PCF Report

Product Carbon Footprint Report



Product	Date	Prepared by
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About Ecobike

Introduction

Ecobike is a leading American company that retails and markets bicycles. As part of its net-zero journey, Ecobike has begun sourcing alternative raw materials for its product to have a lower carbon impact. A Carbon Footprint of a Product (CFP) was completed on Ecobike's best-selling product, the Ecobike X5.

Goal and Scope

This section describes the goal and scope of the study, along with the methodological framework. It includes the study's objectives, a description of the system boundaries, product, data sources, and methodologies.

Goal

Intended Application

This product carbon footprint report will establish a baseline cradle-to-grave carbon footprint for the traditional Ecobike X5 bicycle. Ecobike intends to measure and monitor its progress towards the embodied carbon footprint (CO_2e) of the Ecobike X5 bicycle, specifically through potential decarbonization using lower carbon footprint materials. Ecobike intends to use the analysis conducted by this study to understand the implications of material selection towards its net-zero journey.

Scope

Functional Unit

The functional unit is the cradle-to-grave impact of the Ecobike X5 bicycle for the reference year 2023.

System Boundaries

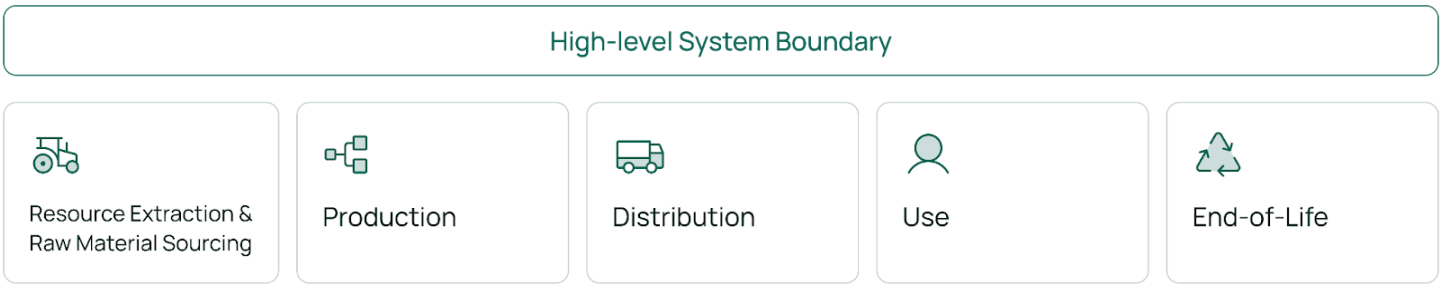


Figure 1. System Boundary

Table 2 outlines a Bill of Materials (BOM) as required for the Ecobike X5 bicycle. This includes the raw materials, accessories, and packaging.

Table 2. BOM for Products Analyzed in the CFP System Boundary

Product Details		Ecobike X5 Bicycle
Material 1	Material Name	Aluminum 6061-T6
	Percent Composition	42.98%
	Material Weight (g)	5200
Material 2	Material Name	Carbon Steel
	Percent Composition	34.71%
	Material Weight (g)	4200
Material 3	Material Name	Rubber
	Percent Composition	16.12%
	Material Weight (g)	1950
Material 4	Material Name	Nylon
	Percent Composition	3.72%
	Material Weight (g)	450
Material 5	Material Name	Polyurethane (PU) Foam
	Percent Composition	1.49%
	Material Weight (g)	180
Material 6	Material Name	Polypropylene (PP)

	Percent Composition	0.98%
	Material Weight (g)	120
Production	All Manufactured Countries	China
Packaging 1	Packaging Type	Corrugated box
	Quantity	1
	Packaging Weight (grams)	2000

Every effort has been made to collect primary data from company systems, subject matter experts, and key stakeholders, such as major suppliers and key vendors. Table 3 lists all activities within the system boundary for which primary input data was utilized. Each data source was assessed using the mechanism utilized for derivation (estimated, measured or modelled).

Careful consideration was taken into account for the source of such data. High-level estimations were replaced by referenced and reputable secondary data sources, such as Life Cycle Assessment (LCA) databases or PCR guidelines. Each data point was then assessed for its completeness, temporal recency, geographical representation and overall value chain alignment.

Table 3. Data Activities

Life Cycle Stage	Data	Data Collection Type	Date	Source of Information
Resource Extraction & Raw Material Sourcing	BOM mass & composition (all parts)	Primary Data	2025/05/01	Provided by Ecobike Team
	Aluminum alloy production (frame/rims)	Primary Data	2025/05/01	Provided by Ecobike Team
	Packaging	Primary Data	2025/05/01	Provided by Ecobike Team
Production	Final assembly electricity & fuels	Primary Data	2025/05/01	Provided by Ecobike Team
	Surface coating (powdercoat/paint)	Primary Data	2025/05/01	Provided by Ecobike Team
	Process yields & in-process scrap	Secondary Data	2025/05/01	ecoinvent v3.10

Distribution	Regional trucking (port/DC → retail)	Secondary Data	2025/05/01	ecoinvent v3.10
Use	Data Source 9	Mixed (Primary + Secondary)	2025/05/01	Ecobike Team + ecoinvent v3.10
End-of-Life	Data Source 10	Secondary Data	2025/05/01	US EPA MSW statistics + ecoinvent v3.10

This CFP was conducted for the Ecobike X5 bicycle following the system boundaries in Table 4.

Table 4. Cradle-to-Grave System Boundary

Life Cycle Stage	Source of Information
Resource Extraction & Raw Material Sourcing	• Extraction and production of all materials • Transportation between individual stages of material production, as well as between final material and production facilities
Production	• Production processes to transform raw material input to the finished product, including heat and electricity usage • Packaging • Waste created during production ◦ Waste treatment of excess waste
Distribution	• Transportation to the distribution center • Distribution center storage • Transportation to the retailer • Retailer storage • Transportation to the final client
Use	• Customer care over the product lifetime, following the care guidelines provided by Ecobike
End-of-life	• Transportation to the waste treatment facility • End-of-life treatment

Selected CFP-PCR

In developing this CFP study, we reviewed publicly available PCRs and rulebooks for relevance to a non-electric bicycle and its main sub-assemblies. A review was conducted of the following:

I. International EPD System materials and PCR library entries for related categories (e.g., metals, plastics/rubber) and general programme instructions.
II. EU Product Environmental Footprint (PEF) method and the PEFCR Guidance for methodological alignment and data-quality rules.

Given that no bicycle-specific CFP–PCR was readily identifiable in the reviewed public PCR libraries at the time of this work, Arbor followed ISO-aligned best practice: applying ISO 14040/44/14025 principles with PEF method guidance for modelling choices, data quality, and reporting.

Life Cycle Inventory (LCI)

During LCI data collection, primary data was collected wherever possible to represent the supply chain context as accurately as possible. Both primary and secondary data were used, and where data was not available, assumptions or equivalences were made based on best judgment and adherence to ISO standards.

Resource Extraction and Raw Material Sourcing

Raw materials listed in the BOM were mapped to specific background datasets by material type and, where known, country of origin. Metals were modelled as aluminum alloy and carbon/stainless steels from primary production with scrap input rates consistent with database defaults; when supplier locations were provided, country-specific electricity mixes were applied for upstream smelting and rolling/extrusion.

To increase geographic representativeness, grid-intensity values were swapped to reflect the manufacturing countries noted earlier (China, Taiwan, Vietnam) when database “market” processes allowed regionalization. Packaging materials were represented with a generic “market for corrugated box” process and plastic film/bag markets; inks, adhesives, and minor coatings were included implicitly where covered by background datasets.

Production

Production covers fabrication of metal parts (tube cutting, forming, extrusion or rolling, welding/brazing, heat treatment), machining of precision interfaces, wheel-building (rim rolling, drilling, spoke forming and tensioning), polymer part molding, tire curing, surface finishing (powder coat or paint), sub-assembly, and final assembly. Primary data were used for the finished-goods mass, packaging configuration, and

assembly locations. Facility energy and fuel were modeled using country-level electricity mixes for the listed manufacturing countries.

Typical yield losses were applied for metalworking and molding to account for offcuts and start-up scrap; in-process recycling of clean aluminum and steel scrap was credited within the plant gate when evidenced by supplier practice, otherwise scrap was treated as sold to external recyclers without on-site credit.The packaged bicycle leaving the final assembly is the production output to distribution.

Distribution

Distribution was modeled as export from the assembly country to the primary sales region using containerized ocean freight to a U.S. port, to a distribution center, and regional trucking to retail or the end customer. Inbound transport of major components to the assembly plant was included using typical distances (ocean + truck) consistent with the manufacturing geography above; where supplier-specific routes were unknown, database “market” transport for traded goods was applied. Load factors, backhauls, and packaging protection were treated per default background assumptions; damage/returns and consumer travel for purchase were excluded. Packaging mass from the BOM was included for transport burdens and retained through to EoL.

Use

The bicycle is a human-powered product; no operational energy or direct emissions are attributed to riding. The use phase therefore consists of scheduled maintenance and consumables over a fixed service life (10 years at 2,000 km/year). Replacement of wear parts was modeled using conservative intervals from manufacturer guidance and industry practice. Replacement parts were represented by the same material datasets as original components, and small volumes of lubricants/cleaners were included using generic petroleum-based products. Storage, cleaning, and rider accessories (e.g., lights) were excluded unless physically included with the product at sale. Because maintenance patterns vary widely, these assumptions are documented for transparency and can be updated if user- or fleet-specific records are available.

End-of-Life

At end-of-life, the bicycle and associated packaging were modeled using U.S. municipal solid-waste practices based on EPA national averages. The baseline scenario allocates discarded mass between landfill and municipal incineration. If documented evidence of metal recovery or organized take-back is provided, a

sensitivity scenario can be reported using closed-loop approximation or substitution to reflect avoided primary aluminum/steel production. Packaging recovered by curbside programs can be addressed similarly in a comparative scenario, but is not credited in the baseline to avoid over-statement.

Results

Carbon Footprint of Ecobike's X5 Bicycle

The total carbon footprint of the Ecobike X5 bicycle is estimated to be **150 kg CO_2e**.

Hotspot Analysis

Figures 2 below show a breakdown of the carbon footprint of the Ecobike X5 bicycle. The life cycle stage with the highest impact is "Resource Extraction and Raw Material Sourcing," accounting for 45% of the total impact.

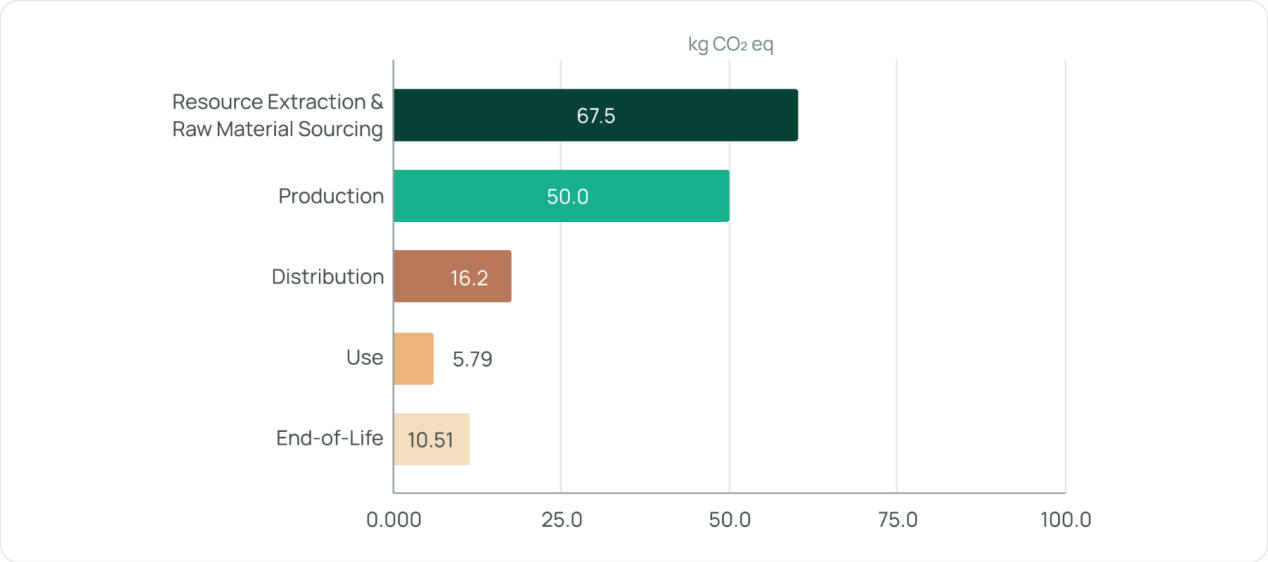


Figure 2. Hotspot Analysis of Ecobike's X5 bicycle (kg CO_2e)

Exclusions & Limitations

Limitations

This CFP study has the following known limitations:

- Primary data were available for final assembly/BOM mass; most upstream processes (material production, some sub-components) rely on secondary databases and industry averages.
- Supplier locations were approximated to country- or regional-average datasets and electricity grid mixes. “Rest-of-World” proxies were used where country data were unavailable.
- Background datasets span recent years but may not reflect current fuel mix, efficiency, or recycling rates.
- Process choices (e.g., aluminum extrusion vs. generic wrought, steel grades, finishing methods) were modeled with best fit proxies.

Exclusions

The following items are outside the system boundary for this CFP and were not modeled. Exclusions were applied consistently across all scenarios and are not expected to materially change hotspot identification or comparative conclusions.

- Aftermarket accessories and rider add-ons. Items not sold as part of the base SKU, such as lights, racks, baskets, fenders purchased separately, locks, child seats, phone mounts, and cosmetic decals are excluded. Their masses and replacement cycles vary by user and retailer and are not representative of the declared product.
- Consumer travel and retail operation loads. Customer trips to and from retail or service locations, package pickup/returns by consumers, in-store energy for display and lighting, e-commerce web hosting, and call-center activities are excluded. Distribution burdens to the retailer/DC are included; beyond-retail consumer behavior is outside scope.
- Tools, fixtures, and minor shop consumables. Reusable assembly jigs, fixtures, molds, calibration tools, and general shop supplies used across many products are excluded. Line-side disposables that become part of the product or packaging are included; durable assets and de minimis consumables are not.
- Per PCR convention, capital goods and infrastructure are excluded. In accordance with common PCR/program rules for product CFPs, construction and maintenance of buildings, machinery, warehousing infrastructure, IT hardware, and transport equipment are excluded from the product system and treated as background enterprise overhead.
- Per PCR convention, corporate overhead and employee activities are excluded. Business travel, employee commuting, sales/marketing, R&D activities unrelated to this specific model year, and general administrative services are excluded per typical PCR guidance for product declarations.

Conclusion

This CFP establishes a defensible baseline for the non-electric city bicycle across the full cradle-to-grave life cycle. The inventory and results indicate that impacts are concentrated in “Resource Extraction & Raw Material Sourcing” (especially aluminum and steel) and “Production” (energy-intensive manufacturing and finishing). Transport contributes a secondary share, while the use phase is driven largely by maintenance consumables rather than operational energy.

With this baseline, the company can now iterate toward decarbonization in a targeted way. Priority actions include: increasing recycled and certified low-carbon metals; reducing yield loss and improving in-process scrap recovery; transitioning manufacturing sites toward renewable electricity and higher-efficiency curing/finishing; redesigning for durability, repairability, and lightweighting without compromising safety; and optimizing packaging for recycled content and mass reduction. Logistics improvements (modal shifts, fuller container loads, and route optimization) and end-of-life pathways that maximize metal recovery will further lower the product footprint. As design and supply decisions are implemented, the CFP will serve as the yardstick to demonstrate real, year-over-year reductions in product emissions.

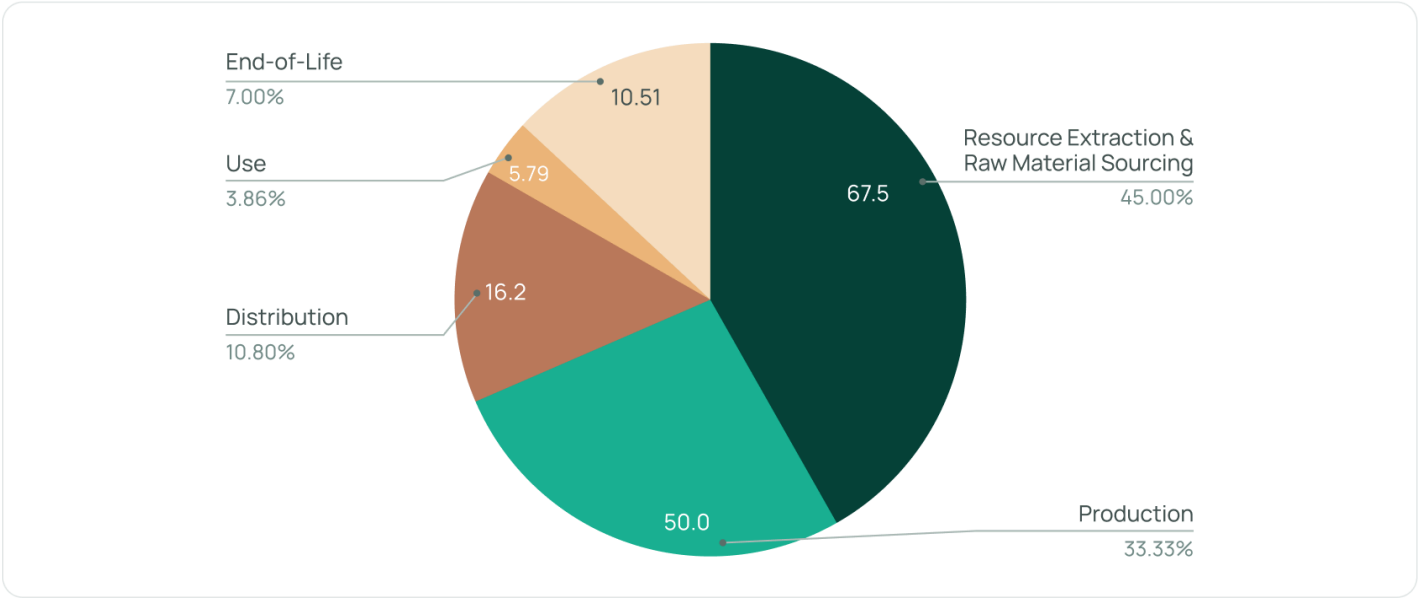


Figure 3. CO_2e Breakdown of of Ecobike’s X5 bicycle (kg CO_2e)

Disclaimer

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Thank you, Ecobike!

Please contact us if you have any questions.