

Representative Product Footprint Methodology

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1. Avoided Emissions Context

1.1. Avoided Emissions for Secondhand Products

This document explains how product footprints are calculated in the context of avoided emission calculations. As defined by the document [Guidance on Avoided Emissions v.2.0](#) created by World Business Council for Sustainable Development “Avoided emissions are the positive impact created when comparing the greenhouse gas (GHG) emissions of a solution to a most likely, alternative scenario where the solution would not be used. Complementary to actions that reduce an organization’s own direct and indirect emissions, these solutions prevent emissions for other actors”.

In short, avoided emissions are emissions which are hypothetically avoided when comparing the emissions between two scenarios, referred to as the alternative scenario and the solution.

In the context of secondhand business models, the alternative scenario is a scenario in which the secondhand marketplace does not exist and users purchase new items instead. The solution is the current situation where the secondhand marketplace does exist and a proportion of the users purchase used items instead of new. This theoretically avoids the raw material extraction and processing, product manufacturing, and primary packaging emissions. Parts of the distribution and secondary packaging emissions might be avoided, depending on the specifics of how the secondhand item is delivered.

Operating the secondhand platform also generates emissions which would not exist in the alternative scenario. The emissions generated by the solution need to be taken into account for a credible comparison.

1.2. Representative Products

To compare the potentially avoided emissions between used items and comparable new items, it is necessary to determine the emissions a new item would generate. The emissions originating from a new item comparable to the secondhand item is called the reference scenario.

Due to the diverse range of products listed on secondhand marketplaces, and the limited availability of primary data for individual listings, analyzing each individual specific product footprint is not feasible. Consequently, it is necessary to deploy representative products to serve as proxies for these unique listings. Representative product is an average product for a given product category. When a specific item, such as a dishwasher with a particular design, manufacturing year, and a brand is listed, it is mapped to the standardized, generic representative product. This approach allows for a scalable methodology when calculating the avoided emissions.

Vaayu maintains an extensive library of representative products for avoided emissions calculations. Because this product library cannot cover the full variety of items that might be

listed on secondhand marketplaces, products without a direct match are assigned a proxy representative product. For example, a small handheld gaming console may be mapped to an electronic tablet.

2. Vaayu Product Footprint Background

Vaayu is a sustainability software empowering businesses within the retail ecosystem to track and cut their carbon and environmental impact. Vaayu provides corporate footprint calculations across Greenhouse Gas (GHG) Protocol Scopes 1, 2 and 3; product footprint assessments; and avoided emission calculations. Vaayu's product footprint calculations are generated within the framework of a cradle-to-grave life cycle assessment (LCA) approach.

The LCA approach formulated and followed by Vaayu is guided and informed by relevant international standards, including ISO 14040, 14044, and 14067. The methodology is also aligned with the core foundational principles of leading standards such as the GHG Protocol.

Furthermore, Vaayu aligns with the methodological details provided by the EU Product Environmental Footprint (PEF) and the PEF Category Rules where available (e.g., Apparel and Footwear). It incorporates all relevant life cycle stages of the purchased product and relies on the best quality data available, according to the rules and goal constraints set forth below.

3. System Boundary

The product footprint estimates calculated by Vaayu's modeling software incorporate all relevant life cycle stages within the boundary of the product system under review. Where available, Vaayu aligns its system boundary and process systems with category rules such as the PEF Category Rules for Apparel & Footwear (PEFCR A&F).

When calculating the representative product footprint for avoided emissions, Vaayu evaluates life cycle stages of raw material extraction and processing, manufacturing, primary packaging, and distribution. The product use phase and end-of-life stage are assumed to be comparable for both new and used items and therefore cancel each other out.

3.1. Raw Material Extraction and Processing

This phase includes the procurement of raw materials used as inputs in the manufacturing and assembly of products. This includes raw materials extraction and any necessary processing to prepare the material for use in manufacturing.

This section takes footwear and apparel items as an example to illustrate the process. For such items, this life cycle phase includes three main steps. The first step is the procurement and processing of raw & recycled plant-based, synthetic, and animal-based materials for the main apparel or footwear components. Secondly, in alignment with the PEFCR, this stage also includes

extraction and processing of raw materials, as well as trim production. The transportation of the raw materials and trims to processing and manufacturing plants is also included.

3.2. Product Manufacturing

This stage pertains to the processes needed to transform raw and processed materials into the final product. This could include all manufacturing and assembly processes.

In the case of apparel and footwear, this stage is grouped into four processes: 1) the production of the materials that are used, 2) the making of the apparel or footwear components, 3) assembly, and 4) the transportation of materials, components, and assembled parts and products.

Sub-processes that can fall under the production of materials include fiber manufacturing, leather tanning, treatment processes, and foam manufacturing. Meanwhile, components production includes upper stitching, midsole production, outsole production, and insole production. Stock fitting and final product assembly are grouped under product assembly.

3.3. Packaging

Packaging is separated from the main life cycle stages to clearly show its own life cycle contribution to the product's impact. It is also worth noting that the entire life cycle of packaging (from raw materials extraction to end-of-life) is included in the analysis.

Packaging can be further grouped into display or secondary packaging, transport or tertiary packaging, and any additional packaging needed for retail and/or e-commerce. Silica gel sachets or anti-mould stickers are also considered under this stage.

3.4. Distribution

This phase includes inbound logistics and outbound logistics. Inbound logistics consists of transport from factory to warehouse or distribution center (DC); further to the local warehouse or retail store, and finally, transport to the end customer.

4. LIFE CYCLE INVENTORY

4.1. Selection Process

Each model and data point go through at least two rounds of internal LCA team peer review and at least one round of review from Vaayu experts in the Climate Strategy Team prior to inclusion in the Vaayu software.

4.2. Data Sources

Vaayu's proprietary emission factor database is derived from reliable third-party sources, validated by Vaayu's internal LCA specialists (e.g. ecoinvent, DEFRA, IEA,...)

5. LIFE CYCLE IMPACT ASSESSMENT

While the term "carbon emissions" is commonly used, carbon dioxide (CO₂) represents only one component of climate forcing. Vaayu expresses footprint estimates in kilograms of carbon dioxide equivalent (CO₂e), a metric that accounts for various greenhouse gases, including methane (CH₄), hydrofluorocarbons (HFCs), nitrous oxide (N₂O), sulfur hexafluoride (SF₆), and perfluorocarbons (PFCs). To ensure scientific accuracy, Vaayu utilizes conversion factors from the [IPCC Fifth Assessment Report](#) to standardize these gases based on their respective global warming potentials and atmospheric lifespans.