product inventory can be found in the table below. The emissions coefficients quantify the amount of emissions produced per unit of activity.

Table 1.5 Use Phase Inputs/Outputs for EF Educational Tours Backpack

Use Phase Activity	Emission Factor Source
Consumer Use (0.00e+00 kg)	Ecoinvent 3.11

2.1.6. End of Life

The "end of life" stage in a product life cycle analysis is a critical phase that focuses on what happens to a product once it reaches the end of its useful life. This stage is an integral part of assessing a product's environmental impact and sustainability. During this phase, the study evaluates how EF Educational Tours Backpack is disposed of, recycled, or otherwise managed after it is no longer functional or desirable to consumers. Understanding the end-of-life dynamics of the product is essential for making informed decisions about resource management, waste reduction, and environmental conservation.

In this portion of the life cycle inventory, quantification of the end results of landfilling and incineration are considered. Secondary packaging is assumed to be recycled or incinerated.

The emission factors for waste treatment of materials are shown below.

Table 1.6 End of Life Phase Inputs/Outputs for EF Educational Tours Backpack

Material	**Emissions Factor Source**
Nylon Carton Straps disposal (incineration)	DEFRA
Nylon Carton Straps disposal (landfilling)	DEFRA
Nylon Carton Straps disposal (recycling)	DEFRA
Anti-cutting Corrugated Board disposal (incineration)	DEFRA
Anti-cutting Corrugated Board disposal (landfilling)	DEFRA
Anti-cutting Corrugated Board disposal (recycling)	DEFRA
Polyethylene (PE) disposal (incineration)	DEFRA
Polyethylene (PE) disposal (landfilling)	DEFRA
Polyethylene (PE) disposal (recycling)	DEFRA
5-ply corrugated board disposal (incineration)	DEFRA
5-ply corrugated board disposal (landfilling)	DEFRA
5-ply corrugated board disposal (recycling)	DEFRA
Hangtag disposal (incineration)	DEFRA
Hangtag disposal (landfilling)	DEFRA
Hangtag disposal (recycling)	DEFRA
Polyester Sewn label disposal (incineration)	DEFRA
Polyester Sewn label disposal (landfilling)	DEFRA
Polyester Sewn label disposal (recycling)	DEFRA
Polyester Elastic Band disposal (incineration)	DEFRA
Polyester Elastic Band disposal (landfilling)	DEFRA
Polyester Elastic Band disposal (recycling)	DEFRA
Nylon Binding tape disposal (incineration)	DEFRA
Nylon Binding tape disposal (landfilling)	DEFRA
Nylon Binding tape disposal (recycling)	DEFRA

Plastic Buckle disposal (incineration)	DEFRA
Plastic Buckle disposal (landfilling)	DEFRA
Plastic Buckle disposal (recycling)	DEFRA
PP Webbing disposal (incineration)	DEFRA
PP Webbing disposal (landfilling)	DEFRA
PP Webbing disposal (recycling)	DEFRA
Zipper tape disposal (incineration)	DEFRA
Zipper tape disposal (landfilling)	DEFRA
Zipper tape disposal (recycling)	DEFRA
RPET 190T disposal (incineration)	DEFRA
RPET 190T disposal (landfilling)	DEFRA
RPET 190T disposal (recycling)	DEFRA
RPET 300D disposal (incineration)	DEFRA
RPET 300D disposal (landfilling)	DEFRA
RPET 300D disposal (recycling)	DEFRA

2.2. Data Collection And Quality Assessment

This report has been put together with the most accurate and up to date information available. The life cycle data used in this study relies upon primary data as well as secondary data sources. Primary data being used is specific to the processes included in the product's life cycle boundary, and may be obtained directly from Ef educational tours , its manufacturers, suppliers, or other indirect commercial or public sources. Secondary data is not specific to the product under study and is taken from commercial databases, industry reports, and academic literature. Where primary data is unavailable or incomplete, secondary data (proxy data or typical industry figures) may have been substituted and declared.

Emission factors are the GHG emissions per unit of activity data, and they are multiplied by activity data to calculate GHG emissions. Due to the variation in sources of emissions factors, each source is reviewed internally to ensure all appropriate emission contributors are accounted for within the scope of the source as well as checks for exclusion of delayed emissions, offsets, and avoided emissions.

2.3. Software and Databases

The CarbonBright Platform provides the framework for environmental assessments of products within the scope of this report. CarbonBright's life-cycle assessment model takes into account a wide range of representative raw material inputs, types of packaging forms and materials, as well as different energy models from different countries and regions.

Additionally, CarbonBright software has relied in good faith on data and emissions information obtained from public and commercial 3rd party sources. Data sources include life cycle databases, published product inventory reports, government agencies, industry associations, company developed factors, and peer reviewed literature. These datasets have been used in life cycle assessment models worldwide in industrial and scientific applications as well as in many critically reviewed and published studies. CarbonBright has reasonably assumed that the information obtained through these sources is correct and is not responsible for the accuracy or completeness of such information.

3. Life Cycle Impact Assessment (LCIA)

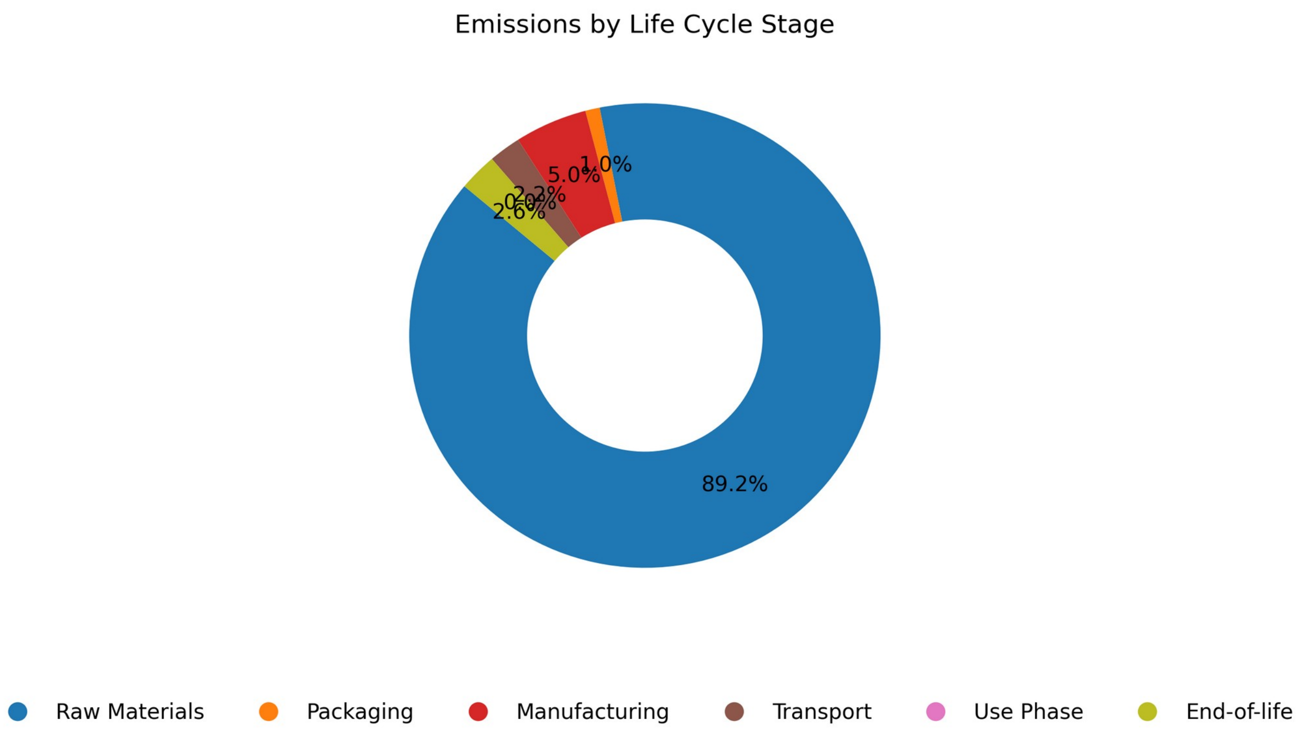
The assessment phase is the step in which the results of life cycle inventory are presented and discussed as a basis for conclusions, recommendations and decision-making in accordance with the goal and scope definition.

3.1. Overview of Results

Using the data obtained in the inventory stage, a life cycle impact assessment has been conducted for EF Educational Tours Backpack. The following tables show the environmental impacts, expressed as GWP Impact [kg CO2e] per 1.0 Unit of the studied product when packaged in its primary container, over the course of the product's lifecycle. Observations and some notable results are discussed in the subsequent section.

Table 1.7 Life Cycle Assessment Results for EF Educational Tours Backpack

Life Cycle Activity	**GWP Impact** [kg CO_2e]	**Share of Total** [%]	
Raw Materials	6.4287e+00	89.19	
Packaging	7.1657e-02	0.99	
Manufacturing	3.5878e-01	4.98	
Transportation	1.5873e-01	2.20	
Use Phase	0.0000e+00	0.00	
End-of-Life	1.8998e-01	2.64	
Total	7.2078e+00	100%	



Graph 1.1 Life Cycle Assessment Results: Emissions by Life Cycle Stage

4. Life Cycle Interpretation

The Life Cycle Interpretation is the final phase of the Life Cycle Assessment (LCA) study, where the results of the inventory analysis and impact assessment are analyzed to derive meaningful conclusions and actionable recommendations. This section ensures that the findings align with the study's goals and scope, identifies key environmental impact hotspots, and evaluates the robustness and limitations of the data and methodology.

4.1. Conclusions & Discussion of Results

In conclusion, the Life Cycle Assessment (LCA) conducted for EF Educational Tours Backpack has provided valuable insight into the environmental impact across its entire life cycle. The assessment evaluated the stages of its product life cycle including raw material extraction, packaging, manufacturing & production, transportation, the use phase, and finally the product's end-of-life.

Throughout the study, it became evident that the environmental profile of EF Educational Tours Backpack is highly dependent on various input factors, particularly the choice of raw materials, manufacturing processes, transportation methods, and consumer behavior. As such, the results of this LCA should be considered in a context-sensitive manner, taking into account different scenarios and potential opportunities for improvement.

In considering the various life-cycle stages of the product, the study found that approximately 89.19 % of its overall impact was associated with the Raw Material extraction phase. This underscores the crucial importance of responsible sourcing and material selection. The choice of sustainable raw materials for a product can substantially lessen its environmental footprint by reducing resource depletion, safeguarding biodiversity, and curbing emissions related to material extraction. Additionally, establishing partnerships with suppliers committed to fair labor practices and biodiversity preservation, is vital to minimizing environmental harm across the supply chain.

Similarly, Packaging made a relevant environmental contribution, accounting for 0.99 % of the overall environmental load. This emphasizes the critical need for regulating the constituent packaging materials and adopting sustainable packaging alternatives. The weight of the packaging also carries substantial importance, as a reduction in material usage not only lessens production impacts but also lowers transportation-related costs. Streamlining the size and weight of product packaging can allow companies to minimize material consumption and transportation expenses while ensuring effective product protection.

The Manufacturing & Production stage was found to contribute approximately 4.98 % of the product's overall emissions. The emissions in this phase can be attributed to the specific processes and energy sources employed during production, which can often represent a material proportion of the product's environmental impact. To address this, implementing energy-efficient production techniques, optimizing manufacturing processes, and transitioning to renewable energy sources are critical pathways to reducing the carbon footprint.

During the Transportation phase, an 2.20% contribution was noted. This can be attributed to the distribution and logistics involved in the product's life cycle, encompassing various transportation stages such as the movement of raw materials to production facilities and the transportation of finished products to warehousing and retail locations. This underscores the potential for optimizing logistics, transportation methods, and energy/fuel consumption throughout the transportation processes.

During the Use Phase of the product life cycle, our assessment focuses on understanding the environmental impacts associated with the everyday utilization of the product by consumers. Our analysis sought to quantify resource consumption, energy use, and emissions produced during this stage. Accordingly, the Use Phase demonstrated a contribution of 0.00% to the overall environmental impact of the product. Factors such as product efficiency, user behavior, and manufacturer suggested usage all play a role in influencing the Use Phase. Opportunities for reducing the environmental footprint during this phase may include designing products for greater efficiency (e.g., energy- or water-conservation), providing clear guidance to consumers on sustainable usage practices, encouraging reuse where applicable, and improving product longevity through improved durability.

Finally, in the End-of-Life phase assessment of this product, we observed that approximately 2.64% of the product's total environmental footprint can be attributed to this phase. Recognizing the role this phase plays in shaping the product's sustainability profile, we emphasize the critical importance of adopting a holistic approach to address end-of-life considerations. By focusing on end-of-life considerations, such as designing for recyclability, promoting proper disposal, and supporting circular economy principles, the environmental burden can be greatly diminished.

4.2. Additional Considerations

This Life Cycle Assessment (LCA) serves as a critical tool for raising awareness and driving actionable change across the supply chain of EF Educational Tours Backpack. While the results are specific to the assumptions and contexts of this study, they highlight clear opportunities for reducing environmental impacts. Key areas for improvement may include adopting renewable and sustainable materials, implementing energy-efficient production processes, optimizing transportation and logistics, and fostering more sustainable consumer usage practices.

To fully realize these opportunities, it is essential for stakeholders - including manufacturers, suppliers, and retailers - to engage in collaborative efforts aimed at integrating sustainable practices throughout the product life cycle. This could involve exploring innovative technologies, forming partnerships with sustainability-focused suppliers, and promoting consumer education to encourage environmentally conscious behaviors.

Further research and iterative improvements are recommended to refine and enhance the sustainability profile of EF Educational Tours Backpack. By continually evaluating performance and adapting to evolving standards and market demands, stakeholders can achieve meaningful progress toward reducing the product's environmental footprint while balancing business and consumer needs.

Appendix

References

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Impact Category Descriptions

Impact Category	Description	Unit
Global Warming Potential (GWP), excluding biogenic CO2	A measure of greenhouse gas emissions, such as CO2 and methane. These emissions are causing an increase in the absorption of radiation emitted by the earth, increasing the natural greenhouse effect. This may in turn have adverse impacts on ecosystem health, human health and material welfare.	kg CO_2 equivalent
Eutrophication Potential (EP)	Eutrophication covers all potential impacts of excessively high levels of macronutrients, the most important of which nitrogen (N) and phosphorus (P). Nutrient enrichment may cause an undesirable shift in species composition and elevated biomass production in both aquatic and terrestrial ecosystems. In aquatic ecosystems increased biomass production may lead to depressed oxygen levels, because of the additional consumption of oxygen in biomass decomposition.	kg N equivalent
Acidification Potential (AP)	A measure of emissions that cause acidifying effects to the environment. The acidification potential is a measure of a molecule's capacity to increase the hydrogen ion (H+) concentration in the presence of water, thus decreasing the pH value. Potential effects include fish mortality, forest decline and the deterioration of building materials.	kg SO_2 equivalent
Smog Formation Potential (SFP)	A measure of emissions of precursors that contribute to ground level smog formation (mainly ozone O3), produced by the reaction of VOC and carbon monoxide in the presence of nitrogen oxides under the influence of UV light. Ground level ozone may be injurious to human health and ecosystems and may also damage crops.	kg O_3 equivalent
Particulate Matter (PM)	A measure of particulate matter emissions of various sizes. Small particulates bypass the body's defenses against dust, penetrating deep into the respiratory system. According to the WHO, most deaths and illnesses due to air pollution are most closely linked to exposures to small particulate matter (PM10 and smaller).	kg PM2.5 equivalent

It shall be noted that the above impact categories represent impact potentials, i.e., they are approximations of environmental impacts that could occur if the emissions would (a) actually follow the underlying impact pathway and (b) meet certain conditions in the receiving environment while doing so. In addition, the inventory only captures that fraction of the total environmental load that corresponds to the functional unit (relative approach). LCIA results are therefore relative expressions only and do not predict actual impacts, the exceeding of thresholds, safety margins, or risks.

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