

Carbon Footprint Manual

Climate change is a complex issue that can be stated simply: the climate is changing because there's too much carbon in the atmosphere. Starting with the original Wool Runner, Allbirds has measured how much carbon dioxide equivalent we produce in making our products – because you can't reduce what you don't measure. The information we gather not only informs product design and development, but enables us to identify hotspots and prioritize efforts in areas we can have the most impact to drive carbon reductions.

We share the carbon footprint of our products for two reasons: to hold ourselves accountable to reducing our impact over time and to help our customers develop a sense for the climate impact of the things they buy. Businesses can't expect people to make better decisions for the planet when they have no information about the environmental impact of the product they're buying. Providing a product's carbon footprint front and center empowers people to make intentional choices.

Our hope is that others in the industry will follow suit and provide the same information for their products, so that someday customers can compare carbon footprints just like they compare nutrition labels.

Background

CARBON FOOTPRINT TOOLKIT

This manual is part of a collection of resources released by Allbirds to open source our carbon footprint tools and encourage other companies to begin labeling products. Other resources in the toolkit are:

Carbon Footprint Manual

To help you get started, this manual provides details on how to start calculating and labeling products with carbon footprints. This includes information on how to gather product primary data, identify secondary datasets, calculate the carbon footprint with the LCA tool, label products, and reduce emissions over time.

Carbon Footprint Calculator

The life cycle assessment (LCA) excel tool enables the calculation of a product's carbon footprint through 5 phases: materials, manufacturing, transportation, product use, and end of life. Once you gather product data and identify datasets, the LCA tool brings the information together to calculate the CO₂e emissions of the product over its lifetime.

Carbon Footprint Labels

Two types of labels are available to put on products; the "nutritional label" version shows the carbon footprint broken down by life cycle phase and the "stamp" version shows the total carbon footprint. You can directly use these labels or use them as inspiration to develop your own label artwork.

GETTING STARTED

We know these resources and tools won't provide *all* of the answers, but it's a good place to start. A jumping off point, if you will. We wish we could give you more – including all of the underlying data specific to your products. Unfortunately, we pay to license a lot of the industry data that we use and can't share it broadly.

While we know it's not perfect, we wished for a resource like this when we were getting started. Not just a calculator that would spit out the answer, but rather a transparent tool that would allow us to see the underlying calculations and thought process, to better understand the drivers of a product's carbon footprint.

Over the years, we've partnered with several consultants to help us develop and validate the tools, methodology, and datasets to calculate carbon footprints for our products. We collaborated with [Clean Agency](#) to develop our initial LCA tool. Most recently, we worked with [SCS Global Services](#) to update our data sets and verify the tool to third-party standards. You might need to collaborate with consultants, too, and we've come across useful [LCA consultant lists](#) so you can find help anywhere in the world. We also recommend leaning on industry-standard data and initiatives from organizations like the Sustainable Apparel Coalition and Textile Exchange. Our first choice is to have a standard methodology across the industry to ensure product carbon footprints are comparable. In the meantime, we think it's important to get started.

System Boundaries

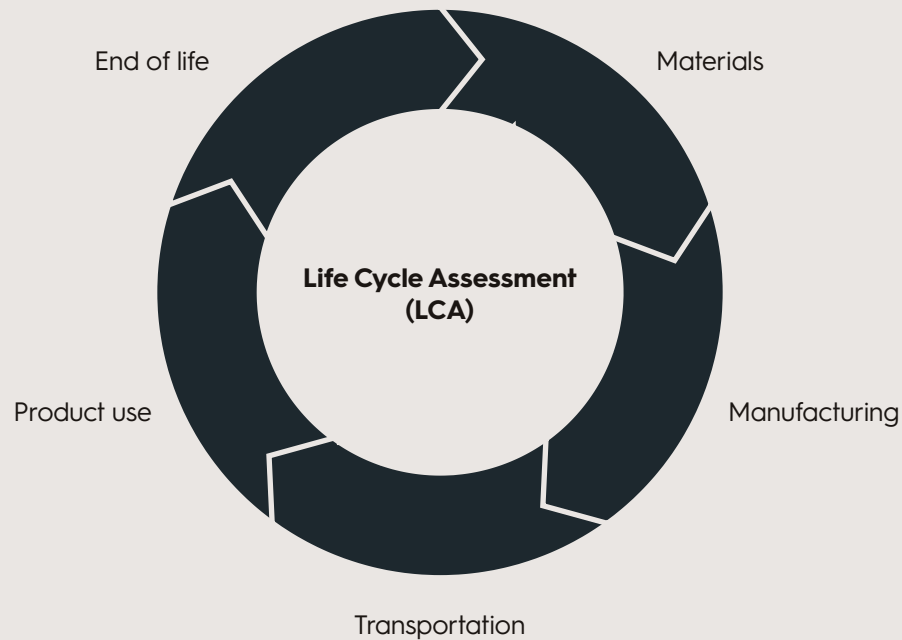
MEASUREMENT UNIT

The LCA tool calculates the kilograms of carbon dioxide equivalent (kg CO₂e) emitted to make a product. That means in addition to calculating carbon dioxide emissions, we also measure other greenhouse gas emissions, like methane, and convert them to CO₂ equivalents using global warming potential values provided by the Intergovernmental Panel on Climate Change (IPCC). The LCA tool calculates emissions for all sources and sinks, including fossil emissions, biogenic emissions/removals and direct land use change, as suggested by ISO 14067 (the international standard for the quantification and reporting of the carbon footprint of a product).

There are various measurement units for CO₂e used in different scenarios and industries. Typically, product-level carbon footprints are communicated as kg CO₂e, while you might see company-level emissions communicated as metric tonnes CO₂e (tCO₂e).

CARBON FOOTPRINT PHASES

There are 5 phases included in a “cradle-to-grave” life cycle assessment calculation for a product:



While it is standard practice to calculate CO₂e emissions for the 5 life cycle phases, there are slightly different approaches that can be taken for the boundary of each phase. Our LCA tool takes the following approach:

Life Cycle Phase	Emissions Associated With:
Materials	<ul style="list-style-type: none"> • Production and extraction of raw materials, including waste • Material processes that occur before Tier 1 factory, which may include yarn formation, textile formation, preparation, coloration • Packaging
Manufacturing	<ul style="list-style-type: none"> • Manufacturing processes that occur at Tier 1 factories, which may include molding, cutting, stitching, and product assembly
Transportation	<ul style="list-style-type: none"> • Raw materials, primary textiles, and materials transportation to Tier 1 factory (if not included in materials phase) • Product transportation from Tier 1 factory to distribution centers • Product transportation from distribution centers to customers, including returns
Product use	<ul style="list-style-type: none"> • Customer care, including washing and drying product over lifetime
End of life	<ul style="list-style-type: none"> • Final disposal of products after use

Carbon footprints are typically expressed as either:

- **Cradle-to-grave**

- Full product life cycle that includes emissions from raw materials (cradle) through the disposal phase (grave).
- Represents 5 LCA phases: materials, manufacturing, transportation, product use, end of life.

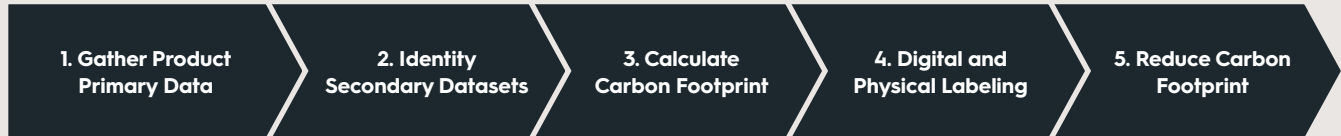
- **Cradle-to-gate**

- Partial product life cycle that includes emissions from raw materials (cradle) to the factory (gate) before it is transported to the consumer.
- Represents 2 LCA phases: materials, manufacturing.

The labels included in the toolkit show the **cradle-to-grave** carbon footprint (5 LCA phases) in order to demonstrate the full impact of products. We think it's important to be accountable to the full lifecycle of a product, even after it's sold to the customer.

Process Overview

Labeling products with their carbon footprint is a process that begins before even using an LCA tool to calculate the CO₂e emissions. The key steps are:



1. Gather Product Primary Data

Carbon footprint calculations typically rely on a combination of primary and secondary data. We prioritize primary data for the most important and influential materials and processes, and fill in the gaps with secondary data or industry averages. The first step is gathering as much primary data as possible related to the specific product.

FUNCTIONAL UNIT

Most footwear and apparel products come in a wide range of sizes, so it's important to establish the functional unit used to calculate the carbon footprint. A reasonable approach is using the most produced size, normalized for men's and women's styles. Separate values can also be calculated for men's and women's versions of the product, which provides greater accuracy if the styles vary. For example, Allbirds calculates one carbon footprint for footwear (men's 9) and two carbon footprints for apparel (men's large, women's medium) because the apparel styles vary more than footwear.

The size selected for the functional unit has a significant impact on the carbon footprint because a product's weight influences characteristics like the quantity of materials used, manufacturing process energy, transportation impact, among other carbon footprint phases.

MATERIALS

Once the functional unit size has been established, detailed data is needed about the product's materials. This step requires close collaboration with internal design, development, and supply chain teams, as well as the factories who manufacture the products.

Products are generally made from various components with different material compositions. Some components are made with a single material (e.g., recycled polyester shoelaces), while other components are made with several materials (e.g., t-shirt rib blend). A good place to start gathering product data is the bill of materials (BOM), which typically includes an inventory of components, material compositions, and processing details.

The following data is needed for every component of the product and packaging:

- Material composition (incl. processing characteristics)
- Weight, in grams (incl. total product weight)
- Waste percentage (incl. if the waste is recycled)

Allbirds has found that integrating data requests with the BOM is a helpful way to streamline the data collection process as products are developed and updated. For example, an apparel BOM template can be adjusted to include the following data requests:

Component Section	Component Name	Description of Materials in Component	Component Weight per Unit (Grams)	Waste %	Waste Recycled?
Fabric / Yarn	Fabric / Yarn 1				
	Fabric / Yarn 2				
Trims	Trims 1				
	Trims 2				
Packaging	Packaging 1				
	Packaging 2				

When products have many distinct parts (e.g., footwear), we typically collaborate with the factories to request the product parts so we can directly weigh each component.

Gathering data for each component's material composition, weight, and waste might seem challenging at first, but as you collaborate with stakeholders and integrate into existing processes, it can quickly become a streamlined part of your product development process.

MANUFACTURING

The manufacturing phase focuses on processes that occur at the Tier 1 factory, as other upstream processes will be captured in the materials phase.

The following data is needed related to the product's Tier 1 factory:

- Country or region
- List of product manufacturing and assembly steps
- Electricity per process (kWh/kg)
- Fuels per process: natural gas (cu. ft/kg), diesel (liters/kg)
- Other impacts per process: chemicals, dyestuff, packaging, direct emissions, etc.

Collaborating with internal product development and supply chain teams will once again be important for gathering data about what occurs during the manufacturing phase.

TRANSPORTATION

Transportation occurs throughout a product's life cycle, from raw materials upstream all the way to the customer. Depending on how your organization sells products (e.g., direct-to-consumer, wholesale) this data might be easy or challenging to gather. The transportation legs represented in this phase can include: upstream (raw materials to Tier 1), inbound (Tier 1 to distribution center), and outbound (distribution centers to customers, including returns). In many cases, the upstream transportation emissions are included in the materials phase.

The following data is needed for the transportation of the product, assuming upstream emissions are already modeled in the materials phase:

- Warehouse locations
- Distribution percentage to each warehouse
- Inbound and outbound transportation mode (ocean, air, truck, rail): percentage by weight
- Consumer purchase method: percentage of online versus in-store
- Product return rate

Transportation emissions can vary significantly based on factory and customer location (transportation to a customer near the factory location is much smaller than to a customer overseas). However, data can be aggregated on an annual timeframe to represent the transportation emissions associated with the average product.

PRODUCT USE

Gathering data for product use is challenging because a wide range of actions can occur throughout the product's life depending on a consumer's behavior. However, organizations can influence the way consumers care for their products through product design and care instructions.

The following data is needed to understand how the consumer will likely care for the product:

- Design or material characteristics that reduce wash/dry frequency
- Product care label instructions

There might not be perfect information on how people use products, but you develop educated guesses to take full responsibility for the items put out into the world.

END OF LIFE

The majority of products end up in landfill, so in most cases it's reasonable to assume average landfill or incineration fates. As end of life solutions are adopted for more products, additional carbon footprint modeling will be needed to understand the climate impact.

After primary data related to the product is gathered for all life cycle phases, the next step is to identify secondary datasets that will then be used to calculate the carbon footprint.

2. Identify Secondary Datasets

In order to identify secondary datasets for the carbon footprint calculations, you will likely need to collaborate with consultants or industry associations to gain access to proprietary data relevant to your products. Sometimes the data you will need is publicly available, but in many cases it will require a sublicense.

The table below demonstrates the types of datasets needed for each phase and some of the sources we've found helpful for calculating Allbirds footwear and apparel carbon footprints:

	Datasets	Sources
Materials	<ul style="list-style-type: none"> Carbon intensity (CI) of raw materials (kg CO₂e/kg) Carbon intensity of material processing steps (e.g., yarn formation, textile formation, preparation, dyeing, finishing) Direct land use change and biogenic carbon emissions/removals (if applicable) 	<ul style="list-style-type: none"> Supplier LCAs LCA databases: ecoinvent, GaBi Sustainable Apparel Coalition's Higg MSI (Material Sustainability Index)
Manufacturing	<ul style="list-style-type: none"> Electricity grid emissions factor (kg CO₂e/kWh) by country or region Carbon intensities of fuels and other impacts 	<ul style="list-style-type: none"> Electricity grid emissions factors: ecoinvent, IGES, EPA Fuels and other impacts: ecoinvent
Transportation	<ul style="list-style-type: none"> Distances by mode, for inbound and outbound Carbon intensities by mode (kg CO₂e/tonne-km) 	<ul style="list-style-type: none"> Searates distance estimator EPA GHG Emission Factors Hub
Product Use	<ul style="list-style-type: none"> Wash cycle energy intensities (kWh/kg laundry) Dry cycle energy intensities 	<ul style="list-style-type: none"> T-Shirt PEFCR (Product Environmental Footprint Category Rules) ENERGY STAR Residential Clothes Dryers Report
End of life	<ul style="list-style-type: none"> Product end of life fate: percentage landfill versus incineration Packaging recycling rate Landfill and incineration carbon intensities (kg CO₂e/kg) by material type 	<ul style="list-style-type: none"> EPA Waste Reduction (WARM) EPA Municipal Solid Waste: paper and paperboard recycled LCA databases: ecoinvent, GaBi

Once product primary data and corresponding secondary datasets have been identified, the information can be entered in the LCA tool to calculate the carbon footprint.

3. Calculate Carbon Footprint

The nitty-gritty of the carbon footprint calculations can be found in the [LCA tool](#), though an overview of the formulas are helpful before diving into the spreadsheet. A high-level summary of the equations are:

Materials (kg CO ₂ e)	=	Component + waste weight (kg material)	×	Material Carbon Intensity (CI) (kg CO ₂ e/kg material)	
Manufacturing (kg CO ₂ e)	=	Energy (kWh/process)	×	Country Grid Factor (kg CO ₂ e/kWh)	
Transport (kg CO ₂ e)	=	Distance (km)	×	Product weight (kg)	×
					Mode CI (kg CO ₂ e/kg product per km)
Product Use (kg CO ₂ e)	=	Number of cycles (#)	×	Product weight (kg)	×
					Wash/Dry CIs (kg CO ₂ e/kg product per cycle)
EOL (kg CO ₂ e)	=	Final product material weight (kg material)	×	Landfill/Incineration CI (kg CO ₂ e/kg material)	

Considerations

COMPARISONS

When starting to calculate carbon footprints, it's helpful to triangulate with available LCAs to see if your calculation falls within a reasonable range for the given product type. Many products will not have existing carbon footprints that you can easily refer to, but it is important to take time to research related academic or industry LCAs to develop an understanding of carbon footprints within different product categories.

In cases where you might want to make comparisons between your product and a comparable product with different characteristics, it's important to ensure consistent methodology and assumptions (i.e., same boundaries, functional unit). To develop comparisons, you can adjust your product's characteristics, such as material composition or manufacturing country, in the LCA tool or enter assumptions from an existing LCA.

For example, when we first calculated the carbon footprints of Allbirds footwear, we thought it would be helpful to have a reference point. We compiled a range of carbon footprints from approximately 5 kg CO₂e/pair to 30+ kg CO₂e/pair within the footwear industry. The [academic LCA](#) of a running shoe, performed by MIT, was published in 2012, but remains the most comprehensive and transparent footwear LCA that is publicly available. We developed a set of assumptions for a ‘standard sneaker’ based on the MIT study, to run through our own LCA tool so the methodology and boundaries were consistent. Although we have a reference carbon footprint for standard footwear, we try to stay away from making claims that our products have “X% savings”, which could promote guilt-free consumption. Instead, we intentionally share the product’s carbon footprint directly.

INDUSTRY STANDARDS

As product carbon footprints become more widespread, industry alignment with standard guidelines – many of which are still being developed – will help support the adoption of best practices. [ISO 14067](#) is an international standard that specifies “principles, requirements and guidelines for the quantification and reporting of the carbon footprint of a product (CFP), in a manner consistent with International Standards on life cycle assessment (LCA) (ISO 14040 and ISO 14044)”. In order to align with best practice, the full Allbirds LCA tool with proprietary data was third-party verified against the requirements of ISO 14067:2018.

Additional resources to consider are the Product Environmental Footprint Category Rules ([PEFCRs](#)), which are supported by the European Commission and developed with industry organizations to provide methodology guidance for the calculation of carbon footprints. In cases where there is a PEFCR related to your product, it is recommended to align with the approach as suggested by ISO 14067.

While developing data, tools, and processes for calculating your product carbon footprints, aligning with industry standards and seeking third-party verification is a critical way to ensure best practices for your approach and assumptions.

METHODOLOGY DOCUMENTATION

A final best practice to consider while calculating carbon footprints is to track the details of your approach and assumptions to summarize in a public-facing methodology document. This can include information about the unique characteristics of your products, the functional unit, system boundaries, data sources, literature reviews of existings LCAs, limitation, future improvements, and any other information related to your carbon footprints. As an example, we released this [Allbirds Product Carbon Footprint Methodology](#) in 2020, and an updated document will be shared in mid-2021 when all carbon footprints are refreshed.

4. Digital and Physical Labeling

The labeling step is the easiest, but also the most important. The carbon footprint labels are what keep us accountable and our customers informed. You can use the ones we provide directly or use them as inspiration for your own.

DIGITAL

Adding the carbon footprints on your website is a quick way to get started. We include the carbon footprint on each Product Detail Page (PDP), along with standard information you would expect, like product features and care instructions. After all, we think it should be standard information, too!

PHYSICAL

It will likely take slightly longer to roll-out the physical labels to your products, given development and distribution time. We develop sticker or label artwork for all products and order in a similar way as trim details like care labels and hang tags. This will require collaboration and coordination with product and supply chain teams to start implementing, though it can quickly become a streamlined part of your internal processes.

5. Reduce Carbon Footprint

When all products are labeled with their carbon footprints, take a moment to celebrate! You're doing important work and the journey – likely challenging at times – was filled with learnings that can be implemented to reduce your impact.

The carbon footprints will enable you to identify hotspots, such as high carbon materials, energy-intensive manufacturing, or inefficient transportation, so you can prioritize areas where you have the largest potential to drive carbon reductions.

Carbon measurement is fun (at least we think so!), but **identifying and implementing carbon reductions is where we should all spend most of our time.** For example, we build a carbon footprint reduction plan for each Allbirds product and then share it with our product teams, so we can consistently evaluate opportunities to drive carbon reductions together.

While you implement carbon reduction initiatives, track the changes made to existing products so you can update the carbon footprint calculations in the LCA tool, and then the whole process starts again. Allbirds refreshes carbon footprints annually to capture updates to product characteristics, as well as methodology improvements. And as we work to eliminate emissions, we believe that we – and all businesses – should be held accountable for our environmental impact. So until we reach our goal of zero, we're taxing ourselves for the carbon we do emit, and investing in offsets to fund projects that neutralize our footprint.

Calculating the carbon footprints enables us to set specific goals to decarbonize our business and sharing the number holds us accountable to bring it down over time. But we can't stop there...



We're sharing this manual, the LCA tool, and our labels with the hope that other companies will start providing the carbon footprints of their products, too! Climate change is a problem bigger than business, and if competition got us into this mess, perhaps collaboration can get us out.

TREAD LIGHTER.