LCA METHODOLOGY V 1.0 – COACH PRODUCT IMPACT CALCULATOR

Methodology Document Purpose

Coach is dedicated to understanding and improving its products' life cycle environmental impacts which is why it commissioned WSP to develop a tool to calculate greenhouse gas (GHG) emissions and waste metrics by applying the life cycle assessment (LCA) to the new Coachtopia line of sustainability-focused leather goods (LG), footwear (FW), and ready-to-wear (RTW) apparel. The tool can interpret a Bill of Materials (BOM) which contains all the materials needed to manufacture the product, apply representative emission factors from leading environmental impact databases in combination with assumptions specific to the product category for transport, use and end-of-life (EOL), and provide the carbon and waste footprint per unit product. Items in the Coachtopia line are designed to maximize the use of recycled and factory scrap materials, thereby reducing the emissions and waste footprints of the products. The tool is therefore built to compare environmental impact differences between Coachtopia products and hypothetical baseline products made from virgin materials, providing insights that are intended to be shared both within Coach to inform design decisions and externally to provide information on the products' impacts to the company's stakeholders. The tool can identify GHG emission hot spots of products' life cycle stages and analyze options to reduce the GHG impact, such as switching to lower carbon intensity materials and analyzing material circularity options.
This methodology is undergoing critical review by a panel of three independent experts.

System Boundary and Data Sources

The system starts with raw material extraction and refinement alongside recycled material processing, and continues through manufacturing, distribution and retail, use, and disposal (also called a cradle-to-grave system boundary). The manufacturing step covers specifically clothing production, all previous steps such as refinement of virgin and recycled materials into textile goods are part of the raw material extraction and processing step. Table 1 provides an overview of the life cycle stages, a summary of calculation methods and data sources, assumptions and included or excluded processes. It is divided into one column for GHG emissions and one column for the waste calculations.

Two databases were used to source background data on GHG emissions for inputs to the systems, while waste calculations were performed directly on the material flows between life cycle stages. Higg is a technology platform that helps consumer goods companies measure and improve their supply chain's sustainability, from which specific material and manufacturing impacts were sourced. ecoinvent is a well-established life cycle inventory database, and version 3.8 was used in the tool. Further complimentary sources were used in specific instances, Table 2 gives a complete overview of the data sources and what they were used for. The model applies the recycled content approach, in line with the background data. In this context, burdens associated with processing an outgoing material into a ready-to-use secondary material are not included – only the outgoing transportation to the recycling facility. For the upstream and input materials, the processing of end-of-waste materials into ready-to-use secondary materials are included. Coachtopia products contain recycled materials for key components. The baseline of comparison is a hypothetical product, assuming Coachtopia products have been manufactured using virgin materials instead of recycled materials. As such, the only difference is the

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sourcing of raw materials, whereas manufacturing, distribution, use and end-of-life remain the same.

Table 1: The life cycle stages of the assessed products.

Stage	Step	Life Cycle GHG Emissions	Partial Life Cycle Waste
Product	**Raw Material Supply** Data sources Higg MSI ecoinvent Supplier data US eGRID	The extraction, production, and treatment of virgin, non-renewable and renewable primary and secondary materials and energy. These materials and semi-finished goods are processed on site to prepare them for transport to the manufacturing site. Note that packaging materials for the raw materials and semi-finished goods were not considered in this study. A specific kind of recycled leather produced using leather scraps is included in Coachtopia product line. Based on LCA studies provided by the suppliers, WSP re-evaluated the impacts of the materials in a new model that was consistent with the system boundaries and assumptions of the Coach tool. For a series of recycled resin and polyethylene components no off-the-shelf background processes were applicable. As such, they were modelled based on the material composition of the components. Furthermore, three kinds of NFC tags to track the Coach products were modeled, also based on material composition.	Waste generated during raw material extraction, processing and packing and then transported to the manufacturing facility was not considered.
	Transport Data sources ecoinvent	Transportation of the raw materials and semi-finished goods to the manufacturing site. The specific locations of suppliers and the manufacturing sites was used to calculate transport distances. It was assumed that truck transport took place to the closest port, followed by sea shipping to the closest port of the factory, and last-mile delivery by truck.	
	Manufacturing Data sources Higg FEM Munasinghe, Druckman, & Dissanayake (2021)	Manufacturing of apparel products through the consumption of ancillary materials, processed raw materials and energy. Manufacturing burdens are allocated based on the number of products manufactured at the facility. No distinction could be made between different kinds of products, as such the impact per unit does not differentiate between different kinds of products. The waste from manufacturing was estimated by the difference between the gross materials weight in the BOM and the final product weight. Information on the types of packaging used for the products was provided by Coach. The emission factors for the manufacturing step is retrieved from the Higg FEM database, which contains primary data from the Coach suppliers that manufacture the applicable products. One exception to the Higg FEM database was made for RTW products, which did not have supplier data in the FEM database. After a literature review, results from a meta-review was adopted (Munasinghe, Druckman, & Dissanayake, 2021) in the form of 0.32 kg CO_2e per kg of manufactured product (proxied for all RTW based on findings for cotton t-shirts). The reuse of scrap leather from previous Coach product systems is accounted for, arriving with no burden. The scrap leather from the Coachtopia manufacturing is accounted for and conservatively assumed to be landfilled.	Waste generated on the factory floor during cutting, sewing, skiving, and similar processes was included. Wastes not associated with manufacturing of specific products, such as from factory offices, meals, and general operations, were excluded. Packaging waste from incoming raw materials was excluded.

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Stage	Step	Life Cycle GHG Emissions	Partial Life Cycle Waste
Distribution	**Inbound Transport** Data sources ecoinvent	All possible transportation paths between the manufacturers and the distribution centers (DCs) have been identified, which was accounted for in the mode of transportation. The transportation distances are weighted based on the contribution share of manufacturing facilities to total supply and the share of products stored at the DC. Air freight is considered for this transportation stage as it is expected that initial production runs will require quicker transportation for the stores to receive the products in time for the Coachtopia line launch. As such, 25% of transportation from DC to RS was made with air freight instead of sea shipping. There is a potential of double counting packaging weights for transport as packaging material weights may be listed both in the packaging matrix of the tool and the BOMs. It is an uncertainty with a conservative result.	
	Energy Data sources EIA eGRID EPA	The energy consumption of the facilities is estimated using data by the US Energy Information Administration, specifically the 2018 Commercial Buildings Energy Consumption Survey (EIA, 2022), together with the floor area of the specific distribution center. eGRID and natural gas emission factors from the US Environmental Protection Agency (EPA) were applied to the energy consumption. These sources were also applied for international sites, climate zones were considered to select the appropriate energy consumption estimates. In this version of the tool it was assumed that all the products stored in the distribution center share the energy burdens equally, based on volume. Two calculation approaches were used, depending on data availability. Quantity share of Coachtopia products at the center was used if data was available, followed by the estimated floor area share occupied by Coachtopia if volume data was not available. The products at distribution centers are repackaged as they arrive in bulk and then are further distributed to retail stores in lower quantities. For this version of the tool, two out of four distribution centers were included.	Bulk packaging of the finished products were assumed to be discarded at the distribution centers. Eg: It was assumed that the pellets used in the bulk packing used only once The difference betweeen the outer packaging and the inner packaging was considered waste at this stage.
	Outgoing Transport[1] Data sources ecoinvent	Transport of the product from the distribution center to the retail store as well as transport from distribution center for e-commerce. Roughly about 70% of all products are sold via e-commerce and the remaining 30% are sent to retail. Similarly to the inbound transportation, the transportation distances are calculated based on the share of products stored at a specific DC and the share of products in a given retail store. Specific transport distances were calculated based on distribution center and retail store locations. Transport from the distribution center to e-commerce customers was covered. E-commerce data was collected based on the average Coach data available, and it was assumed that most common e-commerce transactions are made using air transport and truck transport. The average distances transported are 135 km and 1418 km, respectively. This was calculated based on total amount of shipped packages and total distance transported. 67% of products were assumed to be sold through e-commerce, with 33% going through retail stores.	

[1] Emissions from transportation after manufacturing were calculated using the tool for the Coachtopia launch as 76 MT CO_2e. Carbon offsets and inset credits were purchased to reduce emissions from transportation after manufacturing to effectively 0 MT CO_2e.

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Stage	Step	Life Cycle GHG Emissions	Partial Life Cycle Waste
Retail	**Energy** Data sources EIA eGRID	Energy consumed by the retail stores. The energy burdens are allocated based on the average number of units in the store. If this data was not available, the Coachtopia floor area share was estimated. The energy consumption of the stores facilities is estimated using data by the US Energy Information Administration (EIA), specifically the 2018 Commercial Buildings Energy Consumption Survey (EIA, 2022), together with the floor area with the store and share of Coachtopia products at the location. Emissions & Generation Resource Integrated Database (eGRID) and natural gas emission factors from the EPA were applied to the energy consumption. These sources were also applied for international sites and climate zones were considered to select the appropriate energy consumption estimates. The transportation of products purchased at the retail store to the home of the customer was not considered.	The difference betweeen the outer packaging and the inner packaging was considered waste at this stage
Use	**Use** Data sources Cotton Inc (2016) ecoinvent	Use phase emission factors were estimated based on the care instructions provided by Coach to the customer. No significant care practices were identified for footwear or leather goods. Coach typically recommends leather care for its products, yet the appropriate care for Coachtopia products and the recycled leather is still being evaluated and was thus excluded in this study. For ready-to-wear average washing and drying practices were assumed for t-shirts and casual collared t-shirts. Based on data from Cotton Inc (2016) assumptions for washing and drying cycles with energy, water, and detergent consumption was calculated. These impacts were allocated based on a typical wash load size of 4.04 kg and a drying load size of 4.13 kg. The same average product weight (225 grams for a t-shirt and 275 grams for a casual collared t-shirt) in the Cotton Inc study was considered in this study. As such the RTW use burdens are equal for all items, regardless of individual product weight. Furthermore, washer and dryer efficiencies were selected based on common statistics from American home appliance manufacturers. For this phase, ecoinvent processes were used as no applicable datasets were available with the Higgs databases.	Final packing of the product is considered as waste at the final stage. The product packaging in the case of ecommerce becomes waste in the use stage and is considered. Extra packaging for mailing in ecommerce was not considered. All auxiliary waste (like detergents, etc) from the use phase were excluded.
End-of-life	**Disposal** Data sources EPA (2020)	Product is disposed of. It was conservatively assumed that all products were sent to landfill, for which EPA emission factors were applied. These factors do not include transport to the landfill site, per EPA documentation.	The complete weight of the discarded product.

Infrastructure and capital goods are not included for modelled processes due to their small contribution to the overall impact balanced with the time requied to collect these data. Some data sources, such as ecoinvent, include the impacts of depreciable capital.

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Table 2: The databases and references sourced for the tool and for what application they are used.

Database / reference	Source for
Higg (n.d.) MSI	Material (textile, leather, hardware) emissions
Higg (n.d.) FEM	Manufacturing facility emissions
ecoinvent (Wernet et al., 2016)	Electricity in use phase, transportation, chemicals. Used as background data for WSP modelling of NFC tags, recycled leather and plastic.
US eGRID (EPA, 2023)	Electricity-related emissions for distribution centers and retail stores.
EPA (2020)	Landfilling
Confidential suppliers (2022, 2023) of recycled leather	Activity and emission data for manufacturing of recycled leather
Munasinghe, Druckman, & Dissanayake (2021)	Manufacturing burdens for RTW

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